

URBAN ITS EXPERT GROUP

GUIDELINES FOR ITS DEPLOYMENT IN URBAN AREAS



SMART TICKETING

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Abbreviations and Acronyms

Abbreviation	Description
3DES	Triple Data Encryption Standard
AES	Advanced Encryption Stand
B2B	Business To Business
AFIMB	Agence Française de l'Information Multimodale et de la Billettique
B2C	Business To Customer
CRM	Customer Relationship Management
EFM	Electronic Fare Management
ERP	Enterprise Resource Planning
ETSI	European Telecommunications Standards Institute
GSMA	Groupe Speciale Mobile Association
ID Card	Identity Card
IEC	International Electrotechnical Commission
IFM	Interoperable Fare Management
ISO	International Organisation for Standardisation
ITS	Intelligent Transport Systems
ITSO	Government-backed, non-profit organisation which defines and develops UK-wide technical specification for Smart Ticketing
NFC	Near Field Communication
OTI	Over The Internet
PT	Public Transport
RF	Radio Frequency
RSA	Rivest Shamir Adleman Algorhythm
ST	Smart Ticketing
USB	Universal Serial Bus
TLS	Transport Layer Security
VDV	Verband Deutscher Verkehrsunternehmer

References

ID	Description	Source
[1]	EUROPEAN COMMISSION: WHITE PAPER - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system; Brussels, 2011	http://ec.europa.eu/transport/strategies/2011_white_paper_en.htm
[2]	Civitas Initiative	http://www.civitas-initiative.org/index.php?id=69
[3]	Results of the UITP congress in Dubai 2011	www.uitpdubai2011.org/

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1. Summary

Smart Ticketing has been a topic for over a decade now, but what does the term “smart” mean in this context? When using this term, we’re generally talking about new technologies and integration of services not directly linked to the basic functions of tickets. The main issues of Smart Ticketing are:

- Propose complementary services to users in relation with their mobility
- Modify relationship between Public Transport user and his/her ticket as also between Public Transport operator and its tickets
- Improve overall efficiency and image of Public Transport network as also the depth of data created through usage

Smart Ticketing could permit to contribute to the overall improvement of the public transport network level of services, image, accessibility, with the main aim to facilitate and/or increase the use of public transport and so contribute to the overall political goal of developing a sustainable transport policy. **Smart Ticketing though is NOT necessarily about having ONE ticket for your journey but having ONE wallet for SEVERAL tickets.**

There are a number of potential implementation choices within the guidelines for Smart Ticketing:

- Smart Ticketing using a dedicated application
- Smart Ticketing based on the virtualisation of tickets
- Smart Ticketing based on secure identity and back-office processing

One of the main trends that could be extracted with the development of Smart Ticketing is that we are more and more personalising the “ticket”, the contract used by the final user. The differing needs (and 'ways of consuming' i.e. PT services shall be seen as a consumer good and sold/marketed as such) of groups or communities of people are becoming a challenge for the implementation of the Transport and the Fare Policies.

Implementing Smart Ticketing also means thinking of the **stakeholders and their needs**, therefore how to respond to these needs and elaborate marketing accordingly. To date, the main stakeholders are clients, politicians and authorities, public transport operators, scheme providers, suppliers, payment industry, media and lobbies. Specific focus should be paid to the final user’s needs (easiness, simplicity and fairness), public policy needs (shift in modal split reducing car travel, reduction of pollution, optimisation of operational efficiency, reduction of public expenses) and the transport operator’s needs (reduce operational costs of ticketing, improve fare collection efficiency, improve knowledge of customer’s behaviour/choices/preferences).

It is also important to **recognise the trends** and act appropriately. The trends in ticketing can be specified as ‘from magnetic to contactless’, ‘from cash to smart payment’, ‘from in-house/on the field sales channels to

externalised/remote ones', 'from mono-application to multi-application devices', the 'impact on infrastructure itself' and the 'impact on fare evasion'.

Smart Ticketing should have an impact on the way Public Transport is used. Using a ticket, or wallet, not only for transportation but for mobility services in general could improve the image of Public Transport. Access to fare information and easier remote sales will also help the cause, whereas privacy concerns must be addressed in a code of conduct to be able to develop a trust relationship with customers.

The development of Smart Ticketing in a global urban ITS perspective has to be built in respect to local organisations and to the decentralised nature inherent to public transport and to the importance of its public funding.

The recommendations to deploy Smart Ticketing are therefore:

- **General:** Smart Ticketing should not be seen as a simple replacement for traditional paper or magnetic ticketing. An important step is identifying which features and functionalities of Smart Ticketing can be adopted and how they will integrate with the customers' wider mobility requirements. The introduction of Smart Ticketing is also an opportunity to rethink the current fare policy and to offer additional/alternative fare possibilities to customers.
- **Business models:** Smart Ticketing is a global business and is, for the first time, being driven by standards. This allows off-the-shelf technology to be adopted with only limited local tailoring to reflect specific tariff structures and cross-modal opportunities. By using open International Standards for Smart Ticketing, Public Transport Operators can access supply chains that are responsive, cheaper and address industry best practice.
- **Distribution channels:** Smart Ticketing must allow passengers to plan and book their travel through their choice of distribution and retail channels. This goal required a new system that can accommodate the speed, power and flexibility necessary to handle multiple distribution channels for ticket sales, including contactless payment and pre-loaded value.
- **Smart wallets:** Smart Ticketing covers not just pre-payment and the loading of a ticket onto the smartcard or phone, but can also include post-payment where the customer is identified on entering / leaving a closed system and verified that they are authorised to travel or have suitable payment mechanism available (whether that is a contactless bankcard or pre-arranged credit). A smart wallet also gives the opportunity to integrate other services whether transport related (e.g. bike or car sharing, parking), associated (e.g. tourism information) or non-transport related (e.g. shopping, use fees).

- **Marketing issues / public support:** Urban ITS decision makers should now systematically look for integration in such wider organisations to take benefit from the mutualisation of standard technical tool boxes as well as to insert their customer offer in a wider market.
- **Organisational and legal issues:** Urban and national transport decision makers must actively support the development and implementation of European and international Specifications for Smart Ticketing to ensure mutual compatibility between all schemes.
- **Integration with travel information and traffic management:** By creating a linkage between Travel Information, Journey Planning, Payment and Smart Ticketing, including a liaison with compatible mobile phone and contactless bankcard schemes in Europe, Smart Ticketing can ensure the customer experience consistently meets their highest expectation. As a result this can foster co-modality/intermodality. Interoperability in transport Smart Ticketing implies removing the obstacles for the customer to switching transport modes. All ticketing needs for through journeys should be in one place and on their local transport Smart Ticketing media, even outside their home network. There should be simple registration processes in place so that the customer has a standardised machine interface and easy access in his/her own language.
- **Development of Smart Ticketing standards:** The use of international and open standards can facilitate interoperability, the opening of global markets and compatibility between devices produced by different suppliers.
- **Data privacy:** Protection of the customer's privacy is an ethical requirement of confidentiality, un-linkability, un-observability and anonymity. A low level of protection not only could be punished as a violation of the law but would damage customer acceptance.

2. Introduction

Nowadays, there are a number of challenges lying ahead for the transport system. The idea of a Single European Transport Area, promoted by White Paper for Transport 2011, sets the goals to be achieved by 2050. Transportation has to become more competitive and resource efficient within this time horizon.

The **goals for urban transport**, in this respect, are to promote the use of cleaner cars and cleaner fuels. There is also a need to reduce the number of fatalities. Yet another challenge is that the amount of traffic in Europe's urban areas has been increasing inexorably during last decades. The task of people involved in urban traffic management is to best allocate the scarce resources of road and kerbside space to potentially competing transport modes, within a network that has a finite capacity.

Smart technologies and **Intelligent Transport Systems (ITS)**, in particular, have a role to play in achieving the aforementioned goals. ITS can significantly contribute to a cleaner, safer and more efficient transport system, especially in urban areas. The ITS Directive (2010/40/EU) gives the legal framework in order to accelerate the coordinated deployment of innovative transport technologies across Europe. It aims to establish interoperable and seamless ITS services while giving Member States the freedom to decide which specific systems to invest in.

Two recent European Action Plans include complementary actions on the issue of ITS for urban areas:

- The **ITS Action Plan** (2008) foresees the set-up of a specific ITS collaboration platform to promote ITS initiatives in the area of urban mobility.
- The **Action Plan on Urban Mobility** (2009) foresees that the Commission will offer assistance on ITS applications for urban mobility, possibly in form of a guidance document, to complement the ITS Action Plan.

Resulting from these provisions, the **Expert Group "ITS for Urban areas"** was set up in December 2010 for 24 months, in order to support the European Commission in its work concerning the aforementioned Action Plans. The Expert Group was multi-modal in its focus, broad in nature and covered the urban region taking into account the interfaces between the urban and inter-urban mobility. Both passenger and freight issues were considered and a dialogue between public and private stakeholders encouraged.

The tasks of the Expert Group have been three-fold: to provide guidance on ITS deployment in urban areas, collect Best Practices on successful deployment and identify a possible need of Standardisation. The group had to develop specific **Guidelines** to promote and show the benefits of the use of ITS in urban areas along the individual travellers' mobility chain. The Guidelines despite the fact that they do not have mandatory character have the aim to foster interoperability and continuity of services within Europe.

The Guidelines target the organisations in charge of decision making and technical deployment of ITS on local level. For each **key application of urban ITS** a separate document has been issued:

- Traffic and Travel Information
- Smart Ticketing
- Traffic Management and Urban Logistics

3. Application Concepts and Context

3.1 Ticketing, a Tool for Fare Management

A few years ago, the main objective of a ticketing system was firstly to organise the collection of public transport fares, while secondly to control and try to reduce fraud on the public transport network.

A first fundamental statement would be that a ticketing system (being smart or not) is only the tool that would permit the implementation of public transport fare policy at the level of the whole public transport network. Therefore, there is a need of an overarching authority and a clear code of conduct (in turn this authority could delegate power to sub stakeholders / consortium / operators depending on the tasks to be undertaken). The definition of fare policy is a real condition within the specification and the development of the associated ticketing system. Some of the main strategic issues needing to be addressed include the following:

- Do we want to collect payment before using Public Transport or could the user pay after the event in regards of the travel he will have done?
- What kind of fare policy (flat, zoned, axis or in regard of the distance) do we want to apply?
- Do we want to propose subscriptions contracts and social fares to specific users, and so the treatment of users' personal data? And should there be different pricing for peak, period or advance purchase?
- Another strategic issue is: who is responsible for fare collection and redistribution and fare policy integration along the whole multimodal transport chain / network? Should there be alternative retail distribution channels?

One of the first recommendations to be given is that the public transport fare policy definition or clarification will be the first step of any Ticketing System project, and will be a condition to the a successful implementation. This point, not covered in the present guidelines, needs to be considered by the policy and decision makers.

Furthermore, one of the key issues will, in some cases, be the possibility of having integrated multimodal transports fares, permitting final users to use different transport networks with the same ticket. The recent development of Smart Ticketing permits the interoperability of fares and ticketing.

Another crucial characteristic of any ticketing system is basically to ensure an efficient collection of public transport fares that will, by the way, limit funds leakage and fare avoidance at lower costs for the operators. Intelligent ticketing systems should permit/support final users to pay through different means, including innovative means (e.g. electronic wallet, mobile phone or smart credit cards) and payment processes (e.g. pre or post-payment), while ensuring the ticketing system operator and/or the public transport operator that fares will be collected effectively.

With the arrival of ITS, the ticketing system has incorporated an important statistical function that permits its operator to better know the transport network usage by tracking its user (whilst respecting the privacy rights). This point is also important as it permits public transport operators / authorities to collect significant amounts of statistical data that will be a help for strategic analysis of decision makers. The data can be used to adapt the transport offer better – and faster – according to the customer needs and to manage the network more efficiently. It will be important though to control the flow of data collected, in respect to amount, quality and liability.

Moreover, the ticketing system, using new ITS technologies, and the ticket support used has also become a communication tool, driving the modern image of the public transport. Even if this point could be consider as secondary, it needs to be integrated as it could be a crucial element within the evolution of the system itself and the encouragement of modal switching to public transport.

3.2 Smart Ticketing, a Wallet for Several Tickets / Services

For the last decade, we've been talking about Smart Ticketing, but what is included in the term "smart" ticketing?

Before trying to define it, we need to remember that, when using the term "smart", we're generally talking about new technologies and about integration of services not directly linked to the basic function, in this case public transport ticketing.

The main issues of Smart Ticketing are therefore:

- Propose complementary services to users, in relation to their mobility (encouraging intermodality/multimodality and simplifying the use of public transport) or with a wider global multiservice approach (including services other than transport and transport payment itself);
- Modify the relationship between the public transport user and his/her ticket but also the relation between the public transport operator and its tickets, enhancing security of the processes and reducing fraud and operating costs;
- Improve the overall efficiency (and image) of the public transport network and the depth of data created during usage.

In conclusion, Smart Ticketing will permit to contribute to the overall improvement of the public transport network level of services, image, accessibility, with the main aim to facilitate and/or increase the use of public transport and so contribute to the overall political goal of developing a sustainable transport policy.

Smart Ticketing should be seen as a crucial mean that will benefit travellers within their mobility chain, and moreover within everyday life reducing the constraints / barriers of travelling with sustainable transports.

The fare policy will be the starting point to be applied or implemented, and it must be noted: **Smart Ticketing is NOT necessarily about having ONE ticket for your journey but having ONE wallet with SEVERAL tickets (which can easily be bought) and in the future possibly one wallet for several services.**

In the first case, Smart Ticketing and the application of Interoperability standards will facilitate the development of multimodal tickets permitting the usage of different transport modes with the same ticket. This will mainly rely on a political agreement and a complex decisional process, linked to the share of ticket sale revenues that have no direct relationship with the technical solution applied (introduction of fare communities, e.g. Bremen "BOB card").

The second case is an efficient way of breaking these barriers, offering the final users the possibility to acquire different tickets that will permit them to use a combination of trips and services.

Smart Ticketing will therefore permit interoperability of contract (same ticket for a multimodal travel on a smart support system: e.g. card or mobile) as well as the interoperability of support (different tickets for a multimodal travel on the same smart support system: e.g. "OV-Chipkaart" in Netherlands).

One of the key opportunities of Smart Ticketing is the use of new technologies to simplify the way of using Public Transport and, more generally, of travelling.

This starts with the process of buying the ticket itself and of loading associated rights to get a better price for using transport. The means and process of payment will therefore be addressed together. And finally it integrates the way of accessing / using transport modes, taking into account that simplicity will be directly linked to attractiveness and operations efficiency (e.g. "Oyster Card" concept implemented by Transport for London).

The use of new technologies will clearly permit the implementation of new models of using public transports. Here are some good examples of concrete applications that will be developed further in the next chapters:

- Use of smart technology to access Public Transport quicker:
It could also be an advantage from the PT operator's point of view, as it will specifically reduce the dwelling time and so increase the commercial speed.
- Use of Internet to manage a personal public transport account, associated rights and therefore buy tickets in order to prepare in advance travel and avoid losing time on vending machines:
This will also have a positive impact from the PT operator's point of view, as it should reduce the number of the selling points.
- Simplify the way of consuming public transport, using a pre-payment process or using an electronic wallet or bank account to directly access public transport:
This will also have a positive impact for the PT operator and its commercial organisation.

- Post-payment process and Pay-as-you-Go concept that will permit an automatic calculation of the best price for the final user. This solution is particularly appropriate when the fare policy is complex:
This requires back office processing which can be costly for PT operators.

The last characteristic of a Smart Ticketing system will be its capacity and its level of integration with other services provided by entities other than the public transport operator. The first level will rely on the possibility “to use the same wallet” to gain access to different transport networks / tickets and so improve the intermodality conditions. A second level will rely on the proposal of other services, permitting the same support to use public transport and access to other services. But the most advanced level of integration will be when the ticket is completely virtualised and integrated in other services (e.g. the possibility to take the metro with a Concert Ticket) or a non-dedicated support (like mobile phone or credit card). City Cards implemented in many European cities (like in Lyon or in Toulouse in France) are an illustration of this achievement.

Integrating back-office processes and support at a high level towards all services offered within a Smart Ticketing system will be very complex (and possibly costly) and must not be underestimated.

In conclusion, Smart Ticketing is a tool that is there to simplify the access to public transport for final users and enhance sustainable mobility. It could also give a “smarter image” of public transports that would contribute to their attractiveness and efficiency.

But the tool itself requires a clear vision of the fare management policy and of the “business model” a Public Transport Authority / Operator wants to commercially develop in the field of transport policy and strategy. Smart Ticketing can facilitate implementation of PT services, but the stakeholders’ partnership will be crucial to achieving the goal of improving the final users’ travel facilities.

3.3 Application Concepts

After having “conceptually” defined what Smart Ticketing is, there are a number of potential implementation choices to be decided, also taking into account how it applies to Urban Mobility.

1. Smart Ticketing using a dedicated application:
 - a. Smart Card will be on top of the list, as it is probably the one which has now been developed the furthest in Europe. Note that it could, but need not to be contactless;
 - b. USB Keys or Dongles are also means of support that are used on some networks, based on a contactless communication for the validation;

- c. More recently, the use of NFC applications (loaded onto mobile phones) have been developed and are considered as a promising solution for the future ;
2. Smart Ticketing based on the virtualisation of tickets:
 - a. It would use the concept of electronic tickets that could be printed with a security based barcode. Because a barcode can be copied easily, it is normally restricted to use for long distance trips involving a dedicated seat reservation;
3. Smart Ticketing based on Secure Identity and Back Office Processing:
 - a. Here the customer is identified on entering the transit system by means of the identity number of a smartcard, a government issued ID Card, contactless bankcard or secure tag. The customer either prearranges credit or a period pass / carnet to be associated with the Secure Identity, or the Identity is associated with a method of payment as is the case with a contactless bank or credit card.

There are two main issues that will be developed and explained in the coming chapters and that illustrate the difference between these three categories of Smart Ticketing:

1. In the first and second category, the front-office process will be more developed; specific efforts will be necessary to ensure security, especially when working on the services integration.
2. In the third category, the main 'efforts' will have to be put on the back-office treatment and the relation with the final users in the front office will be reduced as the support is not under the responsibility of the transport retailer.

Security (i.e. of transactions and security as perceived by users) will be a key to the success and requires maximum attention, as the first goals of a ticketing system remain fare collection and fraud control.

In the first two cases, the integration of services will be possible with the support itself. In the third case, the back office treatment will also be a key to success as it will offer added-value services. However, the cost and complexity of the back office must be carefully considered so as to provide value for money and long term sustainability of the Smart Ticketing solution.

The use of mobile phones could potentially offer many new and varied services (e.g. network or traffic information, associated services). However, there are social / behaviour barriers that need to be addressed: some customers can be put off by the idea of using their mobile phone in order to access public transport, fearing that they could be forced to put everything in the same wallet. Also, as not everybody is equipped with a smart phone, some would not be able to benefit from this and therefore not see the offers for additional or associated services. The paradox that would need to be addressed is simplifying access

while offering more services. This needs to be taken into account by developers (cities, travel operators) of such an application.

One of the main trends that could be extracted with the development of Smart Ticketing is that we are personalising the “ticket” more and more, the contract used by the final user. The differing needs of groups or communities of people are becoming a challenge for the implementation of the Transport and the Fare Policies. In consequence, the concept of developing a personalised account for Mobility (not only public transport) is something that needs to be explored as it could probably be a lever for the behaviour change management in relation with the application of a sustainable mobility policy, including integration with journey planning, and traffic management solutions such as park-and-ride, bike hire, congestion charge, etc. The use of internet tools (including social networks) and information services, such as Journey Planner with integrated ticketing option, is a crucial issue that could support Smart Ticketing. This needs to be further explored as it could justify the investment necessary to develop Smart Ticketing technology at a network, national and cross-border level.

4. Stakes and Public Policy

4.1 Identification of Stakeholders

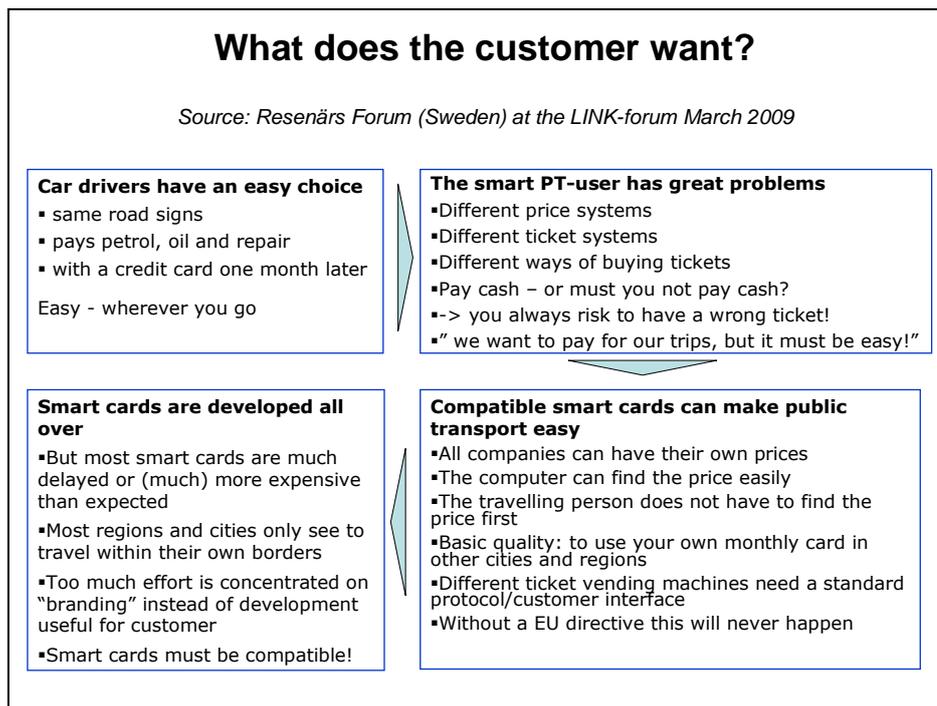
This chapter will permit to define who is considered to be part of the process within the development, introduction and use of a Smart Ticketing solution. There is a great diversity of stakeholders. Presently the stakeholders identified are:

- The clients
 - Clients have to be divided into different groups: permanent travellers, e.g. subscribers, occasional travellers and potential travellers incl. visitors/foreigners.
- Politicians and authorities
 - Public transport authorities, authorities on local, regional and nationwide level, the European Union, national ministries of transport and economy, data protection authorities.
- Public transport operators
 - The public transport organisations and their staff.
- Scheme providers
 - The organisation(s) which is/are responsible for the application, the media, the registration, the secure element and the data-processing. The scheme provider is often owned by public transport operators and/or public transport authorities, but some roles are being adopted by other trusted service providers (such as mobile network operators).
- Suppliers
 - This group represents all necessary suppliers for EFM-Systems, such as hard- and software suppliers, smart ticket solution providers, consultants, service agencies and financial institutions.
- Payment industry
 - Banks, credit card companies and mobile phone operators are coming into the market with solutions for (contactless) payment. As such these solutions can be used for niches or even larger numbers of travellers in public transport.
- Media
 - All media including broadcasters (TV and radio), public press and specialist publications. Not to be underestimated: the internet and its forums, blogs and social media.
- Lobby
 - Lobbyists are groups or organisations with special interests, who attempt to influence decisions made by officials and/or organisations, such as public transport associations, passenger associations, automobile associations, tourist associations or associations for disabled people, the unions for public transport and associations representing industries incl. telecom.

4.2 Focus on the Final User's Needs

The final user of an EFM-system is the traveller who uses public transport. In times of a "fast moving world" the traveller has a lot of needs which can change from one day to another. Moreover, travellers have a wide range of diversity in terms of use of PT, mobility patterns, habits and literacy, and technological media (smart phone, chipcard...).

The following figure describes the different needs:



The main needs for the final users are easiness, simplicity and fairness (of tariffs). Specifically, this means:

- Easy media handling is necessary e.g. chipcard, smart phone, any ONE medium for all applications
- Simple electronic schedule journey planning including automated fare determination & real-time travel information including alternative route suggestions
- Simple and convenient payment process
- Same processes everywhere supporting intuitive handling (i.e. users interfaces)
- Guidance by one trademark and commonly understood pictograms
- Simplification of tariff structures to easily find the best tariff (not necessarily the cheapest)
- Travel related products (i.e. multi-applications)
- Data protection & security
- Growing mobility needs
- Environmental protection

4.3 Focus on the Public Policy Needs

Scope and scale of the public policy objectives vary due to the diverseness in local, regional and nationwide circumstances. Actual public policy issues are:

- Reduction in individual car travel leading to a shift in the modal split
- Reduction of pollution by using public transport, soft modes, clean vehicles or shared travel solutions, such as car-pooling
- Optimisation of operational efficiency
- Reduction of travel expenses and optimisation of profits
- High importance of urban planning in Europe requires sustainable urban transport planning.

Smart Ticketing and all the potential that new technologies and associated services offer are now key instruments that need to be integrated into the toolbox of Transport policy makers. Indeed, these tools would symbolise and could drive sustainable changes in the mobility behaviour of travellers; not only in the way they will effectively travel but also on the way they will consume their mobility.

It is also important to enhance the link between long distance travel and “the first and last urban mile” such as rail, air or ferry so that passengers can include the journeys to and from their origin through to the final destination, in their ticketing.

Indeed, one of the key issues is to make multimodal travels easy, and there are two options to organise ticketing for a cross network or multi-modal journey, or one crossing multiple borders:

- offer the customer one single ticket for the entire journey
- offer separate tickets for each segment with single support

The first offer with a single ticket is complex and costly to implement as it includes not only technical agreements but also business and political agreements. It obliges transport operators to circulate ticket prices for all segments. It is necessary to develop a common ticketing scheme, with common processes to fulfil and control tickets at gates or on board. The parties involved need to agree commissions to be paid to the lead retailer. There are settlement issues and clearing to be carried out. This option has only been feasible on limited urban or regional scales up to now.

Smart Ticketing deals with that inconvenience as it allows multiple tickets to be loaded onto a single device (“several tickets in one wallet”). The customer appears to have purchased a single through ticket, but one made up of multiple segments. There are thus no complex clearing and settlement rules to follow. This solution could also include long distance rail tickets. This scenario however is also dependent on the single smartcard being compatible with the technical standards of each participating transport scheme. At the same time, each

transport operator must have the trust in the smartcard and its issuer, i.e. that the individual tickets are secure and cannot be altered or deleted until used.

4.4 Focus on the Transport Operator's Needs

From the point of view of a transport operator, the main issue would be to reduce the operational costs of ticketing, while improving the fare collection efficiency and applying the fare policy defined by the transport authority. A study done in the UK (Department for Transport – August 2009) has shown that at the national level, integrated Smart Ticketing could deliver net benefits of £2bn per year in the UK.

Indeed, it is far too easy to invest substantial amounts of time, effort, and money in trendy new technologies that fail to improve the customer experience or deliver a satisfactory return on investment. In addition, transport operators must ensure that the Smart Ticketing systems they implement are adaptable, reliable and scalable, and can be adjusted over time to meet continually shifting demands.

Yet the opportunities inherent in Smart Ticketing are very real. Implemented correctly, such systems can revolutionize the ways in which customers use public transport, adding significant amounts of convenience, efficiency and flexibility. These same technologies also have the potential to cut providers costs, grow their revenue, and boost their margins and image.

The key to success is integration and interoperability: Smart Ticketing systems must integrate their customers' preferred communication channels into a cohesive customer experience, and further integrate those channels and (new) services with the existing systems and processes that support the ticketing process and multimodal shift.

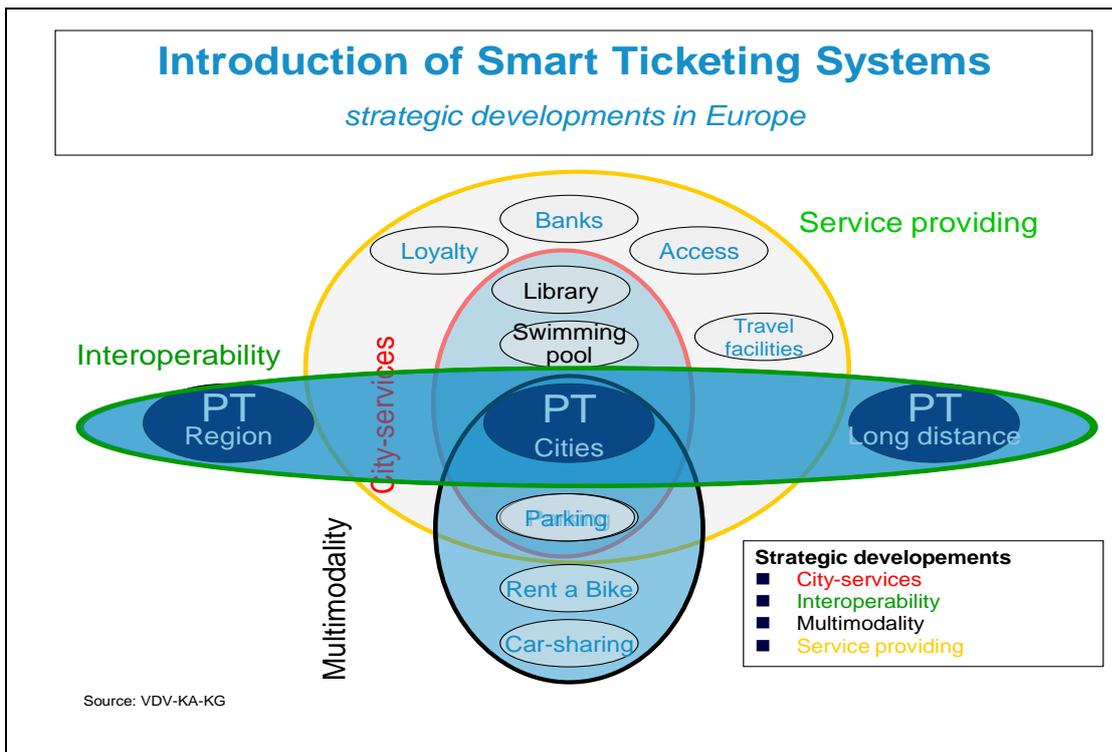
4.5 Conclusive Remarks / Summary

In brief, by keeping up with rapid advances in Smart Ticketing technology in a cost-effective way, today's public transport operators can meet customers' needs for greater convenience while accelerating their pursuit of high performance.

The focus of the customers, operators and policymakers against the technological development in ticketing can be summarized as follows:

	Operators	Customers	Government
Mid 1990s – 2000s Transit Smartcards	<ul style="list-style-type: none"> Faster throughput MIS Fares Flexibility Non-transit apps Reliability 	<ul style="list-style-type: none"> Convenience of e-cash New Sales and payment options "It's modern" 	<ul style="list-style-type: none"> Non-transit apps Transit Integration Fares Flexibility MIS
Mid 2000s → Emerging Electronic Payments (Banks and NFC)	<ul style="list-style-type: none"> Multi-apps and sharing of costs Payment Flexibility 	<ul style="list-style-type: none"> Convenience Convergence Common payment 	<ul style="list-style-type: none"> Convergence Cost sharing Market appeal

Source: Mark Streeting



Source: VDV-Core Application

Multimodal and/or multifunctional Smart Ticketing can be very attractive for the final user; the organisational aspects of such schemes shouldn't however be underestimated. The number of stakeholders will increase and this means strong coordination and management of interfaces is needed.

Smart Ticketing needs to reside in a "Secure Element" (this can be a bankcard, a mobile phone or a USB-Key). The additional Roles and Use Cases for multi-application Smart Ticketing include the Secure Element Provider, its Issuer and Registrar, and the Trusted Service Manager that oversees the relationship with the customer and loads and deletes Applications securely.

5. Impacts of Smart Ticketing for Different Stakeholders

5.1 Trends in Ticketing

From magnetic to contactless

Contactless Smart Ticketing first appeared in the early 90's as a technological evolution for systems that needed renewing. This has been the case for example for RATP, in Paris.

The technological change is mainly justified by the cheaper operational and maintenance costs of the contactless coding or reading devices.

The investment relates to different life cycles depending on the type of components:

- 15 to 20 years for vending machines, valuator or gates,
- 5 to 10 years for the software,
- 2 to 5 years for the cards.

From cash to smart payment

Cash management is a significant cost factor as well as a security risk.

Transport operators haven't been able to rely on bankcards to diminish the amount of cash, as it was necessary to serve customers without a bank and because the bank commission was expensive for small amounts.

Stored value cards have therefore been developed as closed prepaid dematerialised systems. The secure management of stored value cards, very similar to electronic purses, is complex and expensive.

Customer accounts are now being developed as an alternative to stored value cards. They can be post-paid for registered customers and prepaid for anonymous customers. Their back office management is cheaper.

So long as the transport operator deems the financial exposure acceptable, they don't require real-time control at each entry point and can be settled at the end of the day with the identity blocked against further use in the event of payment not being received.

Stored value cards and customer accounts remain closed systems. Interoperability can of course be organised with bilateral or multilateral agreements requiring dedicated clearing systems that can be complex and costly. Translink (NL) is a good example of a single stored value system shared on a wide scale. VDV E-Ticket Germany agreement is an example of a set of interoperable regional stored values.

The use of bankcards for immediate payment at access points becomes an opportunity as the banks start issuing contactless cards and accepting small amounts transactions at low transaction costs for the merchant.

A complete convergence of the technical specifications remains yet to be achieved, and the certification processes of the payment chain may be a new cost factor.

From in-house/on the field sales channels to externalised/remote ones

Smart Ticketing opens up possibilities to a completely new organisation of the distribution channels.

Traditional in house channels based on ticket offices and automatic vending machines can be completed with the use of other existing channels.

Dual interface contact and contactless cards can for example be reloaded in bank cash machines as has been developed in Lisbon.

Remote selling Over The Internet (OTI) can also be developed using USB or contactless interface devices between personal computers and cards or for USB NFC keys or dongles. The Public Transport of Montpellier in France has developed a solution that permits a proposal of a smart device (specific USB key including a RFID chip) to the final user that would also enable integrating and disseminating information on the network offer. What is of interest here is the marketing scheme that could be put into place, promoting the PT network and associated services around the device.

These new channels are cheaper to operate than traditional ones. Their introduction will however create new development and operational costs (as well as potential privacy issues) that will only be returned / recovered if other channels diminish significantly or disappear after an introduction period. The abandonment of distribution channels may be a controversial discussion. Such aspects have to be decided and taken into account in the business plan before a new system is implemented.

From mono-application to multi-application devices

The use of microprocessor cards is now largely accepted as necessary for security and privacy reasons. These cards have been the option of large systems designed for a wide interoperability, such as Calypso, ITSO or VDV-KA. Most systems have now built migration plans in that direction. The extra cost of micro-processor cards now appears to be a second order criterion.

The co-issuance of cards with other businesses has been experienced (e.g. TfL and Barclays bank) but embraces a local scope only. The costs of issuing a card and the costs linked to the security and on-going management of the card are high and the advent of multi-application applications on media issued by banks or on mobile phones allows the cost to be externalised from the transport operator. This could be an important factor in order to reduce the operational costs.

The development of flexible multi-application devices into which different applications can be downloaded opens up the opportunity for new business cases (e.g. NFC phones).

5.2 Impacts for Public Transport Operators

Impact on performance

As already mentioned, the ticketing system includes the access control process, which is mainly defined by two aspects: gated/not-gated networks and check-in/check-in-&-out fare systems.

More than 40 to 50 persons per minute can validate on the same contactless device (applying ISO 14443 norm – the transaction's duration is limited to 500ms), which is approximately 25% more than with magnetic tickets.

This can be a major advantage where the entry or boarding process is critical such as saturated bus lanes, tram lines or underground stations. It is also a factor of economy when designing new stations.

The performance impact for the transport operator, concretely tested and the effect shown on the Madrid network (like on many other networks), is a clear decrease of the passengers' load time at bus stops and consequently an increase of the routes' commercial speed. The main impact is that less buses and less frequency are needed (in urban surface public transport) to have the same capacity (in number of passengers) to transport clients.

Impact on fare evasion

'Smart' ticket or not, it has no influence on people who choose to fraud by travelling without a ticket. Inspections at gates and in the network itself have to remain efficient.

Advanced technology is developed to prevent false tickets being issued or real tickets falsified. Standardised algorithms and processes provide good solutions. Differed controls in the back office however remain necessary to make sure that no undue operations are processed.

Post-paid systems also bring the risk of unpaid trips, which can easily be mitigated by the use of black lists activated as of the first alert.

Each scheme must decide its security policy balancing the risk analysis and the cost of the preventive counter-measures.

5.3 Impacts on Traveller Behaviour / Way of Using PT

Contemporary image of public transport

The very numerous applications all over the world show the unanimous acceptance of contactless ticketing, with easy usage and fast access being the main advantages.

Improving the ridership by bringing more citizens to choose public transport, the ticketing systems should open up to new services and meet the general evolution towards ITS: more services, easier access to information, easier payment.

The development of multi-application media, among which NFC mobile phones will stand, is an excellent opportunity for Public Transport to be considered by the citizens as a major integrator service among the set of urban services.

More services: from local transport network to mobility services

From the customer point of view, interoperability is not a technical issue but a window opener to a wider universe: not only here, but elsewhere, not only traditional modes but also soft modes, not only transport but also parking, etc.

The argument that only 3% of urban transport customers continue their trip on other modes should not be a reason to neglect the needs of this customer segment. Quite the opposite, it should be a reason to try and develop it.

Easy access to fare information

There is a need to address occasional customers entering an urban network with Smart Ticketing.

The development of interoperable media will be a cheaper solution than the issuance of local smartcards for just a few trips. This can be done by steps, as demonstrated within the 7th Framework Programme research project IFM (Interoperable Fare Management).

As customers more and more frequently use travel planners, but still have difficulties in finding precise information about fares for their urban last miles, urban networks can take advantage in encouraging long distance travel planning websites to propose a link to their local websites and provide fare information in the most frequent languages.

Easier remote sales

Internet merchants are developing fast, in all domains. In France more than 30 millions customers (i.e. 50% of the population) buy OTI (3rd trim. 2011) and the proportion grew by 12% in one year.

There is a strong expectation from customers for the development of this type of sales channel by urban transport networks to avoid queuing at distribution points or vending machines, especially at peak times.

Privacy

Customers remain concerned about privacy, especially in the field of their mobility. Proposals have been made, e.g. within the aforementioned IFM project, for a code of conduct, and urban networks should communicate about their action in that field to develop a trust relation with their customers.

5.4 Impacts on Public Transport Organisations

Smart Ticketing changes the organisation of commercial, marketing and retailing resources and creates a need for information system and distribution channel management. Operational management also gets valuable information from the validation points in traffic.

Towards shared resources and common governance

In the 90's, most urban ticketing applications started as independent applications. Transport authorities and operators were at the same time responsible for the definition and the distribution of their application, of fare products and for customer services, even if some of these functions were subcontracted.

Different forms of groups/organisations progressively appeared:

- Technical organisations appeared such as Calypso (EU), VDV-Core Application (D), Translink (NL), ITSO (UK)
- Commercial organisations also appeared, jointly or not: VDV created E-ticket Germany together with VDV-Core Application; Translink manages a national kilometric fare product for occasional trips; ITSO supported the national concession and train franchising programme, BMC supports the Belgian interoperability and uses Calypso specifications, France recently decided to create a common application for occasional trip.

- Calypso Networks Association offers all Calypso networks the possibility of a complementary application TRIANGLE that allows commercial interoperability across their borders.

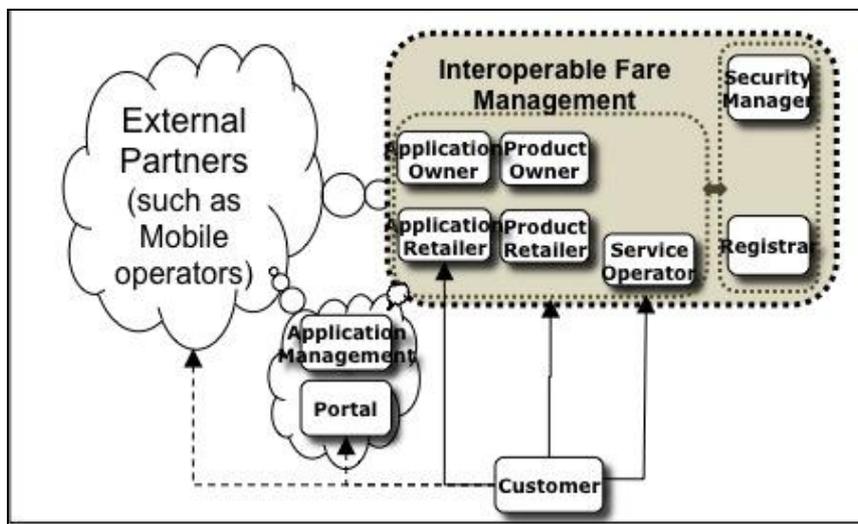
ISO/IEC 24014-1 standard provides a model of the roles to be fulfilled to monitor and operate such fare management systems where many stakeholders can participate.

A new Implementation Specification for the use of Smart Ticketing is in preparation for publication in 2013. This new model refers to the management of different applications in multi-application devices such as Java cards and mobile phones (see figure below). This will closely align with the Implementation Specification for contactless bankcards (EMV Level 1).

This functional model doesn't determine how the roles are split between organisations¹.

The business organisation remains dependant of each implementation. Some Smart Ticketing schemes are simply a "permission to travel" whilst others may include interoperable products that involve distribution, retailing and settlement. In these cases the governance of the systems may vary from case to case, depending on the risks and complexity involved.

All Smart Ticketing schemes will need to analyse their organisation referring to the model and clarify their governance in order to develop interoperability and agree common processes with external partners such as the mobile phone operators.



Role model (Extract from ISO 24014-3)

¹ Organisations can be transport authorities, transport operators, groupings of these or sub-contractors.

In the above figure, the roles inside the interoperable Smart Ticketing scheme (grey area) have agreed to use their multi-application resources with external partners such as mobile phone operators or other organisations. The roles and the interfaces between the applications must be defined, as well as the portals from which the customer can access the applications.

New business models

The multi-application business model has not yet been completely defined.

It requires a common understanding of what are the different B2C, B2B and even B2B2C relations, not only complying with the European competition regulations but also helping the decision makers identifying where public funding is given.

In the particular case of mobile ticketing, ticket sales as an example is a Transport to Customer service, the use of the telephone is a Mobile Operator to Customer service, and the possible billing of the transport service via the telephone bill is a B2B2C service.

5.4 Conclusive Remarks / Summary

The sales and access control processes are to be considered as cost factors, requiring investments and high operational costs. Distribution costs may reach more than 15% in complex kilometric fare systems such as regional railways.

The traditional manual punching of tickets used to require many operators. As shown above, in the description of trend in ticketing, since the 1980's, these processes have been progressively automated with automatic vending machines, bankcard acceptance and magnetic validation of tickets. Simultaneously, more efficient accounting systems have been developed.

It is important to underline that the benefit of rolling out Smart Ticketing systems is therefore very different, depending on the state of development of the existing ticketing system (fare principles, tariff structure, no. of customers, no. of stops or vehicles to be equipped etc.).

Generally speaking, a Smart Ticketing system will be more efficient, but no economies will really be realised if the previous ticketing systems remain in place. A complete step by step migration strategy must therefore be built for an optimal benefit. This migration process should integrate 3 levels:

1. ensure the feasibility of having in the same time cohabitation of the old and new systems, this could be transparent for the final user in some technical conditions, but in the case of a complete change of technology (from magnetic ticketing to a contactless ticketing) this would be necessary to get during a limited period of time two types of devices ;

2. train the whole operational staff that will be involved in the system exploitation including, in the case of public transport, maintenance staff, bus drivers, commercial teams ... and be sure they will be ambassador of this technical / service evolution ;
3. inform in advance final users and promote the advantages (and also anticipate on the disadvantages) of the new system / services ... a communication budget will be necessary for this kind of ambitious project as it will directly affect the way final users are using public transport or mobility services associated.

a) Policy implications

The development of Smart Ticketing in a global urban ITS perspective has to be built in respect of local organisations / circumstances and of the decentralised nature inherent to public transport and to the importance of its public funding.

The responsibility for fare products should therefore remain local and the acceptance of common fare policy be left to bilateral or multi-lateral agreements. All existing examples follow this rule.

An important benefit can be expected from technical convergence and from common references to specification and certification processes.

b) Benefits

The following table summarises the potential main benefits:

Improvement	Benefit
Level of services offered to traveller	<ul style="list-style-type: none"> • Implementation of alternative/additional fare policies • Optimisation of services offered • Bigger choice of services for the traveller
User account	<ul style="list-style-type: none"> • Account for mobility and transport • Possibility to personalise services tailored to the needs of the traveller • One account for all services, easy to monitor and to overview
Cost reduction	<ul style="list-style-type: none"> • New type of payment process used for all services (average costs for development will sink) • Cost reductions can help operators and also be passed on to traveller
Image	<ul style="list-style-type: none"> • Modern technologies making the service interesting, also for younger generations • Modern technologies facilitate the service and support for customers • Modern image is positive to most people
Accessibility and efficiency	<ul style="list-style-type: none"> • Modern technology easy to access and open to a wider audience when using various communication channels

	<p>(internet, smart phones, bankcards etc.)</p> <ul style="list-style-type: none"> • Modern technology more efficient than ,old' technology, reaching out to more people
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c) Issues / weaknesses to overcome

Smart Ticketing is only a tool. If the main goals are not known in advance, there could be a feeling of having developed a complex and expensive tool that doesn't cover the needs of the market.

Moreover, defining a multimodal fare is always a very complex process (e.g. creating a day-ticket for young people will consist of defining the exact duration when the ticket is valid and thinking about what a young person is) that normally needs quite long period of negotiation and harmonisation of policies in consent with all the stakeholders involved. Implementing these ideas will rely heavily on the different ticketing systems concerned and how they bring it on board. These are the reasons why simplification and standardisation are keywords in the overall decision makers' process.

Furthermore, one of the most important negative feedbacks which is generally stated with such a solution is the fact that treatment of groups is harder to manage. Indeed, such solution relies on an individual / personalised treatment that prevents from developing interesting solutions for group of users / travellers. Some technological solution could be developed, but there will be quite complex to set up and could introduce some regression on the overall solution.

Another weakness that mainly concern smart cards is the fact that the final users could not easily know what the contracts downloaded on the cards and/or the date of validity of some rights are. However, with the development of personal account and the integration of new technology, this barrier could now be overcome.

There is also the fear of identity high jacking with electronic purses (copying your account details on another smart card/media).

People without bank account (or such with limited rights) may be excluded for Smart Ticketing and require special attention. There must either be alternative distribution channels for them or special pre-pay options.

People not familiar with technology may feel excluded from Smart Ticketing. In general a stronger support for those people must be offered.

Finally, one important point that also needs to be integrated is the fact concerning all Intelligent Transport Systems - the technical skill level that needs to be increased for the maintenance and operational staff. This represents costs that need to be integrated in the overall costs of such a project. Users also have to be educated, even if the service and applications are easy to use.

6. Recommendations to Deploy Smart Ticketing Successfully

6.1 Introduction

Launching Smart Ticketing capability can be a complex undertaking for a Public Transport Authority or Operator. It is critical that the options chosen meet the requirements and work towards integration at the local, national and cross-border level.

It requires transportation providers to build new systems and infrastructure, train staff and use public funds as sparingly as possible while providing satisfactory returns on investment. All this will be accompanied by keeping customers happy while educating them in new ways for planning their journey, buying their tickets and managing their journey.

Smart Ticketing should not be seen as a simple replacement for traditional paper or magnetic ticketing. An important step is identifying which features and functionalities of Smart Ticketing can be adopted and how they will integrate with the customers' wider mobility requirements. All this must be clear if the new system shall replace an existing distribution channel or be an alternative for the user.

For a Smart Ticketing platform to add value for several years, and thus justify its initial investment, several key attributes are to be considered.

6.2 Distribution Channels

Smart Ticketing must allow passengers to receive Travel Information, plan their Journey and book their Travel through a range of distribution and retail channels. This goal requires new systems that can accommodate the speed, power and flexibility necessary to handle multiple distribution channels for ticket sales onto the customer's preferred Smart Ticketing media including contactless bankcards, mobile phones or specifically issued smartcards. They must also be able to pay for the chosen journey by a range of means including contactless payment and pre-loaded value.

These channels include mobile services, which allow passengers to book their travels on-the-go without having to pre-register, download a mobile application to a Near-Field Communications (NFC) enabled phone as well as mobile websites, and traditional PC-accessed sites.

The adopted Smart Ticketing solution must support the entire customer service process, from journey planning, ticket ordering through to sales and customer service, customer billing and accounting.

Once the passenger has requested tickets, these channels must coordinate and be interoperable with all existing transport operators' ticketing systems to conform or complement their availability and pricing.

The system should be able to manage a wide range of ticket types, zones, and rates, including single-ride and multi-ride tickets with either immediate or triggered validity, as well as periodical passes (weekly, monthly, weekend, tourist, etc.), pay-as-you-go and multi-operator transit.

Regardless of the complexity or simplicity of the passenger's request, the Smart Ticketing system must quickly and accurately calculate a price that is aligned with the transportation provider's itinerary zone and tariff system or provide the customer with a post event billing service that is accurate and timely.

The system must also allow passengers to pay for their tickets in the most convenient way possible, including for example contact or contactless credit/debit cards, via premium SMS, pre-paid wallet, direct debit, personal or employee invoices, etc...

Smart Ticketing must allow the customer to receive Travel Information, plan their journey and book their travel through a range of distribution and retail channels with the speed, power and flexibility necessary to handle multiple distribution onto the customer's preferred Smart Ticketing media. The customer must be able to pay with a range of options including contactless payment or with a pre-loaded value, overcoming geographic limits, using the web potential.

6.3 Smart Wallets

Once the Smart Ticketing system secures payment, it should be able to deliver the ticket or authorise to enter the transit system and travel in a wide variety of ways. The customer should be able to choose whether they wish to pay with a purse or use a pre-purchased ticket. They do this by selecting the wallet (or wallets) they wish to use. This can hold their Identity, purse or tickets for their chosen journey; this can include Identity Cards / tags, Smart Cards and contactless Bank Cards, and NFC-enabled mobile phones.

Smart Ticketing also embraces Mobile Tickets: alphanumeric codes (including conventional and 2-D barcodes) that are visually inspected or read by barcodes scanners or NFC-devices.

As with any system that will be used by large volumes of people on a daily basis, fraud and theft must be addressed whilst respecting the privacy of the customer. These features require a robust yet flexible technology platform capable of interfacing to a range of Smart Ticketing media and supporting applications and services that use a common set of interfaces which, in turn, allows new functionalities to be developed rapidly and cost-effectively. These features address not only the over-the-air communications with the Smart Ticket, but the security algorithms used, file structures for data, as well as the data itself.

It also should feature built-in business and technical administration systems to monitor and manage capacity and performance continually, and connect with in-house business support systems such as billing, CRM, ERP, and travel planning systems.

Such connectivity enables urban decision makers and transport operators to provide fast and seamless customer service, attain a holistic view of customers' purchase behaviours, mobility requirements and service usage; and to use that information to improve billing and customer relationship management processes, and make better decisions regarding mode of travel, routes, schedules, fleets and fares.

Smart Ticketing not only covers pre-payment and the loading of a ticket onto a smartcard or phone, it can also include post-payment where the customer is identified on entering / leaving a closed system. The customer must be able to chose (after a background check) what mode of payment is preferred and define the Smart Wallet.

6.4 Business Models for Smart Ticketing

Existing Public Transport business models are limited, both geographically and modally. Public investments capacity is limited and public concern must be addressed as to why the public sector should lead the introduction of Smart Ticketing services whilst encouraging modal switching to lower carbon transport.

Smart Ticketing is a global business and is, for the first time, being Standards led. This allows off-the-shelf technology to be adopted with only limited local tailoring to reflect specific tariff structures and cross-modal opportunities.

Suppliers are becoming multi-national and one way transportation providers can minimise the costs of providing the customer with the means for Smart Ticketing by taking advantage of the trusted service manager, in which a third party provides all the capabilities necessary to operate Smart Ticketing effectively – including the technology platform, business processes and people.

In addition to examining the need to invest in in-house infrastructure and capabilities, this model gives transportation providers the opportunity to link the amount that they spend to use a Smart Ticketing platform to the number of physical tickets they issue and the volume of passengers they support, thus eliminating the risk of paying for unneeded infrastructure and overhead.

A managed services arrangement can also provide flexibility, enabling a transportation provider to cost-effectively scale its Smart Ticketing operations as demand grows.

With these capabilities in place, transportation providers could be on their way to providing a Smart Ticketing service that coordinates and connects passengers, payment issues, technology, security, and Public Transport Operators across a multi-step process.

By using open International Standards and Specifications for Smart Ticketing, Public Transport Operators can access supply chains that are responsive, cheaper and address industry best practice. Outsourcing certain aspects of the supply chain for Smart Ticketing will also contribute to an efficient and cost-effective service.

6.5 Integration with Travel Information and Traffic Management

Smart Ticketing is just one step in the Customer Travel Experience. From the initial Journey Planning through Fare Selection it must be possible for the customer to seamlessly access Smart Ticketing through their preferred distribution channel, using the identity, purse or tickets in their preferred wallet. This experience continues during the journey with access to timely Real Time Information for the customer and Traffic Management for the Operator.

Smart Ticketing will open up possibilities to collect statistical data that will contribute to the aims of Travel Information and Traffic Management. Always keeping privacy laws in mind, data must be shared between the key application areas.

6.6 Marketing Issues / Public Support

For customers to understand the Smart Ticketing offer, the Public Transport industry must develop a consistent message in simple language that stresses the interoperability benefits, (the opportunity to adopt a lower carbon mobility profile with the consistent customer interface) and the removal of barriers, particularly relating to payment.

Urban ITS decision makers should now systematically look for integration in such wider organisations to take benefit from the grouping of standard technical toolboxes as well as to insert their customer offer in a wider market.

New marketing platforms will be opened by Smart Ticketing and customer expectations must be managed.

Public Support through open customer engagement is essential for trust in the new technologies to be consistently delivered. Urban Decision Makers will have a significant role in developing marketing and modal integration strategies and the business processes in managing customers experience across modes and across borders.

A number of organisations in Germany (VdV KA), UK (ITSO), Netherlands (TLS) and France (AFIMB and Calypso) have shown within the research project IFM (7th Framework Programme, 2009-2010) that their individual Smart Ticketing solutions can co-reside on a single smartcard. There is strong support from the European Mobile Network Operators for such a solution and it parallels developments in the Single European Payments Area for contactless payment in a multi-application environment.

The benefits of an interoperable Smart Ticketing solution in Europe must be communicated. Campaigns must be aligned to a certain extent all over Europe. Naturally, some nations will need a different approach and communication. The message should be simple and easy to understand.

6.7 Organisational and Legal Issues

For Smart Ticketing to operate seamlessly across Europe there must be cooperation between urban and national transport providers, between public (national, regional and local) and private sector operators and suppliers, between journey planners and between retail and distribution channels.

Urban and national transport decision makers must actively support the development and implementation of European and international Specifications for Smart Ticketing to ensure mutual compatibility between all schemes.

It should however be noted that Smart Ticketing does NOT imply clearance and settlement between Operators. The relationship may include interoperable schemes which have settlement, but this is a commercial decision between operators (or has been mandated by Local Authorities). The prime relationship in Smart Ticketing is with the media or wallet owner and the Trusted Service Manager who collectively manages the loading (and cancellation / deletion) of all the applications loaded within the wallet. This is typically the original smartcard issuer or the Mobile Network Operator in the case of an NFC-enabled phone.

Smart Ticketing schemes need to cooperate, build consensus, share best practice and speak convincingly and with one voice to the legislature, to other industry bodies and to customers at large. This can only happen through the development and agreement on relevant standards and relationships, ways to verify compliance and provide all stakeholders with trust in the technology and systems used in Smart Ticketing.

6.8 Data Privacy

Collection of travel data can be challenging; the customer data stored in the system and in the customer medium are used for the benefit of customers to process payments, deliver entitlements and for a more user friendly interface. They are also used to mitigate the risks of misuse, manipulation or passing-on of the media to unauthorised persons that could incur commercial damage to the service operators.

Protection of the customer's privacy is an ethical requirement of confidentiality, un-linkability, un-observability and anonymity. A low level of protection not only could be punished as a violation of the law but would damage customer acceptance.

Smart Ticketing Privacy must defend the following principles:

- **Anonymous accessibility**
- **Protection against risks of abusive use of personal data from applications in the media**
- **Protection against risks of**
 - **abusive use of personal data by staff**
 - **abusive usage of abnormal events**
 - **abuse of direct marketing tools**
 - **hacking and criminal use of personal data in back-offices**
 - **uncontrolled dissemination of identity data**

6.9 Interoperability and Continuity of Service

For the customer to feel Smart Ticketing technology is bringing material improvement to the journey experience and encourage modal switching to lower carbon modes, interoperability between schemes is essential. Smart Ticketing media issued to the customer by one transport operator should be compatible with other Public Transport in region, with other regions and with interurban/international systems.

Interoperability in Smart Ticketing implies removing the obstacles for the customer to switching transport modes. All ticketing needs for through journeys should be in one place and on their local transport Smart Ticketing media even outside their home network. There should be simple registration so the customer has a standardised machine interface and easy access in own language.

Currently there are a number of steps needed to reach full Europe-wide Interoperability through mutual agreements between individual schemes to accept each other's Smart Tickets:

Step 0: Look at your closest neighbours and identify the potential level of interoperability and technical compatibility between their own solutions and your own Smart Ticketing project.

Step 1: Bankcards / Identities and Smart Tickets are issued to common EU Smart Specifications with Schemes joining Ticketing Trust Schemes. .

Step 2: Common Ticketing Applications are defined that allow the customer to download the Smart Ticketing Applications they require to their mobile phones, contactless bankcard or a smartcard.

Step 3: Provide a common web / mobile portal that allows access to a range of national and local Smart Ticketing applications and encourage common cross-border products and their retailing and distribution.

6.10 Development of Smart Ticketing Standards

The use of international and open standards can facilitate interoperability, the opening of global markets and compatibility between devices produced by different suppliers.

There are already Open International Standards covering each of the main interfaces and Use Cases for smartcards in Public Transport to ensure their interoperability at the card, application and data level. There are also examples (listed below) of specific Standards covering the physical and logical security aspects of their use.

RF Communications	ISO 14443
Data Commands	Global Platform /ETSI/GSMA
Operating Systems	Java / Android etc
Filing Structure in card	ISO 7816
Security Algorithms	Global Platform (3DES, AES, RSA etc)
Card physical and logical security	Common Criteria
Smart Ticketing Roles and Use Cases	ISO 24014 (IFM)
Transport Application Design	EN 15320
Transport Data	EN1545

Further European Specifications are being developed for the specific transport requirements of NFC mobile phones, and for the Messages sent between individual Smart Ticketing systems as well as with Mobile Network Operators.

This way mobile phones, ticket machines, gates and valutors can communicate with their back offices. This will include the secure handling of data between operators whilst at all times respecting commercial confidentiality and customer privacy.

There is no need for specific additional urban related standardisation for Smart Ticketing. Additional efforts are needed in order to enable fully interoperable solutions (e.g. for contactless, NFC).

7. Further Information and Contacts

7.1 Best Practices

The Urban ITS Expert Group has collected in a special report a variety of Best Practices. In the area of Smart Ticketing following Best Practices are presented:

DE	Deutsche Bahn: Touch & Travel (NFC Pilot)
DE	Karlsruhe - Handy Ticket KVV
DE	Stuttgart – VVS HandyTicket
DE	Bremen – eTicketing / BOB Card
ES	Madrid - Contactless Card End of 2011- Integration of High Number Of Operators
ES	Barcelona – Steps towards E-Ticketing
FR	Lyon- Global Urban Ticketing
FR	Paris - Passautocar (Coach Parking Pass)
FR	Toulouse – The Electronic Ticketing System
FR	La Rochelle – Electronic Ticketing System
NL	Openbaar Vervoer Chipkaart (Public Transport Chipcard)
NL	Yellowbrick / Parkline
NO	Trondheim - Smart Card Ticketing: t-card
PL	Warsaw - Tickets on Mobile Phones in SkyCash™ and mPay Systems Based on Specialized Applications
PL	Lodz – Electronic Monthly Ticket
RO	RATB Travel Card
UK	London – Oyster Card

7.2 Contact Information

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