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CODECS

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Requirements of urban transport authorities regarding cooperative V2I and I2V systems and their strategic policy implications

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Author(s)

Suzanne Hoadley, Polis
Mark Cartwright, Centaur Consulting (sub-contractor to Polis)

Reviewed

Paul Spaanderman, PaulsConsultancy BV
Onno Tool, Rijkswaterstaat

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Project Coordinator

ITS Niedersachsen GmbH
Dr. Karl-Oskar Proskawetz
Hermann-Blenk-Straße 17
38108 Braunschweig
Germany

Phone: +49 (0) 531 35 630 85
Fax: +49 (0) 531 35 406 74
Email: info@codecs-project.eu

Abbreviations

Abbreviation	Explanation
ANPR	Automatic number plate recognition
CAM	Cooperative awareness message
C-ITS	Cooperative Intelligent Transport Systems and Services
DATEX	Cooperative ITS Deployment Coordination Support
GLOSA	Green Light Optimised Speed Advisory
GPRS	General Packet Radio Service
HTTP	Hypertext Transfer Protocol,
I2V	Infrastructure-to-vehicle communication
ICT	Information communication technology
IP	Internet protocol
ITS G5	European standard for ad-hoc dedicated short range communication of vehicles among each other (V2V) and with ITS stations in traffic infrastructure (V2I)
MAP	A digital map describing the geometry of an intersection
OCIT	Open Communication Interface for Road Traffic Control Systems
OTS	Open Traffic Systems
R&D	Research and development
SPaT	Signal Phase and Timing
SUMP	Sustainable urban mobility plans
UTMC	Universal Traffic Management
VMS	Variable message sign
V2I	Vehicle-to-infrastructure-communication
V2V	Vehicle-to-vehicle-communication
XML	eXtensible Markup Language
3G, 4G, 5G	3^{rd}, 4^{th}, 5^{th} generation mobile networks

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Executive Summary

The report aims to provide insight to the views of city authorities on C-ITS as well some key requirements and opportunities for C-ITS deployment. To understand a city's view on C-ITS, it is important to understand what are the traffic management and ITS priorities and practices of a typical city authority today. This appreciation is important because city authorities tend to view C-ITS in the same way they view ITS, as a new piece of equipment to help manage the transport network. When deciding to purchase new technology, cities apply the same reasoning to C-ITS as they do to ITS: they want to know how can (C-)ITS help them solve their city's transport problems and deliver their city's transport policies. Chapter 2 describes the transport policies and ITS priorities in cities today; they do not necessarily make a good fit with the C-ITS benefits put forth by C-ITS proponents. Whereas cities have been focusing recent ITS investments on encouraging a change in the way people travel, such as modal shift from car to public transport, C-ITS is promoted as a technology to make traffic flow (including car traffic) move more smoothly in cities. These two objectives can appear contradictory to a city authority.

Chapter 3 sets out some of the main requirements for C-ITS deployment to happen in cities. The first two requirements ('problem-led approach' and 'business case') are aimed at clarifying what C-ITS needs to be able to demonstrate in order for cities to consider implementation, namely what is the urban transport problem or urban transport policy that C-ITS is responding to and what additional benefit it can deliver in relation to traditional ITS or indeed non-ITS measures that can deliver a similar outcome.

The remaining sections of chapter 3 focus on what needs to be considered once a decision is taken to implement C-ITS, specifically how C-ITS will affect the established systems, processes and responsibilities in place in cities today. Given the novelty of C-ITS, few cities have any experience of procuring such a system, nor do they know how robust this system will be. For instance, some components of C-ITS may change overtime as the technology evolves and standards are revised. Cities cannot live with such uncertainty, ie, they want to know that what they are procuring today will not be obsolete in 12 months' time. The introduction of C-ITS will no doubt create new roles and responsibilities, but it is not clear who will gain these new roles and responsibilities - the traffic authority, a third party service provider, the OEM? The integration of C-ITS into existing city systems is crucial to ensure the smooth operation of systems and services. ITS is used to deliver more than just traffic management so C-ITS will have to adapt to the existing ITS architecture rather than the other way round. The long transitional period of equipped and unequipped vehicles means that cities may well be inclined to go for services whose benefit can be (partially) achieved even where equipped vehicle penetration is low.

The purpose of Chapter 4, which proposes four thematic areas in which C-ITS may play a beneficial role in the city transport environment, is to provide some direction for the future development of C-ITS, notably the C-ITS use cases. The thematic areas put forward are: (i) intersection-based services; (ii) floating vehicle data; (iii) in-vehicle information and (iv) enforcement. Some of these areas already have some well-established C-ITS use cases, whereas others are not even being considered by the C-ITS community or are not given the consideration they merit.

A series of recommendations to the EC and Member States are given in the final chapter of this report. These recommendations are intended to provide food for thought for policy direction and research requirements.

1. Introduction

1.1. Purpose and scope of this document

This document provides a snapshot of the views and requirements of city authorities regarding C-ITS. While it is widely understood that cities currently remain indifferent to C-ITS; this document attempts to explain why this is the case and what can be done in order to raise the level of engagement of city authorities in C-ITS developments. In this regard, the report highlights the key issues that need to be addressed, covering both the 'why' should I deploy (eg, what is the business case?) and 'how' can I deploy (eg, integration, organisational issues, procurement). Much of the city narrative over the years has focused on the 'why'. However, in view of the gradual deployment of C-ITS in cities and the approaching milestone when C-ITS vehicles will start to become available (2019), it is as important to understand and work through the 'how'.

1.2. Targeted readership

This report is targeted at those stakeholders, public or private, involved in the acceptance, development and deployment of C-ITS, be that at local, national or European level. The report should appeal to anybody who is interested in understanding the urban transport context and specifically the city perspective on C-ITS and ITS more generally. The content is of a non-technical nature and should appeal to readers from a variety of backgrounds.

1.3. Information sources

This report builds on four main types of information sources:

i. The combined knowledge of the report's authors - Suzanne Hoadley and Mark Cartwright – who have spent many years working with local government on traffic management and ITS issues, including C-ITS;

ii. The discussions and findings from the three CODECS City Pool workshops held in 2016 (see point 1.4 and annex);

iii. Input from other CODECS activities (notably around functional roadmapping) and the CIMEC project (www.cimec-project.eu);

iv. Input from a variety of other European and national initiatives on C-ITS, including projects and fora such as the EC's C-ITS Deployment Platform and the Amsterdam Group (both of which the report's main author, Polis, is actively involved in).

1.4. The CODECS City Pool

The City Pool was established within CODECS to provide a forum for city authority representatives and other interested urban transport stakeholders to come together to share experiences and express views on the deployment of C-ITS in the urban environment. This is especially important for CODECS as its primary focus is interurban roads/motorways. All C-ITS stakeholders acknowledge that cities are 'lagging behind' and there is still substantial work to be done to help the urban transport stakeholders engage in the C-ITS discussion to enable C-ITS to deliver its full potential in the urban environment.

Three City Pool workshops were conducted in 2016, on two occasions jointly with the CIMEC project (www.cimec-project.eu). All meetings enjoyed good levels of participation (approx. 55 at the London and Barcelona workshops and 35 at the Glasgow workshop) and in each case, at least half of the people attending came from the public sector. Most importantly, the local government representatives represented a broad spectrum of people with and without C-ITS knowledge and experience. Further information about the City Pool and workshops can be found in the annex.

2. ITS and cities

2.1 The city context

It is important to underline that urban road network is very different to the motorway environment.

The motorway environment is a relatively simple environment in terms of its governance and operating structure, its use (motorised vehicles only), the task of controlling traffic (the operator controls who enters) and its prime goal (to move vehicles safely and efficiently). By contrast, the city environment is very complex: there can be multiple road/traffic authorities and other transport agencies; there are multiple modes (motorised, cylists, pedestrians); it's an open road environment and the city is host to many activities, not just transport, including retail, leisure and residential. Hence, the policy context goes beyond transport.

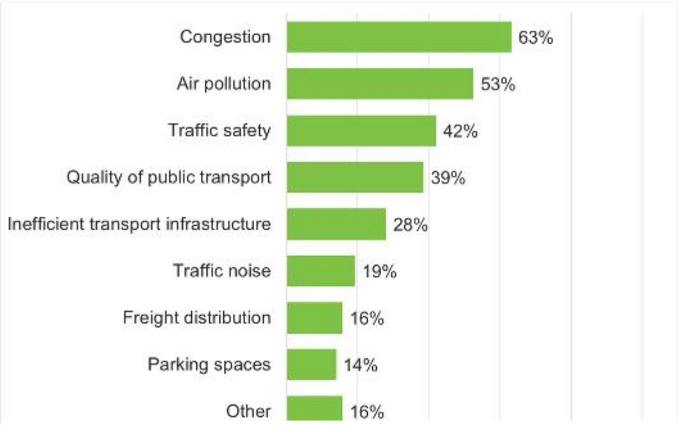

Figure 1: Perceptions of transport challenges among cities- CIMEC WP1 survey - Presentation by Hans Westerheim, Sintef - CIMEC/CODECS City Pool workshop, 3 March 2016, London

Cities do share with motorways the main transport challenges of congestion and road safety; however, they face many other challenges that need to be tackled in order to deliver better quality of life to its citizens, including air pollution, quality of public transport and traffic noise (see Figure 1).

While congestion is recognised as the most pressing challenge for cities according to the CIMEC survey (analyses based on feedback from 53 cities, figure1), the policies devised to deal with this are varied.

Whereas in the past, the implementation of ITS to optimise traffic flow (eg, adaptive traffic control) was considered the most effective way to reduce congestion, this measure is now just one of a package of many. Cities have come to realise that tackling congestion over the longerterm can be better achieved through a large-scale shift in travel behaviour, especially through modal shift from car to sustainable modes, for example public transport, walking and cycling. Indeed, pull measures to enhance model shift, such as integrated information and ticketing for public transport or the construction of cycling lanes, are by far the most popular policy area according to the CIMEC city survey (figure 3).

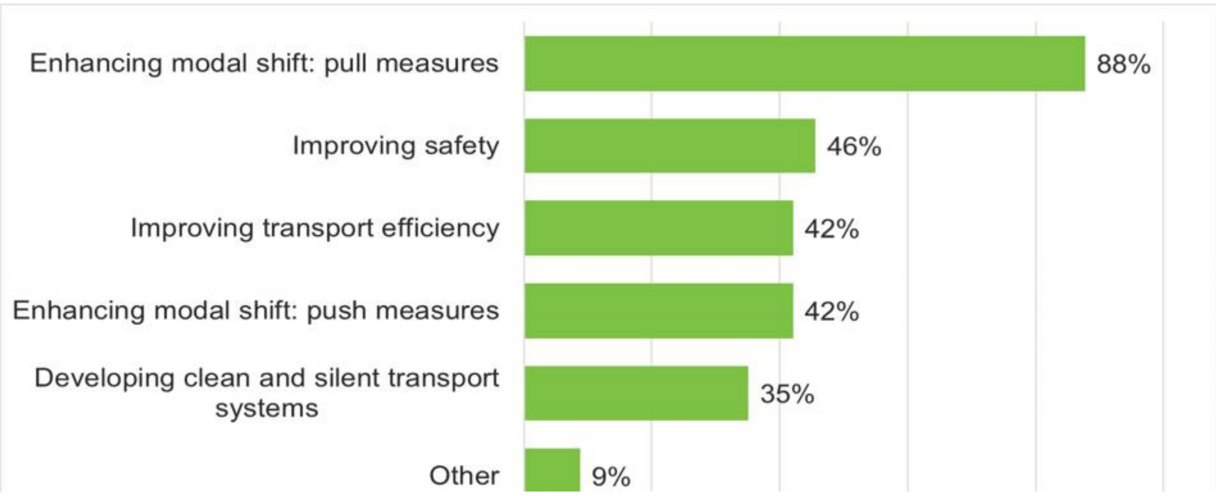

Figure 2: Main urban transport policy areas - CIMEC WP1 survey – Presentation by Hans Westerheim, Sintef - CIMEC/CODECS City Pool workshop, 3 March 2016, London

Urban transport policy is the main informant of transport strategy, which itself determines the measures to be implemented and the corresponding investments. Systems including C-ITS must show how they can respond to policy priorities. It is largely for this reason that the focus of urban ITS investments in recent years has been geared towards systems designed to facilitate seamless and intermodal trips and to make public transport a more attractive travel option, through systems such as bus countdown/departure information services, journey planning services, integrated tickets/smart-card services and public transport priority at traffic lights services. Traditional road traffic management systems have not enjoyed the same level of ITS investment in many cities because traffic management is seen as a completed task. This assertion is based on anecdotal evidence: one major European capital city revealed at a Polis meeting that 50% of its inductive loops – required to gather traffic flow data to support adaptive traffic control - are not working and the city council simply does not have the means to replace them. Another European capital indicated that it had no budget to repair or replace the city's ageing traffic controllers should they break down. As a result, many cities have an ageing ITS infrastructure, which will continue to serve the purpose for which it was originally installed and for as long as it works.

Policy category	Policy examples
Enhancing modal shift by "Push" measures	Road User Charging Access restrictions Clean Zones Parking restrictions
Enhancing modal shift by "Pull" measures	Promotion of public transport Car sharing or Walking and cycling Mobility plans and Awareness raising Interconnectivity
Improving transport efficiency	Road speed regulation Freight transport management and logistics
Improving traffic safety	Road design and regulation Safer vehicles Safer user behaviour
Developing clean and silent transport systems	Targeted noise reduction measures Alternative fuels and retrofitting for captive fleets Access restrictions based
Other	

Figure 3: Examples of urban transport policies – CIMEC WP1 survey - Presentation by Hans Westerheim, Sintef - CIMEC/CODECS City Pool workshop, 3 March 2016, London

From an organisational perspective, the role of the city authority as traffic manager is changing. Traffic management is no longer solely a mechanism for optimising the flow of vehicles on roads but rather a provider of wider transport policies and other policies, such as emissions reduction, safety of all road users especially vulnerable road users, economic regeneration and social cohesion. For instance, the traffic manager must now seek to integrate public transport priority and improved road access for pedestrians and cyclists into his/her task as well as measures to reduce air pollution from vehicles. Furthermore, a combination of market developments and new internal policies mean the traffic manager is no longer alone in managing the roads and guiding vehicles. For instance, the growth in vehicle navigation systems has meant that the driver can choose the route that is best suited to his/her needs independently of the traffic manager's preferences. The move to open up public data, including transport data, is accelerating this trend as more and more third party information service providers appear on the market and the role of the city authority as information service provider diminishes.

A side effect of the open data phenomenon, which is happening independently of C-ITS, is that cities are now having to develop data management skills. This has both positive and challenging effects: on the plus side, data is increasingly perceived as an asset worth investing in and exploiting by a city authority, rather than merely a by-product of systems which was formerly the pervasive view. On the down side, meeting market demand for high quality, frequently-updated data can be resource-intensive and requires city traffic managers to work in different ways, which can be a challenge for city authorities, in the short-term at least.

For example, the Netherlands is currently experiencing a rather radical change in city governance: in the coming years, the Dutch National Data Warehouse will be responsible for collecting traffic data, which cities will procure to support their traffic management services. Dutch cities are now contemplating what this change will mean for them.

2.2 From ITS to C-ITS

ITS is not new to cities; it is widely deployed for managing traffic and fleets (eg, buses, public bikes, trucks), providing traffic and travel information, paying for transport services and enforcing traffic rules (parking, access restrictions, etc) among others.

In many cities, there are already various systems in use today to communicate with the driver, such as the provision of information services to drivers and other transport users, via third party providers such as satellite navigation units or smartphone apps. The use of traffic light priority systems for specific fleets (public transport and emergency vehicles) is becoming popular in many cities. Current systems for bus priority tend to use local or product-specific protocols rather than the European standardised C-ITS messages (SPaT/MAP, CAM, etc). These systems typically use long-range cellular communications (3G or GPRS) or less frequently GPS or short-range tag and beacon. The dedicated short-range traffic safety and traffic efficiency related ITS-G5 protocols availablefor vehicle-infrastructure communications, has so far only been used in pilot projects for this purpose. These two new components, ie, standardised message sets such as SPAT/MAP and CAM and related communication protocol ITS G5, encapsulate the novelty that is C-ITS. An additional important element is that C-ITS will be implemented as a standard feature in cars and trucks in coming years. It remains to be seen whether C-ITS capability will be built into all new vehicles, buses included. The realisation of urban ITS use cases can be expected within a hybrid communication environment in which short-range communication such as ITS-G5 and cellular technologies such as 4G-5G will enrich each other.

For what concerns European-standardised C-ITS, the cities traffic environment is not as advanced as that of the highways with regards to C-ITS deployment. The reasons for this are varied; but an important one stems from the differences in their respective objectives and operating environment: the former aims to move vehicles safely and efficiently through the highway network whereas a city has to manage all modes of transport, not just vehicles, and the priority in recent years has been to shift demand from private car trips to sustainable modes through planning and investments in public transport, cycling, walking and new mobility services (car-sharing and public bike schemes). C-ITS has been widely perceived by city authorities as a technology to enhance car-based transport because most of the service concepts initially developed and piloted have been designed for car drivers. This has led to a certain apathy towards C-ITS among city authorities. The key features of C-ITS, as a standardised communication platform capable of enabling communication with any C-ITS enabled vehicle is not widely understood. Furthermore, the practicality of C-ITS to be used to deliver certain traffic management functions, such as floating vehicle data, or to deliver certain policy objectives (eg, vulnerable road user safety, public transport-centric applications) is only now starting to be investigated by the C-ITS community.

2.3 C-ITS pilots in cities

While the general feeling towards C-ITS is one of caution, some cities are pushing ahead with deployment. Many of these cities have been part of European and/or national R&D projects (Compass4D, Freilot, Smartfreight, CVIS, UR:BAN, among others). The experience gained from the projects has persuaded some of these pilot towns and cities to move forward with deployment: some have decided to continue running the services albeit for a small number of vehicles and on a small part of the road network; some have plans to install additional road-side units to enable the C-ITS service to be extended geographically; some are considering additional C-ITS services to be implemented via cellular communication.

These pilot projects have offered useful technical demonstrations of the C-ITS services bringing experience of implementing and running a C-ITS service. The have generated useful insights, identified gaps to be addressed and led to practical recommendations for future deployment. However, they have not yet succeeded in clearly defining the benefits; an important requisite to motivate implementation by cities on a large scale. This is mainly due to the nature of the pilots, which have been relatively small-scale in terms of vehicles involved and/or limited network coverage, and the types of C-ITS services selected for the pilot.

For example, many projects have identified lower emissions and traffic efficiency as a key potential benefit of GLOSA (green light optimal speed advisory) as this C-ITS application is intended to reduce stop and start at traffic lights by broadcasting the recommended speed to drivers in order to get the green light. While lower emissions and smoother traffic flow may well be achieved in the short-term, there is a worry that this application may well make driving more comfortable and could therefore lead to a growth in car trips in the medium to longer term. Many of the towns and cities that piloted GLOSA which have decided to maintain this application post-project are opting to offer speed advisory only to specific fleets (buses, lorries and emergency vehicles) and not to all vehicles.

The pilot projects have been of great value in building up knowledge about the organisational and technical issues. These pilots provided interesting information about what worked and what didn't. Lessons and recommendations could be derived from this. It important that these pilot experiences are captured in reports and their availability is promoted as widely as possible, for instance, through a central point of access.

- In the Spanish city of Bilbao, the Freilot pilot of a timeslot-based booking service at loading zones intended for freight operators did not work efficiently. Bilbao has learnt from this pilot and the experience has informed the follow-on C-ITS project it is piloting now and possibly implementing in the future.
- The German city of Kassel, which piloted traffic signal-based C-ITS service (SPaT) in the German project UR:BAN, produced a report of its experiences (currently available in German only) as an aid to other cities.
- The Austrian authorities produced a report about the experiences of implementing SPaT, including the necessity to create and maintain a digital map (according to the C-ITS standard MAP) of the intersections running a SPaT application such as GLOSA. It provides good insights to the practicalities of implementing this type of C-ITS service. Experiences to date seem to indicate that those cities holding digital data about their intersection(s) will find MAP far easier to create than those cities without digitalised intersection data.

Many of the pilot cities agree that the integration of C-ITS into the existing traffic management architecture and operating environment is a challenging issue. This has both technical and organisational implications. From a technical perspective, both Copenhagen and Newcastle have identified that the ITS-G5 system does not provide backward-compatibility and interoperability with legacy equipment. Copenhagen has identified the absence of standards at the interface between the road-side unit and the traffic light controller or the central control system. In other countries such as the Netherlands, Germany and Austria they are using country defined and specific interface specifications. This situation could lead to vendor lock-in.

At an organisational level, C-ITS changes the way in which city traffic managers operate. This requires new working procedures and rules. Furthermore, C-ITS is not just about cooperative technology but also requires cooperation between different public and private players and a clear distribution of roles and responsibilities, especially when a service is to be rolled out on a large scale. To take the example of GLOSA, a city may need to create a GLOSA marketing function, a complaints line, a system of public monitoring/reporting of accuracy as well as procedures for working with vendors of “approved” dashboard systems and managing access accounts (if GLOSA is applied to a designated fleet). All these functions and processes are new and virtually untested.

Linked to this point is the need to work with local traffic system providers, who typically lack awareness of the C-ITS capabilities. This was a key finding of the CIMEC project market survey. It showed that most of the smaller (local/national) suppliers, which local authorities tend to work with for systems procurement and maintenance outside of the central control system (which are often supplied by the large, multi-national traffic system suppliers), have little awareness of C-ITS and underlaying technologies and therefore have no plans to include this in their product portfolio in the short to medium term, due to the risks inherent in commercialising a new product that has a low or non-existent market demand.

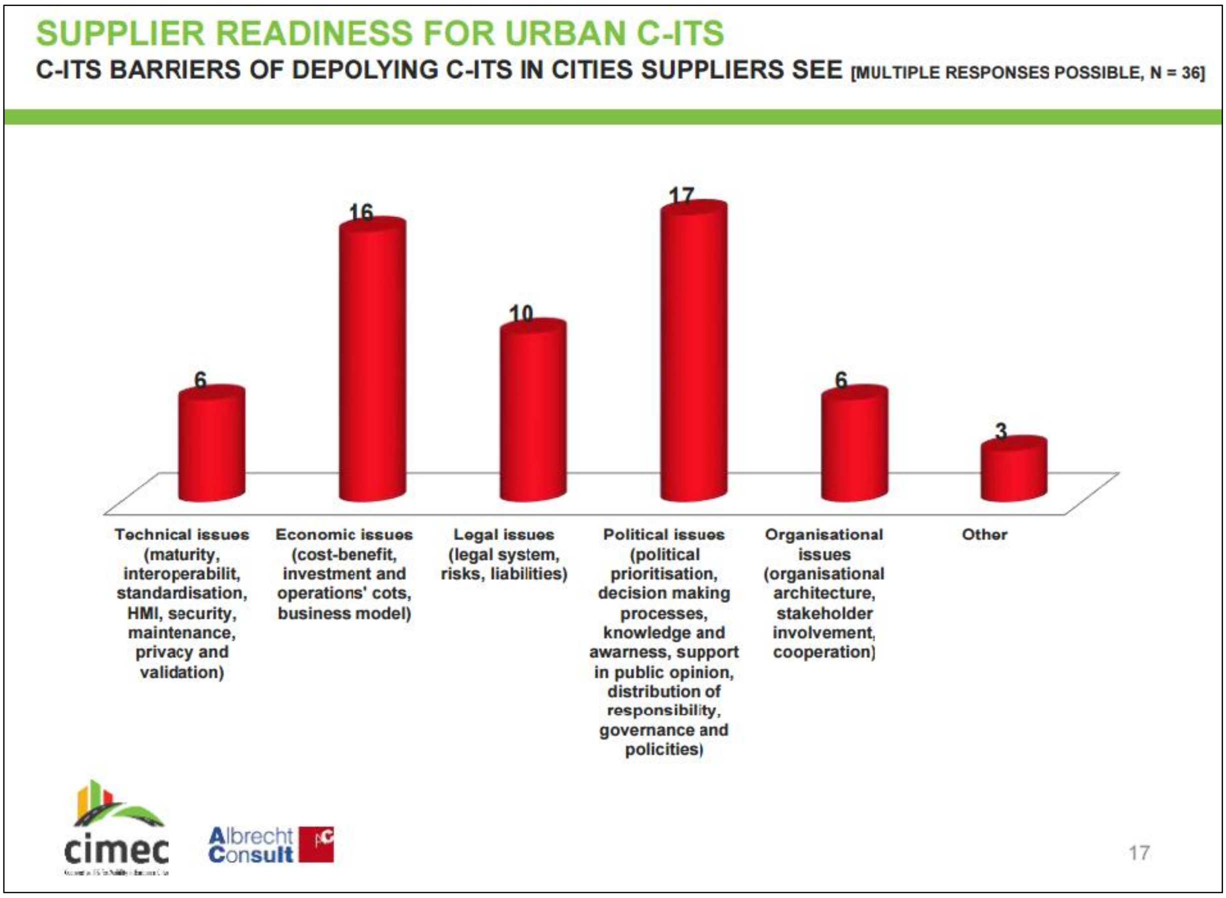

Figure 4 : Main barriers to C-ITS deployment according to suppliers - CIMEC WP2 survey - CIMEC presentation by Osama Al-Gazali, European Transport Conference, 5/10/16, Barcelona

3. Cities requirements for C-ITS

3.1. General viewpoint of cities towards C-ITS

As traffic manager, infrastructure owner and operator, transport operator (eg, buses, trams) and information service provider, city authorities are important users and therefore buyers of ITS. C-ITS can certainly add to the existing ITS mix. However, cities will only invest in cooperative technology where they see a robust cost-benefit use. ITS deployment in cities is increasingly policy-responsive, as described in section 2.1, which is why the last decade or so has seen a significant growth in ITS investments to promote public transport (bus priority at traffic lights, bus countdown information) and multimodality (Smartcards and journey planners), among others.

When discussing C-ITS with cities, the typical questions and comments that are raised are mostly of a strategic nature:

"How will C-ITS help me deliver my policies?"

"Why is a C-ITS solution better than the ITS I have already?"

"How much will it cost to install, operate and maintain?'

"How can C-ITS build on existing investments?"

"Who is liable if technology failure leads to an accident?"

"Isn't C-ITS just for car drivers and highways?"

As C-ITS developments have been driven largely by the car manufacturers and technology providers, many of the Day One C-ITS services (as agreed by the Amsterdam Group) are not necessarily helpful in reaching urban transport policy objectives such as modal shift, multi-modal transport, safety of all road users and mobility efficiency (as opposed to traffic efficiency), most of the Day One C-ITS services are tailored to the motorway environment for vehicles running at high speed and for which vehicle safety and traffic efficiency are paramount. It should be noted that there is work underway within the CODECS project and the C-ITS Deployoment Platform to define use cases of interest for urban areas.

The following paragraphs summarises some of the main points that emerged from discussions with cities at the City Pool workshops and other fora about the deployment of C-ITS in cities.

3.2. Problem-led approach to C-ITS deployment

While city authorities use a lot of technology to run the transport network, this technology has to serve a purpose. For instance, the use of ANPR cameras to enforce congestion charging in London and the limited access zone in Rome, or the provision of journey planning engines to offer seamless trip information thus contributing to intermodal trips in favour of car-based trips. These examples demonstrate that ITS is an enabler, a means to an end rather than an end in itself. It is useful to note that ITS is not widely mentioned in Sustainable Urban Mobility Plans/SUMPs (if at all), yet ITS does have a role to play in delivering some of the measures that are contained in the SUMP.

Many cities hold the view that C-ITS is being sold to them as a 'solution' to a problem that has not been defined. That is not to say that C-ITS cannot solve (or help to solve) urban transport problems, but rather their contribution has not yet been clearly identified. When there is a problem to be solved, be it buses stuck in traffic or an increase in accidents involving cyclists, cities will have to undertake optioneering, ie, they will need to consider a whole range of measures to address a particular need or problem and these measures may involve technology or they may not.

Over the years, a number of shortcomings found in traditional ITS has been raised by cities, shortcomings for which C-ITS may offer a solution. Some of these are listed below. To accelerate C-ITS deployment in cities, it is important that the C-ITS industry shows how C-ITS can address these problems and other problems raised by cities.

- Traffic data (notably inductive loops) is becoming increasingly expensive to procure/sustain.
- Communication costs for different ITS applications are growing rapidly.
- Air pollution is worsening and requires new traffic signal measures (eg, freight priority).
- Electric vehicle charging bays require enforcement to deter illegal parking.
- Vulnerable road user safety is becoming a critical safety issue, especially at junctions.
- In some countries, the public transport priority system is becoming unreliable, thereby offering an opportunity to migrate to a system that can offer a wider gamut of signal priority.

3.3. The business case

This is possibly the most important barrier to the deployment of C-ITS. Furthermore, it is not restricted to cities; it is an issue for the motorway authorities, which have traditionally been more active in C-ITS pilots, and even the vehicle manufacturers themselves. While the car industry has committed to roll out C-ITS equipped vehicles from 2019 onwards (provided EU-level agreement is reached on key issues such as security and data privacy), they know that car owners, who will ultimately have to foot the bill for this equipment, are more willing to pay for 'efficiency' services (such as traffic light assistance or route guidance), which depend on vehicle-to-infrastructure cooperation, than in safety applications which are based on vehicle-to-vehicle communication and proven to offer substantial benefits on high speed roads.

For a city, the societal benefit is of greater importance than the financial benefit, notably in terms of how C-ITS can deliver the key goals of improved liveability and accessibility, which are translated into a variety of policies such as promoting public transport and active modes (walking and cycling), improving the safety of cyclists, improved air quality and providing reliable travel times, among others.

Currently, there is little evidence of the societal benefits of C-ITS in an urban environment as C-ITS has yet not been implemented on a wide-scale. Some figures coming from a variety of European and national projects are pointing to emissions savings through use cases applications such as GLOSA. However, these are often based on pilots operating at a limited scale and/or on extrapolation, and they therefore hold little credibility among city authorities. Furthermore, these benefits are measured in the short-term. The impact on traffic flow (and consequent emissions reductions) in the medium to longer term of large scale implementation is not yet known. Thirty years of implementing adaptive traffic control and ITS to improve flow and reduced congestion has not really achieved its objective due to the continual growth of traffic. Some cities now hold the view that ITS has perpetuated the traffic problem: increasing the operational capacity of the network can attract more vehicles to the road network. It is therefore vital that demand management policies and other measures to promote a change in travel behaviour are implemented at the same time as technologies to improve traffic flow.

Building a case for C-ITS in terms of societal benefits/policy goals may not be possible until we see real-life, large-scale deployment. However, it is possible to start building a case for C-ITS in terms of cost and performance in relation to traditional traffic systems and ITS that are deployed today to deliver similar functionality:

- One example is traffic flow data, which is required for adaptive traffic control: the method most commonly used to gather such data is embedded inductive loops on the approach to traffic lights. Loops are expensive to install; repairing or replacing them can be particularly disruptive to traffic because the road has to be dug up. Some of the larger cities today have confirmed that when their loops break down, they are not replaced precisely for these reasons and are substituted by other equipment (eg, ANPR for travel time measurement) or other sources (eg, third party probe vehicle data). In future, such anonymous traffic flow data can potentially be collected directly from the vehicle through C-ITS.
- A second example concerns traffic lights services for designated vehicles such as priority or optimal speed advice. Today, bus priority at traffic lights is implemented in many cities to improve the commercial speed of buses. Many different types of systems and communication channels are used to

enable this, some of which involve vehicle to infrastructure communication whereas others are just infrastructure based. Moving to a C-ITS bus priority system, ie, one that is based on a standardised communication channel and an open and standardised interface, would enable the same system to be used for any C-ITS equipped vehicle Europe wide. A city could therefore give priority to lorries, emergency vehicles or municipal vehicles (refuse collection for instance) through one system rather than a separate system for each type of vehicle. Furthermore, having a standardised solution would enable buses to be moved from one city to another. A final point to note is that is that the radio channels used in some countries today for communicating with buses will no longer be available in the future.

A further potential benefit that requires further investigation concerns the whole life-cycle costs of C-ITS compared to today's ITS. A key issue to consider is that cities are interested in bringing down revenue costs (operations and maintenance) even if the capital costs are higher, because it is possible to apply for government grants for such capital costs. Furthermore, evidence from those countries adopting ITS standards in urban transport, such as OCIT, OTS and UTMC, shows that the cost of procuring systems goes down because the suppliers' market is broader.

3.4. C-ITS procurement

A city's relationship with C-ITS remains may be passive or active. Passive engagement includes an understanding of how road user behaviour changes as, for example, vehicle-to-vehicle systems begin to be widely used, or as third-party services (such as in-vehicle routing) evolve in the marketplace. Inevitably, though – given the focus of the C-ITS industry on vehicle-to-infrastructure links – there is more interest in understanding how they may become active partners, and begin to deploy their own C-ITS facilities.

Public procurement is governed by regulation: at European level for large-scale expenditure, and through national or local policy for small-scale. Cities will normally have established procurement departments to ensure that these regulations are properly adhered to, including establishing:

- Why the city needs to undertake the project (ie it will have public benefit and is unlikely or unable to be done by anyone else) – through the business case discussed above
- That this procurement is the most cost-effective way of implementing the project
- A clear specification for the goods and services to be procured
- A non-discriminatory way of evaluating tenders

There are two major challenges here for C-ITS. At the technical level, there is little experience in cities of how to undertake the specification and the associated evaluation in a robust way. In particular, the huge number of system options involved in C-ITS means that it is resource intensive to produce an optimised specification, even for someone who has the technical skills. Only large cities maintain the capability to consider this. Smaller cities often depend on larger cities, or national guidance, to choose the right product type.

At the commercial level, the rapid change in what is possible, plus the varied options on who takes what role, mean that it is virtually impossible for a city to be sure that a C-ITS investment made now will continue to be good value for a reasonable length of time. No city wants to spend many euros on a system which becomes obsolete in six months. Equally, no city wants to spend many euros on a system which doesn't begin to yield value for several years.

There isn't even a clear supply market yet for city C-ITS products. So, any investment would be essentially for a bespoke solution (ie the city commissions a supplier to develop a C-ITS for it). Such projects are historically very expensive, and the risk of cost overruns will be seen as high.

So, for many C-ITS, the benefit is difficult to quantify (especially in the longer term), the cost is likely to be large, the specification is difficult to produce and to optimise, and the risks of failure (of the product, the supplier, the cost projection etc) are large. Only where there is a clear policy goal *and* a well-established product response – as is the case with bus priority systems – is a city likely to feel comfortable with a major procurement.

There are two other circumstances where the procurement challenges are mitigated:

- If city direct investment is very small – for example, if almost all of the cost is borne by the private sector (transport operators, city developers, software providers, or OEMs).
- If project funding, technical specification and/or project risk are provided externally – for example, under a grant from their national or regional government.

In these cases, the city challenge is much simpler: do we have the manpower to support our role in this project, and is it likely to cause problems for the city? While not trivial, these are much lower hurdles to jump.

3.5. City role in market adoption

Even where cities are not active partners in C-ITS (eg for V2V applications or commercial service applications) they may still have an important role in facilitating their introduction. And where they are active partners, their project will not just be about buying a system, but also about making sure that it is used to maximum benefit.

The city's role and approach will depend on circumstance. For example, with applications like in-cab warnings for trucks/buses of a nearby pedestrian, it is likely to be limited to encouraging the users to acquire and use the relevant systems. However it may go much further: organising training courses, providing model specifications, pre-selecting a list of "recommended" or "approved" products, etc.

The city could even adopt a regulatory position, especially where there is already a tool that the city can use. For example, it could require all buses that operate under a city licence to include pedestrian-awareness technology, and impose penalties for non-compliance.

For V2I systems, where the city has a technical role as well, it is even more likely to want to use some of these approaches. For example, if it deploys a GLOSA system, it will be keen to ensure that as many road users as possible are equipped to receive the information. These considerations of process – and the associated implications for manpower and cost – will be an integral part of the city's project planning and execution.

It must be emphasised that such market interventions will not be taken lightly. As well as the direct costs, the city will be concerned that it does not take on excessive liability – for example, if its system mistakenly shows a green signal phase to opposing flows and there is an accident as a result. Moreover it will need to ensure that it not acting *ultra vires*, under the prevailing national or European regulations on (say) privacy or competitiveness. For example, what is the extent of its power to give different levels of priority to buses operated by different companies?

3.6. Integration with current city systems

Assuming the hurdles of justifying and procuring a C-ITS system have been overcome, and the city knows how it needs to maximise its use, there will still be a range of technical issues to overcome[1].

Many cities already have a wide range of ITS, as described in section 3.2. While some may still be quite independent, "standalone" systems, there has been an increasing tendency over the past decade or more for ITS systems to be integrated, so that there are efficient data connections between them.

[1] This section builds primarily on experiences in the cities that have taken part in current C-ITS trials, such as Copenhagen and Newcastle in Compass4D.

This integration is at the heart of gaining effective use from city ITS. The manner of achieving this has varied from place to place – some have benefited from open standards frameworks, others have relied on buying solutions from horizontally-integrated suppliers, and still others have paid for ad-hoc interfaces to be developed. This process has taken some time and effort. This has resulted in systems which are cheaper to buy and operate, better supplied with relevant information, able to adopre more sophisticated strategies, and less prone to technical problems.

However, there is currently no clear mechanism for integrating C-ITS into these (already integrated) systems. A city acquiring a C-ITS product, therefore, will be concerned that it will incur additional – expensive and time-consuming – development. Worse, there is a fear that any integration could compromise the existing stable traffic and transport systems.

For example, many C-ITS architectures envisage a roadside unit that undertakes local communication with passing vehicles. To perform a useful function, though, this needs to link into other roadside equipment, such as traffic controllers, barriers, camera or variable signage. However, there is no agreement on what these links should look like: no standards, technical specifications, management functionality, security framework etc.

Of course these concerns are not limited to cities that are already deploying (pilot) C-ITS: they will also be raised by other cities whenever they start thinking about a C-ITS project, and will add yet another risk to the business case and procurement processes.

3.7. Road user utility and response

The way in which C-ITS connect with city systems is primarily a technical matter. By contrast, the way in which they connect with road users, in order to deliver the promised benefits, is as much about behaviour, psychology etc. as it is about technology. This will affect the way in which cities can build a robust business case for investment (section 4.3), as well as what they need to plan for in terms of raising awareness etc. (section 4.5).

To date, there has been very little methodical exploration of these factors on road users. Indeed there is a feeling that the issue is seen as an opportunity for supplier innovation, rather than an extension of transport policy, which leads to the worry that road users might use C-ITS tools in ways which are detrimental to the city.

The classic case here is the time-to-green service. There is typically an assumption that drivers will use this responsibly: slow in advance of a red light, and merely use a green warning as an opportunity to re-ignite their engine (if required). However, there will doubtless be a minority of drivers that abuse it: racing to get through a light that is about to turn red, or pulling away just *before* the light turns green.

At present it is not known how significant this behaviour would be. Any resulting accident, even if the city were not legally liable, would certainly cause bad publicity. At best, there would probably be a need to install much more red-light enforcement (at considerable expense).

Is it possible to design systems that avoid such problems? Possibly: for example, some of the existing trials caused the prediction to cut out at (say) 5 seconds before the change, to force the driver to pay attention to the actual signals. However, there is no guarantee that a commercial system would always respect such norms unless they were regulated, and no clear measure of the level of risk for specific user interfaces in any case.

It is worth noting that driver distraction is already a major concern for road safety, and that the use of mobile phones – and smart phones in particular – has dramatically increased the public sector emphasis on distraction avoidance.

It is partly because of these behavioural concerns, that cities are much more likely to regard favourably systems in which they (a) have a level of control over the in-vehicle system and (b) have a reasonable expectation of driver quality. So, for instance, they are likely to favour:

- Vehicles operated by (or under contract to) the city – gritters, waste collection, etc
- Police and emergency services vehicles
- Public transport vehicles
- Licensed freight vehicles
- Taxis
- Some commercial vehicles, eg those operated by driving schools

3.8. Transition issues

As C-ITS begin to be deployed in vehicles, there will inevitably be a long phase during which some vehicles are equipped and some are not. Compounding this will be the fact that vehicle users vary in the use they choose to make of their C-ITS. This long transition phase will have a complex impact on cities' planning for C-ITS implementation.

The most obvious impact is on the business case (cf section 4.3). Generally, the fewer vehicles that exist to receive the benefits of the service, the lower the benefit will be. An investment plan where costs are up front, but the main benefits deferred perhaps for many years, is likely not to be very attractive. Where this is the situation, a city may well decide to wait until "enough" vehicles are ready to make use of the system – unless there is a good policy reason to try to drive the market.

There are several exceptions to this rule.

- Services where a small fraction of equipped vehicles will deliver the majority impact. It has been argued, for example, that GLOSA is of this kind. If 5% of vehicles approach the stop line more steadily, all the traffic behind them will also be constrained to slow more safely and with fewer emissions.
- Services where the city can ride on the back of vehicle deployment, perhaps itself driven by V2V services. An example might be floating vehicle data. When a city determines that the data captured from FVD is likely to be of high enough quality, investing in "data collecting" C-ITS stations should be a straightforward judgment – and those stations are then available to act as hosts for other C-ITS applications.
- Service that relate to fleets where the city can actively influence the vehicle deployment – such as those listed in section 4.8 above.

There are also cost challenges. Where the justification for C-ITS is cost reduction – for example, in-vehicle signage replacing roadside signage–the case is compromised if "old" services have to be maintained throughout the transition phase. Again, the benefits are only achievable at the end of the process.

The transition phase also raises questions about driver behaviour (section 4.7). Road safety depends hugely on road users knowing how other road users are likely to behave, while always of course recognising that there will be variations. Drivers expect that pedestrians will not step onto the road directly in the path of an oncoming vehicle; conversely, pedestrians expect that drivers will stop at a signalled crossing.

A significant part of this is that the infrastructure is transparently visible to all road users (including danger spots like blind corners). This isn't always perfectly true, but it is generally a reasonable assumption, and those who fall outside the norm – say, blind pedestrians or blue-light vehicles – will both be especially careful and (often) be clearly marked.

C-ITS undermines this, potentially, especially where the road user receives important information from the city. Road users without C-ITS may then be taken by surprise at the sudden, apparently erratic behaviour of equipped users, while (later in the transition) equipped users may falsely expect "sensible" behaviour from an un-equipped user.

One approach would be never to provide information through C-ITS that isn't available otherwise – for example, in-vehicle information would be used only to replicate what is also available on VMS. However, this would seriously constrain the use that could be made of the C-ITS, and may indeed be an unnecessarily restrictive response.

Even in this case, though, there is the potential for conflict in some cases. Currently the primary safety command to a road user is the red phase of a signal: if some users are looking at the physical signal, while others are looking at in-vehicle systems (ignoring the signal in favour of a SPaT-type message), there is scope for misunderstanding and accidents.

3.9. Organisational issues

There is a widespread, though still incomplete, feeling that traffic management is undergoing a fundamental shift, and that ITS-enabled services (including C-ITS) are a key part of this. Some cities have suggested that their future role will be limited to a small subset of what is normal even today, as changes like the following happen:

- Traffic information and route guidance will be provided by third party services
- Much less signage will be required on the roadside, whether for routing guidance or even for traffic instructions like "keep right" or "no entry"
- Intersection management will be handled through V2V optimisation, except possibly at the busiest and most complex junctions
- Collection of traffic data is achieved through probe vehicle services, provided through manufacturers, leasing companies or fleet operators

In this paradigm, the city role would just be one of monitoring the network (perhaps with bought-in data) to ensure that the policy goals of safety, environmental protection etc were being met, and to inform the planning of tools like infrastructure works, traffic restrictions or speed limits.

Conversely, there is an emerging awareness that a city-operated C-ITS service may have significant new requirements for (and costs of) operation, as well as costs of system acquisition. This has an impact both at a strategic (city-wide) level as well as at a tactical (point-based, real-time) level.

Strategically, it is clear that some C-ITS services can reasonably implemented piecemeal, while others need to be done coherently on a large scale. Specifically, traditional bus priority or access control (ie where the vehicle automatically triggers a response from the infrastructure without involving the driver) is generally suitable for a gradual, targeted implementation; applications like enforcement, road-use charging or intersection safety really demand a large scale implementation to be effective and avoid dangerous confusion arising.

However, planning and managing systems which are city-wide, or possibly even larger, raises new challenges. At present the only significant systems that are operated at this scale are the traffic signal systems themselves. Suddenly creating a huge new range of applications potentially increases the complexity of the task manifold. Having said this, of course, the scale of the challenge is not yet known because such systems don't yet exist!

As a tactical example: a number of proposed applications are based on the SPaT/MAP messages which are passed from signal controller to vehicle. Phase and timing information will be available from existing signal control software (although not necessarily in a form suitable for transmission over SPaT), but MAP data is often not.

Therefore, in order to implement these services at a junction, the city will need to undertake a very detailed survey of the junction layout, and create a new database to put the data in; it will then need to manage the accuracy of that database in real time, so that changes caused by road works etc. are correctly represented all the time. The scale of these costs, too, is unknown.

3.10. Supply market competition

As noted above (section 4.6), cities are used to a supply market which generally enables the integration of various systems. Cities both large and small exploit this to mix large, complex systems (typically supplied by established mainstream companies) with smaller, more innovative systems, which could be supplied by anyone from the same (or different) large companies to SMEs, charities, individual developers or even schools. Similarly, they operate a mix of stable, mainstream systems with point-specific solutions, small-scale pilots and short-term research exercises.

Competition is endemic in all of this. The larger suppliers generally began with a focus on a specific area, such as signal control, and incrementally added “industrial strength” applications to this. Open frameworks like UTMC in UK and OCIT in central Europe – and of course DATEX II for highways applications – facilitate competition among these suppliers. Smaller and newer companies make great use of mainstream ICT standards, especially the internet protocol suite (IP, HTTP, XML etc), and compete for innovation.

The market for C-ITS systems is as yet undeveloped: while specific examples exist (eg bus priority, route guidance), the full force of V2I services that is envisaged in current research projects is still at the level of prototypes and technical demonstrators. The future of this supply market is unclear, but cities are strongly of the view that they need to avoid supplier “lock-in”. Standards will be key in this, inevitably.

This issue is, perhaps, less significant than those of sections 4.2-4.8, but any lack of competition will be seen as increasing the cost and risk of any project, and therefore of slowing deployment further.

4. Most interesting use case areas for cities

The purpose of this section is to describe at a high level those areas which cities have identified as being of possible strategic value for the deployment of C-ITS. This information is derived from discussions at the three City Pool workshops organised in 2016 by CODECS and CIMEC, the CIMEC local workshops conducted early 2016 and other recent C-ITS events involving cities. This section has deliberately avoided identifying specific use cases because some of the areas of interest are adequately documented in other C-ITS fora and literature (notably for what concerns public transport and traffic data) whereas other areas are reasonably new to the C-ITS domain and will require further investigation.

In defining these high level areas of interest, no consideration has been made as to whether they are currently technically, legally or financially feasible or desirable. The report authors did not wish to make a judgement on this. Instead, this information is intended to promote reflection and discussion within the C-ITS community on the types of C-ITS deployment that could appeal to a greater number of city authorities than is the case today.

4.1. Intersection-based applications for designated vehicles

City authorities see real benefit in providing services to designated vehicles to help them move smoothly and safely through intersections, such as green light optimal speed advisory or changing to/extending the green light (bus priority). Buses and lorries are of particular interest to local authorities due to the loss of traffic efficiency and emissions generated by these heavy duty vehicles when they are stuck at traffic lights. Furthermore, ensuring buses can pass through intersections with minimum delay is a key measure to make public transport a more attractive option and therefore to achieve modal shift goals.

Systems for bus priority at traffic lights are in operation in many cities across Europe. It is therefore important to understand why a C-ITS solution is better than existing off-the-shelf systems that are widely implemented today, be it in terms of performance (eg, reliability), cost or other factors. Intersection measures for freight vehicles are not widely implemented by cities (if at all). C-ITS is an important enabler of this service. Of even greater benefit is the opportunity to have one system offering GLOSA and/or traffic light priority for both trucks and buses and possibly other types of vehicles that a city may wish to offer priority to, eg, taxis, electric vehicles, or even push bikes.

The potential for C-ITS to offer differential priority should also be explored; for instance, if a bus is behind schedule, it has priority whereas a bus ahead of schedule does not. Differential priority could also be used by cities to incentivise fleet operators to adhere to safety and environmental standards. For example, Torino is developing a pilot which will allow access to bus lanes to those lorries owned by fleet operators that are part of the local freight partnership.

There is far less appetite to offer intersection services to the private car, as explained on many occasions throughout this document. At a strategic level, cities are concerned that making car trips smoother may discourage modal shift and even encourage more cars onto the roads. However, at an operational level, the goal remains to keep traffic free flowing - a goal that is especially important to keep emissions down. In a situation where cities are taking away road space from the private car for the benefit of other modes (bus lanes, cycling lanes, wider footpaths), there is a need for tools to manage the remaining road space in the most efficient way possible.

4.2. Floating vehicle data

The huge potential for vehicle-generated data to feed adaptive traffic management systems, in place of inductive loops for example, was identified at the outset of the C-ITS research and development phase. It was identified in the 2010 Polis position paper on C-ITS. It is also a key C-ITS application that is common to both urban roads and motorway. Traffic flow data is crucial to the operation of traffic management and to keep road users informed of the network status. Quite uniquely at present, this application offers an easy business case for C-ITS, as described in section 4.2.

Given the high level of interest among local authorities, it is puzzling that floating vehicle data has not always been given the attention it deserves by the C-ITS community. Could it be that it is not perceived as a 'service' in itself but rather as a by-product of another service? The data generated by the vehicle is a CAM 'here I am' message, which has been designed to enable other services, such as GLOSA.

In an era when inductive loops are becoming less popular and cities are turning to the market to procure traffic data (probe vehicle data, GPS data, cellular data) the potential for capturing CAM data to support traffic management is significant. Cities need to know if this is likely to happen and how this migration could and should happen in the most efficient way possible. According to the European C-ITS stategy (COM(2016) 766 final, 30/11/16), any data generated by a vehicle is viewed as personal data and is therefore subject to data regulations. It needs to be clarified what this means for the prospect of authorities/operators being able to capture this CAM message in a future when C-ITS cars will be moving through the city.

4.3. In-vehicle information about (local) traffic rules and key infrastructure attributes

Supplementing the traditional road sign with in-vehicle information is of interest to local authorities, especially for what concerns local traffic rules (speed limits, access restrictions, etc), tunnel height/width restrictions and other important information, such as 'school nearby' or the presence of a traffic event. There are already after-market devices providing this information today although the level of information provided varies depending on the device and the service paid for.

C-ITS could offer a standardised platform for delivering this information (independently of communication technology), meaning that information is sent to all C-ITS equipped vehicles in the vicinity, provided the relevant app is available in the vehicle. It remains to be seen whether a local authority would be willing to provide this information itself or whether it would rather open up this data and let the market take over the delivery of the service. In the latter case, there is the risk that implementation of this service becomes fragmented, as is the case today with Smartphone apps.

With regard to in-vehicle information about local traffic rules, there needs to be clarity from the C-ITS community about what is mature enough to be deployed, once the vehicles are instrumented and on the roads (in principle from 2019 onwards), and what requires development.

4.4. Enforcing (local) traffic rules

A natural follow up to in-vehicle information about local traffic rules is enforcement of these rules. Today, ITS is used (along with other mechanisms) for this purpose. For instance, access restrictions or road user charging are typically enforced by automatic number plate recognition (ANPR). For on-street parking enforcement, paper permits or RFID tags are used but these are extremely labour intensive as they require boots on the ground to read or scan the permits. A more recent parking problem is occuring at e-charging stations. Berlin, and probably other cities too, has a problem with conventionally-fueled vehicles 'parking' at e-charging spots because they are 'free' and they tend to be centrally located. C-ITS could in the future offer a practical and cost-effective tool to enforce parking at these charging points.

The role of C-ITS to enforce safety-critical incidents, such as speeding or red-light violation, is of value to city authorities and especially the police. Key to the delivery of these types of use cases is the legal framework, ie, can driver/vehicle owner anonymity be lifted in specific safety-critical cases. These are items that are still under discussion at European level.

5. Conclusions and recommendations

Cities are not interested in C-ITS as pieces of technology. However, they are quite happy to consider C-ITS, as part of their toolkit, where they offer a clear benefit to the city's public role.

At present, although there are many "in-principle" claims for benefit, the evidence is limited. Furthermore, the costs of acquiring and using C-ITS are unknown, the supply market is rapidly developing, the policy and regulatory framework is unclear, and the funding available to cities for any "discretionary" spend is very limited. In this environment, it is unsurprising that there has not been any great momentum towards city investment in C-ITS.

This may change over the coming years if there is a push from national governments. For instance, the recently announced Dutch C-ITS programme to co-fund the installation of C-ITS equipment has significantly raised the level of interest in a number of Dutch cities. Similarly, the imminent introduction of C-ITS-enabled vehicles (anticipated in 2019) may also play a role in raising the level of engagement of cities, especially if a ready supply of reliable floating vehicle data becomes available at low cost.

While gathering evidence of the benefits of the more fully-developed C-ITS services (so-called Day 1 and 1.5 services) is important, it is equally necessary for city and regional authorities to reflect on where C-ITS functionality could serve other public service areas, such as traffic management and enforcement. C-ITS offers significant potential in these areas but requires substantial effort to bring to fruition, notably in terms of development, piloting, standardisation and legal aspects such as data privacy.

To address the above, we make the following recommendations:

Policy recommendations

1. The European Commission and Member States should give greater attention to the deployment of C-ITS in the urban environment, through whatever means are most appropriate, including:
    a. financial incentives for deployment such as the Dutch C-ITS programme;
    b. funding programmes for piloting and deployment such as CEF or CIVITAS;
    c. pan-European city outreach, building on the successful city outreach activity ('City Pool') conducted jointly by CODECS and CIMEC;
    d. collation of deployment use cases, evaluated benefits and the results of pilots (especially lessons learnt) possibly through an "observatory";
    e. knowledge sharing and cooperation with US city and end user-focused initiatives, including the Smart City programme, large-scale pilot in New York and Connected Vehicles Basics web resources.
2. The city requirements and C-ITS use cases outlined in this document should be taken up for consideration by the C-ITS Deployment Platform, and not only in the Urban and Public Transport Working Group of the platform, alongside the existing Day 1/Day 1.5 services that were agreed in Phase 1 (before the Urban Working Group existed).
3. The EC should ensure that adequate attention is given to supporting a coherent picture for European C-ITS, linked clearly to transport policy, alongside other transport innovations such as automation, accessibility and alternative energy. Specifically, the research recommendations detailed below should be taken into consideration in guiding future calls under the H2020 programme for transport.

Research recommendations

1. European policy correctly recognises that transport has a broad role in environmental, social and economic sustainability. In this context, cities are especially sensitive to other classes of road user: public transport, emergency services, freight, and especially VRUs. By contrast, the main efforts within industry are geared to volume cars. Public investment should, therefore, favour research that is beneficial to other classes of road user.

2. Research and development is required to build the services and to validate and quantify the benefits of some key C-ITS functions where cities have exhibited near-term interest: intersection services for designated vehicles, floating vehicle data, in-vehicle signage and traffic enforcement. Specifically, this needs to be framed in ways that cities can respond to directly: long term societal benefits in terms of safety, the environment, the local economy and accessibility.

3. While there has been a considerable amount of work on the benefits that C-ITS might provide, it is much less well understood what risks it might have, and where there might be unintended consequences. For example, if a solution has a genuine modest safety benefit, but turns out also to have a large detrimental environmental impact, it is much less likely to be adopted. Research is required on these issues, and possible mitigations, both at-desk and under conditions as close to mainstream adoption as possible.

4. For the benefits claimed for C-ITS solutions, research is required to address the converse aspect: how do C-ITS compare, in terms of cost-effectiveness, with other (ITS or non-ITS) measures? From the city perspective this should include (where relevant) at least:
    a. Solutions based on (city) roadside units and local communications
    b. Solutions based on (city) central processing and wide area communications
    c. Solutions based on third party services, perhaps using a data-sharing agreement with cities
    d. Solutions based purely on V2V/V2X technologies which do not involve the infrastructure
    e. Solutions based on fixed solutions like lane allocation and speed limit reduction

Annex: CODECS City Pool

The City Pool met on several occasions in a workshop format in order to encourage interactive discussion and cross-sectoral dialogue. Workshops were organised in 2016 in London (3 March), Glasgow (6 June) and in Barcelona on 14 November 2016. These workshops enabled participants to learn about (and provide input to) the work underway within CODECS, the deployment initiatives happening around Europe (mainly on motorways) as well as the views and plans of the main C-ITS stakeholders, notably the OEMs and the system suppliers. The City Pool workshops have also provided an opportunity for city authority representatives to share their C-ITS pilot experiences and plans for deployment. The latter has been most useful in building understanding of the practical aspects of implementing C-ITS.

On two occasions, CODECS teamed up with the H2020 project CIMEC to offer a joint CODECS-CIMEC City Pool workshop. The two-year CIMEC project had also anticipated the creation of a pool of cities to gather urban needs and requirements. Furthermore, the timing of the respective City Pool workshops was similar. It therefore made sense to join forces for two workshops for several reasons: to create synergies between projects, to avoid duplication of effort and to ensure efficient use of resources (workshop costs were divided between both projects).

Although a call for membership of the joint CODECS-CIMEC City Pool was launched at the start of the CODECS project, which itself attracted just over 20 applications, it was decided to retain an open and flexible City Pool membership. The first City Pool workshop in London on 3 March, organised jointly by CODECS and CIMEC enjoyed the participation of more than 50 people, including more than 25 representatives of local government. Some 35 persons attended the second City Pool workshop in Glasgow on 6 March, including some 17 people from city authorities. The third workshop took place in Barcelona on 14 November 2016 and attracted some 55 attendees.

Full details of each of the three workshops can be downloaded from the CODECS website, namely: the workshop note, list participants, agenda and presentations.