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European Roadmap Towards an Integrated Urban Mobility System

Version June 7, 2011

ERTRAC Working Group on Urban Mobility

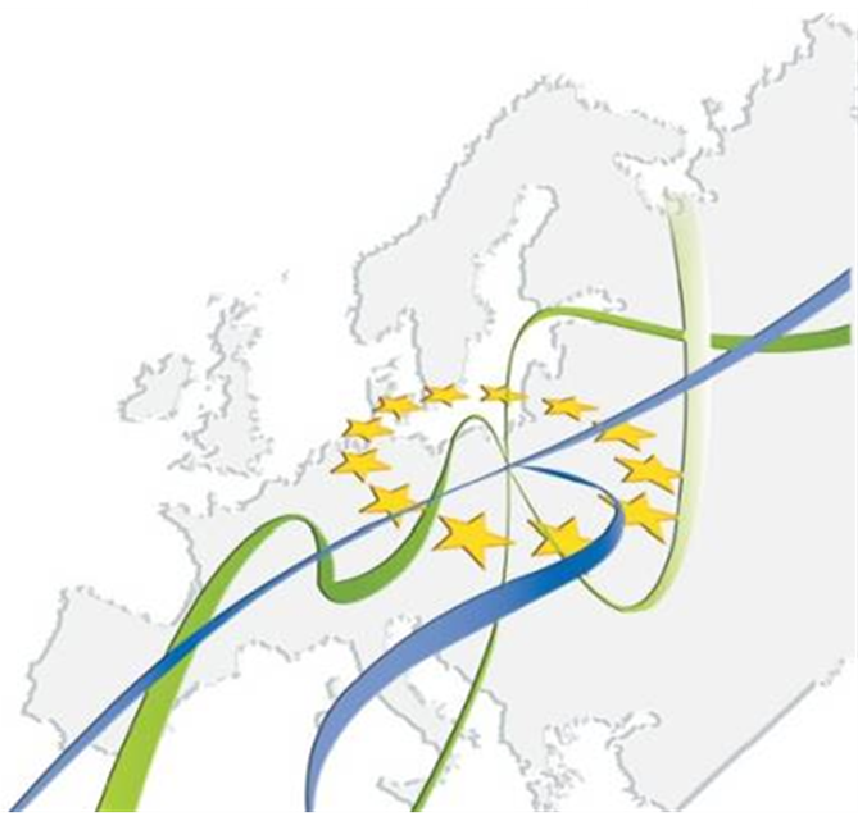


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1. Executive Summary

Urban mobility should evolve towards enhanced mobility and greater efficiency. For this purpose, all modes of transport should be fully exploited in a complementary way, to offer the most convenient overall journeys for passengers and goods, guaranteeing a high level of accessibility and achieving the highest energy efficiency.

This requires their integration, ensuring that their complementarity is guaranteed through intermodal solutions. It also consists in the integration of the most energy efficient vehicles in the network.

To further integrate the urban mobility network and services, obstacles, real and perceived, related to the transfer of travellers/passengers/drivers from one mode to the other should be reduced to their minimum.

It would involve breaking the barriers between the management systems of the various modes to bring them together as much as required to reach the optimum balance to improve accessibility and the energy efficiency of the system as a whole.

A more integrated urban mobility network also integrates and therefore enables further the use of new mobility services in the urban environment.

The greater integration of public and private modes of transport, of collective and individual modes, will lead to greater room to create incentives and management tools influencing not only vehicles traffic but also the movement of people and goods.

Ultimately, it is an essential component of the future smartcity¹ with the deeper integration of mobility in its urban environment and with the other network industries such as energy.

2. Introduction

a. Background

The ERTRAC scenario 2030 illustrates the need for urban mobility systems to address increasing pressure on the networks and increasing congestion. It also describes the need to improve energy

¹ There is no generally accepted definition of the term smart city. We could understand this as a concept of a city where the underlying IT backbone allow the full connection of the individuals, vehicles, buildings, etc. with their environment, enabling a smarter management of services such as energy (cf smartgrids), transport, etc.

efficiency to reduce the impact of mobility on the environment and the cost of mobility services for the public authorities, among other things.

Several modes of transport coexist on the urban mobility network, from walking and cycling to light rail, but also various types of vehicles and services for motorized road transport, for passenger travels and freight delivery, including different categories of services (collective and private transport). The scenarios show that this diversity is likely to increase. This creates a growing need for the integration of the various components of the mobility system.

Increasing levels of congestion and mounting pressure on the network (ERTRAC SRA) will challenge the optimization of urban mobility systems in the urban area. This will require further integration between the various modes of transport and services, to allow as smooth as possible transition between modes and networks for efficient intermodal travel and transport solutions. This should be supported by initiatives enabling integrated services.

With the integration between modes of the traffic and travel information, of charging and payment, and a greater physical integration of infrastructures and services, a broader range of tools emerge to manage the urban mobility network. The integration of these different components of the urban mobility system should be complementary.

For this reason, a single roadmap on the research needed to develop the tools required to allow the integration of the system is justified.

b. Scope

This roadmap addresses the whole urban mobility system. It therefore takes into consideration all type of users, all type of vehicles, all types of modes and all type of urban transport infrastructure and services. Public, collective and private transport, motorized and non-motorized (walking, cycling, etc.) trips are considered here.

In the absence of a commonly agreed definition of the urban environment at the European level, one should refer to academic definitions or legal definition in national legislations for a clear identification of the urban borders.²

Though there are already of course various modes coexisting on the urban mobility network, they are not supported by a level of integration conducting to the optimum intermodal solutions for the most efficient travel choice and the best transport options. This roadmap focuses on the research required to develop systems and tools that enables the highest level of integration possible.

In this respect the roadmap also covers research on intermodal infrastructure supporting efficient and integrated mobility services for passenger transport.

It therefore addresses a range of topics such as ticketing and charging, network management, traffic and travel information, the interface enabling the integration of information from the various actors involved in urban freight delivery, and the physical integration between modes and networks at interchanges. Those are the key topics to focus on to enable a real integration of the urban mobility system.

The roadmap also takes into consideration the integration of electric vehicles in the urban mobility systems for all the component of the system listed above.

²See for instance art. 2-17 of the new Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

It looks at how these components will integrate the deployment of cooperative mobility, i.e. the integration of the vehicle, the traveler and the goods in the network with ICT.

A system approach

This roadmap does not cover specific technology developments, even though these are enabling the integration of the urban mobility network. It therefore does not include the technology developments required for the electrification of road transport which are covered in the joint ERTRAC-EPOSS-Smartgrid roadmap on this topic.

It will neither cover the technological developments required for the deployment of systems and equipments allowing cooperative mobility.

Finally, the roadmap does not cover technological research related to the development and deployment of communication technologies such as NFC or others. Those will influence significantly the exchange of data supporting the integration of the urban mobility network but their development is outside the scope of this document.

This roadmap therefore preserves various scientific and regulatory options and technological solutions and avoids to choose one above the other when the objective (application) can be achieved in more than one way given the current state of knowledge.

Complementarity between ERTRAC roadmaps

The roadmap addresses the interfaces between the long distance and urban networks. It is therefore coordinated and complementary with the ERTRAC roadmap on 'Green, safe, and efficient freight corridors' as the urban delivery of goods is often the end trip of the goods transported on long distance.

The roadmap is also coordinated with the European Bus System of the Future which addresses the integration of the bus system in the urban mobility network.

Most importantly, the research roadmap 'towards an integrated urban mobility system' aims at providing a level of integration of the component of the system which will create tools to influence transport and travel behavior and the related markets for mobility services, transport information, etc. It will therefore offer the traveler/driver/user greater choices. It will also allow to send him or her better and more advanced signals and incentives. This means that a more integrated urban mobility network will give a better place to individuals, as it should allow to provide mobility options more tailored to individual needs.

This roadmap is therefore indissociable from ERTRAC research roadmap on the road user behavior.

The research roadmap 'towards a more integrated urban mobility system' would allow to reach the objectives of the ERTRAC strategic research agenda to the extent that enhances the level of mobility for passengers and goods through improved accessibility and leads road users to make more energy efficient trips.

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This assumes that a greater integration of the system encourages more energy efficient travel behaviour, and a better use of network management tool, also for greater energy efficiency and preserving or improving accessibility.

It therefore presupposed that it will trigger reaction in behaviours from the urban transport users.

The capacity to influence these reactions and their nature is however not sufficiently known. This is the reason why several research topics related to this are identified in another ERTRAC research roadmap on road user behaviour. This roadmap on road user behaviour is complementary with this one. It also addresses several other aspects of the road user behaviours.

The table below identifies the research needs on the transport user behaviour which are of relevance for this roadmap. These research topics are essential to assess how and to what extent the integration of the urban mobility network can contribute to achieve the SRA objectives by influencing travel and transport behaviours. They are detailed and developed further in the ERTRAC research roadmap on the road user behaviour.

Table: Description of the relation between the ERTRAC roadmap on the user behaviour and the roadmap ‘towards an integrated urban mobility system.’

Towards an integrated urban mobility system	Road/transport user behaviour
Traffic and travel information	User response to: <ul style="list-style-type: none"> - intermodal traffic and travel information; - technology used for the provision of information; - environmental information related to trips; - weather information related to trips; - various degree of reliability of information; - road safety risk information; - individual privacy concern and mobility information and services
Integrated charging and payment systems	User response to price signals: <ul style="list-style-type: none"> - PT fares - Parking fares - Congestion charges - Infrastructure charges - Innovative mobility services prices User response to technologies used for the payment of mobility services Individual privacy concern and integrated payment systems Relative user preference for integrated payments through integrated ticketing or credit card systems
Network management	User response to other network management tools <ul style="list-style-type: none"> - Access restriction - Speed management - Trip length and time

2.c Benefits to Grand Societal Challenges

The roadmap will aim at enhancing the level of mobility for passengers and goods through improved accessibility and supporting the integration of all modes of transport in the urban mobility network in the most energy efficient way allowing overall more energy efficient trips.

It will also allow a more efficient management of the network, increasing the efficiency of the system, closer to the optimum of energy efficient and accessible mobility system.

It will finally enable more efficient transport services, for instance for urban freight delivery.

As a result, the roadmap will significantly contribute to the targets set in ERTRAC SRA to increase the energy efficiency of the urban mobility network by 80%.

The improvement of the energy efficiency of the urban mobility network contributes to the decarbonisation objective identified in the ERTRAC scenario. This is part of the effort of the sector to contain and reduce the impact of transport on the climate by reducing CO₂ emissions.

The awareness about CO₂ emissions is growing and would increase in a more integrated urban mobility system. Indeed, this would enable the more systematic provision of information on CO₂ emissions to travellers, and the inclusion of the carbon emissions in the list of parameters used for network management decision support systems.

A more integrated network is also a more climate resilient network as integrated network management tools provide more and better options to adjust to various circumstances.

A greater integration of traffic and travel information, of charging and payment systems, of network management tools and of the infrastructure at interchanges, will also contribute significantly to improve the accessibility on the network. Indeed, if one considers that the accessibility is a composite indicator of the time of travel in the urban environment, the distance travelled and the cost of the trip, a greater integration of the network should impact positively at least one of its components in all cases.

Indirectly, integrated network management tools and traffic and travel information are contributing to better communicate, assess and manage the road safety. For instance they could enable the information about 'safer mobility options' for a given trip. In this respect, they contribute to the road safety objectives of the ERTRAC Strategic Research Agenda.

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By 2030 Road Transport is 50% more efficient than Today		
	Indicator	Guiding objective for 2030
Decarbonisation	Energy Efficiency: Urban Passenger	+80%
	Energy Efficiency: Long Distance Freight	+40%
	Share of Renewables	Biofuels: 25% Electricity: 5%
Reliability	Reliability of transport times	+50%
	Urban Accessibility	Preserve Improve where possible
Safety	Accidents with fatalities and severe injuries	-60%
	Cargo Lost to Theft and Damage	-70%

Table 1. Clear guiding objectives for Decarbonisation, Reliability and Safety in Road Transport.
The mission of '50% more efficient Road Transport' is articulated in leading indicators on Decarbonisation (3), Reliability (2) and Safety (2). Each indicator is furnished by a guiding objective for 2030 either indicating the improvement versus a 2010 baseline, indicated with '+' or '-' sign or an absolute level as is the case with 'Share of Renewables'.

Summary of guiding objectives of ERTRAC 'A strategic research agenda aiming at a 50% more efficient road transport system by 2030 (ERTRAC, 2010)

3. Milestones and Roadmaps

The document will detail roadmaps on several topics:

- The integration of urban traffic and travel information;
- The integration of ticketing and charging services for all mobility related charges in urban areas;
- Interchanges for passenger travel and transport;
- Interfaces for a more efficient urban freight delivery;
- Integrating urban mobility management

The integration of urban traffic and travel information

The roadmap will identify the research needed for tools, models and frameworks enabling the integration of traffic and travel information³. An integrated urban mobility system should be a system where information on all modes of transport is available to users, transport operators and network managers, and updated as required to make optimal decision.

Various efforts are being undertaken for the integration of the urban traffic and travel information.

Most of those have been listed by the in-Time project which provides a good overview of the State of the Art situation.

The process of implementation of the European ITS directive could greatly influence this roadmap.

Indeed, the directive provides for the development of specifications for actions within identified priority areas, as well as for the development of standards.

The directive applies ITS applications and services in the field of road transport and to their interfaces with other modes of transport.

The priority areas identified within the directive and of relevance here are the following:

- I. Optimal use of road, traffic and travel data,
- II. Continuity of traffic and freight management ITS services,
- IV. Linking the vehicle with the transport infrastructure

Within the priority areas the following priority actions for the development and use of specifications and standards, are of relevance for this roadmap:

- (a) the provision of EU-wide multimodal travel information services;
- (b) the provision of EU-wide real-time traffic information services;
- (c) data and procedures for the provision, where possible, of road safety related minimum universal traffic information free of charge to users.

The Commission will first adopt the specifications necessary to ensure the compatibility, interoperability and continuity for the deployment and operational use of ITS for the priority actions.

The Commission will aim at adopting specifications for one or more of the priority actions by 27 February 2013, as illustrated in the graph below.

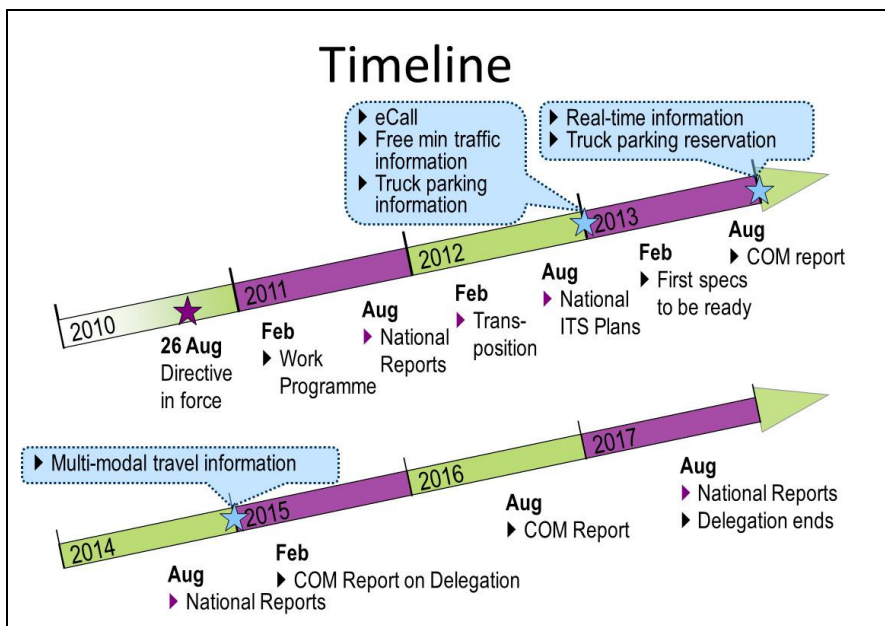
³the ITS directive terminology is the reference for the parts of this roadmap relevant for ITS

Where relevant, and depending on the area covered by the specification, the specification shall include one or more of the following types of provisions:

- (a) functional provisions that describe the roles of the various stakeholders and the information flow between them;
- (b) technical provisions that provide for the technical means to fulfil the functional provisions;
- (c) organisational provisions that describe the procedural obligations of the various stakeholders;
- (d) service provisions that describe the various levels of services and their content for ITS applications and services.

The necessary standards to provide for interoperability, compatibility and continuity for the deployment and operational use of ITS shall be developed in the priority areas and for the priority actions.

This roadmap demonstrates the need for these activities to strongly take into account the specificities of the urban environment if they are to cover the urban environment itself. It also contains several research topics which can be greatly influenced by the content and the speed at which the specifications and standards will be developed in the framework of the directive.



European Commission, implementation of the ITS directive

For a few years, efforts have been made at integrating travel information, essentially about public transport, for several public transport modes and operators.

Efforts are now also concentrating on the integration of the traffic and travel information and of all relevant mobility information on the urban mobility network.

The first objective of the integration of traffic and travel information is the provision of complete information to the travellers about all his or her mobility options on the urban environment for the trip he or she wants to do or has started. It therefore covers pre-trip as well as on trip information. Integrated information should include route planning services.

This information must bring together road traffic information, information on walking, cycling, public transport, parking, traffic regulation (including access control), prices and charges for mobility services and infrastructure use if and when applicable.

With the deployment of **electromobility** in the coming years, information of relevance for the use of electric vehicles should also be considered. It would include the location of publicly available charging points, the type of charging points, and services related to electromobility such as for instance electric car sharing vehicles or public electric vehicles.

The provision of integrated information can also be **a tool for the network manager** to influence travel behaviours, through route planning.

The provision of information therefore includes two components:

- The integration of data on urban transport and mobility;
- Route planning advice, recommendations or incentives

In the later case, and if integrated traffic and travel information is provided by the public authority, it becomes a network management tool.

The requirement regarding **the availability of data**, and the various types of actors likely to use this data to provide information, private or public, local, national or multinational, should be carefully considered for the achievement of this roadmap.

To achieve the accurate provision of integrated urban traffic and travel information, there are a number of pre-requisites which are related to the provision of traffic and travel information beyond the focus of this roadmap. We will therefore not detail these prerequisites which are not specific to urban mobility.

The development of digital maps with updated and accurate transport network attributes, the development of traffic and transport databases or transport data market places, and progresses towards some forms of certification of data quality are all essential to achieve integrated urban traffic and travel information.

They are dealt with at the European and national levels, for instance in the framework of the European directive on ITS.

It should also be stressed that the **governance** supporting data collection and the release of data enabling the provision of integrated traffic and travel information is very important. The cooperation between actors, the role of public authorities, their choice for the release of data to the public and private information providers, ownership of data, and the European and national regulatory framework all condition the terms of the provision of integrated traffic and travel information.

Milestone 2015	Milestones 2020	Milestones 2025
Integration of traffic and travel information and all mobility related information at the urban level, relying on qualified data	Integration of traffic and travel information and all mobility related information, relying on certified quality of data	
	Full integration of externalities with the information: environmental data, risk, etc.	
	Systematic integration of information about all mobility services, including information related to electromobility	
	Integration of information on all urban networks of all sizes	








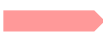




















This aspect of the roadmap is obviously strongly related to the roadmap on the road user behaviour.

Indeed, the contribution of the provision of integrated traffic and travel information, depends on the response of the user to the availability of this information. This is very important as the market for transport related information is not yet a mature market and can still evolve significantly.

It should also fulfil the expectations of the transport users who should have access to the information he/she considers of relevance and importance for himself or herself.

The availability of information should be guaranteed to all potential users, without discrimination between users. This requires that the communication infrastructure in the urban environment has the capacity to accommodate the request for information of all users. Bandwidth and communication tariffs should therefore for instance not create restriction on the access to information, for certain type of users, such as for instance foreign visitors. This is also essential for the integration of payment and ticketing systems.

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Roadmap	2011	2015	2020	2025	2030
Integration of traffic and travel information data as available	 				
Definition of data quality	 				
Integration of traffic and travel information data of pre-defined/certified quality		  			
Integration of accessibility information					
Integration of environmental data	 				
Integration of information on all types of externalities	  				
Integration of information on electromobility	   				
Open interface for the integration of the information	 				
Definition of interfaces for the provision of integrated information in an intuitive and understandable way	  				
Data fusion models					
Governance models enabling the integration of traffic and data information	 				
Security and privacy framework for the provision of mobility data and information	  				



The integration of ticketing and charging services for all mobility related charges in the urban areas

The roadmap identifies research needed for developing systems and models allowing to reach the optimum level of integration for ticketing and payment systems for all mobility related charges.

Mobility related charges can include public transport fares, parking, mobility services such as public bikes, congestion and infrastructure charges, etc. Considering that a key challenge consist in integrating public transport ticketing systems locally and that the number of transactions for public transport is by far the greatest of all payment of mobility services, public transport is driving this integration of ticketing and charging services.

Two parallel streams have to be pursued at the moment. The first one consists in the progressive development of an interoperable fare management system following the recommendations of the EU-IFM project. It should lead to the deployment of a common application for the payment of mobility services across Europe which can be used on various media.

The second stream foresees the integration of the payment of urban mobility services via credit/debit card payment systems used with contactless payment systems.

On the mid-term, these two streams could lead to complementary solutions.

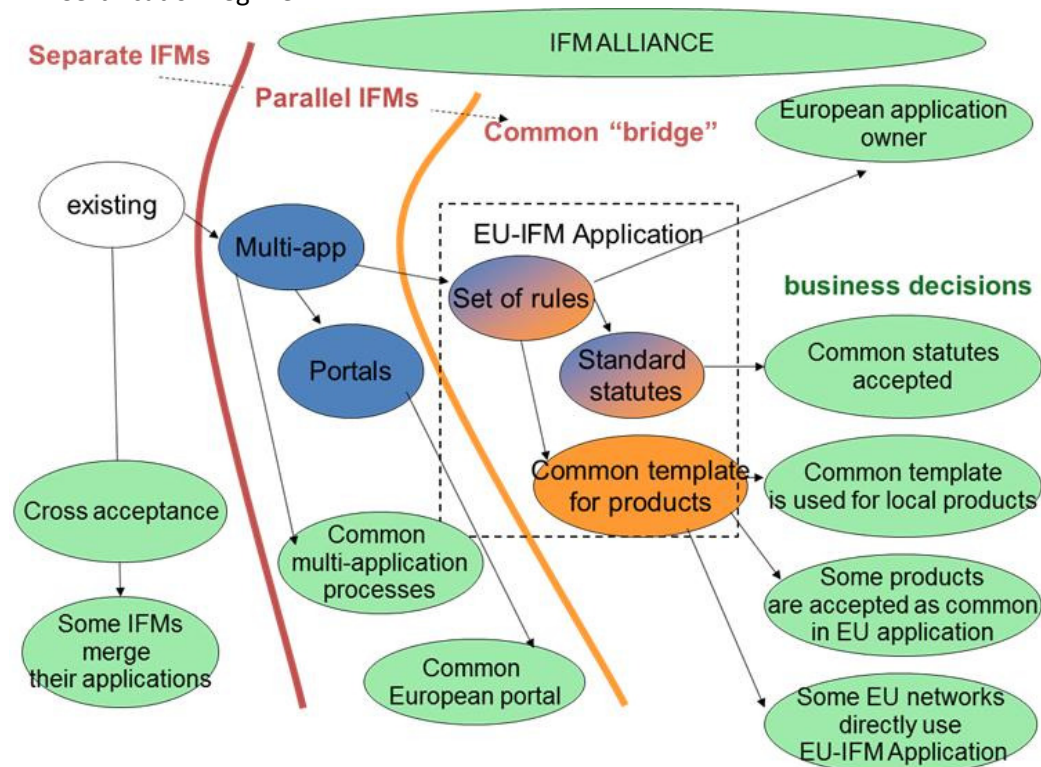
Milestone 2015	Milestones 2020	Milestones 2025
Interoperable common multi-application processes on a single media	Creation of a common application which can be uploaded on several media	
Update of standards for fare collection	Common product template	
	Common fare collection processes	
Integration PT, urban , and urban &LDT, and other mobility services	Integration payment of all mobility services	
integration of the payment of urban mobility services via credit/debit card payment systems used with contact less payment systems		

This figure below illustrates the main principle of the roadmap proposed by the IFM project for the long term development of Interoperable Fare management across the EU.

The implementation of this IFM roadmap requires the following:

- The development of contactless media with an ISO/IEC 14443 Interface that fulfils the requirements of the EU-IFM for Storage Capacity, Performance, and Operating System.
- Development of an Application that can be downloaded by the Internet and/or over-the-air, first by UMTS/GSM

- Secure element is agreed within the media and conditions to use it in a trustful way are defined
- The development of an initial joint EU IFM organisation based on the voluntary participation of each IFM local/regional schemes, which is responsible for EU-Application ownership (which can be third party developed and operated), supply and management of IFM Portal(s), the Security of the IFM, and the Registrar.
- Regional/local products that are available to issue into the EU-Application
- Interoperable EU-Products are defined and available to issue by the customer contract partner which the customer chose
- The system must be designed to ensure the privacy (privacy by 'design system')
- Common security agreement
- Certification regime



Source: IFM project, Roadmap, D. 7.3 Final deliverable

This part of the roadmap covers the integration of the various payment tools but also of the related pricing and charging policies, such as parking, infrastructure charges, public transport fares, ecopass and congestion charges, new mobility services, etc.

It therefore also covers the research on the definition of pricing and charging of mobility services in the urban environment. Research in this respect cover several issues such as the level of charges, prices and fares, regulatory, financing and business models for mobility services and transport infrastructure from the point of view of the whole urban area.

The definition of these policies, which is strongly related to the analysis of the user 's response to price signals, should consider their impact on the overall societal goal of decarbonisation, greater energy efficiency, and greater accessibility.











A key element in the definition of such a policy is of course the response of users to price signals. This part of the roadmap is therefore closely related to the ERTRAC roadmap on the road user behaviour.

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It is also related to the previous part of the roadmap on integrated traffic and travel information as information about charges and fares for mobility services must be a part of an integrating route planning information. Indeed, cost of trips should be part of the integrated traffic and travel information at the urban level.

Roadmap	2011	2015	2020	2025	2030
Establish an EU-IFM Alliance , including funding on the long term					
Create Interoperability for customers through common multi-application processes on a single media in the customer's possession					
Create a Common Portal for customers to remotely load local applications together with the development of an "IFM Brand" to provide assurance and focus					
Update and harmonise current CEN Standards to support EU-IFM					
Create a Pilot operation in a number of Member States in preparation for wider roll-out					
Develop a Common EU-IFM Application and Common Product Templates supporting an extension of the "IFM Brand"					
Develop a commercial and technical framework for the sales and settlement of EU-IFM Products					
Extend functionalities to facilitate inter-modality between road and rail, and support for Demand Management for all transport modes (urban, suburban, regional and inter-urban)					
Engage and merge with existing IFM Systems and other ITS transport modes (including private): e.g. road tolling, bicycle hire, car sharing, public bikes and cars, parking, etc.					

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Extend to non-transport applications and market external to EU		  			
Engage and merge with electricity billing applications for electromobility services and for charging points of EVs		 			
Security and privacy framework for contactless payment	 				
Fares and pricing policies strategies	 				



Interchanges for passenger travel and transport

Interchanges allow the physical integration of the various modes and network and the transfer of travellers from one mode to another.

Research should focus at making interchanges enabling as smooth a transition between modes as possible. Their function in the urban mobility network should be enlarged and their role in the urban environment further researched and thought.

Milestone 2015	Milestones 2020	Milestones 2025
Interchanges as the hubs of the urban mobility network facilitating the transition between all modes of transport, offering several transport services	Integrating interchanges in the smartcities	

They should integrate all modes of transport and go beyond the integration of major modes, such as rail public transport and road public transport.

They should foresee the integration of new mobility services, of cycling, of parking, etc. Integration with walking should be an integral part of the interchange design and conception.





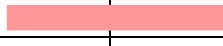





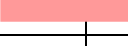



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Various types of mobility related services should be provided at the interchange, in particular specific traffic and travel information.

Thought as place of urban lives, they should be safe and accessible for all citizens.

Transport interchanges should become the future hubs of the smart cities, integrated not only in the transport network but in their urban environment and the other smart networks, in particular the smart electricity grids. They should themselves, as infrastructure, contribute to the increase of the energy efficiency of the city.

As key component of the transport network and of the urban environment, the planning for interchanges should be coordinated with local land use strategies. The identification of the best location of interchanges for the city and the efficiency of the transport network should be part of the research activity covered by this roadmap.

Roadmap	2011	2015	2020	2025	2030
new generation of urban transport interchanges for the greater integration of the urban mobility network					
Financing and business models					
Integrating electromobility services in interchanges					
Integrating interchanges with urban policies (Land use planning, economic development, etc.)					
Building resilient interchanges					
Integrating interchanges, nodes of the smart city					



Interface for a more efficient urban freight delivery

Urban freight delivery suffers from the lack of coordination of the actors whereas they share to a large extent the same objective of an efficient system for the delivery of goods in the city.

The main stakeholders (public authorities, freight operators, retailers, infrastructure managers) lack the appropriate framework and tools to exchange information and adjust accordingly their transport plans.

It is therefore necessary to develop an interface allowing the integration of the information of relevance for urban freight delivery and facilitating the exchange of the relevant information between the public actors, in particular the public authorities regulating and managing the road network, and the private actors. This will enable new delivery concepts and services.

Milestone 2015	Milestones 2020	Milestones 2025
Deployment of a an information exchange platform for urban freight delivery stakeholders	Integration of eFreight in this platform to extend some of its features to the urban environment	

This interface should include all information related to traffic regulation, parking and access related to urban freight delivery. It could also be used for the management of urban distribution centers and logistics platform, and for the use of electric vehicles for urban freight delivery.

The interface should also enable the other stakeholders to upload non commercially sensitive information for the optimisation of the rules and recommendations for freight delivery.

It would lead to useful route planning recommendations and incentives.

The definition of the information to be exchanged by all parties is a first important step for the definition of the interface.

The platform should then be demonstrated, and progressively become a European reference.

Further work on engaging stakeholders – including users such as freight forwarders, is required to ensure their commitment to the platform and their cooperation in using it.

As it is important that the platform protects the commercial interest of all stakeholders and do not allow the communication of sensitive information affecting commercial operations and competition, it should be a very secured environment.

The deployment of eFreight could create further opportunities for managing urban freight delivery. Several features of eFreight could be extended to the urban environment in a second stage.

The platform could support this and integrate some eFreight components, to allow on the longer term to move towards a greater management of the goods directly in an urban logistic system.

This would raise interesting opportunities for maximising the efficiency of consolidation.

Roadmap	2011	2015	2020	2025	2030
Framework for stakeholders engagement in greater exchange of information on urban freight delivery					
Definition of a platform offering an interface for the exchange of information on urban freight delivery by stakeholders	 				
Integration of eFreight in the platform		 			



Integrating urban mobility management

The management of the urban mobility network currently involves a broad range of tools. These include public transport management, traffic management, at intersections and through the control center, and the use of various incentives and regulations.

These are the parking policies, traffic regulations, access rules and regulations, and in some cases access charges. Those can be considered as demand management tools.

Network management also include the provision of various mobility choices in the urban environment such as walking and cycling paths, and the support to various types of mobility services such as car sharing or public vehicles.

Traffic and travel information with travel planning and recommendations, on trip and pre-trip, are another type of network management tool. When these are provided by the public authorities, they can be direct tools for network management.

When they are provided by information providers consolidating various types of data, they provide information about the various tools mentioned above.

The segmentation of the various tools, in particular public transport and traffic, prevents to a large extent a real integrated network management in real time.

The increase of the amount of data collected on the network through cooperative systems, mobile phones, and other data sources, increases the potential for network management. The integration of these various tools is important to enable its optimization.

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As it would bring together data from private and public transport, and from individual and collective modes of transport, it should allow better knowing and managing the movement of persons and not only of vehicles.


























An important number of research activities are required to achieve this objective of an integrated network management.

The research needed to provide models, tools, systems and frameworks for integrating the management of the various components of the network, in particular traffic management and public transport, is identified. These tools and models will aim at allowing the optimization of the use of the urban infrastructure, though for instance a better use of the data collected, and the strategic provision of information.

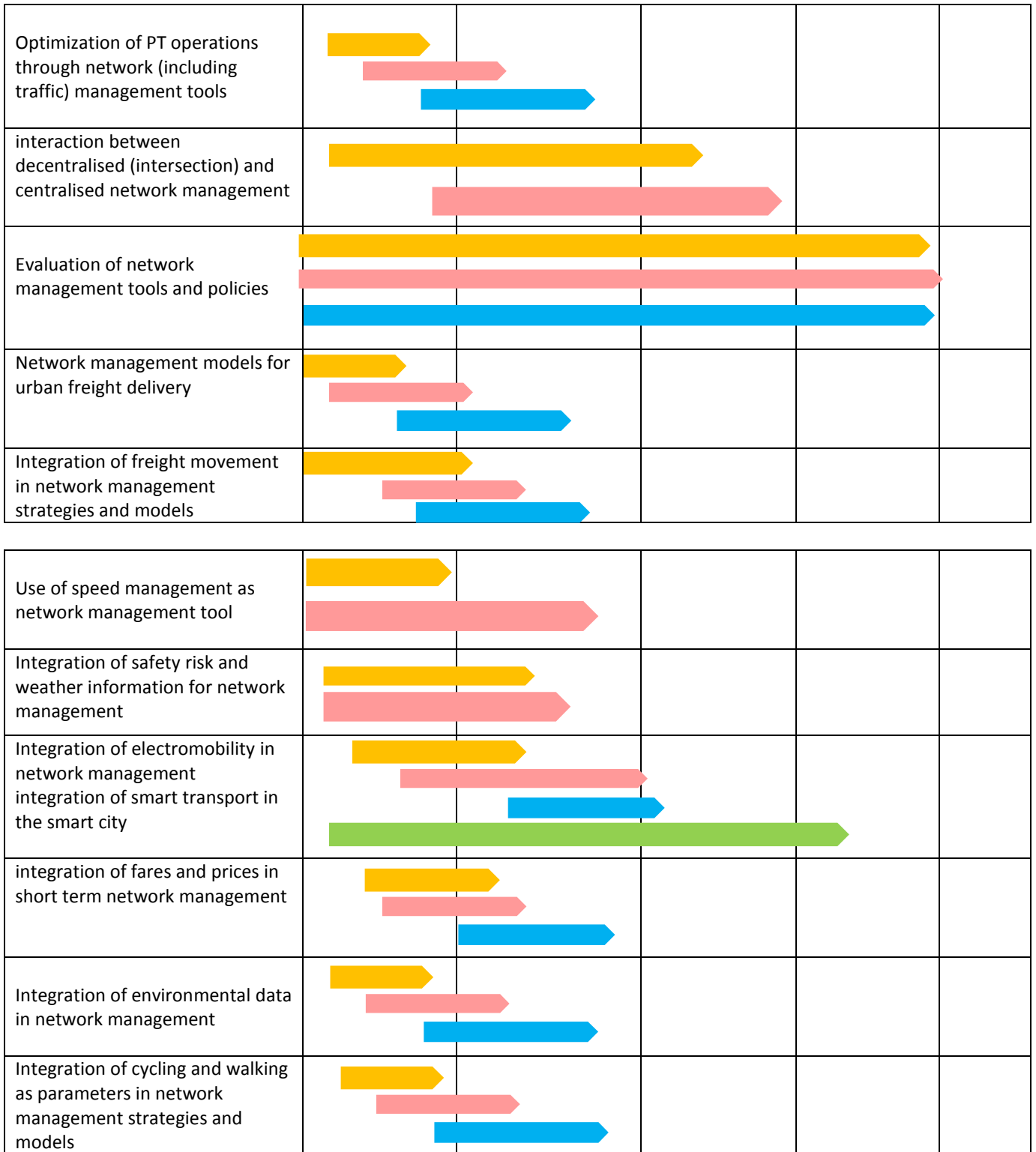
The management of the network should also include and address the management of freight delivery in the urban environment. This should allow for a better consideration for freight movement and gaining efficiency in managing freight traffic (LDVs, etc.) and in enabling innovative freight delivery services.

Milestone 2015	Milestones 2020	Milestones 2025
Integration of network management tools, based on vehicles and individuals data	Integrated network management optimizing individual accessibility and urban mobility network efficiency	

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Roadmap	2011	2015	2020	2025	2030
Network management strategies, integrated with sustainable urban mobility plans					
					
Governance for the coordination of the network management tools					
					
Interaction between private cooperative network management initiatives and public network managers					
					
					
Algorithms for network management integrating: - New levels of traffic; - Multiplication of data sources (cooperative systems, ...);					
					
Short term forecasting models					
					
					
New intelligent decision support systems for network management: - addressing also the identification of the optimum between potentially conflicting objectives - learning cycle for the optimization of DSS - for private operators and for public authorities - real time qualification of traffic situation					
					
					
Integration of demand management tools in short term network management					
					
					
Interaction between centralized and decentralized information management models, also considering communitary information					
					
Strategies and models to face serious network disruption, network management for climate resilience					
					
					
Evaluation of models efficiency (considering also their potential complexity)					
					

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4. References

For the preparation of this roadmap, ERRAC, the European Rail Research Advisory Council has been regularly consulted.

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- EU Spirit
- EU-IFM
- Rosatte
- CONDUITS
- HEAVEN

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- The strategy for clean vehicles from DG Enterprise covering both ICEs and EVs: COM(2010)186, 'A European strategy on clean and energy efficient vehicles';
- The overall Europe 2020 strategy, focusing on sustainability and global competitiveness: COM(2010) 2020, 'Europe 2020 - A strategy for smart, sustainable and inclusive growth';
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