Please check our wiki for help on navigating the form.

Horizon 2020

Call: H2020-ICT-2018-2020

(Information and Communication Technologies)

Topic: ICT-11-2018-2019

Type of action: IA

Proposal number: SEP-210512352

Proposal acronym: HEPTAS

Deadline Id: H2020-ICT-2018-2

Table of contents

How to fill in the forms

The administrative forms must be filled in for each proposal using the templates available in the submission system. Some data fields in the administrative forms are pre-filled based on the steps in the submission wizard.

1 - General information

Topic	ICT-11-2018-2019	Type of Action	IA
Call Identifier	H2020-ICT-2018-2020	Deadline Id	H2020-ICT-2018-2

Acronym	HEPTAS
Proposal title	HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities

Note that for technical reasons, the following characters are not accepted in the Proposal Title and will be removed: < > " &

Duration in months	*36*
Fixed keyword 1	High performance computing
Fixed keyword 2	Cloud Computing models
Free keywords	*Cloud Computing, Smart Mobility, Pilot Test, Predictive Maintenance, Traffic Optimization, Machine Learning, Parking Optimization*

Abstract

HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities (HEPTAS)
Growing populations, public pressure & legalization demand new approaches to mobility, increasing traffic throughput & parking convenience, with lower energy consumption & pollution.
Traffic infrastructure management reaches the limits of traditional methods e.g. improved traffic signal timing. Automotive industry predictive functions to optimize the car e.g. traffic light assistants have high potential, but are limited in city traffic without smart co-operation between vehicles, the traffic flow, & infrastructure e.g. adaptive traffic light timing.
HEPTAS will address this by combining big data flows from diverse sources e.g. vehicles, city sensors. Elastic HPC will continuously analyse & optimize mobility, using machine learning & simulation to optimize flows, and send suggestions to vehicles e.g. best route & speed profile, & the infrastructure e.g. traffic lights, speed limits. Allowing management authorities to react faster, reducing journey times , reducing air pollutants and reducing hotspots.
HEPTAS testbed demo of 'hybrid' i.e. in HPC cloud & in-vehicle predictive functions, that work safely if connectivity is lost. To maximize connectivity, HEPTAS will use a mix of mobile data, WiFi & Satellite communication to increase data availability. Further, HEPTAS will scaleably reduce data flows if bandwidth is restricted e.g. 5G to 3G but still keep meaningful predictive functionality.
Collecting data from ultrasonic, LIDAR & localization sensors, allows HEPTAS machine learning to reduce the time to find a parking slot, further improving emissions.
HEPTAS brings a mobility data value chain supporting monetarized use cases that respect privacy. HEPTAS includes predictive maintenance to reduce breakdowns & costs, supporting faster identification of fleet issues. Vehicles will send data re. 3D map inconsistencies to the HPC cloud, to manage 3D map updates and re-surveys.

Remaining characters 25

Has this proposal (or a very similar one) been submitted in the past 2 years in response to a call for proposals under Horizon 2020 or any other EU programme(s)? ○ Yes ◉ No

Please give the proposal reference or contract number.	
xxxxxx-x	

Declarations

1) The coordinator declares to have the explicit consent of all applicants on their participation and on the content of this proposal.	☒
2) The information contained in this proposal is correct and complete.	☒
3) This proposal complies with ethical principles (including the highest standards of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity — and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct).	☒

4) The coordinator confirms:

- to have carried out the self-check of the financial capacity of the organisation on http://ec.europa.eu/research/participants/portal/desktop/en/organisations/lfv.html or to be covered by a financial viability check in an EU project for the last closed financial year. Where the result was "weak" or "insufficient", the coordinator confirms being aware of the measures that may be imposed in accordance with the H2020 Grants Manual (Chapter on Financial capacity check); or	◉
- is exempt from the financial capacity check being a public body including international organisations, higher or secondary education establishment or a legal entity, whose viability is guaranteed by a Member State or associated country, as defined in the H2020 Grants Manual (Chapter on Financial capacity check); or	○
- as sole participant in the proposal is exempt from the financial capacity check.	○

5) The coordinator hereby declares that each applicant has confirmed:

- they are fully eligible in accordance with the criteria set out in the specific call for proposals; and	☒
- they have the financial and operational capacity to carry out the proposed action.	☒

The coordinator is only responsible for the correctness of the information relating to his/her own organisation. Each applicant remains responsible for the correctness of the information related to him and declared above. Where the proposal to be retained for EU funding, the coordinator and each beneficiary applicant will be required to present a formal declaration in this respect.

According to Article 131 of the Financial Regulation of 25 October 2012 on the financial rules applicable to the general budget of the Union (Official Journal L 298 of 26.10.2012, p. 1) and Article 145 of its Rules of Application (Official Journal L 362, 31.12.2012, p.1) applicants found guilty of misrepresentation may be subject to administrative and financial penalties under certain conditions.

Personal data protection

The assessment of your grant application will involve the collection and processing of personal data (such as your name, address and CV), which will be performed pursuant to Regulation (EC) No 45/2001 on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data. Unless indicated otherwise, your replies to the questions in this form and any personal data requested are required to assess your grant application in accordance with the specifications of the call for proposals and will be processed solely for that purpose. Details concerning the purposes and means of the processing of your personal data as well as information on how to exercise your rights are available in the privacy statement. Applicants may lodge a complaint about the processing of their personal data with the European Data Protection Supervisor at any time.

Your personal data may be registered in the Early Detection and Exclusion system of the European Commission (EDES), the new system established by the Commission to reinforce the protection of the Union's financial interests and to ensure sound financial management, in accordance with the provisions of articles 105a and 108 of the revised EU Financial Regulation (FR) (Regulation (EU, EURATOM) 2015/1929 of the European Parliament and of the Council of 28 October 2015 amending Regulation (EU, EURATOM) No 966/2012) and articles 143 - 144 of the corresponding Rules of Application (RAP) (COMMISSION DELEGATED REGULATION (EU) 2015/2462 of 30 October 2015 amending Delegated Regulation (EU) No 1268/2012) for more information see the Privacy statement for the EDES Database.

2 - Participants & contacts

#	Participant Legal Name	Country	Action
1	VALEO COMFORT AND DRIVING ASSISTANCE	France	
2	VALEO SCHALTER UND SENSOREN GMBH	Germany	
3	FIAT CHRYSLER AUTOMOBILES ITALY SPA	Italy	
4	SEAT SA	Spain	
5	AVL LIST GMBH	Austria	
6	FEV ITALIA SRL	Italy	
7	SES ASTRA SA	Luxembourg	
8	5T SRL	Italy	
9	TELECOM ITALIA SPA	Italy	
10	ANONIMI ETAIRIA PERIVALLONTIKON KAIENERGIAKON MELETON KAI ANAPTIXIS LOGISMIKOU	Greece	
11	גיאוסים מערכות בע"מ	Israel	
12	MAPILLARY AB	Sweden	
13	CloudMade Ukraine LLC	Ukraine	
14	FACTUAL CONSULTING	Spain	
15	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	Spain	
16	CINECA CONSORZIO INTERUNIVERSITARIO	Italy	
17	ISTITUTO NAZIONALE DI FISICA NUCLEARE	Italy	
18	ASSOCIAZIONE ITHACA-INFORMATION TECHNOLOGY FOR HUMANITARIAN ASSISTANCE COOPERATION AND ACTION	Italy	
19	CENTRO RICERCHE FIAT SCPA	Italy	
20	UNIVERSITAT POLITECNICA DE CATALUNYA	Spain	

2 - Administrative data of participating organisations

PIC	***Legal name***
918515311	*VALEO COMFORT AND DRIVING ASSISTANCE*

Short name: Valeo Comfort And Driving Assistance

Address of the organisation

Street 76 RUE AUGUSTE PERRET ZI EUROPARC

Town CRETEIL

Postcode 94046

Country France

Webpage www.valeo.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Comfort and Driving Assistance Business Group ☐ not applicable

☒ Same as proposing organisation's address

Street: 76 RUE AUGUSTE PERRET ZI EUROPARC

Town: CRETEIL

Postcode: 94046

Country: France

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title

Sex ◉ Male ○ Female

First name **Philippe** Last name **GOUGEON**

E-Mail **philippe.gougeon@valeo.com**

Position in org. Collaborative Project Director

Department Comfort and Driving Assistance Business Group ☐ Same as organisation name

☒ Same as proposing organisation's address

Street 76 RUE AUGUSTE PERRET ZI EUROPARC

Town CRETEIL Post code 94046

Country France

Website

Phone +xxx xxxxxxxxx Phone 2 +xxx xxxxxxxxx Fax +xxx xxxxxxxxx

PIC	***Legal name***
991165983	*VALEO SCHALTER UND SENSOREN GMBH*

Short name: VIC

Address of the organisation

Street	LAIERNSTRASSE 12
Town	BIETIGHEIM BISSINGEN
Postcode	74321
Country	Germany
Webpage	

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....05/02/1999 - no

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: DAR Germany ☐ not applicable

☐ Same as proposing organisation's address

Street: Hummendorfer Str. 76

Town: Kronach Neuses

Postcode: 96317

Country: Germany

Dependencies with other proposal participants

Character of dependence	***Participant***	
Same Group	VALEO COMFORT AND DRIVING ASSISTANCE	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: ○ Male ◉ Female

First name: **Andrea**

Last name: **Elser**

E-Mail: **andrea.elser@valeo.com**

Position in org.: R&D Partnership Mgr.

Department: Innovation & Collaborative Research

☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Laiernstr. 12

Town: Bietigheim-Bissingen

Post code: 74321

Country: Germany

Website: www.valeo.com

Phone: +49 7142 9163540

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

PIC	***Legal name***
997740643	*FIAT CHRYSLER AUTOMOBILES ITALY SPA*

Short name: FIAT AUTO S.P.A.

Address of the organisation

Street CORSO GIOVANNI AGNELLI 200

Town TORINO

Postcode 10135

Country Italy

Webpage http://cww.fiat.com/

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....unknown

International organisation of European interest .....unknown

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....10/12/2008 - no

SME self-assessment ..... unknown

SME validation sme.....10/12/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: FCA ICT ☐ not applicable

☒ Same as proposing organisation's address

Street: CORSO GIOVANNI AGNELLI 200

Town: TORINO

Postcode: 10135

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title

Sex ◉ Male ○ Female

First name **Antonino** Last name **Santagata**

E-Mail **antonino.santagata@fcagroup.com**

Position in org. Program Manager

Department FCA ICT ☐ Same as organisation name

☒ Same as proposing organisation's address

Street CORSO GIOVANNI AGNELLI 200

Town TORINO Post code 10135

Country Italy

Website

Phone +xxx xxxxxxxxx Phone 2 +xxx xxxxxxxxx Fax +xxx xxxxxxxxx

PIC	***Legal name***
964510480	*SEAT SA*

Short name: SEAT

Address of the organisation

Street	AUTOVIA A-2 KM 585
Town	MARTORELL
Postcode	08760
Country	Spain
Webpage	www.seat.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Research and Development - VX3

☐ not applicable

☒ Same as proposing organisation's address

Street: AUTOVIA A-2 KM 585

Town: MARTORELL

Postcode: 08760

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title

Sex ◉ Male ○ Female

First name **Diego** Last name **Villuendas**

E-Mail **diego.villuendas@seat.es**

Position in org. Project Manager

Department Research and Development - VX3 ☐ Same as organisation name

☒ Same as proposing organisation's address

Street AUTOVIA A-2 KM 585

Town MARTORELL Post code 08760

Country Spain

Website

Phone +xxx xxxxxxxxx Phone 2 +xxx xxxxxxxxx Fax +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Erwan	Guillotel	erwan.guillotel@seat.es	+xxx xxxxxxxxx

PIC	***Legal name***
999952243	*AVL LIST GMBH*

Short name: AVL

Address of the organisation

Street HANS-LIST-PLATZ 1

Town GRAZ

Postcode 8020

Country Austria

Webpage www.avl.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....31/12/2015 - no

SME self-assessment .....31/12/2015 - no

SME validation sme.....26/03/2010 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Research and Development ☐ not applicable

☒ Same as proposing organisation's address

Street: HANS-LIST-PLATZ 1

Town: GRAZ

Postcode: 8020

Country: Austria

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: (•) Male ( ) Female

First name: **Eric**

Last name: **Armengaud**

E-Mail: **eric.armengaud@avl.com**

Position in org.: Project Manager

Department: Research and Development

☐ Same as organisation name

☒ Same as proposing organisation's address

Street: HANS-LIST-PLATZ 1

Town: GRAZ

Post code: 8020

Country: Austria

Website:

Phone: +xxx xxxxxxxxx

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Nadine	Knopper	nadine.knopper@avl.com	+xxx xxxxxxxxx

PIC	***Legal name***
906381775	*FEV ITALIA SRL*

Short name: FEV

Address of the organisation

Street	Via Vespucci 43
Town	Torino
Postcode	10129
Country	Italy
Webpage	http://www.fev.com/en/italy.html

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....unknown

Non-profit .....unknown

International organisation .....unknown

International organisation of European interest .....unknown

Secondary or Higher education establishment .....unknown

Research organisation .....unknown

Legal person .....yes

Industry (private for profit).....unknown

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: FEV Italy Engineering Department

☐ not applicable

☒ Same as proposing organisation's address

Street: Via Vespucci 43

Town: Torino

Postcode: 10129

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title

Sex ◉ Male ○ Female

First name **Fabio** Last name **Mallamo**

E-Mail **mallamo@fev.com**

Position in org. Technical Director

Department FEV Italy Engineering Department ☐ Same as organisation name

☒ Same as proposing organisation's address

Street Via Vespucci 43

Town Torino Post code 10129

Country Italy

Website

Phone +xxx xxxxxxxxx Phone 2 +xxx xxxxxxxxx Fax +xxx xxxxxxxxx

PIC	***Legal name***
999918002	*SES ASTRA SA*

Short name: ASTRA

Address of the organisation

Street CHATEAU DE BETZDORF

Town BETZDORF

Postcode 6815

Country Luxembourg

Webpage

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....unknown

International organisation .....unknown

International organisation of European interest .....unknown

Secondary or Higher education establishment .....unknown

Research organisation .....unknown

Legal person .....yes

Industry (private for profit).....unknown

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Corporate Strategy and Development ☐ not applicable

☒ Same as proposing organisation's address

Street: CHATEAU DE BETZDORF

Town: BETZDORF

Postcode: 6815

Country: Luxembourg

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Mr.

Sex: (•) Male ( ) Female

First name: **Edgar**

Last name: **Milic**

E-Mail: **edgar.milic@ses.com**

Position in org.: VP, Strategic Business Innovation

Department: SES ASTRA SA

☒ Same as organisation name

☒ Same as proposing organisation's address

Street: CHATEAU DE BETZDORF

Town: BETZDORF

Post code: 6815

Country: Luxembourg

Website:

Phone: +xxx xxxxxxxxx

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

PIC	***Legal name***
996356065	*5T SRL*

Short name: 5T

Address of the organisation

Street	VIA BERTOLA 34
Town	TORINO
Postcode	10122
Country	Italy
Webpage	www.5t.torino.it

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Research and Development

☐ not applicable

☒ Same as proposing organisation's address

Street: VIA BERTOLA 34

Town: TORINO

Postcode: 10122

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Mr.

Sex: (•) Male ( ) Female

First name: **Massimo**

Last name: **Coccozza**

E-Mail: **massimo.coccozza@5t.torino.it**

Position in org.: Project Manager

Department: Research and Development

☐ Same as organisation name

☒ Same as proposing organisation's address

Street: VIA BERTOLA 34

Town: TORINO

Post code: 10122

Country: Italy

Website:

Phone: +xxx xxxxxxxxx

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Fabrizio	Arneodo	fabrizio.arneodo@5t.torino.it	+xxx xxxxxxxxx

PIC	***Legal name***
999908496	*TELECOM ITALIA SPA*

Short name: TELECOM ITALIA SPA

Address of the organisation

Street VIA GAETANO NEGRI 1

Town MILANO

Postcode 20123

Country Italy

Webpage www.telecomitalia.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Research and Development ☐ not applicable

☒ Same as proposing organisation's address

Street: VIA GAETANO NEGRI 1

Town: MILANO

Postcode: 20123

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Mr.

Sex: (•) Male ( ) Female

First name: **Roberto**

Last name: **Gavazzi**

E-Mail: **roberto.gavazzi@telecomitalia.it**

Position in org.: Project Manager

Department: Research and Development

☐ Same as organisation name

☒ Same as proposing organisation's address

Street: VIA GAETANO NEGRI 1

Town: MILANO

Post code: 20123

Country: Italy

Website:

Phone: +xxx xxxxxxxxx

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

PIC	***Legal name***
969215659	*ANONIMI ETAIRIA PERIVALLONTIKON KAIENERGIAKON MELETON KAI ANAPTIXIS LOGISMIKOU*

Short name: EMISIA AE

Address of the organisation

Street	ANTONI TRITSI 21
Town	THESSALONIKI
Postcode	55104
Country	Greece
Webpage	www.emisia.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....11/03/2008 - yes

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

No department involved

Department name *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street *Please enter street name and number.*

Town *Please enter the name of the town.*

Postcode *Area code.*

Country *Please select a country*

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: (•) Male ( ) Female

First name: **Giorgos**

Last name: **Mellios**

E-Mail: **giorgos.m@emisia.com**

Position in org.: Managing Director

Department: ANONIMI ETAIRIA PERIVALLONTIKON KAIENERGIAKON MELETON KAI

☒ Same as organisation name

☒ Same as proposing organisation's address

Street: ANTONI TRITSI 21

Town: THESSALONIKI

Post code: 55104

Country: Greece

Website:

Phone: +30 2310 473352

Phone 2: +xxx xxxxxxxxx

Fax: +30 2310 804110

PIC	***Legal name***
953745905	*גיאוסים מערכות בע"מ*

Short name: גיאוסים מערכות בע

Address of the organisation

Street	Tnufa 4
Town	Petach-Tikva
Postcode	49510
Country	Israel
Webpage	www.geosimcities.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....no

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....28/03/2012 - yes

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

No department involved

Department name *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street *Please enter street name and number.*

Town *Please enter the name of the town.*

Postcode *Area code.*

Country *Please select a country*

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title

Sex ◉ Male ○ Female

First name **Victor** Last name **Shenkar**

E-Mail **victor@geosim.co.il**

Position in org. CEO

Department Research and Development ☐ Same as organisation name

☒ Same as proposing organisation's address

Street Tnufa 4

Town Petach-Tikva Post code 49510

Country Israel

Website

Phone +xxx xxxxxxxxx Phone 2 +xxx xxxxxxxxx Fax +xxx xxxxxxxxx

PIC	***Legal name***
929206845	*MAPILLARY AB*

Short name: MAPILLARY AB

Address of the organisation

Street	BREDGATAN 4
Town	MALMOE
Postcode	211 30
Country	Sweden
Webpage	https://www.mapillary.com/

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Computer Vision ☐ not applicable

☒ Same as proposing organisation's address

Street: BREDGATAN 4

Town: MALMOE

Postcode: 211 30

Country: Sweden

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title

Sex ◉ Male ○ Female

First name **Yubin** Last name **Kuang**

E-Mail **yubin@mapillary.com**

Position in org. Team Leader

Department Computer Vision ☐ Same as organisation name

☒ Same as proposing organisation's address

Street BREDGATAN 4

Town MALMOE Post code 211 30

Country Sweden

Website

Phone +xxx xxxxxxxxx Phone 2 +xxx xxxxxxxxx Fax +xxx xxxxxxxxx

PIC	***Legal name***
906190685	*CloudMade Ukraine LLC*

Short name: CloudMade Ukraine LLC

Address of the organisation

Street 7 Okhtyrskyi Lane

Town Kyiv

Postcode 03022

Country Ukraine

Webpage www.cloudmade.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....unknown

Non-profit .....unknown

International organisation .....unknown

International organisation of European interest .....unknown

Secondary or Higher education establishment .....unknown

Research organisation .....unknown

Legal person .....yes

Industry (private for profit).....unknown

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Research and Development

☐ not applicable

☒ Same as proposing organisation's address

Street: 7 Okhtyrskyi Lane

Town: Kyiv

Postcode: 03022

Country: Ukraine

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title

Sex ◉ Male ○ Female

First name **Harsha** Last name **Bagur**

E-Mail **harsha.bagur@cloudmade.com**

Position in org. Senior Solutions Architect

Department Research and Development ☐ Same as organisation name

☒ Same as proposing organisation's address

Street 7 Okhtyrskyi Lane

Town Kyiv Post code 03022

Country Ukraine

Website

Phone +xxx xxxxxxxxx Phone 2 +xxx xxxxxxxxx Fax +xxx xxxxxxxxx

PIC	***Legal name***
906285454	*FACTUAL CONSULTING*

Short name: FACTUAL

Address of the organisation

Street Josep Valls 13, 2on A

Town Sant Cugat del Vallès

Postcode 08195

Country Spain

Webpage www.factual-consulting.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Management ☐ not applicable

☒ Same as proposing organisation's address

Street: Josep Valls 13, 2on A

Town: Sant Cugat del Vallès

Postcode: 08195

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title

Sex ◉ Male ○ Female

First name **Marti** Last name **Jofre**

E-Mail **marti@factual-consulting.com**

Position in org. CEO

Department Management ☐ Same as organisation name

☒ Same as proposing organisation's address

Street Josep Valls 13, 2on A

Town Sant Cugat del Vallès Post code 08195

Country Spain

Website

Phone +xxx xxxxxxxxx Phone 2 +xxx xxxxxxxxx Fax +xxx xxxxxxxxx

PIC	***Legal name***
999655520	*BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION*

Short name: BSC

Address of the organisation

Street Calle Jordi Girona 31

Town BARCELONA

Postcode 08034

Country Spain

Webpage www.bsc.es

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....01/03/2005 - no

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Earth Science department

☐ not applicable

☐ Same as proposing organisation's address

Street: NEXUS II building, Jordi Girona 29

Town: Barcelona

Postcode: 08034

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: (•) Male ( ) Female

First name: **Marc**

Last name: **Guevara**

E-Mail: **marc.guevara@bsc.es**

Position in org.: Researcher

Department: Earth Science department

☐ Same as organisation name

☐ Same as proposing organisation's address

Street: NEXUS II building, Jordi Girona 29

Town: Barcelona

Post code: 08034

Country: Spain

Website: www.bsc.es

Phone: +34 934137725

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Mar	Rodriguez Rodrigo	mar.rodriguez@bsc.es	+34 934137566

PIC	***Legal name***
999843409	*CINECA CONSORZIO INTERUNIVERSITARIO*

Short name: CINECA

Address of the organisation

Street VIA MAGNANELLI 6/3

Town CASALECCHIO DI RENO BO

Postcode 40033

Country Italy

Webpage www.cineca.it

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....13/07/1967 - no

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: High Performance Computing ☐ not applicable

☒ Same as proposing organisation's address

Street: VIA MAGNANELLI 6/3

Town: CASALECCHIO DI RENO BO

Postcode: 40033

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: ○ Male ◉ Female

First name: **Paola**

Last name: **Alberigo**

E-Mail: **p.alberigo@cineca.it**

Position in org.: Project Management Office Team

Department: High Performance Computing

☐ Same as organisation name

☒ Same as proposing organisation's address

Street: VIA MAGNANELLI 6/3

Town: CASALECCHIO DI RENO BO

Post code: 40033

Country: Italy

Website: www.hpc.cineca.it

Phone: +39 0516171654

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

PIC	***Legal name***
999992789	*ISTITUTO NAZIONALE DI FISICA NUCLEARE*

Short name: INFN

Address of the organisation

Street Via Enrico Fermi 40

Town FRASCATI

Postcode 00044

Country Italy

Webpage www.infn.it

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....25/05/2016 - no

SME self-assessment ..... unknown

SME validation sme.....19/09/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: High Performance Computing ☐ not applicable

☒ Same as proposing organisation's address

Street: Via Enrico Fermi 40

Town: FRASCATI

Postcode: 00044

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title

Sex ◉ Male ○ Female

First name **Stefano** Last name **Bagnasco**

E-Mail **bagnasco@to.infn.it**

Position in org. Technology Researcher

Department High Performance Computing ☐ Same as organisation name

☒ Same as proposing organisation's address

Street Via Enrico Fermi 40

Town FRASCATI Post code 00044

Country Italy

Website

Phone +xxx xxxxxxxxx Phone 2 +xxx xxxxxxxxx Fax +xxx xxxxxxxxx

PIC	***Legal name***
997712707	*ASSOCIAZIONE ITHACA-INFORMATION TECHNOLOGY FOR HUMANITARIAN ASSISTANCE COO*

Short name: ITHACA

Address of the organisation

Street VIA PIER CARLO BOGGIO 61

Town TORINO

Postcode 10138

Country Italy

Webpage www.ithacaweb.org

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

No department involved

Department name *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street *Please enter street name and number.*

Town *Please enter the name of the town.*

Postcode *Area code.*

Country *Please select a country*

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: (•) Male ( ) Female

First name: **Andrea**

Last name: **Ajmar**

E-Mail: **andrea.ajmar@ithaca.polito.it**

Position in org.: Geographic Information Specialist

Department: ASSOCIAZIONE ITHACA-INFORMATION TECHNOLOGY FOR HUMANITA

☒ Same as organisation name

☒ Same as proposing organisation's address

Street: VIA PIER CARLO BOGGIO 61

Town: TORINO

Post code: 10138

Country: Italy

Website:

Phone: +3901119751111

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Luciana	Dequal	luciana.dequal@ithaca.polito.it	+3901119751111

PIC	***Legal name***
999992886	*CENTRO RICERCHE FIAT SCPA*

Short name: CENTRO RICERCHE FIAT

Address of the organisation

Street STRADA TORINO 50

Town ORBASSANO

Postcode 10043

Country Italy

Webpage www.crf.it

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....27/10/2008 - no

SME self-assessment ..... unknown

SME validation sme.....27/10/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Vehicle Innovation & Advance Electrical/Electronics

☐ not applicable

☒ Same as proposing organisation's address

Street: STRADA TORINO 50

Town: ORBASSANO

Postcode: 10043

Country: Italy

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: ○ Male ◉ Female

First name: **Luisa**

Last name: **Andreone**

E-Mail: **luisa.andreone@crf.it**

Position in org.: Programme Manager for Collaborative Projects

Department: Vehicle Innovation & Advance Electrical/Electronics

☐ Same as organisation name

☒ Same as proposing organisation's address

Street: STRADA TORINO 50

Town: ORBASSANO

Post code: 10043

Country: Italy

Website:

Phone: +xxx xxxxxxxxx

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

PIC	***Legal name***
999976202	*UNIVERSITAT POLITECNICA DE CATALUNYA*

Short name: UPC

Address of the organisation

Street	CALLE JORDI GIRONA 31
Town	BARCELONA
Postcode	08034
Country	Spain
Webpage	www.upc.edu

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....yes

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....05/03/2014 - no

SME self-assessment .....05/03/2014 - no

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: inLab FIB

☐ not applicable

☒ Same as proposing organisation's address

Street: CALLE JORDI GIRONA 31

Town: BARCELONA

Postcode: 08034

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: (•) Male ( ) Female

First name: **Jose**

Last name: **Casanovas Garcia**

E-Mail: **josep.casanovas@upc.edu**

Position in org.: Laboratory Director

Department: inLab FIB

☐ Same as organisation name

☒ Same as proposing organisation's address

Street: CALLE JORDI GIRONA 31

Town: BARCELONA

Post code: 08034

Country: Spain

Website:

Phone: +xxx xxxxxxxxx

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

3 - Budget

No	Participant	Country	(A) Direct personnel costs/€ ?	(B) Other direct costs/€ ?	(C) Direct costs of sub-contracting/€ ?	(D) Direct costs of providing financial support to third parties/€ ?	(E) Costs of inkind contributions not used on the beneficiary's premises/€ ?	(F) Indirect Costs / € (=0.25(A+B-E)) ?	(G) Special unit costs covering direct & indirect costs / € ?	(H) Total estimated eligible costs / € (=A+B+C+D+F+G) BENEFICIARY ?	(I) Reimburse-ment rate (%) BENEFICIARY ?	(J) Max.EU Contribution / € (=H*I) BENEFICIARY ?	(K) Costs of third parties linked to participant THIRD PARTIES ?	(L) Max.EU Contribution / € THIRD PARTIES ?	(M) Total Costs for BENEFICIARY & THIRD PARTIES (=H+K) ?	(N) Max.EU Contribution / € BENEFICIARY & THIRD PARTIES (=J+L) ?	(O) Requested EU Contribution / € BENEFICIARY & THIRD PARTIES ?
1	Valeo Comfort And Driving Assistance	FR	484500	106000	120000	0	0	147625,00	0	858125,00	70	600687,50	0	0	858125,00	600687,50	600687,50
2	Vic	DE	1050000	231000	0	0	0	320250,00	0	1601250,00	70	1120875,00	0	0	1601250,00	1120875,00	1120875,00
3	Fiat Auto S.p.a.	IT	906500	115000	0	0	0	255375,00	0	1276875,00	70	893812,50	0	0	1276875,00	893812,50	893812,50
4	Seat	ES	224000	50280	0	0	0	68570,00	0	342850,00	70	239995,00	0	0	342850,00	239995,00	239995,00
5	Avl	AT	987000	100000	0	0	0	271750,00	0	1358750,00	70	951125,00	0	0	1358750,00	951125,00	951125,00

6	Fev	IT	792634	232000	120000	0	0	256158,50	0	1400792,50	70	980554,75	0	0	1400792,50	980554,75	980554,75
7	Astra	LU	184000	392288	0	0	0	144072,00	0	720360,00	70	504252,00	0	0	720360,00	504252,00	504252,00
8	5t	IT	325000	32000	0	0	0	89250,00	0	446250,00	70	312375,00	0	0	446250,00	312375,00	312375,00
9	Telecom Italia Spa	IT	372000	110000	0	0	0	120500,00	0	602500,00	70	421750,00	0	0	602500,00	421750,00	421750,00
10	Emisia Ae	EL	522000	45000	0	0	0	141750,00	0	708750,00	70	496125,00	0	0	708750,00	496125,00	496125,00
11	גיאוסים מערכות בע	IL	412500	60000	0	0	0	118125,00	0	590625,00	70	413437,50	0	0	590625,00	413437,50	413437,50
12	Mapillary Ab	SE	448000	55000	10000	0	0	125750,00	0	638750,00	70	447125,00	0	0	638750,00	447125,00	447125,00
13	Cloudmade Ukraine Llc	UA	576000	15000	150000	0	0	147750,00	0	888750,00	70	622125,00	0	0	888750,00	622125,00	622125,00
14	Factual	ES	600000	16000	0	0	0	154000,00	0	770000,00	70	539000,00	0	0	770000,00	539000,00	539000,00
15	Bsc	ES	522000	23000	0	0	0	136250,00	0	681250,00	100	681250,00	0	0	681250,00	681250,00	681250,00

16	Cineca	IT	324000	76000	0	0	0	100000,00	0	500000,00	100	500000,00	0	0	500000,00	500000,00	500000,00
17	Infn	IT	360000	524800	0	0	0	221200,00	0	1106000,00	100	1106000,00	0	0	1106000,00	1106000,00	1106000,00
18	Ithaca	IT	380000	12000	60000	0	0	98000,00	0	550000,00	100	550000,00	0	0	550000,00	550000,00	550000,00
19	Centro Ricerche Fiat	IT	546000	75000	0	0	0	155250,00	0	776250,00	100	776250,00	0	0	776250,00	776250,00	776250,00
20	Upc	ES	340000	96000	0	0	0	109000,00	0	545000,00	100	545000,00	0	0	545000,00	545000,00	545000,00
	Total		10356134	2366368	460000	0	0	3180625,50	0	16363127,50		12701739,25	0,00	0,00	16363127,50	12701739,25	12701739,25

4 - Ethics

1. HUMAN EMBRYOS/FOETUSES		Page
Does your research involve Human Embryonic Stem Cells (hESCs)?	○ Yes ◉ No	
Does your research involve the use of human embryos?	○ Yes ◉ No	
Does your research involve the use of human foetal tissues / cells?	○ Yes ◉ No	
2. HUMANS		**Page**
Does your research involve human participants?	○ Yes ◉ No	
Does your research involve physical interventions on the study participants?	○ Yes ◉ No	
3. HUMAN CELLS / TISSUES		**Page**
Does your research involve human cells or tissues (other than from Human Embryos/ Foetuses, i.e. section 1)?	○ Yes ◉ No	
4. PERSONAL DATA		**Page**
Does your research involve personal data collection and/or processing?	○ Yes ◉ No	
Does your research involve further processing of previously collected personal data (secondary use)?	○ Yes ◉ No	
5. ANIMALS		**Page**
Does your research involve animals?	○ Yes ◉ No	
6. THIRD COUNTRIES		**Page**
In case non-EU countries are involved, do the research related activities undertaken in these countries raise potential ethics issues?	○ Yes ◉ No	
Do you plan to use local resources (e.g. animal and/or human tissue samples, genetic material, live animals, human remains, materials of historical value, endangered fauna or flora samples, etc.)?	○ Yes ◉ No	
Do you plan to import any material - including personal data - from non-EU countries into the EU?	○ Yes ◉ No	
Do you plan to export any material - including personal data - from the EU to non-EU countries?	○ Yes ◉ No	
In case your research involves low and/or lower middle income countries, are any benefits-sharing actions planned?	○ Yes ◉ No	
Could the situation in the country put the individuals taking part in the research at risk?	○ Yes ◉ No	

7. ENVIRONMENT & HEALTH and SAFETY		Page
Does your research involve the use of elements that may cause harm to the environment, to animals or plants?	◯ Yes ◉ No	
Does your research deal with endangered fauna and/or flora and/or protected areas?	◯ Yes ◉ No	
Does your research involve the use of elements that may cause harm to humans, including research staff?	◯ Yes ◉ No	
8. DUAL USE		**Page**
Does your research involve dual-use items in the sense of Regulation 428/2009, or other items for which an authorisation is required?	◯ Yes ◉ No	
9. EXCLUSIVE FOCUS ON CIVIL APPLICATIONS		**Page**
Could your research raise concerns regarding the exclusive focus on civil applications?	◯ Yes ◉ No	
10. MISUSE		**Page**
Does your research have the potential for misuse of research results?	◯ Yes ◉ No	
11. OTHER ETHICS ISSUES		**Page**
Are there any other ethics issues that should be taken into consideration? Please specify	◯ Yes ◉ No	

I confirm that I have taken into account all ethics issues described above and that, if any ethics issues apply, I will complete the ethics self-assessment and attach the required documents. ☒

How to Complete your Ethics Self-Assessment

5 - Call-specific questions

Extended Open Research Data Pilot in Horizon 2020

If selected, applicants will by default participate in the Pilot on Open Research Data in Horizon 2020[1] , which aims to improve and maximise access to and re-use of research data generated by actions.

However, participation in the Pilot is flexible in the sense that it does not mean that all research data needs to be open. After the action has started, participants will formulate a Data Management Plan (DMP), which should address the relevant aspects of making data FAIR – findable, accessible, interoperable and re-usable, including what data the project will generate, whether and how it will be made accessible for verification and re-use, and how it will be curated and preserved. Through this DMP projects can define certain datasets to remain closed according to the principle "as open as possible, as closed as necessary". A Data Management Plan does not have to be submitted at the proposal stage.

Furthermore, applicants also have the possibility to opt out of this Pilot completely at any stage (before or after the grant signature). In this case, applicants must indicate a reason for this choice (see options below).

Please note that participation in this Pilot does not constitute part of the evaluation process. Proposals will not be penalised for opting out.

We wish to opt out of the Pilot on Open Research Data in Horizon 2020.	○ Yes	◉ No

Further guidance on open access and research data management is available on the participant portal: http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-dissemination_en.htm and in general annex L of the Work Programme.

[1] *According to article 43.2 of Regulation (EU) No 1290/2013 of the European Parliament and of the Council, of 11 December 2013, laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" and repealing Regulation (EC) No 1906/2006.*

Title of Proposal: *H*PC-*E*nabled *P*ilot *T*est-beds to *A*dvance *S*mart mobility and smart cities (HEPTAS)

Call: ICT-11-2018, 'HPC and Big Data enabled Large-scale Test-beds and Applications'

Submission date: April 17th, 2018

Project duration: 36 months

Coordinating person: David Roine

List of participants

No.	Organisation Name	Short name	Country
1	Valeo Comfort and Driving Assistance Systems	VAL-F	FR
2	Valeo Schalter und Sensoren GmbH	VAL-G	GE
3	FIAT CHRYSLER AUTOMOBILES ITALY SPA - FCA ITALY	FCA	IT
4	SEAT S.A.	SEAT	ES
5	AVL List GmbH	AVL	AT
6	FEV Italy S.r.l.	FEV	IT
7	SES Astra S.A.	SES	LU
8	5T S.r.l.	5T	IT
9	Telecom Italia (TIM)	TIM	IT
10	EMISIA SA – Société Anonyme of Environmental and Energy Studies and Software	EMI	GR
11	GeoSim Systems Ltd	GEO	ISR
12	Mapillary	MAP	SE
13	CLOUDMADE UKRAINE LLC	CM	UKR
14	Factual Consulting	FAC	ES
15	Barcelona Supercomputing center-Centro Nacional de Supercomputación (BSC)	BSC	ES
16	CINECA - Consorzio Interuniversitario	CIN	IT
17	INFN	INFN	IT
18	Information Technology for Humanitarian Assistance, Cooperation and Action (ITHACA)	ITH	IT
19	Centro Ricerche FIAT S.C.p.A	CRF	IT
20	Universitat Politècnica de Catalunya	UPC	ES

10 countries involved, combining public authority, large industrials, SMEs, and research institutes, supported by government of Luxemburg and Italy, smart cities associations and relevant tech. partners

Executive summary

HEPTAS project target is to demonstrate HPC-enabled key use cases applied to automotive, and supporting city policy makers to define more efficient urban mobility strategies

Growing population, public pressure and evolving legal and policy frameworks demand new approaches to urban mobility, increasing traffic efficiency and parking convenience, with lower overall environmental footprint, energy consumption and pollution.

HPC-Enabled Pilot Test-beds to Advance Smart mobility and smart cities (HEPTAS) project will address these challenges by combining **Big Data flows** from heterogeneous, real-time, massive sources (e.g. connected vehicles, IoT city sensors, mobile phone data), **elastic HPC** for the continuous analysis and optimization of mobility**, machine learning & simulation** to optimize traffic flows, and **low latency networks** to send advice to vehicles **(**e.g. navigation advice to skip traffic gridlock, and for an improved speed profile) and infrastructure **(**e.g. traffic lights, speed limits) and allowing public authorities and policy makers **to react faster and smarter, reducing journey times,** and **emissions of air pollutants at hotspots**.

HEPTAS will make intensive use **of hybrid computing resources** and related services (cloud computing and HPC) interacting with **in-vehicle resources** (e.g. sensors) and predictive functions (e.g. algorithms) to maintain safety if connectivity is lost.

To maximize Vehicle-to-Anything (V2X) connectivity, HEPTAS will use a mix of **mobile data, WiFi & Satellite** infrastructures, and protocols **to increase data availability** by avoiding bandwidth reduction. At the same time, data flows will be automatically scaled if bandwidth is restricted (e.g. from 5G to 3G) but still keeping meaningful predictive functionalities.

HEPTAS brings a **mobility data value chain** supporting project selected **monitored use cases** that respect **privacy (GDPR and other local privacy regulation)** and **security**. HEPTAS will develop **predictive maintenance to reduce breakdowns & costs** (supporting faster identification of fleet issues), **3D map inconsistencies** sent from vehicles to the Hybrid Cloud infrastructure **to manage 3D map updates & re-surveys** (reducing map errors & correction time), and complex city models supporting city policy makers reduce emissions of air pollutants due to mobility.

1. Excellence

1.1 Objectives

1.1.1 Background and motivation

City mobility challenges

The **quality of life of citizens on the move, with individually efficient and yet inclusive mobility, the growing demand regarding the transportation of goods, the competitiveness of the mobility market**, are the main goals that are targeted by the European Commission White Paper on Transport (ed. 2011). The mobility scenario Strategic Goals includes major highlights from the EC White Paper with the European Commission "Ten Goals" and strategies for a competitive and resource efficient transport system. However, the quality of life and economic growth can only be effectively targeted if the major related problems are known. It's for this reason that main facts and trends related to road safety, demographic changes, traffic congestion, energy availability/consumption, and air pollution shall be core targets for improvement in the urban mobility of the future.

Road Safety introduces the problem of road accidents in the whole of Europe with a highlight on vulnerable road users' road safety that is particularly important in urban environments. When dealing with a mobility scenario the major demographic changes, like the aging of the population, and trends in migration in the European Union are crucial in shaping the future of urban mobility.

Most recent data on **traffic and European citizens' perception on the quality of transport** are saying that the most relevant problem in urban mobility is **congestion**. At the same time, energy demand plus CO2 (and other pollutants) emissions are in the focus as well, as the European Union emission targets to **reduce vehicles' CO2 emissions**, and the current initiatives to tackle the road transport CO2 challenge are progressing.

A large majority of European and worldwide citizens live in an urban environment, with over 60 % living in urban areas of over 10,000 inhabitants in the EU. Consequently, the **main urban mobility challenges are related to the growing density of population, aging of infrastructure, and public transport, traffic congestion and safety, poor air quality, energy consumption, obsolete regulations, and security**.

In the context of urban mobility, ICT is playing a major role in the design of the future of mobility of people and goods. The revolutionary influence of the smart phones on everyday life is a well-known example. Some of the main mobility-related technologies, that are expected to shape the future, are alternative fuelled transport systems, vehicle automation and intelligent transport systems (ITS). But we are not yet able to face all the heavy challenges of urban mobility; in this context the question is, **what can HPC and big data do to help in this direction**?

Vehicle automation is a novelty of the past few years and is rapidly evolving. This is highlighted by major associations like EUCAR, with its "Safe and Integrated Mobility Pillar Task Force Vehicle Automation", and ERTRAC with the "Automated Driving Roadmap". Urban vehicle automation trends were reported on in the "Strategy for Automated and Connected Driving" issues in 2015 by the German Federal Government.

Intelligent Transport Systems are the key enabler for the Digital Single Market and are demanded by the European Commission and by the US DOT ITS Joint Program Office Strategic Plans to play a big role in the future of mobility of people and goods. ITS Intelligent Transport Systems states this fact, for example, with the 2014 European Commission document "ITS Action Plan Final Report". Meanwhile, the European Global Navigation Satellite Systems Agency is working to complete the constellation of the Galileo Program, the EU global satellite-based navigation system, and cellular technology is shaping the future of 5G. Cybersecurity is a vital part of everyday life and connected mobility in all its aspects. For this reason, a huge number of national and international public authorities and industries are intensively active on the topic. Smart mobile devices, APPs, future internet, clouds, internet of the things will also play a big role in future mobility.

In this context, a major step forward will be represented by joining existing technologies with HPC and Big Data analytics (incl. Artificial Intelligence), to enable the "eHorizon 5.0" vision of urban mobility.

High Performance Computing is strategic for the competitiveness of Europe

The most important sectors of European Industry will be strongly impacted by HPC, for example, automotive, aviation, energy, oil, and gas, pharmaceutical, etc. All reports **dedicated to HPC conclude that it produces returns faster and greater than most other technologies**, and hence HPC investment is necessary to protect and increase competitiveness. It is estimated [IDC] that every $1 invested in HPC generates $551 on average in revenues, and $52 of profits or cost savings. Industry accounted for 24.5% of EU GDP in 2015 [Statista]. Studies by IDC and others

have firmly established the link between HPC and industrial competitiveness. **HPC will bring strong contribution to both jobs and GDP creation helping the EU to reach 20% GDP target by 2020**.

Europe is in fierce competition on HPC with USA, China, Japan, all of which are investing massively.
Europe has defined its strategic priorities:

- **Infrastructure**: Put in place the capacity by acquiring leadership-class HPC systems
- **Technology**: Securing independent European HPC systems and technology supply
- **Applications**: Excellence in HPC applications and widening the usage of HPC

EuroHPC2021 is a major initiative to position Europe as a global player in HPC.
In March 2017, ministers from seven European countries (France, Germany, Italy, Luxembourg, Netherlands, Portugal, and Spain) all signed a declaration to support the next generation of computing and data infrastructures **to enable world-class high-performance computing infrastructure in Europe.**

A strong HPC eco-system is needed to strengthen European Cloud initiatives
The European Cloud Initiative has called for the support of EU Member States to develop a High-Performance Computing ecosystem based on European technology, including low-power HPC chips. **The goal is to have Exascale supercomputers based on European technology in the global top three by 2022**.

HPC is already tested in Automotive industry
Recently Renault used the CURIE supercomputer for performing the biggest multi-physics car optimization study ever made, with hundreds of crash simulations. This study provided Renault with **unprecedented results in mass reduction, CO2 limitation, safety improvement**, and will be key in fulfilling future EuroNCAP6 safety rules.

Objectives of HEPTAS in this context
With the support of Cineca and Barcelona Supercomputing Center **ranked respectively #1 and #3 in Europe in the 500 list of worldwide supercomputers**[1], the HEPTAS consortium will demonstrate HPC capabilities to address the challenges of predictive maintenance, the e-Horizon 5.0, and the new mobility reducing air pollution and optimizing energy consumption of private and public vehicles. **HEPTAS will demonstrate that HPC technology can significantly contribute to CO2 / other pollutant emissions reduction, increased safety, driving/parking convenience, with reduced maintenance costs and breakdowns.**

1.1.2 Project objectives and main criteria

HEPTAS has the following four SMART (specific, measurable, achievable, realistic, and time-bound) **objectives** (O1-O4), with the indication of the project month (M) for their expected achievement.

OBJECTIVE 1 (O1): HPC enabled cloud managing smart city data via machine learning & simulation

- **HPC city traffic management systems.** Current approaches whilst sophisticated are reaching the limits of what is solvable with traditional methods. Optimal management of a highly complex system of systems like citywide traffic requires a more intelligent approach, which is now possible through HPC enabled processing of big data, via techniques such as parallelized traffic flow simulations and thus optimization, machine learning & artificial intelligence. **HEPTAS will improve the ability of traffic management authorities to react to traffic flow issues 20 to 30% faster, despite greater flows and / or disruptions.**
- **Optimal interaction between smart cyber-physical systems**: Vehicle OEM/suppliers already have connectivity enabled predictive features (e.g. traffic light assistant, cooperative adaptive cruise control, platooning) to improve the efficiency, convenience & safety of individual and small groups of vehicles, but their potential whilst significant is ultimately limited by the lack of appropriate co-operation between vehicles, the wider city traffic flow, and smart city infrastructure (e.g. adaptive traffic light timing and dynamic speed limits). HEPTAS will directly address this limitation with the **further development & test-bed demonstration of hybrid (i.e. part based in the city HPC cloud, part based in-vehicle) approaches to predictive control for 2 smart city use cases**.
- **Dependability.** As 100% connectivity coverage is not yet possible, nor can be always guaranteed, it is vitally important that each ego-vehicle remains responsible (i.e. locally on-board) for the final determination of its route, and its dynamic trajectory including the refinement of its optimal speed profile, to ensure minimal energy consumption, and ensure a safe and timely arrival, even in the case of

[1] see www.top500.org, 11/2017

interrupted cloud and connected data flow. **HEPTAS will demonstrate in-vehicle demonstrators that predictive and smart mobility is maintained when data connection is lost for the aforementioned 2 smart city Use Cases.**

Key Outputs:	The HEPTAS Platform, HEPTAS Demonstration use cases
Quantified Targets:	1 Open Source Multisided Big Data Platform, 4 different Demonstrator cases, 1 Business Validation & Impact Assessment Report, Impact Metrics (see Section 2)
Means of Validation:	Platform Architecture & Design Blueprints. Technical Verification & Validation Plan & Results. Business Validation & User Acceptance Plan & Results. Feedback acquired via demonstration events.

OBJECTIVE 2 (O2): To build a comprehensive & diverse smart mobility data value chain that is relevant & sustainable

- **Predictive and proactive maintenance** of public and private vehicles, using machine learning in a HPC-enabled cloud, based on existing vehicle electronic signal data including Diagnostic Trouble Codes, intrinsic functional parameters, contextual datas deducted from individual drivng styles, maintenance manuals, accumulative maintenance database, maintenance models and algorithms. The aim is to **reduce breakdowns by 10 to 15%,** reducing the cost of individual and fleet ownership, improving emissions, safety, and convenience.
- **Early detection of vehicle fleet issues** by OEM & their suppliers. Real-time data collection and machine learning in a HPC-enabled cloud to support early detection of issues. Compared to techniques based on the analysis of dealer/service based vehicle diagnostics, **the time reduction to the identification of possible systematic fleet issues is expected to be reduced by 30% or more**.
- **Sustainability**. HEPTAS requires a sustainable and technically rich data value chain to realize societal and economic benefits. Industrialization of the data value chain requires its affordable and monetarized usage for multiple applications by various stakeholders (incl. public transport authorities, infrastructure and communication providers, vehicle OEM and suppliers, SME, private individuals). **HEPTAS aims for appropriate (considering privacy) re-usage of anonymised data.**
- **Communications to/from the cloud and HPC to be tailored, targeted and prioritized**, to ensure that the right information (what is necessary and as appropriate anonymized to respect data privacy) is securely made available to legitimate and relevant users at the right time. HEPTAS will scaleably reduce data flows to a still sufficient level when communication bandwidth is restricted (e.g. from 5G to 3G) to support meaningful and continuous big data based intelligent / predictive functionality. **HEPTAS targets scaling down data flows by 50% on average whilst retaining meaningful functionality.**

Key Outputs:	HEPTAS Data Sharing Principles & Business Models, Value Distribution Methods, Patterns, & Templates for Stakeholder Collaboration and SLAs.
Quantified Targets:	1 inclusive Market Analysis of smart mobility data & related services sector incl. sectors connected to smart cities, 1 PESTLE Analysis of HEPTAS ecosystem, 1 SWOT analysis of HEPTAS platform, 4 different Business Model templates for value sharing, 1 consortium wide Exploitation plan, 1 inclusive Financial Strategy plan with cost breakdowns & future projections, 1 consortium wide Platform Sustainability plan, Individual Partners Business Models & Exploitation plans.
Means of Validation:	In-depth State-of-the-Art Analysis. Business Models & Processes presentation. Experimentation Documentation. International Journals / Conferences / Proceedings. Cost Structure Analysis & Feasibility Analysis; Breakeven Analysis & Risk Management Analysis; Communication & Collaboration for Funding Schemes to ensure research continuity, market readiness & viability.

OBJECTIVE 3 (O3): To demonstrate environmental, societal & economic benefits of smart European city mobility test-beds

- **Optimised city traffic flow & throughput.** Real-time elastic HPC powered parallel traffic flow simulations to optimise in real-time both overall city traffic flows, and localised traffic flows to better distribute the flow of traffic over the city, and to group vehicles to better drive green waves through adaptive traffic lights, especially during periods of disruption when major traffic arteries are blocked due to accidents, construction, public events. **Journey times during peak periods to be reduced by 5 to 15%** by HEPTAS, leading to **at least similar pollution reductions** due to decreased travelling time and smoothing of traffic conditions.

- **Reduced city air pollution with traffic flow tailoring.** Overall city air pollutants due to vehicular traffic to be reduced by 10 to 15 %, urban air-quality hotspots may be reduced by up to 25% if some traffic, especially higher emitting (e.g. heavy commercial) vehicles diverted to less environmentally sensitive routes.
- **3D maps for highly automated driving**. Vehicles to send meta-data or selected segmented image data regarding 3D map inconsistencies e.g. missing landmarks, to be processed in the HPC cloud, to manage static and medium 3D map updates and prioritize re-surveys. **Reducing city static map errors by up to 10%, and the time taken to correct maps by 30% or more.**
- **Car positional accuracy meeting L3+ AD requirements.** Positional accuracy based on navigation receivers is sometimes unreliable, especially in dense urban areas: when cars are driving in narrow streets surrounded by houses (street canyons), the reduced number of visible satellites and other signal interferences lead to a decrease of the positional accuracy of several metres, not matching the range of few centimetres required to enable higher degrees of assistance or autonomy. Additionally, assisted/autonomous cars can be subject to cyber-attacks. By comparing the 3D environmental contexts produced by the car's own sensors' suite with a reference 3D model, positional accuracy may be improved by several metres, if map errors are eliminated.
- **Parking** accounts for up to 40% of driving time. The HEPTAS cloud will collect data from existing vehicle sensors (e.g. LIDAR camera), which combined with localization, allows HPC based HEPTAS machine learning to make real-time parking suggestions, redu**cing the time to find a space to 15%, lowering ego-car energy costs, freeing the remaining traffic**, and **reducing the environmental impact** due to congestion.

Key Outputs:	HEPTAS Public Showcase & Web Presence, Marketing Kit, HEPTAS Dissemination & Stakeholders' Engagement Plan.
Quantified Targets:	Dissemination & Communication Targets & KPIs as in Section 2.2.4
Means of Validation:	Dissemination-Communication-Stakeholder Engagement Reports.

OBJECTIVE 4 (O4): To implement a connected & integrated HPC cloud platform able to support new users, data & use cases

- **Nearly always connected.** Up-to-date and reliable big data sets require near continuous and cost-effective connectivity everywhere. HEPTAS will utilize as appropriate communications via Mobile Cellular network (5G/LTE/4G/3G), Wi-Fi ((G5), and Satellite, to affordably maximize connectivity and data flows connecting:
  i) Potentially billions of sensors and actuators send data to the Data Lake(s), where it is stored;
  ii) Data Lake(s) to the HPC(s) centres;
  iii) HPC(s) systems among them.

  The HEPTAS approach to dynamically select the most appropriate communication technology will **increase data availability (with respect to both connected time and vehicle location) by 5 to 30%** depending on city topology, buildings (street canyons), communication infrastructures etc.

- **Sufficient elastic HPC & cloud storage.** Sufficient and affordable cloud based storage, as well as elastic and distributed HPC to ensure timely and reliable processing (e.g. machine learning, simulation) of huge amounts of city mobility data. **HEPTAS will demonstrate that the HPC available capacity can be elastically increased / decreased in size by a factor at least 10 times in less than 30 seconds.**
- **Openness.** Whilst is essential that privacy, security and IPR rights are fully respected, a suitable and up-to-date city wide HPC cloud needs to be open to include new data sources, and applications, such as those provided by innovative SMEs. HEPTAS aims to develop/deploy one additional undefined complimentary mobility use case

Key Outputs:	HEPTAS Platform, HEPTAS Data Repositories, HEPTAS Open API, Assets Brokerage Engine, Documentation & Usage manuals.
Quantified Targets:	1 Data Analytics Platform, 1 Querying API, 1 Real-time Analytics API with Documentation, 1 Application Catalogue.
Means of Validation:	Platform Architecture & Design Blueprints. Technical Verification & Validation Plan & Results. User Acceptance Plan & Results. Feedback via Demos at Events.

The achievement of Objectives O1-O4 is made possible by **the extensive experience of the HEPTAS participants** in previous, highly-successful FP7 and Horizon 2020 projects, and **levered by the support from relevant national / regional research and innovation programmes** such as in the case of Turin or Barcelona test-beds (see Section 1.3.3) **and as member of the advisory board** (see the ten Letter of Supports in the annex - including Luxemburg and Italy governments), to promote best practices and disseminate success stories to other European cities.

1.2 Relation to the work programme

1.2.1 Relation to the ICT-11-2018 specific challenges

HEPTAS is an Innovation Action, targeting the **topic ICT-11-2018, 'HPC and Big Data enabled Large-scale Test-beds and Applications'.** Table 1 **addresses the specific challenges of the H2020 ICT-11-2018 call and the** corresponding **HEPTAS solutions**, with indication of the respective objectives. The alignment of HEPTAS with the expected impact of ICT-11-2018 is described in Section 2.1.4.

Table 1: Specific challenges of the ICT-11-2018 topic and HEPTAS contributions

ICT-11-2018 specific challenge	*HEPTAS solution*
"The Internet of Things and the convergence of HPC, Big Data and Cloud computing technologies are enabling the emergence of a wide range of innovations."	HEPTAS' core concept is built around technology convergences and collaboration principles and aims to break down information silos and promote cross-sector collaboration through data exchange powered by an innovative satellite-terrestrial connectivity solution. The idea of HEPTAS is to tackle sectors that are related and linked to the smart mobility/smart cities sector datasets and allow analysis producing added value insights ➢ Related objectives: Obj 1 and 4
"Building industrial large-scale application test-beds that integrate such technologies and that make best use of currently available HPC and data infrastructures will accelerate the pace of digitization and the innovation potential in Europe's key industry sectors"	The modular architecture of HEPTAS, the different core data services and added value service bundles that will accompany the platform are able to create an easy to use and powerful environment for (big) data related management activities, supporting at the same time data, knowledge as well as services sharing, catering for the nurturing of a data scientists network of stakeholders that are interested in smart mobility related data. ➢ Related objectives: Obj 2 and 3

1.2.2 Addressing the scope of the ICT-11-2018 call

Table 2: Scope of the ICT-11-2018 topic and HEPTAS contributions

ICT-11-2018topic	*HEPTAS solution*
"Targeting the development of large-scale HPC-enabled industrial pilot test-beds supporting big data applications and services by combining and/or adapting existing relevant technologies (HPC / BD / cloud) in order to handle and optimize the specific features of processing very large data sets"	HEPTAS will heavily rely on existing HPC, telecom (both terrestrial and satellite) and data infrastructures and platforms to get data, analysing and release them to the final user, including utilising specific services already available from the partners or developed in previous EU projects, that will prove highly valuable. **CINECA, INFN, Barcelona Supercomputing Centre** will provide **HPC capabilities** that are key to process massive, heterogeneous data sets as the ones described below, with a specific target to assess emissions of air pollutants caused by urban mobility, and providing tools to raise awareness on this issue and propose strategies to mitigate, in liaison with local policy makers. HEPTAS has secured valuable extra support and advice from the Big Data Center of Excellence Barcelona[2], which has committed to cooperate to fulfil the common goal of better air quality in Barcelona. This, of course, will serve the Big Data CoE to gain expertise on the topic to exploit some of the findings and strategies with other client companies and cities, contributing to multiplying the international reach of HEPTAS outcomes. ➢ Related objectives: Obj 1 and 4
"The industrial pilot test-beds should handle massive amounts of diverse types of big data coming from a multitude of players and sources and clearly demonstrate	Smart mobility and related data are highly diverse, combining data from engine sensors, video streams, traffic flow sensors, meteorological forecasts, etc. As such, the platform will be tasked to handle such diverse data in an effective and information lossless fashion. These data, whether they come from open/free sources (being stored in open data repositories or coming from the web or from social media), or from private

[2] Centre driven by Eurecat Technology Centre, the Government of Catalonia, the Barcelona City Council and Oracle that builds, develops and provides tools, data sets and value-added Big Data capabilities enabling companies on defining, testing and validating Big Data models before their final implementation: https://www.bigdatabcn.com/en/about-big-data-coe-barcelona/

how they will generate innovation and large value creation"	repositories of stakeholders are mostly unstructured and not following translation friendly patterns of storage. HEPTAS platform will contribute to enhance the cross-sector collaboration and wider knowledge sharing amongst organisations from different entities, including HPC, Cloud and connectivity service providers and application developers. ➢ Related objectives: Obj 1, 2 and 4
"The proposal shall describe the data assets available to the test-beds and, as appropriate, the standards it intends to use to enable interoperability"	To facilitate the brokerage service mentioned above, the HEPTAS methodology will contain the concept of a Data Policy framework that will be used to address data related issues that relate to provenance, quality, security, trust, and IPR. The framework will be the key driver behind the planned services and will be triggered upon insertion of any kind of data into the platform, performing the necessary annotations both at dataset and on dataset element level, ensuring that the accumulated data are fully describe with respect to their IPR, quality and privacy levels. ➢ Related objectives: Obj 2 and 3
"Pilot test-beds should also aim to provide, via the cloud, simple secure access and secure service provisioning of highly demanding data use cases for companies and especially SMEs"	Apart from caring for the monetisation that will be made possible through the service activities, HEPTAS will also safeguard commercial confidentiality and personal data, suggesting data anonymization, secure exchange of information, data quality validation methods. These services will be for instance supported by the existence of containerised spaces within the overall architecture that will be used to secure and keep data only in the hands of owners in case they are characterised as private and non-shareable. In the Consortium as stakeholders two SME: Mapillary and EMISIA will benefit of services created and provided by HEPTAS platform. ➢ Related objectives: Obj 3 and 4
"Proposals should be led by and show strong industrial commitment. They should explain how the proposed activities will be industrialized and have impact on the competitiveness and leadership of European industry."	HEPTAS necessarily includes in its partnership industrial and related key players in EU for the whole value chain related to smart mobility and smart systems, from automotive OEM and suppliers, to mapping service providers, to telecom and satellite industries, to HPC and cloud service providers, to traffic and emission optimisation service providers, to city transport management authorities. ➢ Related objectives: Obj 2 and 3
"They should target a wide participation and/or applicability and use of the targeted industrial pilot test-bed by industrial members/users from different countries and regions. They should also define quantifiable outputs and impact Key Performance Indicators, in particular related to the "Expected Impact" of the topic"	HEPTAS carefully selected two diverse pilots covering different needs and regions. As it is indicated in the concept of HEPTAS, these pilots will be served by a common underlying engine, the platform (including the associated connectivity solution), with clearly documented APIs. Quantifiable outputs and impact Key Performance Indicators (KPI) are clearly listed in Section 2.1.1. ➢ Related objectives: Obj 2 and 3
"Proposals could seek synergies and co-financing from relevant national / regional research and innovation programmes, including European Structural and Investment Funds (ESIF) addressing pre-identified smart specialisation priorities at regional / national level. Proposals combining different sources of financing should include a concrete financial plan detailing the use of these funding sources for the different parts of their activities."	**Consortium include entities participated by local** (at city level or above) **governments**, ensuring collaboration and interest from funding bodies. **Ten Letters of Support** (e.g., government of Italy and of Luxemburg) have been collected and they are available in the Annex. ➢ Related objectives: Obj 2 and 3

1.3 Concept and methodology

1.3.1 Overview of the approach

HEPTAS' core concept is built around **technology convergences and collaboration principles**, and aims to **break down information silos and promote cross-sector collaboration and innovative hybrid approaches** through data exchange. The idea of HEPTAS is to tackle **sectors that are related and linked to the smart mobility/smart cities/smart automotive sector** datasets, allowing analysis and optimisation of traffic, parking, energy consumption, emissions, as well as enabling predictive maintenance etc., that would otherwise not be possible to nearly the same extent, so producing added value insights. The focus of the project is on **use cases and demonstration in pilot industrial test beds**, **combining existing technologies to build a platform devoted to managing smart city data via machine learning & simulation** and allow deployment and release of valuable services to the stakeholders.

HEPTAS develops on existing HPC, telecom (both terrestrial and satellite), data infrastructures and platforms. HEPTAS infrastructures will **get various data, analysing and releasing them to the end user, utilising specific services** already provided by the partners or developed in previous EU projects, that will prove very valuable. The **modular architecture of HEPTAS** (see Figure 1) and the different core data services and added value service bundles that will accompany the platform are able to create an **easy to use and powerful environment for big data related management activities**, supporting at the same time data, knowledge as well as services sharing, catering for the nurturing of a data scientists network of stakeholders that are interested in smart mobility-related data.

Data policy

To facilitate the brokerage service mentioned above, **the HEPTAS methodology will contain the concept of a Data Policy framework that will be used to address data related issues that relate to provenance, quality, security, trust, and IPR**. The framework will be the key driver behind the planned services and will be triggered upon insertion of any kind of data into the platform, performing the necessary annotations both at dataset and on dataset element level, ensuring that the accumulated data are fully describe with respect to their IPRs, quality and privacy levels. Apart from caring for the **monetisation that would be made possible through the service activities, HEPTAS will safeguard commercial confidentiality and personal data, suggesting data anonymization, secure exchange of information, data quality validation methods**. These services will be supported by the existence of containerised spaces within the overall architecture that will be used to secure and keep data only in the hands of owners.

Two major European smart cities used to demonstrate in real world HEPTAS use cases

The HEPTAS partnership includes key industrial EU players for the whole value chain related to smart mobility and smart systems, from automotive and components manufacturers to terrestrial and satellite telecom industries, entities participated by local city level or above governments, ensuring collaboration and interest from funding bodies. Demonstration of HEPTAS platform will be based on 2 carefully selected pilots covering different needs and regions, namely Turin and Barcelona. These pilots will be served by the common underlying engine: the HEPTAS platform. The Value Chain will be expandable thanks to clearly documented APIs that will enable 3rd parties and SME to develop additional services and features. In Figure 2 a representation of the processing domain is shown.

HEPTAS relies on High Performance Computing (HPC) and High Throughput Computing (HTC) infrastructures to provide the computing power, and on Cloud resources to quickly and flexibly provision the intermediate-layer services that are required to advance the described models and methods for smart mobility, such as pre-processing of raw data coming via the connectivity domain, high-throughput data curation or the post-processing of secondary data to be shipped back to the Data Lake for further exploitation.

In this direction, **HEPTAS will take a three-fold approach**:

1) it will leverage on the experience of the infrastructure partners on adapting the HPC software stack to allow for efficient execution of Big Data processing frameworks on top of HPC resources.
2) it will interface the HPC resource management layer with high-level big data processing frameworks.
3) It will integrate the HPC resources with Cloud services in an orchestration layer (i.e.: INDIGO-DataCloud).
4) it is supported by a powerful and innovative connective solution based on the optimal combination of both terrestrial and satellite communications capabilities. it is **necessary to bridge the gap between the worlds of Cloud, HPC and Big Data, born from different class of challenges**, which reflects to the system architecture and to the adopted software stacks. The infrastructure used in HEPTAS includes heterogeneous systems, both typical HPC/HTC resources (like the CINECA MARCONI cluster or the HTC clusters at the INFN centres), and systems built explicitly for data analytics/AI (like the CINECA DAVIDE cluster) and Private Cloud facilities, to explore the full scaling and computing capabilities of HPC and Cloud resources.

5) **A core issue to be addressed within HEPTAS is efficient data transfer and staging, to handle the volume and velocity of data**, both in the transport of data from sources to the computing systems, and as I/O in the HPC facilities themselves. On HPC infrastructures, computing and storage resources are decoupled, and storage is usually optimized for infrequent I/O of large batches of data; traditional Big Data infrastructures rely on low-latency local storage, with a distributed file system handling the data for performance and fault-tolerance, and typical HTC facilities provide very large storage areas tuned for high-bandwidth access from computing nodes, but little low-latency storage. The mismatch between the architectures can cause severe performance degradation when executing big data frameworks over HPC resources, as big data frameworks are designed with the principle of data being close to the processing unit. We will alleviate this mismatch by using local file systems mapped by the shared file system and software layers that reduce overheads, or by splitting the workload across different facilities depending on its data access patterns. Container technologies (e.g. Docker, Singularity) will be also explored for seamless adaptation of the software stack to the needs of the application, to elastically build complex service stacks on Cloud infrastructures and to allow for uniform application software deployment across heterogeneous computing resources.

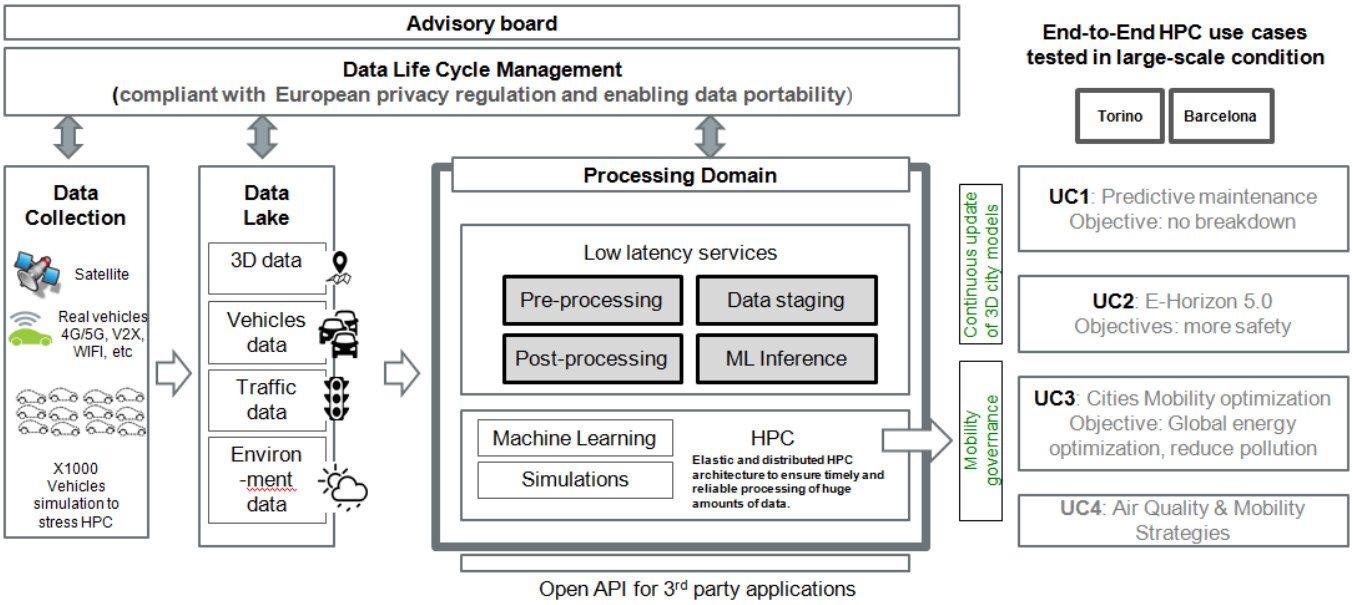

Figure 1: HEPTAS architecture overview

HEPTAS will also work on efficiently coupling the resource management for Big Data frameworks over HPC resources. HPC resource managers (SLURM, etc) statically grant the resource allocation at the beginning of the job; the allocated resources (compute nodes and accelerators) remain unmodified until completion of the application. In contrast, Big Data resource managers usually allocate resources elastically: they either allocate resources to meet changing application demands on the fly, or they do not necessarily guarantee a set of resources. To integrate the execution of Big Data frameworks on HPC resources, we will use OpenStack, Spark, INDIGO DoDAS or other such middleware to create virtual clusters on resource allocations granted by HPC resource managers and, when applicable, Cloud IaaS or PaaS resources.

HEPTAS involves multiple use cases, which in turn will involve diverse tasks of data curation and preparation, as well as modelling and simulation. The data preparation and modelling tasks fall under the category of Big Data processing and analytics and need to run efficiently for several different data types and sources. The HEPTAS architecture will support a variety of frameworks, like for example Hadoop for batch processing, Apache Kafka for streaming processing or Apache Spark for iterative processing, being run on the most suitable resources provided by partners, either located close to the data sources or consumers or in large HPC facilities, depending on the computing and data latency requirements. Several of these frameworks come with components that will serve the needs of HEPTAS demonstrators for machine learning, deep learning, predictive analytics, graph analytics, and many offer support for hardware accelerators, namely GPUs. The efficient execution of analytics workflows and the management of resources and data flows downstream of the V2X communication comes with multiple challenges. In HEPTAS we will work on the following aspects: i) how to optimize workflows on different frameworks for performance, ii) how to schedule tasks on resources to meet resource, performance, and time constraints, iii) how to provision the distributed service infrastructure to manage data transfers and low-latency processing tasks.

For workflows with time constraints, e.g. stream processing, HEPTAS will rely on dedicated data analytics platforms, again co-located in large HPC facilities or close to the data sources or consumers, as appropriate. Finally, we will work with best practices and optimized software, coming from the world of HPC, to enhance the performance of compute-intensive workflows such as deep learning tasks on high-dimensional data, through scaling and efficient utilization of all available compute resources (CPUs, GPUs, FPGAs, etc).

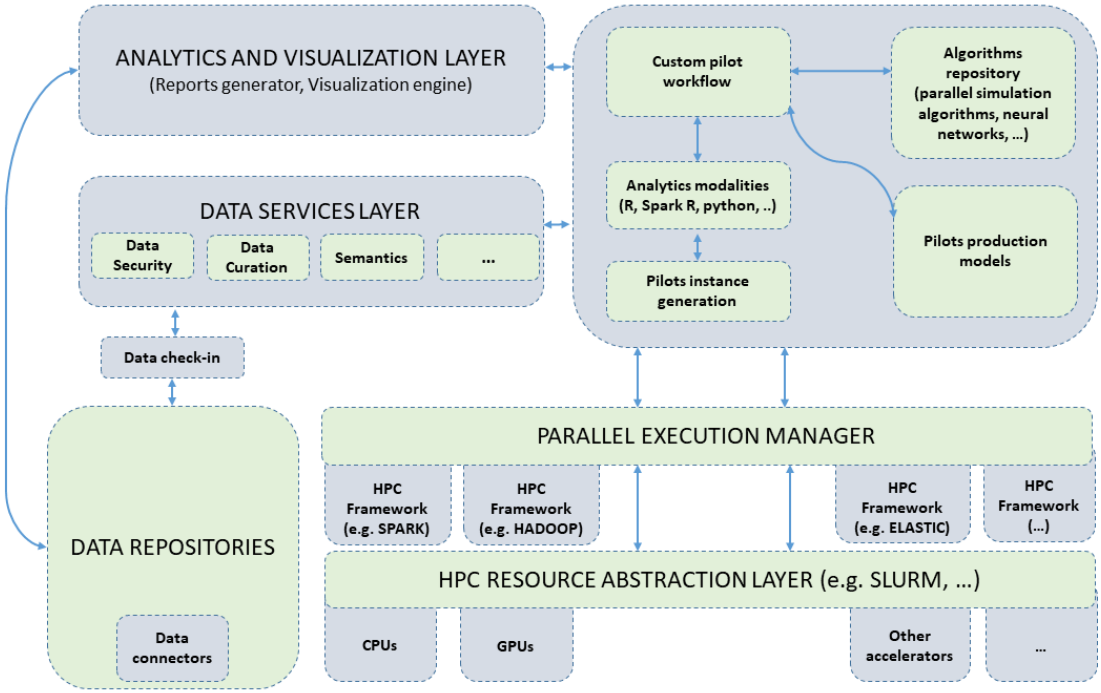

Figure 2: HEPTAS HPC processing domain architecture

Innovative connectivity solutions, combining the best of terrestrial and satellite communications capabilities, underpin the efficient execution of the above-described data processing aims by efficiently connecting i) the potentially billions of sensors and actuators to the Data Lake(s), where data is stored; and ii) the Data Lake(s) to the HPC centres; and iii) the HPC systems among them.

1.3.2 Use Cases description

The project is focused on 4 use cases and their implementation in 2 pilot industrial test beds to demonstrate the use and the benefits of HEPTAS platform.

1.3.2.1 Use Case 1: Vehicle Predictive and Preventive Maintenance

Rationale

Today vehicle connectivity is technically feasible. However, the market deployment of connected vehicles is still moving slowly as different business cases and estimated socio-economic impacts are not yet moving in the direction of a wide scale value creation. At the same time, the **future perspective of connected vehicles shall also consider the roadmaps on vehicle automation** (e.g. ERTRAC Automated Vehicles Roadmap[3]). In the next decade the European mobility scenario foresees a **gradual introduction of connected vehicles and of vehicles that will include growing SAE automation levels**. As a result, the European road traffic landscape is expected to host a heterogeneous mixture of connected and automated vehicles. "Without HPC we cannot remove the bottlenecks of the digital transformation"[4]: for future connected and automated vehicles, **HPC and Big Data switch on the digital age.**

However, **large scale HPC value creation** can only be tested with a massive and real-time data flow. For this target the proposed test-bed involves real and simulated vehicles to enable an overwhelming amount of data feeding into the HPC and **Big Data host**. Vehicles will be connected and may also include a SAE level of automation up to L3, at the same time a simulator will replicate the behaviour of the small vehicle fleet with thousands of emulated vehicles.

[3] http://www.ertrac.org/index.php?page=ertrac-roadmap
[4] R. Viola, Euronews, Nov. 27, 2017

The test-bed will focus on vehicle proactive & early warning applied to connected, and also automated vehicles.

Both real and simulated vehicles will generate the big data flow feeding the HPC and Big Data infrastructure:

- Real VEHICLES will be connected and may also include a SAE2-3 automation.
- A SIMULATOR will expand a small vehicle fleet up to many thousands of vehicles.

The **Pilot Test-bed** will include on-board and off-board vehicle data for:

- Predicative and proactive (i.e. preventive) maintenance.
- 3D detailed dynamic data: eHorizon 5.0 (e.g. road works, road conditions, traffic, meteorological, etc.

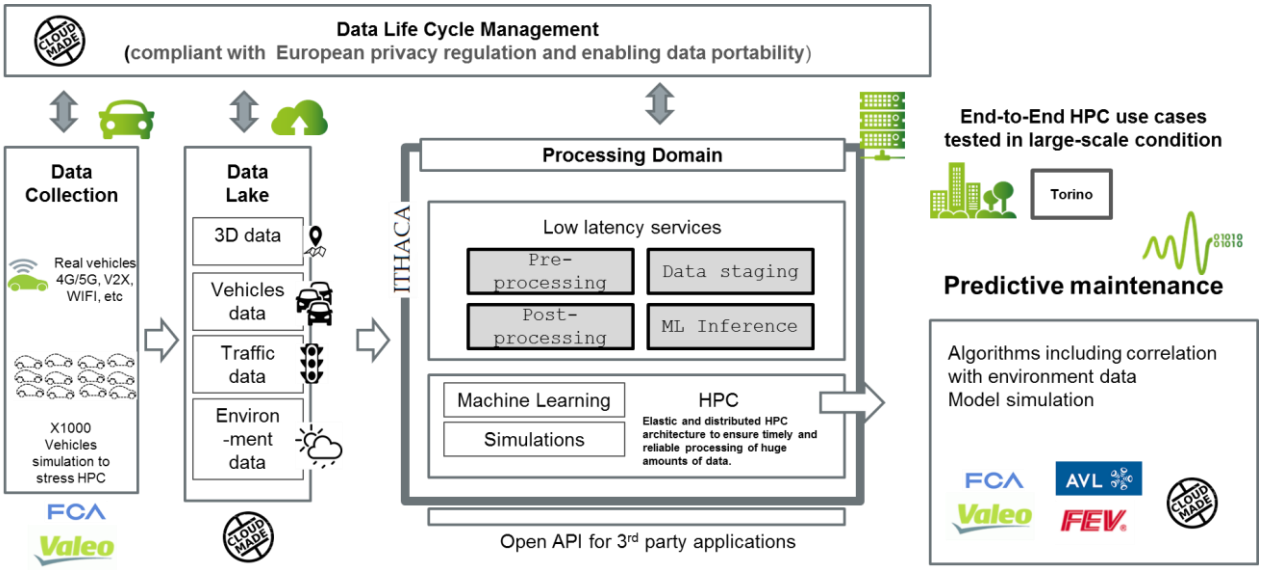

Figure 3: Use Case 1: Vehicle Predictive and Preventive Maintenance

Data monetization: vehicle predictive and preventive maintenance
Proactive and early warning will vary from preventive maintenance, emulated ECUs failure, etc. This test bed will become of peculiar importance once a huge amount of automated vehicles will be on the roads: vehicle electronic redundancy and resiliency to different traffic situations will become a crucial issue, as it is for airplanes today.

The vehicle predictive and preventive maintenance can potentially involve a full set of vehicle data, ranging from data related to vehicle dynamics in the diversity of vehicle driving environment to specific vehicle data related to different vehicle ECUs (controlling vehicle sensors, suspension, air conditioning etc.). This industrial pilot test bed represents also a starting point towards a future vision of self-repairing vehicles: today OTA, Over The Air updates of vehicles' ECUs, is just moving its first steps in this direction.

Data utilization from the involved actors will generate other events, conditions, etc. in other words yet more data. Data lifecycle management. and related transactional technologies (e.g. blockchain), as well as data trading models, methodologies, and related solutions design for business opportunities, are part of this use case.

1.3.2.2 Use Case 2: "eHorizon 5.0" next generation cooperative 3D map based horizon

Improved car positioning by 3D car contextualization – eHorizon 5.0

Today solutions for vehicle 360° scenario reconstruction are still lacking data. Next generation highly detailed 3D mapping of the traffic scenario represents the revolution that is needed to boost vehicle automation, and to enable several vehicle connected traffic services that today are available either locally or in corridors. The communication enabling technology is coming soon and it's the 5G cellular technology, whose deployment is in the roadmap of every telecom operator from 2020: here lays the definition of eHorizon 5.0.

The Italian test site located in Torino plans to build on the recent experience of the TEAM (Tomorrow Elastic Mobility) European project, where several vehicle connected services (including public and private transport) have been developed based on 4G / V2X technology: a wide scale implementation of these solutions requires 5G and Big Data to become pervasive. Along with advancements in data acquisition, 3D reconstruction, and applications, 3D

city models have become common geospatial data assets for cities[5]. A comprehensive study by Morton et al. (2012)[6] already identified over one thousand 3D city models worldwide.

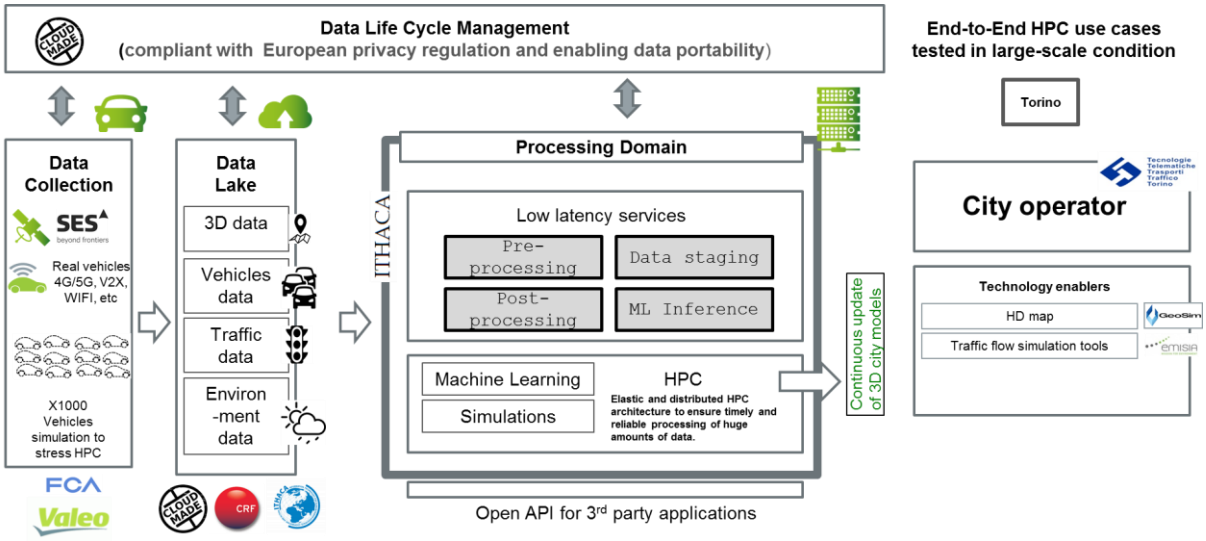

Figure 4: Use Case 2: "eHorizon 5.0" next generation cooperative 3D map based horizon

Image segmentation algorithms, mainly based on deep learning technology, and point cloud extraction from video sequences are mature technologies already systematically applied in the mobility domain[7]. Currently, cars use satellite navigation receivers to determine their position: positional accuracy in dense urban areas could be unreliable especially in narrow streets surrounded by houses (street canyons), where the reduced number of visible satellites and other signal interferences lead to a decrease of the positional accuracy of several metres. Transferring the elaboration capacity for image segmentation and point cloud extraction on board of vehicles, and coupling it with the ability to constantly compare the 3D environmental context with accurate 3D reference models is a solution for answering to one of the major requirement of autonomous driving: an accurate positioning of the vehicle.

Furthermore, the availability of precise reference 3D models enables the development of self-driving cars: by comparing the actual car surrounding to what included in a reference model, algorithms can focus on recognising elements that are different, like a pedestrian or a bicycle[8], and therefore applied for e.g. collision prevention and on-street parking finding. The same technological solution can be used to reduce the risk of cyber-attacks in terms of jamming and spoofing. In this perspective, keeping a 3D reference model updated is particularly relevant. Video sequences from cars and other moving vehicles can be also exploited to systematically detect locations where the reference 3D model is not coherent with vehicle surroundings, triggering a process for manage and prioritize re-surveys.

1.3.2.3 Use Case 3: Mobility optimization for traffic flow, parking, energy consumption & emissions

This use case targets following value creation:

- **Increase quality of life**: reduce transportation time (best route and speed profile), reduced noise and pollution, reduce time lost due congestion by offering recommendation and routing for parking possibilities.
- **Increase energy efficiency and reduce costs**: City-scale traffic flow optimization, providing significant (expected ca. 5-8%) global energy consumption reduction and bring respective economical savings.

Current state of the art

[5] http://www.mdpi.com/2220-9964/4/4/2842/pdf
[6] Morton, P.J.; Horne, M.; Dalton, R.C.; Thompson, E.M. Virtual city models: Avoidance of obsolescence. In Digital Physicality, Proceedings of the 30th eCAADe Conference, Prague, Czech Republic, 12–14 September 2012; Achten, H., Pavlicek, J., Hulin, J., Matejovska, D., Eds.; Education and Research in Computer Aided Architectural Design in Europe-eCAADe: Brussels, Belgium, 2012; pp. 213–224.
[7] https://blog.mapillary.com/update/2016/09/27/semantic-segmentation-object-recognition.html
https://blog.mapillary.com/update/2016/09/27/mapillary-joins-berkeley-deepdrive.html
[8] https://www.ft.com/content/2a8941a4-1625-11e8-9e9c-25c814761640

Mobility optimization with respect to traffic conditions, energy efficiency and emissions, as well as safety, is a key challenge. Today two very different and independent approaches exist which are summarized below:

1) **Local optimization of individual ego-vehicle routing, speed, and powertrain control,** based upon internally measured vehicle and powertrain signals, and importantly considering to some degree information regarding the anticipated route conditions. For example, use of the eHorizon for predictive cruise control is state of the art for heavy duty trucks to reduce fuel consumption over hills, whilst V2X for traffic light assistants has recently become state of the art with first applications available in series from AUDI in the USA[9]. However, note such systems do not generally communicate back to the general traffic management systems.
2) **Global citywide traffic optimization,** implementing macroscopic analysis of traffic flow to effectively manage the city road network. Turin traffic centre (operated by HEPTAS partner 5T) uses such a state-of-the-art traffic management system, where traffic light green cycle is adjusted based on actual traffic conditions mostly measured by traffic count sensors. However, note such systems cannot generally discriminate between vehicles with different powertrains, nor individually optimize routing for each vehicle.

In other words, **local ego-vehicle control typically operates based on instantaneous, reaction based decision making logic** with either no or limited (and typically 1-way interaction) with the city traffic management system to determine its control actions (e.g. vehicle velocity, gear selection or powertrain driving mode for hybrid vehicles). **Independently the city traffic management system operates based on prediction models using traffic flow data** to determine control actions (e.g. re-assignment of traffic light phases, and dynamic speed restrictions) without considering individual vehicle capabilities.

Other state-of-the-art control functions like predictive energy management, predictive gear shifting, predictive thermal management and predictive after-treatment management **optimize the behaviour or states of the powertrain for a given vehicle velocity profile to further improve the vehicle efficiency over a given trajectory** (e.g., capability to influence the velocity profile through traffic lights and finally with higher degree of integration via connectivity with infrastructure, see Figure 5). These systems correspond to the state-of-the-art environmental optimization of vehicle for given traffic conditions today. Although predictive velocity control methods can lead to a significantly increase in the average efficiency of the vehicle, they typically operate over a prediction horizon of some distance on a given route. The management of city traffic on the other hand is a global optimization problem, which encompasses the entire city network of alternative routes. **Predictive control methods for individual ego-vehicles shown in the state-of-the-art only have a very limited benefit on the overall city traffic conditions.** For example, in the case of the traffic light assistant communication is used in a basically one-way fashion, so whilst the ego car benefits the city traffic management does not.

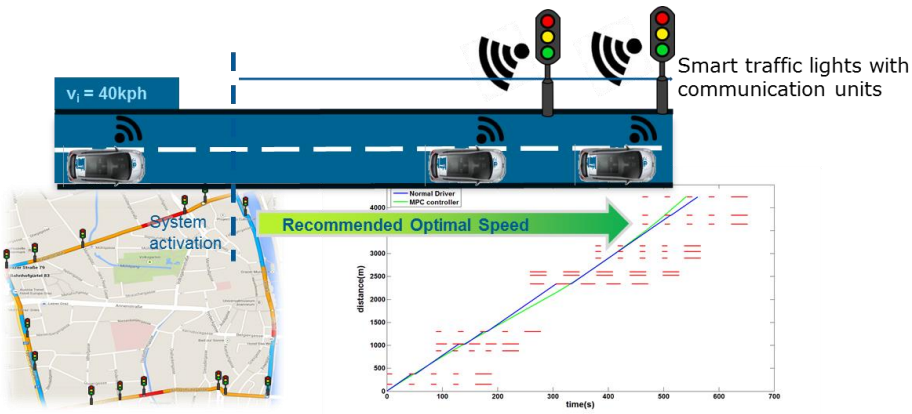

Figure 5: Predictive energy management & ADAS traffic light (or bus stop) assistant

Furthermore, and very importantly **a different and complimentary branch of mobility optimization focusses on the reducing the effort of looking for a city parking space**. The current state of the art is in large modern parking garages, that uses electronic sensors and systems to monitor the number and location of available parking spaces, and feed this information back with electronic park garage signs to users looking for a space. However, **in many cities much of parking is at along the roadside, and such spaces are not monitored or communicated to driver seeking a space, so up to 40% of city driving time is spent searching for a parking space**. Although the state-of-the-art parking space monitoring systems are partially effective in reducing the traffic congestion around centralized and managed parking garages, the implementation of a corresponding parking management system at typical

[9] www.audiusa.com/newsroom/news/press-releases/2016/08/audi-announces-first-vehicle-to-infrastructure-service

unconnected or unmonitored roadside parking is difficult and/or expensive. **Moreover, because such parking locations are located directly aside roads that are also used for city traffic throughput, the congestion problems caused by road users seeking for a parking location are much more severe**.

HEPTAS Ambition

The target of HEPTAS use case 3 is to develop and simultaneously demonstrate in the HPC and on the road, a truly innovative bi-directional communication and optimization. In this, individual routing optimization for vehicles is performed on the HPC cloud, considering vehicle specificities, **to achieve citywide mobility optimization on a global city level, and local optimization of each connected individual ego-vehicle, for mutual advantage** (i.e. reduced energy consumption and emissions of both the fleet and individual vehicles). In fact, HEPTAS capability to **improve connectivity** between vehicle and infrastructure to exchange reliably and quickly relevant data, combined with the **capability to run complex powertrain and traffic flow simulations** relying on elastic HPC infrastructure in the cloud, opens the door for this highly disruptive innovation.

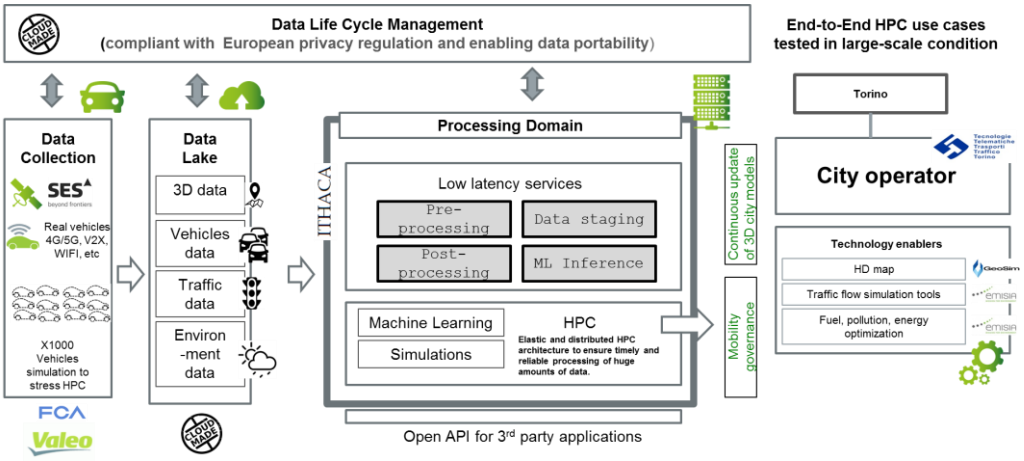

Figure 6: Use Case 3: Mobility optimization for traffic flow, parking, energy consumption & emissions

An outline of the approach is shown in **Figure 6**. The HPC based city-centric control system allows the c**ombining of large data flows from many diverse and relevant data sources and sensors** (e.g. cars, buses, city traffic flow sensing loops, local city emissions sensors) to analyse and optimize mobility and traffic flows in the city. Using the **elastic HPC to apply machine learning, AI, and traffic flow simulation techniques**, it is possible to connect, fuse and process enormous amounts of data in quasi-real-time, and **send instructions to the intelligent infrastructure** (e.g. traffic light phases and dynamic speed limits), **as well as timely recommendations to individual vehicles** (e.g. new routing information and speed profiles). With knowledge of the individual vehicle characteristics, routing can also take environmental criteria into account (e.g. for conventional and hybrid vehicles) or environmental boundary conditions (such as forbidden environmental zones for older more polluting vehicles).

At the **second lower level local in-car controllers will optimize each ego-vehicle speed for its new route** according to the upcoming traffic, terrain and importantly traffic light phases. This is vital as a 100% coverage of connectivity is not possible, nor can be guaranteed, so each **ego-vehicle remains responsible for the final determination of its route and its optimal trajectory for minimal consumption, and a safe and timely arrival**, while considering the vehicles and traffic infrastructure nearby, as well the its own powertrain state and efficiency.

In HEPTAS optimization will occurs at two levels. On a high level, with the use of cloud HPC services and environmental optimization algorithms to be developed in the project, **the traffic is equilibrated not just trying to minimize travelling time but to optimize fuel consumption and air pollutant emissions on both citywide and hotspot levels**. For this, vehicle type and the emission technology of each vehicle in the circulating city fleet are required. Since this information is not going to be available for all operating vehicles at the time of demonstration, a default fleet mix stratification will be used. Rerouting of the vehicles will be done in quasi-real-time considering actual traffic flow conditions, the vehicle fleet stratification, and applicable environmental criteria. For example, in **daytime reduction of NOx in the city may be more important than minimization of energy consumption**.

For the traffic optimization at a high level, COPERT (www.emisia.com/copert) emission and consumption functions will be suitably adjusted and will be used in the cloud to **optimize routing, considering both vehicle powertrain and aftertreatment conditions**. Specific methodology based on the ICT-Emissions project will be further enhanced to fit the purpose. For optimization at the vehicle level, real-time capable approaches to finally and safely optimize each specific vehicle's route, velocity, and powertrain state, will be used on board the vehicle.

In terms of parking optimization, HEPTAS will integrate a **machine learning and AI parking space monitoring** system in the HPC cloud. Using vehicle fleet sensor data HEPTAS can economically **keep a real-time overview of the available roadside parking locations** (as well as at parking garages) over the whole city. Road **users looking for a parking space can be guided directly to a location with a high probability of free space**, and so traffic congestion and emissions will drastically reduce, as well as energy consumption, and driver stress.

1.3.2.4 Use case 4: Air Quality & Mobility Strategies

Barcelona will leverage world-class HPC from the Barcelona Supercomputing Centre (BSC), combining and evolving extremely detailed and customizable city models (see Figure 8) and running complex, multi-dimensional algorithms – co-developed together with the inLab FIB of the Universitat Politècnica de Catalunya (UPC) and readily available for the project - for the evaluation of different urban mobility policies targeting one of the most pressing issues in Barcelona (and in many other European cities): air quality and related health issues largely caused, among other factors, by inefficiently managed transport.

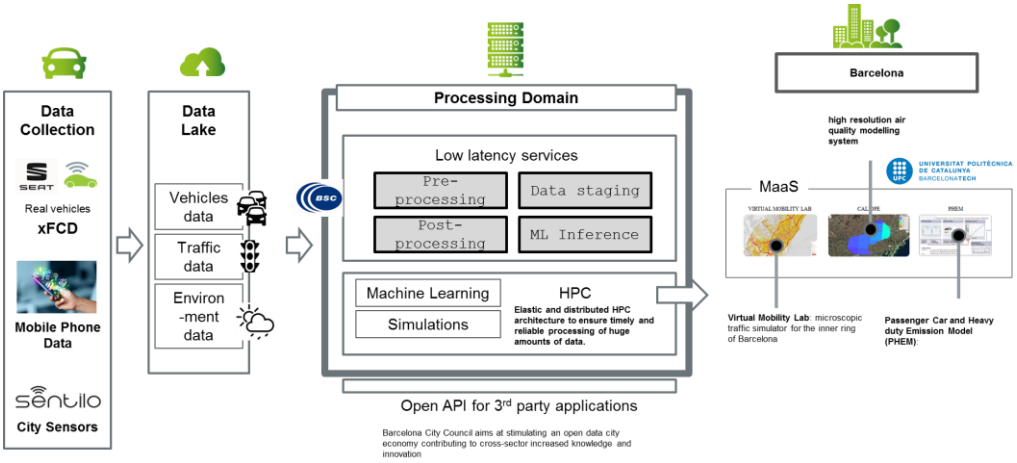

Figure 7: Use case 4: Air Quality & Mobility Strategies

(1) **Baseline** Current situation in Barcelona:

- Map of Real-Time Traffic: http://mct.gencat.cat
- Barcelona Air Quality Map: https://ajuntament.barcelona.cat/qualitataire/en/

(2) **Models**

- **Barcelona Virtual Mobility Lab**: microscopic traffic simulator for the inner ring of Barcelona. It can analyse and assess the impact of smart mobility initiatives in Barcelona - e.g. deploying fleets of shared vehicles in a given area -, and the results can be extrapolated before the actual implementation of given measures. It will be calibrated to Barcelona conditions at the start of the project, reflecting latest city conditions (e.g. if a new MaaS-like service has been deployed in the city). In case of air pollution episodes in Barcelona, the developed model will be able to ground decisions such as closing specific road lanes, restricting access to certain types of vehicles or increasing the public transport offer, measuring the impact of each strategy, becoming a very valuable support to the implementation of urban mobility policies in Barcelona and its metropolitan area (see Figure 8).
- **CALIOPE**: high resolution air quality forecast system for Barcelona that produces an open, operational, and detailed forecast at 24 and 48 hours for Europe (12 x 12 km) and the Iberian Peninsula (4 x 4 km) using a set of models (emissions, meteorological and atmospheric chemistry) coupled and executed in the so-called "MareNostrum" supercomputer at the BSC. The forecast is aimed at air pollution managers and citizens interested in the quality of the air we breathe. CALIOPE provides quantitative and qualitative information about the main pollutants regulated by the European Directive 2008/50/EC and the World Health Organization (ozone, nitrogen dioxide, carbon monoxide, sulphur dioxide, particulate matter, and benzene). Results are evaluated using a system in near real time, which uses data obtained from air quality monitoring stations. It is currently being upgraded to CALIOPE-Urban, which is coupled with the street dispersion model R-line (Snyder et al. 2013[10]), able to quantify pollutants dispersion along streets.

[10] https://www.sciencedirect.com/science/article/pii/S1352231013004470?via%3Dihub

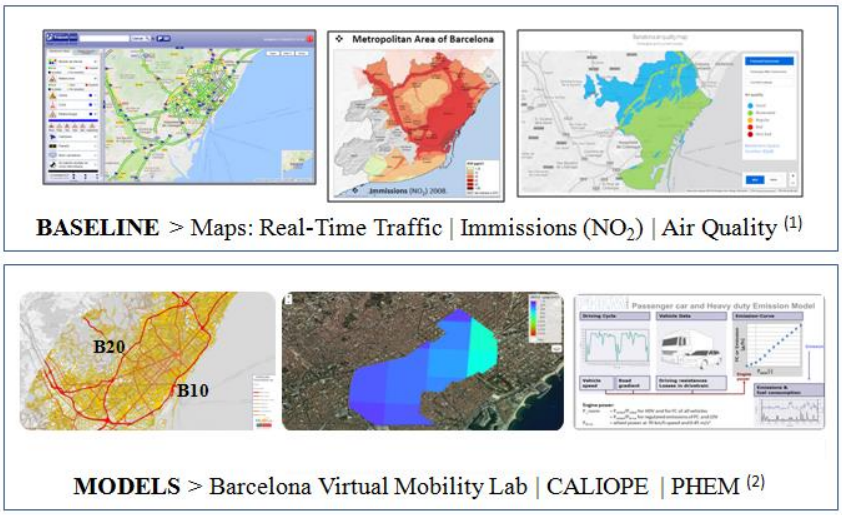

Figure 8 Baseline & Models to be used in the Barcelona test-bed

- **Passenger Car and Heavy-Duty Emission Model (PHEM)**: microscopic vehicle emission model, which originates HBEFA (Handbook Emission Factors for Road Transport[11]). It uses more than 1000 measures of vehicles for different drive cycles in both laboratory and on road tests from the ERMES group (European Research for Mobile Emission Sources). It calculates the emissions for every vehicle estimating the engine power at every second by the longitudinal dynamics and driving resistances. HEPTAS will select, compare, and improve if necessary the vehicle emission model, and will couple and evaluate the vehicle emission results with CALIOPE-Urban and observed data.

The work to be carried out in HEPTAS will support and build on the diverse, concurrent, sometimes not fully aligned urban mobility measures being developed and progressively applied in Barcelona City and its metropolitan area (AMB) by incumbent public authorities[12], providing evidence-based insights, enabled by HPC processing huge amounts of data, for further and continuous improvement and better-grounded, coordinated and progressive implementation of these measures towards a shared goal of reducing emissions of air pollutants in Barcelona city and its whole metropolitan area. This main objective is also aligned with the broader strategy of the Barcelona City Council which aims at stimulating an open data city economy contributing to cross-sector increased knowledge and innovation, widening the use of and facilitating access to Big Data infrastructures to companies, SMEs, startups, researchers, academia and ultimately concerned citizens[13].

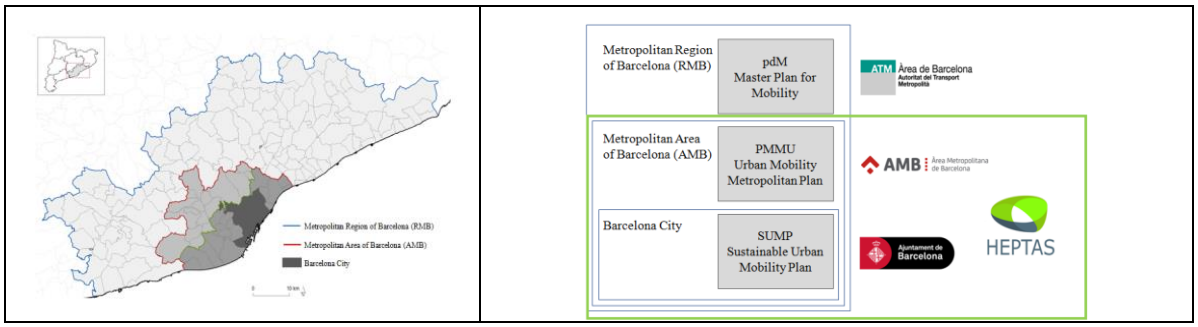

Figure 9 HEPTAS contributions to urban mobility measures in Barcelona

[11] The Handbook Emission Factors for Road Transport (HBEFA) provides emission factors for all current vehicle categories (PC, LDV, HGV, urban buses, coaches and motor cycles), each divided into different categories, for a wide variety of traffic situations. Emission factors for all regulated and the most important non-regulated pollutants as well as fuel consumption and CO2 are included.

[12] AMB - Metropolitan Area of Barcelona's PMMU (Urban Mobility Metropolitan Plan) is the framework for the coordination of Urban Mobility Plans (PMU) of the several AMB municipalities, Barcelona being, obviously, the most important one: http://www.amb.cat/en/web/mobilitat/pla-metropolita-de-mobilitat-urbana/presentacio, and it has the Metropolitan Transport Authority (ATM) above all in hierarchy with its Master Plan for Mobility: http://www.atm.cat/web/en/PDM.php encompassing the broader Metropolitan Region of Barcelona (RMB). The Barcelona City Council is currently developing, together with local stakeholders, its new Sustainable Urban Mobility Plan (SUMP) for the period 2019-2024 http://ajuntament.barcelona.cat/ecologiaurbana/en/noticia/barcelona-city-council-starts-work-on-drafting-the-new-urban-mobility-plan-for-20192024 which includes: Health Mobility, Sustainable Mobility, & Smart Mobility.

[13] http://ajuntament.barcelona.cat/digital/sites/default/files/LE_MesuradeGovern_EN_9en.pdf

The Barcelona Digital City Plan provides the digital infrastructures to support environmental goals and ground mobility measures. These infrastructures are the means for improving the services provided to city residents, making data available to companies, startups, SMEs, researchers, and to face such major urban challenges as housing, unemployment, social exclusion, health, energy, and mobility.
Increasing emphasis is being placed by the BSC on encouraging and facilitating interactions with industry at all levels, from direct R&D collaborations, to educational activities and staff exchanges with private industry R&D laboratories. This objective is achieved by means of: (1) Collaboration with the private sector to promote the use of HPC as a tool for innovation and competitiveness; (2) Transferring cutting-edge HPC technologies to society; (3) Disseminating the benefits of HPC for companies and society; (4) Ensuring the efficient management of public supercomputing resources.
Barcelona test-bed has raised explicit interest from IoMob, a Barcelona-born startup that has developed a disruptive blockchain powered stack enabling Mobility as a Service. IoMob is interested to calibrate and test their blockchain protocol against the models and data exposed by HEPTAS (in Barcelona and, eventually in other cities, too).

1.3.3 Test Bed Description

The project use cases will be developed and implemented by the partners using two different Test Beds that will allow test and demonstration not only of the specific use case, but also of the interoperability features offered by the HEPTAS platform architecture.

Main characteristics of the Two Test Beds are shown in the following two paragraphs.

1.3.3.1 Turin Test Bed

In Italy on December 27th 2017 the **Italian Infrastructure and Transport Ministry authorized testing of autonomous driving vehicles to upgrade the Italian infrastructure for Smart Services and Autonomous Vehicles**. On March 30th 2018 The City of Turin approved and signed a MOU with 14 Industrial and Research Companies to promote Turin as a City Lab for Autonomous and Connected Driving in Urban Environment. Among the signers of this MOU 3 industrial partners FCA, FEV, TIM and one Public Company 5T are also participating in the HEPTAS Project giving a measure of the Italian and Turin commitment on HPC and Mobility topics. With the additional support of INFN and its strong relationship with CINECA HPC center (Ranked 1st in EU and 14th in the Top500 in the world), **Turin Test Bed is offering an ideal ground for HEPTAS Project and its Use Cases**. In the specific 5T is already managing the Turin and Piemonte regional area and its infrastructure (Traffic Operation Center, Urban Traffic Control and ITS Systems) is one of the valuable assets available for HEPTAS project.

5T Traffic Operation Centre - In 2010, Piedmont Region Government has charged 5T to develop a Traffic Operation Centre (CSR-TOC), based on a Traffic Supervisor system (SVR) aimed at:

- Real-time traffic monitoring: traffic measurement acquisition, treatment, and fusion.
- Real-time Data Completion: estimate traffic state also on areas without measurements.
- Automatic real-time anomalous traffic situations identification (e.g. traffic jams).
- Traffic control, by informing and providing forecast traffic states to the Urban Traffic Control (UTC) subsystems.
- Off-line determination and real-time actuation of traffic strategies for special events.
- Integration and management of data from all physical devices on CSR-TOC road network: sensors, Variable Message Signs (VMS), parking, UTC traffic lights.

Traffic sensors are usually available only on a subset of the main roads and they are always expensive in terms of installation and maintenance, so the CSR-TOC has already been conceived to integrate Floating Car Data (FCD). Currently a huge amount of such data aliments the system.

Main task of SVR system is real-time traffic monitoring, forecast and its short-term evolution (1 hour), in terms of traffic flow, average speed and traffic density on every link of the road network. To design the SVR, a simulation approach has been used, implementing a model for the transportation offer (Graph) and one for the transportation demand (O/D Matrix). It has a quite complex architecture, based on one “on-line” and one “off-line” system. SVR elaboration starts from a “base traffic state” calculated for six different day types by means of traffic macro simulation models based on multimodal (private cars and goods transports) Dynamic Traffic Assignment (DTA) algorithm. The results, obtained in the “off-line environment”, are traffic flows, speeds, densities and turning percentage on every link of the Graph for the 24 hours of each day type (based on 15’ time slot).

In the “on-line environment” SVR has a concept of near real-time, operating on a per 5’ time slots basis, called *time_code* (the primary time interval of the whole system). It receives real-time traffic measurements of:

- Traffic flow and/or (punctual) average speed, on a road section, provided by physical data sources
- Travel time, on a link of the network and provided by vehicular data sources (Floating Car Data)

After that, it executes, based on the base traffic state, a process called Network Loading, consisting in the 'forward propagation', both in time and space, of the real-time traffic conditions defined by real-time measurements, considering also traffic events, acquired every *time code* from different data providers (DATEX and DATEX II nodes, through their standard interfaces).

This information is used as impedance in traffic models. Also, data about real-time cycle duration and green percentage in traffic lights managed by UTC are provided to SVR system. The results of the *Network Loading* process are the current traffic state on the entire monitored network (flow, speed, density) and the forecast at 15', 30', 45' and 60' time horizons, updated every time_code. A key factor for the quality of the current traffic state estimation is availability of an adequate amount of real-time traffic measurements. Following figure shows the overall architecture of 5T SVR on-line environment of CSR-TOC.

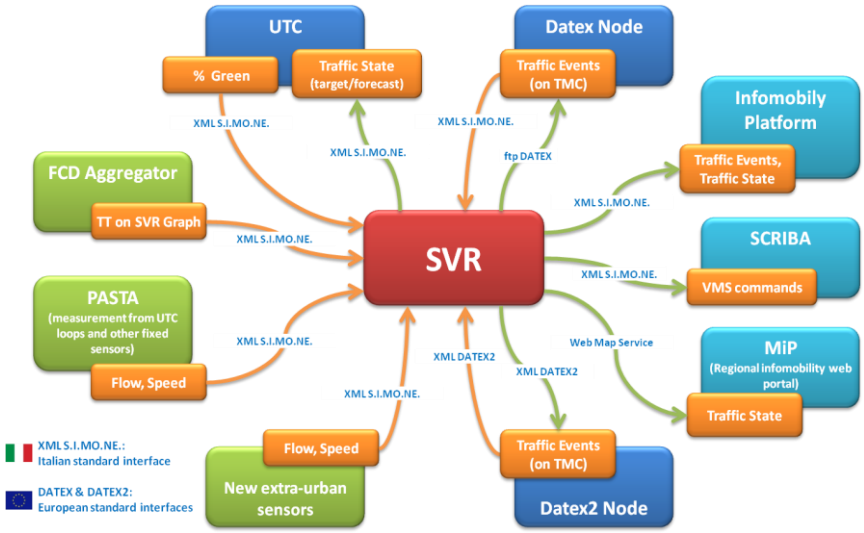

Figure 10 Turin test-bed: data sources

Physical Data Sources - Physical data sources are "classic" fixed traffic sensors that collect measurements related to a road section (traffic flow and/or average speed). The collected data are transmitted to the central systems through a dedicated web service. Physical data sources are classified in:

- Different technology fixed sensors, detecting traffic flow and average speed in the road sections (35 controlled by Turin Limited Traffic Zone - LTZ - gates, 25 by Infrared sensors in Turin urban area and 80 by various types sensors in extra-urban area). Typical time resolution ranges from 1' to 5' depending on device type.
- Inductive loops, for the detection of traffic flow in junctions controlled by UTC subsystem (nearly 1.400). Typical data time resolution is 5'.
- 120 fixed sensors, installed on the main extra-urban roads.

Traffic measurements, collected in real time, are conveyed to a dedicated subsystem and made available with uniform temporal aggregation and latency lower than 2' and then transferred to SVR by means of a dedicated interface module.

Floating Car Data - The elaboration of FCD is performed by a dedicated component named FCD Aggregator, which produces travel times (and average speeds) on each link of the road network by merging the received data (data fusion). Trajectories of probe vehicles (FCD) are provided by vehicular data sources (fleet managers) in the following formats:

- *Raw Data* (RD): information about speed, position (provided by GPS receivers) and time of sample gathered on the vehicles; RD are elaborated by a map-matching algorithm that associates coordinates to the relevant element of the SVR transportation Graph;
- *Travel Time* (TT): travel times for each single element of the geographic reference system already calculated by the fleet managers; in this case FCD Aggregator translates the geo-reference information and matches it with the correct links in the SVR transportation Graph.

FCD Aggregator applies a filtering process (based on spatial and temporal criteria, note data with a latency higher than 2' are not used) on data, and then performs the projection of FCD on the SVR Graph. Finally, it performs an elaboration of travel times and average speeds on the links of the SVR transportation graph by merging data on a per vehicle type basis. Travel times are produced with 5' time aggregation. Every *time_code*, the FCD Aggregator

produces travel times and average speeds for nearly 25,000 links of the SVR transportation graph, corresponding to 3,000 km. During daytime FCD covers more than 4,000 km corresponding to 12% of the regional network extension. This is a very huge contribution, in terms of real-time data, for the SVR traffic state estimation algorithms, so the results of Network Loading process should be near to the actual traffic conditions.

5T Urban Traffic Control System - The core of the system is an integrated application that measures traffic by means of physical sensors and tries to optimize traffic flows while at the same time, considering public transport lines priority. Public transport monitoring and prioritization are performed via a centralized monitoring system that knows the state of the network, in terms of position of every vehicle and of delay or advance with respect to the planned service. This monitoring system is interconnected with the Urban Traffic Control (UTC) system, an adaptive traffic light control which operates on 300 intersections (the main ones on a total of roughly 600 intersections in Turin urban area).

UTC system can determine optimal strategies in green light phases for a fine regulation of urban traffic: it is reliable on overall complex city network and can react to critical traffic situation. The best traffic light strategy is calculated through specific algorithms in few seconds, based on traffic sensors measurements (coils), surrounding intersection situation and predefined traffic policies decided by Traffic Operation Centre. It has also predictive algorithms that can forecast traffic state and avoid critical situations.

The optimization is based on state of the art traffic models: the system knows the road network structure and all the model parameters can be adjusted; in this way it is possible to favour some vehicle flows, reduce vehicle stop times, privilege public transport and so on. It is developed on a two-levels hierarchical-distribute architecture. The higher level has a core sub system with mid to long term forecasting and control duties for the whole area. At this level, reference traffic light plans are dynamically elaborated together with necessary criteria for adaptive coordination of the level; a whole system permanent diagnostic activity is also performed. The lower layer is made of a multifunctional unit network with Local Controllers (SPOT): these units are interconnected, each controlling a single road intersection. Local Controllers determine dynamically optimal phase time using higher level coordination criteria together with local traffic measurements and information from surrounding controllers. Each SPOT performs constant diagnostics on its components, peripherals and sensors transferring functional status to the higher level.

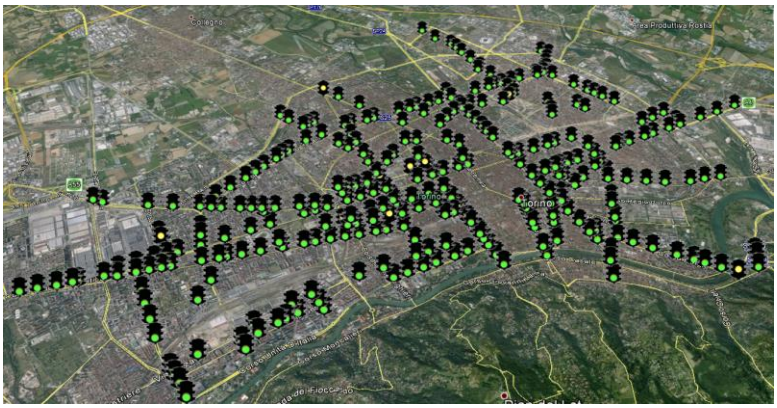

Figure 11 Turin test-bed: instrumented intersections

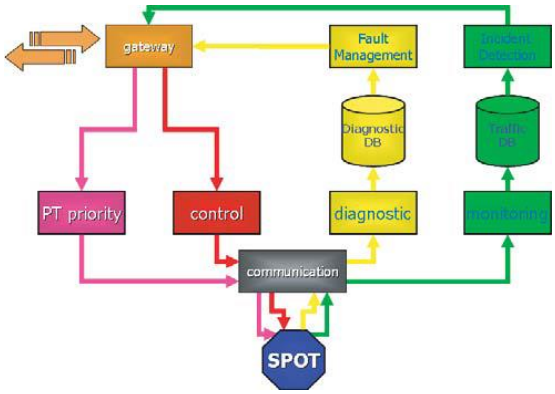

Figure 12 Multifunctional unit network with local controller (SPOT)

5T ITS Subsystems - 5T manages the following ITS subsystems in in Turin urban area with:

- over 1,500 Fixed Traffic sensors
- over 300 traffic-lights intersections controlled by UTC system
- 70 Traffic cameras
- 100 Variable Message Signs (VMS)
- 41 LTZ electronic gates
- 34 Parking lots

These devices exchange real-time data by means of their own Protocols but also through the S.I.M.O.NE. Protocol, an innovative solution developed by 5T for the interoperability among different actors operating in the Traffic Management field, for the gathering of FCD and other traffic data, for their integration into the mobility centres and for the delivery of real-time traffic and limited access zones information services.

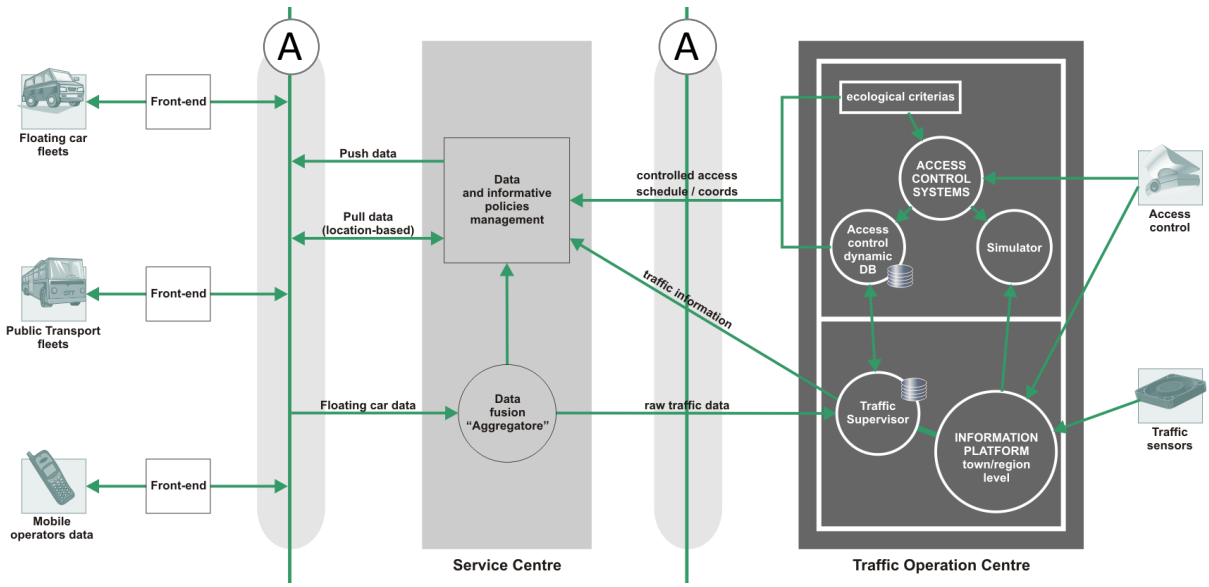

Figure 13 Turin test-bed: The SIMONE protocol for the interoperability among different actors

1.3.3.2 Barcelona Test Bed

The Metropolitan Area of Barcelona (AMB) is, at the time of writing this project proposal, modelling the impacts of mobility on urban air quality and health by analysing diverse scenarios as part of the implementation of their PMMU (Urban Mobility Metropolitan Plan). AMB models (model of urban mobility and emissions, model of air pollution exposure and health) will be able to use HEPTAS results, insights and recommendations as additional inputs to scenario development and fine tuning (e.g. using the Barcelona Virtual Mobility Lab tool to simulate expected impacts of proposed measures in given areas of the city under diverse environmental conditions and urban mobility settings; implementation of Metropolitan Low Emission Zone (MLEZ), implementation of a Urban Low Emissions Zone (ULEZ) inside the Barcelona urban ring, implementation of different LEZs for restricted areas in the city centre, construction of new bikeways along several metropolitan municipalities, renewal of the bus fleet in the AMB towards zero diesel vehicles and electrification of fleets, 30% reduction in emissions of metropolitan taxis.

SEAT will set the required communication infrastructure to the BSC, and provide access to coveted connected car eXtended Floating Car Data (xFCD) not used in the BSC models to date, while UPC's InLab and BSC, coordinated with the AMB and Barcelona City Council, will grant access to the continuous provision of required data sets to calibrate and feed Barcelona city models and algorithms. Factual will lead and coordinate the overall activities of the Barcelona test-bed stakeholders, aligning their individual needs, strategic and technical requirements, with the overall project activities, driving the project to the sought impact, and effectively measuring and disseminating it to the relevant audiences, maximising the awareness of the HPC-supported measures implemented in the context of urban mobility in Barcelona as inspiration for other cities facing similar challenges, both within the project and beyond.

Barcelona footprint

- **Vehicles density:** with almost 6000 vehicles/km^2 Barcelona doubles Madrid and triples London vehicles density.
- **Geographical characteristics:** sea/land breezes recirculation patterns facilitated by the mountain ranges behind, blocking air renewal.
- **Meteorological conditions:** stable mesoscale systems, the Iberian Thermal Low (ITL), strong sun radiation and high temperatures facilitate the formation of secondary pollutants (O_3, PM) and the stagnation of the air masses, while the low precipitation difficult their elimination**.**
- Barcelona test-bed in HEPTAS will handle the following data sets: Origin – Destination passenger data obtained from Floating Mobile Data (FMD) – i.e. from mobile phones. Latest data available will be provided, when the project starts, by the UPC through agreements with technological partners involved to date in the development of the Barcelona Virtual Mobility Lab.

As from June 2019 SEAT will start to produce and distribute its first connected cars, in that case "Ibiza" and "Arona" types of data to the Automotive Car Data Collector (ACDC), an infrastructure designed and managed by Audi AG that will store data from connected cars of all brands of the VW group. It is estimated that from the end of 2019, at the time the data collection campaign will be launched, to end of 2020 nearly 6100 connected cars in average will circulate in the Barcelona metropolitan area (AMB). For the Barcelona pilot test-bed 6 types of data will be needed

to feed the prediction model: a timestamp, GPS coordinates, speed, acceleration, consumption, and type of engine. SEAT will program a one-year campaign to acquire data every second from these vehicles which will lead to ca. 15TB of generated data. Barcelona's smart city sensor network Sentilo data[14] will be used to support calibration of the diverse city models used.

1.3.4 Positioning of the project

Through its 9 work packages (WPs, see Section 3), HEPTAS is structured to strike the correct positioning for an Innovation Action (IA), as indicated in Table 3, reporting the initial and final Technology Readiness Levels (TRL) of its outputs. The details on the ownership of the individual outputs are provided in Table 8 in Section 2.

Table 3: TRL values of the main HEPTAS project outputs and relevant type of innovation actions

HEPTAS output	*Project objective*	*Initial TRL*	*Final TRL*	*Actions*
Automotive solution for predictive energy management	O3	5	7	System prototype demonstration in operational environment
Enhanced automated driving functions	O3	5	7	System demonstration in operational environment
Predictive and proactive maintenance	O2	3	7	System demonstration in operational environment
Data life cycle management	O1, O4	5	7	System demonstration in operational environment
e-Horizon 5.0 dynamic 3D HD Map	O3	5	7	System demonstration in operational environment
HPC platform and infrastructure and API for developers	O4	4	7	System demonstration in operational environment
Virtual vehicles, Traffic and Pollution models by simulation	O1, O3	4	6	Large scale system prototype demonstration on traffic simulator
4G/5G and satellite data pipelines	O2, O4	4	7	Sub-system demonstration in relevant environment

1.3.5 International and national research and innovation activities linked with HEPTAS

In the last few years **the HEPTAS participants have been part of several successful research projects** dealing with subjects strictly related to that of HEPTAS, as indicated in Table 4. This will significantly contribute to the HEPTAS effectiveness and outputs.

Table 4: Main international and national projects linked with HEPTAS

Project	*Relation to HEPTAS*	*Participant/s transferring the results*
AUTODRIVE and 3Ccar (ECSEL)	Automated and connected vehicle technologies, including consideration of energy efficiency & co-modality. Electronics for control of complex automotive systems**.**	AVL
INDIGO-DataCloud	Development of computing platform & related Cloud services, deployed on multiple HW & on hybrid private/public e-infrastructures.	INFN
eXtreme-DataCloud	Development of data management services for extremely large datasets in heterogeneous and distributed e-infrastructures.	INFN
DEEP Hybrid-DataCloud	Integration of heterogeneous cloud resources in a Hybrid Cloud, focusing on intensive techniques for the analysis of very large datasets, exploiting specialized HW like GPUs & low-latency interconnects.	INFN
ICT-Emissions	Traffic optimisation algorithms considering fuel consumption and environmental impacts of vehicle technologies.	EMISIA
EUDAT/EUDAT2020	Development of a sustainable pan-European infrastructure for improved access to scientific data.	CIN

PRACE	PRACE is a pan-European Research Infrastructure for HPC, with world class computing, data management resources & services.	CIN
EPI	EU Processor Initiative (EPI) gets together 23 partners from 10 European lands, to bring to market a low power microprocessor.	BSC
SUMP	SUMP (Sustainable Urban Mobility Planning) project's specific objective is to strengthen the capacity of Local Authorities of Yangon City (Myanmar) urban mobility planning and traffic reduction.	ITHACA
H2020 IMPERIUM	Improvements in predictive control aimed at performance optimization of components is applicable to HEPTAS as basis for the pilot test-bed 3.	AVL, FEV
H2020 EUDAT/EUDA	The modules and services related to data management are directly applicable for integration in the HEPTAS platform.	CINECA
H2020 ICARUS	Architectural structure developed in this project may be adapted to HEPTAS.	CINECA
H2020 PRACE	Architectural structure developed in this project may be adapted to HEPTAS.	CINECA
FP7 OpEneR	Predictive speed features such as Traffic Light Assistant developed. Subsequently refined in real-time in Austrian FFG TASTE project. These 2 projects provide a very strong basis for HEPTAS pilot test-bed 3.	AVL

1.3.6 Sex and/or gender analysis

Gender analysis in the context of HEPTAS is examined from a two-fold perspective:

Gender balance in the specific research and innovation domain. The R&D and innovation activities carried out in the context of HEPTAS can be considered gender and sex neutral. The domains tackled, both from the R&D (HPC, big data and cloud computing technologies) and from the industrial and business communities do not provide uneven opportunities, nor are they biased in any way. Nevertheless, to minimise the likelihood of gender or sex specific bias, the project will adopt the policy measures for benchmarking gender equality in science by the European Commission, but no such bias is anticipated.

Gender balance in the participating research teams: Overall, HEPTAS has a strong female representation among the executive members, as demonstrated in the partners profiles (see Section 4). HEPTAS is committed to promoting equal employment opportunities and aims to establish a program of actions to make the H2020 gender and equality policy fully effective. Finally, it will establish a system for monitoring gender equality in mobility schemes such as equality of access and participation, which causes subsequent impact on professional careers. HEPTAS will encourage balanced recruitment of female and male researchers, as well as of family-friendly policies, such as flexible working arrangements.

1.4 Ambition

1.4.1 State of the Art

Main technologies and components available individually

HPC and Big Data: The HPC and Big Data paradigms have traditionally relied on different infrastructure and software stacks, to serve the different classes of problems. HPC systems are built to serve compute-intensive simulations, while Big Data systems are built around the concept of fast and reliable local storage. On HPC systems, compute and storage resources form separate partitions. A parallel file system, such as LUSTRE or GPFS, allows nodes to view storage resources as a shared file system. Compute resources are managed by centralized manager e.g. SLURM[15]. The resource manager views computation resources as "slots" (e.g. cores, GPUs, memory, etc). HPC applications are submitted to the system and request a specific set of slots, which are granted to the application once they become available and do not change until the application execution completes. Resource allocation and scheduling is done by the resource manager at job-level, and state-of-the-art policies aim at maximizing system throughput. On Big Data infrastructure, a distributed file system, typically HDFS[16] or Ceph[17], handles the batches of

[15] https://www.slurm.schedmd.com/
[16] https://wiki.apache.org/hadoop/HDFS/
[17] https://ceph.com/

data efficiently and performs data replication for fault-tolerance. As a result, processors view persistent local storage (e.g. HDDs) as part of their local hierarchy. Compute resources are managed either directly by built-in schedulers of the data analytics frameworks, e.g. MapReduce, Hadoop, Apache Spark, and others, running over HDFS, or by schedulers like MESOS[18], which can manage more than one framework and allow for multi-tenancy. In contrast to HPC applications, data analytics applications are composed of short tasks and resources are elastically provided to applications, while HDFS exposes a mechanism that allows schedulers to move computation closer to data. Schedulers for big data are more tightly integrated with the application frameworks running on top and the file system.

HPC and HPDA infrastructure and software rely on different design principles: storage infrastructure in HPC is optimized for bandwidth, while in Big Data, it is optimized for latency. Data analytics frameworks are designed to view storage as the bottom part of a memory hierarchy, a fact that hinders performance of such frameworks over typical HPC storage, which is shared and unoptimized for frequent batch I/O. In addition, HPC resource managers provide rigid resource allocations and do not support any type of elasticity. In addition, they do not consider I/O in their scheduling decisions, which further inhibits the deployment of data analytics frameworks on typical HPC infrastructure. Near storage can alleviate the effects of the shared filesystem, however, the I/O-oblivious scheduling in HPC fails to consider any I/O congestion. Another challenge for HPDA applications over HPC infrastructure is the usage of accelerators. HPC applications come with beforehand knowledge of accelerator usage and the related codes, and request a pre-defined set of accelerators to execute on. Big Data analytics have only recently started to adopt accelerators, while code generation and acceleration resource management are open issues.

This Lighthouse project "Transforming Transport" is aiming at "demonstrating in a realistic, measurable and scalable way the important transformations Big Data Science and Technologies bring to Transport & Logistics (T&L) in the 21st century. The target is to demonstrate increase of productivity and impact under seven domains, covering important areas for T&L". These domains cover resp. highways, passenger vehicles, rail, maritime ports, airports, urban mobility, supply chain. Even if the core of the project is centred around the Big Data, strong links exist with the targets of the HEPTAS project, but also complementarities in terms of test sites, focus on HPC, and mobilities for Smart Cities. Therefore, pending an agreement from both project consortiums, we would recommend implementing a relationship between the two projects, to benefit from lessons learned, compare results, share data sets from Pilot Tests.

Traffic Management and ITS: Current traffic optimisation algorithms are based on travelling time (or travelling distance) minimization, without considering the environmental performance of vehicles also depends on the driving pattern (operation mode). While for urban secondary streets, an increase in mean travelling speed generally leads to a reduction in emissions, the opposite is true for urban motorways where speed increase leads to emission increase on a per unit distance basis. Because of this complex nature, traffic condition optimisation is based on empirical responses by urban city authorities because it is not possible to simulate in real time the complete traffic of a city to deliver the optimum solution. These responses are according to baseline traffic conditions, which are somewhat adapted based on live feeds from a limited number of traffic count systems positioned in main arteries and cross-sections. Especially when unexpected events occur (e.g. accidents, road blockages due to strikes, etc.), empirical systems are incapable of efficiently diverting traffic. An additional complication is how to deliver vehicle specific information to individual vehicles. Traffic information communicated to the driver is not considering the vehicle properties but it is only generic guidance (e.g. on alternative routes) not tailored for a specific vehicle type. Routing tools (like Wiseride from partner EMISIA, www.wiseride.gr) show that routing optimisation is too much vehicle powertrain and condition specific.

Big Data will have a profound economic and societal impact in the mobility and logistics sector, which is one of the most-used industries in the world contributing to approximately 15% of GDP. Big Data is expected to lead to 500 billion USD in value worldwide in the form of time and fuel savings, and savings of 380 megatons CO2 in mobility and logistics. With freight transport activities projected to increase by 40% in 2030, transforming the current mobility and logistics processes to become significantly more efficient, will have a profound impact. A 10% efficiency improvement may lead to EU cost savings of 100 BEUR. Despite these promises, interestingly only 19 **%** of EU mobility and logistics companies employ Big Data as part of value creation and business processes.

Vehicles and ADAS: The automotive domain is currently facing two revolutions at a time: the shift towards electrification and towards connected and automated driving. Both aiming at facing the new regulations and incentives for e-mobility and new business models such as car sharing. Thus, the technological evolution is accelerating and already vehicles on the road have more and more sensors, controls and ADAS features. Nonetheless,

[18] https://mesos.apache.org/

currently **vehicle control typically operates based on instantaneous, reaction based decision making logic** without significant interaction with the city traffic management system to determine its control actions (e.g. vehicle velocity, gear selection or powertrain driving mode for hybrid vehicles). In parallel and largely independently, the city **traffic management system operates based on forward prediction models using low level traffic information** (e.g. traffic density and vehicle throughput) to determine its control actions (e.g. reassignment of traffic light phases, route recommendation via roadside electronic displays).

1.4.2 Progress beyond the State of the art

HEPTAS moves one small, but decisive step further

HPC and Big Data: Based on the analysis of the state of the art for HPC and Big Data, HEPTAS will provide more research to determine which mechanism is more adapted and the right tools will be developed to manage mixed Big Data and HPC workloads under various combinations of hardware partitions and software ecosystems. Furthermore, new scheduling algorithms will be studied for optimal execution of mixed workloads.

To better study the mix of stream and batch processing workloads and the impact that this may have in different metrics such as system utilization and slowdown, the usage and extension of simulation methods will be needed. This will allow us to study the efficiency and scalability of the internals of our mechanisms prior of deploying upon the real-scale system.

Traffic Management and ITS: 5T is a public agency in deal with Solutions for Mobility, which have been historically approached with focus on innovation, both in terms of technology and service.

In this perspective, 5T has defined an evolutional road map which involves some of its core sub systems, as TOC, UTC, traveller's information services, etc., oriented to the improvement of Mobility Governance, also in the point of view of the promotion of MaaS.

Therefore, the current State of the Art could be improved through:

- Introduction of GLOSA (Green Light Optimized Speed Advisory) services on the main urban road network axes (controlled by UTC traffic lights), capitalizing the experience gained in the framework of TEAM project;
- Integration real-time data relevant to the availability of roadside park along the main urban road network axes in the Parking Management System;
- Usage of xFCD data (extended Floating Car Data), which can provide several additional information about traffic, road condition and mobility behaviours;
- Integration of near real-time traffic state estimation, based on data mining techniques, in the TOC systems;
- Application of Deep Learning techniques to traffic data (both historical and real-time), aimed to the individuation of traffic patterns, early detection of unexpected events, etc.;
- Introduction of Routing Services based on global traffic and environment optimization.

The HPC capabilities of HEPTAS together with real-time information flow from the operating fleet will provide the possibility to deliver tailor-made and adaptive routing guidance to individual vehicle types. Tailor-made means that the real traffic conditions of the city are considered based on live information and that the optimal solution is provided in quasi real-time so that traffic authorities efficiently respond to existing driving conditions. In contrast to existing systems, live traffic feeds are not only originating from stationary traffic count sensors but from thousands of operating vehicles (floating cars) thus providing a much better coverage of the complete city, including secondary streets and even a more representative portion of main arterial streets. For such optimisation algorithms, it is necessary to consider the powertrain and emission control system of each vehicle type. This will be made possible as this information is going to be transmitted to the cloud system. Hence, the solution algorithms will not provide only a generic solution for the typical vehicle operating in the city but custom-made solutions, considering vehicle specificities. This is particularly critical in case of unexpected events where re-routing may be varied depending on vehicle type. Alternatives routes may be proposed for petrol-hybrid or electric vehicles compared to e.g. diesel ones, depending on which routes offers the highest benefit for the particular vehicle type. Single vehicle pattern (micro-simulation) over traffic flow optimisation (macro-scale simulation) algorithms will be developed for co-operative solution seeking.

Discrimination of vehicle technology will also enable the consideration of boundary conditions, such as environmentally sensitive zones, like urban hot-spots or environmental zones. Vehicles of latest standards will be able to use environmental zones while older ones will be diverted to routes outside of environmental zones. Today this is only primitively performed in existing traffic management models, as it is not possible to discern individual vehicle types and propose tailored-made routing.

Accurate vehicle positioning (up to centimetres) is an essential precondition for enabling L3+ Automated Driving (AD). Car positioning systems currently in production are based on satellite navigation receivers (with or without the support of IMUs) that, especially in dense urban areas may be unreliable e.g. when cars are driving in narrow streets surrounded by houses (street canyons), the reduced number of visible satellites and other signal interferences lead to a decrease of the positional accuracy of several metres. Additionally, assisted/autonomous cars can be subject to cyber-attacks in terms of jamming and in terms of spoofing. The availability of very accurate and updated 3D reference models coupled with the capability to constantly compare the reference environment with the 3D environmental contexts produced by the car from its own sensors' suite should improve vehicle positioning.

The complexity of existing city traffic management is reaching its limits

Improving **European mobility** in urban and extra urban areas **requires ever greater throughput (traffic flow capacity), efficiency, safety, and reduced emissions.** Already today city traffic management systems are widely used, but their complexity is reaching the limits of what is solvable with traditional methods, and some cities may impose vehicular restrictions to limit NO_X. Management of highly complex systems requires an intelligent approach, which is possible with artificial intelligence (AI) and related training data. Automotive OEM and suppliers already introduce predictive features to improve efficiency of individual vehicles, but their potential is ultimately limited by the lack of appropriate and sophisticated co-operation between the city traffic flow (e.g. cars, trucks, buses, trams), and intelligent infrastructure (e.g. adaptive traffic lights signal phase timing, dynamic speed limits and advanced connectivity solutions).

HEPTAS will go very significantly further, leveraging HPC for smart cities applications

By **combining big data flows in real-time from many diverse and relevant data sources and sensors (e.g. cars, buses, city traffic flow loops, local city emissions probes), analysing them with state-of-the-art HPC systems and algorithms**, and providing services and value-added information through the Cloud. The addressed tasks of HEPTAS require targeted and fast-enough update of relevant data sets according to each use case and its test-bed.

Communications to and from the cloud and HPC need to be tailored, targeted, and prioritized, to ensure that the right information is available to the relevant users at the right time. Such enormous data amounts and the complexity of the required simulations demand new approaches requiring HPC and cloud provisioning methodologies, to **connect & quickly process these data in parallel, to fuse them, as well as to securely manage, store, and communicate them privately and intelligently** to legitimate users.

Up-to-date and reliable **big data sets require continuous, cost-effective, and innovative connectivity everywhere**, with sufficient and affordable **Cloud based storage, with robust anonymization and compliance with privacy regulations, as well as elastic (i.e. rapidly performance scaleable) and distributed HPC to ensure timely and reliable processing (e.g. AI, machine learning, simulation) of huge amounts of data**. Existing machine learning approaches are expensive in terms of hardware and consume significant amounts of electrical energy. Thus, citywide HPC approaches are far preferable to scenarios where a significant part of the underlying calculations is unnecessarily and energy intensively performed by every vehicle.

HEPTAS needs to manage and transfer big data sets and hence **requires innovative end-to-end connectivity** solutions to ensure timely flow of input and output data, as well as instructions and recommendations.

HEPTAS needs **elastic HPC to continuously analyse and optimize city mobility, using machine learning, and/or simulation to improve traffic flows and send unique recommendations to individual vehicles** via V2X (e.g. 3G, 4G, LTE, 5G, G5, WiFi, Satellite) in real-time regarding the best route, an efficient speed profile, and available parking spaces, as well as instructions to city infrastructure like smart traffic lights, dynamic speed limitations, or other traffic warnings / messages.

As 100% connectivity coverage is not yet possible, nor can ever be guaranteed at all times, **it its vitally important that each individual ego-vehicle remains responsible (i.e. locally on-board) for the final determination of its route, and its dynamic trajectory including the refinement of its optimally efficient speed profile**, taking into account the actual vehicles and traffic infrastructure nearby, as well the ego-vehicle's powertrain state and efficiency characteristics, **to ensure minimal energy consumption, and ensure a safe and timely arrival, even in the case of interrupted cloud and data flow**.

HEPTAS requires a technically rich data value chain to industrially realize its societal and economic benefits.

Sustainable industrialization of the data value chain requires its affordable and monetarized usage for multiple applications by various stakeholders (incl. public transport authorities, infrastructure and communication providers, vehicle OEM and suppliers, SME, haulage/delivery firms, and private citizens) in and around smart cities

HEPTAS will provide a platform that will be developed and tested through a series of carefully chosen and **highly integrated or hybrid use cases**, and their demonstration in smart city test-beds that demand elastic and cloud based HPC for ongoing machine learning and simulation of smart mobility (public and private).

Parking in a city can account for up to 40% of driving time, and many parking spaces being at the side of the road are likely to remain digitally unmanaged. In addition, vehicles looking for a parking spaces significantly slow down the overall traffic flow, and thus represent a major cause of traffic congestion and emissions. To address this topic, HEPTAS cloud and HPC will collect data from existing sensors (e.g. ultrasonic, LIDAR, camera) from numerous cars, which combined with localization, allows **HPC based machine learning to reliably make in real-time parking suggestion** to those vehicles seeking a space to minimise the kilometres driven, emissions, consumption, driver stress, and thus indirectly improve safety.

HPC for continuous 3D map updates allowing very accurate localization for automated driving applications

L3+ Automated Driving (AD) for safety, efficiency and convenience needs far more accurate and reliable vehicle localization (actual and future predicted) than satellite navigation and on-board sensor technologies currently support, especially in dense urban areas. By constantly comparing the 3D environmental contexts produced by the car from its own sensors' suite, with high precision 3D maps provided by surveying specialists with up cm level precision, **vehicle localization accuracy can be significantly increased to the enabling level for L3+ AD**. By comparing the car's actual surroundings to what is given in the map, AD car systems can focus their attention on things that are different and important, like identifying a pedestrian or a bicycle[19]. The same approach implicitly improves **vehicle resiliency to cyberattacks** in terms of jamming and spoofing. However, such 3D maps are expensive to create and maintain, and more suited to rather static environments, which is often not the case in dynamic urban situations where 3D maps quickly become out of date. HEPTAS will **allow end user owned vehicles to send meta-data and/ or selected segmented image data regarding 3D mapping inconsistencies** (e.g. missing landmarks), which will be processed in the HPC cloud, to economically manage and prioritize re-surveys, hence providing **timely and relevant static 3D map updates** essential for highly automated driving. Such approaches will further usefully support the creation of medium term dynamic 3D maps (including temporary construction sites, or roadworks, or accidents).

HPC enabled and affordable predictive and proactive maintenance of public and private vehicles

The HEPTAS platform will enable **predictive and proactive maintenance of both public and private vehicles**, to reduce breakdowns, inconvenience, and reduce the cost of ownership, and improve further emissions and safety. While traditionally predictive and proactive maintenance approaches are restricted to very high value industrial plant (e.g. remote condition monitoring of power stations), the HEPTAS cloud and HPC allows realization to lower value and mobile assets like vehicles such as buses and cars.

Such **predictive maintenance approaches will also enable vehicle OEM (& their suppliers) to quickly identify issues that may affect product quality and even safety**, especially with the trend towards more Autonomous Driving (AD) and over-the-air (OTA) software updates.

1.4.3 Innovation Potential

One of the objective of HEPTAS solution is to enable third parties and SME to easily offer their applications and techniques to a wider audience of customer, including other companies, public administrations, and citizen. They will be able to easily use and/or adapt the delivered services for their needs and enabling collaboration networks around these services, leading to a better coordination of the existing activities. **HEPTAS, combining AI with Big Data and cloud based elastic HPC, in an open and cooperative platform represent a disruptive solution that will allow to go much further than the demonstrative use cases of the project itself.** It enables the possibility to increase the number of customers, industrial players, and stakeholder enlarging the Data Value Chain, facilitating the integration and co-evolution with the other components of smart mobility and smart cities technologies, possibly opening to new mobility solutions and new experiences for citizens.

Only a cloud based elastic (i.e. performance scaleable) HPC can receive, store, and process (via AI, machine learning and simulation), and **manage the huge amounts of data generated in smart cities**, privately distributing relevant parts to legitimate mobility uses, in time to optimize their driving behaviour, predictively monitor their vehicles, and furnish them with precise and up to date 3D maps for highly automated and smart driving. In HEPTAS, the cloud based elastic HPC will be powered by an **innovative connectivity solution** to connect i) the potentially billions of sensors and actuators to the Data Lake(s), where data is stored; and ii) the Data Lake(s) to the HPC(s) centres; and iii) the HPC(s) among them.

[19] https://www.ft.com/content/2a8941a4-1625-11e8-9e9c-25c814761640

Possible innovation areas that could be triggered and boosted are:

- **Transportation:** In the transportation area it will be possible to better exploit the MAAS approach opening business model opportunities and offering further significant improvements in terms of overall transport efficiency.
- **Insurances:** The insurance industry will be able to offer tailored services based on the level of services used by the customer for example reducing premium in accordance to ADAS level (reduced crash risk)
- **Urban Planning:** Introduction of higher AD levels and the possibility to better optimize urban mobility will open new opportunities to also optimize the physical space for the new mobility models contributing to further improve overall efficiency.
- **Society:** New ways to urban mobility and use of the city with even more emphasis on shared services and cooperation will also open opportunities for better social inclusion (e.g. aged, disabled). Moreover, it will provide citizens with new, simple, and secure access to mobility services.

Public Security: The possibility to access the huge amount of real time data on traffic evolution and vehicles movements enables better public security and emergencies management. As a result, potential innovation should lead to an even greater optimization of mobility services with resulting reduction of energy consumption, time spent for travels, stress to find parking and drive in traffic, Pollution (emission, noise, etc.)

2. Impact

2.1 Expected impacts

The automotive domain is currently facing two revolutions at a time: the shift towards **electrification** and towards **connected and automated driving**. Both revolutions are **tightly linked to societal challenges** such as clean transportation, zero fatalities, mobility for an ageing population, as well as to **customer needs** towards more personalized mobility. Both revolutions are strongly **supported or even enabled by ICT** (information and communication technologies) and consequently result to a **shift in the value creation** as well as required skills in the automotive domain. **New regulations and incentives** for e-mobility are published to support this trend[20]; parallel to this, **new business models** such as car sharing are emerging[21]; connected cars[22], operating through a seamless and innovative integration of both satellite and terrestrial networks, is a further important driver in this context. Summarizing, the **automotive market is currently being revolutionized and reorganized**, **electrification and automated driving supported by ICT playing a central role**. Solid market predictions are almost impossible to find. Two trends indicating either **an evolutionary process,** or a **disruptive mobility change** can be identified.

2.1.1 Contributions of HEPTAS to the ICT-11-2018 call targets

While designing the HEPTAS project, special care has been taken regarding the alignment of project approach with the ICT-11-2018 call. Table 5 summarizes the relation to the "expected impact".

Table 5: Specific challenges of the ICT-11-2018 topic and HEPTAS contributions

ICT-11-2018 call (expected impact)	*HEPTAS solution*
"Demonstrated increase of innovation and productivity in the main target sector of the Large Scale Pilot Action"	➢ Traffic flow optimization, reducing pollution emission and global optimization energy consumption. Reduce finding parking slots. ➢ Transportation exerts a great deal of pressure on the environment, and it has become the first source of emission of harmful local pollutants (impacting on population health with huge associated costs, but also competitiveness of companies e.g. caused by wasted time and fuel in traffic congestion). HEPTAS objective is to develop high spatial resolution and integrated model of intra-urban mobility to assess population exposure to traffic emissions, and derive urban mobility strategies to mitigate their impact. HEPTAS will provide input to the Strategic Environmental Assessment of the Barcelona Metropolitan Mobility Plan (PMMU). HEPTAS will allow the development and simulation of different scenarios to reflect the environmental and health impacts of the proposed measures, clearly quantifying them to assess the improvement enabled by HPC. In

[20] https://tfl.gov.uk/info-for/media/press-releases/2017/november/gla---ultra-low-emission-zone-will-start-in-2019
[21] http://www.dw.com/en/daimler-buys-car2go-on-road-to-car-sharing-venture-with-bmw/a-42781570
[22] https://www.bcg.com/de-at/publications/2017/connected-vehicles-road-revenue.aspx

	addition, it will serve to analyse social and spatial disparities in exposure to pollution according to different urban and economic settings. ➢ HEPTAS will provide input to, and support the implementation and monitoring (i.e. by proposing concrete KPIs) of the SUMP 2019-2024 measures being currently developed by the Barcelona City Council with the contribution of local stakeholders. ➢ SEAT will consider incorporating some of the urban mobility policies being implemented in Barcelona in their connected cars – first compatible cars launched by late-2019 with a prevision of ca. 500k circulating units by mid-2020 – (e.g. during an episode of environmental pollution some cars will not be allowed to enter the city, and this restriction will be shared with the navigation system of connected cars in the affected area). ➢ The examples mentioned in the Barcelona Test-bed can be extended to similar situations in the Torino Test-bed within HEPTAS.
"Increase of market share of Big Data technology providers if implemented commercially within the main target sector of the Large Scale Pilot Action"	➢ Value massive amount of data generated by smart cities and vehicles to address societal challenges of air quality, mobility as a service. ➢ Barcelona is an excellent test-bed for the application of HPC to assessing urban mobility issues (i.e. having air quality concerns attributable to traffic and mobility) and has the right mix of local partners with internationally renowned expertise in the field. Improved and further developed models ingesting different sources of data, and generated urban mobility strategies that will make use of the insights provided, will be disseminated to a wide and diverse audience of other cities and interested stakeholders globally (e.g. by presenting at conferences, such as Mobile World Congress (MWC), Smart Mobility WC and IoT Solutions WC, in Barcelona, and other international congresses and professional forum). HEPTAS will engage Barcelona Big Data Centre of Excellence in engaging tech companies interested to leverage this opportunity.
"Effective integration of HPC/BD/Cloud/IoT technologies in the main target sector(s) of the Large Scale Action, resulting into integrated value chains and efficient business processes of the participating organizations"	➢ Global connectivity coverage combining cellular and satellite networks. ➢ Best usage of big data/HPC for targeted use cases. ➢ Connecting the potentially billions of sensors and actuators to the Data Lake(s), where data is stored. ➢ Connecting the Data Lake(s) to the HPC(s) centres. ➢ Connecting the HPC(s) among them.
"Widening the use of and facilitating the access to advanced HPC, big data and cloud infrastructures stimulating the emergence of the data economy in Europe"	➢ HPC Open API for 3rd party development and stimulate new data revenues of vehicles and smart cities data. ➢ HEPTAS will stimulate the use of HPC from the BSC and provide a framework favouring a broader utilization of as many available sources of relevant data to the use case being investigated as possible, i.e. connected car data, environmental data from smart city sensors, mobile telephony data, etc. This is very well aligned with Barcelona city strategy towards a more open and effective unlock of data to be used by any interested stakeholder, with a clear focus on adding value for the city and generating opportunities for companies in the Big Data sector (in cooperation with Barcelona Big Data Centre of Excellence for instance).
"Stimulating additional private and public target investments in HPC and Big Data technologies from industry, Member States and Associated Countries, and other sources, as referred to in the contractual arrangements of the HPC and/or the Big Data Value Public Private Partnerships."	➢ HEPTAS consortium regroup large and SME private companies with research institutes and will open API to 3rd party for applications addressing private and public usages. ➢ At European level, HEPTAS will promote the use of the project results to solve air quality issues related to transport & mobility in cities other than Barcelona, e.g. by linking with initiatives such as CIVITAS, and liaising with organizations such as Polis and OASC (Open and Agile Smart Cities). HEPTAS aims at actively raising the interest to leverage the produced results with at least 15 other European cities, building on the extensive network of cities granted by CIVITAS, Polis and OASC.

Table 6 refines the objectives in terms of impact creation.

Table 6: Quantified metrics for impact creation

ID	*Impact objective*	*Impact description and quantification*
I01	**Data and intensive computing offered as production services through e-Infrastructures**	The project is aimed at improving the current e-Infrastructure state and design by prototyping an architecture that provides the technical capabilities to build, orchestrate and execute HPC intensive computing applications and data analytics applications, offering them as production services. The project will address the needs of the automotive domain, and relevant examples will be analysed with implementation of the pilot test-beds for the use cases.
I02	**Bring services accessible to industry and to the society**	The HEPTAS solutions will enable private to easily offer their applications and techniques to a wider audience of customer, including other companies, public administrations, and citizens. They will be able to easily use and/or adapt the delivered services for their needs and enabling collaboration networks around these services, leading to a better coordination of the existing activities.
I03	Identify ways to enhance Europe competitiveness and job creation	The HEPTAS eco-system deployed will contribute to identify opportunities to create new businesses and new highly qualified jobs for instance in the predictive maintenance, simulation tools, dynamic 3D mapping or in service development thanks to the access to HPC APIs
I04	**Appropriate communication plan** (See Section 2.2.4)	**Identification of main targeted audience and of appropriate communication channels**, including the quantification of dissemination activities, see Table 10.

The remaining of this section is organized as follows: First, the **alignment of HEPTAS to the market needs** is made evident by a market analysis (see Section 2.1.2) supported by a business model canvas (see Figure 15). Parallel to this, the alignment to the call as well as to relevant roadmaps (e.g., BDVA, ERTRAC, HPC4EU) further consolidates the correct positioning of the project, both in terms of technical content and in terms of business appropriateness. Second, the **exploitation plans at partner level** is presented (see Section 2.2.1). Hence, each partner is strongly committed to strengthen its industrial competitiveness and support its growth and sustainability, as well as impact and visibility in the community. The list of assets to be created in the project (see Table 7) has been defined fully in line with the partners' core strategy, such that **European funding is levered with private invests**. Third, a dedicated section is dedicated to **IPR management and data management** (see Sections 2.2.2 and 2.2.3) to define proper foundation for asset management and monetization; clearly **declaring data as a valuable asset**. Finally, a **communication plan** including the identification of the targeted audience as well as appropriate communication channels is presented in Section 2.2.4.

2.1.2 Growth and competitiveness

2.1.2.1 Market rationale for HPC

Cloud computing is in general an established market that it is expected to continue growing in the next years. EuroCloud[23] sees Cloud Computing as "*one of the most important drivers of a knowledge based society, where physical resources are optimised and shared resources are common*". In this context, Europe is moving towards a Digital Single Market[24] that will provide better access for citizens to digital goods and services, a huge improvement on the economy and the creation of hundreds of thousands of new jobs.

On the other hand, the HPC market is expected to grow from USD 32.11 billion in 2017 to USD 44.98 billion by 2022. The main reasons for such growth is related to the fact that HPC solutions can handle vast volumes of data, extensively support high performance data analysis, provide for faster processing of data with high accuracy, and is foreseen that they will be widely adopted and exploited across industry verticals.

Starting from such premise, the global hybrid computing solution market (mainly based on both Cloud and HPC) is gaining importance in recent years. According to TechSci Research[25], the Global Hybrid Cloud Market it has an estimated growth from USD 31 billion during 2016 to USD 118 billion by 2026 at a CAGR of 14.3%. This is mainly due to the increasing demand of digital services and applications in large as well as small and medium enterprises, with cost effective hybrid computing solutions fully interoperable with existing systems to avoid vendor-lock in.

[23] EuroCloud, https://www.eurocloud.org/about.html
[24] Digital Single Market, https://ec.europa.eu/commission/priorities/digital-single-market_en
[25] TechSci Research, https://www.techsciresearch.com/report/global-hybrid-cloud-market/1356.html

To support this business need, the HEPTAS platform will incorporate an orchestration layer to support heterogeneous data and resource models, as well as coupled data analytics and service analysis for large open datasets.

The European Commission, aiming at unifying the existent national markets into a single one, is pushing down the barriers for the creation of a Digital Single Market. This strategy is built on three pillars: better access to digital goods and services; allow digital networks and innovative services to flourish; and maximising the growth of the digital economy. Under this approach, the beyond the state of the art environment proposed by HEPTAS targets different applications and the integration of heterogeneous resources, bringing down barriers and supporting such strategy.

2.1.2.2 Market rationale for the automotive domain

Automotive domain and smart transportation in general is a **key industrial sector for Europe**[26] by securing 12.2 million jobs, producing 22% of the vehicle worldwide (out of 90 million vehicles produced yearly worldwide), and generating a yearly trade balance over €100 billion.

Parallel to that, the automotive market is impacting different major societal challenges such as **reduction of pollutant emissions**[27], **reduction of traffic fatalities**[28], or **increased mobility for an ageing population**. The following key technology trends strongly support these societal challenges:

- **Electrification**[29], with the introduction of e-mobility (hybrid, pure electric vehicle) to optimize or even completely remove the internal combustion engine, finally reducing the resulting pollutant emissions during vehicle operation
- **Ubiquitous access to data** enabling the seamless and continuous access to the car telemetry independently from the car location to process maintenance, traffic, or other relevant tasks. To this extent, connectivity for high amount of data must be ensured continuously, leading to the need of synergizing multiple access networks to the car, to the processing facilities, to the automotive service centres and to the public authorities in charge of traffic, safety, and security.
- **ADAS and autonomous driving functions**[30], with the purpose of providing more comprehensive information to the driver for better context awareness, up to taking over specific driving maneuvers, finally reducing the demands on the driver and reducing number and/or severity of accidents.
- **Connected vehicles** enabling optimization of vehicle's operation or the emergence of new services relying on external information.
- **Digitalized manufacturing (Industry 4.0)**[31] with the target of optimizing production in terms of higher customization (management of large variant numbers), production cost reduction, higher product quality.

2.1.2.3 Market rationale for satellite-terrestrial connectivity

Ubiquitous broadband connectivity is one of the most important assets in today's world, and represents a strategic infrastructure for Europe. While the networks of today prepare to transition to 5G, the next generation of networks, important challenges remain about how to provide coverage and connectivity to all populations around the globe. Integrating satellites seamlessly with terrestrial connectivity represents an efficient way to support the world's growing communications needs. This enables to quickly deploy scalable, reliable, and cost-effective means to bring connectivity to the world's citizens, no matter where they are located. In particular, satellites are an ideal choice to deploy connectivity in challenging or remote areas, or to increase the capacity provision in the network to address the surge in traffic demand, also thanks to recent innovations like High Throughput Satellites.

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[26] European Automobile Manufacturer Association, „The Automobile Industry Pocket Guide 2016 - 2017", available at http://www.acea.be/publications/article/acea-pocket-guide

[27] COUNCIL The Paris Protocol – A blueprint for tackling global climate change beyond 2020, available at https://ec.europa.eu/clima/sites/clima/files/international/paris_protocol/docs/com_2015_81_en.pdf

[28] European Commission, Mobility and Transport, Road safety in the European Union: Trends, statistics and main challenges, March 2015, https://ec.europa.eu/transport/sites/transport/files/road_safety/pdf/vademecum_2015.pdf

[29] ERTRAC, European Roadmap Electrification of Road Transport, 3d version, June 2017, available at http://www.ertrac.org/uploads/documentsearch/id50/ERTRAC_ElectrificationRoadmap2017.pdf

[30] ERTRAC, Automated Driving Roadmap, 7th version, May 2017, available at http://www.ertrac.org/uploads/documentsearch/id48/ERTRAC_Automated_Driving_2017.pdf

[31] [1] EFFRA, Factories 4.0 and Beyond – Recommendations for the work programme 18-19-20 of the FoF PPP under Horizon 2020, Sept 2016, available at http://www.effra.eu/sites/default/files/factories40_beyond_v31_public.pdf

By 2022, connected services revenue generated by connected cars (mobility/vehicle management, entertainment, navigation, etc.) is expected to exceed USD 42.8 billion[32]. By 2030, it is forecasted that more than USD 100 billion in recurring revenues will come from data connectivity services, including apps, navigation, entertainment, remote services, and software upgrades[33]. To realize this potential, innovative connectivity solutions are essential.

Within the context of HEPTAS, connectivity plays a critical role in the following three links:

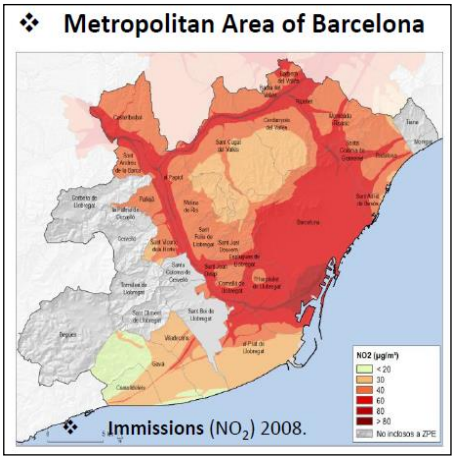
- Connecting the potentially billions of sensors and actuators to the Data Lake(s), where data is stored.
- Connecting the Data Lake(s) to the HPC(s) centres.
- Connecting the HPC(s) among them.

A combination of satellite and terrestrial connectivity, catering for the various geographic and application requirements, represent an efficient, innovative, and comprehensive infrastructure solution to deal with these critical connectivity challenges.

2.1.2.4 Market impact for the Smart Mobility domain

The Smart Mobility Domain represented in the project are already operating with a good level of equipment, processes, and mobility system integration. Nevertheless, several assets developed during the project will have significant impacts to enhance the efficiency of the Metropolitan public transport organization. These impacts related to HEPTAS can be further integrated for similar urban situations in Europe.

Public health:
For a city like Barcelona, the Public Health Agency of Barcelona estimates that 95% of the city's population is potentially exposed to annual levels of suspended particles higher than the World Health Organization (WHO) benchmarks, while NO2 exceeds 68% of the population.
HEPTAS ambition is reducing PM2.5 to the annual average level proposed by the WHO, which will imply preventing annually some 650 premature deaths in the city due to diseases directly attributable to bad air quality.



In 2014, 30% of the population living in the Metropolitan Area of Barcelona were exposed to high levels of NO2 emissions (>10 Tn/day), 30% were exposed to medium levels (5-10 Tn/day) and the remaining 40% at low levels (<5Tn/day). 15% of health and 10% of compulsory education facilities were exposed to high levels of NO2 emissions. HEPTAS will contribute to efficiently implement urban mobility measures (specifically within the PMMU) with the goal to improve the previously described statistics and drastically reducing them by at least a 40% factor.

For a Metropolitan area like Torino (1.555.000 inhabitants), an average of 2.962.000 trips occur per day, either by car (1.430.000) or by public transport (532.000) or by walk (869.000) or by other (131.000 bicycle or motorcycle or taxi). If we consider an extrapolation of Torino to the approx. 400 Million of European inhabitants living in European cities, we reach the total of 750 Million trips a day, corresponding to around 275 Billion trips per year. A market impact can be assessed by the benefits provided by the other following assets developed in HEPTAS:

Traffic light advisor system: this system will provide more information to the drivers or to the automated driving systems about the traffic light phase and duration, in addition to the Urban Traffic Operation (UTC) which is currently performed. Therefore, traffic flow, fuel consumption and pollution should be improved, in the magnitude of 5 to 20% depending on the situations and on the vehicle equipment.

Traffic Simulation with HPC. The Smart Mobility operators will provide traffic probe data and floating car data to the traffic simulation tools. In exchange, an improvement is expected to the re-routing strategies proposed to the drivers, which will generate positive impacts against the congestion and pollution. In Europe, the health costs from air pollution are estimated to be €330 to €940 billion a year, with a strong contribution from transport.

Deep learning in HPC: today, most of the traffic prediction tools have been gradually improved but are not sufficiently predictive. The usage of Deep Learning will allow to have a better classification of the various traffic situations, and a better modelling their evolutions and consequences, and will provide better decision tools to define

[32] Connected Car Report, PWC, 2016
[33] Monetizing Car Data, McKinsey, 2016

the appropriate counter measures. This Deep Learning process can also be linked to the traffic simulation tool for situations never experienced before, or for a combination of factors approaching the limits of practical feasibility. Congestion equivalent societal costs are usually estimated to 10€ per hour lost in traffic for passenger cars, and 30€ per hour for commercial vehicles.

2.1.3 The HEPTAS Eco System

Based on the global system architecture defined in section 1.3.1, the HEPTAS ecosystem is pictured in Figure 14:

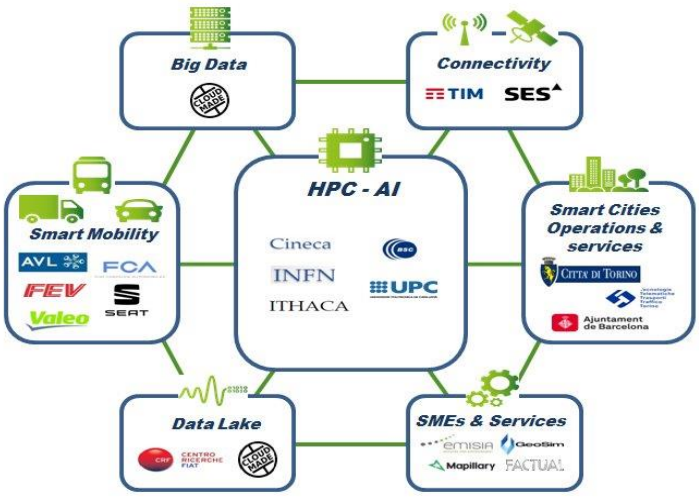


Figure 14: The HEPTAS ecosystem

The HEPTAS ecosystem is further enhanced with an **advisory board**, already consisting of 7 partners at proposal submission (see the annex). These organizations will be **active followers and connectors** to other European cities interested to be informed about the progress achieved by HEPTAS, the potential for solving common issues related to urban mobility, and ultimately contributing to spread the word, to promote best practices and disseminate success stories (those achieved in HEPTAS test-beds in Torino and Barcelona) to European cities. Furthermore, HEPTAS has secured valuable extra support and advice from the Big Data Center of Excellence Barcelona[34], which has committed to cooperate to fulfil the common goal of better air quality in Barcelona. This, of course, will serve the Big Data CoE to gain expertise on the topic in order to exploit some of the findings and strategies with other client companies and cities, contributing to multiplying the international reach of HEPTAS outcomes. The letter of support encompasses the following institutions:

- **Governments**: government du grand duché de Luxemburg, Italian government
- **Smart cities associations**: Open and agile smart cities, POLIS, EIP-SCC,
- **Related technology centres**: IoMob, BigDataCoE
- **Large companies interested in collaboration**: INRIX Inc., GoodYear S.A., SCNF

2.1.4 Business model canvas

In order to illustrate the expected impact enabled by the HEPTAS Eco System, a business model overview for the HEPTAS project has been drafted according to the Canvas template, see Figure 15. The unique value proposition is aligned with the main project objectives and mainly consists of a set of assets comprising of:

- **Asset A1** (derived from O3): Automotive solution for predictive energy management
- **Asset A2** (derived from O3): Enhanced automated driving functions
- **Asset A3** (derived from O2): Predictive and proactive maintenance
- **Asset A4** (derived from O1, O4): Data life cycle management
- **Asset A5** (derived from O3): e-Horizon 5.0 dynamic 3D HD Map
- **Asset A6** (derived from O4): HPC platform and infrastructure and API for developers
- **Asset A7** (derived from O1, O3): Virtual vehicles, traffic & pollution models by simulation
- **Asset A8** (derived from O2, O4): 3G/4G/5G & satellite data pipeline

[34] Centre driven by Eurecat Technology Centre, the Government of Catalonia, the Barcelona City Council and Oracle that builds, develops and provides tools, data sets and value-added Big Data capabilities enabling companies on defining, testing and validating Big Data models before their final implementation: https://www.bigdatabcn.com/en/about-big-data-coe-barcelona/

Key partners

The consortium is providing cross-sector and cross-border expertise by integrating relevant industry partners and relevant scientific expertise

Key activities

- Design of large and complex real time and secure systems
- Operation and supply of HPC and cloud computing
- Adressing multiple societal challenges in Smart Cities
- R&D in automotive industry adapted the digital revolution
- Access to massive data storage capabilities in the Cloud
- Supply of strong and reliable and secure data transmission channels
- R&D in traffic simulation

Key resources

- Qualified employees
- R&D innovation capabilities
- Access to **relevant industrial use cases** and related data sets
- Appropriate labs and test environments for the development, validation and evaluation of the proposed assets
- ***Multiplier effect*** provided by project content aligned with company strategies

XY assets

- Asset A1 (O3): Automotive solution for predictive energy management
- Asset A2 (O3): Enhanced automated driving functions
- Asset A3 (O2): Predictive and proactive maintenance
- Asset A4 (O1, O4): Data life cycle management
- Asset A5 (O3): e-horizon 5.0 dynamic 3D HD Map
- Asset A6 (O4): HPC platform and infrastructure and API for developers
- Asset A7 (O1, O3): Virtual vehicles, Traffic and Pollution models by simulation
- Asset A8 (O2, O4): 4G/5G and satellite data pipelines

Customer relationships

- **Dedicated personal assistance / co-creation**: direct interaction with customer (e.g., car manufacturer) to support integration or deployment of technology solution at customer site or for customer product
- ***Personal assistance***: assistance during sales and after sales to end customer

Channels

- Partners and their **respective distribution networks**
- HEPTAS project and related **demonstrations** or **dissemination activities**
- Participation in relevant European **expert groups, standardization activities** and relevant scientific and industrial events

Customer segments

- **Seg1 : European and worldwide vehicle mass market** for road transportation expecting improved vehicles and **added value creation supported by HPC and Big Data**
- **Seg2**: **Industry partners** (all domains) seeking for **components, engineering support and tools** to increase their competitiveness by tailoring and deployment of HPC Big Data solutions
- **Seg3**: customer related **to smart cities, public organizations,** and **end-users**

Cost structure

- ***Fixed costs*** such as personal (expertise), marketing, lab and material parts
- Higher system complexity generates higher initial R&D costs vs current status
- Co-investment provided by the companies to support technology development and support access to relevant labs

Revenue streams

- Product selling, after-sales services, fleet maintenance, new mobility usages
- Engineering partners: income per engineering hour for engineering services, license based for software modules and tools, development contracts
- Improvement of public image, increase of tourism and businesses, higher ROI for transport equipments

Figure 15: Business Canvas for HEPTAS

The development of this value proposition is enabled by the HEPTAS consortium providing **complementary set of expertise, covering the supply chain** (car manufacturers, Tier1, engineering solutions, connectivity providers, tool provider, HPC technology and services providers) and providing the appropriate environment in terms of knowledge, lab infrastructure, test site, connectivity, and access to the appropriately large, complex, and realistic data sets. Further, the project targets and partners' contributions are fully in line with their own roadmap, ensuring **a high commitment** from technical development up to go-to-market strategy, and further **providing a lever effect between the European funding and the companies' internal invests**. The exploitation plan at partner level – as well as the list of assets – is provided in Section 2.2.1.

The HEPTAS assets are addressing distinct segments:

- **Seg1: European and worldwide vehicle mass market** for road transportation expecting improved vehicles and **added value creation supported by HPC and Big Data**
- **Seg2**: **Industry partners** (all domains) seeking for **components, engineering support and tools** to increase their competitiveness by tailoring and deployment of HPC Big Data solutions
- **Seg3**: customer related **to smart cities, public organizations,** and **end-users**

2.1.5 Contributions of HEPTAS to relevant roadmaps

2.1.5.1 BDVA BDV SRIA Document v4.0

Mobility, transport, and logistics is one of the strategic sectors of the Big Data Value Association (BDVA) PPP[35]. According to their Strategic Research and Innovation Agenda, urban multimodal transportation is one of the most complex and rewarding Big Data settings in the logistics sector. In addition to sensor data from infrastructure, vast amounts of mobility and social data are generated by smartphones, V2X technology (communication among and between vehicles), and end-users with location-based services and maps. Big Data will open-up opportunities for innovative ways of monitoring, controlling, and managing logistical business processes. Deliveries could be adapted based on predictive monitoring, using data from stores, semantic product memories, internet forums, and weather forecasts, leading to both economic and environmental savings.

HEPTAS is targeting exactly such crucial points. HEPTAS partnership include full members of the BDVA (like CINECA). The project will organize meeting with the BDVA board of director to insure a full alignment with the PPP strategic objectives and exchange of lessons learnt.

2.1.5.2 HPC-related ETP4EU (EU technological platform for HPC 2017)

The thematic is also crucial for the HPC community. The Strategic Research and Innovation Agenda of the European Technology Platform for High Performance Computing (ETP4HPC) PPP clearly states that even the ultimate convergence of the HPC and High Performance Data Analytics (HPDA) ecosystems, could it be achieved, would not help with the ongoing breakdown of this other, more basic paradigm, namely, the one in which networks only forward datagrams while all other storage and computation is performed outside the network. The problem is that much if not most of the explosive growth in data generation today is taking place in "edge environments" i.e. across the network and outside both HPC and Cloud data centres. This includes not only major scientific instruments, experimental facilities, and remote sensors (e.g., satellite imagery), but even more importantly, the generators of an incredible welter of digital data coming from the **Smart Cities** and "Internet of Things" (IoT) concepts. Thus, this remarkable reversal of the direction of the data tide, which turns the familiar "last mile problem" into a multidimensional "first mile problem", represents a challenge for which neither cloud-based HPDA, nor centre-based HPC have a solution. In fact, explosive growth in data generation in edge environments seems to clearly indicate that revolutionary innovation in distributed computing systems is becoming an increasingly urgent requirement.

The HEPTAS platform will integrate solutions and technologies originated in the two different worlds of HPC and HPDA, and will highlight viable solutions to real-life challenges. HEPTAS partnership include full members of the ETP4HPC (like CINECA and BSC). The project will organize meeting with the ETP4HPC representatives to insure a full alignment with the PPP strategic objectives and exchange of lessons learnt.

2.1.5.3 ERTRAC (electrification, autonomous driving): 2017 Roadmap to Automated and Connected Driving

In the section addressing the key challenges and objective of their 2017 Roadmap, ERTRAC outlines 3 topics directly related to the scope of the HEPTAS project: new mobility services, big data and Artificial Intelligence, digital and physical infrastructure. The new mobility use cases in HEPTAS cover mostly the automated passenger cars, but can

[35] http://www.bdva.eu/sites/default/files/BDVA_SRIA_v4_Ed1.1.pdf

be transposed to automated freight vehicles and public transport thanks to the simulation tool capability. Other assets developed in HEPTAS such as Machine Learning in HPC, traffic simulation and dynamic update of 3D HD Maps match well with ERTRAC key challenges.

Finally, in his Strategic Research Agenda published in February 2018, ERTRAC mentions as one of the future research topics for 2020-2030 the 'Development of advanced digital tools exploiting high performance computing to enable rapid optimization and customization of next generation vehicles'. The HEPTAS projects fits perfectly with these mid-term research goals.

HEPTAS will promote interesting, innovative, original results to the benefit of the research and industry community by contributing to standardization activities and related roadmap. Although there are initiatives in the field of Cloud Computing dealing with standardization in ICT technologies, a significant coordinated effort is still required to reach a mature state. HEPTAS will promote its research advancements by contributing, but also influencing, standardization bodies to adopt the project's research approach in their discussions and standardisation processes. HEPTAS will consider industry requirements from the respective R&D branches to contribute towards reaching a consensus between European and International stakeholders and researchers through standardization activities.

2.1.6 Strengthening industrial competitiveness, growth, and sustainability of companies

Automotive domain and smart transportation in general is a **key industrial sector for Europe**. The HEPTAS consortium consists of **partners along the supply chain** (scientific partners, technology, component and tools providers, connectivity providers, car manufacturers), therefore being in the position to **cover the relevant part of the value creation chain**. Strengthening industrial competitiveness, growth and sustainability of companies is planned by an **appropriate innovation process** comprising (a) identification of relevant innovation (Section 1), appropriate positioning in the market (Section 2.1.2), and exploitation plan at partner level aligned with company strategy (see Section 2.2.1), thus levering public European funding with private funding, to finally strengthen industrial competitiveness.

2.1.7 Improving innovation capacity and the integration of new knowledge

Key aspect for innovation capacity and integration of new knowledge is a **good balance between scientific partners, technology and component providers and OEM**s (see Section 3.2 "consortium as a whole"), as well as the planned tight interaction (see Section 3 – work package description). Hence, this **tight cooperation will act as a catalysator** to understand and respond to the market needs with the best technology and R&D outcomes in a very agile way.

2.1.8 Barriers/obstacles and Framework conditions (regulation/standards)

While there are excellent conditions to support the work proposed by HEPTAS such as 1) the extensive knowledge and experience of the Consortium members; 2) the support to new technologies like Cloud computing and HPC; 3) the increasing relevance and market trend of the arguments tackled by the project, the expected impacts may be limited by a number of barriers and obstacles that exist on the way:

Data privacy protection and Ethics: HEPTAS will comply with the new General Data Protection Regulation (GDPR) which will be enforced on 28/5/2018. The leader of WP2 will act as the 'Digital Officer' of the project, and will report activities and issues to the Project Management Team.

Demonstration vehicle costs for Pilots: to keep the cost of the demo vehicles under control, the Use Cases will use a massive usage of simulation tools, so that large quantities of data are produced by virtual vehicles. This usage of virtual vehicles allows the testing of several penetration rates of connected and automated vehicles, and their impact in the Pilot Test site mobility metrics. Another benefit is to use the simulated vehicles as 'Ground Truth', so that the performance of data transmission and feature modelling can be assessed.

Legal, Regulatory and Certification obstacles: the demo vehicles equipped for the Pilot test in HEPTAS will be allowed to be driven on open roads thanks to the national authorizations for experimentations. To anticipate the deployment of Connected and Automated Vehicles in Europe before the adoption of the regulations, HEPTAS will use the simulation tool creating the virtual vehicles of different kinds, with different Automation levels.

Lack of standardization: the project will make an intensive use of standards, but unfortunately some standards that will be adopted during the project lifetime can rapidly evolve, and it might be difficult to run up these changes. However, the presence in the Consortium of partners with a long-standing experience in software development and computing infrastructure management will minimize such a barrier. No obvious common standard for high-definition 3D maps, nor any sharing of data is fully applied today, since the companies involved consider this to be important proprietary information.

Sustainability: the use cases developed in the project target to tackle again inefficiencies impairing the operations of smart cities such as CO2 emissions, pollution and congestion. The gradual transition towards vehicle electrification and connected automated driving will be considered on a large scale during the project thanks to the modelling of virtual vehicles, leading to the simulation of their beneficial effects on smart cities. HEPTAS will contribute to solutions that are targeted to a broader audience (i.e., citizen, innovation in industry, etc.), and we aim to integrate them both in relevant open source projects and in industry production chains to promote a wider adoption and support of such solutions.

2.1.9 Addressed societal challenges

Challenge of the pollution in European cities
Some 3.7 million premature deaths annually are attributed to outdoor air pollution (World Health Organization). The health costs from air pollution alone is estimated to be €330 to €940 billion a year in Europe, with a large contribution being due to transport. The automotive industry is massively investing to reduce the weight of vehicles, electrify the vehicles (EV and Hybrid). But the transition towards EV is progressive, and the baseline scenario forecasts that Gasoline vehicles will still represent 50% of total new cars in 2030, with hybrid + EV reaching 30%. Hence, radically improved approaches to the optimization of the traffic flow is also essential to reduce air pollution still more quickly. The assets developed in HEPTAS (Real-time 3D based, HPC powered optimisation of city traffic flows including parking), **will support improving air quality**. Furthermore, vehicles may fully anonymously (neither owner, nor OEM, nor Vehicle Identification Number) broadcast not only their speed and location, but also powertrain type, homologation class, and operating state, enabling city wide and local emissions reduction via HPC.

Challenge of reducing total cost of ownership of the vehicle
Most of the maintenance cost is coming after 3 years. Thus, expenses can skyrocket when warranty and free-maintenance periods are over. Better understood causes of systems failures will contribute significantly to reduce Maintenance and Repair cost. The auto industry witnessed a record number of recalls in 2016 reaching 52,985,779 in total[36], which is increasing year after year, resulting billions of Euros of cost for the automotive industry.

HEPTAS will validate that HPC technology can significantly contribute to CO2 and other pollutant emissions reduction, increased safety, driving and parking convenience, and reduced maintenance costs and breakdowns.

2.2 Measures to maximise impact

2.2.1 Exploitation of results at partner level

One of the crucial reasons for the proposed work originates from the potential industrial development and consequent gain of the market share through improved competitiveness. The following paragraphs address future market strategy as a result of the proposed work by individual partner organisations. During the proposal phase, an alignment between the project targets and partners' contribution has been performed, ensuring **a high commitment** of each partner from technical development up to go-to-market strategy, and further **providing a lever effect between the European funding and the companies' internal invests**.

AVL as engineering partner, the path for exploitation targets the **increase of market share** for existing AVL tools and engineering solutions regarding innovative powertrain engineering services relying on HPC and big data services. The approach is to strengthen competences and create success stories – respectively applying these skills in cooperation with potential customers. In the context of HEPTAS proposal, AVL contributions toward predictive energy management (WP6) have been defined fully in line with the company business strategy, therefore maximizing the chance for successful exploitation based on existing position of solutions and services in the market. Both markets (engineering solutions and tools) are expected to be complementary and lead to cross-fertilization. Furthermore, AVL's turnover was about 1.4 Billion € in 2017, linearly increasing by 10% / year in the last decade. Assuming ICT solutions – and especially HPC and Big Data based – impacting 25% of AVL portfolio, then the **HEPTAS project might indirectly impact an overall turnover of 400M€ - 600M€ for 2023 to 2025 timeframe**. Consequently, the outcomes of HEPTAS has the opportunity to positively impact this very large and fast-growing market. Further, AVL is active in many European interest groups like **ARTEMIS** Joint Undertaking (member of the Steering Board), **ERTRAC**, **EARPA**, **European Green Vehicles Initiative**, **EUCAR**, etc. These channels will be activated to disseminate HEPTAS results and **increase the visibility and impact** of the project.

FCA is seventh car maker in the world, located in more than 40 countries and with customers in more than 150 countries. FCA is expecting from the results of the HEPTAS project to deepen the potential impact HPC/Big Data

[36] https://www.cnet.com/roadshow/recalls/

and Connectivity on after – sales scenarios (e.g. maintenance services) and related business opportunities (data monetization) arising in the future.

- From a Big Data analytics point of view, HEPTAS will enable **designing and validating technological architectures and algorithms** as a reference for engineering deployment according to available infrastructures.
- From the HPC and connectivity point of view, the HEPTAS project will **validate distributed and flexible models**, implementation technologies and related performances that are very valuable from an industrial point of view since different operating conditions will be considered. At the same time, Turin test-bed will allow to test use cases within a best in class technological landscape.
- From the simulation point of view, realistic modelling, and performance elaborating by HPC on connected cars scenario will **enhance FCA capabilities for future extensions towards always more complex scenario** as AD.
- From a business models perspective, the HEPTAS results will provide **data monetization models and data federation lifecycle management architectures** that are needed for industrial utilization as soon as possible.

CloudMade, as a research partner, we see the potential of adding new products, solutions, and technologies under our current landscape of customer offerings. This will, eventually enable to reach more customers and increase our customer base. We also see a direct possibility of the technologies addressed in HEPTAS to enable us to grow in our sales and hence the revenues. By studying and implementing the specific machine learning and AI models being addressed in this project, we see ourselves being able to provide robust solutions for Smart Cities, Mobility, and Autonomous driving. Contributing towards the Data Governance would enable us to increase our competence and develop new capabilities to address the data driven market with new solutions that handles scalability and availability while also being compliant to the regional and industry specific regulations. Moreover, CloudMade already works with most of the major Car OEMs (Vehicle Makers). Developing the competencies through this project participation, as well as developing the new solutions addressed in HEPTAS, will enable us to reach out to other OEMs, as well as, offer our existing customer base of OEMs with new solutions. CloudMade's sales and marketing team is already active in different geographies. We envisage the possibilities of disseminating the results from HEPTAS through our network in various conferences, forums, and networking events.

ITHACA is a research institution that has built strong competences in the field of acquisition, management, and elaboration of geographic and cartographic data and in providing services based on spatial data. Innovation actions planned within HEPTAS are considered crucial for positioning ITHACA among the provider of services to support the transition to self-driving cars: 3D maps will be crucial to ensuring safety during at least the early years of self-driving cars. By developing algorithms capable to compare reference 3D models with an environmental context produced by the car from its own sensors', ITHACA will be capable to provide services aimed to improve overall safety. Based on the same solutions, ITHACA will be able to keep reference 3D models regularly updated, serving not only the automotive sector but, more in general, all markets related to augmented reality.

SES, as the leading global satellite connectivity provider, is ideally positioned to provide solutions and services to transport and broadcast huge amount of data between sites wherever located. Satellite operators with large and powerful satellite constellation, like SES, have already incurred the investments of deploying those assets in Space and can activate the needed links without the need of large infrastructure adaption. To that extent, HPC enabled services for the automotive industry are of significant interest for SES and are synergistic with additional development currently on-going in the field of flat panel antennas; at that respect, SES is currently a minority investor in the ALCAN GmbH, a German flat panel antenna manufacturer with innovative LCD-based solutions, particularly relevant for the automotive industry and the large scale Big Data transfer. In perspective, starting 2021 SES will deploy a revolutionary High Throughput Satellite (HTS) system, O3b mPower, capable of deploying Terabits of capacity worldwide for fixed data, governmental and mobility applications and with built-in flexibility to create point-to-point or wide area networks with minimal setup efforts. The constellation will have 30,000 fully-shapeable and steerable beams that can be shifted and switched in real time to align with customers' quickly changing growth opportunities, making it the most bandwidth-efficient system ever. O3b mPOWER will provide unrivalled coverage to an area of nearly 400 million square kilometres, four fifths of the Earth's surface.

Through its involvement in this project, SES aims to strengthen its technological offer by demonstrating the integration of satellite connectivity into the next generation network, helping at the same time to scale network deployments through providing efficient multicast/broadcast resources for data delivery towards the network edges and directly to user equipment. SES satellites will be used as a fully integrated part of the network, and will be able to provide ubiquitous, reliable, and secure connectivity to vehicles and their environment, especially where the terrestrial network coverage is insufficient. Testing and validation of antennas and other related hardware will be also enabled by the participation in this test-bed. Moreover, the impact of the satellite's network latency in an HPC environment will be tested and assessed, allowing a better understanding of future technological needs for similar

applications. With the results obtained in this project, SES will be able to further drive innovation in its products and services roadmap, especially for fixed data, governmental and mobility applications, which represent high growth segments in the satellite sector.

CINECA and **INFN**, although they are no-profit research entities, Technology Transfer activities are in the core mission of both institutions, especially the SCAI (Super Computing Applications and Innovation) department at CINECA and in the TTLab (Technology Transfer Laboratory) in INFN. A range of 'commercial' added value services are at disposal of industries that can benefit from Cloud/HPC/HPDA, based on a long tradition of high-level quality of services, like:

- Access to the state-of-the-art systems most suitable for scientific and technical computing.
- Advanced and deep technical expertise.
- Co-development of customer-specific applications.
- Continuous support over the entire process or the project life-time in case of services not catalogued.
- Consulting in ICT and new technologies.

This kind of activities produced a number of success stories, mainly related to technology transfer actions being long-lasting collaborations with many Italian top industries and public administrations. Besides these collaborations, CINECA and INFN maintain great attention to technology transfer actions towards SMEs, these being the skeleton of the Italian and European production system. One of the main activities is the support for adoption of Data Storage and Analytics solutions in EU industry-related context, as from the HEPTAS project. The extremely CPU-demanding and/or data-intensive use cases will enable a full exploitation of the specific infrastructure and competence provided by CINECA and INFN. The impact from this Project for CINECA and INFN will be twofold:

- Being consultants of choice for the pilots' industries when the workflow will be implemented at a production-ready level, with related potential revenues;
- Profiting from the success story obtained with this Project to target SMEs in the European market, and especially in the smart mobility/smart cities industries, having Data Analytics needs.

FEV is an engineering partner and aims at continuously extend its know-how and capabilities in the new automotive and e-mobility technologies to exploit them in development projects with customers from the automotive and transport sector and **increase the market share** for its engineering solutions and tools. FEV is already strongly committed to expand its competences and skills in these new technologies and in Italy has recently signed a MOU "Turin City Lab for Autonomous Driving and Connected Vehicles" (March 30th 2018) between the City of Turin and 14 other partners among which also some of the Italian partners involved in HEPTAS project (FCA, FEV, 5T, TELECOM ITALIA) *promoting the realization of **a real world urban laboratory** with roads and technological infrastructures where to test autonomous and connected vehicles*. FEV participation in the HEPTAS project will enhance and strengthen cooperation with the other players and enable FEV to enlarge the spectrum of its customer and therefore impact to the overall turnover. FEV is active in many European interest groups like "**European Green Vehicle Initiative**", **"5G Automotive Association" (5GAA)**, **ERTRAC**, **EARPA, etc.** and will use all its channels to communicate and disseminate HEPTAS project results to **increase the visibility and impact** of the Project.

Valeo as one of the major Tier1 supplier for the automotive market, and in addition to working in a strong multi-national eco-system, Valeo is expecting 4 different types of exploitation from the results of the HEPTAS project:

- Define and develop the transformation of perception sensors: today sensors like cameras or laser scanners or ultrasonic sensors are mostly used for the perception of objects around the car. The processing of these data is performed by electronic control units in the vehicle. With the availability of reliable connectivity means with sufficient data flow capability, the sensor suppliers plan to use their sensors also to send data to the cloud platforms. New services and applications with a significant potential customer value will be performed using these aggregated data, to detect dynamic objects in a 3D HD Map for instance. HEPTAS will provide Valeo with the foundation to develop and experiment this new usage of perception sensors.

- Deep Learning has taken in the recent years a significant place in the R&D activities of Tier 1 suppliers. This is mainly due to the high performance increase provided by these techniques vs the other more deterministic algorithms used until then. These deep learning processes require massive amounts of data and processing power, reaching the limits of the most powerful processing stations or GPUs available on the market. Through its contribution to HEPTAS, Valeo intends to increase its knowledge and understanding of the benefits or drawbacks related to the usage of HPC for the Deep Learning process, so that sound business and investment decisions can be made to ramp up their development capabilities.

- Smart cities have recently significantly strengthened their position in the fight against city congestion and pollution. Connected and Automated Driving for Electric vehicles is frequently considered as the only sustainable mobility in the long term. But, in the meantime, Valeo sensors and Driving Assistance systems can provide a valuable benefit to the Smart City organizations dealing with traffic and pollution. For instance, Valeo Parking Systems can detect the available or occupied parking slots on the roadside, and provide a reliable input to the end user about the probability to find a parking space in an area. Valeo plans to use the developments made in HEPTAS to reinforce its relationships with the Smart City organizations, so that its sensors systems can provide maximum value to all citizens.
- HEPTAS provides a unique opportunity to test the new Telematic Control Units (TCU) which will equip all Connected and Automated Vehicles in the future. These TCUs will be tested in a real environment during the Pilot Tests, using WiFi 802.11p, and cellular 3G/4G/5G networks especially to verify latency performances, For the virtual vehicles simulated in HEPTAS, a simplified model of the TCU will be developed and tested on a large scale, which is also a strong tangible benefit obtained from HEPTAS.

Table 7: List of assets, management, and ownership for HEPTAS outcomes

Item	*Asset*	*Owner*	*IPR*	*Comm. channels*	*Path for exploitation*
#1	Automotive solution for predictive energy management	AVL	Patents, Confidentiality	Industrial congresses, direct customer network Demonstrations	B2B with OEM and Tier1 suppliers
#2	Enhanced automated driving functions	Valeo	NDAs, Patents	Demonstrators	B2B with OEM
#3	Predictive and proactive maintenance	FCA	NDAs, Patents	Dealer networks or through commercial public channels Demonstrators	B2C for automotive end users B2B with mobility providers
#4	Data life cycle management	Cloud Made	NDAs, Patents, Development Contracts,	Demonstrators	B2B with service providers
#5	e-horizon 5.0 dynamic 3D HD Map	FEV	NDAs, Patents, Licenses	Demonstrations	B2B with OEMs and Tier1 suppliers
#6	HPC platform and infrastructure and API for developers	INFN	NDAs, Patents, Licenses	Demonstration of technology, Development contracts	B2B with all stakeholders in eco-system
#7	Virtual vehicles, Traffic and Pollution models by simulation	EMISIA	NDAs, Patents, Licenses	Demonstration of technology	B2B with public transport authorities and B2G with smart city organizations
#8	4G/5G and satellite data pipelines	TIM SES	NDAs, Patents, Licenses	Demonstration of technology, Development contracts	B2B with all stakeholders in eco-system

2.2.2 Data management plan

The HEPTAS consortium is aware of the **transition towards a data-driven economy**. However, before such step can be envisaged, different technical (e.g., data volume, performance of the data management system) and non-technical aspects (e.g., data ownership, possible confidentiality and / or privacy issues) need to be carefully analysed. The analysis (and the respective plan) will clearly address issues such as: the specification of data types that the project generates and/or collects, the standards that will be used, the process of how this data will be collected, exploited, and/or shared/made accessible for verification and re-use, the data preservation and maintenance processes etc. Similarly, to knowledge management and IPR, we target the **development of a data management plan according to EC's guideline**[37] for the proper management of the data. Hence, this document shall describe all relevant information and attributes of the data to be managed, to support later monetization of the project outcomes.

[37] http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-data-management/data-management_en.htm

Geographic position is the piece of information allowing the interaction among the different components (static reference data, dynamic data, vehicle sensor data, etc.) A **spatial data infrastructure (SDI)** is a data infrastructure implementing a framework of geographic data, metadata, users, and tools that are interactively connected to use spatial data in an efficient and flexible way. The SDI implementation involves:

- an analysis of available reference GIS layers (transportation/mobility including traffic sensors and events, built-up areas, hydrography, etc.), with particular attention to authoritative and open ones
- an analysis of available mission traces, e.g. vehicle position, speed, brake pedal, accelerator pedal, etc.
- the generation of a geographic reference dataset (combining different sources, e.g. 3D data model developed within WP5, open geographic data, etc.)
- the provision of data access and analysis services to the different component of the project

Copernicus data and information from the different services accessible through Copernicus Data and Information Access Services[38] (DIAS) will be a building block of the HEPTAS data lake. ITHACA has a specific competence in developing SDI solutions.

Table 8 presents a preliminary overview of the data sets managed in HEPTAS. Note that a data management plan (DMP) is foreseen during project execution within WP2 (Task T2.1). This document will encompass a data summary, basically a refinement of Table 8, as well as an approach for FAIR data to finally make the data findable, accessible, interoperable, and re-usable.

Table 8: Description and quantification of data sets to be managed in the industrial pilot test-beds

Items	***Descriptions***
Information content & planned usage	Basic reference GIS datasets (different themes) 3D city model, traffic model, pollution model, predictive maintenance model Real-world vehicle sensors datacameras, laser scanners, messages extracted from CAN Bus, GPS coordinates, vehicle type and equipments, people on board Virtual vehicles: same as real world vehicle except dummy recordings for cameras and laser scanners
Volume / velocity / variety of data	Several hundreds of GB for reference GIS datasets and 3D city model 1 TB/day per vehicle of video streaming and recordings of laser scannings
Ownership	Basic reference GIS datasets is basically open 3D city model, real world car data, predictive maintenance models, traffic simulation models, pollution simulation models: co-owned by project task contributors
Data Lifecycle	3D city model, traffic model, pollution model, predictive maintenance model: continuously updated.
Confidentiality / privacy aspects	Face/plate masking needed if raw video streaming need to be shared
Data Sharing & Access Aspects	Limited to the partners defined in the relevant clauses in the consortium agreement
Quality and Reliability	3D city model geometric accuracy target can reach the 10 cm level for relative positioning of objects to vehicles, 30 cm for absolute positioning of objects relative to earth coordinates Overall performance targets of HEPTAS models vs Ground Truth: equal or better than 95% True Positive detection rate and less than 1% False Negative detection rate, with tolerance criteria defined case by case (criteria on latency for instance),
Regulatory Compliance	GDPR Compliance with National rules for the experimentation of modified vehicles, including Connected and Automated vehicles

2.2.3 Strategy for knowledge management and protection

Generally, knowledge will be and stay the property of the respective partner generating it. In the case of jointly generated knowledge, the property is shared as well, unless otherwise agreed upon. Before signing the Grant Agreement, the consortium will negotiate a Consortium Agreement to lay down the rules for knowledge management and protection. This Consortium Agreement will be based on the DESCA model for H2020[39].

Background knowledge (Intellectual property (IP) held before the project and brought into the project)

[38] Copernicus Data and Information Access Services (DIAS)
[39] http://www.desca-2020.eu/

This IP will be listed in the Annex to the Consortium Agreement. All other project partners can then (upon a written request) use this IP for free during the project (excluding the right to sub-license) if this is needed for project implementation. No partner has access to the IP unless it is listed, they requested access directly from the owner and it is needed for the project. After the project ends, if a party requires any IP to exploit their own project results, access rights to the IP shall be granted under "fair and reasonable" conditions. These conditions are to be agreed between the parties. Use for internal research (without publication or the involvement of any third party) is permitted for free.

Results (IP generated during the project)

The same rules as for background knowledge apply here: all other project partners can (upon written request) use this IP for free during the project (excluding the right to sub-license) if this is needed for project implementation. No partner has access to the IP unless it is listed, they request access directly from the owner and it is needed for the project. After the project ends, if a party requires any IP to exploit their own project results, access rights to the IP shall be granted under "fair and reasonable" conditions. These conditions are to be agreed between the parties. Use for internal research (without publication or the involvement of any third party) is permitted for free in any case.

Joint results (IP jointly generated with another project partner during the project)

If IP is generated jointly and the respective contribution of each beneficiary cannot be determined the respective partners jointly own the IP. The partners then should establish a joint-ownership agreement (on the allocation and terms of exercise of their joint ownership) within 6 months. Until this agreement is in effect, the following rules apply concerning the use of the IP:

- each of the joint owners shall be entitled to use their jointly owned results for non-commercial research activities on a royalty-free basis, without requiring the prior consent of the other joint owner(s), and
- each of the joint owners shall be entitled to otherwise exploit the jointly owned results and to grant non-exclusive licenses to third parties (without any right to sub-license), if the other joint owners are given:
    1) at least notice 45 calendar days in advance and
    2) fair and reasonable compensation.

2.2.4 Communication management and dissemination activities

HEPTAS consortium is fully aware that dissemination and exploitation are of crucial importance in EU research projects. All project partners will actively work on these activities from the beginning of the project activity. The developed dissemination and communication activities will operate on different science, application, and public levels. To maximize the impacts of the project, the HEPTAS consortium will develop and implement ambitious communication measures aiming at:

- Raising positive public awareness through the website and through campaigns directed at social media. This becomes all the more relevant towards the market introduction phase.
- Improving transfer of scientific/technical knowledge to industry and communities, OEMs, and other businesses as well as to regulatory organizations and policy makers involved in the automotive business.
- Reinforcing and demonstrating both technological and economic benefits of the developed and validated technologies for automotive applications, with special regards to durability, efficiency, and security.

Focus will be given to the content of communication strategies to produce targeted information and to convey clear, simple, and straightforward messages to ensure the result dissemination at local, national and EU levels. The draft-plan (Figure 16) describes the HEPTAS communication measures to be implemented during and after the project execution. Communication and dissemination will reach the full range of stakeholders and potential users, local, national and EU level authorities as well as deployment in research, commercial, investment and environment, tailored to the specific technical, market and organizational issues addressed in the project. All partners will be actively involved in the creation of an initial communication and Dissemination Plan released by month 6 and updated in month 18. WP8 is responsible for communication management and dissemination activities.

For the first year of the project the overall objective of dissemination will be to raise awareness on project aims and expected results within the automotive networks and public community as well as the automotive industry. This plan is set to be a living document and will be updated regularly considering the ongoing project results distributed via (i) scientific/industrial publications (see Table 11), technical presentations at conferences, dedicated presentations for the industry alongside in-house or industrial fairs and (ii) trainings and workshops. The latter activities will ensure the feedback from scientific and industrial experts, especially via the interaction with related EU-funded projects, consumers and application followers, the public as well as citizens and policy makers.

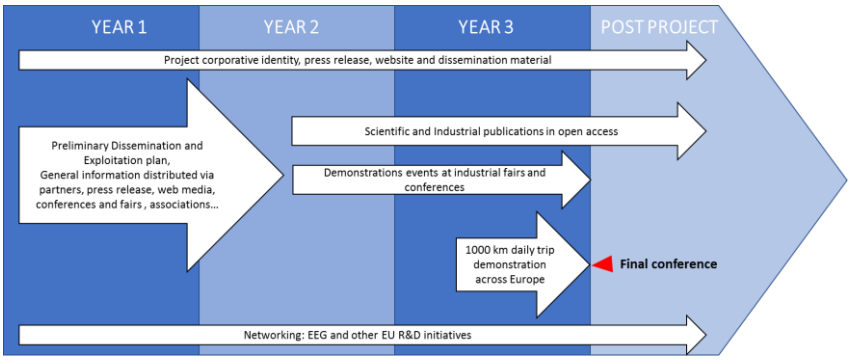


Figure 16: Draft plan of dissemination and communication activities

The following target groups have been identified as starting point for the HEPTAS work:

- **Scientific communities**: Especially communities focussing HPC, big data and automotive are targeted. Mostly the research partners will address these groups for communicating the main technical and scientific results.
- **Technology users**, like car manufacturers, Tier 1 suppliers, are addressed by the application and technology partners to communicate technical project outcomes.
- **Technology providers**, i.e. companies and institutions developing tools and methods for HPC and big data, are addressed by the application and technology partners to communicate technical project outcomes and to synchronize technologies related to the project.
- The **European Commission**, as the main stakeholder of the project and responsible for the set-up of R&D projects in line with the project call will be addressed to communicate the project status as well as the project impact on scientific communities and on the market.
- **R&D projects** related to HEPTAS, i.e. by similar targets, technologies, or interests, are necessarily targeted for a dedicated technical communication and synchronization on project results.
- The **public community** is addressed to communicate important project impacts on the public sector.

To address different target groups identified above, the following communication channels have been selected as starting point:

- **Project corporative image and dissemination material**: A logo will be designed, to be used for the communication activities. In addition, a publishable poster targeted to a non-specialist audience will be realised together with brochures that could be distributed by the partners when participating/attending events. Related e-newsletter will be distributed via the project public website subscribers and the partners' networks.
- **Web and media:** through the specific HEPTAS project website which contains all relevant information on the project and its findings. The project website and the project group are designed to direct the different stakeholders and target groups to information respectively entry points to access further detailed information. The project will also be disseminated through web articles, videos, other websites, and social medias.
- **Press releases** will be written during the project for public communication on main project outcomes having important impact on the society and/or dedicated communities.
- **Demonstrators** (related to WPs4, 5, 6, 7) show the project outcome on a technical, prototypical level. One professional video for each demonstrator will be produced as dissemination material.
- **Presentations** on the project and outcomes, with the content of the presentations varying on the selected target groups. Presentations are in any case applicable to reach any of the target groups.
- **Scientific papers** provide a detailed description of selected project outcomes – usually for a dedicated community. As defined by the Grant Agreement, the consortium will strive at least for "green access" for publications generated by the project members. Where appropriate, "gold access" will be aimed for. The authoring organisation will decide on the preferred model considering the budget reserved and possible organisational rules in place. An initial list of journals or conferences where the scientific papers are to be published can be seen in Table 11
- **Participation in standardization activities** (see Table 12) targeting the transfer of the main HEPTAS outcomes in the relevant future standards and roadmaps.
- **Participation in open research data pilot** and provision of domain-specific application data

Table 9: Mapping of target groups versus communication channels

<table>
<tr><th>Channel / Group</th><th>Web/ Media/ Press</th><th>Publication</th><th>Presentation</th><th>Public report</th><th>Demon-strator</th><th>Standard-ization activities</th><th>Open research data pilot</th></tr>
<tr><td>Scientific Community</td><td colspan="4">Public descriptions of selected project outcomes to enter detailed technical dialogue</td><td>Illustration of concepts applied to use cases</td><td rowspan="5">Disseminat ion and sustain-ability of most relevant HEPTAS outcomes</td><td rowspan="5">Relevant application data (domain specific)</td></tr>
<tr><td>Technology users</td><td colspan="3" rowspan="3">Raising awareness on the project to enter dialogue</td><td colspan="2">Highlight the impact and end user benefit generated by project findings</td></tr>
<tr><td>Technology providers</td><td colspan="2">Show the market potential for solutions adopting the HEPTAS approach</td></tr>
<tr><td>Related R&D projects</td><td colspan="2">Support synchronization of activities and exchange know-how, avoid duplication of efforts</td></tr>
<tr><td>European Commission</td><td colspan="3" rowspan="2">Providing public communication and videos on main project outcome(s) and their impact</td><td colspan="2">Increase visibility of project</td><td>Illustration of concepts applied to use cases</td></tr>
<tr><td>Public community</td><td>Increase visibility of project</td><td></td><td></td><td></td><td></td></tr>
</table>

To ensure that the project meets the dissemination target and to be able to measure the dissemination results, Table 10 provides an overview of measurable quantifications of the dissemination targets.

Table 10: Quantification of dissemination targets

Press Release	*Fairs and conferences*	*Public Deliverable*	*Industrial test-bed*	*Publications*	*Videos*	*Participation to EU associations, clusters, communities*	*Other EU projects for networking*
4	25	14 (45%)	4	20	4	14	20

Table 11: Individual initial dissemination plans per partner

Partner name	*Title and description*	*Audience*			
		Industry	*Academia*	*Policy makers*	*General public*
AVL	Transport and Research Arena (http://www.traconference.eu/) Europe's biggest Transport Research Conference	X	X	X	X
All partners	IEEE conferences (https://m.ieee.org), leading IEEE conferences: Industrial Electronics Society, Intelligent Vehicle Symposium (IV), Intelligent Transportation Systems (ITSC)	X	X	X	
AVL	ERTS (https://www.erts2018.org/index.html) Embedded Real-Time Systems and Software	X	X	X	
AVL	AMAA (https://www.amaa.de/), International Forum on Advanced Microsystems for Automotive Applications (Germany, Berlin)	X	X	X	
CIN, INFN, BSC	Super Computing conference (SC), largest HPC event in the world (USA), and its European counterpart International Supercomputing Conference (ISC) (Germany, Frankfurt)	X	X		
Valeo	Intelligent Transport Systems (ITS) congresses	X	X	X	X
Valeo	Consumer Electronics Show (CES) in Las Vegas	X		X	X

Valeo	Auto Shows in Frankfurt, Paris, Detroit, Shanghai	X		X	X

Besides the activities planned on conference/event level shown in Table 11, the project participants will actively interact with different communities and associations where the partners are already part, see Table 12

Table 12: Impact on the community and on standardization activities

Name of network	***Description***
CLEPA European Association of Automotive suppliers (https://clepa.eu)	Industrial Association - European automotive suppliers. Roberto Vavassori from Brembo is the current President.
EARPA (https://www.earpa.eu)	Automotive Association - Founded in 2002, EARPA is the association of automotive R&D organisations. It brings together the most prominent independent R&D providers in the automotive sector throughout Europe
EUCAR European council for automotive R&D (http://www.eucar.be)	Automotive association - EUCAR is the European Council for Automotive R&D of the major European passenger car and commercial vehicle manufacturers
EGVIA European Green Vehicle Initiative (https://www.egvi.eu) ERTRAC European Road Transport Research Advisory Council	The EGVI and ERTRAC PPP aim at accelerating research, development and demonstration of technologies allowing the efficient use of clean energies in road transport, as well as connected and automated driving
ECSEL Electronic Components and Systems for European Leadership (https://www.ecsel.eu)	ECSEL Joint Undertaking is a EU-driven, public-private partnership, empowering innovation in electronic components and systems
ARTEMIS Advanced Research & Technology for Embedded Intelligent Systems (https://artemis-ia.eu)	Industry Association - ARTEMIS is an Industry Association is a membership organisation with more than 180 members and associates from all over Europe.
International Standard Organization (ISO), European Telecommunications Standards Institute (ETSI)	International organizations working on standards strongly related among others to Connected and Automated Driving
Verband der Automobilindustrie (VDA) and Plateforme Filiere Automobile (PFA)	National association of Automotive Industries in Germany and France. Define positions for the national representatives to UNECE new regulations (for instance new R79 ACSF homologation) and new legislations (articles of the Vienna Convention for road safety).

Moreover, with the goal to deliver true impact to issues that matter in Europe, HEPTAS will seek to establish a close and continuous link, and actively nurture the European Commission with thorough advice on **the potential of HPC to support urban mobility strategies and policy recommendations**, e.g. by providing input to the different directives, policy initiatives and other stakeholder fora as compiled in the 'Mobility and Transport' section of the European Commission[40]. Good balance between this European approach and meeting local goals and policy initiatives will be sought by HEPTAS.

In HEPTAS training is envisaged, through different forms and activities, as that given by and for personnel working in the project. Different training approaches will be adopted at various levels, such as: i) research and HPC partners (like CINECA, INFN will organise at least two technical workshops to facilitate the transfer of knowledge and technology transfer at later stages; ii) Periodic technical meetings will be also an opportunity of training, cross-fertilization and for deepening the understanding of HEPTAS related topics.

[40] https://ec.europa.eu/transport/transport-categories/urban_bg?page=4

3. Implementation

3.1 Work plan — Work packages, deliverables

HEPTAS project implementation is directly mapped to the main project's objectives, see Figure 17. The work package and management structure are designed to ensure effective delivery and integration. WP1 governs the overall management of the project. WP2 addresses the data governance over the four industrial test-beds. WP3 is related to HPC core technology (e.g., infrastructure, services), while WP4 to WP7 targets the development of the four industrial test-beds. WP8 addresses the communication management and dissemination of the project outcomes. Finally, WP9 targets innovation management and impact assessment. Figure 18 shows the timing of work packages and tasks with the milestones planned, and Table 13 provides a list of the work-packages. Figure 19 provides a Pert Chart for the HEPTAS project. This chart describes the dependencies between the work-packages and between the deliverables, in the context of the five milestones (see Table 24).

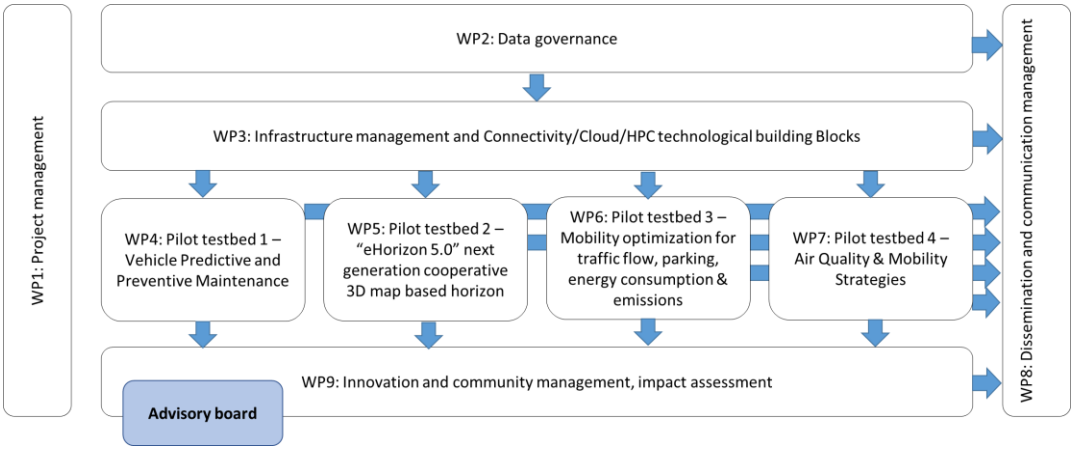


Figure 17: HEPTAS project structure

Table 13: List of Work Packages[41]

WP No	Work Package Title	Lead Part. No	Lead Part. Short Name	Person-Months	Start Month	End month
1	Project Management	1	VAL-F	81	1	36
2	Data governance	13	CM	165	1	36
3	Infrastructure management and Connectivity/ Cloud/HPC technological building Blocks	17	INFN	156	1	36
4	Pilot test-bed 1 – Vehicle Predictive and Preventive Maintenance	3	FCA	119	1	36
5	Pilot test-bed 2 – "eHorizon 5.0" next generation cooperative 3D map based horizon	5	AVL	417	1	36
6	Pilot test-bed 3 – Mobility optimization for traffic flow, parking, energy consumption & emissions	6	FEV	318	1	36
7	Pilot test-bed 4 – Air Quality & Mobility Strategies	14	FAC	223	1	36
8	Dissemination and communication management	16	CIN	148,5	1	36
9	Innovation and community management, impact assessment	5	AVL	82,5	1	36
			Total months	1710		

[41] If your action taking part in the Pilot on Open Research Data, you must include a data management plan as a distinct deliverable within the first 6 months of the project. This deliverable will evolve during the lifetime of the project in order to present the status of the project's reflections on data management. A template for such a plan is available on the Participant Portal (Guide on Data Management).

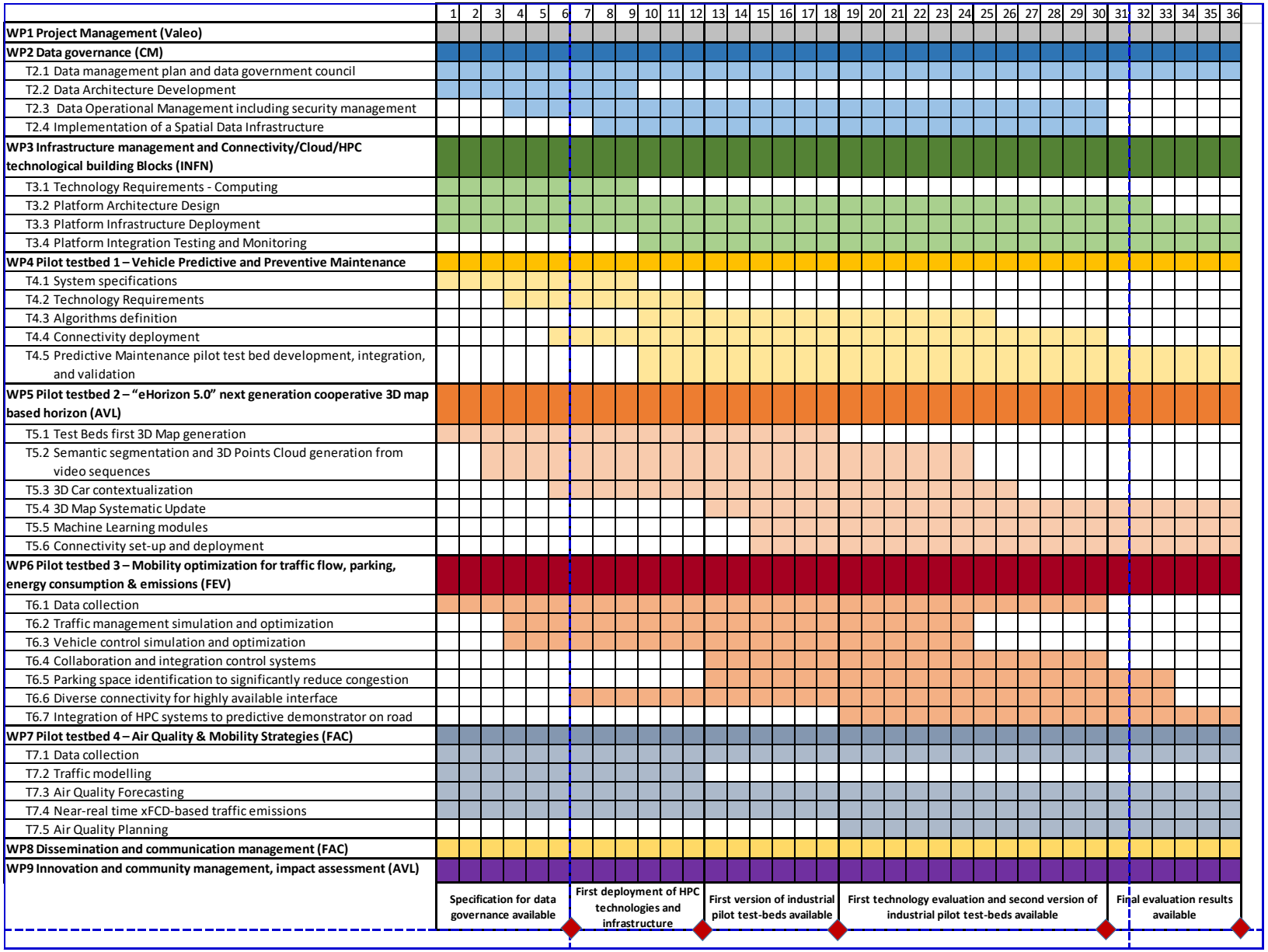


Figure 18: HEPTAS Project timeline

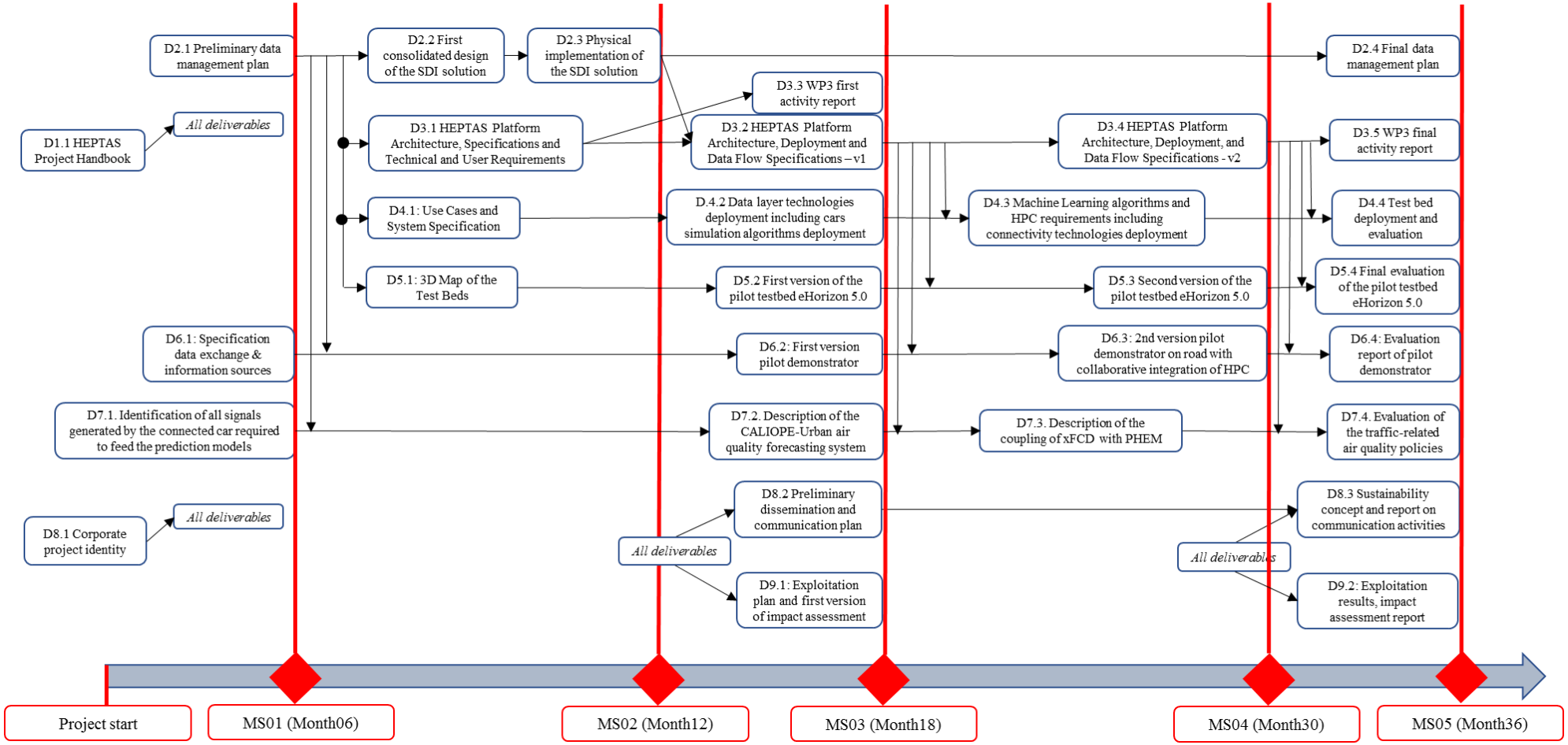


Figure 19: HEPTAS Pert Chart

Table 14: WP1 description

Work package number 1	**Lead beneficiary**								VAL-F		
Work package title	Project Management										
Participant number	1	2	3	4	5	6	7	8	9	10	11
Short name of participant	VAL-F	VAL-G	FCA	SEAT	AVL	FEV	SES	5T	TIM	EMI	GEO
Person/months per participant:	26	2	2	2	18	6	1	3	2	1	1
Participant number	12	13	14	15	16	17	18	19	20		
Short name of participant	MAP	CM	FAC	BSC	CIN	INFN	ITH	CRF	UPC		
Person/months per participant:	1	0	0	1	1	2	9	3	0		
Start month	1					End		36			

Objectives

The objective of this WP is to ensure that the project is delivered on time, according to the budget and to ensure that the overall project objectives are met. This includes technical project coordination, management of financial aspects, especially the project funding, legal issues and IPR management.

This work package will address the following aspects:

- Coordination of the technical activities of the project and linking together all project components.
- The overall legal, contractual, ethical, financial, and administrative management.
- Maintaining communication with European Commission & partners ensuring progress is reported effectively.
- Coordination of knowledge management & innovative activities regarding dissemination & exploitation.
- Establishing & maintaining conflict resolution procedures & management of strategic orientation of the project.

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

Task 1.1: Project Coordination (Lead: VAL-F, Participants: all)

The aim of the project management set up is to ensure **compliance of all project activities with the objectives set out in the Grant Agreement, the Consortium Agreement, and the relevant annexes**. To achieve this objective, the project management structure will maintain a continuous flow of communication and information to and between all partners and the European Commission. The project management is divided into 2 levels: **1) technical coordination** and **2) administrative project management**. The technical coordinator focuses on the technical execution of the work ensuring effective project planning, risk management and information flow within the consortium and alignment between work packages. The technical coordinator is supported by an administrative project leader on the aspects of financial, legal, and administrative project management. The technical coordinator and the administrative project leader (the project management team) will jointly work on managing the consortium, ensuring a smooth progress of the whole project, keeping track of the progress, costs, and budget situation, and providing the necessary reports to EC. All partners will report the necessary information to the project management team by means of **regular reporting and updates** (see Section 3.2). A defined communication cadence and decision-making structure will govern the consortium and is outlined in Section 3.

The project coordination also includes continuous assessment and monitoring of the project execution in **comparison to metrics set to achieve the project objectives**. This activity provides the basis for strategic decision-making in the Project Steering Board and ensures compliance of all project activities to the project objectives and gives indications for the exploitation of results.

Task 1.2: Project Steering Board (Lead: VAL-F, Participants: all)

The Project Steering Board is **composed of one senior partner representative per partner organisation**. The Project Steering Board will be **chaired by the technical project coordinator**, its responsibilities include:

- Decisions on the **strategic orientation** of the project.
- Highest **decision-making body for topics not finding a resolution** in the WP Leader Board.
- Coordination of **risk management** (risk monitoring, final decision making), see Section 3.2.
- **Quality Management** (release of deliverables), see Section 3.2.

The Project Steering Board will meet on a regular basis **twice a year in a face-to-face meeting** with additional electronic meetings (WEBEX, Videoconferences) as requested during the project execution.

Task 1.3: Work Package Leader Board (Lead: VAL-F, Participants: all work package leaders)

The work package leader board consists of **all seven work package leaders and is chaired by the technical coordinator**. It is the 1st level decision-making body. It is within the WP Leader Board's responsibility to:

- Ensure and monitor proper **cross-WP cooperation** including timing of deliverables and risk monitoring.
- Decide **technical matters** that affect more than one WP.
- Assure **quality of deliverables** by reviewing deliverables and project results.
- **Report to the Project Steering Board** on continuous basis.
- **Escalate to the Project Steering Board** when considered as necessary.

Each WP Leader will be responsible for the delivery of their respective work package and communication with partners inside the WP to ensure and monitor execution of tasks according to time and resource plan. Any **deviations and risks will be identified** inside the WP Leader Board and mitigation plans implemented.

Task 1.4: Continuous Risk management (Lead: AVL, Participants: all)

To identify and minimise project risks, thus ensuring a smooth project execution, a continuous process for risk management will be established, **tracking possible project risks throughout the whole project**. Within this process, **risks will be clearly identified and assessed, and the respective contingency plans will be available**.

The initial **risk register** identified in this bid will be regularly updated and monitored by the technical project coordinator in cooperation with all work package leaders.

Deliverables (brief description and month of delivery)

D1.1: HEPTAS Project Handbook (M2, CO) [AVL]

The HEPTAS project handbook will be the guidebook for all partners. It will clearly outline the management processes to be followed in the project, and include timelines for requests (e.g., for dissemination requests) and reporting information.

The midterm & final reports are conducted via specific SyGMa sessions & are thus not listed as WP1 deliverables.

Table 15: WP2 description

Work package number 2	**Lead beneficiary**								CM		
Work package title	Data governance										
Participant number	1	2	3	4	5	6	7	8	9	10	11
Short name of participant	VAL-F	VAL-G	FCA	SEAT	AVL	FEV	SES	5T	TIM	EMI	GEO
Person/months per participant:	0	12	24	2	16	8	1	3	0	4	0
Participant number	12	13	14	15	16	17	18	19	20		
Short name of participant	MAP	CM	FAC	BSC	CIN	INFN	ITH	CRF	UPC		
Person/months per participant:	3	36	8	6	3	8	25	6	0		
Start month	1					End	36				

Objectives

The objective of this work package is to ensure that there is a robust governing body, a set of policies and a pre-defined set of processes for addressing all the aspects related to data management. This WP would achieve the following goals:

- Enable better co-ordination and decision making among the data stakeholders
- Build a set of standard and repeatable processes for data management
- Build a robust Data Architecture that, along with addressing the project needs, also addresses the aspects of scalability, reliability, and availability
- Derive a set of processes and tools for data protection and enable the overall system to be regulatory compliant

Train all the project stakeholders in data handling and to adopt common approaches to data issues

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

T2.1 Data management plan and data government council (Lead: CM, Participants: all)
The target of this task is the setup and the maintenance of a **data management plan (DMP).** This document shall encompass a **data summary** as well as an **approach for FAIR[42] data**; to ultimately make the data searchable, accessible, interoperable, and re-usable in the context of industrial confidentiality as discussed in Section 2.2.2. The required resources for making data FAIR are foreseen in WP3, WP4 and WP5 to provide the overall framework for the respective use-cases, while WP6 aims to apply the framework and generate the data.
Data Governance Council will be a decision making, monitoring and enforcement body that has the authority over data management. **The task leader to T2.2 will be made responsible for data Governance** in the project, who will serve as an advisor to the Project Steering Board and the work package leaders in matters of data management and FAIR data.

Satellite connectivity data governance connectivity is the identification and generation of adequate references of data resources for later transmissions between all stakeholders involved. It includes the definition of what and how data will be transferred between different elements of the architecture. A dedicated SatCom expert will oversee the management, implementation, and maintenance of the satellite connectivity data governance, which should be in accordance with data security and data operational management. Results will be a specific section in the data management plan.

T2.2 Data Architecture Development (Lead: CM, Participants: all)
Data Architecture will be composed of models, policies, rules that govern which data is collected, how it is stored, processed and put to use in the overall system. As an artefact, Data Architecture will be a part of the Data Management Plan. **A dedicated Data Architect** will be responsible for deriving the Data Architecture and maintaining this architecture over the complete lifecycle of the project. The data architecture is prone to changes as the data sources, mechanism of data collection and aggregation, project requirements, etc change. So, it is important that a data architecture is adopted and evolved to suit project needs and ensure an efficient data operation.

T2.3 Data Operational Management including security management (Lead: CM, Participants: all)
Data operations management is the development, maintenance, and support of the data to maximize the value of the data resources to the data stakeholders. It involves deriving and implementing the necessary distributed data architecture that will support a wide range of tools and frameworks in test beds and in production environments. **A dedicated DevOps expert** will oversee the management, implementation, and maintenance of the Data Operational management. This will produce an artefact which will be a specific section or appendix in the data management plan. Data operational management must be maintained over the complete lifecycle of the project.

Data Security Management will oversee the aspects of Data Protection, Privacy handling and Regulatory compliance. This will produce an artefact, which will also be a specific section or an appendix in the Data Management Plan. **A dedicated Data Security expert** will oversee the management, implementation, and maintenance of Data security management. The artefact will address the necessary architecture for data security and will define the set of policies to be followed for achieving regulatory compliance. As the landscape of data handling evolves and as new regional regulations become effective (e.g. GDPR), it is important that the data security architecture is regularly monitored and maintained.

T2.4 Implementation of a Spatial Data Infrastructure (Lead: ITHACA, Participants: all)

Geographic position is the piece of information allowing the interaction among the different components (static reference data, dynamic data, vehicle sensor data, etc.) A **spatial data infrastructure (SDI)** is a data infrastructure implementing a framework of geographic data, metadata, users, and tools that are interactively connected to use spatial data in an efficient and flexible way. The SDI implementation involves the development of tools to generate a geographic reference dataset physically or virtually (combining different sources e.g. 3D data model developed within WP5, open geographic data) to expose data access services to the different components of the project responsible to develop analytical modules requiring access to positional data (WPs 4 to 7), adopting standards/respecting requirements set in WP3.

Deliverables (brief description and month of delivery)

[42] http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-data-management/data-management_en.htm

D2.1 Preliminary data management plan (M6, CO) [CM]: This deliverable creates an initial version of the DMP for the approach for FAIR data and for the measures ensuring to preserve privacy and confidentiality for all data acquired for the project.

D2.2 First consolidated design of the SDI solution (M9, PU) [ITH] Schematic design of all the components of the SDI solution and definition of the standards/requirements for the data access services

D2.3 Physical implementation of the SDI solution (M12, PU) [ITH] Schematic design of all the components of the SDI solution and definition of the standards/requirements for the data access services

D2.4 Final data management plan (M36, PU) [CM] Final version of the DMP according to the outcomes of the project

Table 16: WP3 description

Work package number 3	**Lead beneficiary**								IFNF		
Work package title	Infrastructure management and Connectivity/Cloud/HPC technological building Blocks										
Participant number	1	2	3	4	5	6	7	8	9	10	11
Short name of participant	VAL-F	VAL-G	FCA	SEAT	AVL	FEV	SES	5T	TIM	EMI	GEO
Person/months per participant:	0	6	24	1	0	3	1	2	5	4	0
Participant number	12	13	14	15	16	17	18	19	20		
Short name of participant	MAP	CM	FAC	BSC	CIN	INFN	ITH	CRF	UPC		
Person/months per participant:	0	0	8	8	32	58	4	0	0		
Start month	1					End	36				

Objectives:

- Identify Use Case requirements and technological building blocks in order to produce a high-level description of the HEPTAS platform.
- Develop and deploy the platform infrastructure to host the use case industrial test-beds.

T3.1-Technology Requirements - Leader: CIN, Participants: **SES, TIM, INFN, BSC, pilot partners**
This task includes two aspects: Computing, (CIN) and infrastructure connectivity (terrestrial: TIM, satellite: SES).
Computing: T3.1 will collect from Use Cases and from WP2 the technical requirements for the HEPTAS platform computing components downstream of the V2X (G4/5, WiFi or satellite) communication. It will then identify a set of components to be integrated, identifying their interfaces, APIs, data schemas and operational requirements. Furthermore, requirements will be collected to define an Open API to enable exploitation access to project's data. T3.1 will receive input from WP2 for the data collection, storage, and management requirements, and from WP4 through WP8 for the computational requirements of each Use Case, identifying the technical constraints and specifications of the platform to be designed. Also, requirements will be collected to define an Open API to allow access to the project's data from outside of the project to allow commercial exploitation of the assets by WP9.
Infrastructure connectivity**:** T.3.1 will collect from Use Cases and from WP2 the technical requirements for the end-to-end connectivity between the data lake(s) and the HPC platform(s). For the mobile HPC infrastructure connectivity, identify a set of components to be integrated, identifying their interfaces, APIs, data schemas and operational requirements with respect to the terrestrial network aspects. For the satellite HPC infrastructure connectivity, this task will, based on the end-to-end requirements in T.3.2, identify a set of components to be integrated, identifying their interfaces, APIs, data schemas and operational requirements with respect to the satellite network aspects. Furthermore, requirements will be collected to define an Open API to enable exploitation access to project's data.

T3.2-Platform Architecture Design [M1-M32] Leader: INFN (Platform Architect) Participants: CIN, BSC (Computing components), SES (Satellite Connectivity), TIM (Mobile Connectivity)
T3.2 is responsible for drafting the conceptual architecture and detailed specifications of the integrated Connectivity/Cloud/HPC HEPTAS platform. The task, after translating the technical requirements and the user stories into specific features and defining the modular components of the platform, will describe thoroughly the

tools, the interfaces, and components as well as the integration logic behind the complete architecture, to produce the needed input for T3.4. Scalability and interoperability of the system, essential for a big data platform, will be achieved by designing the infrastructure for extensibility while preserving a considerable degree of implementation platform-independence. In particular this task provides:

- Authentication and Authorization services for single sign-on on the entire infrastructure, compliant with the already available authentication technologies (e.g., OAuth, SAML, OpenID-Connect). Roles, groups, and access control lists will guarantee data privacy. Users will use their own local credential to access the entire infrastructure (or the resources where they will be authorized);
- computing resource interoperability, orchestration, and complex workflow creation tools
- transparent and unified data/storage access across the various stakeholders of the infrastructure with an easy integration of multiple data sources;
- based on the end-to-end requirements in T.3.1, identify a set of components to be integrated, identifying their interfaces, APIs, data schemas and operational requirements with respect to the terrestrial and satellite network aspects
- define Open API to enable exploitation access to project's data
- If needed, high level application portals and mobile applications to guarantee easy access to resources and services.

Extreme care will be taken to reuse as much as possible existing open source solutions not only for optimizing effort consumption but also for increasing the impact of the approach by bringing close various development communities and maximizing interoperability with third party systems. Whenever possible, production-quality services aimed to manage HPC and Cloud resources at the PaaS level and data management services for distributed resources, on which the partners participating in this task have extensive experience, will be integrated in the HEPTAS architecture. Most of the needed tools are already available and production ready; development should be limited to the implementation of missing functionalities in existing components, or be residual. As an example, several tools that leverages existing open source solutions developed in the context of the INDIGO-DataCloud, eXtreme-DataCloud (XDC) and DEEP Hybrid-DataCloud will be adopted to facilitate the interoperability between heterogeneous Cloud, HTC, HPC and storage resources.

T3.3-Platform Infrastructure Deployment [M1-M36] Leader: INFN (Platform deployment coordination) Participants: INFN, CIN, BSC, TIM (mobile connectivity), SES (Satellite connectivity)

T3.3 will deal with the deployment and management of the main infrastructure of the platform. Furthermore, T3.3 will be responsible for the development of any missing functionalities that will be deemed necessary and described by T3.2. In this task, the consortium partners will set up the tools to manage the different data streams from vehicles and infrastructures identified by WP2 to the relevant staging areas and storage facilities, work on the data management components and on all the components that will manage the shipment of the relevant workflows to HPC or Cloud facilities, including the APIs and interfaces required to access secondary data. The final platform will integrate all the components needed by WPs 4 through 8 to deploy the Industrial Test-beds, including monitoring tools. Since the project aims to develop a sustainable platform that can be exploited by being further deployed on commercial Cloud and HPC facilities, and be both vertically and horizontally scalable, any components designed and implemented throughout the platform will be built as independent modules by adapting existing software solutions developed in the context of the already mentioned EU projects. Good development and management practices, such as Agile Development and DevOps, will be adopted to ensure software quality and adherence to requirements; in this task, the various APIs defined in T3.1 will be evaluated and refined in case this is necessary by providing feedback back to T3.1.

T3.4-Platform Integration Testing and Monitoring [M9-M36] Leader: CIN Participants: INFN, SES (satellite connectivity), BSC (Technical testing and monitoring leader), TIM (mobile connectivity)

T3.4 will support all software development activities and will manage a software verification and testing framework to be used on all software outputs and to check software integrity. An integration plan will be prepared to guide the integration of the developed infrastructure with the various services and components. Moreover, a development test-bed will be defined and implemented using resources already contributed by the partners participating to the Project. The components of the platform will be covered by functional and integrated tests where possible. Execution of both automated and manual test will be performed on a regular basis synchronized with release schedules. The deployed software integration and testing platform will be made available also to WPs 3 through 8 to support their development activities, if needed. As a second activity, the Task will be responsible for the monitoring of the deployed infrastructure, operating the monitoring tools deployed by task 3.3. A uniform monitoring of resources usage is essential to ensure both a monitoring and metering of the whole platform and related services. To this purpose, a scalable, federation-ready, and multi-monitoring infrastructure system must be

implemented between all the service layers, exposing consumption metrics which can be used both for resource usage supervision and for interfacing to existing billing systems. Finally, this task will also work towards ensuring the future deploy-ability of the final solution on commercial infrastructures for further industrial exploitation, in connection with WP9.

Deliverables:

D3.1-HEPTAS Platform Architecture, Specifications and Technical and User Requirements-v1.00 (M8, CO) [CIN] Produced by T3.1-T3.2. A first version of the system architecture, including technical and user requirements.

D3.2-HEPTAS Platform Architecture, Deployment, and Data Flow Specifications-v1.00 (M18, CO) [INFN] Produced by T3.1-T3.2. A first deployment of the architecture to be adopted and used by the industrial test-beds.

D3.3 – WP3 first activity report (M18, PU) [CIN] Produced with the contribution from all tasks, will provide a summary of the WP related activities in the period M1 – M18, including best practices and lessons learnt on infrastructure deployment and testing.

D3.4-HEPTAS Platform Architecture, Deployment, and Data Flow Specifications-v2.00 (M30, CO) [INFN] Produced by T3.1-T3.4. Incremental updated of designs and specifications, based on the feedback received by the project's development and industrial test-bed activities.

D3.5 – WP3 final activity report (M36, PU) [INFN] Produced with the contribution from all tasks, will provide a summary of the WP related activities in the period M19 – M36, including best practices and lessons learnt on infrastructure deployment and testing.

Table 17: Work package 4 description

Work package number 4	**Lead beneficiary**								FCA		
Work package title	Pilot test-bed 1 – Vehicle Predictive and Preventive Maintenance										
Participant number	1	2	3	4	5	6	7	8	9	10	11
Short name of participant	VAL-F	VAL-G	FCA	SEAT	AVL	FEV	SES	5T	TIM	EMI	GEO
Person/months per participant:	21	0	45	0	0	8	3	2	0	0	0
Participant number	12	13	14	15	16	17	18	19	20		
Short name of participant	MAP	CM	FAC	BSC	CIN	INFN	ITH	CRF	UPC		
Person/months per participant:	0	12	0	0	0	0	4	24	0		
Start month	1					End	36				

Objectives: to develop and deploy the pilot for automotive predictive maintenance

- Use case analysis and system specifications
- Data management models and technologies
- Machine learning algorithms analysis and validation
- Deployment of Predictive Maintenance pilot test bed

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

T4.1 System specifications (Lead: FCA, Participants: all)
In this task the system and components detailed specifications will be defined, starting from the detailed analysis of Use Cases included in the pilot test bed. Both Predictive Maintenance and possible future related business opportunities based on data monetization will be considered.

T4.2 Technology Requirements (Lead: FCA, Participants: all)
Data management and generation: In this subtask the requirements, accordingly with WP2 activities and results, and the needs of task 4.1, the data models and lifecycle will be defined and technologies designed and deployed. Procedures to collect, store and elaborate developed.

Cars simulators (FEV): In this subtask cars simulators methodologies are defined. Simulators are then developed to be deployed on HPC infrastructure.

T.4.3 Algorithms definition (Lead: FCA, Participant CRF, FEV, CM, ITH)

The development of the Architecture, the implementation, and the continuous maintenance of the specific set of modules that implement the Machine Learning algorithms for Predictive Maintenance will be handled in this task. The implementation will involve two high level components – one for continuous learning and the second for real-time predictions using the models derived from the learned data. Specific artefacts will involve the architecture documents and the implementation. HPC design and performance requirement is an artefact of this task.

T4.4 Connectivity deployment (**Lead: SES, Participants: TIM**)

T.4.4.1 Mobile Pilot Test-bed 1 Connectivity (Lead: TIM): 4G and 5G connectivity depending on Latency and bandwidth requirement will be provided in Turin for Pilot 1.

T.4.4.2 Satellite Pilot Test-bed 1 Connectivity (Lead: SES)

This task is split into two main subtasks: i) definition; ii) deployment and validation

i) Definition

This subtask covers the definition and specification of the optimal solution with respect to the management, implementation, operation, and maintenance of the satellite connectivity aspects of the end-to-end connectivity requirements as established in T.4.x.

ii) Deployment and validation

This subtask encompasses the support of the practical implementation of the satellite part of the network. For connecting, via satellite, certain sensors, and actuators relevant for Test-bed 1, SES will deploy and operate a satellite network consisting of up to 5 VSAT satellite terminals each connected to an aggregator of such sensors and actuators. These terminals will share a satellite link with a maximum aggregate inbound (VSAT to gateway) throughput of approximately 0.5 Mbps and a maximum aggregate outbound (gateway to VSAT) throughput of approximately 10.0 Mbps. These satellite communications capabilities will be made available for a total of maximum 12 months over the project duration.

T4.5. Predictive Maintenance pilot test bed development, integration, and validation (Lead: FCA, Participants: all)

In this task, the developed components are integrated and validated for pilot test bed and deployment.

Deliverables (brief description and month of delivery)

D4.1 Use Cases and System Specification (M9, PU) [FCA] This deliverable summarizes the outcomes of T4.1

D.4.2 Data layer technologies deployment including cars simulation algorithms deployment (M18, CO) [FEV] This deliverable summarizes the outcomes of T4.2

D4.3 Machine Learning algorithms and HPC requirements including connectivity technologies deployment (M24, CO) [FCA] This deliverable summarizes the outcomes of T4.3

D4.4 Test bed deployment and evaluation (M36, PU) [FCA] This deliverable summarizes the outcomes of T4.4 and T4.5

Table 18: Work package 5 description

Work package number 5	**Lead beneficiary**								AVL		
Work package title	Pilot test-bed 2 – “eHorizon 5.0” next generation cooperative 3D map based horizon										
Participant number	1	2	3	4	5	6	7	8	9	10	11
Short name of participant	VAL-F	VAL-G	FCA	SEAT	AVL	FEV	SES	5T	TIM	EMI	GEO
Person/months per participant:	0	43	54	0	42	12	3	20	20	0	70
Participant number	12	13	14	15	16	17	18	19	20		
Short name of participant	MAP	CM	FAC	BSC	CIN	INFN	ITH	CRF	UPC		
Person/months per participant:	60	12	0	0	0	0	24	26	0		

Start month	1	End	36

Objectives
The objective of Work Package 5 is to improve the car positioning up to a centimetric accuracy level enabling AD L3+ and parking finding service.
Work package execution will be articulated in six main tasks:

- provide a high resolution (cm level) 3D map of the Test Bed
- implement algorithms for low-latency computation of 3D Point Clouds
- implementation of the data fusion algorithms between 3D map and 3D Point Cloud
- definition and implementation of a systematic update process of the 3D map

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

T5.1 Test-beds first 3D Map generation (Lead: GEO, Participants: ITH, MAP)
This task is devoted to the generation of the first 3D map of each Test Bed areas. It will be comprised of: (i) collection high resolution air and ground data (photos and laser scans), (ii) pre-processing and precise geo-referencing of collected data, and (iii) high-definition 3D reality modelling of Test Bed areas. The pre-processing and 3D reality modelling stages will involve most advanced algorithms combining data fusion, pattern recognition, computational geometry, and machine learning to generate a high-fidelity 3D map of complex urban environments with unprecedented spatial precision and level of detail.

T5.2 Semantic segmentation and 3D Points Cloud generation from video sequences and lidar sensor data (Lead: MAP, Participants: GEO, ITH, INFN, VAL-G, AVL)
This task is focused on the core technology needed to perform semantic point cloud generation and correlation analysis with high definition 3D reference maps. Specific algorithms will be adapted and implemented to run with low-latency using vehicle video streams generated by on-board cameras. The resulting 3D Point Clouds will be used for car contextualization. To support the reconstruction of 3D point clouds based on video data there will be also lidar sensor data used. The proper execution approach will be also defined by the output of this task: local, cloud-based or hybrid.

T5.3 3D Car contextualization (Lead: FEV, Participants: VAL-G, FCA, GEO, CM, ITH, MAP, AVL)
This task will focus on correlation between the 3D Points Clouds (derived from vehicle-based sensors) and the high definition 3D reference maps needed to generate more precise car localization and better driveway situation awareness, as compared to the (GPS + IMU based) current solution. A special attention will be paid to achieving low-latency performance (conventional 3D correlation algorithms may be too slow for this application). The output of this task will also define the proper execution approach: local, cloud based or hybrid.

T5.4 3D Map Systematic Update (Lead: ITH, Participants: MAP, GEO, CM, 5T, VAL-G)
Data correlation algorithms developed in Task 5.3 will also be used to detect locations where the existing reference 3D reference maps are not consistent with the current roadway situation and to determine changes and modifications needed to keep the high definition 3D reference maps up-to-date. This task will focus on determining a process that will lead to economically viable way of keeping the high definition 3D reference maps up-to-data (which is essential to secure safety of autonomous vehicles). Such a process will also eliminate the need for expensive and logistically cumbersome air and ground surveys, and will dramatically shorten the update time/cycles (to include representations of such events like road works or accidents).

T5.5 Machine Learning modules (Lead: CM, Participants: all)
The development of the Architecture, the implementation, and the continuous maintenance of the specific set of modules that implement the Machine Learning algorithms for eHorizon use-cases will be handled in this task. The implementation will involve two high level components – one for continuous learning and the second for real-time predictions using the models derived from the learned data. CloudMade's technology will be able to provide predictions of journeys and their destinations for individual vehicles in a fleet at any specific point of time. This is key for analysing and predicting the demand of Parking Spots at specific junctions in the city at any point of time. Along with Parking other use cases in eHorizon that need machine learning will be addressed as part of this task. Specific artefacts will involve the architecture documents and the implementation.

T5.6 Connectivity set-up and deployment (**Lead: SES**, **participants: SES, TIM**)

Terrestrial Pilot Test-bed 2 Connectivity (Lead: TIM) 4G and 5G connectivity depending on Latency and bandwidth requirement will be provided in Turin for Pilot 2.

T.5.6.2 Satellite Pilot Test-bed 2 Connectivity (Lead: SES)

This task is split into following main subtasks:

I. Definition

This subtask covers the definition and specification of the optimal solution with respect to the management, implementation, operation, and maintenance of the satellite connectivity aspects of the end-to-end connectivity requirements as established in T.5.x.

II. Deployment and validation

This subtask encompasses the support of the practical implementation of the satellite part of the network. For connecting, via satellite, certain sensors, and actuators relevant for Test-bed 2, SES will deploy and operate a satellite network consisting of up to 5 VSAT satellite terminals each connected to an aggregator of such sensors and actuators. These terminals will share a satellite link with a maximum aggregate inbound (VSAT to gateway) throughput of approximately 0.5 Mbps and a maximum aggregate outbound (gateway to VSAT) throughput of approximately 10.0 Mbps. These satellite communications capabilities will be made available for a total of maximum 12 months over the project duration.

Deliverables (brief description and month of delivery)

D5.1: 3D Map of the Test Beds (M9, CO) [GEO] This deliverable summarizes the outcomes of Task 5.1

D5.2 First version of the pilot test-bed eHorizon 5.0 (M18, CO) [VAL-G] This deliverable provides an intermediate report on the advance of all tasks in WP5

D5.3 Second version of the pilot test-bed eHorizon 5.0 (M30, CO) [AVL] This deliverable provides report on the final demonstrator

D5.4 Final evaluation of the pilot test-bed eHorizon 5.0 (M36, PU) [FCA] This deliverable summarizes the evaluation results

Table 19: Work package 6 description

Work package number 6	**Lead beneficiary**								FEV		
Work package title	Pilot test-bed 3 – Mobility optimization for traffic flow, parking, energy consumption & emissions										
Participant number	1	2	3	4	5	6	7	8	9	10	11
Short name of participant	VAL-F	VAL-G	FCA	SEAT	AVL	FEV	SES	5T	TIM	EMI	GEO
Person/months per participant:	0	12	0	0	51	116	3	28	20	72	0
Participant number	12	13	14	15	16	17	18	19	20		
Short name of participant	MAP	CM	FAC	BSC	CIN	INFN	ITH	CRF	UPC		
Person/months per participant:	0	12	0	0	0	0	4	0	0		
Start month	1					End	36				

With the exceptionally large size and high domain complexity, and the high relevance of WP6 for both AVL and FEV, it was decided to have a common share of this work-package between the two partners. This is implemented by having FEV in the overall lead of this WP6, cooperating tightly with AVL who supports the WP6 lead role, with AVL having the responsibility for defined core tasks related to predictive control for mobility optimization for traffic flow, parking, energy consumption & emissions.

Objectives

- Demonstration of cooperative interface between a centralized citywide traffic management system that optimizes in quasi real-time in the HPC cloud the traffic flows, and redirect individually connected vehicles with predictive controls (e.g. traffic light and parking assistants) to significantly improve smart city mobility.
- HEPTAS optimization occurs in two levels in this 'hybrid' approach. On a high level, with the use of cloud based HPC services of and environmental optimization algorithms to be developed in the project, the traffic is equilibrated (i.e. balanced) by not only trying to minimize travelling time but to optimize energy consumption and pollutant emissions on a fleet level. On the lower level, HEPTAS transmits new routing to individual vehicles, and relevant traffic light timing, congestion & speed data. A local in-car predictive controller is used to optimize the ego-vehicle speed on the new route safely and securely according to traffic light timing etc.

- Improve mobility in urban and extra urban areas by increasing the traffic flow capacity & throughput of an existing road network, enabling direct travel to available parking spaces, reducing energy consumption, vehicular emissions (in hot spots and over the city) of both private cars and public buses.

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

T6.1 Data collection (Lead: FEV, Participants: AVL, 5T, VAL-G, CM, Emisia, Ithaca, TIM, SES, ITH)
This task will focus on the collection of data from various sources such as city traffic flow and emissions sensors, individual vehicles), combining/ translating this data to a representation of the real-time mobility.
T6.1.1 Data specification: This task will focus on the data requirements and specifications, what information is desired by the city traffic management system, and what information exchange is useful for the intelligent cooperation between the city traffic management system and individual road users.
T6.1.2 Data gathering: This task will focus on how the information desired by the city traffic management system can be gathered and how big data flows from many diverse and relevant data sources and sensors (e.g. cars, buses, city traffic flow, local city emissions sensors) can be combined or fused in the cloud with real-time processing.
T6.1.3 Translate big data into real-time traffic conditions: This task will focus on how the enormous amount of gathered anonymized data from the different data sources can be used to obtain an accurate but simplified real-time understanding of the mobility conditions. The gathered big data must be translated into current traffic density levels, traffic throughput and congestions, plus city emission levels, that accurately describe the state of the city's mobility conditions. The most probable path and ideally destination of each road user must be anonymized and be available to traffic management system.

T6.2 Traffic management simulation and optimization (Lead: 5T, Participants: EMI, FEV, AVL)
This task will focus on the analysis of mobility conditions, tailoring the traffic control to future conditions.
T6.2.1 Current mobility state analysis and predictions of future states: This task will focus on the analysis of both historical and real-time mobility conditions to make in quasi real-time forward predictions of the future mobility conditions (i.e. both anticipated future traffic conditions and future emission levels) using large-scale traffic simulations in cloud based elastic HPC.
The computing power of HPC enables the exploration in quasi real-time (without HPC this would take many hours) analysis of many different scenarios and traffic control policies, by allowing many computationally-demanding simulations to be computed and analysed in parallel, to obtain the traffic control policy that optimizes the city mobility conditions (in terms of traffic flow capacity, journey times and emissions levels).
T6.2.2 Sending commands to smart infrastructure: This task will focus on translating the optimized city mobility solution into specific targeted commands that are individually sent to city infrastructure objects (e.g. smart traffic lights, dynamic speed limitations, electronic route advice signs, and traffic messages).

T6.3 Vehicle control simulation and optimization (Lead: AVL, Participants: FEV, VAL-G, EMI)
This task will determine an optimal trajectory for individual ego-vehicles for the local route conditions. The predictive vehicle control system for each ego-vehicle is responsible for the final determination of its route and its dynamic trajectory (including importantly the refinement of its optimal speed profile via a traffic light assistant or CAAC) should determine the optimal strategy. For this the vehicle control system considers other vehicles and traffic infrastructure nearby, and its own ego-vehicle's powertrain state for minimal energy consumption, and a safe and timely arrival. In cases of interrupted connectivity, the system must remain 100% capable of determining a suitable route and driving strategy despite the data interruption.

T6.4 Collaboration and integration control systems (Lead: AVL, Participants: FEV, 5T, CIN, INFN)
This vital task will focus on intensifying the collaboration and integration between the HPC city traffic management platform and the vehicle control system of individual vehicles in this innovative hybrid approach.
T6.4.1 Sending unique suggestions to individual vehicles**:** This task will focus on sending data and recommendations to individual vehicles from the optimized city mobility system. It will share this data with individual vehicles via V2X (e.g. 4G Wi-Fi, Satellite) in real-time regarding current/expected traffic conditions and the best route / speed profile for the vehicle's destination.
T6.4.2 Integration of unique suggestions into individual driving strategies**:** This task will focus on the integration of the recommendations from cloud based HPC into the driving strategies (route and trajectory including speed) of individual ego-vehicles. The suggestions of the centralized HPC city traffic management system must be evaluated towards the objective of the ego-vehicle's driving strategy and, if acceptable, be included in the final synthesis of the vehicle's driving route and dynamic trajectory.

T6.5 Parking space identification to significantly reduce congestion (Lead: VAL-G, Participants: AVL, CM, FEV, 5T)
This task will focus on the systematic updating of a detailed map that keeps track of the parking spaces.

T6.5.1 Parking spaces - static map creation: This task is dedicated to the generation of a parking spaces map with field campaign to collect the relevant data. The data will be processed within a cloud using machine learning and pattern recognition to generate an online map accessible by connected services. This map would act as a static list of existing parking spaces (especially those at the side of the road or similar which are not normally managed and thus inefficiently utilized) in the city.
T6.5.2 Parking spaces – updating of dynamic map in cloud: Within this task we develop a system for real-time update of space availability (including probability), including of previously missing spaces, and detecting changes in the urban environment that leads longer term loss of spaces. AI or machine learning analyses available data and predicts which areas are most probable to provide free parking spaces at a given time. Data regarding free spaces is reported to the online map and shared with users.

T6.6 Diverse connectivity for highly available interface (**Lead: VAL-G, Participants: FEV, AVL, SES, TIM**)
This task will focus on defining and implementing end-to-end connectivity to enable a highly available real-time cooperative interface between a centralized citywide traffic management system in the HPC cloud and individual ego-vehicles in city canyons. Thus, HEPTAS uses a mixed and bandwidth flexible approach to 2-way communications via cellular mobile data, satellite, and Wi-Fi. Data to be sent in real-time from the vehicles may include their location, speed, path and destination, their type e.g. homologation class, powertrain plus engine speed and power. Data to be sent in from the infrastructure or cloud may include route change recommendations, speed advice incl. dynamic speed limits, traffic, and traffic light timing, parking locations, as well as traffic incidents.
T6.6.1 Mobile Pilot Test-bed 3 Connectivity**:** Here G5/WIFI and mobile cellular data (3G/4G/LTE/5G) will be used in an approach to increase communications coverage and availability. A flexible approach used so only key data is transmitted if the bandwidth is reduced.
T6.6.2 Satellite Pilot Test-bed 3 Connectivity: Satellite communications are important to ensure coverage in areas where cellular data is not so available e.g. more remote cities, extra urban roads, and intra-urban roads in the countryside.

T6.7 Integration of HPC systems to predictive demonstrator on road (Lead: FEV, Participants: AVL, VAL-G)
Pilot demonstrator is developed and to evaluate on test-bed 3 the performance and cooperation between the systems of the smart mobility platform. Traffic data is gathered for HPC evaluation of mobility and to optimize the traffic control. Mixed forms of connectivity are used to send unique commands and suggestions to smart infrastructure and individual ego-vehicles with predictive vehicle control systems.

Deliverables (brief description and month of delivery)

D6.1: Specification data exchange & information sources (M6, CO) [FEV] This deliverable summarizes the outcomes of T6.1

D6.2: First version pilot demonstrator, focusing on traffic management to optimize mobility via big data, and on predictive control to optimize ego-vehicle driving (M18, CO) [AVL] This deliverable provides an intermediate report on the advance of all tasks in WP6

D6.3: Second version pilot demonstrator on road with collaborative integration of HPC (M30, CO) [FEV] This deliverable provides report on the final demonstrator

D6.4: Evaluation report of pilot demonstrator (M36, CO) [FEV] This deliverable summarizes the evaluation results

Table 20: Work package 7 description

Work package number 7	**Lead beneficiary**								FAC		
Work package title	Pilot test-bed 4 – Air Quality & Mobility Strategies										
Participant number	1	2	3	4	5	6	7	8	9	10	11
Short name of participant	VAL-F	VAL-G	FCA	SEAT	AVL	FEV	SES	5T	TIM	EMI	GEO
Person/months per participant:	0	2	0	24	0	0	3	2	5	0	0
Participant number	12	13	14	15	16	17	18	19	20		
Short name of participant	MAP	CM	FAC	BSC	CIN	INFN	ITH	CRF	UPC		

Person/months per participant:	0	0	24	93	0	0	4	0	66		
Start month	1					End	36				

Objectives

- To define and gather xFCD (eXtended Floating Car Data) needed to feed real time traffic and emissions model.
- To model and deliver street-scale traffic emissions and air quality estimations on real time.
- To assess impact of city mobility & environmental measures on reducing emissions & improving air quality.

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

T7.1 Data collection (Lead: SEAT, Participants: FAC, BSC, UPC, SES)

This task will aim at defining the requirements and specification of data sources and connectivity, according to the required inputs for traffic, emissions and air quality models. Data management and delivery methods to feed test-bed models will be developed and deployed during test-bed operations.

T7.2 Traffic modelling (Lead: UPC)

Development of a traffic simulation model of the selected area of study, the inner crown of the Barcelona Metropolitan Area.

- Construction of the network including all the needed details to emulate private and public transport. It is important to note that this task will not start from scratch. It will reuse a current existent model of the 1st Crown of the AMB from 2017 and will be detailed and further improved during this phase. UPC is currently involved in the Barcelona Virtual Mobility Lab project where the first detailed model of the Barcelona Metropolitan Area (inner crown) has been developed in the 1st phase (2017). The model is innovative because it is multimodal (car, metro, bus, tram, trains - FGC, Rodalies Renfe) and detailed for the whole study area. It has been developed using the modelling tools provided by tech companies PTV and KINEO.
- Demand analysis using Origin - Destination matrices built from Floating Mobile Data (KINEO).
- Calibration process including position/speed data from connected cars and other data from xFCD sources.
  - <u>Processing of traffic and transport data sources for calibration</u>
    - Identify available sources, define data collection process and generate the databases and query processes.
    - Traffic Data Analytics processing to generate clean working databases.
    - Data fusion algorithms to achieve a reliable and accurate observed input to be included in VISUM model (from PTV). Depending of VISUM available procedures observed data for calibration purposes will be processed.
  - <u>Model calibration</u>
    - Private network calibration to fulfil observed speeds and travel times obtained from available sources.
    - 4-step model calibration:
      - Sociodemographic information about travellers and TAZ zones preparation.
      - Generation/Attraction models
      - Trip distribution models
      - Modal split models

T7.3 Air Quality Forecasting (Lead: BSC)

This task aims at developing and delivering air quality forecasts for the city of Barcelona, following a phased approach:

- M1-M6. Development of the operational CALIOPE air Quality Forecast system for the city of Barcelona at high spatial and temporal resolution (1km^2 and 1 hour)
- M6-M18: Delivering of urban-scale air quality forecast for the city of Barcelona for NO2 (1km^2, 1hour)
- M1-M18: Development of the CALIOPE-Urban Air Quality Forecast system for the city of Barcelona at street-scale resolution (20m and 1 hour)
- M18-M36: Delivering of street-scale air quality forecast for the city of Barcelona for NO2 (20m, 1 hour)

T7.4 Near-real time xFCD-based traffic emissions (Lead: BSC, Participants: SEAT, UPC)

This subtask aims at coupling of Extended Floating Car Data as defined in T7.1 and Virtual Mobility Lab traffic modelling outputs (T7.2) with PHEM traffic emission model, to finally delivering near-real time street-scale traffic emissions for the city of Barcelona.

T7.5 Air Quality Planning (Lead: FAC, Participants: BSC, UPC, SEAT)

This subtask will target the evaluation of different public policy measures aiming to improve air quality in the city of Barcelona. In a first phase, the consortium will work with Barcelona City Council and the AMB to select the air quality measures for evaluation. These measures will drive the estimation of emission scenarios and integration with the CALIOPE-Urban system. Simulations will be performed in order to quantify the effectiveness of the air quality measures in terms of air pollutant reductions.

Deliverables (brief description and month of delivery)

D7.1. Identification of all signals generated by the connected car required to feed the prediction models (M6, CO) [SEAT] This deliverable summarizes the outcomes of T7.1

D7.2. Description of the CALIOPE-Urban air quality forecasting system (M18, PU) [BSC] This deliverable summarizes the outcomes of T7.2

D7.3. Description of the coupling of xFCD with PHEM (M24, PU) [BSC] This deliverable summarizes the outcomes of T7.4

D7.4. Evaluation of the traffic-related air quality policies (M36, PU) [FAC] This deliverable summarizes the outcomes of T7.3 and T7.5

Table 21: Work package 8 description

Work package number 8	**Lead beneficiary**								FAC		
Work package title	Dissemination and communication management										
Participant number	1	2	3	4	5	6	7	8	9	10	11
Short name of participant	VAL-F	VAL-G	FCA	SEAT	AVL	FEV	SES	5T	TIM	EMI	GEO
Person/months per participant:	0	2	24	1	9	3	0,5	3	5	5	2
Participant number	12	13	14	15	16	17	18	19	20		
Short name of participant	MAP	CM	FAC	BSC	CIN	INFN	ITH	CRF	UPC		
Person/months per participant:	0	0	20	6	36	4	2	24	2		
Start month	1					End	36				

Objectives

This WP is intended as a transversal and integrated range of activities ensuring the communication and the visibility of the project as well as the promotion of its results. The overall objective is to define and implement a strategy that will lead to the successful dissemination and communication of project goals and activities.

It will include both internal and external communication activities and a set of dissemination actions aimed at:

- Creation and maintenance of a project's corporate identity.
- Maintaining and consolidating and dedicated dissemination and communication plan.
- Creation of a data management plan.
- Innovation management for impact creation by the coordination and maintenance of an exploitation plan as well as the creation of a sustainability concept.
- Networking with the main EU and worldwide automotive stakeholders.

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

T8.1 Project's corporate identity (Lead: VAL-F, Participants: all)
The target of this task is the creation of the corporate identity/design of the project. This comprises the creation of **templates for external communication** (presentation, deliverable, internal reports), and the creation of **general project information** (folder, presentation, poster), together with usage guidelines. This activity is tightly related to T1.1 (Project initiation) and especially the outcomes shall be integrated as annex to deliverable D1.1 (Project management guide). Task 8.1 will contribute to Deliverable 8.1.

T8.2 Project's website and social media presence (Lead: FAC, Participants: all)

This task is responsible for creating and maintaining a representative **website for HEPTAS,** together with accounts on most suitable social media platforms, like Twitter or LinkedIn. The website is designed in accordance with T8.1 and used to provide **general information** about HEPTAS, **news** about the project as well as information about **project outcomes** for the public. A complete version of the website shall be available at M3 and must be maintained throughout the whole project. Task 8.2 will contribute to Deliverables 8.1, 8.2 and 8.3.

T8.3 Dissemination and Communication management (Lead: CIN, Participants: all)
This task targets the consolidation of the communication strategy and the monitoring of the dissemination activities. During a first step, the preliminary communication strategy described in Section 2.2.4 will be consolidated during a workshop. This shall support **identifying the relevant target audiences** while integrating both the scientific (impact creation by scientific excellence) and the industrial points of view (impact creation by preparing exploitation of selected project outcomes). Furthermore, this task will perform the **systematic monitoring and reporting of dissemination activities**. Beside publication in scientific and industrial conferences, the co-organisation of side events to existing conferences will be evaluated. Social media campaigns related to the project achievements will be planned.

HEPTAS foresees also a series of training activities that will be implemented by and for personnel working in the project and interested stakeholders. Different training approaches will be adopted at various levels, such as: i) Organisation of at least two technical workshops to facilitate transfer of knowledge and technology transfer at later stages; ii) Periodic technical meetings will be also an opportunity of training, cross-fertilisation and for deepening the understanding of HEPTAS related topics. By the end of the project, HEPTAS will organize a **final conference to present and promote the main results and the four industrial pilot test-beds. 4 videos** will be produced towards the end of the project, one for each use case, aimed at presenting project's results, addressing wider industrial and research communities. Finally, this task targets the publication of **four professional press releases** during the project execution. Task 8.3 will contribute to Deliverables 8.2 and 8.3.

Deliverables (brief description and month of delivery)

D8.1 Project's corporate identity (M3, CO) [VAL-F] This deliverable involves templates, project information, and website setup as described in T8.1 and T8.2.

D8.2 Preliminary dissemination and communication plan (M18, CO) [CIN] This deliverable targets the preliminary and intermediate reporting of the activities in this work package. Especially, this deliverable shall report on clustering activities and first iteration of exploitation plan consolidation according to intermediate project results.

D8.3 Sustainability concept and report on communication activities (M36, PU) [CIN] This deliverable regroups the outcomes of T8.2 and T8.3 and targets the final reporting of the activities in this work package. Especially, this deliverable shall report on dissemination activities performed on the course of the project (T8.2), report on clustering activities (T8.4)

Table 22: Work package 9 description

Work package number 9	**Lead beneficiary**								AVL		
Work package title	Innovation and community management, impact assessment										
Participant number	1	2	3	4	5	6	7	8	9	10	11
Short name of participant	VAL-F	VAL-G	FCA	SEAT	AVL	FEV	SES	5T	TIM	EMI	GEO
Person/months per participant:	10	0	12	2	14	2	0,5	2	5	4	2
Participant number	12	13	14	15	16	17	18	19	20		
Short name of participant	MAP	CM	FAC	BSC	CIN	INFN	ITH	CRF	UPC		
Person/months per participant:	0	0	15	2	0	0	0	12	0		
Start month	1					End		36			

Objectives

Objective of this work package is to maximize impact creation. This will be relying on three pillars

- Proper innovation management with maintenance of list of assets (see Section 2)
- Community management – by interfacing to relevant initiatives and with specific focus on the advisory board
- Assessment of the project impacts

Description of work (where appropriate, broken down into tasks), lead partner and role of participants

T9.1 Innovation management (Lead: AVL, Participants: all)
The target of this task is the **management of the innovations created in the HEPTAS project**. Especially the approach identified in Section 2.1.3 and Section 2.2.1 shall be maintained and consolidated during project life time. This consists of the update of the business model canvas (see Figure 15) as well as the management of the asset list (see Table 7), using cross-references, by continuously screening the project assets by continuously screening the project assets and identifying the owner, IPR, communication channels and path for exploitation. It shall be noted that "exploitation" can be either **commercial exploitation** (e.g., new assets integrated into a company portfolio) or **impact creation** (e.g., creation or support of European communities). This activity shall be concluded by a **sustainability concept** report identifying how the most relevant project outcomes will be sustained after the end of the project.

T9.2 Networking & community management (Lead: VAL-F, Participants: all)
The consortium will promote a series of **networking activities with other EU R&D initiatives** like Green Vehicle, Mobility for Growth, BDVA, CIVITAS, etc. Moreover, many of the partners are actively involved in several European initiatives (e.g., EGVIA, ARTEMIS-IA, ECSEL, EPoSS, EUCAR and ERTRAC). Joint activities will be co-organised between the HEPTAS consortium and the above-mentioned initiatives. This activity also includes the identification of possible joint dissemination activities. A second aspect is the **management of the advisory board** (see the ten letters of support in the annex) to embed the external stakeholders in this project and therefore maximize impact creation. By liasing with supporting organizations such as Polis, OASC (Open and Agile Smart Cities) and Big Data Center of Excellence Barcelona[1], HEPTAS has secured valuable extra support and advice to enhance the exploitation of some of the findings and strategies with other client companies and cities. For that, annual alignment meetings are planned.

T9.3 Impact assessment (Lead: AVL, Participants: all)
Target of this task is the review of the projects outcomes toward project objectives and in terms of impact creation. For that purpose, the business model canvas drafted in Section 2 will be continuously updated, finally providing recommendation for the steering of the project

Deliverables (brief description and month of delivery)

D9.1: Exploitation plan and first version of impact assessment (M18, CO) [AVL] This deliverable provides an intermediate report for WP9

D9.2: Exploitation results, impact assessment report (M36, PU) [VAL-F] This deliverable report on activities performed in WP9

Table 23: List of Deliverables

Deliverable (number)	Deliverable name	WP No.	Short name of lead participant	Type	Diss. level	Delivery date (in months)
D1.1	HEPTAS Project Handbook	1	AVL	R	CO	M02
D2.1	Preliminary data management plan	2	CM	R	CO	M06
D2.2	First consolidated design of the SDI solution	2	ITH	R	PU	M09
D2.3	Physical implementation of the SDI solution	2	ITH	R	PU	M12
D2.4	Final data management plan	2	CM	R	PU	M36
D3.1	HEPTAS Platform Architecture, Specifications and Technical and User Requirements-v1.00	3	CIN	R	CO	M8
D3.2	HEPTAS Platform Architecture, Deployment, and Data Flow Specifications-v1.00	3	INFN	R	CO	M18
D3.3	WP3 first activity report	3	CIN	R	PU	M18

D3.4	HEPTAS Platform Architecture, Deployment, and Data Flow Specifications	3	INFN	R	CO	M30
D3.5	WP3 final activity report	3	INFN	R	PU	M36
D4.1	Use Cases and System Specification	4	FCA	R	PU	M09
D4.2	Data layer technologies deployment including cars simulation algorithms deployment	4	FEV	R	CO	M18
D4.3	Machine Learning algorithms and HPC requirements including connectivity technologies deployment	4	FCA	R	CO	M24
D4.4	Test bed deployment and evaluation	4	FCA	R	PU	M36
D5.1	3D Map of the Test Beds	5	GEO	R	CO	M09
D5.2	First version of the pilot test-bed eHorizon 5.0	5	VAL-G	R	CO	M18
D5.3	Second version of the pilot test-bed eHorizon 5.0	5	AVL	R	CO	M30
D5.4	Final evaluation of the pilot test-bed eHorizon 5.0	5	FCA	R	PU	M36
D6.1	Specification data exchange & information sources	6	FEV	R	CO	M06
D6.2	First version pilot demonstrator, focusing on traffic management to optimize mobility via big data, and on predictive control to optimize ego-vehicle driving	6	AVL	R	CO	M18
D6.3	Second version pilot demonstrator on road with collaborative integration of HPC	6	FEV	R	CO	M30
D6.4	Evaluation report of pilot demonstrator	6	FEV	R	CO	M36
D7.1	Identification of all signals generated by the connected car required to feed the prediction models	7	SEAT	R	CO	M06
D7.2	Description of the CALIOPE-Urban air quality forecasting system	7	BSC	R	PU	M18
D7.3	Description of the coupling of xFCD with PHEM	7	BSC	R	PU	M24
D7.4	Evaluation of the traffic-related air quality policies	7	FAC	R	PU	M36
D8.1	Project's corporate identity	8	VAL-F	R	CO	M03
D8.2	Preliminary dissemination and communication plan	8	CIN	R	CO	M18
D8.3	Sustainability concept and report on communication activities	8	CIN	R	PU	M36
D9.1	Exploitation plan and first version of impact assessment	9	AVL	R	CO	M18
D9.2	Exploitation results, impact assessment report	9	VAL-F	R	PU	M36

All deliverables, regardless of the dissemination level, **will include an executive publishable summary**, which will be published on the project website as soon as it has been approved by the EC.

3.2 Management structure, milestones, and procedures

3.2.1 Milestones

The project flow is organized around the following main milestones, see Table 24:

Table 24: List of milestones

Milestone number	Milestone name	Related WP(s)	Estimated date	Means of verification
1	Specification for data governance available	WP2, WPs 4-7	M06	D2.1, D6.1, D7.1

2	First deployment of HPC technologies and infrastructure	WP2, WP3	M12	D2.2, D2.3, D3.1, D4.1, D5.1
3	First version of industrial pilot test-beds available	All WPs	M18	D3.2, D3.3, D4.2, D5.2, D6.2, D7.2, D8.2, D9.1
4	First technology evaluation and second version of industrial pilot test-beds available	All WPs	M30	D3.4, D4.3, D5.3, D6.3, D7.3
5	Final evaluation results available	All WPs	M36	D2.4, D3.5, D4.4, D5.4, D6.4, D7.4, D8.3, D9.2

The first third of the project is dedicated to concept refinement, data governance (MS01) and deployment of HPC infrastructure and services (MS02). This targets the set-up of solid foundations for the industrial pilot test-bed. Then, two iterations are foreseen for industrial pilot test-bed integration, deployment and populating with industrial data (MS03 and MS04). Finally, the final evaluation of the test-beds at real scale is performed (MS05). Figure 18 shows the timing of work packages and tasks with the milestones planned, while Figure 19 is illustrating the list of deliverables in HEPTAS as well as their inter-dependencies.

3.2.2 Organizational structure and decision making

The following section describes the organisational structure and the decision-making hierarchy to be employed in HEPTAS. The management procedures will be fully outlined in the project consortium agreement to be signed by all partners covering all relevant issues necessary for the proper execution of the project. Relevant issues include the Steering Board, Project Coordinator, and individual partner responsibilities, liabilities, intellectual property rights (IPR), knowledge management, rules for publishing information, conflict resolution and financial management etc.

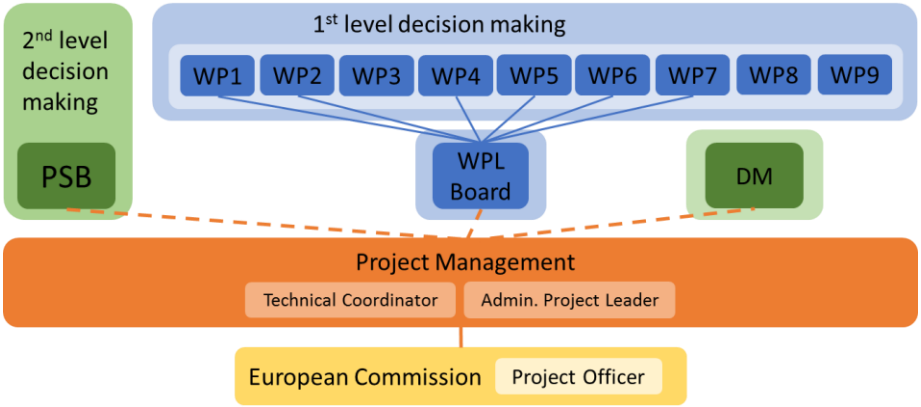


Figure 20: Project Structure and decision levels

Project management

The Project Management Team is made up of the technical project coordinator and administrative project leader. The Coordinator will deal with the daily technical execution and synchronization within the consortium. The administrative project leader supports the coordinator in dealing with the legal, financial, and administrative aspects of the project coordination. The overall coordination is by done by Valeo, by teaming David Roine (Marketing Manager for the Valeo Connected Car Product Group) as business and technical expert, with Philippe Gougeon (Director of collaborative research projects for the Comfort and Driving Assistance Business Group) as technical expert and expert for the management of H2020 project, further supported by third party (subcontracting) for the administrative tasks. The management team is further strengthened by AVL with Stephen Jones (Product Manager Systems & Principal Engineer) as senior technical expert, and Eric Armengaud (Project Manager R&D) as technical expert and coordinator of previous FP7 and H2020 projects. This set-up is implemented by having two dedicated work-packages related to different aspects of project management (WP1 “project management”, and WP9 “Innovation and community management, impact assessment”) and having main contributions from both Valeo and AVL in both work-packages. The management structure presented in this section is appropriate for the size of the consortium and the nine work packages and takes into consideration lessons learned in previous projects. The management structure is intentionally simple to ensure effective executive and clear communication in to enable the innovation process. To keep the travel costs low, project meetings will be conducting using a combination of virtual and face to face methods (e.g. Teleconferencing etc.).

The project will employ a management by exception principle where decisions are taken on the lowest level possible with first level decision taken inside the Work Packages. Where decision affect more than one work package the issue will be escalated to the Work Package Leader (WP Leader) Board. The Project Steering Board, composed of

senior partner representatives, will take decision on escalation levels on issues not resolved at WP level or where strategic or directional input is required.

Work Packages and Work Package Leader Board (WPL board)

The first level decision making is performed either (1) on WP level for topics affecting the execution of the Work Package where no interaction with other WPs is necessary or (2) on the WP Leader Board where decisions influencing the cooperation between Work Packages are taken.

The WP Leader will be responsible for managing their WP as a self-contained entity. It is the WP Leader's responsibility to maintain communication with partners inside the WP including regular meetings by electronic means (WEBEX and Videoconferencing) and face-to-face where necessary, to ensure and monitor execution of tasks inside the WP according to time and resource plan. A WP specific delivery plan will be drawn up to include division of responsibility and timings, and to report any deviations and risks identified inside the WP Leader Board

The WP Leader Board, headed by the technical coordinator, is the level of decision making for WP interactions. It is within the WP Leader Board's responsibility to:

- Ensure and monitor proper cross-WP cooperation including timing of deliverables and risk monitoring
- Decide technical discussions that affect more than one WP
- Assure quality of deliverables by reviewing deliverables and project results
- Report to the Project Steering Board on continuous basis
- Escalate to the Project Steering Board when considered as necessary.

The WP Leader Board will meet on at least monthly basis by electronic means (WEBEX, Videoconferences) and in a face-to-face meeting twice a year. Ad hoc meetings will be scheduled as required.

Project Steering Board (PSB)

The Project Steering Board consists of senior partner representatives from each partner organization and is required to attend the Project Steering Board that is chaired by the technical project coordinator. The responsibilities of the Project Steering Board include:

- To take decisions on the strategic orientation of the project including ensuring the cooperation with other related R&D initiatives
- Second level decision making body for topics not finding a resolution on WP Leader Board
- Proposals for changes to Annex I of the EC-GA to be agreed by the European Commission
- Changes to the Consortium Plan (including the Consortium Budget)
- Changes with respect to the consortium agreement
- Evolution of the Consortium (e.g. addition or withdrawal of partners)

The Project Steering Board will meet twice a year in a face-to-face meeting with additional electronic meetings (WEBEX, Videoconferences) as required during the project lifetime.

Data Manager (DM)

Target of the DM is to maintain the data management plan up to date and to advise the project team on data related issues. DM is the task leader of T2.1

A preliminary meeting schedule is provided

Table 25: Meeting Schedule

Meeting	Format	Date	Participants
Kick off meeting	Face to Face	Project start	All
Project Steering Board	Face to Face (virtual as required)	Every 6 months	All partners: PSB members
Work Package Leader Board	Virtual	Monthly WEBEX meeting	All WP Leaders
Work Package Leader Board	Face to Face (combined with PSB meetings)	Every 6 months	All WP Leaders
Work Package internal synchronization	Virtual (face 2 face upon request)	Every second week WEBEX meetings	WP participants

3.2.3 Execution and monitoring of the project

All documents relevant to the project will be shared over the HEPTAS SharePoint, an extranet platform with exclusive access for the project partners. The SharePoint site has already been used during the proposal preparation phase and allows central handling of all documents including version control. It is the responsibility of the participants to ensure their access data are not available to other individuals. The WP Leader Board will undertake technical Progress monitoring. In its regular meetings, the Work Package leaders are requested to provide information on the status of activities in the Work Package to ensure effective cooperation both inside the WP and in collaboration with other WPs. For each innovation cycle, clear technical expectations will be set and corrective measures taken as required. On administrative level, the partners will provide status updates on efforts spent on each task to ensure spend remains in line with project progress. Each partner will nominate a representative as a main contact point for legal, administrative, and financial aspects. Financial data will be provided for each review period along with partner specific periodic reports. The accumulation of WP reports, status reports and the partner specific periodic reports will constitute the project periodic reports planned in months 09 and 18 and the final project report in month 36.

3.2.4 Innovation Management

Innovation management in HEPTAS strongly relies on the following pillars

a. **Delivering the correct innovation to the correct market** – by the interconnection of technical innovation with business needs (see Section 2, business model canvas),
b. **Proper management of assets** to be created in the project, see Table 7 and WP9.
c. **Appropriate IPR and communication plan** to secure innovation and ensure that the dedicated audience is aware of the project outcomes.

With the innovation management as proposed in HEPTAS, the project can count on the following advantages:

- Increased visibility of project results and their impact
- Keeping track of results generated by the project and organize their evaluation
- Brings together solution providers and end users
- Support coordination and management of overall development effort
- Actively motivate and support communication and collaboration
- Ensure visibility and transparency for all partners
- Clear overview of solutions provided by the project and how they can be used/exploited
- Enable quick reaction on new input from different sources (project internal and external)
- Ensure technical management and traceability to project goals

3.2.5 Critical Risks and Mitigation Measures

The continuous risk management of HEPTAS will be in the hands of project management team. They will be the first to identify, rate and provide mitigation strategies for risks coming up during project execution. Accordingly, risk management will be part of the monthly telephone conferences in the WP Leader Board. A first list of risks identified during the project preparation is shown in Table 26. The critical risks for the implementation of HEPTAS are identified as **5 potential Technical risks (T1–T5), 2 potential Commercial risks (C1–C2)** that could endanger the timely and successful completion of the project and **1 risks** related **to the coordination and Management (M1)** of the consortium. These risks are explained below, and contingency plans are described to manage and mitigate the effect of the potential problems on the project outcomes. This list will be revised at project start and updated on a continuous basis.

Table 26: Critical risks for implementation

Description of risk / Likelihood	WP(s) involved	Proposed risk-mitigation measures
C1 (Low): Major change in the HPC or automotive market lowering the expected impact of HEPTAS outcomes	All WPs	Risk management implemented within WP1 to identify external risks and adapt course of the project appropriately. Partners involved in respective expert groups (e.g., ERTRAC, BDVA) to monitor changes in technology and legislation.
C2 (Low): HEPTAS outcomes not achieving customer satisfaction, leading to risks for go-to-market	All WPs	Responsible HEPTAS partners – already implemented on the market – to monitor market change and adapt the direction of the project accordingly
T1 (Low): Results from the technical WPs are delayed	WPs 2, 3, 4, 5, 6	Isolate parts that can be completed and re-plan parts that can be delayed. Consider reallocating resources and building task forces.

T2 (Low): Technical results delivered do not meet industrial pilot test-bed expectations	WPs 2, 3	Close cooperation between end users and technology providers right from the beginning of the project – supported by WP2 and WP3
T3 (Medium): Effort to implement the platform architecture needed is underestimated, leading to missing functionalities and / or delayed platform release	WP2,3	The long-standing experience of the partners in EU funded projects and activities related to the development/integration of cloud and HPC platforms lowers this risk. The project will perform a careful requirements re-prioritization during project execution. Effort re-distribution will be evaluated
T4 (High): Requirements to the platform being incomplete, not consistent, platform implementation cannot proceed	WP3	The requirements will be further investigated and the details level increased through multiple interactions with the use-cases providers. The project management will organize specific meetings involving also the involved partners.
T5 (High): Incompatibilities between components, components of the platform could not be released or integrated significantly delaying the pilot's implementation	WP2, 3	Incompatibilities will be addressed. The implementation will be driven by specific convergence decisions on a case-by-case basis. To minimize the risk the involved WPs will perform a detailed analysis of all the interfaces and protocols needed during the initial phase of the project, before delivering the detailed design architecture
M1 (Low): Partner not performing as expected in the technical annex	WP1	Regular synchronization and appropriate project monitoring and governance structure (See Section 3.2)

3.2.6 Quality Management

To ensure the overall quality of the HEPTAS project, a Project Handbook (Deliverable 1.1) is available to all project participants. This document sets the guidelines for data exchange between partners on a dedicated project SharePoint (including naming conventions), the use of the HEPTAS corporate identity and communication to the public, the use of confidential information and IPR management, and the project quality management procedures. These procedures include a review process for deliverables, for publications and for dissemination material.

3.3 Consortium as a whole

The consortium is composed of 20 partners from ten European countries. When establishing the project consortium, the following parameters have been considered:

- Integration of relevant industrial partners to ensure industrial relevance and brand-independence of the solution to be developed
- Combination of partner expertise
- Exploitation potential by strong partners well implemented in their respective market
- Partner's trust in the project cooperation

Figure 21: Consortium as a whole

The **HEPTAS consortium** is made of leading automotive companies, cities operators, HPC, big data, traffic management experts, joining forces to build fully interoperative cities ecosystems to demonstrate in the real world the value of HPC technologies applied to city challenges. **Two EU smart cities clusters are defined as test-beds** in Turin and Barcelona to validate how HPC will achieve the societally important objectives of this project. Hence, this unique combination within this small ecosystem strongly supports know-how transfer and identification of cross-domain, innovative solutions, and further shall illustrate the relevance and scalability of HEPTAS's approach.

Further, the mix of 14 industrial partners and 6 scientific partners provide a perfect balance (a) to **generate state-of-the-art concepts**, (b) to **industrialize the concepts towards innovation**, and finally (c) to **pre-industrialization of the innovations** to products and solutions in a global market, thus increasing European competitiveness. An additional strength of the consortium is it tight integration in the European R&D ecosystems for automotive domain as well as ICT technology.

Finally, the strong integration in the ecosystem is highlighted by **10 letters of support** (see Annex). These organizations will be active followers and connectors to other European cities interested to be informed about the progress achieved by HEPTAS, the potential for solving common issues related to urban mobility, and ultimately contributing to spread the word, to promote best practices and disseminate success stories. The letter of support encompasses **governments** (government du grand duché de Luxemburg, Italian government), s**mart cities associations** (Open and agile smart cities, POLIS, EIP-SCC), **related technology centres** (IoMob, BigDataCoE), and **large companies interested in collaboration** (INRIX Inc., GoodYear S.A, SCNF).
Emisia is directly involved and a strong contributor to the Greek ESFRI related Research Infrastructure in the Energy focus area entitled "**FuVEP - Centre of Excellence for future Vehicle Environmental Performance**"[43]. FuVEP is being funded via a multi-annual investment plan through the European Structural and Investment funds (ESIf) and builds on the competitive position of Greece in specific research areas, identified on the basis of the principles of Smart Specialization (RIS3), fostering innovation and entrepreneurship.

Contracts such as the Grant Agreement and the Consortium Agreement will lay out rules of cooperation across the consortium. They are the necessary framework around a cooperation that first needs to build on trust. It is the trust in each partner that the organization and the persons involved to have the right skills and needed commitment to fulfil the task they are dedicated for. Beyond the topics already addressed in the sections above, this trust was a further selection criterion. Although the consortium has never formally cooperated in exactly this configuration before, there is a strong trust in the cooperation. This trust is based on (1) the fact that individual partners have already cooperated in previous projects (see Table 4) and (2) the cooperative spirit established during the proposal generation phase.

3.4 Resources to be committed

Table 27: Summary of staff effort

No.	Part.	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	Total Person Month
1	**VAL-F**	26,0	0,0	0,0	21,0	0,0	0,0	0,0	0,0	10,0	**57,0**
2	**VAL-G**	2,0	12,0	6,0	0,0	64,0	12,0	2,0	2,0	0,0	**100,0**
3	**FCA**	2,0	24,0	24,0	45,0	54,0	0,0	0,0	24,0	12,0	**185,0**
4	**SEAT**	2,0	2,0	1,0	0,0	0,0	0,0	24,0	1,0	2,0	**32,0**
5	**AVL**	18,0	16,0	0,0	0,0	42,0	51,0	0,0	9,0	14,0	**150,0**
6	**FEV**	6,0	8,0	3,0	8,0	12,0	116,0	0,0	3,0	2,0	**158,0**
7	**SES**	1,0	1,0	1,0	3,0	3,0	3,0	3,0	0,5	0,5	**16,0**
8	**5T**	3,0	3,0	2,0	2,0	20,0	28,0	2,0	3,0	2,0	**65,0**
9	**TIM**	2,0	0,0	5,0	0,0	20,0	20,0	5,0	5,0	5,0	**62,0**
10	**EMI**	1,0	4,0	4,0	0,0	0,0	72,0	0,0	5,0	4,0	**90,0**
11	**GEO**	1,0	0,0	0,0	0,0	70,0	0,0	0,0	2,0	2,0	**75,0**
12	**MAP**	1,0	3,0	0,0	0,0	60,0	0,0	0,0	0,0	0,0	**64,0**
13	**CM**	0,0	36,0	0,0	12,0	12,0	12,0	0,0	0,0	0,0	**72,0**
14	**FAC**	0,0	8,0	8,0	0,0	0,0	0,0	24,0	20,0	15,0	**75,0**
15	**BSC**	1,0	6,0	8,0	0,0	0,0	0,0	93,0	6,0	2,0	**116,0**
16	**CIN**	1,0	3,0	32,0	0,0	0,0	0,0	0,0	36,0	0,0	**72,0**
17	**INFN**	2,0	8,0	58,0	0,0	0,0	0,0	0,0	4,0	0,0	**72,0**
18	**ITH**	9,0	25,0	4,0	4,0	24,0	4,0	4,0	2,0	0,0	**76,0**
19	**CRF**	3,0	6,0	0,0	24,0	36,0	0,0	0,0	24,0	12,0	**105,0**
20	**UPC**	0,0	0,0	0,0	0,0	0,0	0,0	66,0	2,0	0,0	**68,0**
	Total WP	**81,0**	**165,0**	**156,0**	**119,0**	**417,0**	**318,0**	**223,0**	**148,5**	**82,5**	**1710,0**

[43] https://ec.europa.eu/research/infrastructures/pdf/roadmaps/greece_national_roadmap.pdf

Table 28: 'Other direct cost' items

Partner	*Other Direct Costs (€)*	*Justification*
VAL-F	176.000	***Travel***: Travels for regular project meetings and for working meeting (€36.000) ***Other goods and services:*** financial audit (€20.000) ***Subcontracting***: Administrative support to management (€120.000)
VAL-G	195.000	***Travel***: Travels for regular project meetings and for working meeting (€20.000) ***Equipment***: test car extension (€50.000), recording hardware and communication module adaptation hardware (€80.000), field test hardware (€20.000), SCALA Laser scanner DNN development - PC, HW (€20.000) ***Other goods and services:*** financial audit (€5.000)
SEAT	50.280	***Travel***: Project meetings (6 bi-annual + 2 review), project workshops and dissemination event/year (average cost (in agreement with SEAT's policy) of 500€ for transport, 150€/night for hotel, 70€ for subsistence allowance, 500€ for events registration ***Other goods and services***: 6-month FTE access to data server for connected cars campaign programming and data pre-processing (€ 2.000,00), Data transmission cost based on 1,65€/Gb and 48bits of data transmitted per second over a 12-month campaign including 10,000 connected cars in Barcelona area (25.000)
FEV	232.000	***Travel***: Travels for regular project meetings and for dissemination (€26.000) ***Equipment***: On Board Acquisition instrumentation (€26.000) ***Other goods and services***: Base Vehicle to build prototype (€70.000), ADAS sensors and electronics (€80.000), Communication Instrumentation for V2X and processing (€30.000) ***Subcontracting***: Support on ADAS functionalities Modelling and Simulation (€120.000)
SES	392.288	***Travel***: Six project meetings, 2 trips to international conferences, internal meetings, conferences and/or congress participation (total: €25.000) ***Equipment***: Two O3b user terminals (antenna and modem) for MEO HTS Ka-band satellites, 5 VSAT terminals per pilot test bed (for a total of 20 terminals) (€60.000) ***Other goods and services***: This includes 1. O3b Standard Demo Fee for MEO Ka-band Satellite Demo per 1 month (>1Gbps of MEO satellite capacity, NOC support, IP from GW), HW costs of allocating ground equipment that O3b will make available incl. commissioning, shipping, installation etc. 2. Standard fee for GEO Ku-band Satellite per 1 month per pilot test bed for a period of 12 months (uplink of 0.5 Mbps and downlink of 10 Mbps), and 3. A financial audit cost.
TIM	110.000	***Travel***: Travels for regular project meetings and for dissemination (€30.000) ***Equipment***: 5G Network Equipment (€80.000)
CIN	76.000	***Travel***: approx. Approx 30 travels (project meetings (4 per year) +2 review meetings (x2 persons) +10-12 dissemination events) at approx. €1.000 costs per person (total: €30.000) ***Other goods and services***: Publishing costs for 1-2 peer reviewed articles describing the HEPTAS platform (€5.000), Dissemination material (flyers, banners, videos). In particular, a professional video will be realized for each use case (€41.000)
INFN	584.800	***Travel***: Kick off meeting (4 people), Project meetings (3), Conferences (3), Training and technical workshops (3), Project review meetings (2, as WP3 leader) (total: €27.200) ***Equipment***: Computing - hardware solution for demonstrator infrastructure between the V2X layer and HPC facilities; hosting the cloud-based services (€240.000), Storage - 1PB for the needs of the project (€200.000), Networking – HW and SW for interconnection of the storage and computing resources (€50.000) ***Other goods and services***: Fees for 3 conferences (€1.000), Audit costs (€6.600)
UPC	96.000	***Travel***: Six project meetings, 2 trips to international conferences, internal meetings, conferences and/or congress participation (Smart Cities World Congress, ITS World Congress, etc.). (total: €26.000) ***Other goods and services***: Two VISUM traffic simulator licenses from PTV (€20.000), Demand data (origin-destination matrices) (€50.000)

COVER PAGE Section 4-5

HEPTAS: **H**PC-**E**nabled **P**ilot **T**estbeds to **A**dvance **S**mart mobility and smart cities

List of participants

No.	Organisation Name	Short name	Country
1	Valeo Comfort and Driving Assistance Systems	VAL-F	FR
2	Valeo Schalter und Sensoren GmbH	VAL-G	GE
3	FIAT CHRYSLER AUTOMOBILES ITALY SPA - FCA ITALY	FCA	IT
4	SEAT S.A.	SEAT	ES
5	AVL List GmbH	AVL	AT
6	FEV Italy S.r.l.	FEV	IT
7	SES Astra S.A.	SES	LU
8	5T S.r.l.	5T	IT
9	Telecom Italia (TIM)	TIM	IT
10	EMISIA SA – Société Anonyme of Environmental and Energy Studies and Software	EMI	GR
11	GeoSim Systems Ltd	GEO	ISR
12	Mapillary	MAP	SE
13	CLOUDMADE UKRAINE LLC	CM	UKR
14	Factual Consulting	FAC	ES
15	Barcelona Supercomputing center-Centro Nacional de Supercomputación (BSC)	BSC	ES
16	CINECA - Consorzio Interuniversitario	CIN	IT
17	INFN	INFN	IT
18	Information Technology for Humanitarian Assistance, Cooperation and Action (ITHACA)	ITH	IT
19	Centro Ricerche FIAT S.C.p.A	CRF	IT
20	Universitat Politècnica de Catalunya	UPC	ES

10 countries involved, combining public authority, large industrials, SMEs, and research institutes, supported by government of Luxemburg and Italy, smart cities associations and relevant technology partners

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Section 4: Members of the consortium

4.1. Participants

Partner 1: Valeo FR	
Company Website: www.valeo.com	

Valeo is an automotive supplier, partner to all automakers worldwide. As a technology company, Valeo proposes innovative products and systems that contribute to the reduction of CO2 emissions and to the development of Intuitive Driving. In 2017, the Group generated sales of €18.6 billion and invested over 10% of its original equipment sales in research and development. Valeo has 184 plants, 55 research & development centers and 15 distribution platforms, and employs 111,800 people in 33 countries worldwide. Valeo is listed on the Paris Stock Exchange and is a member of the CAC 40 index.

For HEPTAS, Valeo France intends to perform mainly the coordination of the overall HEPTAS project, including the aspects related to technical, legal, financial and administrative responsabilities. Valeo France will also contribute to the activities related to the predictive maintenance services developed in HEPTAS.

CVs of involved key researchers / staff members

David Roine graduated as an Electrical Engineer from INSA Lyon in 1993. His first position lead him to work for a start-up company working on sensors for injection and drilling pumps. In 1998, he joined Sagem and Alcatel in France to pioneer the developments of GPRS cellular technology, and became an expert for Alcatel GPRS mobile phone. From 2003 to 2016, he worked for the chipmaker STMicroElectronics with various positions as Product Marketing Manager, Strategic Marketing Manager for the JV with Ericsson and for the Consumer Product Division. Since 2016, David Roine is Marketing Manager for the Valeo Connected Car Product Group. His responsabilities cover a wide range of new products and services from Telematics to C2X connectivity, using RF or Bluetooth or Wifi or cellular communication. David is the Valeo representative to the 5G Automotive Alliance.
Qualifications: Engineering Diploma in Electrical Engineering, 18 years of telecom experience, 2 years of automotive experience.
Expertise: Electrical Engineering, Marketing, Strategic planning, Cellular telecommunications, Automotive connectivity and Services.

Philippe Gougeon Philippe Gougeon, 55, graduated as Mechanical Engineer from INSA in Lyon in 1984. He started his career in the aerospace industry at SNECMA, working on the design of Structures and Compressors for jet engines. He joined the automotive supplier Valeo in the Wiper System branch in France and in the USA. Then, as Director of the research projects for the Driving Assistance Systems, he managed several internal and collaborative projects in the fields of Driving Assistance and Connectivity. Since 2014, he is the coordinator of the collaborative projects for the Comfort & Driving Assistance business group.
Qualifications: Engineering Diploma in Mechanical Engineering, 9 years of aerospace experience, 22 years of automotive experience.
Expertise: Mechanical Engineering, Driving Assistance, Automated Driving, Management of Innovation Projects, Innovation tools like QFD, AHP, KCP

Thierry Gesnel obtained a Bachelor degree in Business Law from Université Paris Sorbonne in 1987, and graduated from IFAG Management School of Paris with a Master degree in Business Administration in 1991. He first joined joined Alfa-Romeo and Fiat France as spare parts and after sales manager. In 1993, he started to work the automotive alarm supplier Cobra as Commercial Director, Export Manager in Italy and Fleet Division Director in France. In 2010, he joined the company CapsAuto as Business Development and Strategy Director involved in the management network linking 800 repair shops. After working as Aftermarket Director for GT Motive, he joined the Valeo Sevice Business Unit in 2015. Since then, in his position of

Global Business Development Manager, he supervises the expansion of the traditional aftermarket product business towards the innovations in aftermarket services and applications.
Expertise: Marketing, Management, Business Development, Automotive aftermarket, Repair shops, Insurances

Benjamin DELAMARE (male), Data Science Director, Valeo Group

Florent HALBOT (male), Chief Information Security Officer, Valeo Group

Relevant publications, and/or products, services or other achievements

- A Green Light Optimal Speed Advisor for reduced CO2 emissions, B. Bradaï, A. Garnault, V. Picron, P. Gougeon, Valeo 2012

- Event-based performances generation for ADAS validation – Application to Speed Limit Assistance, Benazouz Bradaï, Boussad Ferrah, Philippe Gougeon, Valeo 2010

List of relevant previous projects or activities, connected to the subject of this proposal

Project acronym	Funding source/ period	Topic of the project / activities	Relevance and link to HEPTAS
Co-Drive	France FUI 2010-2013	The goal of this project was to perform a first experimentation of a cooperative system from the vehicles on the road to the motorway infrastructure operators. Both Wifi ITS-G5 and cellular communication were successfully integrated for end to end demonstrations with two demo cars on circuit and on open roads.	End to end service between road vehicles and motorway operators. Traffic management. Cooperative systems. Car2Infrastructure communication Wifi and cellular connectivity. Green Light Optimal Speed Advisory.
SafeStrip	H2020-MG3.4-2016 2017-2020	The goal of this project is to implement cooperative systems between on-road sensors, road-side units and connected vehicles to enhance road safety. The main use cases cover situations with meteorological difficulties, temporary road works, exit ramps and tolling areas. CAM and DENM and new data transfer formats are being used to provide highly reliable data for road safety purposes.	Car2Infrastructure connectivity Road traffic alerts Safety related C2X communication.

Description of significant infrastructure and major items of technical equipment relevant to the project

- N/A

Partner 2: Valeo GE	
Company Website: www.valeo.com	

Valeo is an automotive supplier, partner to all automakers worldwide. As a technology company, Valeo proposes innovative products and systems that contribute to the reduction of CO2 emissions and to the development of Intuitive Driving. In 2017, the Group generated sales of €18.6 billion and invested over 10% of its original equipment sales in research and development. Valeo has 184 plants, 55 research & development centers and 15 distribution platforms, and employs 111,800 people in 33 countries worldwide. Valeo is listed on the Paris Stock Exchange and is a member of the CAC 40 index.

The Product Group Valeo Driving Assistance is leading the development of research projects and innovative solutions in the fields of Advanced Driving Assistance Systems and Automated Driving.
This entity is in charge of all the developments and validations of the exterior sensors (ultrasonic, cameras, radars, laser scanners, rain sensors), as well as electronic control units of different levels of complexity. These control units include sophisticated software modules performing functions like Automated Parking, 360° surround view, Object trajectory detection, etc. The team Driving Assistance Research Germany is more specifically working on the future Driving Assistance functions preparing the future Connected and Automated Driving functions. This team is working on the new technologies such as Machine Learning, Simultaneous Localization and Mapping (SLAM), Trajectory planning. These new developments are integrated, tested and demonstrated on state-of-the-art demo cars which have the authorization to be tested on open roads.

For HEPTAS, Valeo Germany intends to work mainly on providing two demo cars equipped with massive exterior sensing capabilities that can be used as reference and ground truth for the needs of the project. The other main activities will consist in contributing to collect datas for the detection of parking spaces on open roads, and to perform data fusion between on-board SLAM and the 3D HD Digital Map.

CVs of involved key researchers / staff members

Johannes Petzold received his Diploma degree of Information and Communications Engineering from University of Erlangen in 2010. Since then he was working for different Automotive Tier1/Tier2 suppliers like Lear Corporation, ASL-Vision, Continental (ADC GmbH) and Valeo and has gathered a lot of expert experience especially in the field of Advanced Driver Assistance Systems as well as in the field of Highly Automated Driving. Johannes is currently Team Leader for all Research activities in Valeo DAR (Driving Assistance Research) Germany (located in Kronach) and is responsible for all European and German funded projects where Valeo DAR Germany is participating and contributing. His team is mainly working on Artificial Intelligence (DNN) and Computer Vision algorithms and has experience in setting up demo vehicles for automated driving on highway and city scenarios (Valeo Cruise4U and Drive4U). Johannes is Valeo Expert due to his expertise in computer graphics and especially in the field of 3D Surround View system.
Qualifications: Dipl.-Ing Informations und Kommunikationstechnik, 8 years of automotive experience.
Expertise: Surround View, Computer vision, Image Processing.

Dr. rer. nat. Georg Pelzer (male) studied Physics at the University of Erlangen Nuremberg and received his Master Degree in October 2012. Afterwards he continued at the chair for “Experimentalphysik” as scientist and received his promotion in October 2016. The topic of his thesis was: "Investigations on spectral effects in grating-based x-ray phase-contrast imaging". During this time he collected experience with leading and managing funded projects and was involved in proposal for funded projects. With his major experience here he will be one of the fundamental managers on our side managing and contributing to the ICT18-
5GMOBIX project if it will be awarded

Simon-Denis Werner (male) studied Mechatronic at University of Saarland in collaboration with the Ecole Nationale Supérieure d'Ingénieurs en Informatique, Automatique, Mécanique, Energétique et Electronique in Valenciennes (Frankreich) and received his Master and Ingénieur diplomé in 2016. Simon has great experience in GPU based optimisation and programming and is currently responsible for the two Research Demo cars in Kronach that are used for data recording and highly automated driving on highway and urban area. He is also currently involved in other European funded projects (VIDAS and CLSVA) where he is managing the Valeo deliverables and contribution

Mathieu Bulliot (male) studied Mechatronics at Institut National des Sciences Appliquées of Strasbourg (FR) and received his Master in 2013. He received his second Master degree also in 2013 from Telecom Physique Strasbourg in "Master Imagerie, Robotique et Ingénierie pour le Vivant (IRIV)". Mathieu has gained experience in various automotive projects and joined Valeo in 2015. He gained experience in embedded parking solutions and has a strong knowledge of lightweight and efficient software. He is currently working in the Valeo - DSF Cloud and AI team. His main activities concern applying Deep Learning techniques to solve existing limitations or reduce projects complexity.

Heinrich Gotzig (male), Valeo Master Expert, Advanced Development Manager, Product Group Comfort and Driving Assistance

Relevant publications, and/or products, services or other achievements

- Dipl.-Ing. Jörg Schrepfer, Vanessa Picron M. Sc., Dipl.-Ing. (BA) Joachim Mathes, Dipl.-Wirt.-Ing. (FH) Harald Barth, Automatisierte Fahren und seine Sensorik im Test, AZT, 2018/1.

List of relevant previous projects or activities, connected to the subject of this proposal

Project acronym	Funding source/ period	Topic of the project / activities	Relevance and link to HEPTAS
Cloud-LSVA Cloud-Large Scale Video Analysis	H2020-ICT 16-2015 01/2016-12/ 2018	The goal of this project is to define the methodologies and perform the analysis and annotation of video meta-data. Valeo is specifically in charge of : System architecture specification, Scenarios & test cases definition, Data recordings for evaluation by the consortium.	Contribution to HD map update, physical tests
VI-DAS Vision Inspired Driver Assistance System,	H2020-MG 3.6a-2015 09/2016 –08/ 2019	This project goal is to design the next generation 720° connected advanced driver assistance systems. Valeo is contributing on system architecture, specification; use cases definition, standardisation, data recordings for evaluation by the consortium, Driver Monitoring system (no raw data).	Contribution to HD map update, physical tests
@City1	German National Project BMWi, 09/2017 – 08/2021	Valeo is developing requirements and use cases, sensors, fusion and planning for L2/3/4 city , building ; uptest car and show use case parker 2nd row; develop	The project focus on automated driving in cities; AD functions will be realised in prototype and tested in realistic scenarios.

		VLSAM, SCALA DNN, road barrier prediction of future situation evolution in city scenarios	

Description of significant infrastructure and major items of technical equipment relevant to the project

- 2 demo cars with Level 3/Level 4 Automated Driving fully equipped with cameras, laser scanners, radars, GNSS, with data recording capabilities
- Connectivity capabilities provided by Valeo Peiker, such as 3 Telematic Control Units (TCU) equipped with 4G and 5G cellular communication chipsets and their associated smart antennas, as well as the necessary software stack and data transfer protocol interfaces.

Partner 3: FCA Italy	
Company Website: www.fcagroup.com	

Fiat Chrysler Automobiles (FCA), the seventh-largest automaker in the world, designs, engineers, manufactures and sells passenger cars, light commercial vehicles, components and production systems worldwide. The Group's automotive brands are: Abarth, Alfa Romeo, Chrysler, Dodge, Fiat, Fiat Professional, Jeep, Lancia, Ram, Ferrari and Maserati, in addition to the SRT performance vehicle designation and Mopar, the parts and service brand. The Group's businesses also include Comau (production systems), Magneti Marelli (components) and Teksid (iron and castings). In addition, the Group provides retail and dealer finance, leasing and rental services in support of the car business through subsidiaries, joint ventures and commercial agreements with specialized financing services providers. FCA is an international auto group engaged in industrial activities in the automotive sector through companies located in 40 countries and has commercial relationships with customers in approximately 150 countries. FCA is strongly involved in the use and development of new tools and techniques for design, testing and production of its products.
The Group's emphasis on innovation plays a key role in product research and development, including our product strategy.
The FCA company involved in the project is FCA-Italy, primarily with the function of Information and Communication Technology
.

CVs of involved key researchers / staff members

Antonino Santagata is responsible for ICT Public Funded projects for FCA and FCA ITEM organizations. In almost thirty years of experience, he's been responsible of several ICT projects, both for FCA and CNHi groups, within the context of Product Development, Quality and Manufacturing.
He's been in charge of many collaborative regional and national funded projects mainly on ICT technologies applied to industrial processes.

Description of significant infrastructure and major items of technical equipment relevant to the project

Applications, platforms and infrastructure architectures for BIG Data, Analytics, IoT and technologies integration solutions will be provided for the HEPTAS project.

Partner 4: SEAT S.A.	
Company Website: www.seat.com	

Sociedad Española de Automóviles de Turismo (SEAT) is a Spanish car manufacturer, a subsidiary of the German Volkswagen Group, with its headquarters and main manufacturing facilities located in Martorell (Barcelona), Catalonia, Spain. In terms of production, SEAT's Martorell plant is the most important car factory in Spain, recognized with the Lean & Green Management Award, which confirms it as the most efficient factory in the European automotive industry, and a special mention to quality in the Factory of the Year awards for excellence in its manufacturing process. To face the challenges of Industry 4.0 and build one of the smartest, most digitized and coordinated factories in the sector, SEAT has created a new Smart Factory and Innovation department composed of top experts in key paradigms and technologies, such as Internet of Things (IoT), Big Data and Analytics, and Advanced Robotics, among others. This department works closely with Production and Quality areas in new agile labs built to design and test prototypes and to develop pilots. In the project, SEAT will provide its know-how linked to the connected car, what parameters can be extracted from the various embedded sensors, what information is provided and in which format, and how to access them. The resulting data will be passed on to the HPC experts to feed air quality prediction models.

Role in this project

SEAT will provide a key contribution to WP7 (Barcelona air quality test-bed 4). It is the owner of the connected car fleet's data. SEAT will identify the sensors which data will be collected for the purpose of feeding the prediction models run at BSC's HPC. It will program the data collection campaigns that will be sent to the fleet, supervise the good functioning of said campaigns and take counter actions if need be to correct possible emission/reception issues. Given that the collected data will be stored in an infrastructure managed by Audi AG, which will enter as a Linked Third Party of SEAT since both companies are subsidiaries of VW group, It will also coordinate the interactions with Audi to ensure a correct access to the raw data. Finally, SEAT will pre-process the data (data cleaning) before delivery to BSC partner.

SEAT will also be involved in project administration and coordination for the proper progress of the project. All in all, SEAT will contribute to the project activities with 17.5PM in different WPs, namely: WP1 (project management) with 2XPM; WP2 (data governance) with 1PM, WP3 (HCP infrastructure and technology bricks) with 1PM; WP4, 5 and 6 (pilot test-beds 1, 2 and 3 resp.) with 0.5PM in each WP; WP7 (pilot test-bed 4) with 8PM, WP8 (dissemination, communication and community management) with 1PM and WP98 (exploitation) with 2PM.

CVs of involved key researchers / staff members

- **Dr Diego Villuendas Pellicero** (male) is the Head of Market Intelligence unit within the VX – Customer Journey department where he coordinates the activities of data science and data analytics. He also acts as SEAT's representative for data science and business intelligence in several VW group committees in charge of defining the group strategies linked to the generation, use and licensing of data. Additionally, he is a member of the organizing team of DataBeersBCN, a local initiative aiming at converting Barcelona in a world reference hub for data science and big data. Previously, he worked as Assistant Professor at the University of Barcelona where he was in charge of several computer-related courses at graduate and master levels. Dr Villuendas received a B.Sc., a M.Sc. and a Ph.D. in Physics from the University of Barcelona in 2007, 2008 and 2015 respectively and attended in 2015 the postgraduate course on Data Science and Big Data from the same university.
- **Dr Erwan Guillotel** (male) is currently a Data Scientist within the VX – Customer Journey department, in charge of on-demand requests about data generated by SEAT's Connected Cars. He is responsible for programming data retrieval campaigns and the subsequent preparation and analysis of the data, as well as the definition of requirements for next versions of the Connected Car. He received a B.Sc. and a M.Sc. in physics from Uni. Paris 11, France as well as a Ph.D. in Physics from Uni. Paris 7, France and a

M.Sc. in Data Science from Uni. Barcelona, Spain, in 2005, 2006, 2010 and 2017 respectively. Dr Guillotel brings a wealth of project management experience from funded research projects. In FP7, he has successfully served as project manager of coordinated European projects MERGING (GA no. 309150); NANO - TEC (GA no. 257954) and the Spanish CONSOLIDER project nanoTHERM (GA no. CSD2010 - 00044). He has also been involved as a partner in numerous projects, such as NANO - RF (GA no. 318352) and NANOTHERM (GA no. 318117). In H2020 he has coordinated SPIRE - 8 project IbD (GA no. 680565). He is very familiar with all the modalities of EC research projects.

● **Anna Hernández Castellà** (female) is a Business Analyst Manager within the VX – Customer Journey department where she deals with advanced statistical analysis of data generated on SEAT's various platforms. Previously, she worked as Commercial Business Analyst at Spanair, then as Database Manager at vLex.com where she gained a handful experience in data analysis, database management and business intelligence. Ms. Hernández received a B.Sc. in Statistics from University of Barcelona in 2002.

Relevant publications, and/or products, services or other achievements

SEAT currently produces 7 car models (Mii, Ibiza, León, Toledo, Arona, Ateca, and Alhambra) under its SEAT brand and 2 more car models (e-Racer and CUPRA Ateca) under its new CUPRA Sports brand. The production of SEAT cars is distributed among SEAT factories located in Barcelona, Spain, and other Volkswagen Group factories located in Czech Republic, Portugal and Slovakia. SEAT exports 80% of its cars and is present in more than 80 countries through a network of 1.700 dealerships. In 2017, SEAT sold almost 470.000 cars. SEAT also offers car sharing services through its recently acquired start-up company called Respiro and e-mobility services (Justmoove, Shazam, etc.) through its recently created subsidiary company called XMoba.

List of relevant previous projects or activities, connected to the subject of this proposal

Project acronym	Funding source/ period	Topic of the project / activities	Relevance and link to HEPTAS
BIG IoT	H2020-ICT-2015/H2020-ICT-2015 Jan. 2016 – Dec. 2018	The objective of the BIG IoT project is to ignite really vibrant Internet of Things (IoT) ecosystems. We will achieve this by bridging the current interoperability gap between the vertically integrated IoT platforms and by creating marketplaces for IoT services and applications.	The establishment of a marketplace where platform, application, and service providers can monetize their assets could be improved introducing extra HPC services which relance will be demonstrated through HEPTAS pilot test-beds.

Description of significant infrastructure and major items of technical equipment relevant to the project

SEAT will provide its agile labs and other facilities to integrate, test, and validate the proposed solutions coming out from the project in real-life environments. More specifically, the Thinking Lab (Figure 1) and the Tech Lab (Figure 2) are open spaces for innovation to carry out research activities such as challenge exploration, solution ideation, solution feasibility (concept and prototype design, test and validation), and solution pilot development. The Metropolis Lab (Figure 3) is a digital laboratory that aims to analyze and seek out intelligent solutions of the challenges facing future mobility. It is composed of top professionals with significant experience in different areas, with special focus on Big Data and Analytics. SEAT will access data stored in a tailor-made infrastructure with petabytes capabilities called ACDC and property of Audi AG. The ACDC is the infrastructure that the VW group decided to use as a repository for the data generated by the connected cars of all the brands of the group.

Figure 1. A SEAT Production team organizing an innovation workshop in the Thinking Lab

Figure 2. The SEAT Smart Factory team working in the TechLab

Figure 3. SEAT experts in Big Data and Analytics working in the Metropolis Lab

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Partner 5: AVL List GmbH	
Company Website: www.avl.com	

AVL List GmbH is the world's largest privately-owned company for development, simulation, and testing technology of powertrains (hybrid, combustion engines, transmission, electric drive, batteries and software) for passenger cars, trucks and large engines. AVL has about 3700 employees in Graz (Austria), and a global network of 45 representations and affiliates resulting in more than 8600 employees worldwide. AVL´s Powertrain Engineering division activities are focused on the research, design, and development of various powertrains in the view of low fuel consumption, low emission, low noise and improved drivability. The Advanced Simulation Technologies division develops and markets the simulation methods which are necessary for the powertrain development work. The Instrumentation and Test Systems division is an established manufacturer and provider of instruments and systems for powertrain and vehicle testing including combustion diagnostic sensors, optical systems as well as complete engine, powertrain, and vehicle test beds. AVL supplies advanced development and testing solutions for conventional and hybrid vehicle components and systems like simulation platforms, development tools and system integration tools.

AVL is work-package leader for WP5 “Pilot testbed 2 – “eHorizon 5.0” next generation cooperative 3D map based horizon” and WP9: “Innovation management and impact assessment”. In this position, AVL will support the overall project management and will be responsible for one of the pilot testbed. As engineering partner of leading OEMs throughout the world, AVL is constantly seeking for new capabilities and their exploitation. AVL is continuously carrying out research and technical development in the field of advanced automotive powertrains including e-mobility. AVL is active in many European interest groups like ARTEMIS Joint Undertaking (member of the Steering Board), ERTRAC, EARPA, EGVI, European Green Cars Initiative, EUCAR etc. Since Framework Program 3 AVL has been participating in more than 140 European RTD projects as partner and coordinator.

CVs of involved key researchers / staff members

Eric Armengaud received his M.Sc. from ESIEE Paris, in 2002, the PhD. degree from the TU Vienna, in 2008 and the MBA degree from IBSA, in 2016. He has more than 15 years of experience in automotive embedded systems in different positions. He is currently project manager R&D with the responsibility to identify, set-up and manage national and European R&D programs within the AVL PTE business unit. Eric Armengaud is author and co-author of more than 70 peer reviewed publications and patents, and is guest lecturer at the University of Applied Sciences FH Joanneum. Together with Nadine Knopper (in administrative lead) he was technical project coordinator of the FP7 project INCOBAT, and is technical coordinator from the ICT-01-2016 DEIS project.

Nadine Knopper received her Master’s degree in International Business from the University of Applied Sciences FH Joanneum in Graz in 2013. She joined AVL in 2012 and started working for the department of Research and Technology Development for Powertrain Engineering in 2014. She currently holds the position as specialist on EU project management, working in the project coordination of national and international funded projects. In this position, she is the administrative project coordinator for five H2020 projects as well as the administrative and legal contact for more than twenty H2020 projects.

Stephen Jones graduated from Cambridge University UK in 1996 with a PhD. in Natural Sciences. He began working at Ford, initially in Manufacturing, then in Gasoline Engine Calibration/OBD, & finally CAE. Afterwards he joined Prodrive as Lead Engineer Gasoline Calibration. In 2001 he started at LuK in Transmission Controls. He then moved to DE, where after a period as Technical Specialist for vibration damper development, & their electronic integration into powertrains, he became Leader Simulation Techniques where he automated/standardized simulation methods. During this time, he industrially supervised a PhD. in Controls at TU Karlsruhe. Later he worked in the UK at Scottish & Southern Energy, where he established a Condition Monitoring Centre for the generation fleet. Late in 2008 he moved to AVL in AT, initially Leading Production Controls, & later Hybrid & System Simulation. Currently he is Senior Product

Manager Systems & Principal Engineer. He is a Chartered Mechanical Engineer & MIMechE. He is interested in the development of novel simulation methods to frontload the development of vehicles. He has acquired, worked in, & lead advanced & series production projects with many OEM & TIER1 worldwide. Since 2011, when he managed AVL's work in the FP7 OpEneR project, he has remained passionately involved in the development of predictive controls & ADAS, as well as the development of dampers for downsized/hybrid applications. He has published papers in ADAS, powertrain control, simulation, & thermodynamics. He holds various patents. He is a part-time tutor to MSc. students at IFP School in FR.

Relevant publications, and/or products, services or other achievements

- S. Jones, *et al.*, Optimal energy efficiency, vehicle stability and safety on the OpEneR EV with electrified front and rear axles. AMAA 2013, 269-284.
- R. Ellinger, *et al.*, Traffic Light Assistant to increase energy efficiency of EV. ATZ. 2015 Vol. 117. 4-9.
- E. Armengaud *et al.*, Industry 4.0 in the automotive domain as digitalization over the entire product lifecycle, EuroSPI 2017.
- E. Armengaud *et al.*, DEIS: Dependability Engineering Innovation for industrial CPS, 21th Int. Forum on Advanced Microsystems for Automotive Applications. AMAA 2017.
- S. Jones, *et al.*, Optimal electric vehicle energy efficiency & recovery in an ITS. 19th ITS WC, 2012.
- S. Jones, *et al.*, Seamless development of vehicle energy management, recuperation & safety systems: Pure office simulation to 4WD powertrain testbed.
- E. Kural, *et al.*, Traffic Light Assistant system for optimized energy consumption in an electric vehicle, The 3rd Int. Conf. on Connected Vehicles & Expo. Nov. 3-7, 2014, Vienna.
- S. Jones, Adv. co-simulation HMI Environment for Fully Electric Vehicles, IEVC Dec. 2014, Florence.
- J. Holzinger, *et al.*, Objective assessment of driveability while AD. ATZ 2014. Vol. 116.

List of relevant previous projects or activities, connected to the subject of this proposal

Project acronym	Funding source/ period	Topic of the project / activities	Relevance and link to HEPTAS
IMPERIUM	H2020 GV-06-2015 Sept. 2016 – Aug. 2019	Fuel economy is key to reducing operating costs & improving efficiency of freight traffic, so increasing competitiveness. Under the coordination of AVL, the main objective of IMPERIUM is to reduce diesel/urea consumption by up to 20% keeping the vehicle in legal limits for pollutant emissions.	Improvements in predictive and comprehensive powertrain control aimed at performance optimisation of individual components is directly applicable to HEPTAS as basis for the pilot testbed.
DEIS	H2020 ICT-01-2016	DEIS project addresses this important and unsolved challenge by developing technologies that enable a science of dependable system integration.	Link to the dependability management and possible extension for data governance.
OpEneR	FP7-2011-ICT-GC May 2011-Sept. 2014	OpEneR (Optimal Energy consumption & Recovery) developed driving strategies & assistance systems that significantly increased efficiency, driving range, & safety of EV. electric vehicles by merging data from on-board & off-board.	Predictive features like Coasting Assistant & Traffic Light Assistant, provide a very strong basis for the HEPTAS pilot testbed 3.

Description of significant infrastructure and major items of technical equipment relevant to the project

As an engineering service provider, AVL has the know-how, the tools and the equipment which is required within this project; no project related investment costs are necessary. Most of the test equipment and simulation tools is developed and manufactured by AVL, which enables a very high flexibility in case that new systems require updated test procedures.
Worldwide AVL holds a variety of 207 test beds (104 in the headquarters in Graz); including test beds especially equipped for gas engine and exhaust gas after treatment development.

An important strength in AVL's participation to the project is sourced in its ability to design, assemble and test the vehicle using its proprietary tools, methods and services. AVL is investing a wide range or tangible assets and technical competence with the aim of getting the demonstrator vehicles from the concept, through the design, all the way to the real driving environment, where its full potential could be tested, not just in theoretical, but in real terms. This will be valuable to support pilot testbed execution and gathering real data.

Partner 6: FEVItalia s.r.l	
Company Website: www.fev.com	

FEV Italia s.r.l. is the Italian company of FEV Group, an independent internationally recognized company in the design and development of powertrains, power units and burners as well as a manufacturer of prototypes and instrumentation systems. FEV is certified at DIN ISO 9001 in research and development, manufacturing, sale and service - TÜV cert (Certificate registration N° 01 100 0000 10). FEV was founded in 1978 and has now almost 5000 employees at different facilities on four continents of the world. A large number of them are upgrade engineers (PhD and Diploma engineers).
As a supplier FEV conducts the powertrain and power unit development projects from the initial concept phase through production release under direct implementation of the latest scientific discoveries. FEV has extensive experience in designing and developing new power systems as well as in the modification of existing designs. Its capabilities and experiences extend to power system packaging and powertrain systems integration, including the control of integrated powertrain functions, certification, calibration and homologation. FEV develops and uses computational models for the analysis of mechanical stress and noise and acoustic, combustion and flow processes, medium flow and thermal management and for catalysis processes. Simulation activities cover all levels of depth from microscale multi-physics up to system level real-time models for Hardware-in-the-Loop simulation or for embedded systems. Moreover, FEV has gained significant experience in electrification of vehicles from 48 V mild hybrid vehicles to high voltage hybrid electric Vehicles and plug-in vehicles, Range Extender vehicles up to full battery electric and fuel-cell vehicles. The necessary control functions for advanced drive trains such as battery management, energy management, and model based controls are also developed by FEV.
The “FEV Software and Testing Solutions” product portfolio complements these services with cutting-edge test fields, measuring equipment and software solutions that help make the development process more efficient and transfer significant process steps from the road to the test rig – or even to computer simulation.

FEV is also strongly committed to research and innovation and participates to relevant public/private initiatives and European/Local funded projects aiming at continuously extending its know-how and capabilities to exploit them further in development projects with clients from the transport sector.

FEV is active in many European interest groups among which:
- “European Green Vehicle Initiative”, the PPP conceived by the EC in 2009 to focus public and private research on issues of direct and significant relevance to the Europe with regard to the competitiveness of industry and employment;
- “5G Automotive Association” (5GAA) created to connect the telecom industry and vehicle manufacturer to develop end-to-end solutions for future mobility and transportation services. 5GAA commends European Strategy on C-ITS Report for fostering fair competition, technology neutrality and EU wide cooperation.
- European Technology Platform ERTRAC (road transport)
- European Research Platform EARPA the Association of Automotive R&D association that brings together large companies, SMEs, national institutes and universities

FEV is strongly engaged in the new technologies and e-mobility and presented its connectivity solutions for future vehicle communicating with each other and with the cloud at opening of the "5G Mobility Lab” in the Aldenhoven Testing Center (ATC), an urban testing ground currently being created for mobility research.

FEV Italia s.r.l. is committed to participate in the project by providing its automotive and simulation expertise, providing two vehicles and working with the Partners for the implementation of the Turin industrial Test Bed, the deployment of the use cases and achievement of the objectives.
The first act of FEV Italy commitment has been the signature of the MOU “Turin City Lab for Autonomous Driving and Connected Vehicles” (March 30th 2018) between the City of Turin and some of the Italian partners involved in HEPTAS PROJECT (FCA, FEV, 5T, TELECOM ITALIA) *promoting the realization of **a real world urban laboratory** with roads and technological infrastructures where to test autonomous and connected vehicles*.

The agreement promotes the experimentation on the territory of technological solutions for the support of connected vehicles and autonomous driving, as well as the adaptation of the infrastructure network to the most advanced smart services and for automated driving.

FEV Italia plans to involve FEV Europe GmbH as a linked third party for the preparation of the vehicles and support on the communication and control specific SW.

CVs of involved key researchers / staff members

Fabio Mallamo received his Master Degree in Aerospace Engineering from Politecnico di Torino in 2000, and a PhD Degree in Energetics from the same University in 2004.
He has been working in the automotive development field since 2001, both in R&D and in "product engineering" projects. As an R&D automotive engineer, he actively participated in the development of the first "multijet" applications of the Diesel common rail system, at Centro Ricerche Fiat, and was a Researcher and an Assistant Professor at Politecnico di Torino until 2006. In 2006 he joined General Motors Powertrain Europe, where he become responsible of the Calibration development for different Diesel engine families, for European, North-American and Asian markets. In GM he was also the manager of the Numerical Analysis Group, developing advanced models for the prediction of the energy management in automotive applications. In 2013 he founded a start-up company focused on the development of numerical tools for the prediction of the general performance of automotive systems, and in 2014 he joined FEV Italia, where he is currently the Technical Director of the Turin engineering site.

Mauro Scassa received his degree in Mechanical Engineering in 2011 from Polytechnic of Turin with a Thesis on "Numerical simulation of cycle-to-cycle variation and abnormal combustion in SI engine".
He has over 7 year experience on modeling and simulation of electrified automotive powertrains, with focus on emission and consumption prediction as well as energy management. Besides working on customer projects and public founded projects, he's also responsible for a simulation platform development. He joined FEV in 2011 and spent 4 years in Germany at FEV GmbH headquarter. Since 2015 he works as Engineering Group Manager at FEV Italia.

Alberto Migliorero received his MsC in Automotive Engineering in 2007 at Turin Polytechnic with a Thesis on 1.4 turbocharged SI bi-fuel (Gasoline and CNG) engine. After a first experience in CRF (Fiat Research Center) as calibration engineer for heavy duty CNG engines he attended a 16 months program of Powertrain Engineering at IFP school, with an internship at FEV GmbH. Later he had an experience as Altran contractor at PSA for powertrain adaptation. HE joined FEV Italy in August 2010 starting as contractor at GM Powertrain Europe working on Lean NOx Trap technology screening. In 2012 he started a turn key calibration program for FCA which involved him in Turin, Aachen and Detroit, plus several test trips across USA. In 2014 he started being in charge of the Testing and Operations team of FEV Italy for both engine test bench and chassis dyno vehicle activities plus related workshops. He manages today a 15 people team leading all experimental activities in FEV Italy and leading integration of Operation business unit (BO) in FEV Europe.

Ettore Rampa received his degree in Physics in 1988 from University of Turin with a Thesis on "Anti-collision Radar System for Vehicles". He has over 25 year automotive development experience. 12 years in R&D at CRF where he developed the first Real Time HIL simulators (HW, SW and simulation models) for internal combustion engines and worked on Automatic Controls for Hybrids, Fuel Cells and first ADAS developments (ACC, Emergency breaking, Obstacle Avoidance). 10 years in Product Development at IVECO for Power Generation and Industrial applications and 8 years managing the Technical Benchmarking at FCA. Since 2018 he is working at FEV on national and EU funded projects and on Testing and Data Management SW and Tools development.

List of relevant previous projects or activities, connected to the subject of this proposal

Project acronym	Funding source/ period	Topic of the project / activities	Relevance and link to HEPTAS
IMPERIUM	H2020 2016-09-01 to 2019-08-31	Implementation of powertrain control for economic and clean real driving emission and 20% lower fuel consumption	Controls development for hybrid systems and predictive control for energy optimal operation strategy
Advice	H2020 2017-06-01 to 2020-05-31	Advancing user acceptance of general purpose hybridized vehicles by improved cost and efficiency	Usage analysis and market acceptance as well as energy optimization strategies
ASSURED	H2020 2017-11-01 to 2020-10-30	fASt and Smart charging solutions for full size URban hEavy Duty applications	Collection of City & Operators Strategies and Needs
HIFI-ELEMENTS	H2020 2017-10-01 to 2020-09-30	High Fidelity Electric Modelling & Testing	Virtual development process which will heavily support activities within CEVOLVER
ECOCHAMPS	H2020 2015 to 2018	The ECOCHAMP project extends the functionality and improves the fuel economy of hybrid vehicles whilst at the same time minimizing their cost premium. One of the technical approach focuses on modularization and standardization for developments of hybrid components	Usage analysis and market acceptance as well as energy optimization strategies

Description of significant infrastructure and major items of technical equipment relevant to the project

FEV will not claim for cost for major infrastructure and technical equipment.

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Partner 7: SES ASTRA S.A.	
Company Website: www.ses.com	

SES S.A. ("SES"), the parent company of SES ASTRA S.A., is a world-leading satellite operator. Through providing reliable and secure satellite communications solutions, SES connects and enables broadcast, telecom, corporate and government customers, and enriches the lives of billions of people worldwide. SES owns and operates a fleet of over 50 geostationary (GEO) satellites that is complemented by a network of teleports and offices around the globe. This far-reaching infrastructure enables it to reach 99% of the world's population. SES focuses on value-added, end-to-end solutions in two key business units: SES Video and SES Networks. As the leader in direct-to-home (DTH) and High Definition (HD) television, SES transmits over 7,700 TV channels around the world; more than 2,600 of them in HD. SES's satellites reach more than 350 million TV homes worldwide and over 1 billion people around the world. Beyond video, SES enables businesses and communities with reliable data connectivity services. Secured broadband connectivity solutions delivered via satellite is enriching the travel experience on ships and airplanes and catering to the diverse connectivity needs of government and institutions. SES's subsidiary, MX1, is one of the leading media service providers and offers a full suite of innovative digital video and media services. Through its ownership of O3b Networks, a next generation medium-earth orbit (MEO) satellite network combining the reach of satellite with the speed of fibre, SES significantly enhanced existing video and data capabilities. SES is the first satellite provider in the world to deliver a differentiated and entirely scalable GEO-MEO offer with powerful technical capabilities across numerous market segments and geographies. SES is headquartered in Luxembourg and listed on Euronext Paris and on the Luxembourg Stock Exchange (SESG).

As part to its innovation activities, SES, directly and through its affiliates, has been actively involved in several EU, ESA and National R&D projects with major focus on satellite and ground segment technologies.

CVs of involved key researchers / staff members

Edgar Milic (M) was born in Italy in 1972. He received his MSc in Aerospace Engineering from the University La Sapienza of Rome in 2000 and his Executive MBA from the Instituto de Empresa of Madrid in 2006. Today, Mr. Milic is in charge of the Strategic Business Innovation team at SES (2008-2018), one of the cornerstone of SES innovation strategy in new business fields and leveraging innovative systems and technologies. In that role, Mr. Milic and his team have been instrumental in pushing forward SES investments in flat panel electronically beam steering antennas, product developments for the IoT sector and investment in innovative business instruments, e.g. venture capital funds and incubators. In previous roles at SES, Mr. Milic has been responsible for business development in the Middle East and North Africa region, negotiating important deals for achieving access to satellite capacity over the region. Before joining SES, Mr. Milic has covered the position of Commercial and Business Development Director of TCP Sistemas and Ingeneria (2007-2008), a company based in Madrid and providing extensive services to the ESA ground stations network. Additionally, he has developed extensive experience in mission analysis, operations analysis and system engineering during his years at GMV SA, also in Madrid (2001-2007). His experience at GMV has exposed him to multiple satellite projects for the European Space Agency, participating in consortia with the largest European companies, e.g. Airbus, Thales Alenia Space. He is a member of Advisory Board of the Seraphim Space Tech Fund and a mentor of startups within the Luxembourguish ecosystem.

Dr. Alexander Geurtz (M) is a VP, Strategic Business Innovation in the SES Corporate Development department. He has over 20 years of experience in satellite and mobile communications from the strategic, business and technical perspectives. He was a key member of the team that created Solaris Mobile Ltd, an integrated satellite/terrestrial operator in S-Band, representing the company inter alia at 3GPP. He received an MS in Electrical Engineering from Delft University of Technology and a PhD from the EPFL in Lausanne, Switzerland.

Relevant publications, and/or products, services or other achievements

- "Backhaul to the Future", SES, 2018
  https://www.mobileworldlive.com/wp-content/uploads/2018/03/20822-SES-White-Paper.pdf

- "Sky High Connectivity", SES, 2016
  https://www.ses.com/sites/default/files/2016-10/Sky%20High%20Connectivity.pdf

- "Intelligent Transport Systems", ESOA
  https://www.esoa.net/Resources/1296-A4-size-ESOA-2page-Connected-cars-ad.pdf

- "Satellites and IoT", ESOA
  https://www.esoa.net/Resources/A4-IOT-flyer-FINAL.pdf

Product/Service Description:
SES, through its SES Networks business unit, enables telecoms, Internet and Cloud Service Providers (ISPs/CSPs), Mobile Network Operators (MNOs), governments, and enterprises, to dynamically deliver differentiated fixed and mobile communication solutions to their customers in the most inaccessible places on the planet to provide customers with:

1. Managed network infrastructure services with fiber performance and satellite reach
2. Industry and customer focused, purpose built network and communication solutions for market differentiation
3. Carrier-grade core network, backhaul, and mobile edge computing solution

SES operates satellites in both geostationary (GEO) and medium earth orbit (MEO). The SES MEO fleet of satellites orbit close to Earth at 8,062km, transmitting signals in the Ka-Band. This low orbit position provides customers with maneuverable spot beams delivering fiber equivalent data throughput to specific locations on land, in the air, and at sea. MEO powered services continuously optimise the Quality of Experience for users of latency sensitive applications. Complementary to MEO, are GEO fleet satellites that orbit at 36,000km/22,000 miles above Earth, providing wide beam coverage over large geographic areas, transmitting signals in the C, Ku and Ka bands. Traditional GEO and newer GEO High Throughput Satellites (HTS) provide a range of primary and secondary connectivity options suited to customers' specific requirements.

SES provides tailored, industry-focused network and communication services to maximise its customers' opportunities by offering:

- Connect Services – Connectivity as per Customer Requirements
- Network Services – Intelligent, Application-Adaptive Connectivity
- Engagement Services – Partnering for Transformational Change
- Application Services – Optimise Applications for Superior Quality of Experience
- Lifecycle Services – Focus on Customers' Core Business
- Market-Focused Solutions – Purpose-Built for Better Results

List of relevant previous projects or activities, connected to the subject of this proposal:

H2020 5G PPP Phase II SaT5G (http://sat5g-project.eu/): SES has been contributing to the SaT5G (Satellite and Terrestrial Network for 5G) project which aims to research, develop, validate and demonstrate the key technology enablers for "plug-and-play" integration of SatCom into 5G networks, with focus on eMBB use cases.

ESA ARTES SATis5 (https://artes.esa.int/news/esa-live-testbed-satellite-terrestrial-integration-context-5g): SES has been contributing to the SATis5 (Demonstrator for Satellite-Terrestrial Integration in 5G Context) project which aims to build a large-scale real-time live end-to-end 5G integrated satellite terrestrial network Proof-of-Concept testbed, with focus on eMBB and mMTC use cases.

EUREKA Celtic+ LEAN (https://www.celticplus.eu/project-lean/): Through its 100% owned affiliate, O3b Networks, SES has been contributing to the LEAN (Low-cost, Emerging countries, Architecture, Network infrastructure) project which aims to research, develop and demonstrate the new 5G Ultra Low Cost (5GULC) protocol in areas of emerging countries based on combination of complementary technologies.

ESA ARTES 1 MENDHOSA: SES contributed to the MENDHOSA (Media & ENtertainment Delivery over Hetnet with Optimized Satellite Architecture) study which addressed the future satellite technology and integration into 5G. Its main objectives were to elaborate a vision and to propose a strategy for the satellite telecom sector based on an innovative yet realistic technology roadmap, to both alleviate risks and exploit opportunities of the "Digital Disruption" that will affect most sectors of the world economy, and the IT and Media & Entertainment industry in particular, in the coming decade.

ESA ARTES 1 INSTINCT: SES contributed to the CCN of the INSTINCT (Scenarios for integration of satellite components in future networks) study which investigated the feasibility of satellite networks integration with terrestrial clouds to dynamically and optimally offer services towards 5G networks and services. The INSTINCT CCN produced a business and technology oriented whitepaper titled "Assessing satellite-terrestrial integration opportunities in the 5G environment"[1] about positioning satellite solutions in the emerging 5G landscape.

National R&D "Intelligent Satellite Overlay": SES led the Luxembourg-funded innovation project "Satellite-Based Asymmetric Backhaul Solution for 3G/4G Cellular Networks", which addressed an integrated satellite-terrestrial networking concept designed to enhance the traffic-carrying capacity and cost efficiency of existing cellular networks by providing a highly efficient transport path, satellite, for only the most bandwidth-intensive and latency-tolerant content, video. The successful completion of this project led to the currently ongoing U.S. innovation project with **Rutgers University** whose first phase addresses a CDN development to demonstrate and measure the effectiveness of SES's CDN overlay solution in meeting the growing demand for streaming OTT video whereas its second phase will address a national demonstration of the satellite-based CDN through a collaborative effort involving other universities and their network test beds across the U.S.

SES's participation in these research, development, and innovation projects, on a national and European basis, put SES in a strong position to provide the innovative connectivity needs of the HEPTAS project.

Description of significant infrastructure and major items of technical equipment relevant to the project

SES owns and operates the world's largest commercial satellite fleet with more than 65 satellites covering 99% of the globe and world population. SES is strategically positioned as the unique satellite operator to offer combined GEO-MEO service capabilities for state-of-the-art communications globally.

In HEPTAS, SES will provide GEO HTS Ku-band satellite capacity, MEO HTS Ka-band satellite capacity, and associated support services.

[1] https://artes.esa.int/sites/default/files/Whitepaper%20-%20Satellite_5G%20final.pdf

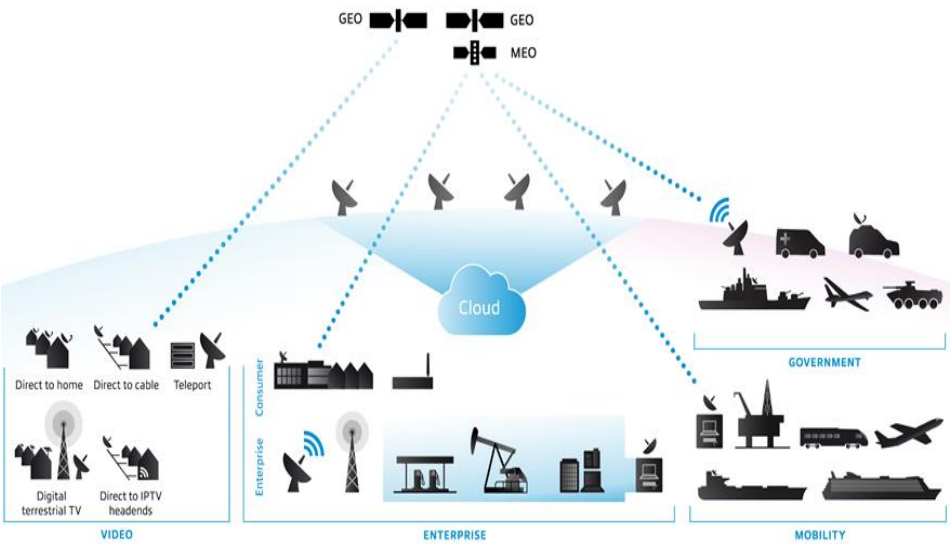


Figure 1: SES network overview

Partner 8: 5T S.r.l.	
Company Website: http://www.5t.torino.it/5t/en//home.jsp	

5T S.r.l. is a private company, full owned by Public Administration, focused on ITS (Intelligent Transport Systems) solutions, with the aim to improve individual and collective mobility.
5T supports their customers, in particular Local Public Administrations, in the design, development and operations of ITS systems and services. 5T has matured a strong experience in all the segments of smart mobility, from traffic management to public transport management, from ticketing systems to travelers information services.
5T also provides specialised consultancy in ITS and sustainable mobility, in order to support all mobility stakeholders in facing the challenges of fast-changing mobility behaviours and models.
Thanks to over 20+ years of experience, 5T is able support local government institutions to address their needs in transport and mobility, providing highly specialized consulting services in the field of ITS. From the pioneering ITS solutions of the early '90s, 5T has designed and deployed, and currently operates, efficient and reliable state-of-the-art ITS systems in North-West Italy.
The ITS platforms operated by 5T include:

- the Urban TOC (Traffic Operation Centre) of the city of Torino, responsible for traffic monitoring, traffic control, limited traffic zone control and speed control;
- the Metropolitan TOC of the metropolitan city of Torino (around 2 Million inhabitants), developed for the XX Winter Olympics Games in Torino 2006;
- the Regional TOC of Piemonte region (over 4 Million inhabitants), in charge of real-time and historical traffic monitoring over the whole regional road network (34,000+ km roads) and of traffic and travel information services (www.muoversinpiemonte.it).

5T is able to provide specialised services along the whole value chain of Intelligent Transport Systems:

- Analysis of intelligent mobility scenario (assessment "as is" and "to be", feasibility studies, SWOT analysis)
- Definition of ITS Master Plans and/or ITS Action Plans
- Design of ITS solutions and project/service requirements
- Development and Coordination of ITS deployment
- Technical Operations of ITS systems and services.

Concerning the role within this project, given its experience in design and development of innovative solutions for traffic control and mobility management in urban or regional contexts.

CVs of involved key researchers / staff members

Fabrizio Arneodo (M) In the PT0302 team of experts, he covers the Data Modeller 4 (assistant) and Dissemination Manager roles. He received a degree in Computer Science, Methodologies and Theoretical basis specialization, from University of Turin (Italy).
He has been active in the Telecommunication domain for 10 years and since 2008 works on Intelligent Transport Systems one. His international experience includes involvement in programs and consultancy in Europe, India, Malaysia and Myanmar. He deal with standardization activities since 2010 at European and Italian national levels, with particular focus on ITS for Public Transport.
Public profile available at: https://www.linkedin.com/in/fabrizio-arneodo-7634564/ .
Giandomenico Gagliardi (M) has a II Level Degree in Civil Engineering – Transportation branch and a II level Vocational Master in Transportation got in 2007 at Technical University of Torino (Italy). In 2007 he made the Personnel Mobility Management Plan for the main hospitals of Torino, commissioned by 5T. In 2008 he joined 5T in R&D department and is involved mainly in management and development of "MATRIX Traffic Supervisor" and in other projects in the ITS and Transport Planning domains. In 2008 he collaborated on the preparation of the "Circulation and Road Transport Infrastructure Plan" for the city of Bacau (Romania). In 2009 collaborated with the Municipality of Torino on the preparation of P.U.M.S., the urban traffic and transportation master plan. In 2011 he was one of the main contributor of the new Traffic Supervision system (so called SVR) for the traffic control and real-time monitoring to the whole Piemonte Region (about 35,000 km): he designed the logical and functional architecture of the SVR system for the traffic control and real-time monitoring to the whole Piemonte Region and then he coordinated all the

activities related to the software provision and the system deployment (operational since 2014). Moreover, he was involved in design and development of technologies for Floating Car Data (FCD) gathering. Currently is the technical manager of the SVR platform, of the FCD collecting and processing system and of the DATEX node (real-time traffic information exchange). He was involved in the "SUMP Yangon Project", coordinated by the City of Torino, with the aim of building the institutional and technical capacity of the Yangon Local Authorities in mobility planning capacity and ITS technologies and solutions in order to increase their performance in the planning processes.

Davide Gastaldi (M) is an ITS expert with 15 years vertical experience as *technical leader* and *customer solution engineer* in designing and integrating complex scenarios. He is currently technical leader for Piemonte Region Electronic Ticketing System "BIP" and the experimental metropolitan IoT wireless network based on LoRaWAN technology; additionally, he takes part in European CEN Workgroup for standardization of on-board telematics network in Public Transport Systems. His experience spans from electronic technology, to network engineering and software development, to field-bus communications. In the past he contributed to several Italian and international projects, including the ATM Messina connected fleet monitoring system, the Expo 2015 mobility and Parking Platform and Torino XX Winter Olympics Traffic Operation Centre. He also directly contributed in development and deployment of Google's GTFS and GTFS-RT open standards.

Relevant publications, and/or products, services or other achievements

Publications

1. Arneodo F., Castelli R., Gagliardi G., Sabatelli F. (2017) – *Muoversi in Piemonte: an integrated platform for infomobility services*, Geomatics Workbooks, December 2017.
2. Emere Arco, Andrea Ajmar, Fabrizio Arneodo & Piero Boccardo (2017) - *An operational framework to integrate traffic message channel (TMC)in emergency mapping services (EM*S), European Journal of Remote Sensing, Volume 50, 2017 - Issue 1.
3. Arneodo F., Botta D., Castelli R. (2017) – *Towards a "Smart Region" paradigm Beyond Smart Cities borders: Piedmont Region experience*, IEEE Explore, June 2017.
4. Bourée K., Tibaut A., Arneodo F., Bjersing U., Duquesne C., JS Knowles N., Reynolds S. (2017) – *Importance Of Data Standards For European Passenger Mobility*, 25th International Symposium ISEP 2017, March 27th 2017, Ljubliana (Slovenia).
5. Arneodo F., Botta D., Gagliardi G. (2016) – *Managing by Data the Governance of Regional Transport Network*, 11th ITS European Congress, 6-9 June 20 Glasgow (Scotland).
6. Arneodo F., Botta D., Gagliardi G. (2015) – *Floating Car Data for wide area traffic monitoring and forecast*, 22nd ITS World Congress, 6-9 october 2015, Bordeaux (France).
7. Berger M., Bottero M., Bono M., Cassinelli P., Dalla Chiara B., Deflorio F. (2014) – *Effetti della priorità semaforica ed ITS sui consumi energetici*, rivista Trasporti Pubblici novembre-dicembre 2014, pag. 31-37.
8. Boccardo P., Arneodo F., Botta D., (2014) – *Application of Geomatic techniques in Infomobility and Intelligent Transport Systems (ITS)*, European Journal of Remote Sensing, Volume 47, 2014 - Issue 1.
9. Arneodo F., Botta D., Gagliardi G. (2012) – *Traffic Supervisor system on wide regional area*. In: Proceedings of the 19th ITS World Congress, 22-26 ottobre, Vienna, Austria.
10. Arneodo F., Foti G., Cocozza M. (2009) – *S.I.MO.NE. Innovative system for metropolitan area mobility management*. In: Proceedings of the 16th ITS World Congress, Stockholm, Sweden.
11. Antoniola M., D'Angelo P., De Cantis G., Foti G., Panero R. (2007) "*Turin: From Pioneer Traffic Management Solutions to the Innovative Access Rights Control System*", In Proceedings of the 14th ITS World Congress, Bejing China.

(see: http://www.5t.torino.it/en/library/)

List of relevant previous projects or activities, connected to the subject of this proposal

ITS Systems and Services Deployment, Operations and Maintenance for the Municipality of Turin

5T is the technical partner for the Municipality of Torino (1 Million inhabitants), in charge to deploy, operate and maintain the overall ITS systems and services related to traffic management in the metropolitan area of Torino. The ITS systems of Torino involve around 500,000 vehicles and 4 Million journeys on average per day.

The involved ITS systems are:

- Traffic Operation Centre (TOC): covering the metropolitan area
- Urban Traffic Control system (UTC): over 300 traffic-lights controlled intersections
- 1,500 Fixed Traffic sensors
- 70 Traffic cameras
- 100 Variable Message Signs (VMS)
- Floating Car Data (FCD) Aggregator: real-time measured traffic data (travel times) on 4,000 km roads
- Public Transport Automatic Vehicle Monitoring system (AVM): 1,400 buses and trams.

The services provided are:

- Traffic monitoring and supervision
- Traffic control
    - Dynamic traffic lights optimization, based on real-time traffic conditions, for traffic flow improvement
    - Dynamic traffic lights optimization for signal priority to public transport
- Traffic jams forecast through traffic supervisor software platform
- Real-time traffic information services and parking guidance (traffic conditions, incidents, road works, availability of parking lots, etc.)
- Real-time public transport information services (journey planner, live bus arrival time, etc.).

The main activities performed are:

- Deployment of ITS systems and integration in the existing ITS platform
- Operations of ITS systems and services, ensuring contractual Service Level Agreements
- First and second level maintenance of ITS sub-systems
- Collection of traffic and public transport data coming from different sources and integration into the ITS platform
- Delivery of real-time traffic and travel information services

Deployment of Business Intelligence tools and dashboards for the Local Administration, based on real-time and historical data.

The ITS systems operated in Torino produce the following benefits, both for the urban Authority and the citizens:

- Private vehicle travel time reduction of 12%
- Public transport speed increase of 13%
- Pollution decrease of 10%.

These results were so interesting that the regional government decided in 2010 to extend the system's coverage to the whole Piemonte regional area (4,4+ Million inhabitants, 25,400 km^2 and 34,000+ km roads), currently in operation since 2014.

TEAM - Tomorrow's Elastic, Adaptive Mobility

TEAM is a 7th FP project that aims at developing systems for participants in transportation networks, which help them to behave better – by explicitly taking into account the needs and constraints of other participants and the network itself. Focus will be placed upon decision-making in a time interval, above what is commonly associated with reactive safety (typically less than 5 seconds) and below long-term planning applications (typically 5 minutes and longer). In this interval human actors can employ modern technology to collaboratively devise socially optimal strategies. Thereby, we believe we will be able to reduce the social cost of traffic while increasing its efficiency and flexibility.

The project is built around four basic themes:

1. Basic technologies to realise collaborative mobility: We will advance communication technologies that underpin V2X by integrating LTE technologies, and by developing an automotive cloud-computing platform to support advanced and decentralised traffic management algorithms.
2. Infrastructure-centric technologies and algorithms for elastic mobility: We will develop proactive infrastructure-centric algorithms and technologies to enable behavioural change in order to improve transportation networks in a way that takes into account real-time needs and constraints of all network users.
3. Distributed technologies and algorithms to realise elastic mobility: We will develop proactive user-, community and group-centric algorithms and technologies to achieve (and complement) the goals of theme 2. The vision is to use nomadic devices such as smart phones or on-board units to realise massively distributed collaborative control and optimisation concepts.

4. Demonstration: the success of the project has been demonstrated via innovative leading-edge cooperative applications and a Europe-wide mobility experiment to illustrate the systems' benefits in a pan-European setting.

Easy Rider: sustainable mobility by integrating intelligent roads, vehicles and services

A research project for sustainable mobility that creates an information-remote platform for the safety and management of people and/or goods in urban environments.

Consistently with the directives of the European Community's 7th Framework Program for a *greener*, *smarter*, *safer*, *integrated* transport system, the project has two strategic objectives:

- the reduction of the environmental impact of road traffic
- the increase in mobility safety in urban and non-urban contexts.

The first objective is pursued by regulating traffic, reducing traveling times and the time required to search for a parking place, and by controlling driving styles.

The second objective is pursued by monitoring drivers' psychological-physical conditions, gathering and sending information to vehicles about the presence of dangers on the roads, emergency calls, increasing efficiency and efficacy of aid in the event of accidents and developing ways to interact with devices on board vehicles which do not distract the driver.

Easy Rider is divided into four sub-projects, each represented by a line of activity. Each activity has the aim of developing an element of a complex architecture comprising cooperative vehicles, infrastructures and service centres.

Easy Rider, therefore, aims to devise and implement a communication network between vehicles, control centres and road infrastructures that allows the provision of services for information mobility and traffic safety in urban contexts, with the possibility of extending it into non-urban contexts too.

The demonstrators has been set up in the city and province of Turin, the city of Rome, on the Naples ring road and in the Region of Sicily.

S.I.MO.NE. - Sistema Innovativo per il MOnitoraggio delle Aree metropolitaNE

In Italy, the integrated use of information and telematic technologies in the transport world allowed to develop systems for fleet monitoring and management, traffic control and traffic light regulation, for survey of atmospheric pollution emissions and the provision of Infomobility services to road users. These systems, although developed in a form that is still not coordinated and with different results, have highlighted the strategic role of telematic technologies in solving mobility problems.

The ever-evolving experience of the 5T system in Turin is one of the first and most significant examples in Europe for monitoring and regulating mobility.

S.I.MO.NE. (Innovative System for Metropolitan Area Mobility management) was a research project founded by Italian government with main object to foster the innovation of local administration offices in the mobility management of metropolitan areas. S.I.MO.NE. was technically coordinated by 5T, under mandate of Torino Municipality (leading partner of the project) and has involved the following public organizations: Bologna and Genova Municipalities, Provinces of Cagliari and Firenze, to provide:

- starting from the existing local operating platforms, the creation of a system for decision support in the management of the mobility of people that allows to measure, evaluate and adopt diversified policies for management and control of mobility and access (LTZ systems and electronic gates) and at the same time providing citizens with accurate information on these measures;
- the use of vehicle fleets as data acquisition (Floating Car Data) to increase the extension and the capillarity of existing information collection systems by reducing the necessary infrastructures on the territory and at the same time improving the timeliness and the significance for the user of the information provided.

Actors involved in the reference scenario was also leader private industrial companies such as: On Board Unit providers, Telco companies, Fleet Managers, Vehicle Service Centres and Traffic Operation Centres.

Key objective of the project was the definition of a framework at national level to collect and aggregate Floating Car Data, to improve mobility management. The criteria definition to accept data coming from Fleet Managers, to project and aggregate FCD on geo-database, to perform Data Completion and to provide Value Added Services were the challenge of the project.

S.I.MO.NE. project have implemented new Decision Support Systems (DSS) and standard communication protocols to address private mobility management, in particular: Traffic Monitoring and Control, Limited Traffic Zones (LTZ) management and Infomobility.

In S.I.MO.NE. project all elements of its architecture have been validated through field tests carried out in the areas covered by the project partners (Bologna, Cagliari, Firenze, Genova and Torino).
The adoption of the S.I.MO.NE. architecture has demonstrated the following main benefits:

- Usage of FCD significantly reduces traffic data collection costs in TOCs (i.e. in 5T Regional TOC), compared to fixed-sensor traffic monitoring equipments;
- Usage of FCD enables TOCs to improve their monitoring with more accurate data and enhance geographic coverage;
- Usage of standard protocol makes easily available a large amount of real time information enabling the deployment of Real Time Services (e.g. provide information to drivers about road works, traffic limitations, traffic flows, congestions etc.);
- The definition of standard communication protocols contributes to the scalability of the architecture facilitating the growth of FCD market and the set-up of new TOC.

Description of significant infrastructure and major items of technical equipment relevant to the project
At urban and metropolitan level, 5T operates the following services in the city of Torino (around 2 Million inhabitants):

- Traffic Monitoring: Traffic Operations Centre (TOC) in the metropolitan area of Torino
- Traffic Control: Urban Traffic Control (UTC), a real-time adaptive traffic light system that covers over 300 controlled intersections, improving traffic conditions and providing priority green light to public transport in the city of Torino
- Low Emission Zone: Limited Traffic Zone (LTZ) control in the city centre of Torino and urban speed control systems
- Public Transport: Automatic Vehicle Monitoring system (AVM) for real-time monitoring of 1,400 buses in the city of Torino
- Traveller Information Services, both for traffic and public transport:
    - Real-time information about traffic conditions, incidents, road works, availability of parking lots, etc. distributed through Variable Message Signs (VMS) and web site (https://www.muoversiatorino.it/en/startpage/)
    - Public transport information services about travel planning, travel times, real-time arrival times at bus stops, etc. distributed through different channels (bus stops displays, on-board displays, sms, apps for smartphones, website).

At regional level (over 4 Million inhabitants), 5T plays the role of technical coordinator in the implementation of the Regional ITS Action Plan of Piemonte Region.
Starting from the experience of the Winter Olympic Traffic Operations Centre, 5T extended the coverage of Traffic monitoring and information systems to the whole regional area. The main duties of the Regional Traffic Operations Centre (TOC) are:

- Traffic monitoring and supervision for the whole regional network (over 35,000 km), based on both traditional sensors and innovative traffic sensors (floating car data)
- Real-time information services about traffic conditions, incidents, road works distributed to motorists through radio bulletin and news reports, website (www.muoversinpiemonte.it)
- Support to local public administrations in transport and mobility planning thanks to historical traffic data collection and analysis

The Regional TOC represents nowadays one of the most innovative and challenging wide-area traffic monitoring projects worldwide, in terms of field range, road network kilometres, capillarity, traffic modelling (based on dynamic traffic assignment algorithm) and traffic prediction capabilities.

Partner 9: Telecom Italia	
Company Website: www.telecomitalia.com	

TIM (the single brand of the Group from the beginning of 2016 which combines Telecom Italia's solidity and TIM's innovation) operates in all the sectors of the advanced communications chain, with highly developed business in fixed-mobile communications and the Internet; in the office & system solutions (Olivetti); in research and development (TIMLab). It is present mainly in Europe, the Mediterranean Basin (TI Sparkle) and South America. At March 31, 2016, TIM has 11,6M retail physical accesses in Italy and a broadband portfolio equal to 9M accesses (7,1M retail and 1,9M wholesale). In the Italian mobile market, TIM is one of the main player with 29,8M lines. Abroad, TIM Brasil is the second largest operator by number of mobile lines (67,3M).

The work carried out by the R&D Departments is the outcome of a strategic partnership with the main manufacturers of telecommunications equipment and systems, and with centres of excellence in research at the most highly qualified national and international academic institutions. On the international level TIM has pledged a substantial commitment to the task of standardisation and has been involved from the beginning in the European Union Framework Programmes starting with the first pilot projects of the ESPRIT programme in 1983 and continuing as one the primary European collaborators in terms of both finance and the number of projects. In the Seventh Framework Programme TIM (formerly Telecom Italia) has been involved in more than 50 projects; in the Programme Horizon 2020 TIM is at present involved in 19 projects.

The digital era has had a strong impact on the behaviour and habits of individuals and companies, requiring a new type of communication with an increasing amount of services and content.

Thanks to advanced technological capacities, the Group can create new markets and new business areas; it has technologically advanced networks, widely distributed infrastructures and integrated platforms, to provide customers with advanced, innovative solutions, and provide access to new ways of communicating.

Expertise from previous and on-going projects:

On the international level Telecom Italia has pledged a substantial commitment to the task of standardisation and has been involved from the beginning in the European Union Framework Programmes starting with the first pilot projects of the ESPRIT programme in 1983 and continuing as one the primary European collaborators in terms of both finance and the number of projects. In the Seventh Framework Programme Telecom Italia is at present involved in more than 40 Projects. Main research areas are: the evolution of mobile communication, from third generation mobile systems to a variety of overlapping wireless networks increasing access flexibility; the diffusion of broadband bandwidth, studying affective techno-economic solutions to deploy optical fibers; the dissemination of identification and localization systems embedding tagging technologies within telecommunication functionality, Future Internet Projects, Smart City Projects.

In particular, related to the key role to be played for this consortium, important to underline is that:

- TI is the coordinator of the XIFI – FI PPP project
- TI is involved in several Projects and in particular is WP responsible for the following related Projects:
    a. ALMANAC SCP (Smart City Platform);
    b. FIWARE FI PPP
    c. Other CPS related project: Compass4d, Mobinet, URBeLOG (Italian funded), Smart Health 2.0 (Italian funded), Maseltov, TEAM …

- TI is actively involved in 3GGP, TISPAN, GSMA and others networks SdO with direct responsabilities. TI is also chairman of OMA (Open Mobile Alliance).

Relevant achievements:

Given the profile and role of TI we list hereby major achievements directly related to this Project and the selected call.

- Management EC funded projects (for example XIFI);
- Member in the FI (Future Internet) PPP Program Steering Board and EBM (Exploitation and Business Models) WG (Working Group). Member of AB (Architecture Board) in phase 1 of FI-PPP Program.
- XIFI Exploitation Manager and Responsible editor of XIFI D10.1 Exploitation strategies.
- Responsible for ALMANAC Project for the provisioning of the capillary network and the M2M platform;
- Responsible for Interface to the Network WP for the FI (Future Internet) PPP Core Platform called FIWARE.

In the past TI was chairman of the ETSI M2M Group and he is currently heavily involved in both ETSI M2M and ONEM2M SdO.

Key Personnel:

Dr. Roberto Gavazzi After completing his Electronical engineering studies at Politecnico in Turin, Roberto worked for three years in the aerospatial area where he spent one year in Toulouse in a European Consortium for designing and developing SW for manned shuttles and satellites. Since then, Roberto has spent more than 19 years in Telecom Italia Laboratories in the telecommunication area focusing first on network management. Afterward Roberto was responsible for the "Service Management" functional unit. In the last years Roberto has been responsible for: Programs (projects cluster) of Service Developments for Telecom Italia and Client Area Management for TILab internal Customers (TI Marketing and Network Departments). Moreover Roberto was Account Manager for TIM (Telecom Italia Mobile) Brazil. Other Roberto's jobs have been: Telecom Italia Technology Plan editor, OMA (Open Mobile Alliance) standard forum Telecom Italia delegate, FI PPP (Future Internet European Commission Program) Architecture Board member, Exploitation and business manager for XIFI Project. In this last period Roberto is managing projects both European funded and Italian on Smart City, Smart Grids and Internet of Things services. During his career Roberto has been speaker at many Telecom Conferences worldwide (IMS World Forum – Amsterdam, Dallas, Singapour - FMC World Forum – Amsterdam, San Francisco - 3GSM series events - Dubai) and Comverse annual User Forum. He is a co-author of one of the chapters of the book: "Broadband Networks, Smart Grids and Climate Change" by Springer:(http://www.springer.com/business+%26+management/book/978-1-4614-5265-2), IEEE paper reviewer invited by Fraunhofer Institute (Prof. Magendaz) and teacher to the postgradute master: Smart Solutions - Smart Communities from University of Pisa - Scuola Superiore Sant Anna.

Partner 10: EMISIA SA	
Company Website: www.emisia.com	

EMISIA S.A. (http://www.emisia.com), established in February 2008, is a spin-off company of the Aristotle University Thessaloniki (AUTh) in Greece, and the managements team consists of previous members of the Laboratory of Applied Thermodynamics (LAT). The company specialises in the areas of emission inventorying and modelling, impact assessment studies of transport and environmental policies, and emissions measurements with the use of PEMS systems.
EMISIA staff consists of mechanical, electrical and software engineers with a strong scientific background in the areas of transport emissions and environmental pollution. The focus is given, but is not limited, to transport emissions of all modes (road, rail and aviation). The expertise of the team has been built in a number of projects funded by either the public or the private (industrial) sectors. In addition, the personnel have been involved in a number of studies related to the formulation of environmental policy at a European level.
EMISIA researchers have developed and use specialised methodologies for the estimation of technological development in vehicle fleets and the calculation of pollutant emissions from transport, mainly through their previous involvement in LAT/AUTh. These methodologies have been fully implemented into relevant computer software. In order to estimate the dynamics of the vehicle stock replacement, the FOREMOVE software has been developed, where the lifetime probability functions and new registrations are estimated. The COPERT software (http://emisia.com/products/copert) is the most recognized and widely used tool for road transport emission inventories. This is supported by the European Environment Agency and the Joint Research Centre, while it has been developed, maintained and constantly updated by EMISIA researchers. A dedicated Australian version of COPERT was developed in cooperation with the Department of Science, Information Technology, Innovation and the Arts (DSITIA) in Brisbane Australia (http://emisia.com/products/copert-australia). Finally, the combination and enhancement of these software tools led to the development of the SIBYL tool (http://emisia.com/products/sibyl) that estimates vehicle stock, energy consumption and air pollutant and GHG emissions up to 2030.
In addition, EMISIA undertakes impact assessment studies from transport, technological and legislative measures, in local, urban, national or international level, with the use of appropriate calculation tools. Finally, EMISIA personnel has been developing software for inventorying of emission sources at a national level, including calculations with the EMEP/EEA Guidebook on emission inventories, reporting over GIS maps, presentation of temporal profiles of road transport activity and other functions.

CVs of involved key researchers / staff members

Dr. Giorgos Mellios (male) is the Managing Director of EMISIA. He graduated from the Mechanical Engineering Department, Aristotle University Thessaloniki and received his PhD in 2007. He has co-ordinated and managed numerous projects of EMISIA, sponsored by the public (including EU Institutions) and private sector. He has almost 20 years of experience in the modelling and inventorying of emissions from road transport and manages the maintenance and further development of the COPERT model. He is contributing to the work of the European Topic Centre on Air Pollution and Climate Change Mitigation and has reviewed and evaluated several methodologies and tools for estimating transport emissions for UNECE and Eurostat. He has also worked on emission testing at periodic inspections, on OBD systems, and on fuel quality issues.

Dr. Leonidas Ntziachristos (male) graduated from the Mechanical Engineering Department, Aristotle University Thessaloniki and received his PhD in 2000. He specialises in the characterisation of emissions from mobile sources, and has extensive experience in conducting research for European projects. He has been responsible for the development of the COPERT emission calculation tool on behalf of the European Environment Agency. His work on fleet emission measurement, modelling and predictions has been conducted in the framework of European research projects such FP6 Transphorm, FP7 ICT-Emissions, LIFE+ EC4MACS, and multiple other studies for the European Commission and the industry. He has been the author of more than 100 scientific and technical papers.

Dr. Petros Katsis (male) graduated from the Electrical and Computer Engineering Department, Aristotle University Thessaloniki and received his PhD in 2011. He specialises in multicarrier communications, EM measurements, resource allocation algorithms, computer programming and custom-designed simulation tools. He has more than 10 years of experience on data processing and handling, review and validation techniques and environmental algorithm development.

Dr. Giannis Papadimitriou (male) graduated from the Technical University of Crete and received his PhD from the Aristotle University of Thessaloniki in 2006. He joined EMISIA in 2012 as a research engineer and, since then, he has been actively involved in many projects related to environmental and energy studies, emission modelling, data collection, processing, and analysis. He has significant experience with vehicle stock and activity data evolution, as well as compilation and review of air pollutant and GHG emission inventories.

Mr. Thomas Papageorgiou (male) graduated from the Applied Informatics Department, University of Macedonia and completed an MSc in Networks, Communications & Systems Architecture. He specialises in computer programming, web programming, database creation and administration, management of wired and wireless networks, multimedia and communication technologies. He has long experience in environmental software development, handling and processing of large volumes of data, and methods, visualization techniques, GIS data processing, etc.

Relevant publications, and/or products, services or other achievements

- Samaras, C., Tsokolis, D., Toffollo, S., Magra, G., Ntziachristos, L., Samaras, Z. 2017. Improving fuel consumption and CO2 emissions calculations in urban areas by coupling a dynamic micro traffic model with an instantaneous emissions model. Transportation Research Part D. https://doi.org/10.1016/j.trd.2017.10.016.
- Samaras, Z., Ntziachristos, L., Burzio, G., Toffolo, S., Tatschl, R., Mertz, J., Monzon, A. 2013. Development of a methodology and tool to evaluate the impact of ICT measures on road transport emissions. Procedia – Social and Behavioral Sciences 48, 3418-3427.
- Samaras, C., Ntziachristos, L., Samaras, Z. 2014. COPERT Micro: a tool to calculate the vehicle emissions in urban areas. Transport Research Arena 2014, Paris, France.
- Toffolo, S., Morello, E., Samaras, Z., Ntziachristos, l., Vock, C., Maier, W., Garcia-Castro, A. 2014. ICT-emissions methodology for assessing ITS and ICT solutions, Transport Research Arena 2014, Paris, France.

List of relevant previous projects or activities, connected to the subject of this proposal

Project acronym	Funding source/ period	Topic of the project / activities	Relevance and link to HEPTAS
ICT-EMISSIONS	Collaborative Project, STREP	The EU FP7 ICT-EMISSIONS project has developed and validated a novel methodology and tool set to	The off-line methods developed in the project will be further elaborated and be used in an

	(Grant Agreement No: 288568) 01/10/2011 – 31/09/2014 + 6 months extension	evaluate the impact of ICT-related transport measures on mobility, energy consumption and CO2 emissions of vehicle fleets under real-world conditions. The methodology combines traffic and emission modelling at micro and macro scales. The integration of micro and macro scales is an important element of the approach, because a measure that influences the behaviour of single vehicles may have an impact on the whole network and vice versa - traffic management on the network level influences the behaviour of single vehicles.	on-line HPC cloud environment in the framework of HEPTAS.

Partner 11: GeoSim Systems Ltd.	
Company Website: www.geosimcities.com	

GeoSim Systems is a private company incorporated in Israel in 2000, headquartered in Israel; GeoSim operates in several regions of the world, primarily in USA and Canada.

GeoSim has developed a complete end-to-end solution for data-collection, data-fusion, 3D-modeling, production management software and Internet-based dissemination of its 3D-models and their applications, which allows unique integration of the physical and digital worlds.

Based on this unique technology, GeoSim creates interactive online 3D-models of real places, which exhibit unprecedented precision and level-of-detail, cover a wide range of scales and augmented with rich semantics.

The main differentiators of GeoSim's 3D reality models are as follows:

- Absolute spatial accuracy of 5-10 cm with 1 cm/pixel level-of-detail.
- Complete ground-level details, including seamless extensions into indoor spaces.
- Built-in "intelligence" based on highly parametric structure and the ability to integrate all city-related data (zoning, utilities, traffic, retail, real-estate, etc.).
- Real-time data streaming supporting continuous 3D-navigation and visualization.

Main professional applications of GeoSim's 3D reality models include a variety of Smart/Safe City use cases (based on integration of GIS and CAD/BIM data), as well as sophisticated traffic simulation and infrastructure for autonomous driving in urban cores.

GeoSim's 3D reality models also support a variety of consumer applications (like immersive integration of shopping, real-estate, tourism, and social media), which are less relevant for the HEPTAS project.

GeoSim's current flag-ship project is a multi-million dollar production of *Virtual Vancouver*. The project in Vancouver is tightly coupled with the city government, achieving the first-of-its-kind integration of city government needs with a 3D real-time dynamic city model. The end result will be a "system of systems" tool for generating multiple dynamic representations of city activities.

GeoSim demo movie is posted at: www.new.geosimmovies.com .

Role in Project

Geosim will lead research, development and implementation of the following tasks:

- Air and ground data collection and 3D reality modeling of a "test-bed" city (Torino).

- Configuring the 3D reality model of Torino into an application platform.
- Integration of the 3D reality model of Torino with autonomous driving simulation and traffic flow situation awareness application.
- Integration of the 3D reality model of Torino with other automotive domain information and communication applications.

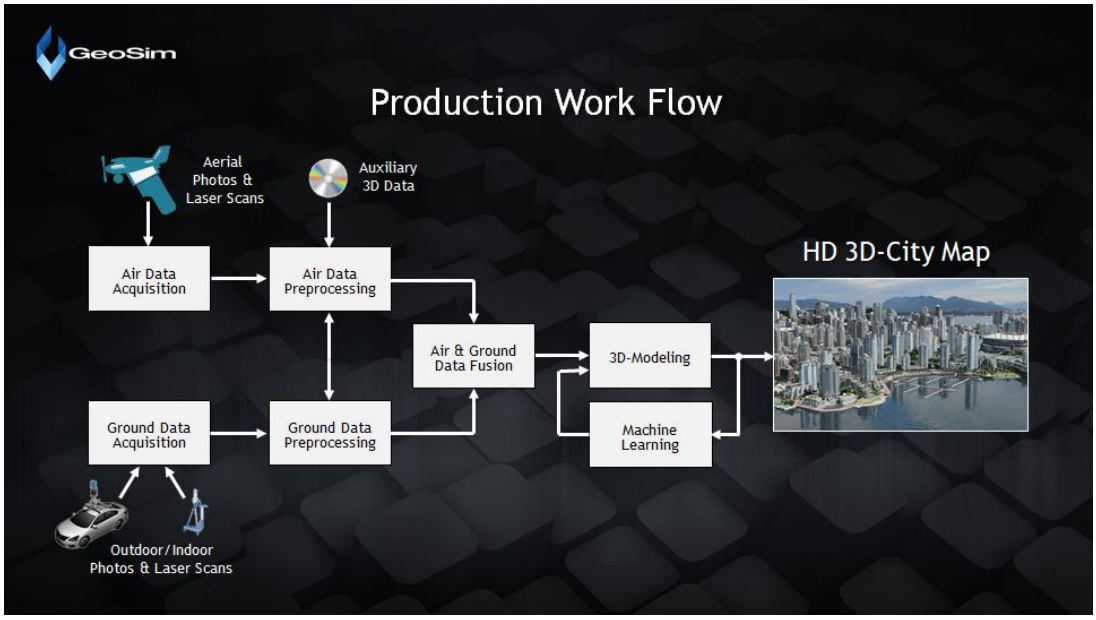
Geosim will also participate in defining system level architecture and the specification of system components and definition of use cases.

Relative Expertise/Experience

General Expertise:

GeoSim's main expertise lays in the following technological areas:

- *Data Collection* – GeoSim developed and operates mobile data collection systems, capturing precise and high-density laser point clouds and high-resolution (RGB) panoramic imagery, along with navigation and 3D attitude metadata (inertial and GPS).
- *Data Preprocessing* – GeoSim developed tools and expertise for geo-referencing of ground data, providing a unique solution for "street canyons" (in which surrounding buildings frequently block GPS signals).
- *3D-Modeling* – GeoSim developed a complete environment for efficient production of precise, large-scale 3D-models.
- *Application Development and Deployment* – GeoSim created a multi-application platform, which allows efficient, Web-enabled utilization of its 3D-models, running on all kinds of devices (desktops, laptops, tablets and smart phones) and operating systems (Windows, iOS, Android, etc.).



Expertise for the project: GeoSim's main contribution will be development and delivery of a high-definition, large-scale 3D reality model of Torino, which will be configured as a multi-purpose application platform. In particular, this application platform will enable multi-user online collaboratgion, which will be used by other consortium members taking part in the HEPTAS project.

CVs of involved key researchers / staff members

Key Personnel's CVs

Victor Shenkar *(Male)* serves as Chief Executive Officer of GeoSim Systems. Dr. Shenkar cofounded Tiltan Systems Engineering and served as its Chief Executive Officer. He was Head of R&D Division of the Israeli Air Force (ret. Colonel). He attained national recognition for his achievements in R&D management,

creative thinking and technological innovation. He is a recipient of a prestigious Israel Defense Prize for outstanding achievements bolstering Israel's defense and security. Dr. Shenkar is a graduate of Technion, Israel (M.Sc. in EE) and of Stanford University, USA (Ph.D. in AA).

Yigal Eilam *(Male)***,** experienced software architect and systems designer; specification and development of complex graphics and image processing applications; in particular: 3D-modeling and visualization, precise navigation and geo-spatial data collection, geo-referencing, fusion and predictive streaming of imagery and laser point clouds.

Ramon Axelrod *(Male)***,** experienced software architect and machine learning expert […]

List of relevant products/services

The main GeoSim products that will be used in the project include:

- Street-Level Data Collector (SLDC):
- 3D-modeling tools – a large set of proprietary plug-ins for Autodesk 3DStudio Max and stand-alone modelling tools (among them: (1) Sldr Auto for automatically registration of ground data, (2) City Show for generation city block borders, border lines, buildings foot prints, SLDC routes, streets delineation, etc., (3) Texture Manager for selection and mapping of textures from Textures Library, (4) Studio Manager for planning and tracking assignments of modellers to City Blocks and to other modelling and QA tasks).
- Machine learning infrastructure for image recognition and 3D modelling.

The main GeoSim services that will be provided in the project include:

- Air and ground data collection.
- 3D-modeling services (based on the collected data).

Street-Level Data Collector

List of Relevant Research Projects

- Virtual Vancouver project.
- The Electro Optic Ground Navigation module (EOG) developed for the Singapore harbour.
- OMEK consortium operating within MAGNET program sponsored and funded by the Israel Chief Scientist of the Economic ministry. OMEK is focusing on application of machine learning to scene understanding and retrieving depth information of objects from variety of sensors, objects classification and tracking, creation of 3D from video and still images. OMEK is highly relevant to the HEPTAS project.

Expected Benefits

The project will significantly extend GeoSim's products line and services, likely to significantly increase current Company's revenue.

Partner 13: Mapillary	
Company Website: www.mapillary.com	

Mapillary provides a street-level imagery platform powered by collaboration and computer vision. As one of the largest street-level images platform. Mapillary is now hosting 270M street-level images contributed by the community including cities from more than 190 countries, where all the images are connected across time, over all contributors, and positioned in a 3D coordinate system for coherent viewing and navigation. Mapillary's cloud-based platform is optimized for large-scale processing and is capable of processing 1M images on a daily basis. With computer vision and deep learning, Mapillary performs strict data anonymization with face and license plate blurs, traffic sign recognition, road scene object recognition, and 3D reconstruction from images which are aggregated to generate map objects and map objects globally.

Mapillary was founded in September 2013 in Malmö, Sweden. The subsidiaries were created in January 2016 (US) and May 2016 (Austria). The company has raised external funding in three financing rounds: $1.5M in December 2014 led by Sequoia, $8M in February 2016 led by Atomico, and $15M in April 2018 led by BMW i Ventures. Mapillary consists of a consortium of three legal entities, Mapillary AB (the Swedish parent company), Mapillary Inc. (a US subsidiary), and Mapillary GesmbH (an Austrian subsidiary). Mapillary GesmbH is the company's main R&D center and leads the developments in artificial intelligence and image recognition.

Mapillary's customers are in three major sectors: geographical information system (GIS) users such a cities and local governments, map makers such as local, regional, national, and international mapping services, the automotive sector especially autonomous driving and transportation.

Main tasks in the project

Mapillary will be leading the efforts in developing algorithms for generating accurate semantic 3D point clouds with video streams from vehicles with the eHorizon 5.0 (WP5). Mapillary will also participate in developing algorithms and providing processing services for vehicle and map updates. Mapillary will also be providing support for data anonymization with computer vision (WP2).

CVs of involved key researchers / staff members

Yubin Kuang received his Ph.D. in Mathematics from Lund University in 2016 for his work in geometric computer vision at Lund, Sweden. He did two internships on computer vision at Apple, Cupertino, during his PhD studies. He has published papers in different computer vision and signal processing conferences including CVPR, ICCV, ECCV, and ICASSP. His main research interests are optimization and deep learning, and their applications in sensor localization, object recognition, and large-scale structures from motion problems. He is the co-founder and leading the computer vision team at Mapillary AB, Sweden. He is currently focusing on developing algorithms for generating accurate map data from images.

Pau Gargallo received his Ph.D. in Computer Vision from the University of Grenoble in 2008 for his work on 3D reconstruction at INRIA Rhône-Alpes. He worked as a researcher in 3D Computer Vision at Barcelona Media, where he participated in the FP7-ICT European projects "20-20 3D Media" and "FINE". In a career parenthesis, he has also worked on data analysis for online advertising systems. He currently works for Mapillary as a Computer Vision engineer developing 3D reconstruction algorithms for world-scale image sets. He is the lead developer of OpenSfM, an open-sourced structure from motion library widely used in the industry.

Gerhard Neuhold received a BSc and MSc (with honours) in computer science from the Graz University of Technology in 2013 and 2016, respectively. From 2007 to 2010, Gerhard worked as a full-time software engineer in the Bing Maps division of Microsoft. He continued working part-time during his computer science studies from 2010 to 2016. At Microsoft, he conducted research and development to build a vehicle-based,

mobile mapping system to collect street-level data on a global scale. Furthermore, he was involved in the complete software development cycle of the industry leading UltraCam product line for digital aerial camera systems. In April 2016, Gerhard joined Mapillary as a Computer Vision Engineer where he is responsible for advancing state-of-the-art algorithms for semantic segmentation and optimizing and scaling them to large-scale production environments on the cloud for 200M+ images. He filed two patent applications.

Relevant publications, and/or products, services or other achievements

- Y Kuang, JE Solem, F Kahl, K Aström (2014) Minimal solvers for relative pose with a single unknown radial distortion. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2014
- Y Kuang, K Åström (2013) Pose Estimation with Unknown Focal Length Using Points, Directions and Lines. International Conference on Computer Vision 2013
- P Gargallo, P Sturm (2005) Bayesian 3D modeling from images using multiple depth maps. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2005
- P Gargallo, E Prados, P Sturm (2007) Minimizing the reprojection error in surface reconstruction from images. International Conference on Computer Vision 2007
- G Neuhold, T Ollmann, SR Bulò, P Kontschieder (2017) The Mapillary Vistas Dataset for Semantic Understanding of Street Scenes. International Conference on Computer Vision 2007
- Samuel Rota Bulò, G Neuhold, P Kontschieder (2017) Loss-max pooling for semantic image segmentation. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2017

Significant infrastructure and major items of technical strengths

As one of the largest street-level imagery platform, Mapillary has built a large-scale processing pipeline for extracting map data and generating map updates from images. Mapillary's platform is cloud-based and is designed as a streaming processing pipeline, i.e. images are uploaded and processed with minimum delays. With Mapillary's engineering expertise, the architecture has been utilized to processed 200M+ images efficiently with the flexibility of scaling up automatically based on processing demand. Mapillary has also built a highly-optimized database for fast spatial and temporal query of extremely large-scale map data e.g. 20 billion map objects. This will be very valuable for enabling efficient data access for vehicle localization and map updates.

Left: Mapillary coverage in April, 2018 Right: Traffic sign recognition from street-level images

Mapillary's well-established computer vision capabilities lie in both object recognition and 3D reconstruction from monocular images. To protect privacy, anonymization is performed on all images with highly accurate face and license plate detection algorithms. From images, with Mapillary's computer vision algorithms, more than 900 traffic signs are detected and recognized automatically. Additionally, Mapillary has developed a state-of-the-art semantic segmentation algorithm which achieves top-ranked accuracy in well-known

benchmark datasets[2]. With semantic segmentation trained on the Mapillary Vistas Dataset[3], which is the largest street-level dataset with instance-aware semantic segmentation created by Mapillary, 97 semantic object classes in the road scene are recognized for each image uploaded to Mapillary. In terms of 3D reconstruction, Mapillary has developed a highly efficient pipeline for processing at scale and handle map updates with well-designed scheduling procedures. Mapillary is also leading the development of the widely-used open-sourced 3D reconstruction library OpenSfM[4]. Mapillary's 3D reconstruction pipeline also consists of components for image-based localization, which can serve as a building block for vehicle localization. By combining semantic segmentation and 3D reconstruction seamlessly, Mapillary has also built the processing pipeline to generate 3D semantic maps from monocular images captured by diverse camera sensors.

Left: Semantic segmentation automatically generated by Mapillary's algorithm. Right: Semantic point clouds generated using only monocular images

[2] Cityscapes Benchmarks: https://www.cityscapes-dataset.com/benchmarks/#scene-labeling-task
[3] Mapillary Vistats Dataset: https://www.mapillary.com/dataset/vistas
[4] OpenSfM Library: https://github.com/mapillary/OpenSfM

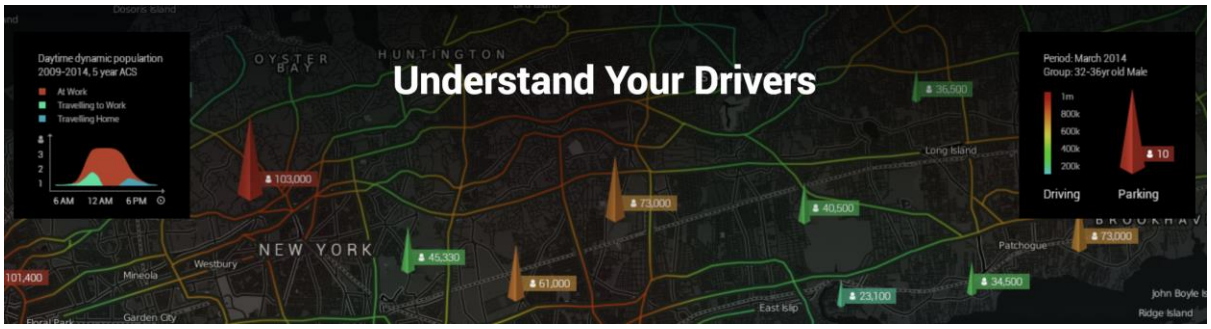
Partner 13: CloudMade	
Company Website: https://cloudmade.com/	

CloudMade is an expert in the design, development and delivery of artificial intelligence based solutions for automotive. CloudMade's software solutions are used by the world's leading OEMs to transform the vast quantities of data generated by today's connected cars into meaningful occupant profiles.

Sitting inside the electronics systems of a connected car, CloudMade becomes the brain of the intelligent vehicle. The profiles created by CloudMade impact almost every functional area of the connected car – from the navigation system to the cockpit, seating, chassis and powertrain. By delivering deeply personalized experiences to their customers, OEMs building upon CloudMade are jumping the AI learning curve to deliver stunning user experiences and equally stunning business performance.

Our Predictive Learning System is a contextual awareness engine that makes cars smarter and drivers happier, safer and more loyal. Cars with CloudMade's Predictive Learning System feel particularly personal to their driver. Using the Predictive Learning System to reward driver loyalty with a car that gets better and better the more its driven, manufacturers create powerful incentives that keep drivers attached to their brand.

CloudMade's Predictive Learning System
Powered by distributed machine learning architecture and modular, extensible inference engines. Architected for security and driver privacy



CloudMade's Car and Driver Analytics Solutions
A full solution that lets OEMs collect, manage, explore and interpret driver analytics

James Brown, CloudMade's CTO (male), has been working in the field of telecommunications, geo-spatial data, database/ERP and retail industries for over 25 years. Jim has spent most of this time on creating new products and building/running technical groups and consulting practices. Jim has great experience working with a mix of large corporates (places like Kmart, Oracle and EDS) and startups/smaller technology organizations (places like Symbian, Sonopia, and SurfKitchen). He has been keeping his hands on technically around database, technical architecture and app development.

Robert Pitt, Director of Intelligent Vehicle (male), leads the CloudMade design team. Robert has worked in large design organisations (Jaguar Land Rover, Samsung and Nokia) and smaller agencies.
Robert brings with him 20 years of experience in creating products, spanning from consumer electronics, domestic appliances and automotive. His specialities include design research; analysis; running the innovation pipeline; creation of physical and digital design for production. Currently, he's developing the next generation of Automotive HMI and the surrounding ecosystem.

Harsha Bagur, Solutions & Program Lead (male), has more than 16 years of experience in the field of Connected Cars, Mobility and Embedded Systems. He has, in the past, worked with Automotive majors like Delphi and Bosch and Mobility device makers like Samsung & Kyocera. He is currently developing innovative Solutions that enable the realization of Connected and Smart Cars.

Partner 14: Factual Consulting (FAC)	FACTUAL
Company Website: www.factual-consulting.com	

Factual is a disruptive innovation and consultancy firm specialized in all things mobility. Factual builds on an extensive international network of highly skilled and experienced professionals, independent consultants, entrepreneurs, researchers who bring in their background and knowledge, adapting to our customers' requirements with a more flexible, sharp, and focused approach than more traditional consultancies. Factual believes in high performance individuals delivering passion, expertise, vision and commitment to fulfilling customers' goals, and always steer towards exceeding them: meeting a customer's goal is not a finish line for Factual; our mindset is already planning for the next frontier, identifying a new revenue stream, working to leverage an unmet opportunity.

Core role of Factual in HEPTAS will be leading and coordinating the overall activities of the Barcelona test-bed stakeholders (HEPTAS actual partners and local urban mobility policy makers), aligning their individual needs, strategic and technical requirements, with the overall project activities and objectives, driving HEPTAS to achieving the sought impact, and effectively measuring and disseminating it to the relevant audiences, maximising the awareness of the HPC-supported measures implemented in the context of urban mobility in Barcelona as inspiration for other cities facing similar challenges, both within the project and beyond.

CVs of involved key staff members

Martí Jofre (male)
Martí Jofre is Factual founder, ITS (Intelligent Transportation Systems) Business Manager at Pildo Labs and Innovation Consultant for Fundació Creafutur. He holds a Master's Degree in Telecommunications, for both Telecom Paris and the Technical University of Catalonia (UPC), and a Master in Marketing Management for EADA Business School. He accumulates a wide experience in the definition, sale and management of R&D and innovation projects, mostly related to satellite navigation applications and urban mobility, obtained at companies such as European Space Agency (ESA), Centre de Tecnologia Aeroespacial (CTAE) and European GNSS Agency (GSA). He is the coordinator of the GSA-funded European project "Galileo for Mobility", aimed at fostering the adoption of Galileo location technologies for Mobility as a Service (MaaS) applications.

Josep Laborda (male)
Josep Laborda is Intelligent Mobility Project Manager at RACC and advisor to Factual. He holds a Master's Degree in Telecommunications for the Technical University of Catalonia. He has a track record in defining business strategies as an analyst at Deloitte. At RACC, he has participated in numerous EC-funded R&D projects in the CASE – Connected, Autonomous, Shared & Service, and Electric – fields. In recent years, he has led the development and launch of the traffic and mobility information service at RACC, and is currently the technical coordinator of new MaaS services. He has served as member of ERTICO ITS Europe Strategy Committee. He is active in several national and international working groups and task forces, including the CARNET platform in Barcelona (Cooperative Automotive Research Network), the FIA task force on connected vehicles and the Mobility as a Service Alliance, where he leads a WG looking at identifying business models and best practices being developed worldwide. He is a part-time lecturer and advisor at the UPC Postgraduate Course on "Smart Mobility: Intelligent Transportation Systems".

Relevant publications, and/or products, services or other achievements

- Jofre, M. "Citizens and the future of Mobility: the Barcelona case", POLIS Annual Conference 2017, Brussels (Belgium)
- Jofre, M., Ortuño, J., Soley, S. "Advanced positioning service for smart mobility applications". ITS World Congress 2015, Bordeaux (France)

- Portouli, E., Amditis, A., Lytrivis, P., Tzanidaki, J., Laborda, J., Rodrigues, N., van Waes, F., Liebermann, J., Dafonte, P. "Traffic Management of the future and Road Automation" (2016). 11th ITS European Congress, Glasgow (Scotland) (conference proceedings)
- Rehrl, K., Salanova, J., Laborda, J., Tzanidaki, J., van Waes, F. 'Traffic Management 2.0 - The Win-Win" (2016). 11th ITS European Congress, Glasgow (Scotland) (conference proceedings)
- Laborda, J. "Loop sensor and Floating Car Data fusion for traffic information in Spain" (2011). 8th ITS European Congress, Lyon (France) (conference proceedings).
- Laborda, J., Castells, X., Hesselbach, X. "Design and implementation of a J2EE platform to handle standardised telematics emergency calls originated from vehicles" (2004). 15th IEEE International Symposium on Personal, Indoor and Mobile Radio Communications, Barcelona (Spain) (conference proceedings).

For a more complete list of articles on urban mobility by Josep Laborda:
https://www.linkedin.com/in/joseplaborda/detail/recent-activity/posts/

List of relevant previous projects or activities, connected to the subject of this proposal

Project acronym	Funding source / period	Topic of the project / activities	Relevance and link to HEPTAS
smartCEM (smart Connected ElectroMobility)	European Commission, Competitiveness and Innovation Framework Programme (CIP), 2012-2015	Main goal of the project was to design and develop services tailored to Electric Vehicles and pilot them in different European cities (Barcelona, San Sebastian, Newcastle, Reggio Emilia) implementing various business scenarios. Mr Laborda was the coordinator of a pilot test in Barcelona of a novel one-way sharing mobility service with electric scooters, which was successfully launched after the project lifetime and currently expanding to other European cities. Mr Jofre was a central contributor to the business model of the service.	HEPTAS will generate insights on the expected impact of innovative urban mobility strategies aimed at solving common issues facing cities today, such as air quality caused by mobility. Accumulated experience in successfully developing, launching and evaluating new urban mobility services (specifically based on EVs) will definitely contribute to the HEPTAS goal of supporting urban mobility policy makers in defining their strategies.
CARNET (Cooperative Automotive Research Network)	Public-Private Partnership, funded by partners	CARNET is a knowledge hub for automotive science and technology, focused on urban mobility, and based in Barcelona. http://www.carnetbarcelona.com	The Technical University of Catalonia (UPC) and SEAT are founding partners of CARNET; Factual is a regular contributor to its activities. CARNET network and links with the mobility industry, local universities and institutional partners will be very valuable for HEPTAS, with the ultimate aim to leverage HPC to achieve true impact in Barcelona urban mobility strategies.
MaaS Alliance	Public-Private Partnership, funded by partners	The Mobility as a Service (MaaS) Alliance is a public-private partnership creating the foundations for a common approach to MaaS, unlocking the economies of scale needed for	Mr. Laborda coordinates a Working Group in the Alliance devoted to assessing pioneer landmark MaaS implementations worldwide to understand best practices,

		successful implementation and take-up of MaaS in Europe and beyond. The main goal is to facilitate a single, open market and full deployment of MaaS services. https://maas-alliance.eu	lessons learned and levers towards successful implementation of MaaS. HEPTAS aims at making recommendations and contributing to the definition of urban mobility strategies (including MaaS) grounded on HPC support. Having the views from other cities having implemented MaaS will be a very valuable complement.
Galileo For Mobility	European Global Navigation Satellite Systems Agency, 2017 – 2020	Galileo For Mobility fosters the adoption of Galileo location technology to support and improve MaaS services. Mr Jofre is the coordinator of the project. http://www.galileo4mobility.eu	HEPTAS will leverage technical inputs and advice from Galileo For Mobility, specifically when MaaS-like services are simulated and its expected impact evaluated contributing to the implementation of future urban mobility measures in European cities.
Citizens and the future of Mobility: the Barcelona case	Joint funding of 11 public and private entities from Barcelona mobility ecosystem	The project aimed at identifying the shift we might observe in the coming years on the attitudes and behaviour of Barcelona citizens related to daily mobility, looking at the impact that shared mobility or urban planning policy might have in modal share distribution. More specifically, the study performed a segmentation of citizens according to their attitudes towards mobility and other sociological aspects, and assess the potential for behavioral shift in each segment.	HEPTAS impact will be assessed according to the citizen segments and behavioural change opportunities as identified in the study.

Partner 15: Barcelona Supercomputing center-Centro Nacional de Supercomputación (BSC)	
Company Website: www.bsc.es	

The Barcelona Supercomputing Center – Centro Nacional de Supercomputación (short named as BSC), created in 2005, is the leading supercomputing centre in Spain. It specialises in High Performance Computing and its mission is twofold: to offer supercomputing facilities and services to Spanish and European scientists, and to create knowledge and technology to be transferred to society. At the BSC, more than 500 people from 40 different countries perform and facilitate research into Computer Sciences, Life Sciences, Earth Sciences and Computational Applications in Science and Engineering. This multi-disciplinary approach and the combination of world-leading researchers and experts in HPC (High-Performing Computing) with state-of-the-art supercomputing resources make BSC unique. The BSC is one of the first eight Spanish 'Severo Ochoa Centre of Excellence" awarded by the Spanish Government, it is managing the Spanish Supercomputing Network, as well as one of the four hosting members of the European PRACE Research Infrastructure. The BSC hosts MareNostrum supercomputer, a Tier-0 PRACE system currently ranked as the #3 most powerful supercomputer in Europe (#13 in the world) with 13.7Pflop/s capacity. In addition, the BSC hosts other High-Performance Computing (HPC) resources, among which it is worth mentioning Minotauro, one of the most efficient supercomputers in the world (#35 in the last ranking of the top500 green list). The Earth Sciences Department at BSC (ES-BSC) has developed into a reference institution in Europe in the field of climate predictions, air quality and atmospheric composition modelling. The Earth System Services group at ES-BSC aims at better understanding and predicting the spatiotemporal variations of atmospheric pollutants along with their effects on air quality, weather and climate and contributes to a variety of forecasting activities and services.

A core activity of the ES-BSC group is emission modelling and air quality from regional to global scales. BSC contribution in the HEPTAS project will be the integration of extended floating car data within the air quality forecasting system CALIOPE for the city of Barcelona to better estimate emissions and air quality levels and develop a tool to analyse the impact of mobility plans in air quality levels.

CVs of involved key researchers / staff members

Dr. Marc Guevara (male)
Dr. Marc Guevara holds B.S. in Industrial Engineering (Technical University of Catalonia, Spain, October 2010) and PhD in Environmental Engineering (Technical University of Catalonia, Spain, December 2014). He is a postdoc researcher with 6 years' experience in the areas of Emissions and Air Quality. His main expertise includes high resolution emission modelling (development, evaluation and improvement), air quality modelling, geographic information systems and environmental impact assessment. He is co-chair of the Emissions Working Group of the FAIRMODE community. He coordinated the development and implementation of an air quality forecast system for the Mexico City's Environment Secretary. He has participated in the Spanish air quality-related CALIOPE-And project and the FP7 Framework programme APPRAISAL, as well as in several national technology transfer projects related with air quality impact assessment. He has participated in capacity building and transfer of knowledge activities with technical people of the Environmental Ministry of Turkey (period of Execution: Jun 2013). He has coauthored 13 papers in international scientific journals and 8 communications to International conferences.

Dr. Albert Soret (male)
Dr. Albert Soret holds a PhD in Environmental Engineering from the Polytechnic University of Catalonia (Barcelona). He is head of the Services group at the Earth Sciences Department of the BSC. The group host ~20 engineers, physicists, social scientists, economists, communication experts and other air quality and climate researchers who try to bring the latest developments in earth sciences to the society. He is a postdoc researcher with 10 years of experience in the areas of Air Quality and Climate. His main expertise includes emission modelling, meteorological modelling, air quality modelling and climate services. His research

facilitates technology transfer from local, national to international levels to advance sustainable development in key sectors such as energy, urban development, infrastructure, transport, health, and agriculture and water management. He is the principal investigator of the S2S4E project (EC-H2020). Work Package leader within Clim4Energy (Copernicus), VISCA (H2020) and MAGIC (Copernicus) and he is also involved in EC-FP7 and H2020 projects: NEWA, EUPORIAS, SPECS, IMPREX, PRIMAVERA and APPRAISAL. He coordinated the development of an air quality forecast systems for Southern Spain-Andalucia and Canary Islands. He has participated in the Spanish air quality-related CALIOPE for the Spanish Ministry and the air quality forecast system for the Mexico City's Environment Secretary. His work has resulted in 11 peer-reviewed publications, 5 chapters in books, proceedings and reports, more than 50 contributions to conferences/workshops/seminars. He is supervisor of several postdocs and three PhD students.

Dr. Francisco Toja-Silva (male)
Dr. Francisco Toja-Silva is Industrial Engineer by the Universitat Politècnica de Catalunya (UPC) and PhD in Aerospace Engineering by the Universidad Politécnica de Madrid (UPM). He carried out doctoral research in micro-scale simulation (using computational fluid dynamics, CFD) of the wind flow in urban areas at the CIEMAT Research Centre (Madrid, Spain) and the Fraunhofer IWES (Oldenburg, Germany). He was postdoctoral researcher at the Technische Universität München (TUM), dealing with high-resolution modelling of pollutant emissions in the urban environment. He is member of the Earth Science Department of the BSC, working with high-resolution emission inventories, meteorology and pollutant dispersion modelling, and air quality assessment in urban environments, focusing on applied projects. He has co-authored several papers in international scientific journals and participated in international conferences.

Relevant publications, and/or products, services or other achievements

- Guevara, M., C. Tena, A. Soret, K. Serradell, D. Guzmán, A. Retama, P. Camacho, M. Jaimes-Palomera and A. Mediavilla (2017). An emission processing system for air quality modelling in the Mexico City metropolitan area: Evaluation and comparison of the MOBILE6.2-Mexico and MOVES-Mexico traffic emissions.Science of The Total Environment, 584-585, 882-900
- Guevara, M., López-Aparicio, S., Cuvelier, C., Tarrason, L., Clappier, A., Thunis, P. (2017). A benchmarking tool to screen and compare bottom-up and top-down atmospheric emission inventories. Air Quality, Atmosphere & Health, 10, 627-642, doi:10.1007/s11869-016-0456-6.
- Lopez-Aparicio, S., M. Guevara, P. Thunis, C. Cuvelier and L. Tarrason (2017). Assessment of discrepancies between bottom-up and regional emission inventories in Norwegian urban areas. Atmospheric Environment, 154, 285-296, doi:10.1016/j.atmosenv.2017.02.004.
- Turco, M., A. Ceglar, C. Prodhomme, A. Soret, A. Toreti and F.J. Doblas-Reyes (2017). Summer drought predictability over Europe: empirical versus dynamical forecasts. Environmental Research Letters, 12, 84006, doi:10.1088/1748-9326/aa7859.
- Soret, A., M. Guevara and J.M. Baldasano (2014). The potential impacts of electric vehicles on air quality in the urban areas of Barcelona and Madrid (Spain). Atmospheric Environment, 99, 51-63. doi:10.1016/j.atmosenv.2014.09.048.

For a complete list of publications of the Earth Sciences Department at BSC:
https://earth.bsc.es/wiki/doku.php?id=publications:publications

List of relevant previous projects or activities, connected to the subject of this proposal

Project acronym	Funding source/ period	Topic of the project / activities	Relevance and link to HEPTAS

CALIOPE	Spanish Enviromental Ministry, Regional administrations and Vodafone 2007-2018	The system operationally provides air quality forecast at 24h and 48h for Europe (12x12 km), the Iberian Peninsula (4x4 km) Andalusia (1x1 km), Canary Islands (2x2 km), Catalonia (1x1 km) and Madrid (1x1 km) by means nesting techniques. http://www.bsc.es/caliope/en?language=en	HEPTAS will take advantage of the CALIOPE air quality forecast system. At the same time HEPTAS will be an opportunity to further develop the emission model to better estimate air pollutant emissions from road traffic and design appropriated air quality management measures to improve urban air quality.
AQFS_MEXICO	SEDEMA	Air quality forecast system for the city of Mexico. http://www.aire.cdmx.gob.mx/	HEPTAs will benefit from the developments done within the context of the air quality forecast system for Mexico.

Description of significant infrastructure and major items of technical equipment relevant to the project

- The high-performance capabilities of BSC and the close collaboration with the HPC experts allow to integrate extended floating car data within the CALIOPE air quality forecast system and to increase the spatial and temporal resolution of atmospheric modelling systems, in order to improve our knowledge on dynamic patterns of air pollutants in complex terrains and interactions and feedbacks of physico-chemical processes occurring in the atmosphere.

Partner 16: CINECA – Consorzio Interuniversitario	
Company Website: www.hpc.cineca.it	

CINECA - Consorzio Interuniversitario established in 1969, is a non-profit consortium of 70 Italian Universities, the National Institute of Oceanography and Experimental Geophysics (OGS), the National Research Council (CNR), and the Ministry of Education, University and Research (MIUR). CINECA is the largest Italian supercomputing centre with an HPC/HPDA environment equipped with cutting-edge technology and highly-qualified personnel which cooperates with researchers in the use of the infrastructure, in both the academic and industrial fields. CINECA's mission is to enable the Italian and European research community to accelerate the scientific discovery using HPC/HPDA resources in a profitable way, exploiting the newest technological advances in computing, data management, storage systems, tools, services and expertise at large.

On mandate of the MIUR Ministry, CINECA represents Italy in PRACE, the Partnership for Advanced Computing in Europe (www.prace-ri.eu), a persistent pan-European Research Infrastructure (RI) providing leading HPC resources to enable world-class science and engineering for academia and industry in Europe. CINECA is one of the PRACE Tier-0 Hosting Centres. CINECA is one of the founding members of the European Technology Platform for HPC (ETP4HPC), an industry led forum providing a framework for stakeholders, to define research priorities and action plans on a number of technological areas where achieving EU growth, competitiveness and sustainability requires major research and technological advances in the medium to long term period. Moreover CINECA SCAI is the Italian representative in the pan-European EUDAT Collaborative Data e-Infrastructure and core partner in Human Brain Project, the EU flagship project facing the big challenge of understanding the human brain.
CINECA is also full member of the BDVA (Big Data Value Association), where is also recognized as i-Space.
The SCAI Department in CINECA has a long experience in cooperating with the researchers in parallelising, enabling and scaling-up their applications in different computational disciplines, covering condensed matter physics, astrophysics, geophysics, chemistry, earth sciences, engineering, CFD, mathematics, life sciences and bioinformatics, but also "non-traditional" ones, such as biomedicine, archaeology and data-analytics.
CINECA has strong relationship with its own stakeholders and collaborates with the scientific communities (including hospitals) to enable and develop new applications and tools to better address the challenges of the High-end HPC/HPDA systems. CINECA has a wide experience in providing education and training in the different fields of parallel computing and computational sciences and is one of the six PRACE Advanced Training Centres (PATCs).
CINECA is involved in several EU projects on-going, which includes ANTAREX, FORTISSIMO2, HBP, HPC_EUROPA3, MAX, PRACE-5IP. A detailed list of the active and closed projects is available at http://www.hpc.CINECA.it/projects

CVs of involved key researchers / staff members

Sanzio Bassini (M) joined CINECA in 1979; in 1981 he was nominated responsible for the scientific computing systems installed at CINECA, and in 1984 he joined the Italian Supercomputer Project that introduced the first supercomputer of this class in Italy. In 1996 he was appointed Director of the High Performance Systems Division, then SuperComputing Applications and Innovation Department.

Paola Alberigo (F) has a degree with honor in Mathematics from the University of Bologna. Since 1998 she is involved in the management of the European Commission funded projects. She has been in charge of the financial and administrative coordination of several projects, I3s, STREPs and IP, from FP4 to H2020. Her skills include the management of project contracts in all the phases, from the "idea" to a successful completion, especially in the financial area. Starting from 1999 she works in the SuperComputing Department of CINECA and in 2010 she got the PMI certification as Project Manager

Roberta Turra (F) is Head of the Big Data Analytics team at CINECA. She graduated in Economic Statistics at the University of Bologna in 1991and has been working at CINECA since 1994 where she's been developing data mining applications for retail, insurance and telecommunication companies. She developed information extraction and semantic annotation tools for the analysis of textual documents in different languages and in different application domains. She participated to several National and European funded research projects and she represents CINECA at the EU PPP BDVA (Big Data Value Association).

Dr. Claudio Arlandini (M) got a PhD in nuclear astrophysics at the University of Heidelberg. He worked as business manager in the area of IT infrastructure management and data center operations at CILEA Interuniversity Consortium, and since the merging of CILEA in CINECA he is involved in simulation and technology transfer services for industries.

Relevant publications, and/or products, services or other achievements

- Giovanni Erbacci, "The SHAPE Programme for Competitive SMEs in Europe". PRACEdays14 Proceedings http://www.prace-ri.eu/pracedays14
- Claudio Arlandini, Roberto Vadori, "Design improvement of a rotary turbine supply chamber through CFD analysis". PRACEdays14 Proceedings http://www.prace-ri.eu/pracedays14
- Giovanni Erbacci, Stephane Requena, Ari Turunen, Tina Leiponen (eds), "PRACE OpenR&D: a Catalyser for innovative Industrial Processes". PRACE Digest 2013,N.2 http://www.prace-ri.eu/PRACE-Digest
- Fiameni, Mariani et al. "A HPC Infrastructure for Processing and Visualizing Neuro-anatomical Images Obtained by Confocal Light Sheet Microscopy" – Proceedings of HPCS'14.
- Riedel, Fiameni, Cacciari, et al. - "A data infrastructure reference model with applications: towards realization of a ScienceTube vision with a data replication service" - Journal of Internet Services and Applications 2013, 4:1 doi:10.1186/1869-0238-4-1

List of relevant previous projects or activities, connected to the subject of this proposal

Project acronym	Funding source/ period	Topic of the project / activities	Relevance and link to HEPTAS
EUDAT/EUDAT2020	H2020 FP7-INFRASTRUCTURES-2011-2 (2011-2015) / H2020-EINFRA-2014-2 (2015-2018)	The EUDAT project aims to Europe's scientific and research communities with a sustainable pan-European infrastructure for improved access to scientific data.	The modules and services related to data management are directly applicable for integration in the HEPTAS platform
PRACE	H2020 PRACE-5IP: H2020-EINFRA-2016-1 (2017-2019)	EU Research Infrastructure, funded under the PRACE Preparatory and Implementation Phase Projects (latest: PRACE-4IP 2015-2017, PRACE-5IP, 2017-2019). Its mission is to enable high impact scientific discovery and engineering research and development across all disciplines	The modules and services related to HPC systems provisioning are directly applicable for integration in the HEPTAS platform

		to enhance European competitiveness for the benefit of society. PRACE offers world class computing and data management resources and services through a peer review process.	
ICARUS	H2020 H2020-ICT-2017-1 (2018-2020)	Using methods such as big data analytics, deep learning, semantic data enrichment, and blockchain powered data sharing, ICARUS will address critical barriers for the adoption of Big Data in the aviation industry (e.g. data fragmentation, data provenance, data licensing and ownership, data veracity), and will enable aviation-related big data scenarios for EU-based companies, organizations and scientists, through a multi-sided platform that will allow exploration, curation, integration and deep analysis of original, synthesized and derivative data characterized by different velocity, variety and volume in a trusted and fair manner.	The architectural structure developed in this project may be adapted to HEPTAS
FORTISSIMO 2	H2020 H2020-FoF-2015 (2015-2018)	The Fortissimo Marketplace provides onestop, pay-per-use, on-demand access to advanced simulation and modelling resources including software, hardware and expertise. The marketplace helps find novel solutions to your challenges discover new opportunities and brings together all necessary actors to construct the exact solution that meets your business requirements.	Link to the exploitation phase

Description of significant infrastructure and major items of technical equipment relevant to the project

The main systems of the current HPC infrastructure available to CINECA users are:

- MARCONI-A1 partition: consists of 21 Lenovo NeXtScale racks with 72 nodes per rack. Each node contains 2 Broadwell processors each with 18 cores and 128 GB of DDR4 RAM
- MARCONI-A2 partition: consists of 3600 Intel server nodes integrated by Lenovo. Each node contains 1 Intel Knights Landing processor with 68 cores, 16 GB of MCDRAM and 96 GB of DDR4 RAM. Marconi-KNL has been ranked at Number 12 in the Top500 list (November 2016)
- MARCONI-A3 partition; is based on 2*24-core Intel Xeon 8160 with 192 GB DDR4 RAM (SkyLake); 1.512 nodes at first, followed by about 800 more, few months later, will complete the system, reaching a total computational power of about 20Pflop/s.
- DAVIDE: is a Petaflop-class HPC solution, designed, integrated and tested by E4 that is based on OpenPOWER architecture, funded by Pre-Commercial Procurement by PRACE, and it is devoted to

AI applications. It consists of Power8 processors with NVlinks bus and the GPGPU Nvidia Tesla P100 SXM2.

The CINECA data centre is equipped to provide business continuity technology. A virtual theatre, where viewers can make a semi-immersive virtual reality experience, completes the entire infrastructure..

Partner 17: INFN	
Company Website: www.infn.it	

INFN (National Institute for Nuclear Physics) is the Italian research agency dedicated to the study of the fundamental constituents of matter and the laws that govern them, under the supervision of the Italian Ministry of Education, Universities and Research (MIUR). It conducts theoretical and experimental research in the fields of subnuclear, nuclear and astro-particle physics. All of the INFN's research activities are undertaken within a framework of international competition, in close collaboration with Italian universities on the basis of solid academic partnerships spanning decades. Fundamental research in these areas requires the use of cutting-edge technology and instruments, developed by the INFN at its own laboratories and in collaboration with industries. In the ICT area, INFN has been developing all along in-house open innovative solutions for its own advanced needs of distributed computing and software applications. It has a remarkable excellence expertise on Grid and Cloud technologies, having fostered and participated, with leadership roles, to many of the large Projects financed by EC, that promoted the realization of the European Grid Infrastructure – EGI. INFN led the INDIGO-DataCloud project, under Horizon2020 EU Framework Program for Research and Innovation, and participated actively to the Open City Platform national project, funded by the Italian Ministry of Education and Research and belonging to the Smart Cities and Communities framework.

Main tasks attributed in the project

INFN operates a large and inter-connected distributed computing infrastructure throughout Italy, thanks to the distributed nature of his facilities across Italy (4 Laboratories and more than 20 Divisions). INFN has been part of the global projects fostering the development and adoption of the GRID, and has been key partner in the definition of the interfaces used by current generation of data-crunching experiments. More recently, INFN is participating in computing efforts towards biological science medical sciences, biology and genomic. INFN has been developing, hosting and supporting large scale computing facilities and tools. Besides classical distributed computing solutions, INFN has also pioneered multi-site solutions, where geographically detached sites are presented to the users as a single logical entity. The development of tools enabling high performance access to scientific data, and the deployment of the infrastructure needed to support them, have been part of INFN competences.
INFN will contribute its expertise to the project in the areas of HPC (WP3 and support to the different industrial pilot testbeds)

CVs of key people

Antonio Zoccoli (M) is Full Professor in Physics at the University of Bologna and vice-president of INFN, he is a member of the INFN Executive Board. He is also the President of Fondazione Giuseppe Occhialini (Fossombrone-Italy) and member of the Consortium GARR Board of Directors. He is a member of the Board of Directors at the Gran Sasso Science Institute (GSSI). His scientific activity focused on the study of exotic states predicted by the QCD theory, like glueballs and hybrids and contributed to the study of the production and decay of heavy quarks in hadronic interactions. More recently, he actively worked on the Higgs Boson search and discovery, Higgs couplings measurements, Supersymmetries studies and search for new physics beyond the Standard Model. He has been involved in the OBELIX Collaboration at LEAR (CERN), in the HERA-B Collaboration at HERA (DESY) and is now participating to the ATLAS experiment at CERN. He is also a member of the FOOT (FragmentatiOn Of Target) collaboration (Italy).

Davide Salomoni (M) is Director of Technology (Dirigente Tecnologo) at the Italian National Institute for Nuclear Physics (INFN). His role is Manager of the Research and Development team at CNAF (the INFN National Center for research and development on IT technologies), Bologna. He is the Project Coordinator of the INDIGO-DataCloud project [https://www.indigo-datacloud.eu], which has the goal of developing an open source, multi-disciplinary Cloud platform for computing and data tailored to science, deployable on public and private Cloud infrastructures. He also leads or participates to several national and international projects. Davide is the coordinator of the INFN Cloud computing workgroup and is engaged with activities related to teaching and technology transfer in universities, Public Administrations and industries through seminars,

courses and lectures. He is member of the EGI Executive Board and collaborates with EOSC-hub, a project jointly prepared by INDIGO-DataCloud, EGI and EUDAT.

Alessandro Costantini (M) is working as a Researcher in Technology (Tecnologo) at the Italian Institute for Nuclear Physics (INFN). Since 2007, he acquired experience working within national and international initiatives dealing with distributed and parallel computing. During the EU-funded EGEE project series and EGI-InSPIRE project he worked for the Italian Grid Infrastructure fulfilling the deputy manager role in User Support activities becoming an expert in the application porting to different distributed computing platforms such as distributed computing GRIDs, HPC systems and low power architectures. Since 2014 he is working in the Distributed Systems group at the INFN National Centre for research in ICT technologies (CNAF) where he enriched his expertise becoming a Cloud technologies expert and operating in different national and international projects. Recently, he enriched his expertise in project management by leading the project management activities of the eXtreme-DataCloud project and being the local representative for the DEEP Hybrid-DataCloud project.

Stefano Bagnasco (M) is currently a Technology Researcher (Tecnologo) at the Italian Institute for Nuclear Physics (INFN) and head of the INFN-Torino Computer Centre. He is a member of the ALICE Computing Board, of the INFN Computing and Networks Committee and of the Scientific and Management Boards of the Scientific Computing Competence Centre of the University of Torino. Since 2002 he has been working in the field of Scientific Computing, first in the contexts of the EU-Funded DataGrid and EGEE projects and then of the INFN-Torino Computer Centre, which also hosts and jointly manages OCCAM, the University of Torino HPC facility. He gained both technical and managerial experience in the design, building and operations of Scientific Computing facilities, distributed computing, Cloud technologies applied to Scientific Computing, also as a member of the EU-funded INDIGO-DataCloud and DEEP-HybridDataCloud projects. Recently he has been instrumental in the creation of the Scientific Computing Competence Center (C3S) of the University of Torino

Relevant publications

1) D. Salomoni *et al.* (2016), “INDIGO-Datacloud: foundations and architectural description of a Platform as a Service oriented to scientific computing”, http://arxiv.org/abs/1603.09536
2) M. Bencivenni *et al.* (2014), “Accessing Grid and Cloud Services through a Scientific Web portal”, *J. of Grid Computing* DOI:10.1007/s10723-014-9310-y
3) D. Cesini *et al.* (2013), “Porting workflows based on small and medium parallelism applications to the Italian Grid Infrastructure”, in the Proceedings of Science for the International Symposium on Grids and Clouds 2013 (ISGC2013), Mar 2013, Taipei, TW, ISSN 1824-8039
4) S. Bagnasco *et al*. (2015), “Interoperating Cloud-based Virtual Farms” *J. Phys.: Conf. Ser*. **664** 022033

Relevant Projects or activities

1) **eXtreme-DataCloud** (http://www.extreme-datacloud.eu/): an H2020 project follow-up of the INDIGO-DataCloud. Deals with the development of data management services for extremely large datasets in heterogeneous and distributed e-infrastructures.
2) **DEEP-HybridDataCloud** (https://deep-hybrid-datacloud.eu/), an H2020 project follow-up of the INDIGO-DataCloud. It aims at integrate heterogeneous cloud resources through a Hybrid Cloud approach, focusing on intensive computing techniques for the analysis of very large datasets, exploiting specialized hardware components like GPUs and low-latency interconnects.
3) **INDIGO-DataCloud** (https://www.indigo-datacloud.eu): an H2020 project, coordinated by INFN, developing a cloud platform to support different scientific communities in their use of federated computing and storage resources
4) **EGI-Engage** (https://www.egi.eu/about/egi-engage/): INFN participates to the EGI infrastructure with its many resource centers and its software solutions and services. Its CNAF National Data Center is one of the largest computing and storage centres in the EGI federation and a key asset of the WLCG infrastructure. INFN is also coordinator of the EGI Italian JRU.

5) **Helix Nebula Science Cloud** (http://www.helix-nebula.eu), a Pre-Commercial Procurement (PCP) project co-funded by the European Commission Horizon 2020 Programme, aiming to create a competitive marketplace of innovative cloud services serving scientific users from a wide range of domains.

Significant Infrastructure and Equipment

INFN has deployed in the last 15 years a distributed computing system, located at its units and laboratories across Italy. The major computing infrastructures are contributing resources to WLCG to support the LHC Experiments and several other international scientific collaborations. INFN operates a Tier-1 data center (located at CNAF, in Bologna), and 10 Tier-2 sites, including one in Torino. The resources deployed at CNAF amount to of computing power (close to 30000 computing cores), 30 PB of net disk space and 30 PB of custodial tape. The total aggregated resources offered by the Tier-2s are again in the order of few hundreds of kHS06 and 20 PB of disk resources. The connection between INFN sites, provided by GARR (the Italian NREN), normally is provided using 10 Gbit/s Ethernet technology, with a link of 40 Gbit/s towards the international partners (via GEANT network).

Partner 18: ITHACA	
Company Website: ithacaweb.org	

The non-profit association **ITHACA**, based in Torino, Italy, is a centre of applied research devoted to support humanitarian activities in response to natural disasters by means of remote sensing techniques. ITHACA has built strong competences in the field of acquisition, management and elaboration of geographic and cartographic data for emergency response purposes, delivering methodologies, analytical services and technical tools to improve the capacity of the international humanitarian community in early warning, early impact assessment and other risk management related areas.
The association was founded in November 2006 by Politecnico di Torino, with the financial support of Compagnia di San Paolo and in cooperation with the WFP (World Food Programme) - the food aid arm of the United Nations and the world's largest operational humanitarian agency.
The assigned UKAS international certification ensures the compliance of the services offered by ITHACA to the UNI EN ISO 9001:2008.
Concerning the role within this project, given its long-lasting experience in acquiring and managing spatial data, ITHACA will be mainly involved in the design and implementation of the project Spatial Data Infrastructure and in the Horizon 5.0 test-bed, developing algorithms aimed to create 3D models from imagery acquired by on-board cameras and compare them with 3D reference models.

CVs of involved key researchers / staff members

Andrea AJMAR (Male)
Andrea Ajmar holds a master degree in Geology (Università degli Studi di Milano, 1994) and a Ph.D. in Environmental Engineering (Politecnico di Torino, 2010). He has more than 20 years of experience in environmental studies, with all the support provided by Geographic Information Systems: from geostatistical approaches for soil classification, to global soil cartography and databases, to flood risk reduction analysis and modelling, to interferometric DEM derivation, to geodatabases and SDIs development. Since joining ITHACA in 2007, he has covered the role of Project Manager in several international projects focusing on i) SDIs mainly dedicated to emergency response, ii) E-R model for geographic data storage, iii) multiuser geodatabase management, iv) software procedures in support of early-warning and early impact analysis. He is currently senior staff at ITHACA, member of the Rapid Mapping team since 2012. He has been involved as trainer in GIS for international organizations, NGO's and local authorities, mainly in developing countries. He has been Member of the scientific committee of ASITA (Federation of the Italian Scientific Associations devoted to Geomatics and Environmental applications) in the period 2008-2012 and Secretary of the ISPRS (International Society for Photogrammetry and Remote Sensing) ICWG IV/VIII - Updating and Maintenance of Core Spatial Databases in the period 2008-2012.

Fabio GIULIO TONOLO (Male)
Fabio GIULIO TONOLO has a master degree in Environmental Engineering (Politecnico di Torino, Italy, 2001) and holds a Ph.D. in Geodesy and Geomatics (Politecnico di Milano, Italy, 2005). He is currently senior researcher and geographic information specialist at ITHACA, where he is in charge of the emergency mapping activities and covers the role of Project Manager for several international project. His main interest is on research and operational activities focused on the use of geomatics techniques to provide spatial data services including acquisition, management and processing of geo-spatial data. He was involved in different Italian national projects of relevant interest also focused on the use of high resolution satellite imagery for large scale map updating/generation, evaluating the positional accuracy (2D and 3D) and the information content. He carried out studies on the evaluation of the accuracy of DTM/DSM derived by satellite stereopairs. Dr. Giulio Tonolo has been lecturer in several training courses (also in developing countries) for both universities, NGOs and private companies and is co-author of more than 70 national and international publications, among which an article on the prestigious journal SCIENCE. He has the national scientific qualification to function as associate professor in Italian Universities for the period 2015-2020.
He is member of the Steering Committee of the Italian Association of Remote Sensing since 2014 (member since 2003).

Simone BALBO (Male)
Simone Balbo holds a Master's degree in Environmental Engineering (Politecnico di Torino, 2008) and a Ph.D. in Environmental Protection and Management (Politecnico di Torino, 2012). He specializes in GIS software development, GPS surveys, Mobile Mapping Systems surveys, Spatial Data Infrastructure management, GIS data processing. He was short term consultant at the Global Facility for Disaster Recovery and Reduction of the World Bank - Washington, DC (US) on the implementation of a Web platform for geospatial data sharing in 2011. In 2012-13 he was consultant for the WFP for the development of their Spatial Data Infrastructure. He is currently senior staff at Ithaca, member of the Rapid Mapping team since 2012.

Lorenza BOVIO (Female)
Lorenza Bovio has a Master's degree in Environmental Science (University of Milano-Bicocca, 2006). She has more than ten years' experience in remote sensing multispectral data processing in support to environmental analysis and thematic information extraction with particular focus on pixel and object oriented classification, time series analysis of optical image data. Furthermore, she has been involved in the development of applications for automatic image processing and 3D image analysis.
From 2007 to 2014 she has worked as remote sensing specialist for an Italian consulting company in the field of water resources management, hydraulic and geophysics and she has been involved in projects mainly in Iraq and Kazakhstan.
She is currently environmental researcher at Ithaca supporting the activities of the EU GMES/Copernicus Initial Operation - Mapping in Rush Mode project and Land Cover validation for "Global Land High Resolution Hot Spot Monitoring within the Global Land Component of the Copernicus Land Service (C-GL-HRM) – Lot 1" - 2015-2019.

Irene ANGELUCCETTI (Female)
Irene Angeluccetti holds a Master's degree in Territorial and Environmental Engineering (Politecnico di Torino, 2007) and a Ph.D. in Environmental Protection and Management (Politecnico di Torino, 2014).
She is currently collaborating with Ithaca working on drought the development of models for the detection and monitoring through satellite data analysis and on the following projects: Malawi Spatial Data Platform; EU GMES/Copernicus Initial Operation - Mapping in Rush Mode.
From 2008 to 2010 she has worked as project manager for international NGOs in Africa (Burkina Faso and Mali) working in the cooperation and development sector. Since 2010 she has been collaborating with NGOs in the field of water management and soil conservation. She has also joined the Vulnerability Analysis and Mapping unit of Niger WFP office for an internship during her Ph.D.

Paolo PASQUALI (Male)
Dr. Paolo Pasquali has a master degree in Architecture (Politecnico of Milano, 1998). During his studies he focused on computer graphic design and GUI. He has a ten-year experience in the private sector in digital cartography as responsible for Location Based Services and technical coordinator. He worked on projects for mobile and web based GIS applications (such as routing with traffic and weather conditions and fleet management) and Portable GPS Car Navigation Systems. Since joining Ithaca in early 2008 he has developed WebGIS applications based only on Open Source Software in order to publish and distribute 2D and 3D data layers. He is currently developing web applications based on a flood early warning system and a drought monitoring service.

Luciana Dequal (Female)
Luciana Dequal holds a Master's Degree in Foreign Languages (Torino University, Italy, 1998). She has 20 years of experience in international projects, external relations and international bids. Before joining ITHACA in 2008, she worked for 2 years as Export Dept. Manager in an Italian SME operating in the electro-medical sector and for 8 years in the business promotion area at the Foreign Trade Office - Piemonte Chambers of Commerce, where she was in charge of the organization of collective participation to international

Relevant publications, and/or products, services or other achievements

Publications

• GIULIO TONOLO F., FRANCESCO NEX, FRANCESCA PEREZ, MARCO PIRAS (2008). 3-D map production using an Orbview-3 stereo pair. In: Geoinformation in Europe. Bolzano, June 2007, ROTTERDAM: Millpress, vol. 1, p. 601-608, ISBN/ISSN: 978 90 5966 061 8
• AGOSTO E, AJMAR A, BOCCARDO P, GIULIO TONOLO F., LINGUA A (2008). Crime Scene Reconstruction Using a Fully Geomatic Approach. SENSORS, vol. 8; p. 6280-6302, ISSN: 1424-8220, doi: 10.3390/s8106280
• AJMAR A, BALBO S, BOCCARDO P, GIULIO TONOLO F, PIRAS M, PRINCIC J (2011). A Low-Cost Mobile Mapping System (LCMMS) for field data acquisition: a potential use to validate aerial/satellite building damage assessment. INTERNATIONAL JOURNAL OF DIGITAL EARTH, ISSN: 1753-8947, doi: 10.1080/17538947.2011.638991
• ARCO E., AJMAR A., ARNEODO F., BOCCARDO P. (2017) An operational framework to integrate traffic message channel (TMC) in emergency mapping services (EMS). European Journal of Remote Sensing 50(1), pp. 478-495

Products:
LCMMS (Low Cost Mobile Mapping System) - low cost operational System devoted to the acquisition of movies and single georeferenced frames by means of a transportable device easily installable (or adaptable) to every type of vehicles.
The device is composed by four webcams, with a total field of view of about 180 degrees, and one GPS receiver that allows to record the webcam position with a high frequency. The number of the webcams and their orientation can be easily customized according to the acquisition needs (e.g. vehicle type, survey requirements, etc.)
The instruments have been integrated in a compact device, similar to a flashing, easily installable on the top of a vehicle by means of a magnetic base or a suction holder. The direct link with a laptop allows to monitor and record the acquisitions and to tag points of interest and related metatada in real time.

List of relevant previous projects or activities, connected to the subject of this proposal

SUMP (Sustainable Urban Mobility Planning)
EuropeAid Contract nr DCI-NSAPVD/2014/355-057
02/2015-07/2017
SUMP project's specific objective is to strengthen the capacity of LAs of Yangon City (Myanmar) urban mobility planning and traffic reduction as a key towards a sustainable urban environment. For further information: http://www.sump-project.eu
ITHACA involvement in SUMP is related to support the Yangon City Development Committee (YCDC) in developing competences in acquisition, management and analysis of geographic data related to traffic and public transportation planning, using OpenStreetMap as data structure and platform.
Specific training sessions provide YCDC with the technical know-how. A mapathon event has been organized to promote project activities and to stimulate citizens contribution.

Services supporting the European Environment Agency's (EEA) implementation of cross-cutting activities for coordination of the in situ component of the Copernicus Programme – Lot 2 (Spatial Data Themes)
05/2016 – 05/2020
The overall objective is to assist the EEA in implementing the cross-cutting activities for coordination of the in situ component of the Copernicus Programme.
These activities are divided into the following main: i. Establish and maintain an overview of the state of play of in situ data for Copernicus services; ii. Operational provision of in situ data including access to reference data for Copernicus services; iii. Managing partnerships with data providers to improve access and use conditions of in situ data for Copernicus services; iv. Support to the EC and Copernicus services on in situ data issues.
The main tasks to be carried out under this framework service contract refer to spatial data themes and are: A. Extensive thematic support to the EEA regarding the spatial data themes covered by this lot; B. Technical support to the EEA regarding the spatial data themes covered by this lot; C. Collection and analysis for the Copernicus services' in situ and reference data requirements, data available to and used by the services, and data gaps; D. Information and outreach activities related to the in situ data domains covered by this lot.

ELF (European Location Framework)
European Commission – DG COMM
Competitive and Innovation Framework Programme (CIP)
03/2013 - 10/2016
The goal of this project is to deliver the European Location Framework (ELF) required to provide up-to-date, authoritative, interoperable, cross-border, reference geo-information for use by the European public and private sectors. This versatile cloud-based and cascade-supporting architecture provides a platform of INSPIRE compliant geo-information, harmonized at a cross-border and pan-European level. The three-year project is supported by a consortium of 30 partners across Europe and it will foster the wider use of geo-information and enable the creation of innovative value-added services. The project's proactive stimulation of content markets involves the creation of sample applications using thematic communities to make user-led developments by SMEs (both inside and outside the consortium). ITHACA is involved in the Emergency Mapping use case, whose main purpose is to demonstrate the impact the ELF platform has on operational services focused on emergency mapping. More specifically, the availability of the ELF platform is expected to eliminate the current time-consuming digitising operations based on the visual interpretation of suitable satellite images, thus drastically reducing the delivery time for data. Furthermore, the geometric and thematic accuracy of standard (official and authoritative) digital maps and raster topographic maps available at local level is generally higher than that achievable through digitising ortho-corrected satellite imagery.

Provision of a Web GIS Application containing a Survey on Cultural Heritage sites in Cyprus
United Nations Development Programme Partnership for the Future (UNDP – PFF)
08/2010 – 11/2010
The project was dedicated to the provision of a Web GIS Application containing a Survey on Cultural Heritage sites in Cyprus, a system that incorporates the existing surveys and inventories on Cultural Heritage in Cyprus into a customized WebGIS application.
It implied the design and implementation of a WebGIS application in which the existing data on Cultural Heritage of Cyprus converged; the systematization of a list of Heritage sites in Cyprus; the execution of mapping surveys with a self-developed Low Cost Mobile Mapping System (LCMMS) focused on the Heritage Sites list.

Description of significant infrastructure and major items of technical equipment relevant to the project

N/A

Partner 19: Centro Ricerche Fiat S.c.p.A.	
Company Website: www.crf.it	

Centro Ricerche Fiat S.c.p.A. .

CRF is headquartered in Orbassano (Torino) and founded in 1978 acts as a point of reference for FCA (Fiat Chrysler Automobiles) research activities, having 3 main goals: develop powertrains, vehicle systems, materials, methods and processes to improve FCA products, while participating in pre-competitive research projects too. CRF focuses its research and development activities on 3 areas: (1) environmental sustainability, (2) social sustainability and (3) economically sustainable competitiveness. CRF has developed strategic competencies in manufacturing, in the study of functional materials, ICT and electronics. Further CRF supports programs initiated by the Community institutions through the European Technology Platforms, ERTRAC (road transport), EPOSS (smart systems), EUMAT (materials), MANUFUTURE (manufacturing), NANOfutures (nanotechnology) and the Joint Technology Initiative ECSEL. At national level, CRF participates in the Cluster Transport Italy in 2020. CRF has recelntly led the industrialization of vehicle components products e.g.: energy saving air conditioning systems, vehicle connectivity based on Blue & Me™, driver assistance systems (Driving Advisor and Magic Parking) and eco-navigation (ECODriveTM).

Within this project CRF will operate to develop the solutions for connected vehicles small fleet targeting the use cases of proactive / predictive maintenance and of eHorizon 5.0. Moreover CRF will operate to support the implementation of vehicle simulation environment as well as on the business model an deployment planning .

CVs of involved key researchers / staff members

Luisa Andreone in FCA-CRF, is Member of EMEA Vehicle Research & Innovation, coordinating collaborative research on “safe & integrated mobility”. She is working on Public Funded activities as FCA-CRF reference for automotive information and communication technologies, human machine interface and advanced driver assistance systems. Her expertise includes the design and development of drivers’ support systems, connected and HMI solutions for vehicles. She coordinated the European co-funded projects DARWIN, EUCLIDE, EDEL, WATCH-OVER, in the field of ADAS and HMI. Today she is Member of the Steering Committees of the European co-funded projects L3 Pilot and FABRIC dealing with the design and development of vehicles’ automated maneuvers and smart mobility. She is leader of the EUCAR Expert Group “Driver Vehicle Dialogue”, co-leader of the EUCAR Expert Group “Automation” and Member of the Strategy Committee of ERTICO ITS Europe.

Roberto Tola Graduate in Computer Science at Turin University. He is in CRF since 1986 firstly as consultant developing several Knowledge based systems in the Product Development Process and Resource Evaluation System areas and then, since 1999, as senior researcher involved in several European projects (PEKING, SeCSE, XMEDIA, Sofia, SmartProducts and many others) classified in several areas: SW engineering, knowledge management and ambient intelligence. His current interest is mainly focused on the new technologies for the development of smart objects in the automotive field and the interaction between 5G -T 31
the vehicle and nomadic devices. He is involved as coordinator of CRF developments in the projects: e-DASH, SmartFusion, SmartCEM, eco-FEV and FABRIC.

Relevant publications, and/or products, services or other achievements

- P. Bosetti, M. Da Lio, A. Saroldi, “On Curve Negotiation: From Driver Support to Automation,”
- (2015) IEEE Transactions on Intelligent Transportation Systems, Article in Press. Open Access
- http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7045558.

- M. Da Lio, F. Biral, E. Bertolazzi, M. Galvani, P. Bosetti, D. Windridge, A. Saroldi, F. Tango,
- "Artificial co-drivers as a universal enabling technology for future intelligent vehicles and
- transportation systems," (2015) IEEE Transactions on Intelligent Transportation Systems, 16 (1), pp.
- 244-263.
- A. Amditis, E. Bertolazzi, M. Bimpas, F. Biral, P. Bosetti, M. Da Lio, L. Danielsson, A. Gallione, H.
- Lind, A. Saroldi, A. Sjögren, "A holistic approach to the integration of safety applications: The
- INSAFES subproject within the European framework programme 6 integrating project PReVENT,"
- (2010) IEEE Transactions on Intelligent Transportation Systems, 11 (3), pp. 554-566.
- E. Bertolazzi, F. Biral, M. Da Lio, A. Saroldi, F. Tango, "Supporting drivers in keeping safe speed
- and safe distance: The SASPENCE subproject within the European framework programme 6
- integrating project PReVENT," (2010) IEEE Transactions on Intelligent Transportation Systems, 11
- (3), pp. 525-538.
- M. Da Lio, F. Biral, M. Galvani, and A. Saroldi. "Will Intelligent Vehicles Evolve into Human-peer
- Robots?", IEEE Intelligent Vehicles Symposium, Alcalá de Henares, Spain, 3-7 June 2012.

List of relevant previous projects or activities, connected to the subject of this proposal

Project acronym	Funding source/ period	Topic of the project / activities	Relevance and link to HEPTAS
AdaptIVe	H2020 ended in 2017	Development of vehicle automation solution	Use cases proactive / predictive maintenance and eHorizon 5.0
L3 Pilot	H2020 running	Testing vehicle automation solution	
5G Transformer	H2020 running	Design of vehicle connectivity related services based on 5G	
C-ROADS IT	H2020 running	Testing vehicle automation and connectivity solution	

Description of significant infrastructure and major items of technical equipment relevant to the project

FCA Centro Sicurezza Proving Ground, located in Orbassano (Torino), to fine tune and pre-test the project use cases.

Partner 20: Universitat Politècnica de Catalunya	
Company Website: http://inlab.fib.upc.edu/en	

UPC (Universitat Politècnica de Catalunya) is a public institution with a vocation to serve society. It offers broad higher education in a wide range of technical, artistic and humanistic fields. Research Areas: Architecture and Civil Engineering, Physics and Chemistry, Mathematics and Statistics, Environment, Energy and Natural Resources, Information and Communication Technologies, Production Technologies.
Under the current Horizon 2020 programme (2014-2020), to date the UPC has been granted 81 projects, coordinating 26 (5 of them are funded by European Research Council grants). The UPC is also acting as a third party in 6 projects. Besides the Horizon 2020 programme, the UPC also has 14 projects (coordinating 3) funded by other European programmes. All of these projects have a total EU financial contribution of 38m€. According to the H2020 country profile and featured projects for Spain, published in November 2016, by the European Commission (EC), the UPC is the top university and third institution in Spain in terms of income from the EC for H2020 funded projects. As a large Technical University, UPC has a dedicated specialized unit in contractual, legal and financial issues of European projects, its European Projects Office (EPO) http://www.upc.edu/euresearch, based within the Technology Transfer Centre that assists researchers in drafting, submitting, and implementing proposals.
The UPC participation in this proposal for topic ICT-11 would be through the inLab FIB (the Barcelona School of Informatics innovation and research lab) that are currently cooperating in areas related to that topic. **inLab FIB** (http://inlab.fib.upc.edu/en) specializes in Smart Mobility; Simulation, optimization, and modeling; Data Science & Big Data; Software Engineering; Mobile Solutions; Cybersecurity and ICT learning environments and services. The ICT & Transports group at inLab FIB of UPC has been involved in many projects in the field of smart mobility concerned mainly with the application of data analytics, optimization and simulation models to transportation problems.

Main tasks attributed in the project

UPC will mainly be involved in the tasks related to the development of the use case 4, WP7. In particular in the development of the traffic simulation model of the selected area of study: First Crown of the Barcelona Metropolitan Area. Briefly, this development will consist in the construction of the network (including all the needed details to emulate the private and public transport), the demand analysis (using origin-destination matrices built from mobile data) and the calibration process (including speed data from floating car data).
It is important to note that the construction of the network subtask will not start from the scratch. UPC is currently involved in the Barcelona Virtual Mobility Lab project where the first detailed multimodal of the Barcelona Metropolian Area (1st Crown) has been developed in the 1st phase (2017). The model is innovative because it is multimodal (Car, metro, bus, tram and train). Thus, UPC will reuse this current existent model of the First Crown of the AMB from 2017 that will be detailed and improved for the whole study area during this project.
Furthermore, UPC will contribute with the emulation of the proposed traffic or mobility policies using the developed model thought the design and the execution of suitable simulation experiments.
In addition, UPC will collaborate in the dissemination of the project results in the research community.

CVs of key people

Dr. MªPaz Linares (F) (PhD in Statistics and Operation Research, Msc in Logistics, Transport and Mobility, Degree in Mathematics). She is a researcher at inLab FIB and assistant professor at the department of Statistics and Operation Research at UPC. She completed her PhD in 2014 with a thesis dedicated to Dynamic Traffic Assignment using mesoscopic simulation which was awarded with the XII Premio Abertis and finalist of the IV International Award on Transport Infrastructure Management Research. Since 2005, she works on projects specialized on the application of optimization and simulation techniques to transportation problems. She's also an expert in AIMSUN simulation environment. She has recently been involved in several CARNET research projects, as the Barcelona Virtual Mobility Lab project, and is currently working on the H2020 BIG IoT project.

Dr. Lídia Montero, (F) (PhD in Computer Science). She is an associate professor (tenure position) of the department of Statistics and Operations Research at UPC and specializes in the application of statistics and data mining to transportation planning, demand modeling, traffic management, traffic simulation and other related transportation problems. She has been involved in many development projects with public administrations and companies. She has presented her research work in more than 60 international congresses and conferences. She's currently leading the simulation of projects related with future urban mobility simulation in CARNET.

Prof. Josep Casanovas (M) (PhD in Computer Science, Industrial Engineer, MSc in Economics). Director of in LabFIB at Barcelona School of Informatics. He's full professor of the Statistics and Operations Research Department at UPC. He has been Vice-rector for University Policy of Universitat Politècnica de Catalunya (UPC) (2006-2011) with responsibilities in new strategic projects like the definition of new university governance models. His main research areas are modelling and simulation, agent based modelling and HPC. He's the author of research articles and other publications and has collaborated in many projects for the EU and different companies and institutions.

Juan Salmerón (M) (Degree in Computer Science)- He is a researcher at inLab FIB UPC in the Smart Mobility group, collaborating in European H2020 projects (BIG IoT project). He is also been involved in several CARNET projects (CitEffects, Barcelona Virtual Mobility Lab) and in private projects for large and sme companies. He has focused his career towards the use of the information and communication technologies in the smart cities and mobility area. He has participated in several R+D projects focused in traffic data analytics, routing algorithms and traffic simulation UPC.

Relevant publications

Some of the relevant publications of UPC members are listed below.

M. P. Linares, L. Montero, E. Lorente, J. Salmeron, J. Casanovas (2017). Analytics tool for assessing mobility concepts, vehicles and city policies (CitScale). 5th IEEE International Conference on Models and Technologies for Intelligent Transportation Systems. 2017, Italy.

L. Montero, M.P. Linares, O. Serch, J. Casanovas (2017). A visualisation tool based on traffic simulator for the analysis and evaluation of smart city policies, innovative vehicles and mobility concepts. In Proceedings: Winter Simulation Conference 2017, December 3-6, 2017, Las Vegas.

M. P. Linares, J. Barceló, C. Carmona, L. Montero (2016). Analysis and operational challenges of dynamic ride sharing demand responsive transportation models. Transportation Research Procedia, Vol. 21. Elsevier, 2016.

MP. Linares, L. Montero J. Barceló and C. Carmona (2016) A Simulation Framework For Real-Time Assessment Of Dynamic Ride Sharing Demand Responsive Transportation Models. In the Proceedings: Winter Simulation Conference. December 11~14, Washington D.C

L. Montero, M. Pacheco, J. Barcelo, S. Homoceanu, J. Casanovas (2016). A case study on cooperative car data for traffic state estimation in an urban network, Transportation Research Board Annual Meeting 2016 selected for publication in Transportation Research Record: Journal of the Transportation Research Board, No. 2594 pp 127-137 DOI 10.3141/2594-16.

J. Barceló, L. Montero, M. Bullejos, M.P. Linares, O. Serch (2013), Robustness and computational efficiency of a Kalman Filter estimator of time dependent OD matrices exploiting ICT traffic measurements from information and communications technologies. Transportation Research Records: Journal of the Transportation Research Board, vol. 2344, 4, 31-39.

Relevant Projects or activities

UPC participated and participates in the following relevant projects:

1. **Bridging the Interoperability Gap of the Internet of Things (BIG IoT)**. Year of start: 2016, Year of end: 2018. Type of project / funded by: H2020-ICT-2015-688038 (http://www.big-iot.eu). UPC is leading the piloting work package, coordinating the Barcelona pilot and its use cases related with traffic monitoring, parking and bus monitoring. In Barcelona, the project team is using infrastructure based traffic detectors to measure speed, car count and related parameters.

2. **Barcelona Virtual Mobility Lab (**https://inlab.fib.upc.edu/en/barcelona-virtual-mobility-lab). UPC is currently involved in the Barcelona Virtual Mobility Lab Project where the first detailed multimodal model of the Barcelona Metropolitan Area (1st Crown) has been developed in the 1st phase (2017). In the HEPTAS project, UPC will take advantage of the possibility to start from this BCN model that will allow assess the impact of the Barcelona air quality measures and mobility policies.
   Some references where the work has been presented:
   a. Smart City Expo World Congress (Nov 2017) http://www.carnetbarcelona.com/index.php/2017/12/20/virtual-mobility-lab-modelling-transport-in-the-first-ring-of-the-barcelona-metropolitan-area/

   b. The 9th International Conference on Cloud Computing, GRIDs, and Virtualization (Feb 2018) http://www.iaria.org/conferences2018/ProgramCLOUDCOMPUTING18.html

   c. IX Jornadas sobre ITS en Cataluña (Feb 2018) https://cdn.website-editor.net/2d40cc63851f4d94b11848ff5435fcc3/files/uploaded/Programa%20ITS%20Catalunya.pdf

3. **Connected Car Barcelona Simulative Evaluation Project.** Year of start: 2014, Year of end: 2016. Type of project / funded by: CARNET project funded by Volkswagen Research. CARNET (Cooperative Automotive Research Network), is an open hub focused on mobility and automotive knowledge, an initiative by SEAT, Volkswagen Group Research and UPC, simulating new urban mobility concepts. In this project, developed together with Volkswagen Research, 10.000 equipped vehicles were emulated, acting as mobile traffic sensors that coexisted with the rest of the city's vehicles. The simulation allowed the team to assess the quality of the information collected by this type of vehicle, in order to estimate the state of the city's traffic, opening the door to future lines of research. (http://inlab.fib.upc.edu/en/simulating-future-urban-mobility)

4. **Simulative evaluation of a cooperative urban mobility concept**. Year of start: 2014, Year of end: 2015. Type of project / funded by: Volkswagen Research. This project focused on the analysis and evaluation of the impact of a system consisting of a fleet of vehicles shared between multiple users, exploiting in an efficient, flexible and profitable way the fact that their routes coincide totally or partially. http://inlab.fib.upc.edu/en/simulating-future-urban-mobility.

5. **Advanced Information System on the Mobility of Persons and Vehicles (In4Mo).** Year of start: 2010, Year of end: 2012. Type of project / funded by: Subprogram Avanza Competitividad I+D+I, 2010-2012. Reference: TSI-020100-2010-690. Several data collection/filtering/completion/fusion techniques and methodologies have been developed by ICT & Transports group at inLab FIB to elaborate information from traffic data coming from different ICT sources as a result of the research done in these projects of the Spanish R+D National Programs. The data filtering and fusion techniques have were specifically tuned, calibrated and configured for Bluetooth and loop detectors in Barcelona local urban environment. Prediction and state estimation methodologies have also been explored.

Additionally, UPC participates in **CARNET** (Cooperative Automotive Research Network), an open hub focused on mobility and automotive knowledge, an initiative by SEAT, Volkswagen Group Research and UPC, simulating new urban mobility concepts. UPC is also member of The European Innovation Partnership on Smart Cities and Communities.

UPC is also member of the consortium organizing the Erasmus Mundus Joint Master Degree Programme in Big Data Management and Analytics (BDMA).

Significant Infrastructure and Equipment

UPC will use technical equipment of the Simulation laboratory and software tools related to traffic management system, including **CitScale** environment (http://inlab.fib.upc.edu/en/tools/citscale): Analytics Tools and Services for the Assessment of Innovative Mobility Concepts, Vehicles and City Policies. It has been designed to facilitate the analysis of impacts of innovative mobility concepts and vehicles considering different levels of penetration. It consists of a data analysis and visualization tool and a simulation lab engine which can be extended with customized modules to evaluate new mobility and vehicle concepts.

4.2 Third parties involved in the project (including use of third party resources)

VALEO France

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)?	Yes
Valeo plans to subcontract some administrative project management activities	
Does the participant envisage that part of its work is performed by linked third parties?	Yes
The linked third party for Valeo France declared for this project is Valeo Services. This Valeo entity will provide the contribution to the predictive maintenance tasks within the services developed in the HEPTAS project. This entity is linked to the coordinator Valeo France since both consolidate their reports to the Valeo Group.	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)?	N
Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	N

VALEO Germany

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)?	N
Does the participant envisage that part of its work is performed by linked third parties?	Yes
The linked third party for Valeo Germany declared for this project is peiker acustic GmbH. This entity is linked to the contributor Valeo Germany since both consolidate their reports to the Valeo Comfort and Driving Assistance Business Group. The linked third party will provide the connectivity equipment mentioned in the section above and will deliver contributions (development and delivery of connectivity equipment) to WP 5, with minor contributions in WP 2 and 3.	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)?	N
Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	N

FCA Italy

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)?	Y
ICT support mainly for configuration, integration and security	
Does the participant envisage that part of its work is performed by linked third parties?	N
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)?	N
Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	N

CloudMade

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)?	N
Does the participant envisage that part of its work is performed by linked third parties?	Yes
Specific tasks to be performed by CloudMade UK: DMP, data architecture, data security and solution architecture	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)?	N
Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	N

SEAT

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)?	N
Does the participant envisage that part of its work is performed by linked third parties?	Yes
The Linked Third Party associated to SEAT S.A. is Audi AG. Audi AG is linked to SEAT S.A. since both are subsidiary companies of Volkswagen group. The Linked Third Party will provide access to the data stored on the Automotive Car Data Collector,), an infrastructure designed and managed by Audi AG that will store data from connected cars of all brands of the VW group.	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)?	N
Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	N

FEV

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)?	Yes
Support for vehicle ADAS functionalities, modeling and simulation	
Does the participant envisage that part of its work is performed by linked third parties?	Yes
The linked third party for FEV Italy declared for this project is FEV Europe Gmbh FEV Italy is 100% under control of FEV Europe GmbH and the Balance Sheet is consolidated in Germany in the FEV Holding.	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)?	N
Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	N

Mapillary

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)?	Yes
If there is requirement for data annotation. the annotation task might be sub-contracted to an annotation company.	
Does the participant envisage that part of its work is performed by linked third parties?	N
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)?	N
Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	N

SES

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)?	N
Does the participant envisage that part of its work is performed by linked third parties?	Yes
Wholly-owned affiliates of SES based in Luxembourg and the Netherlands will be providing the satellite connectivity and associated services. These entities are linked to the contributor SES since they all consolidate reports into the SES group account.	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)?	N
Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	N

ITHACA

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)?	Yes
Implementation of algorithms based on Ithaca specifications for 3D data set comparison and update	
Does the participant envisage that part of its work is performed by linked third parties?	No
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)?	N
Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	N

Section 5: Ethics and Security

5.1 Ethics

N/a - No ethical issues were entered in the respective table.

5.2 Security[5]

Please indicate if your project will involve:

- activities or results raising security issues: (NO)
- 'EU-classified information' as background or results: (NO)

[5] Article 37.1 of Model Grant Agreement. *Before disclosing results of activities raising security issues to a third party (including affiliated entities), a beneficiary must inform the coordinator — which must request written approval from the Commission/Agency;* Article 37. *Activities related to 'classified deliverables' must comply with the 'security requirements' until they are declassified; Action tasks related to classified deliverables may not be subcontracted without prior explicit written approval from the Commission/Agency.; The beneficiaries must inform the coordinator — which must immediately inform the Commission/Agency — of any changes in the security context and — if necessary —request for Annex 1 to be amended (see Article 55)*

Annex: Letter of supports

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Économie

LETTER OF INTENT

Dr. Jean-Luc Di Paola-Galloni
Corporate Vice-President
VALEO
43, rue Bayen

F-75848 PARIS CEDEX 17
FRANCE

Luxembourg, April 13rd, 2018

Re: HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities (HEPTAS)

Growing populations, public pressure and legalization demand new approaches to mobility, increasing traffic throughput & parking convenience, with lower energy consumption & pollution.

The target of HEPTAS is to develop industrial testbeds relying on high performance computing (HPC) and big data to show case the opportunities of ICT (Information and Communication Technologies) to create added value in smart mobility and smart cities. Especially, elastic HPC will enable to continuously analyse and optimize mobility, using machine learning and simulation to optimize flows, and send suggestions to vehicles e.g. best route and speed profile, taking into account infrastructure information e.g. traffic lights, speed limits.

The four targeted use cases will cover predictive maintenance, eHorizon 5.0 and autonomous driving, comprehensive energy optimization, and finally urban mobility.

Hereby the Ministry of Economy of the Grand Duchy of Luxembourg expresses its support to the HEPTAS proposal to be submitted for the H2020 ICT-11-2018 call in April 2018.

We welcome this initiative. Its results will greatly reduce - and unify - the effort to deploy HPC based solutions in the automotive market, and lead to better products and solutions on the market.

The Ministry of Economy will support the HEPTAS project by actively participating over three years in up to two public workshops annually, organized by the HEPTAS consortium.
The Luxembourg Ministry of Economy will join the HEPTAS advisory board.

Yours sincerely,

Mario GROTZ
Director General for Research,
Intellectual Property and New Technologies

19-21, boulevard Royal
L-2449 Luxembourg
TVA LU 158 52 112

Tél. (+352) 247-82478
Fax (+352) 46 04 48
IBLC 158 52 112

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L-2914 Luxembourg

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Ministero dello Sviluppo Economico

DIREZIONE GENERALE PER LA POLITICA INDUSTRIALE, LA COMPETITIVITA' E LE PICCOLE E MEDIE IMPRESE

Jean-Luc Di Paola-Galloni
Corporate Vice-President
VALEO
43, Rue Bayen
F-75848 PARIS CEDEX 17
FRANCE

Rome, April 16th, 2018

HPC-Enabled Pilot Testbeds to Advance Smart mobility and smart cities (HEPTAS)

The target of HEPTAS is to develop industrial testbeds relying on HPC and BIG Data to create added value in smart mobility and smart cities.

HPC-Enabled Pilot Testbeds to Advance Smart mobility and smart cities (HEPTAS) project will address these challenges of combining **Big Data flows** from heterogeneous, real-time, massive sources (e.g. **connected vehicles**), **elastic HPC** for the optimization of mobility, machine learning & simulation to optimize traffic flows. Furthermore, **low latency networks** will be used to send advice to vehicles (e.g. navigation advice to skip traffic gridlock), and infrastructure (e.g. traffic lights), allowing public authorities and policy makers **to react faster and smarter, reducing journey times**.

Hereby Italian Minister of Economic Development (MISE) express its support to the HEPTAS proposal to be submitted in April 2018 - (H2020 call ICT-11-2018: HPC and Big Data enabled Large-scale Test-beds and Applications).

We welcome this initiative.
HEPTAS project will also greatly contribute to improve synergies among involved Italian partners, leveraging on a significant EU context to unify the effort to deploy HPC-Big Data solutions within a connected architecture supporting automotive industry and mobility authorities.
Today solutions for urban mobility are fragmented and not achieving the impact that is set by European common targets by Member States on traffic efficient, safety and green driving.
Correspondingly HPC and big data can trigger avalanche effect, that is needed to accelerate the deployment of connected and automated vehicles on the market at a very wide scale.

Best regards,

Stefano Firpo
Director General

OPEN & AGILE SMART CITIES

Open & Agile Smart Cities vzw
Pleinlaan 9
1050 Brussels
Belgium
www.oascities.org

9 April 2018

Letter of Support for project proposal:

HEPTAS – HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities

[H2020 Topic ICT-11-2018-2019 HPC and Big Data enabled Large-scale Test-beds and Applications]

I, the undersigned, hereby confirm that Open & Agile Smart Cities vzw embraces and supports the HEPTAS proposal objectives. Open & Agile Smart Cities vzw is committed to promoting innovation and helping solve major issues facing cities in Europe today. That is why we are very interested to follow up on the applications of High Performance Computing to be developed within the HEPTAS project, and applied to assessing and solving urban mobility issues. We will gladly be involved in the subjects investigated by the project, as we have a strong interest in these topics and therefore we are interested to be informed about the development of the project, and in using and disseminating its results and findings to our wide network of cities and other stakeholders.

In case the proposal is successfully evaluated, we would be also willing to participate occasionally in technical workshops, providing indications and advices based on our experience and knowledge.

We look forward to cooperating in a European initiative contributing to a more sustainable urban mobility.

Yours sincerely,

Dr Davor Meersman
General Manager
Open & Agile Smart Cities vzw

OPEN & AGILE SMART CITIES
OASC VZW
Pleinlaan 9
1050 Elsene
BTW : BE 0686623804

EUROPEAN CITIES AND REGIONS NETWORKING
FOR INNOVATIVE TRANSPORT SOLUTIONS

Rue du Trône 98, B-1050 Brussels, Belgium
Tel +32 (0)2 500 56 70 - Fax +32 (0)2 500 56 80
VAT BE 0460400701

10 April 2018

Polis (Promotion of Operational Links with Integrated Services)
Rue du Trône 98
1050 Brussels
BELGIUM
www.polisnetwork.eu

Letter of Support for project proposal:

HEPTAS – HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities

[H2020 Topic ICT-11-2018-2019 HPC and Big Data enabled Large-scale Test-beds and Applications]

I, the undersigned, hereby confirm that Polis (Promotion of Operational Links with Integrated Services) embraces and supports the HEPTAS proposal objectives. Polis (Promotion of Operational Links with Integrated Services) is committed to promoting innovation and helping solve major issues facing cities in Europe today. That is why we are very interested to follow up on the applications of High Performance Computing to be developed within the HEPTAS project, and applied to assessing and solving urban mobility issues. We will gladly be involved in the subjects investigated by the project, as we have a strong interest in these topics and therefore we are interested to be informed about the development of the project, and in using and disseminating its results and findings to our wide network of cities and other stakeholders.

In case the proposal is successfully evaluated, we would be also willing to participate occasionally in technical workshops, providing indications and advices based on our experience and knowledge.

We look forward to cooperating in a European initiative contributing to a more sustainable urban mobility.

Yours sincerely,

Karen Vancluysen
Secretary General
Polis

POLIS AISBL
Rue du Trône 98
B-1050 Brussels
☎ : +32 (0)2 500 56 70
Fax : +32 (0)2 500 56 80

www.polisnetwork.eu

Brussels, 12 April 2018

Letter of Support for project proposal:

HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities (HEPTAS)
[H2020 Topic ICT-11-2018-2019 HPC and Big Data enabled Large-scale Test-beds and Applications]

Growing populations, Citizens pressure & legalization demand new approaches to mobility, increasing traffic throughput & parking convenience, with lower energy consumption & pollution.

Target of HEPTAS is to develop industrial test beds relying on high performance computing (HPC) and big data to showcase the value of ICT (Information and Communication Technologies) to create added-value in smart mobility and smart cities. Especially, elastic HPC will enable to continuously analyse and optimize mobility, using machine learning and simulation to optimize flows, and send suggestions to vehicles e.g. best route and speed profile, taking into account infrastructure information e.g. traffic lights, speed limits.

The four targeted use cases will cover predictive maintenance, eHorizon 5.0 and autonomous driving, comprehensive energy optimization, and finally urban mobility.
Hereby Integrated Planning Policy and Regulation Action Cluster from EIP Smart cities expresses its support to the HEPTAS proposal to be submitted for the H2020 ICT-11-2018 call in April 2018

We, welcome this initiative. Its results will greatly reduce - and unify - the effort to deploy HPC based solutions in the automotive market with the objective to significantly contribute to be more optimized traffic management.

EIP Smart cities is willing to support the HEPTAS project by actively participating over three years in up to two public workshops annually, organized by the HEPTAS consortium.

As Action Cluster leader I will join the HEPTAS advisory board.

Simona Costa
Action Cluster Leader
Integrated Planning Policy and Regulation
EIP Smart cities and Communities

IoMob
THE INTERNET OF MOBILITY

12 April 2018

IoMob Technologies OÜ
C/ Floridablanca 66, 4-4 08015 Barcelona, Catalonia Spain
www.iomob.net

Letter of Support for project proposal: *HEPTAS – HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities*

[H2020 Topic ICT-11-2018-2019 HPC and Big Data enabled Large-scale Test-beds and Applications]

I, the undersigned, hereby confirm that IoMob Technologies embraces and supports the HEPTAS project proposal objectives. IoMob is developing what we call the Internet of Mobility: an open protocol for mobility service providers of all sizes across any mobility service (e.g. ridehailing, carsharing, bikesharing, public transit, EV carcharging networks, etc.) to announce their availability and to share access to passengers, underpinned by blockchain technology.

IoMob is very interested to follow up on the applications of High Performance Computing to be developed within the HEPTAS project, and applied to assessing and solving urban mobility issues. We will gladly be involved in the subjects investigated by the project, as we have a strong interest in these topics and therefore we are interested to be informed about its development, and in using and disseminating its results and findings to our customers, partners and other stakeholders in the mobility space. As part of our product roadmap, we are aiming at incorporating map data from real cities (such as testbed cities in the HEPTAS project) with public transit network, simulating citizens and mobility patterns. This will help IoMob parameterize and test our developments under realistic simulated environments, thus increasing the value of our blockchain-based tech to stakeholders, and maximizing our impact.

In case the proposal is successfully evaluated, we would be also willing to participate occasionally in technical workshops, providing indications and advices based on our experience and knowledge.

We look forward to cooperating in a European initiative contributing to a more sustainable urban mobility.

Yours sincerely,

Josep Sanjuas Cuxart, PhD
Chief Technology Officer
IoMob Technologies OÜ

9 April 2018

Big Data CoE
Av Diagonal, 177, Floor 10 08018 Barcelona
https://www.bigdatabcn.com/en/

Letter of Support for project proposal:

HEPTAS – HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities

[H2020 Topic ICT-11-2018-2019 HPC and Big Data enabled Large-scale Test-beds and Applications]

I, the undersigned, hereby confirm that **Big Data CoE Barcelona** embraces and supports the HEPTAS proposal objectives. Our Centre of Excellence (CoE) for Big Data is driven by Eurecat Technology Centre, the Government of Catalonia, the Barcelona City Council and Oracle, and it builds, develops and provides tools, data sets and value-added Big Data capabilities enabling companies on defining, testing and validating Big Data models before their final implementation. This is very well aligned with the specific goals of the Barcelona testbed in the HEPTAS project, and we will gladly be involved in the subjects investigated by the project, as we have a strong interest in these topics and therefore we are interested to be informed about the development of the project, and in using and sharing its results and findings.

In case the proposal is successfully evaluated, we would be also willing to participate occasionally in technical workshops, providing indications and advices based on our experience and knowledge.

We look forward to cooperating in a European initiative to contribute to a more sustainable urban mobility.

Yours sincerely,

Dr. Marc Torrent
Director of the Big Data Centre of Excellence
Barcelona, Spain

11 April 2018

INRIX, Inc.
10210 NE Points Dr., Suite 400
Kirkland, WA 98033
www.inrix.com

Letter of Support for project proposal:

HEPTAS – HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities

[H2020 Topic ICT-11-2018-2019 HPC and Big Data enabled Large-scale Test-beds and Applications]

I, the undersigned, hereby confirm that **INRIX** embraces and supports the HEPTAS project. **INRIX** is very interested to follow up on the applications of High Performance Computing to be developed within the HEPTAS project with a focus on assessing and solving urban mobility issues, which is a goal **INRIX** pursues as well. **INRIX** will be gladly involved in the subjects investigated by the HEPTAS project, as there is a shared and strong interest in the abovementioned topics, and therefore **INRIX** is interested to be informed about its development, and in using and disseminating its results and findings to customers and stakeholders.

In case the proposal is successfully evaluated, **INRIX** would be also willing to participate occasionally in technical workshops, providing indications and advices based on our experience and knowledge, and eventually sourcing data for the applications and use cases being developed and/or investigated (on traffic conditions, on Origin-Destination matrixes, etc.) building on a commercial agreement to be discussed, agreed and approved by the project management at the right time.

We look forward to cooperating in a European initiative contributing to a more sustainable urban mobility.

Yours sincerely,

CARLOS ROMAN
Channel Sales Director

LETTER OF SUPPORT

To Whom It May Concern

Project introduction:

HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities (HEPTAS)

Growing populations, public pressure & legalization demand new approaches to mobility, increasing traffic throughput & parking convenience, with lower energy consumption & pollution.

Target of HEPTAS is to develop industrial testbeds relying on high performance computing (HPC) and big data to showcase the opportunities of ICT (Information and Communication Technologies) to create added value in smart mobility and smart cities. Especially, elastic HPC will enable to continuously analyse and optimize mobility, using machine learning and simulation to optimize flows, and send suggestions to vehicles e.g. best route and speed profile, taking into account infrastructure information e.g. traffic lights, speed limits.

The four targeted use cases will cover predictive maintenance, eHorizon 5.0 and autonomous driving, comprehensive energy optimization, and finally urban mobility.

Hereby Goodyear S.A. expresses its support to the HEPTAS proposal to be submitted for the H2020 ICT-11-2018 call in April 2018

We, Goodyear S.A. welcome this initiative. Its results will greatly reduce - and unify - the effort to deploy HPC based solutions in the automotive market, and lead to better products and solutions on the market.

Goodyear S.A. is willing to support the HEPTAS project by actively participating over three years in up to two public workshops annually, organized by the HEPTAS consortium.

The name of the Goodyear S.A. associate to join the HEPTAS advisory board will be communicated later.

Colmar-Berg, April 17, 2018

Carlos Cipollitti,
Vice President EMEA Product Development

DIRECTION INNOVATION & RECHERCHE
40 avenue des Terroirs de France
F-75611 PARIS Cedex 12

Dossier suivi par : M. Frédérick GETTON
E-mail : frederick.getton@sncf.fr
Tél : +33 (0)7 77 60 49 39

M. Jean-Luc DI PAOLA GALLONI
VALEO Group Corporate VP
Sustainable Development and External Affairs
43 rue Bayen
75017 PARIS

Subject : Letter of support HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities (HEPTAS) [H2020 Topic ICT-11-2018-2019 HPC and Big Data enabled Large-scale Test-beds and Applications]

Paris, April 17th 2018

Dear Mr. Di Paola Galloni,

Following your invitation on behalf of the HEPTAS consortium, this letter formally confirms that SNCF is committed to participating to the Advisory Board for the « HPC Enabled Pilot Testbeds to Advance Smart Mobility and Cities » project under the topic ICT 11-2018 for HPC and Big Data enabled Large-scale Test-beds and Applications.

We will be supporting the consortium in particular with regards to the use cases proposed and our expertise within the SNCF Group, especially within the Innovation&Research Division :

- urban mobility,
- comprehensive energy optimization,
- predictive maintenance,
- eHorizon 5.0 and
- autonomous driving.

We look forward to work with the HEPTAS consortium.

Yours sincerely on behlf of SNCF,

Carole DESNOST, Innovation & Research Director
Frédérick GETTON, Head of Innovation Management and Performance, Doctoral Training and IP

European Commission

PARTICIPANT PORTAL E-RECEIPT

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