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Integrated urban e-ticketing for public transport and touristic sites

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Integrated urban e-ticketing for public transport and touristic sites

Final report on application concepts and the role of involved stakeholders

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Abstract

This final report deals with the development of integrated e-ticketing systems for public transport and touristic sites in cities. The idea of integrated e-ticketing is to combine several modes of transport (e.g. tram, bus, car-, and bike-sharing) on a single ticket. Modern multi-application smart cards are able to incorporate additional fields of application (e.g. leisure activities or tourist attractions) on one fare medium. Such systems aim at facilitating the combination of modes and transferring between them by making the ticketing system as easy and attractive as possible. For over a decade, integrated ticketing has been on the agenda of EU transport policy. While technologies are already available and ready to meet multi-function requirements, e-ticketing has not yet been implemented on a wider scale in Europe. The implementation of an integrated e-ticketing system is a complex process that requires the synchronised activity of heterogeneous actors. Public transport operators and authorities, financial service providers, telecommunications operators, and the tourism sector need to work together to combine their products on a single card. Besides technological characteristics, legal and economic aspects play a decisive role. Stakeholders that are involved in the implementation of an integrated ticketing system need to agree on technical specifications as well as on institutional and governance issues. For this report, relevant studies, reports and surveys have been reviewed in order to provide an overview on technical and non-technical aspects on the e-ticketing environment. Such an integrated perspective is needed to understand and govern successful pathways towards integrated e-ticketing schemes. This report focuses on the interrelations between different stakeholders; on the factors that might influence their decision making to engage in the implementation process and it explains the role of each actor in the systems architecture. A particular focus lies on potential and existing end-users. It will be highlighted that end-users are not a homogenous social category, but that they desire different products, predominantly based on their travel purposes.

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EXECUTIVE SUMMARY

Both the transport sector and the tourism sector are subject to a transformation that is shaped by information and communication technology (ICT). ICT is an enabling and integrative technology in nearly all areas of daily life, and it also affects urban transport and tourism. The technology changes the way travellers search for information and opens up innovative branding and marketing opportunities for the tourism sector. In transport, ICT helps to better organize transport flows, thus affecting the way people use the transport system. ICT is believed to be an enabling technology for the formation of a single multimodal transportation system that does not distinguish between transport modes. This is closely connected with the European Union's goal of increasing sustainable intermodal passenger transport.

The overarching idea of a multimodal transportation ticketing system is to combine all modes on a single ticket. Integrated ticketing schemes aim at facilitating the combination of modes and the transfer between them by making the ticketing system as easy and attractive as possible. The integration of tariffs, operators and modes is proved to have a positive impact on transport demand. In their electronic version, integrated ticketing schemes could be extended to other applications. Most experts agree that multiple services, such as for purposes of tourism or leisure or e-payment, seem to have a considerable attractiveness for the public transport sector, as this means added value for the customers. European cities are major tourist destinations and major centres of entertainment, making this an attractive field of service expansion to reach further customer groups.

For many years, public transport operators have been trying to replace paper-based tickets with electronic media, and many countries have implemented or are about to introduce e-ticketing systems. The main characteristic of e-ticketing is that tickets are sold and stored in electronic devices, such as smart cards or mobile phones. In Europe most countries have an e-ticketing system at least in their capital; many of them have only recently been launched. However, there is at present no wider-scale application available in Europe. Systems are, in principle, able to cooperate, but direct interaction and mutual acceptance are currently not possible. In fact, a lack of interoperability is seen as one of the main barriers to cross-border services. Actually several organizations exist that ensure national specifications for smart ticketing. The difficulty is that complete interoperability would mean that systems would have to agree on identical commercial structures.

Besides different technical specifications, there are various e-ticketing media available. The most promising are smart cards and mobile ticketing. At present smart cards (making use of Radio Frequency Identification [RFID] technology) are still the most common form of e-ticketing. It is likely that, in the future, ticketing applications will evolve to be integrated into bank cards and/or Near Field Communication (NFC) enabled smartphones. Smart cards have the portable size of a credit card, are technologically simple and relatively cheap to produce. Smart cards either need to be brought into contact with a reader (contact-based smart cards) or the card needs to be placed in close proximity to (within about 10 cm of) the reading device to start the communication process (contactless smart card). Mobile ticketing is basically a virtual ticket that is held on mobile phones, tablets or personal digital assistants (PDAs) and can be ordered and obtained from any location. For both ticketing media, the most important network technologies are RFID and NFC. RFID tags can process data or communicate with other RFID tags and are thus compatible with existing contactless smart card infrastructure. NFC is basically an advanced form of RFID technology that also permits short-range communication between electronic devices. It is often possible to use existing infrastructures, because NFC is able to emulate RFID readers and tags.

However, while technologies are already available and ready to meet multi-functional requirements, such integrated schemes often do not reach implementation in spite of positive expectations regarding the positive effects of integrated ticketing on sustainable transport. Despite some pilot projects, e-

ticketing has not yet been implemented on a wider scale in Europe. The implementation of an integrated e-ticketing system is a complex process. Besides technological aspects, legal and economic aspects play a decisive role. The integrated ticketing environment comprises different actors, who each have a different role to play and for each of whom drivers and restraints apply in the decision to participate or not in the process. The most important actors involved in operation can be categorised as follows:

- Public transport operators and authorities
- Government and other administrative authorities
- Tourism sector
- Intermediaries (telecommunications operators and financial service providers)
- Existing and potential end-users

Public transport operators: This group of actors offers a well-established market segment, making them an interesting and important partner for other stakeholders. Transport operators might also be the right actors to include other transport-related services, such as car or bike sharing or car rental. However, the benefits of a comprehensive e-ticketing system for public transport operators are hard to quantify, as the main aim of e-ticketing is an improved service quality. In monetary terms, e-ticketing could reduce administrative costs as fewer cashiers are needed, fare processing times could be reduced and a better throughput of passengers could be allowed. Moreover, fare evasion and fraud resulting from cash handling could be reduced and better price differentiation would be possible. E-ticketing enables a better integration of alternative services into the scheme, making it more attractive for customers to use it. Due to accurate data on passenger flows it might also help to better exploit the network's capacities and to improve the user experience by setting up tailor-made services for individual passengers. Costs apply that can be easily quantified, e.g., investment and operation costs, particularly the initial one-off costs (e.g., readers, software and consultancy on the scheme design). Additionally, running costs for marketing, maintenance and replacement need to be considered. Costs apply for training staff or resolving passenger disputes and for setting up a (regional or even national) clearing house responsible for centralised data and fare collection. The fear of outsourcing their expertise and responsibilities in ticketing to a third party of suppliers remains a worry to public transport operators. Another reason for the relatively slow take-up of e-ticketing is fears about investing in a technology that could prove to be the market loser in the long run. However, the assumed costs and benefits vary heavily, as framework conditions are different, especially in respect to the applied technology and the existing infrastructures of the schemes.

Government and other authorities: This group of actors has proved to be important for institutional coordination. They could have a facilitating role in supporting the standardisation process where appropriate and in coordinating the efficient use of infrastructures. The most important role that governments have to play is that they need to convince the most important players to participate in the process. Financing pilot projects and subsidising installation seem to be important as well. Governments expect some positive indirect effects for the national economy and the environment. Knowledge and technical expertise gained in the smart card system could be applied and transferred to other sectors, and e-ticketing could create a positive economic climate for companies. Regarding the positive effects for the environment, it is assumed that e-ticketing could increase public transport usage at the expense of car usage. A strong brand could provide a strong identity to the community.

Intermediaries: As it is more likely that e-ticketing applications will evolve to be integrated into bank cards and/or NFC-enabled smartphones, the role of telecommunications operators and financial service providers could grow. The key driver for financial institutions to involve themselves in the ticketing domain is to replace small cash transactions with e-payment. Moreover, for telecommunication operators ticketing offers a well-established market segment and thus strong potential for additional transactions. NFC-enabled e-ticketing could result in additional GSM/UMTS

transactions, and the additional services generated by NFC technology might attract and retain customers.

Tourism sector: Europe is the world's most frequently visited destination, with a high density and diversity of tourist attractions. Many cities in Europe actively promote their attractive potential and have indeed experienced spectacular growth rates in city tourism. Cultural tourism is becoming increasingly popular and includes journeys to exhibitions, performances, festivals and other cultural attractions. However, marketing destinations is an extremely difficult task, as the relationships between stakeholders that develop and produce tourism products appear to be highly complex and present a whole range of professional and personal interests. On the other hand, tourists perceive the destination as an integrated product composed of different elements, such as public transport, hotels, bars and restaurants, local attractions and events. So-called destination cards market and manage their products as an integrated package. They are often designed as smart cards valid for a specific period, but usually without a payment function. They are mostly dedicated to specific cities and usually include discounted prices for major attractions and events. The most successful destination-card systems offer free or discounted prices for public transport. However, the technology behind the system seems to be of minor importance: what is important is the promise of the experiences to be had at a destination. Nonetheless, NFC technology provides several interesting opportunities for the tourism sector; in particular, the possible integration into mobile devices opens up innovative ideas to guide tourists through the cities.

Existing and potential end users: It is particularly important to look at this group of actors, as they are the ones who ultimately need to purchase the product, based on their preferences and willingness to participate. Research has shown that there seems to be latent public support for public transport smart cards and a ticketing system that is easy to understand. For end users, e-ticketing is an improvement in quality, as it enables enhanced ease of use, flexible mode choice and easier interchange, as well as saving time and money. However, regarding public transport, there is at least reason to doubt that the introduction of integrated e-ticketing will have a large effect on modal shift. Other improvements designed to increase reliability, speed or frequency play a decisive role as well. It is therefore likely that an e-ticketing system alone is not sufficient to attract car users and that it needs to be accompanied by further quality improvements in addition to the ones mentioned above. For existing public transport users, however, integrated e-ticketing could remarkably enhance the quality of their experience. It is important to note that end-users are not a homogenous group of people, which makes it difficult to speak about the demand of 'the end users'. People travel for different purposes, to different destinations and with different frequencies. Moreover, perceptions and attitudes are an important aspect of modal choice. All of these different user groups have different requirements on the refinement of an e-ticketing system.

However, for most stakeholders the recording of personal user data holds enormous potential for better understanding their customers, as e-ticketing allows the creation of a precise picture of people's travel behaviour, spending habits and preferred places to be. This information can be used to better exploit the network's capacity, to offer personalised advertising or to run loyalty programmes. Customers can expect lower prices, more efficient services and time savings. However, this bears the risk of abuse, either through unauthorised parties or through the enterprises themselves. There are also potential threats related to informational inequality, because the information a person obtains could be filtered according to his or her travel characteristics and preferences. Since data collection occurs 'en passant' and thus mostly invisibly, individuals could feel that they are losing data privacy and the right to control information about themselves. It is not clear to what extent users will be willing to engage in implementation without strong data-protection regulations.

Experience with integrated e-ticketing systems prove that implementation requires great effort, since many stakeholders need to agree on standards, overall arrangements, interfaces and designs and

overall purpose as well as on data and revenue sharing. This is a difficult task in multi-actor contexts and including further stakeholders in an environment that is already very difficult to govern does not necessarily simplify the implementation process. Each of the stakeholders has a different role to play and, for each of them, drivers or restraints apply in the decision to participate in the process or not. Furthermore, the context of implementation varies across different cities and regions. The exact nature of stakeholder arrangements, as well as the geographic, socio-economic and technical preconditions, are not transferrable from one case to the other. A one-size-fits-all solution does not seem desirable and feasible. Instead, a user interface is needed that is compatible with other applications, but takes into account the diversity of contexts. It should offer different payment options, include local fare policies, respect data privacy requirements and it should be open to further development.

1. INTRODUCTION

Both the transport sector and the tourism sector are subject to a transformation that is shaped by information and communication technology (ICT). ICT is an enabling and integrative technology in nearly all areas of daily life, also affecting urban transport and tourism. E-services are rising in importance in urban tourism (e.g. interactive maps, location based services, mobile tourist guides, etc.). This changes the way travellers search for information and opens up innovative branding and marketing opportunities for the tourism sector. In transport, ICT helps to better organize transport flows, affecting the way people use the transport system. In 2007 72% of all inland passenger kilometres in the EU-27 were private car-journeys (European Environment Agency (EEA), 2010). In its 2011 White Paper on transport, the European Commission sets out the vision that "New transport patterns must emerge, according to which (...) greater numbers of travellers are carried jointly to their destination by the most efficient (combination of) modes." (Commission of the European Communities, 2011:5). Further, the Commission point out that ICT is seen as an adequate tool to allow easier and more reliable transfers. Especially the public transport sector could profit from ICT in various ways. An important strategy to overcome the imbalance in the mode share of individual transport compared to collective transport is to offer users a public transport system that is organised as an "integrated set of multimodal alternatives" (Banister & Stead, 2004:621). However, most often the different transport modes still operate separately; users of the system are noticing this in form of different fare structures, service information and sales channels, which make a combination of different transport modes complicated. The challenge for future transport policy is thus to form a single multimodal transportation system that doesn't separate between transport modes, but instead enables users to choose the most suitable means of transport for each trip. ICT is believed to be an enabling technology to do so but it is yet not clear which impacts it can really have.

The overarching idea of a multimodal transportation ticketing system is to combine all modes on a single ticket. Integrated ticketing schemes aim at facilitating the combination of modes and the transfer between them, and they are thus closely connected to the European Union's goal to increase sustainable intermodal passenger transport. Hence, integrated networks and services with high values for the users are necessary. Integrated ticketing combines several modes of transport and other potential services provided by one or more operators on a single ticket. Its main aim is to improve service quality for (potential) public transport users and therefore to encourage the use of alternatives to the car. For over a decade integrated ticketing has been on the agenda of EU transport policy and there seems to be a considerable potential for intermodal transport and also for tourism related e-services within Europe. Several integrated ticketing systems have already been implemented or are about to be developed all over Europe. However, they mostly do not use the same technical standards and can thus only be used for that particular transport system. Until now systems remained small, they are often restricted to specific regions or cities and there is no all-encompassing solution for Europe. The recently published White Paper on transport states that "Smart inter-modal ticketing, with common EU standards that respect EU competition rules is vital" (Commission of the European Communities, 2011:13). The Commission presents key initiatives to achieve their vision of future transport in this White Paper. One of the initiatives claims to "Complete the established legislative framework on passenger rights with measures covering passengers on multimodal journeys with integrated tickets under a single purchase contract" (Commission of the European Communities, 2011:23).

E-ticketing could be extended to major entertainment and touristic sites and thus facilitate access to major points of interest within cities, making e-ticketing also interesting for travellers. Urban tourism is the fastest growing tourism sector in the world (Paskaleva, 2010). Several cities offer tourists the possibility to purchase a kind of "destination card" (or "welcome card") that combines public transport usage and free or reduced entry to major points of interest. These cards are not always

"smart", most often they are traditional paper tickets that do not bring in the favour of collecting data on their users. There is no existing public transport ticketing scheme that has been extended to major tourist attractions. Therefore there are no wide-scale experiences that interested stakeholders could benefit from. New co-operation models between transport operators, banks, mobile phone providers and stakeholders from the leisure and tourism market are needed.

However, while technologies are already available and ready to meet multi-function requirements, such integrated schemes often do not reach implementation in spite of the positive expectations of integrated ticketing on sustainable transport. Regardless of some pilot projects, e-ticketing has not been implemented on a wider scale in Europe and those schemes that are already in place have most often been introduced with major efforts. Obviously decision-making processes take longer than innovation cycles. A large number of stakeholders, with partly diverging interests are involved in the implementation process, and it appears that one of them needs to be the dominant actor.

Against this background, the STOA project applies a systemic perspective on the e-ticketing environment. It aims at highlighting and assessing the different drivers and barriers that appear for the different stakeholders involved in the process. This integrated perspective on both, technical and non-technical aspects is needed to understand and govern successful pathways towards integrated e-ticketing schemes. The main intention of this report is to go beyond the supply-side oriented analysis of technologies, but to focus on the interrelations between the different stakeholders on the one hand, on their motivations and restrictions and on the demand side of integrated ticketing solutions. It will be analysed what is known on users' preferences and attitudes towards integrated ticketing systems and it will be shown that users are no homogenous group, but that they desire different products, predominantly based on their travel purposes.

Therefore, the report at hand provides a set of definitions in respect to integrated ticketing (see chapter 2) and an overview on the technical details of integrated ticketing (see chapter 3). Moreover there are a variety of rather different examples that are worth looking at. Therefore chapter 4 presents several case studies that illustrate successfully implemented e-ticketing schemes, by taking into account the respective background for implementation and the systems characteristics. A comparative table at the end of this chapter is provided to present the main results. Chapter 5 presents a broad analysis of the different actors involved in the e-ticketing architecture, by looking at the different roles and potential benefits each stakeholder has when engaging in the implementation process. A particular focus lies on potential and existing end-users. Chapter 6 provides a short summary of the main findings of the STOA Workshop that was held in October 2013. Finally, chapter 7 and 8 present policy implications and concluding remarks.

2. INTEGRATED TICKETING

Ticketing basically represents a company's pricing policy. In the public transport market, several types of tickets can be distinguished (e.g. single journey tickets, single-operator tickets, multi-journey tickets, weekly or monthly passes, off-peak tickets, group tickets or special event tickets). Usually ticketing classification is based on the mode of transport (e.g. tram, bus or ferry), the area of travel (e.g. zones, duration, with or without connections etc.) or the technology (Bak & Borkowski, 2010). Tickets can basically be delivered by paper tickets or electronically. Paper tickets usually need manual intervention to reach validity and they show relatively high maintenance costs (Ampelas, 2001). Considering the diversity of tariff structures it seems evident that public transport (non) users, especially, those that are not familiar with using public transport, occasional passengers, or those that are not familiar with the tariffs in one specific region (e.g. tourists) are likely to lose the overview of the different fares and tariffs.

In order to facilitate the use of public transport, cities aim at making the ticketing system as easy and attractive as possible. Commonly grouped under the term *integrated ticketing*, pricing structures and information are made coherent between different public transport operators and valid for all modes in one specific region. Integrated tickets are not necessarily smart (regarding the technology), in most cases they are still paper-based (Berry, 2012).

Several long-term studies exist that examined the impacts of tariff integration on public transport demand. FitzRoy & Smith (1999) analysed the impact of an integrated season ticket in Switzerland from 1971 to 1996 and conclude that the extension to an inter-operator transferable ticket in the city of Bern significantly affected the demand positively. A study by Matas (2004), conducted in the years between 1979 to 2001, comes to similar conclusions. In the greater Madrid region, the introduction of a travel card for the whole transport network led to demand growth rates of 7% to 15% in the long run. Abrate, Piacenza, & Vannoni (2009) show that integrated tariff systems in 69 Italian cities, observed from 1991 to 2002, exerted a demand increase of up to 12% in the long-run. The most important feature was shown to be the extension of the area of validity and the transferability to different operators.

Having this in mind, it indeed seems that integrated ticketing schemes facilitate the combination of modes and the transfer between them. In their electronic version, integrated ticketing schemes could be extended to other applications, such as major entertainment and touristic sites, making it also more interesting for other customer groups (e.g. tourists). In line with this, most European cities make an effort to introduce integrated ticketing schemes, especially to facilitate access to public transport and offer tailor-made services (e.g. personalized travel costs that take into account the most frequent journey). Another important aspect regarding integration is to have easy access to information about timetables and tariffs, irrespective of different operators being involved. Abrazhevich (n.d.) defines a payment system as interoperable if "it is not dependent on one organisation, but is open and allows as many as necessary interested parties to join" (Abrazhevich, n.d.:86). In other words, the key benefit of integrated ticketing is that a number of operators are working together and combine their products on a single card, ideally throughout different operating regions. Even though integrated ticketing is being discussed all over Europe, implementation status is very heterogeneous; border-crossing applications are rare. Most systems only function within a relatively small area (local or regional level) and do not necessarily operate between all modes, not to mention other non-transport related payment options (Müller et al., 2004).

2.1. Automated fare collection

Automated fare collection (AFC) is a central element of intelligent transportation systems (ITS) and a basis for integrated ticketing. Its main characteristic is the automation of the collection of fares for a

public transport network. An AFC system is most often a closed system, demanding every passenger to have a valid ticket to enter the system and exit at the destination station. AFS systems usually consists of fare media (such as public transport smart cards), readers/ writers for ticket status and passenger control, back office computers and a central clearing house to gather revenue data and performance reports.

Modern AFC systems are able to calculate the best price for the user, depending on the trip length, previous journeys and/ or any applicable discounts (e.g. student pass). AFC can therefore bring value added to end-users and the transport authorities. According to Blythe (2004), the way transport fees are collected, i.e. if it is transparent for the users, is one of the most important factors for the customers satisfaction. A key barrier for multimodal travel is "a lack of information and motivation, and incorrect perceptions of the alternatives to the car" (Brög, Erl, Ker, Ryle, & Wall, 2009). People that are unfamiliar with public transport usage, especially those that use public transport only occasionally, as well as frequent users travelling to unfamiliar areas, need a sales system that is clear and easy to understand; modern AFC system might be able to provide. Transport operating companies profit from AFC systems because financial transactions are automated and thus secure revenues; furthermore the collected data brings accurate information on passenger flows that can be used for planning purposes (Trépanier, Tranchant, & Chapleau, 2007).

The long term objective of AFC is to provide a system that does not need any passengers' action. In this context, different technologies can be distinguished:

- *Check-in/ Check-out:* (also called Tap-In/ Tap-Out or Touch-In/ Touch-Out) The check-in/ check-out process requires customers to hold their smart card (or mobile phone) in front of a reader when entering a vehicle to check-in, and by the end of the journey customers need to check-out again. The system calculates the fees which are then automatically charged to the customer's account. In other words, passengers need to actively scan their tickets into the system. It is also possible to correct trip matrices based on current data. This means, if a customer makes the same trip frequently and a monthly pass would have been cheaper for, the system calculates new values based on this data (Siemens AG, 2012).
- *Be-in/ Be-out:* The be-in/ be-out principle no longer requires the passenger to actively register at specific access control points as the system automatically detects and registers the presence of a smart card (or other fare media) in a vehicle. The system automatically captures the smart card when entering or exiting a transport mode and also periodically during the trip. The system automatically calculates the most favourable fare, also according to the class travelled. Customers pay afterwards, e.g. on a monthly basis (Siemens AG, 2012).
- *Walk-in/Walk-out:* The walk-in/ walk-out principle works similar to be-in/ be-out as no action is required from the passenger. The difference is only a technical, as the systems registers and detects the smart card while walking through the doors of the vehicle (GWT-TUD GmbH, 2009).

Basically three subsequent generations of AFC fare media co-exist, not only in different regions of the world, but sometimes also in the same city (Mezghani, 2008). In the 1970s there was the contact based smart card (or magnetic stripe card), that enabled automated data reading for the first time, then contactless smart cards were introduced. Those are replacing magnetic stripe cards fast and the most recent technological step forward is mobile ticketing, based on the use of the passengers mobile phones (see chapter 3).

2.2. E-ticketing

Electronic ticketing is a form of electronic commerce for different kinds of tickets, e.g. for public transport or for long-distance travel by train or airplane, but also for touristic sites or leisure events.

Main characteristic is that tickets are sold and stored in an electronic device, such as smart cards or mobile phones (Haneberg, 2008). Magnetic stripe cards are already electronic, even though technologically simple and cheap to produce. However, they are easy to copy and only able to save very little information. Electronic memory chips render to store money on the card, but once the value stored on the card is spent, they cannot be re-programmed and are thus not suitable for further usage. Cards equipped with a microprocessor on a card can be re-programmed. However, nowadays most applications are heading towards contactless systems (Bak & Borkowski, 2010).

For many years, public transport operators are trying to replace paper-based tickets by electronic media (Stroh, Schneiderbauer, Amling, & Kreft, 2007) and many countries have implemented or are about to introduce e-ticketing systems. According to the online encyclopaedia Wikipedia[1], 26 countries in Europe operate smart card ticketing systems; some of them nationwide, but most countries have at least an e-ticketing system in their capital. Many of the schemes listed in Wikipedia have only recently been launched („List of smart cards", n.d.). The different applications differ in technological and economical design. However, regardless of these national projects, e-ticketing has not yet been implemented on a wider scale in Europe. According to Stroh et al. (2007) the pending situation in Europe has several reasons. Besides financial issues, complexity and technology issues have so far hindered wide scale implementation. The complexity of national or even Europe-wide e-ticketing system with a large number of stakeholders with partly diverging interests is difficult to govern in federal systems. Those schemes that have been set up successfully (e.g. London or Hong Kong) had different starting positions that are not necessarily transferable to other parts of the world. In London and Hong Kong for example, gated stations were already installed which reduced initial investments. Moreover the different requirements of rural and urban areas and the resulting structural differences make overall solutions complicated. The authors argue that "applicable technologies have been advancing faster than the typical decision cycles (...) continuously causing decision stages lagging behind actual technology developments." (Stroh, Schneiderbauer, Amling, & Kreft, 2007:4). Huomo (2009) distinguishes five different business models for public transport e-ticketing:

- *Prepaid-value model:* The prepaid value model is currently the most common form of automated ticketing. The ticket is issued by a transport operator and based on the value stored on a card (value can be in form of eCash, number of rides, time-based).
- *Enhanced payment card:* The enhanced payment card is a contactless credit or debit card or a payment application on an NFC phone which is used to pay the fares. This application is provided by an intermediary, usually a financial institution. The user presents the card to a reader and the payment transaction is processed based on the public transport operators fare structure.
- *Post-paid model:* The post-paid model is based on smart cards or NFC enabled phones. The applicable fares are billed afterwards, according to the recorded usage. Therefore user identification and location data is needed.
- *Combined/ enhanced collaborative models:* In the collaborative model a smart card or phone incorporates multiple applications (e.g. transit and payment). The transit application can be prepaid or post-paid (see above), whereas the payment function usually works as a credit or debit card.
- *Embedded secure element/ (U)SIM:* In this model, an intermediary, usually a trusted service manager (e.g. a financial institution), or a mobile network operator, or a handset manufacturer determines the business rules. This can be the case for all the business models mentioned

[1] As smart card ticketing is constantly and fast evolving in public transport, Wikipedia seems to provide the most up-to-date data in this field.

above. According to the International Association of Public Transport, (2007), "fare systems may become managed by owners of the ticketing application rather than issuers of the electronic media".

For a STOA report on eco-efficient transport futures in Europe, an online survey with 14 stakeholders from the transport industry was conducted. The survey included questions on the feasibility and desirability of an interoperable electronic ticketing application for public transport that will enable users to use the same means of payment for different modes and services (including conventional public transport and e.g. bike-sharing and car-sharing). The results show that most of the stakeholders believe that this development will come true before 2030. Uncoordinated institutional action is seen by the majority as a factor to impede a roll-out. But also lack of political and entrepreneurial vision or ongoing technical problems are mentioned as barriers for the development. There is a very high degree in desirability; the vast majority find it desirable or very desirable that such a system becomes reality. There are no negative impacts seen in the development of integrated ticketing, but many positive impacts. Among the most mentioned positive outcomes are the accessibility of the transport system, reduction of congestion levels and a modal shift towards more resource-efficient transport modes (STOA, 2013). Additionally to this survey, 40 European scientists in the field of transport have been asked the same questions. The results have not yet been published, but as a first tendency it can be concluded that nearly half of the interviewees expect the development to be realized before 2030. A majority sees uncoordinated political action as the main impeding factor. Other than the stakeholders, none of the experts say it is not desirable to have such a system. In the questionnaire, the thesis on integrated ticketing showed up as the thesis with the highest degree in desirability. Most of the experts see positive impacts on the accessibility of the transport system.

In fact, a lack of interoperability, and thus in a broader sense uncoordinated institutional action is seen as a main barrier for cross-border services. Compared to the stakeholders, the scientists assess the desirability higher, but are more sceptical about the feasibility (STOA; 2013).

2.2.1. Interoperability

As outlined above, many local smart ticketing schemes already exist. The next step forward is to combine existing schemes to create national solutions to finally come to cross-border interoperability (Howell, 2013). Obviously, there are difficulties in agreeing on common standards, especially in countries that have already agreed on and invested in specific standards. But also in Asia, where the largest e-ticketing schemes exist, there is no true interoperability between neighbouring territories or networks (de Chantérac, 2009). Similar problems account for the tourism market. In order to take advantage of the many technologies that exist for e-tourism (search for information, booking or personalized packages), interoperability of the products is necessary. Until today there is no real interoperability for touristic e-services, resulting in high deployment costs and a lack in flexibility (TOURISMlink Consortium, 2012). For the public transport sector many national ticketing organisations are already working on interoperable solutions. Leading ticketing organisations in this field are ITSO from the UK, AFIMB from France, VDV-KA from Germany as well as the Calypso Network Association. The different schemes are, in principle, able to cooperate, but direct interaction and mutual acceptance is currently not possible, as most of them have not been developed with the aim of greater regional interoperability (International Association of Public Transport, 2007). Various initiatives have been launched to stimulate inter-issuer interoperability in Europe for not ending up in a fragmented market. The best known is probably the European Interoperable Fare Management Project (EU-IFM). The project consisted of the respective ticketing organisations from the UK, France and Germany, the Calypso Network and the UITP. The aim was to develop standards that ensure step-by-step progress towards cross-border interoperability. Additionally the project developed specific guidelines on Privacy and Trust Schemes and Back Office data needs. The difficulty of

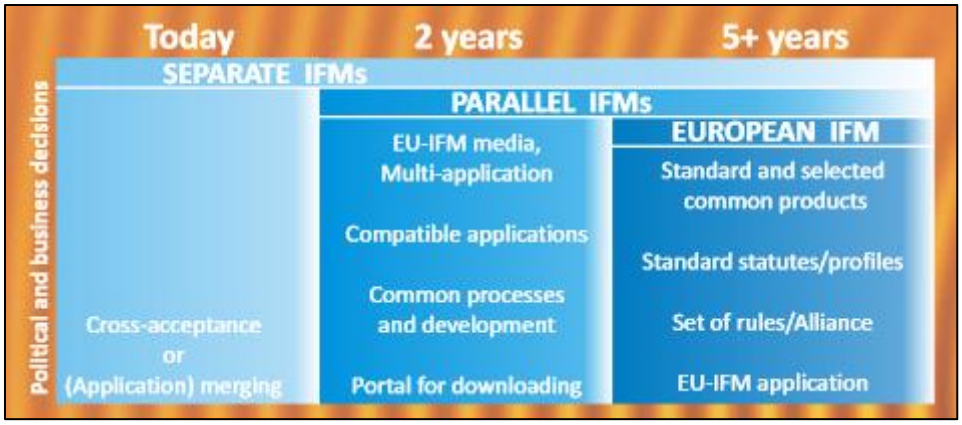
absolute interoperability lies in the fact that interoperability is often interpreted as agreeing on identical commercial structures. Though, the world of public transport, as well as the tourism sector is characterized by local solutions and their specific frameworks and circumstances, which make agreements on, e.g. fare structures, often impossible. For this reason the EU-IFM Project did not seek to deliver standardisation in the sense to develop one e-ticketing system for Europe, but to ensure compatibility across Europe. Compatibility respects the independence of commercial policies of different authorities and operators but permit all forms of cooperation.

This means that customers should be enabled to download an application onto their preferred (and compatible) media (smart card or mobile phone), which can be recognised in all participating countries. When travelling abroad, users would be able to use that media and buy a transit pass for the duration of the stay. The fare media does know the status of its owner, e.g. if he is older than 60 years, if he is a student or disabled. If special prices are available for this user group, the owner would be able to benefit from them automatically (de Chantérac, 2009). In that sense, interoperability in e-ticketing for public transport "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." (Urban ITS Expert Group, 2013:3).

In February 2012, the Smart Ticketing Alliance was established, consisting of the organisations ITSO (UK), Calypso Networks Association and VDV –KA (Germany), AFIMB (France) and under the umbrella of UITP. They strongly invite other organisations to join the alliance. The Smart Ticketing Alliance is in the position to lead the way towards certification processes that all transport operators, mobile operators and financial service providers can trust. It also needs to be resolved urgently how new specifications of smart ticketing applications could look like that can be loaded onto a specific mobile phone. In short, the smart ticketing alliance' aim is to create a platform for cooperation on establishing a trust schemes, specifications and certification (EU IFM Alliance, 2012).

It has already been shown that it is technically possible to adapt applications and download them onto multi-application cards/ mediums. According to the ticketing alliance the EU-IFM media is ready to be issued, but concrete developments depend on further EU funding. A next step would be to develop a generic EU IFM-Application for standardised products (e.g. day pass or single ticket) that can be downloaded from an internet portal. A further step could be to include the customers status (e.g. age, address, profile) to allow special fares, just as outlined in the vision above. The idea of the alliance is that local operators and authorities that are willing to support the interoperable scheme locally, migrate to the next technical level at their own pace (International Association of Public Transport (UITP), 2010).

Figure 1: Roadmap to interoperability



Source: International Association of Public Transport (UITP), 2010.

At the STOA workshop on Integrated Ticketing on the 16th of October Mr. Ringqvist compared that undertaking with the mobile phone sector, where roaming is available all over Europe, meaning that one and the same phone can be used in different countries and networks, because operators agreed on how to trust each other. Mr. Ringqvist further presented two solutions to bring forward the idea of compatibility, as proposed by the EU-IFM project (Ollier & Ringqvist, 2013). First, cooperation on global standards is needed that are borne jointly by EMV, NFC and ID-based platforms. A new implementation specification for smart ticketing is planned to be issued in 2013. It will refer to the management of smart ticketing for multi-application devices, such as mobile phones and will be closely in line with the Implementation Specification for contactless bank cards (Urban ITS Expert Group, 2013b). Second, the information from many sources needs to be linked together. Both solutions together could be a major step forward to enable users to choose their preferred fare media. However, it is not yet apparent how quick they will reach a reasonable amount of supporters. Verity (2013), ITSO chief advisor, expects that there will be 10 to 12 member countries by the end of 2013.

Another solution that UITP follows is the idea of ´open data`. However, various terms exist to express more or less the same idea[2]: that certain data should be freely available to everyone and that this data is reusable, accessible, intelligible and assessable (Hester, 2014; Boulton, 2012). A challenge inherent to the idea of open data is to find a balance between trust and confidence on the one hand and a free and open creativity culture on the other. In general it can be said that there is a conflict between the non-commercial nature of ´open ideas` and the fact that companies invest resources to develop business models. In other words, it is difficult for companies to make revenues if data is available to everyone. In the case of public transport, static data is not sufficient, it rather needs to be based on real-time information (exact position of a vehicle) in order to gain the maximum benefit. However, this involves huge amount of data that needs to be handled in a meaningful way. In the case of e-ticketing there is an overall consensus that further cooperation with other stakeholders, also public private partnerships, are needed in order to bring the idea forward (European Commission, 2013b).

2.2.2. Multi-service approach

Apart from its core application in the transport sector, e-ticketing could be extended to other areas, such as tourism and leisure activities, library services, retail discounts or payment functionalities. That way, users of the e-ticket could make use of a service package that promises greater flexibility and convenience. The Urban ITS Expert Group on Smart Ticketing identified multi-service approaches as a

[2] Open source, open space, free data, open movement etc.

trend in the ticketing environment. The integration of payment functionalities appears to be a key success factor for the largest systems in Asia. In order to offer customers additional services on one and the same media, transport providers are required to provide an e-money scheme or EMV technology (see chapter 3.2.4) to provide further payment functionalities to their customers. The UK transport sector, however, has tried out similar functionalities without significant take-up rates (Turner & Wilson, 2010). According to a report commissioned by the UK Department for Transport, main barrier for the integration of transport services into e-money schemes is, that there is yet no market leader in the e-money market, not within the public transport market, nor within other markets that could provide low cost infrastructure for card value-load or transaction clearing (MVA Consultancy, 2008).

In an effort to encourage the uptake of electronic means of payment across Europe, the European Parliament has reformed the rules of governing e-money in the EU. The threshold required to start up an e-money institution is now significantly lower than before and restrictions on mixed-businesses have been removed so that e-money issuers can also offer other services and new companies can access the market. The aim of this Directive was to facilitate the issuing of e-money for others than just financial service providers, such as public transport operators, telecommunication operators or retailers (European Parliament, 2009). And indeed, an uptake of e-commerce through the internet and the ownership of smartphones have taken place since then, also affecting the public transport sector. Though, the market is described as largely fragmented along national borders with some international players from outside Europe. Apple and Google for example announced major interests in entering the m-payment market (European Commission, 2012b).

However, according to the urban ITS Expert Group, one of the major advantages of smart ticketing should certainly be to propose complementary services, other than transport payment services. They emphasize that smart ticketing does not necessarily mean to have one ticket for one journey, "but one wallet with several tickets (which can easily be bought) and in the future possibly one wallet for several services" (Urban ITS Expert Group, 2013:8). Integrating other services, such as the possibility to enter a museum with that ticket, represents the most advanced level of integration. So called "destination cards" are an illustration of the integration of public transport and touristic opportunities (see chapter 0). The expert group further emphasizes that the complexity of such undertakings should not be underestimated, especially the back-office processes and high-level support that would be necessary.

3. TECHNICAL PERSPECTIVE ON E- TICKETING

This chapter will give a brief overview on the technical details, i.e. on the necessary hard- and software used in ticketing media. Table 1 at the end of this chapter will provide an overview of the different network technologies, their conditions for usage, security features and smartphone compatibility.

3.1. Fare media

3.1.1. Smart cards

Smart cards are not at all a new invention. The idea of combining plastic cards with microchips has been patented in 1968, first larger scale trials were made in the 1980s. In 1992 French financial institutions replaced their magnetic stripe cards with smart cards to reduce fraud (Shelfer & Procaccino, 2002). Today smart cards are being used in many sectors: health care, banking, government, human resources and transportation. Cards are used to store information, such as transportation fares, banking data, or other individual data (Pelletier, Trépanier, & Morency, 2011). However, public transport is one of the main fields of application. After the successful introduction of large-scale electronic ticketing schemes in Asia (Hong Kong and Seoul), also some small-scale demonstration trials in Europe started. However, these European applications were rather pushed forward by authorities (technology push), which created costly failures (Blythe, 2004). Until today smart cards (making use of RFID technology) are still the most common form of e-ticketing.

Smart cards have a portable size of a credit card; they are technologically simple and relatively cheap to produce. The embedded microchip stores, processes, and writes data in a secure environment. The card holders details and additional services and applications can be stored on the card (Blythe, 2004). A smart card with a memory chip (but without microprocessor) incorporated has the facility to store value on the card, but is not re-programmable (Bak & Borkowski, 2010). However, different forms of smart cards exist. The Smart Card Alliance (2011) differentiates between reloadable and non-reloadable smart cards. The latter are usually purpose-specific and are not being processed through a bank network. They are in effect "a medium for converting cash into an electronic transaction" (Smart Card Alliance, 2011). Reloadable smart cards are usually issued by financial institutions, but are easier to obtain than credit or debit cards. Only a simple identification is needed for registration. These cards are usually open for other applications. They can be obtained from convenient retail locations, from self-service kiosks, via phone, or via a web site; there is no necessity to visit a bank. Despite the fact that there are even more types of cards (the prepaid card industry is highly segmented), the two types introduced above are the most common products (Smart Card Alliance, 2011).

Two possibilities exist of how a smart card communicates with other devices: contact-based or contactless:

- *Contact-based smart cards:* Contact based smart cards have a chip embedded into the plastic card. Only the surface of the chip is not covered as it needs to be brought into contact with a reader (such as telephone cards or bankcards). Most contact-based smart cards are covered by ISO/IEC781.
- *Contactless smart cards:* Contactless smart cards contain a chip completely embedded into plastic. The card needs to be placed in close proximity (about 10 cm) to the reading device to start the communication process with the reader. This is done by high-frequency waves similar to RFID. The energy needed for this process is provided by an electromagnetic field generated by the reader (Pelletier u. a., 2011). More recently, also public transport agencies are considering to accept contactless bank cards to make usage more convenient for the user

(Smart Card Alliance, 2011). For most contactless smart cards several standards apply, most contactless smart cards comply with the ISO/ IEC14443 standard, but also ISO/ IEC15693 vicinity card, Felica ISO/IEC15408 EAL4; and NFC ISO/IEC18092 standards are used.

3.1.2. Mobile ticketing

In mobile ticketing applications, the mobile phone is used as an electronic version of a ticket. The ubiquitous use of mobile phones and the internet has changed the way users buy products and services. The European Central Bank (2010) expects mobile commerce to become increasingly popular. This development is also relevant for public transport ticketing. Mobile ticketing is a service offering passengers to receive textual or graphical content on their mobile device. Main applications are mobile check-in and boarding passes, event ticketing, consumer discounts and transport ticketing. Mobile ticketing is basically a virtual ticket that is held on mobile phones, tablets or personal digital assistants (PDAs) and can be ordered and obtained from any location. However, mobile ticketing is still in its early stage (AECOM, 2011). Ticket issuers and public transport operators could benefit from reduced production and distribution costs. Users could benefit from greater convenience and flexibility. Basically three different possibilities for mobile ticketing exist:

- *Premium SMS based transactional payments:* Users send their request using short messages (SMS) and pay their fare with the next phone bill
- *Optical character recognition (OCR):* Users receive an image that functions as a code (e.g. 2D barcode) that contains all required information (see chapter 3.2.1).
- *Contactless Near Field Communication*: The process is similar to OCR, but the information is instead stored in the NFC memory of the phone. That way, many different tickets can be stored on a single phone; also related to different services (see chapter 3.2.3).

3.2. Identification technologies

3.2.1. Optical Character Recognition (OCR)

Optical Character Recognition (OCR) is the electronic conversion of scanned images, such as 1-dimensional barcodes or QR codes (but also scanned documents, PDF files or images) into machine readable characters. Original sources, e.g. receipts, tickets or other forms of printed records can be captured by a digital camera and converted into editable and searchable data (United Nations Economic and Social Commission for Asia and the Pacific, n.d.).

A barcode is the visual representation of information that can be read and understood by computers. 1 dimensional (1-D) barcodes consist of vertical bars and spaces that contain information only in the horizontal direction; data that can be stored in one barcode is thus limited (see Denso ADC, 2011). They can be used to track objects and persons; this way barcode tickets allow their holders to enter sport arenas, theatres and cinemas or public transport. However, demand grew and more data storage capacities were required. Therefore, 2-dimensional barcodes have been developed.

Figure 2: 1-dimensional barcode

Source: Denso ADC, 2011.

QR Codes (Quick Response Codes) are one form of a 2 dimensional (2-D) matrix code that is composed of small, symmetrical elements arranged in a square or rectangle containing information in the horizontal and vertical direction. QR codes are usually attached to an item and entails information related to this item. They are accepted in diverse industries, such as manufacturing and warehousing, logistics, healthcare, tourism or transportation. Especially with the increasing use of smartphones, QR codes are used for mobile marketing and location based services; they are increasingly printed on signs, billboards, posters, business cards, clothing or other items. By using the camera of a mobile phone the QR code can be scanned and the phone then automatically accesses the Internet by reading the URL encoded in the QR code. Users are then connected to a relevant web page and receive targeted marketing (Denso ADC, 2011). It can be used for location-based services (e.g. on timetables in subways to find out arrival times of the next transport means) or for e-payment using a mobile phone and QR code printed on tickets (Soon, 2008).

Figure 3: QR code

Source: Denso ADC, 2011.

3.2.2. Radio Frequency Identification (RFID)

The function of Radio Frequency Identification (RFID) is basically the same as for barcodes, but with the important difference that RFID tags can, other than barcodes, process data or communicate with other RFID tags and are thereby compatible with existing contactless smart card infrastructure. The systems consists of a reader that can wirelessly read and write data in real-time to a RFID tag. These tags include an integrated circuit that usually stores a static number (ID), and an antenna to transmit the data to the reader using radio waves. Initially, RFID applications were used to process and track the flow of goods, e.g. in the retail sector, supply chain management and warehouse management, logistics and manufacturing. But also the tourism sector can profit from RFID applications, e.g. several museums have already implemented RFID to inform their users about the exhibited pieces, hotels offer keyless entry, or casino chips are tagged with RFID (Öztayşi, Baysan, & Akpinar, 2009). There is only very little security during the communication with the reader. Typically RFID tags can be read from distances of several centimetres to several meters (Smart Card Alliance, 2009). For the purpose of transport ticketing, a reader will be informed about the passengers' departure and destination. The tags are usually attached to smart cards carried by the passengers. This allows passengers to be charged automatically, according to the zones or the time they have travelled (depending on the tariff structure) (Hasan, Tangim, Islam, Khandokar, & Alam, 2010).

However, the very high one-time investments and ongoing operating costs for the technology infrastructure (check-in/ check-out devices at stations and in vehicles, smart cards, back-end systems and communication infrastructure) have so far hindered a wide scale implementation of e-ticketing solutions (Stroh et al., 2007).

3.2.3. Near-Field Communication (NFC)

Near-Field Communication (NFC) is basically an advancement of RFID technology, also enabling short-range communication between electronic devices. By bringing two NFC capable devices together, they automatically start communicating. It is often possible to use existing infrastructure,

because NFC is capable to emulate RFID readers and tags. Credit cards could for example be integrated into an NFC tag in a mobile phone and used by a contactless credit card reader over NFC (VTT Technical Research Centre of Finland, 2009). According to Fischer (2009) the most obvious application for NFC is the electronic wallet. NFC could integrate several independent payment services, such as credit, debit, access or loyalty cards on a single device, possibly the mobile phone.

Compared to other technologies, NFC has the advantage of having fast and automated connections, it has good user experiences and it has very fast set up times (see e.g. Madlmayr & Scharinger, 2010; Dubey, Giri, Sahare, & Dubey, 2011). The focus of NFC is rather on interaction than on identification (Pesonen & Horster, 2012).

Because the user does not need to configure the setup, this technology is said to be intuitive, while the short transmission ranges provide security, which makes it appropriate for payment and financial applications (Mezghani, 2008). One of the most important drivers for NFC has been the mobile phone industry; where many manufacturers claim to or are already integrating NFC tags into their devices (Chaumette, Dubernet, Ouoba, Siira, & Tuikka, 2011). Also network operators claim to support or implement NFC technology, according to Berry (2012), 45 operators have already signed up to do so. The NFC chip can either be embedded into the hardware shell of a mobile phone or it can become an integral part of the SIM card.

Possible applications of NFC are all forms of electronic ticketing, but also for micro payments or smart posters. Ticketing is said to be one of the "killer applications" of NFC, since it can simulate to be a smart card and is thus compatible with the contactless card standards. Several public transport operators around the globe have launched pilot projects with NFC compatible technologies. Public transport is supposed to have the highest adaptation rates for NFC. According to Stroh et al. (2007), initial investments for the e-ticketing infrastructure could be reduced by 75-80% compared to smart card technology. Main reason for the cost savings are that users would no longer need to actively check-in (e.g. by holding a card onto a reader); instead public transport devices automatically determine the active NFC mobile phones that passengers are carrying with them (be-in/ be-out). Gate systems could be replaced by low-cost RFID tags at stops or in vehicles. The installation of cost intensive hardware could be outsourced to the passenger, or their mobile phones respectively. Data is then transmitted through the already existing infrastructure of telecommunications operators (Stroh et al., 2007). However, depending on the system, users need to have their phone switched-on (as a flat battery would exclude them from usage). However, diverse business and co-operation models are seen as major restraints by the public transport industry (VTT Technical Research Centre of Finland, 2009).

3.2.4. EMV technology

EMV is the acronym for Europay, MasterCard and Visa; those companies initiated the development in 1994. It is a global standard for credit and debit payment cards, including card accepting devices (e.g. ATMs). In the second quarter of 2012, there were 1.55 billion EMV compliant chip based cards in use worldwide. The EMV specification was created to foster global interoperability for chip based payments. Members now include Visa, MasterCard, Japan-based JCP, and American Express, Discover and Union Pay.

Until today, the EMV standard can be used for electronic payment, but does not cover the back office infrastructure that would be necessary for smart ticketing schemes or to store entitlement to travel (such as weekly passes). The difficulty for EMV lies in the specific circumstances of urban transport fare collection; these are different from other contactless transactions. First, the ticket price is often not known before the journey is completed. Second, there is usually no PIN pad and third, the throughput needs set a maximum of 500 ms (Burden, n. d.).

Table 1: Network technologies overview

Network technologies overview							
Technology	**Type**	**Description**	**Multi-application possible**	**Security**	**Check-in/ check-out compatible**	**Be-in/ be-out compatible**	**Smartphone compatible**
OCR	1D-barcode	Horizontal barcode	☐	Security relies on back office system, no user data is stored on barcode	☐	☐	☐
	QR code	2D matrix barcode	☐	Security relies on back office system, no user data is stored on barcode	☐	☐	✓
Smart card	Magnetic or gold plated chip card	Contact-based	☐	Data is often not encrypted, security relies on back office system.	✓	☐	☐
	RFID	Radio frequency enabled chip card	✓	Data is encrypted and stored in a "secure element"	✓	☐	☐
NFC	Active (phone needs to be switched on)	NFC chip actively communicates with a tag or a reader	✓	Same security standards as RFID; additional PIN is possible; data is stored in "secure elements" for each NFC application	✓	✓	✓
	Passive	NFC chip acts as passive RFID tag	✓	Data is encrypted and stored in a "secure element"	☐	☐	✓

4. CASE STUDIES

As already outlined, different types of e-ticketing exist. The most prominent schemes have their origin in public transport; and of those the most extensive schemes are domiciled in Asia. This has several reasons and most of them are not transferrable to the European context. Several factors have come together that facilitated the implementation in Asia. First, the population density and a high demand potential for public transport services must certainly be mentioned. Second, the public transport networks are often characterised by a strong market segmentation (privately owned and publicly owned operators). Third, public transport operators are often part of large and diversified consortia that are, besides public transport, involved in real estate, communication and entertainment, retail, travel agency and international travel, as well as hotels (making multi-service offers more feasible to realise). Fourth, cooperation is rather partial instead of being organised in large transport associations. Fifth, ticket gates had already been installed; and last, the young urban Asian population has the reputation of being rather tech-savvy (Retzmann, 2011). However, not only Asian systems enjoy the status of being exemplary. The Oyster card scheme in London and the OV-chipkaart in the Netherlands as well are often referred to as being excellent, though they can also not easily be transferred to other contexts. The business case for the Oyster card in London was driven by the replacement of magnetic stripe cards; ticket gates were already available which lowered initial investments. Additionally, solutions that are primarily focused on metropolitan areas (like in London or Hong Kong) do not need to meet the same criteria as national or even transnational solutions with their urban and regional networks. The introduction of the nation-wide OV-chipkaart scheme in the Netherlands was possible because a hybrid system with open and closed elements was applied. The scheme was largely policy-driven, especially by emphasizing the overall economic benefit for the country and by providing dedicated funding. Moreover, the national rail operator took a leading role in the process (Stroh et al., 2007).

In the following, a number of different case studies will be presented in more detail. Basically, they can be categorised into different types of schemes. The first category belongs to schemes that are primarily driven by public transport, usually allowing visitors from outside to use them. They do not necessarily have a direct link to the tourism sector (as e.g. reduced entrance fees at museums), but they have been chosen because they are either forerunners in the system's technology or they are characterised by special features that could potentially be interesting or relevant for the tourism sector. Chapter 4.1 to chapter 4.7 belong to this category. Another type of schemes is directly linked to tourism and can be described as 'destination cards'. It is important to note that all major tourist destinations have a sort of destination card (or 'welcome card', see chapter 0), which are not essentially different from each other and that often entail free public transport usage. The description of the iAmsterdam scheme and the Saint Petersburg City Card are therefore exemplary for other systems that exist in many places. Solely CityZi (chapter 4.8) is enhanced by the fact that it has been set up as an NFC application and not primarily as a marketing tool. As a last type of e-ticketing schemes, a so called local authority card will be presented. This type is also interesting for both public transport and the tourism sector as they aim to appeal to a certain target group (such as elderly people) and combine different services and products on a single card (see chapter 4.12).

4.1. Oyster Card

Table 2: General overview Oyster card

General Overview „Oyster Pay As You Go “	
Name of the system	Oyster
Located in	London, United Kingdom
Website	www.oystercard.com
System technology	Contactless smart card using MIFARE technology
Payment system	Stored value smart card, possibility to link card to bank account for "auto top up"
Scope of application	Public transportation
Number of users	Approximately 43 million cards issued in 2012
Main stakeholders	Public-private partnership project on behalf of Transport for London and the Department for Transport and operated by EDS and Cubic Transportations, ICL and WS Atkins (TranSys consortium)
Funding	n. a.
Scope of integration in transport	London Bus, London Underground, London Overground, DLR, Tramlink, London River Services (limited), National Rail (except high speed trains)
Scope of integration in tourism	Visitor Oyster cards available

4.1.1. Background

London is the most populous city in Europe. It has today 8.17 million residents and the population is forecast to exceed nine million by 2021 with the biggest rise in the 65 plus age group. Yet, today London’s population is younger than the rest of the UK with nearly two thirds being younger than 44 (London Councils, 2012). According to comScore, smartphone penetration rate in the UK is slightly above average with 64% (comScore, 2013). London is an integral part of the UK transport network with two-thirds of all rail journeys either starting or ending in London and around 6.3 million bus journeys per day (Department for Transport, 2009). Public transport in London is mainly organized and managed by “Transport for London” (TfL). TfL was created in 2000 as an integrated body responsible for all transport issues in London, for public transport, road based transport, cycling and walking, for managing the congestion charge and regulating the taxis (Transport for London, n.d.). The London transport network is unbundled, consisting of privately and publicly owned operators. Bidders for providing transport can submit bids on any number of routes within the network. TfL ensures that the execution of contracts is properly made and benchmarks private operators with their public competitors (Amaral, Saussier, & Yvrande-Billon, 2009).

There had been some experimentation with smart card ticketing in the UK in the mid 1990s that ended-up with costly failures. The trials indeed showed that smart card schemes could offer the benefit of offering a ticket that is flexible and interoperable, but that stakeholder cooperation is of utmost importance and that binding specifications are needed. Therefore and for not ending up in a fragmented market for smart card ticketing, the Integrated Smart-card Organisation (ITSO) was formed in 1999. However, the development of the ITSO specification has taken longer than expected and hold back a large roll-out of smart cards in the UK, and the pan-London smart card schemes contract was signed before the formation of ITSO. The Oyster card was launched without being ITSO compatible (Blythe, 2004). The Department for Transport has committed around 60 million pounds to

enable the Oyster network to read ITSO smart cards for establishing ITSO as a national specification (Department for Transport, 2009).

In a field trial around 80.000 tube and bus staff had tried out the technology before it was introduced in 2003. The system has been designed, developed and managed by TranSys, a consortium of EDS, Cubic Transportation Systems, ICL and WS Atkins on behalf of Transport for London and the Department or Transport. The project was developed as a public-private partnership project. The consortium has installed new ticket gates, new touch-screen ticket machines, new bus ticket machines and has upgraded the ticket machine facilities at underground stations („Contactless card trials underway in London", 2003). The Oyster card was a success story from the beginning on: more than 3000 applicants registered for the card on the first weekend alone („London's Oyster card goes public…", 2003).

Smart card ticketing is available in a number of UK cities and regions with London's Oyster card being by far the most successful card scheme. Most of the existing schemes are incompatible with each other (Turner & Wilson, 2010). However, the governments vision is to extend e-ticketing across the country and to potentially use mobile phones or contactless bank cards instead of smart cards (Department for Transport, 2009). Touristic Background

4.1.2. Tourism

According to the Flash Eurobarometer on attitudes towards tourism (European Commission, 2013a), the UK is mentioned in seventh place to be a popular destination for future holidays. It is more likely that most of the travelers are going to or at least passing by London during their trip to the UK. In 2011, a total of 26.3 million domestic and overseas tourists had been attracted by the city of London; international tourists stay on average six days in the city, while a typical domestic visitor stayed 2.4 days (London & Partners, n.d.). London is a vibrant city and a leading destination with many places of interest, such as museums, galleries, nightlife, shops and markets.

London visitors have the possibility to obtain a destination card, called London Pass that combines more than 50 attractions, such as the Tower of London, St. Pauls Cathedral or the Shakespeare's Globe Theater, where the pass enables the holder to skip the line. Additionally, the pass and provides discounts at many restaurants, shops and entertainment options. The London Pass is issued by European Cities Marketing, an organization promoting and linking the interests of more than 100 member cities. European Cities Marketing offers similar products for around 40 destinations in Europe (European Cities Marketing, n.d.).

The London Pass has yet not included public transport. Tourists have the possibility to either buy a paper based travelcard (valid for a 24 hours or 7 days for unlimited travel) or to obtain a visitor Oyster card for getting around. Visitor Oyster cards are plastic smart cards for pay-as-you-go travel and are the cheapest way to buy single journeys. They can be reused and do not expire (Transport for London, n.d.). However, a stakeholder consultation conducted by the Department for Transport revealed that it could be an decisive benefit to generate tourism applications to the Oyster card (Department for Transport, 2009).

A visitor survey commissioned by the London Development Agency revealed that London tourists are generally extremely satisfied with public transport. They use it intensively, nearly all of the visitors used public transport at least once during their stay. However, respondents of the survey mentioned that less expensive transport would make their visit more enjoyable. The mostly used ticket was the one-day travelcard (54%), followed by Oyster Pay As You GO (17%), visitor Oyster cards (5%) and only 2% paid cash. Generally, travel cards and Oystercards were well known among the respondents, the Pay As You Go scheme were not so well known, though (Ruggles-Brise, 2009).

4.1.3. System characteristics

For using Oyster cards, passengers need to touch their smart card on a reader at ticket gates at the start and end of their journey. It is applicable for everyone, whether living or just visiting London. Oyster smart cards can be obtained online, at ticket offices and at London Information Centres for a deposit of 5 pounds (Transport for London, 2012). The Oyster scheme operates across the London Underground network, London buses, several boats and light rail services, as well as some national rail services that start or end their journey in London. The Oyster card can store pre-purchased tickets (including weekly or monthly passes) and single fares (that are cheaper than single cash fares). An online auto top-up option that is linked to ones bank account ensures that credit never drops below a specified amount. Since February 2005 a capping system ensures that users will never be charged more than the best combination of single tickets, return tickets and travelcards would have allowed that day. This feature has resulted in 300% increase of Oyster usage (from Feb. 2005 – Feb. 2006), but for the same period the sales of single and return paper tickets have dropped, resulting in an overall decline of ticket sales. After the roll out of the Oyster scheme around 98% of the passengers rated the scheme as "like" or "strongly like" in a monthly passenger survey (Department for Transport, 2009).

In 2007/2008 TfL and O_2 ran a six month trial with Oyster products stored on an NFC enabled phone which proofed to be a success from the customers point of view. For this project O_2 partnered with AEG, Barclaycard, Nokia and TfL (Turner & Wilson, 2010). However, the online magazine Techworld cites the head of business development for fares and ticketing at TfL, Mr. Matthew Hudson, that he is not convinced about NFC and mobile phones because too many stakeholders would fight for their share of revenues (Curtis, 2013).

In conjunction with Barclay card, TfL developed the so called OnePulse card. OnePulse was developed as a three-in-one credit card that functions as a normal credit card, additionally containing an integrated Oyster functionality and contactless payment functions. For regular Visa transaction a PIN is required, whereas Oyster functionality doesn't need further authorization. However, the card doesn't seem to be available to new customers anymore. The website automatically redirects to a page for existing customers, without any further comments.

More than seven million cards are used regularly in London, each week 57 million journeys are made using Oyster and more than 80% of all bus and tube payments are with Oyster (Transport for London, 2012).

4.2. Mi Muovo

Table 3: General overview Mi Muovo

General Overview „Mi Muovo “	
Name of the system	Mi Muovo
Located in	Emilia Romagna region, Italy
Website	http://mobilita.regione.emilia-romagna.it/mi-muovo-1
System technology	Contactless smart card technology with microchip
Payment system	Season tickets (annual and monthly)
Scope of application	Public transportation
Number of users	More than 200.000 cards have been issued
Main stakeholders	Emilia Romagna region, local authorities, local mobility agencies, regional LPT bus service operators, and rail operator (Trenitalia, Tper)
Funding	Share of regional funding amounted 50% and 50% local public transport companies
Scope of integration in transport	Urban and suburban busses, local and regional trains, bike sharing, car sharing, electric recharging of e-vehicles
Scope of integration in tourism	None announced

4.2.1. Background

Emilia Romagna is located in the north of Italy, bounded by the River Po, the Apennine rage and Adriatic Sea. It is the fifth largest region in Italy. Emilia Romagna region is home to more than 4,4 million people, with an urban population of around 40%. The region encompasses nine provinces and 348 municipalities. Bologna acts as the regional capital. Before the introduction of the integrated ticketing system the public transport network was not well connected (Mirco & Cocchi, 2013). The introduction of Mi Muovo allows an effective integration between bus and rail services, particularly among the urban services of the 13 major cities and the extra urban services of the whole region.

In order to solve this shortcoming, the Emilia Romagna region has worked with the regional public transport companies for many years to create an intermodal network by integrating (mobility) services and by developing an integrated fare structure and ticketing system. The region has strongly committed itself to “facilitate and encourage the use of local public transport” (Ferrecchi, 2013). The regional mobility and transport council of Emilia Romagna is responsible for the planning of the infrastructure, mobility systems and services as well as for the improvement of urban mobility in general in the region. The council was responsible for defining principles, structure and specifics for a new integrated ticketing system of travel documents (the project was initially called STIMER). Aim of this initial project was to allow transparency, accessibility and promotion of public transport and to improve its quality by enabling the users to use different modes of transport as easy as possible. The fare system is operational since 1995 in the province of Modena. In 2001 a study was commissioned to evaluate the effects of a wider introduction of the fare system. Since 2008 it has been introduced gradually in the Emilia Romagna region (Smith, n.d.).

The project was promoted by addressing not only the public transport end-users, but also by addressing the different actors (local authorities and private companies) that were needed to roll out the system. The system gives several opportunities for involved stakeholders to improve their services. The electronic card allows the issuer to track the exact movement of each Mi Muovo card. That information will be used to plan the public transport services and to control the quality of the

service (e.g. punctuality of modes). The project was supported by a strong regional financing, accounting for more than 50% of total costs (Ferrecchi, 2013).

4.2.2. Tourism

There are no plans that Mi Muovo will find any application in tourism, though there might be some potential. Already today, a variety of "destination cards" exist in Emilia Romagna. The Emilia Romagna Visit Card combines free entrances, discounts (e.g. to museums or other attractions) and other specials for the provinces of Forlì-Cesena, Ravenna and Rimini. However, according to the official website, this product is no longer available. Another destination card is the Emilia Romagna Green Fee Card that allows special price reductions on the regions golf courses. Additionally, the city of Bologna and the Castelli del Ducato die Parma offer their own welcome cards with discounts and special offers for their visitors.

4.2.3. System Characteristics

Main characteristic of the Mi Muovo fare system is its regional scale. The fare system changed from a kilometer fare to a zone system. The electronic ticketing system is operative in eight out of nine provinces. Services include urban and suburban busses and local trains, bike sharing, car sharing and electric recharging of e-vehicles, all with the same ticket and throughout the whole region. It is a contactless smart card, valid as a season ticket (annual or monthly). The ticket price depends on the distance travelled and not on the number of vehicles used, independently from the different companies that manage the service. It is possible to upload the different service subscriptions on the card. Additionally the system allows some user groups to receive special conditions, for example students, disabled or elderly. In 2012 around 37000 Mi Muovo tickets were sold, in particular monthly tickets. The tickets can be recharged at ATMs and through home banking and the uploading service will soon be offered at supermarket chains as well as through internet or mobile phone NFC (Ferrecchi, 2013).

The total investment was more than 34 million Euros, of which 17 million were contributed by the region. Costs applied for the clearing system and the start-up (e.g. ticketing managing systems, contactless ticket validators, charging devices for tobacconists and newsstands) and for a comprehensive promotion campaign. 1,8 million Euros are needed as a yearly contribution for operating costs (Ferrecchi, 2013).

In a user survey on customer satisfaction, around 92% of the participants answered to be satisfied with the service quality. Especially the easier ticket purchase is mentioned to be a major success factor. However, the definition of "clearing rules" for the revenue allocation among the participating transport companies is seen as a difficulty by project officials (Urban mobility and local transport department, 2012).

4.3. Octopus Card

Table 4: General overview Octopus

General Overview „Octopus“	
Name of the system	Octopus
Located in	Hong Kong, China
Website	www.octopus.com.hk/en
System technology	RFID Smart card (Sony FeliCa)
Payment system	CICO system for public transport Prepaid smart card with auto top up features Mobile payment with NFC-enabled android phones
Scope of application	Transport Tourism Retail shopping eGovernment
Number of users	More than 10 million cards issued (in 2007)
Main stakeholders	Octopus Holdings Ltd.
Funding	Octopus Holdings Ltd.
Scope of integration in transport	Bus, Tram, Ferries, Taxis, Railways, Parking
Scope of integration in tourism	Destination card

4.3.1. Background

Hong Kong is located on the southeastern coastline of the People's Republic of China. It is one of the most densely populated areas in the world, inhabiting a total of 7 mio. people within 1100 km². The gross national income p.c. in 2011 was at 36010 US $ (The World Bank, 2013).

With the end of colonial rule in July 1997 Hong Kong became Chinas first special administrative region. The intention of the special administrative regions was to open up Chinese markets to western economies. Under British rule Hong Kong already became an intense growing economic power in Asia, making it one of the world's most important financial districts. With its growing economy and population over the last decades space and infrastructure became a very valuable asset in Hong Kong, which grew into high density (Sung & Oh, 2011).

The public transport smart card Octopus has been developed by the five main private transport providers in Hong Kong since 1994. It was rolled out to the public in 1997. Public transport played an important role to ensure an efficient transportation network. Public transport in Hong Kong is carried out by five major transport operators: MTR, KCRC, KMB, Citybus and HYF. Transport providers started offering prepaid magnetic tickets for mass rapid transport in the 1980s and formed first cooperation for unified ticketing solutions in the early 1990s to lower cost of maintenance and improve commuter throughput (Hirsch, Jain, & Yau, 2007). In 1994 those five operators founded Creative Star Limited to establish the public transport smart card solution "Octopus Card". The company was renamed Octopus Cards Limited in 2002 and became a subsidiary of "Octopus Holdings Limited" when the company was restructured and opened up for multi-application and ePurse features (Octopus Holdings Limited, 2013a).

4.3.2. Tourism

Hong Kong plays an important role in Chinese tourism and it is a constantly growing sector. In 2011 almost 42 million visitors arrived in Hong Kong staying an average of 3.6 nights per visitor (Hong Kong Tourism Board, 2013).

The Octopus card offers a special type of cards for tourists, the so called *sold tourist octopus* card. The tourist card features all of Octopus cards applications but has no prestored value, is not linked to a certain user account and can be refunded. It features no combined entry packages for museums or day passes for public transport like many other destination cards but it can still be used for entry as most attractions allow octopus card payment, day tickets for transport can be added if needed. There is no further destination card offered by the Hong Kong Tourism Board („Sold Tourist Octopus", 2012).

4.3.3. System Characteristics

The Octopus smart card system is the world's first complete integrated contactless ticketing system in public transport, leading the way for many other systems in Asia and all over the world. After its release to public in 1997 it became adopted very fast. After 16 weeks there were already 2.5 mio transactions processed per day, which raised to 7,5 million in 2002 and 8.4 in 2004. In 2002 there was already a penetration of 90% of the population between 15 and 90 growing to 95% in 2004 (Hirsch u. a., 2007; Smart Card Alliance, Inc., 2005).

The system is based on a check-in/check-out prepaid smart card infrastructure. The system blocks the highest fare amount when checking in and calculates the correct fare when checking out. Different payment models established fast, featuring automatic top-up features and the possibility to overrun credit.

Its huge success made it attractive for further application other than public transport soon. So Octopus Holdings Ltd. enabled Octopus for retail payment. In 2005 only 25% of Octopus transactions were related to public transport. Octopus Holdings keeps a fee for every transaction made.

More applications are e-purse applications in retail, self-service vending machines and copiers, leisure facilities, parking, online payment, access control and e-governmental services (Octopus Holdings Limited, 2013b).

4.4. T-Money

Table 5: General overview T-Money

General Overview „T-Money“	
Name of the system	T-Money
Located in	Seoul, South Korea
Website	eng.t-money.co.kr
System technology	RFID Smart cards
Payment system	CICO System for public transport, prepaid smart card with auto-top-up features
Scope of application	Public transport Retail
Number of users	25 million T-Money and 28 million affiliated cards issued (2009); 1.3 million Mobile T-Money users (2010)
Main stakeholders	Korea Smart Card Co., Ltd.
Funding	Seoul Metropolitan Government LG Credit Card Union
Scope of integration in transport	Bus Rail Ferry Taxi
Scope of integration in tourism	Seoul City Pass

4.4.1. Background

Seoul, the capital of South Korea, is located near the north western coast of the country.

Korea faced a fast growth of economy after ending of Korea War in 1953. Emerging from one of the poorest countries in the world to the G20. Korea's rapid growth is often referred to its authoritarian regime pushing the development and the strong anti-communism, pro-capitalism tendencies resulting from the separation of North Korea after war (List-Jensen, 2008).

In 2007 Seoul inhabited 10.4 mio. residents within 603.3 km². Making it the most densely populated city in the world with more than twice person/km² then Hong Kong. Public transportation plays a major role in ensuring the city's transportation networks and therefore economy. Such high density city needs transit oriented development and always needs to improve it transportation systems efficiently, especially during peak times (Eom & Schipper, 2010; Sung & Oh, 2011).

One possibility to ensure high quality passenger data and improving throughput was seen in the establishment of a contactless smart card scheme.

4.4.2. Tourism

Tourism in Korea, as in many other Asian markets, is a fast growing sector. Arrivals have more than doubled over the last decade bringing a total of 11.2 mio. arrivals to Korea. A major share coming from other Asian countries with a growing importance of Chinese arrivals (Korea Tourism Organization, 2013; Waitt, 1996).

Seoul City Pass is a public transport day pass based on the T-Money technology. It works on public transportation and city tour buses. Tourists can use public transport depending on the type of city

pass purchased and public transportation is limited to 20 uses a day. It features no further dedicated applications in tourism (Korea Smart Card Co., Ltd., 2012). Though, T-Moneys ePurse application can be used for entrance fees to several tourist attractions.

4.4.3. System Characteristics

The Korea Smart Card Corporation (KSCC) was established as a joint venture of the Seoul Metropolitan Government, main investor being in charge to ensure public transportation, LG Electronics, the technology suppliers, and credit card issuers.

T-Money started in 2004 as a public transport smart card and soon expanded its scope of application to function as ePurse and adding applications ever since, following the model of Octopus in Hong Kong. It can be used for parking, in more than 8.000 retail shops and at over 21.000 vending machines, in universities and city administrations. Since 2010 more than 100.000 taxis have carried out technical upgrades to accept T-Money (Retzmann, 2011).

Similar to Hong Kongs Octopus scheme, the system is based on a check-in/check-out prepaid smart card infrastructure. Blocking the highest fare amount when checking in and calculating the correct fare when checking out. It fast established different payment models featuring automatic top up features and the possibility to overrun credit.

T-Money features a mobile phone version working with dedicated USIM cards of contracted mobile phone operators. In 2013 T-Money introduced postpaid services for mobile T-Money. Since 2009 T-Money can be used in almost all parts of the country (Korea Smart Card Co., Ltd., 2013).

In 2008 KSCC exported their smart card solution to New Zealand and in 2010 to Malaysia (Retzmann, 2011).

4.5. EZ-Link

Table 6: General overview EZ-Link

General Overview „EZ-Link“	
Name of the system	EZ Link
Located in	Seoul, South Korea
Website	www.ezlink.com.sg
System technology	Singapore
Payment system	CICO system for public transport Prepaid Smart card with auto-top-up features m-payment with NFC-enabled Android phones
Scope of application	Transport, tourism, retail shopping, e-government
Number of users	12 million cards circulating (2012)
Main stakeholders	Land Transport Authority (LTA) and subsidiaries, Ministry Of Transport, public transport operators (SMRT, SBS Transit), Singapore Tourism Board, IBM (Backend Solution), Wirecard and Starhub (NFC solution), Sony (smart card provider)
Funding	LTA, a subsidiary of Ministry of Transport
Scope of integration in transport	Heavy Rail, Light Rail, Bus, Taxi, Electronic Road Pricing (ERP), Parking, CarSharing
Scope of integration in tourism	Destination card (Go Singapore Pass)

4.5.1. Background

Singapore became independent in 1965 and developed in the last 50 years from one of the world's least developed countries to a new industrial country (NIC) and later to one of today's most developed industrial states. Singapore's political system is based upon the British one, giving privilege to the ruling party (Marohn, 2010). Singapore's policy in the 1990s prioritized economic development. Incentives for investors and privileged land use were the main instruments of Singapore's government (Kong, 2000). To maintain its full economic functionality a fast and stable transport system was seen as inevitable.

All decisions affecting transport are following a multi-pronged strategy on land transport since the 1970s. It is containing five main components: 1) integration of town and transport planning, 2) expansion of road network and improvement of transport infrastructure, 3) harnessing the latest technology in network and traffic management, 4) management of vehicle ownership and usage and 5) the improvement and regulation of public transport (Lam & Toan, 2006).

The aim of automated fare collection was set in 1994, when research for a new technology for the replacement of magnetic stripe paper tickets in mass rapid transit started. The introduction of an "Enhanced Integrated Fare System" (EIFS) with public transport smart card solution EZ-Link in 2002 aimed to provide easy access, faster commuter throughput and real time data on travel behavior (L.S.K. Sim, E.A.C. Seow, & S. Prakasam, 2003).

In the early 1990s the pressure on Singapore's streets was growing and land in Singapore was a scarce resource. In 2006 streets occupied about 12% of land use and residential areas needed the same share at that time. About four million residents were taking an average of 7.6 million motorized trips a day, 60% were carried out by public transport (Lam & Toan, 2006). Public transport at that stage was mainly carried out by buses (Chin, 1996; Prakasam, 2009). In order to lower pressure on the road, public transports share had to be increased or at least kept at the same level with growing demand, since the country is still facing growth of population and an even more significant economic growth. In many countries growth of gross national income (GNI) per capita is strongly linked to rising shares of motorized individual transport. Until 2012 the population has risen to 5.18 mio while GNI per capita has almost tripled since 1990, one can say Singapore has been recovered from the Asia crisis in the late 1990s („Worldbank Data on Singapore", 2012). To sustain the modal share and improve sustainability Singapore's Land Transport Authority (LTA) had to act on a wide scale.

4.5.2. Tourism

The tourism industry is a growing sector since Singapore's independence, with a short period of recession during the Asia crisis in the late 1990s. Income and occupancy rates have recovered fast and continued growing. Occupancy rates in the last 5 years were between 75% and 85% in the last five years with an upwards tendency. The main visitor markets were Asia with a growing importance of Chinese visitors. International visitors were at a total of 13.2 mio in 2012 with growth rates between 6% to over 30% since 2001 (CBRE Hotels, 2012, Singapore Tourism Board, 2012). The overall impact of tourism on Singapore's economy can be considered favorable (Heng & Low, 1990).

Destination management is done by the Singapore Tourism Board by the brand yoursingapore.com. The Singapore Tourism Board offers smartphone applications and the Singapore Tourist Pass, an EZ-Link powered destination card, in cooperation with the LTA. It brings users all features of EZ-Link with time based ticketing for public transport (EZ Link Pte Ltd., 2012b).

4.5.3. System Characteristics

Investments in Singapore's ITS, and especially EZ-Link, were mainly undertaken by LTA and its subsidiaries. Main work was done by MSI Global. The implementation of the smart card system is

amounted at a total cost of 200 million US$. TransitLink Pte Ltd. was formerly owned by the two main transport operators, but later became subsidiary of LTA in 2010. Both operators are listed at the Singapore Exchange. They were not involved in the funding of the smart card system (Land Transport Authority, 2012; Prakasam, 2009).

When EZ Link was introduced as a public transport smart card it faced its most significant change in infrastructure and scope of application in 2009 when EZ-Link was upgraded to the newly developed contactless ePurse application standard (CEPAS). The goal of CEPAS was to create a single transport card for all means of transport and simultaneously open up for third party applications. In 2009 most EZ-Link cards were replaced with new cards featuring the new technology. Public transport usage levels did not change as CEPAS remained downward compatibility, needing no change in hardware infrastructure. From now on it was possible to use EZ-Link to pay for Park&Ride fares, public transport as well as electronic road pricing. The new technology also improved the cards security algorithms (L.S.K. Sim u. a., 2003; Prakasam, 2009). The latest advancement in CEPAS and EZ-Link's technology is the implementation of NFC-based services. As NFC is downward compatible to RFID again no new infrastructure is needed. NFC on smartphones allows to combine features like live account balancing and analysis of travel with the comfort of a one device solution as well as to improve security features by giving the possibility of two step authentication for higher volume transactions. Involved in NFC Technology are StarHub and WireCard, two technology and IT suppliers bringing their expertise in mobile payment technologies (EZ Link Pte Ltd., 2012a; StarHub, 2012; „Wirecard supports EZ-Link with Singapore's national NFC payment service", 2012).

The CEPAS standard also allowed third party suppliers, such as financial service providers, to issue their own smart cards with EZ-Link functionality. The wider scope of possible applications soon featured common eWallet usage as well as e-Governmental services. EZ-Link can be used for payment all over Singapore featuring thousands of retail stores and vending machines. Similar to other types of electronic payment a fee to the operator is charged for every transaction. A reward and loyalty program implemented in EZ-Link (EzRewards) is collecting user data similar to other popular services such as Payback. This information can be used for marketing purposes of the third party businesses (EZ Link Pte Ltd., 2013).

4.6. Ventra

Table 7: General overview Ventra

General Overview „Ventra"	
Name of the system	Ventra
Located in	Chicago, USA
Website	www.ventrachicago.com
System technology	RFID Smart cards
Payment system	CICO System for Public Transport Prepaid Smart card with Auto-Top-up Features
Scope of application	Public Transport Retail
Number of users	n.a.
Main stakeholders	Chicago Transit Authority (CTA), Pace, Cubic Transportation
Funding	Chicago Transit Authority
Scope of integration in transport	Mass Rail Transit Bus
Scope of integration in tourism	None Announced

4.6.1. Background

In 2000 Chicago introduced their first public transport smart card, the Chicago Card. Funded and operated by the Chicago Transit Authority (CTA), the Chicago Card introduced contactless ticketing to public transport. Chicago Card is a prepaid stored-value RFID smart card. In 2004 CTA introduced Chicago Card Plus, adding auto-top-up features to the Chicago Card and the possibility to add iGo Carsharing on the same card, introducing the ChicagoCard Plus iGO (Chicago Transit Authority, 2013d). In 2012 CTA announced Ventra, a new RFID Smart card for public transport that will replace the Chicago Card. Contrary to Chicago Card, Ventra will not be issued by CTA, but by a third party supplier, Cubic Transportation, to reduce cost and extend the use of application in public transport. Ventra is supposed to save CTA 50 mio. US$ during its 12 year contract with Cubic Transportation (Chicago Transit Authority, 2013a; Nichols, 2012). There is no clear statement yet if the upcoming Ventra system will feature a car-sharing application as well.

Chicago is located in the state of Illinois in the United States of America. Chicago is Illinois most populated city, with a population of 2.7 mio. living in an area of 366 km² it is facing about the same density as Singapore. As most American cities were built car user friendly, the role of public transport is not as high as in the compared Asian or European transportation systems (Buehler, 2011).

4.6.2. Tourism

Chicago Card and Chicago Card Plus had no application in tourism. It is not yet clear if Ventra will find any application in tourism, but there might be a potential. Chicago welcomes up to 40 mio. visitors a year, of which 75% come for holiday reasons. Most of the tourists are from the United States (Bergen, 2013; Chicago Chamber of Commerce, 2011). However, the so-called “Go Chicago Card” is available for tourists. This card is completely separated from any transport application and instead focuses on the integration of major tourist attractions’ entrance fees. It is offered by the Smart Destinations corporation that offers similar products for nine destinations in the USA (Smart Destinations, 2013).

4.6.3. System Characteristics

Ventra now features a wider scope of application in public transport. Bringing all three public transport operators on one Smart card: CTA, Pace and Metra. With Pace and Metra Ventra extends its route network to the rural areas of Chicago reaching more customers commuting to the city on a daily basis.

Ventra widens the scope of application, following the Asian model of an integrated public transport smart card with ePurse applications. Ventra will cooperate with Mastercard to deliver contactless electronic payment in transportation and retail (Chicago Transit Authority, 2013b, 2013c).

4.7. Touch & Travel

Table 8: General overview Touch & Travel

General Overview „Touch&Travel“	
Name of the system	Touch&Travel
Located in	Germany
Website	www.touchandtravel.de
System technology	NFC-enabled smartphones or simcards
Payment system	NFC-enabled payment
Scope of application	Long distance trains and public transport in selected areas
Number of users	n. a.
Main stakeholders	Deutsche Bahn AG
Funding	Deutsche Bahn AG
Scope of integration in transport	Long distance trains, bus, tram, and light rail in selected areas
Scope of integration in tourism	No integration in tourism

4.7.1. Background

Germany is a federal parliamentary republic and part of the European Union as well as the Euro zone. German infrastructure and the transportation of goods as well as public transportation are playing a major role in ensuring its economical power. The German railway network and all usage were carried out by Deutsche Bundesbahn (BRD) and Deutsche Reichsbahn (DDR) state owned transport operators. In 1994 Deutsche Bahn AG was founded, a privatized stock company with the federal republic as major shareholder. Germany inhabits about 81 million citizens with the car as their favorite mode of transportation. The Deutsche Bahn AG (DB) and its subsidiaries is a privatized railway operator. DB AG is responsible for the entire German railway network and cargo transportation. Public transport is traditionally organized through regionally operating public authorities that fully coordinate public transport services (so called “Verkehrsverbuende”). Respective public transport firms are still responsible for supplying the services (provide vehicles, personel, work schedule and maintanence). The “Verkersverbuende” are directed by representatives of the state (Laender), local governments and the public transport firms; they are responsible for planning, marketing and data exploitation and thy give subsidies to the operating firms. Usually public transport tickets are valid for an entire trip within one of these specified regions and integrated timetables are available (Pucher & Kurth, 1995). All long distance railway travel is operated by DB. Ticketing is regulated by DB Mobility Logistics AG (Bundesministerium für Verkehr, Bau und Stadtentwicklung, 2013).

4.7.2. Tourism

Touch and Travel requires a German bank account to be linked with. Unfortunately it is not attractive for international visitors. Its current and potentially growing multimodal scope might make it attractive for seamless short trips within Germany. As there has to be an account and device for every traveler it is not suited for family travel.

4.7.3. System Characteristics

The DB offers customers since 2001 several possibilities of ticketing. Starting with the QR-Code based Print-At-Home Ticketing, to mobile ticketing via WAP and MMS Based QR Codes on mobile phones

to an integrated smartphone application called the DB Navigator bringing QR codes based mobile ticketing to Android and iOS devices with the possibility to store user data and fixed discounts such as "BahnCard" into the application. Besides ticketing for DB public transportation the DB Navigator also features a multimodal transportation planner for public transportation all over Germany including local transport operators (Hüske, 2010). With the previous ticketing possibilities still existing, DB started the development of an innovative approach on mobile Ticketing in 2007 featuring NFC in the new smartphone based eTicketing concept called Touch&Travel (T&T). The System was tested in a closed beta and became public in 2012.

T&T customers check in at the train station before starting their journey by touching an NFC Tag (or alternatively GPS based location fix) and check out after completing their journey by touching another tag. The cost of the journey will then be calculated by duration and way of the customers' journey and eventually be reduced if the user is qualified for discounts. To ensure the correct fare calculation the customer has to enable location tracking on his mobile phone. Most German mobile phone providers feature touch&travel in 2013 (Duesener, Gemeinder, & Greve, 2007; Hüske, 2010).

The fare sums up to a month and will then be debited from the customers' bank account.

T&T started on long distance travel within the DB network but started expanding on several local transportation networks. In 2013 T&T includes 7 transport associations, including VBB (Berlin Area) and RMV (Rhein-Main Area), two of the biggest German transport associations (DB Mobility Logistics AG, 2013).

There is currently no data available on the scope of customers and daily usage.

4.8. CityZi

Table 9: General overview Cityzi

General Overview „Cityzi"	
Name of the system	Cityzi
Located in	Nice, France
Website	www.cityzi.fr
System technology	NFC-enabled smartphones or simcards
Payment system	"Pay-by-Phone" NFC-enabled payment (CI/CO)
Scope of application	Public transport ticketing and schedule information, smart posters for tourism information, mobile payment (retail), loyalty program
Number of users	4.000 during trial (2010), 1 million in summer 2012, 2.5 million in spring 2013 (whole France)
Main stakeholders	Mobile phone operators, banks, public transport operator (Veolia TransDev)
Funding	French government offered funding for cities to integrate CityZi (42 cities responded, about 2/3 of France)
Scope of integration in transport	Information on bus and train schedules Payment for local public transport in Nice (bus and tram)
Scope of integration in tourism	Cityzi provides information on touristic sites via NFC tags. It is likely to be integrated in payment for museums and sites as the number of users is growing fast. Shopping (in selected stores, see Pesonen & Horster, 2012) and collection of loyalty points are possible as well.

4.8.1. Background

Public transport in France is mainly in the responsibility of cities and communities, and regions. While railway transit, since decentralization in the 1980s, is coordinated by the regional councils (conseils régionaux) (Barone, 2008), local public transport (urban bus and tram systems) is in the responsibility of local authorities (i.e. cities or cooperative groups of communities) (Amaral, Saussier, & Yvrande-Billon, 2009).

The Cityzi system in Nice was introduced in a cooperation of "four mobile operators, two banks and the operator of public transport in Nice" (Pesonen, & Horster, 2012:15). The system is coordinated by the Association for Mobile Contactless in France (Association Française du Sans Contact Mobile, AFSCM[3]). AFSM also provides information for end users and businesses on how to use the system and on how to offer services. For end users, the system is supported by the four mobile phone providers (Bouygues Telecom, Orange, SFR, and NRJ mobile).

Nice has got 344,000 inhabitants (Toutes-les-villes.com 2013). In 2011 53% of the French users of mobile phones owned a smartphone (Comscore 2012).

Nice is well known in France and Europe as a senior citizens' residential area, which might be reflected in the city's median age and also technology affinity.

Nice's tram and bus network is operated by Veolia Transdev. Veolia Transdev is as well operating a bike-sharing scheme and an e-car-sharing scheme in Nice. Two private companies offer taxi services.

4.8.2. Tourism

Located in the Cote d'Azur region, Nice welcomes 4 million visitors every year (French Riviera: 10 million). 10,000 rooms are available for tourists. 80% of the tourism in Nice is leisure tourism, while 20% is business-related. Tourists on average spend 6.6 days (Cote d'Azur region, 2006). In Nice, half of the tourists are international, while in the whole Cote d'Azur region there are significantly more domestic tourists. As Nice Airport is the main hub for international visitors to visit Cote d'Azur (5 million touristic passengers), Nice accounts for 40% of touristic traffic in the French Riviera region. Most tourism is domestic and visitors arrive mostly by car (58%). Nice harbor welcomes about 1.3 million cruise ship passengers per year.

4.8.3. System Characteristics

Under the label "Cityzi", a NFC-based payment system has been launched in Nice in 2010. With well-recognizable logos for different applications (brand logo, screen symbol, NFC tag) (Association Française du Sans Contact Mobile 2012), Cityzi offers different solutions to service providers that want to offer e-payment to their customers. For end users, various NFC-capable smartphones are sold (Cityzi 2013). Nice's public transport operator has been part of the Cityzi field trial Nice that started in 2010 (Pesonen & Horster, 2012, p. 15). Within Nice's public bike sharing system ("Vélo Bleu"), Cityzi phones can be used for identification at rental stations (Vélo Bleu, 2013).

Cityzi aims at providing a solution for all over France. In the end of 2012, 2.5 million NFC-capable mobile phones were in use in France (Association Française du Sans Contact Mobile 2013). The city of Strasbourg will introduce NFC-based charging based on Cityzi technology in 2013 (Strasbourg.eu 2013).

[3] see http://www.afscm.org/en/index.php

4.9. iAmsterdam

Table 10: General overview I amsterdam city card

General Overview „I amsterdam City Card“	
Name of the system	I amsterdam City Card
Located in	Amsterdam, Netherlands
Website	www.iamsterdam.com
System technology	RFID
Payment system	Prepaid public transport smart card with touristic features
Scope of application	Unlimited use of public transport, entrance to museums, discounts and special offers at touristic sites.
Number of users	130.000 cards issued yearly
Main stakeholders	Amsterdam Transport Authority and Tourism Board, European Cities Marketing (CityCards (by ECM) are backed by the tourism industry with a wide range of stakeholders)
Funding	n. a.
Scope of integration in transport	Local public transport (GVB: bus, tram, and metro)
Scope of integration in tourism	Smartphone application features information on touristic sites Discount and "free" entry to museums and touristic sites

4.9.1. Background

Since 2001 twelve provincial and six urban area governments function as public transport authorities in the Netherlands (as opposed to the former responsibility of the central government) (van de Velde, Veenemann, & Schipholt, 2008). These public transport authorities are required by legislation to “establish public transport policy goals” (van de Velde, Veenemann, & Schipholt, 2008:52) and to introduce competitive tendering. However, the three biggest cities of the Netherlands (Amsterdam, Rotterdam and The Hague) were afterwards excluded from the obligation of tendering in public transport, public transport in Amsterdam is therefore until now directly awarded to the municipally-run operator GVB (Veenemann, 2010).

Public transport ticketing in the Netherlands is provided by the so-called “OV-chipkaart”, which is used nationwide (OV-chipkaart, 2013). After having agreed on the development of a nationwide smart card system in 1998, the system was developed in cooperation by the country’s major transport operators (Cheung, 2006, p. 127). Technically, the OV-chipkaart is based on the Octopus system in Hongkong (Octopus, 2013). The goals of the introduction were to provide transport operators with up-to-date ridership information and ease operational planning, but to ease public transport use and help with liberalization in the transport market, e.g. by making price differentiation possible, as well (Cheung, 2006). The cost-benefit analysis by Cheung (2006) investigated the introduction of the ov-chipkaart and concludes that the system, if developed and adopted in close cooperation of operators and stakeholders, can offer “significant mutual benefits” (Cheung, 2006:132) for them.

The I amsterdam City Card is compatible with the ov-chipkaart system. Beyond that, it is part of the “EuropeanCityCards” initiative (EuropeanCityCards, 2013), run by the “European Cities Marketing” association (European Cities Marketing, 2013).

Amsterdam has got 790,000 inhabitants (Gemeente Amsterdam, 2013b). Public transport is operated by the “Gemeentelijke Vervoerbedrijf” (GVB), as far as bus, tram, and metro services within

Amsterdam and the surrounding areas are concerned (Veenemann 2010). Furthermore, besides trains run by Nederlandse Spoorwegen (NS), the private companies Connexxion, EBS and RET operate additional bus lines spreading out into the regions.

4.9.2. Tourism

Amsterdam is a major European travel destination. More than 50,000 people work in the tourism sector (Gemeente Amsterdam, 2013c). 5.3 million tourists visit Amsterdam every year and they spend 9.8 million nights in Amsterdam's hotels (gemeente Amsterdam, 2013d). 19% are domestic tourists, while 14% come from the USA and 17% from the BRIC nations (Brazil, Russia, India, and China); The rest is mostly coming from Europe (Gemeente Amsterdam, 2013a). Around 50% of the visitors mention that the good museums are the main reason for their visit and 62% use public transport in and around Amsterdam (Dominicus, 2013).

4.9.3. System Characteristics

The I amsterdam City Card combines free usage of the local public transport operator GVB (no trains and no additional bus companies) for either 24, 48, or 72 hours with free entrance to 38 museums and discounts at more touristic sites. Monthly special offers (e.g. additional free entrances) are offered as well. Additionally, a smartphone app is available that provides information on the included attractions and a map (I Amsterdam, 2013).

The I Amsterdam City Card is a smart card that is automatically activated at the first use. Some discount offers may be offered for a whole year, i.e. the card can still be shown after the specific days of its validity. For public transport as well, the card is activated at the first use and has be used for every check-in and check-out (I Amsterdam, 2013).

4.10. BodenseeErlebniskarte

Table 11: General overview Bodensee Erlebniskarte

General Overview „BodenseeErlebniskarte“	
Name of the system	BodenseeErlebniskarte ('Lake Constance Experience Card')
Located in	Lake Constance region, Austria / Germany / Liechtenstein / Switzerland
Website	www.bodensee.eu
System technology	OCR, issuing at points of sale
Payment system	one-time payment
Scope of application	mainly tourism
Number of users	25.000 per year
Main stakeholders	Internationale Bodensee Tourismus GmbH
Funding	n. a.
Scope of integration in transport	some of the included touristic services also serve as public transport
Scope of integration in tourism	swimming, museums, mountain railways, ship cruises, guided tours, other attractions

4.10.1. Background

The Lake Constance region finds itself between Austria, Germany, Liechtenstein and Switzerland, with Lake Constance being the third largest lake in Europe and a major tourist destination (Internationale Bodensee Tourismus GmbH, 2012). In a wide definition, about 3.5 million people lived

in the region and were represented by about 5,000 regional politicians in 2000 (Scherer, & Zumbusch, 2011). Because of the regional heterogeneity of institutions, governance is more complicated than elsewhere without such complicated and heterogeneous, tri-national institutional frameworks, also challenging collaboration in the transport and tourism sectors.

Public transport is developed fairly well across the region, and public transport operators, while mostly already participating in integrated tariff schemes on the sub-regional level, also cooperate in offering the tri-national "Tageskarte Euregio Bodensee", providing daily passes with different zoning options (euregiokarte.com, 2013). In the respective zones, these tickets are valid on all public transport lines participating in the local integrated schemes, including all railway lines, bus services, and two ferry lines crossing the lake.

4.10.2. Tourism

The economic characteristics of the several sub-regions around Lake Constance differ significantly, but particularly the importance of the tourism sector is similar across the whole region and it "serves as area for recreation and holidays for more than 10 mio. people each year" (Scherer, & Zumbusch, 2011, p. 107). Presumably because of a more narrow geographical framing of the region, Internationale Bodensee Tourismus GmbH (2012) refers to 7.3 million overnight stays in 2011, complemented by 32 million day guests, with the German part of the region (which also has the longest section of the lake's shoreline) clearly being most visited.

4.10.3. System Characteristics

The BodenseeErlebniskarte is a destination card that integrates many tourist attractions in the Lake Constance region, including public swimming pools, museums, mountain railways, ship cruises, guided tours, and other attractions (bodensee.eu, 2013). While visiting some of these attractions is free for card holders, other attractions offer reduced entrance fees for them. The card scheme was introduced in 2000 as the first cross border destination card in Germany, and Kuhn (2000) refers to intense collaboration of all involved actors (through reflecting all their particular interests in the overall strategy) as the most crucial factor for the scheme's success (Kuhn, 2000, p. 455). Today, variations of the card exist, differing in included entrance fees and, specifically, in inclusion of the ship cruise services. An additional smartphone app (technically independent from the card) provides detailed information on all included attractions and has been downloaded more than 25,000 times until May 2013 (Südkurier Medienhaus, 2013).

However, public transport is not included in the scheme. While the ship cruises on Lake Constance and some of the included mountain railways (like the Rorschach–Heiden line) do in various degrees also serve local public transport purposes, those are, obviously, included for touristic reasons (e.g. scenic views). This is underlined by the fact that the ferry service between Constance and Meersburg and the catamaran service between Constance and Friedrichshafen are not included in the card (bodensee.eu, 2013), while some services (like the Säntis aerial tramway) are included that are explicit exceptions from the respective integrated public transport tariff schemes.

A linkage between the BodenseeErlebniskarte and the above-mentioned existing regional public transport ticket (Tageskarte Euregio Bodensee) seems self-evident. In fact, the Interreg IV project „Positionierung Bodensee" (‚Positioning Lake Constance') took this to its agenda. Various other local guest cards exist in the region as well and a further development of the regional card scheme, bearing in mind the local schemes and public transport, was strived for (Internationale Bodensee Tourismus GmbH, 2011; 2012). Tommasi et al. (2005) already explicitly recommended merging the BodenseeErlebniskarte with the Tageskarte Euregio Bodensee or at least mutually incorporating additional characteristics. Consultation of the officials at Internationale Bodensee Tourismus GmbH, who are in charge of running the BodenseeErlebniskarte, revealed that this idea is still followed. The

system's recent technological change towards issuing OCR-based cards (in contrast to the previous pre-loaded cards) will therefore allow adding additional services via a web-based system, making further product differentiation possible and also opening up the potential of integrating public transport options (Frischmuth, 2013). Such a development of the existing destination card scheme is believed to contribute to the further development the Lake Constance region as a cross-border tourist destination, as suggested in a study by Rehage (2011) as well.

4.11. St. Petersburg City Card

Table 12: General overview Saint Petersburg city card

General Overview „Saint Petersburg City Card"	
Name of the system	Saint Petersburg City Card
Located in	Saint Petersburg, Russia
Website	www.petersburgcard.com
System technology	one-time pass with integrated electronic purse for public transport (RFID)
Payment system	for public transport electronic purse: e-terminals or cash desks at subway stations, online portal
Scope of application	Tourism, public transport
Number of users	n. a.
Main stakeholders	E-Card "Podorozhnik" Visit Petersburg Government of Saint Petersburg Saint-Petersburg Tourist Information Bureau European Cities Marketing
Funding	n. a.
Scope of integration in transport	including public transport electronic purse (metro, tram, bus)
Scope of integration in tourism	Museums, entertainment, shopping, restaurants

4.11.1. Background

The Russian transport sector faces significant challenges along the country's slow transition towards market economy. While cities' populations remained relatively stable, motorization and private car use increased sharply (Oh, & Gwilliam, 2013). With the command-and-control approach of the Soviet times not being applicable anymore, Russia still lacks behind in introducing the necessary "comprehensive regulatory framework" (Oh, & Gwilliam, 2013, p.1) for the transport sector. Public companies are "plagued with financial difficulties and operational inefficiency" (Oh, & Gwilliam, 2013, p. 1) and private companies started to fill the gaps in an uncoordinated way.

In Saint Petersburg as well, passenger volumes in public transport went down in the last decades (decreasing by almost 60% from 1990 to 2008), with the poorly maintained public transport sector often being conceived as hindering private automobile traffic (Trumball, 2013).

Still, Saint Petersburg (together with Moscow) is, due to its importance, ahead in keeping up with the mentioned challenges. Demand management is included in the city's "15-year urban transport strategy" (Oh, & Gwilliam, 2013, p. 19) and there is some progress in implementing advanced transport management systems. A smart card for Saint Petersburg's citizens has also been introduced, including a public transport application (Hass, Marchesani, & Naumovski, 2003). Saint Petersburg's

public transport administration operates a metro network, a tram network that until recently used to be the biggest in the world, and bus and trolleybus services. These are supplemented by private bus ('mashrutki') services that are, however, not included in the public tariff structures (saint-petersburg.com, 2013[a]).

4.11.2. Tourism

Saint Petersburg has got a population of roughly 5 million (saint-petersburg.com 2013[b]) and, according to Moreau et al. (2011) who rely on data from the STR Global consultancy, approximately 5 million tourists visit the city every year, with numbers significantly increasing in the last years. With parts of the city centre being on the UNESCO World Heritage list, the city is highlighted as Russia's cultural capital and the "leading leisure destination in Russia" (Moreau et al., 2011), well connected by an international airport, rail services, and cruise ships as well. The city has is traditionally one of Europe's "'classic' urban tourism destinations" (van der Borg, 1994, p. 67), but the downside of the city's attractiveness is that Saint Petersburg "regularly appears in the very top tier of rankings of the world's most unaffordable cities" (Trumball, 2013, p. 469).

4.11.3. System Characteristics

Gathering information about the characteristics of the Saint Petersburg City Card program is difficult due to a multitude of seemingly official websites (European Cities Marketing, 2012; petersburg.com, 2013[b]; Saint-Petersburg "Guest Card" Tourist Program, 2012) and additional information on other websites (e.g. Buzykina, 2011). All these contain information that partly contradict each other and that are partly only available in Russian language, not even to mention the naming of the program as either 'Saint Petersburg Guest Card', 'St Petersburg Tourist Card', or 'Saint Petersburg City card', which appears to be the most up-to-date name.

The guest card provides free entry to a number of the city's museums and tourist attractions (once per museum/attraction), free excursions (e.g. on the boat), and discounts in shops, restaurants and hotels (petersburg.com, 2013[a]). The free entrances are provided on a paper basis, i.e. the visited attractions are ticked in a catalogue handed out when the card is bought. For discounts, the card is valid during the whole calendar year of the purchase. Public transport can be used with an additional smart card that is compatible with the existing ticketing infrastructure (see above). When the guest card is bought this so-called "Electronic Transport Purse" (Petersburg.com, 2013[a], p. 136) is already pre-loaded with 100 rubles, which can be supplemented at metro stations or online.

In 2012 the guest card program has joined European Cities Marketing, since then being advertised under the common label of 'EuropeanCityCards' (Saint-Petersburg "Guest Card" Tourist Program, 2012).

4.12. Southampton Smartcities Card

Table 13: General overview Southampton smartcities card

General Overview „Smartcities Card“	
Name of the system	Smartcities Card
Located in	Southhampton, United Kingdom
Website	www.southampton.gov.uk/living/smartcities
System technology	Dual interface (hybrid) card with an embedded microchip based on Javacard and MIFARE technologies (contactless system for library, leisure center and transport services and contact-based for loyalty program and e-purse)
Payment system	Stored-value card
Scope of application	Public transport, loyalty, library, leisure, ID and toll collect (card is only for Southampton resident)
Number of users	80.000 (2012)
Main partners	Schlumberger (smart card producer); city of Southhampton; Europay International; Motorola; University of Southhampton; IT Innovation Centre; University of Notre Dame de la Paix; City of Gothenburg
Funding	Funding from the EC through the FP5 project “Multi-application Smart cards in Cities”; Department for Transport
Scope of integration in transport	includes bus pass for students, elderly and eligible disabled
Scope of integration in tourism	no integration in tourism

4.12.1. Background

The public sector across the UK is being forced to change its role and structure since changes at national level mean profound losses of funding. The Southampton city council has been seeking new ways for funding options and to be a modern and efficient organization that is focused on its citizens. The Southampton city council picked up the issue and took the lead in the SmartCities project funded by the EC (FP5 – IST, project duration 2000 – 2003). During this pan European research project, which was entitled “Multi-application Smart cards in Cities”, the Southampton Smartcities card was developed. The main objective of the project was to develop a dynamic, multi-application smart card scheme for citizens; which was intended to be a prototype for the European city card of the future (Creese & Abric, 2000). Business cases from other cities have proved that real benefit is provided when transport smart card schemes are introduced with local authority city card schemes (Blythe, 2004). The card was launched in 2001. The cards main aim was to enable public and commercial service providers to improve their services through enhanced information they obtain about their customers, to deliver better value to citizens and to enhance social inclusion (McKewan, Gair, & Upstill, 2003).

The Southampton City Council succeeded in taking on board several partners. Schlumberger, one of the world’s leading smart card producers at that time took the project management. The city of Southampton was responsible for the project evaluation (through citizens’ experience). Europay International, an e-commerce card service, brought in its electronic purse “Clip”. Motorolas contribution was initially to facilitate the use of the card for people on the move through its dual interface phones, but Motorola withdrew from the project. The staff and students of the University of Southampton proofed the concept and the Uni-Link bus service smart card scheme was introduced into the Smartcities card. The IT Innovation Centre worked on the transfer of information analysis and

Technolution developed the city card applications. CRID was responsible for the legal issues surrounding the introduction and the City of Gothenburg provided checks and balances for the project (Creese & Abric, 2000).

There is not much information how the funding continued after the initial funding of the EC. Creese & Abric (2000) assume that Schlumberger (one of the partners) has contributed a sizeable amount, as a supplier of card technology he has a major interest in the functioning of the project.

Southampton is a middle sized city with a population of 236.000 in 2009 (Southampton City Council, 2010). Local public transport is mainly provided by buses from several operators. The University of Southampton, which was a partner in the implementation process, has commissioned its own bus service (Uni-link) to provide transport from university to town. The river Itchen is bridged by the so called Itchen Bridge, which is a toll bridge.

4.12.2. System Characteristics

The Smartcities card is a multi-application smart card that allows Southampton city residents to access a number of services. It can be a bus pass, donor card, library card, leisure card or it can be used to proof age. It is also possible to pay for the toll on the Itchen Bridge. Therefore credit needs to be added to the card. The Unilink buses allow loading multi-trip tickets on the card. Since 2008 all operators have included the national concessionary bus pass. This allows residents over 60 and eligible disabled persons to get free off-peak travel on local buses throughout England. In selected leisure venues it is possible to receive discounts if subscribed to the so called “Get Active Subscription” (Southampton City Council, 2013). The card stores information for different organizations, such as the university or the city council.

Particularly interesting in the scheme is that it is up to the user which of the services he/ she wants to apply for, people can choose one or all of them. All cards are personalized with photo, name, account number and card number; bus passes also have the ITSO number on the front.

Table 14: Case studies overview

CASE STUDY	Transport modes: Railways	Local public transport	Taxi services	Bike Sharing / Bike rental	Car Sharing / Rental	Road Charging	Technology: OCR	RFID	NFC	Application: Tourism	Shopping	Other	Description	Users	Actors: PT Operators	Tourism	Intermediaries
Public transport schemes																	
Oyster Card, London (UK)	✓	✓						✓	✓				CICO system, prepaid smart card, trials with NFC enabled phones	7 million	✓		✓
Mi Muovo, Emilia Romagna (I)	✓	✓		✓	✓			✓				✓	CICO system, prepaid smart card	200,000 (2012)	✓		
Octopus Card, Hong Kong (CN)	✓	✓	✓					✓	✓	✓	✓	✓	CICO system, prepaid smart card, mPayment functions (NFC)	10 million (2007)	✓		
T-Money, Seoul (KR)	✓	✓	✓					✓		✓	✓	✓	CICO system, prepaid smart card	18 million (2012)	✓		✓
EZ Link, Singapore	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	CICO system, prepaid smart card, mPayment functions (NFC)	12 million (2012)	✓	✓	✓
Ventra, Chicago (USA)	✓	✓						✓					CICO system, prepaid smart card	starting 2013	✓		✓
Touch & Travel (D)	✓	✓							✓				NFC enabled CICO system, monthly debit from bank account	n.a.	✓		✓

(continued)

CASE STUDY	Transport modes: Railways	Transport modes: Local public transport	Transport modes: Taxi services	Transport modes: Bike Sharing / Bike rental	Transport modes: Car Sharing / Rental	Transport modes: Road Charging	Technology: OCR	Technology: RFID	Technology: NFC	Application: Tourism	Application: Shopping	Application: Other	Description	Users	ctors: PT Operators	ctors: Tourism	ctors: Intermediaries
Tourism schemes																	
Cityzi, Nice (F)	✓	✓		✓	✓				✓	✓	✓		"Pay-by-Phone" NFC-enabled payment	2.5 million (2013)	✓	✓	✓
I amsterdam City Card, Amsterdam (NL)		✓		✓			✓			✓			Prepaid public transport smart card with touristic features	100,000 (2007)	✓	✓	
Bodensee-Erlebniskarte (A, CH, D, LI)							✓			✓			One-time pass with OCR code	25,000 per year		✓	
Saint Petersburg City Card, Saint Petersburg (RU)		✓		✓				✓		✓	✓	✓	One-time pass with integrated electronic transport purse	n.a.	✓	✓	
Local authority schemes																	
Smartcities Card, Southampton (UK)		✓				✓					✓	✓	Local authorities citizen smart card with prepaid functionalities	80,000 (2012)	✓		

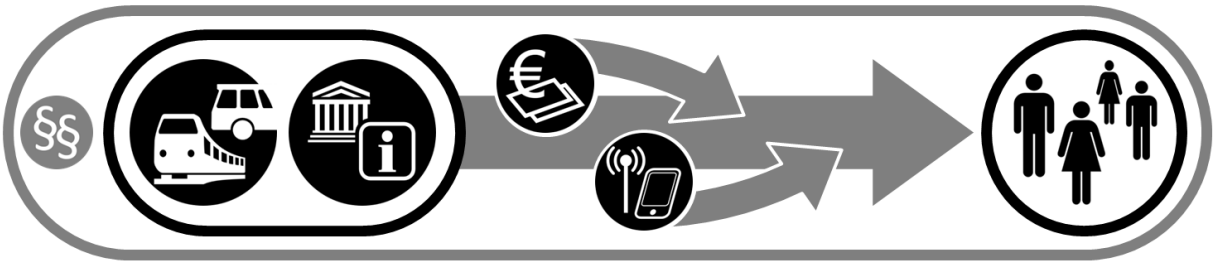
5. SOCIO-ECONOMIC PERSPECTIVE ON INTEGRATED TICKETING

The implementation of an integrated e-ticket system is a complex process - and not just from a technological point of view. Stakeholders that are involved in the implementation of an integrated ticketing system need to agree on two sets of issues. First, they need to agree on technical specifications, such as hardware and software compatibility and data management. But legal and economic aspects play a decisive role as well; and this is the second set of issues that need to be addressed. Stakeholders need to agree on institutional and governance issues, such as the identification of leading institutions, revenue distribution models and incentives for participation (Yoh, Iseki, Taylor, & King, 2006). The integrated ticketing environment comprises different actors, who each have a different role to play and for each of whom drivers or restraints apply in the decision to participate in the process or not. This certainly varies according to the political and economic background of the cities and the exact conditions under which a scheme is implemented. But in order to start the roll-out process of integrated ticketing, it is essential for each individual participating company to create economic value. A review of different schemes that combine public transport and tourism, as well as relevant studies in this field, indicate that the most important actors for the operation can be categorised as the following (see figure 4):

- Public transport operators and authorities
- Government and other administrative authorities
- Tourism sector
- Intermediaries (telecommunications operators and financial service providers)
- Existing and potential end-users

This chapter summarises what factors might influence the decision making of the different actors to engage in the implementation process and explains the role of each actor in the systems architecture. Basically, public transport operators and the tourism sector play a key role in the systems architecture as they provide a well-established market segment. Intermediaries, such as telecommunications operators and financial service providers, provide access to customers' mobile devices or provide technical expertise. Governments have the important role of providing a platform for cooperation and assisting with additional funding and subsidies. Existing and potential end-users finally decide on the success of a system, as they are the ones who apply or reject an innovation. At the end of this chapter, table 20 provides a summary of the possible roles and benefits of each stakeholder.

Figure 4: Partnerships across the integrated ticketing value chain



5.1. Government and other administrative authorities

Government and other administrative authorities establish the framework for the exact nature and conditions of the schemes. Even though most countries have introduced market forces to increase cost-effectiveness or have deregulated their public transport market, in many – but not in all – European countries, public transport is publicly planned, owned and operated (Gleijm, 2003). In any case, government subsidies together with passenger fares are usually the largest sources of revenue

for public transport operators. Government authorities usually aim to provide a public transport network that is affordable, accessible and integrated, and purely economic reasoning would in most cases not justify operation. Traditionally the purpose of public transport has been to provide mobility for everyone, including those groups that have no alternative to public transport (or do not have a bank account). In the meantime other challenges have emerged that can be combated by the provision of public transport and that are particularly important to any government or authority: reduction of congestion and accidents as well as environmental protection (Commission of the European Communities, 2001). Furthermore, the tourism sector is one of the most important employers in many European cities, making it particularly necessary for the cities to secure their market shares.

Strong governmental support has proved to be important for institutional coordination of integrated ticketing schemes in the Netherlands and the UK (International Transport Forum, 2012). The extremely successful card systems in Hong Kong and Singapore have been set up with strong, centralised government control as well. MVA Consultancy (2008) states in a report on e-money usage in public transport, carried out for the UK Department for Communities and Local Government that this department provided a platform for commercial bodies to push initiatives forward. The authors further stress that the government had a facilitating role in supporting the standardisation process where appropriate and that the department coordinated the efficient use of infrastructures (i.e., terminals). In general, the department's role is described as a 'policy-implementation driver role', whereas the private sector's role is described as the best supplier for implementation and operation. However, the most important role governments have to play is that they need to convince all stakeholders to participate in the process. Financing pilot projects and subsidising installation seems to be important as well (Yoh et al., 2006). The practitioners' panel that was consulted for the study on public transport smart cards agreed that the development of smart ticketing 'should be led by national government bodies with public transport providers in each country' (AECOM, 2011:11). A binding set of standards should be endorsed and promoted at the EU level.

Table 15: Costs and benefits for governments and other administrative authorities

Costs	Benefits
Costs for financing (pilot) projects; subsidies for installation	Economic effects: increased expertise in ICT which can be applied to other sectors; better economic conditions for companies so that they locate or expand their businesses in that area; provides identity to the community
Costs for setting up a platform for the stakeholders to push initiatives forward	Environmental effects: increase in public transport usage; reductions in traffic congestion

Governments which have engaged in e-ticketing schemes expect some positive indirect effects for the national economy and the environment. A cost-benefit analysis of the nationwide smart card system in the Netherlands (OV-chipkaart) by Cheung (2006) estimates that the knowledge and technical expertise gained in the smart card system could be applied and transferred to other sectors. It is also assumed that the system creates a positive economic climate for companies. However, these estimations could not be precisely quantified. Environmental effects were assumed to be twofold: the author expected a 15% increase in public transport usage at the expense of car usage, which would result in positive effects for the environment and reductions in traffic congestion. Overall the cost-benefit analyses result in a positive outcome for the central government (Cheung, 2006). In Hong Kong the Octopus card has proved to provide a strong identity to the community (Li, 2008). However, institutional arrangements are different and cannot be transferred from one place to another.

Local authorities are also interested in setting up smart card schemes for their citizens. Governments of the UK have been particularly active in doing so. Between 2002 and 2005, the office of the Deputy Prime Minister set up a national smart card project to provide smart card technology to local authorities. The local schemes were primarily set up to create safer and stronger communities, to promote healthier communities by targeting key local services such as healthcare and housing, to improve the quality of life for special target groups (children, students, senior citizens or people with disabilities) by facilitating access to services that exist to address their needs, to meet transport needs more precisely and to promote the economic vitality of the respective localities (Wood et al., 2011).

5.2. Public transport operators and authorities

Public transport operators are the most important partner in the systems architecture. Most of the existing schemes are run by public transport companies; they are most often the lead partner and the ones that try to integrate other services into their scheme. As public transport customers are usually used to dealing with small amounts of cash, they offer a well-established market segment, that is particularly interesting for other stakeholders (see chapter 0). Financial service providers, such as Visa or Mastercard state that public transport is a likely area of expansion for e-ticketing services and that it could provide a great support for pushing forward the general acceptance of contactless technology (AECOM, 2011). Transport operators might also be the right actors to include other transport related services, such as car or bike-sharing or car rental. Larger transport authorities might structurally offer the capacity to host the clearinghouse functions on behalf of other authorities. As outlined above, the implementation of a smart and integrated e-ticketing system still requires all actors to cooperate closely, which is obviously a difficult task in the world of public transport, as this market is characterised by "decentralised decision-making, split between public authorities and operators and by the parcelling-up of a market that must cater for the needs of everyone" (de Chantérac, 2009:24). Rather than technological aspects, the many different transport environments, fare structures and subsidy models seem to be the major hindrance to implementation. Organisational aspects and especially a lack of co-operation seem to be an obstacle, too. As well as the division of revenues within integrated systems is a barrier to realize integrated ticketing. If it is not possible, technically or for reasons of data protection, to monitor the complete movements of passengers, it is only hardly possible "to estimate which partner should receive what proportion of income from common tickets" (Müller et al., 2004:55), except by regularly updated complex and expensive passenger surveys.

In order to fulfil the expectations placed on public transport operators and authorities (provide mobility that is affordable, reduce congestion and increase road safety as well as ensure environmental protection), transport operators may pursue policies that aim at improving service quality and the accessibility of their operational network. Integrated ticketing could be one means to do so. Of course this is connected with several costs, but also several benefits for individual operators. Not all operators publish cost-benefit analyses of their integrated e-ticketing schemes, but some are available, especially from outside observers. However, the results can by no means be comprehensive, as methods, scope and regional characteristics differ substantially. It needs to be noted that the public transport sector is comprised of numerous companies that all have different drivers and restraints for taking up (or not) the idea of integrated e-ticketing. The implementation, success and final layout of potential e-ticketing schemes cannot be generalised, as it depends on the specific public transport environment (fare principles, tariff structures, number of customers and number of stations or vehicles that need to be equipped) of the given region and the collaboration of the many stakeholders involved in the process (Urban ITS Expert Group, 2013b).

Table 16: Costs and benefits for public transport operators and authorities

Costs	Benefits
Capital costs: e.g., for buying or upgrading equipment and infrastructure	Reduced administrative costs through automation of manual processes: fewer cashiers needed, reduced fare-processing time, better passenger throughput in high-demand areas
Operating costs: maintenance and replacement	Reduction of fraud resulting from cash handling and fare evasion
Additional costs: e.g., for training staff to use and handle new technology or campaigns to inform users about new technology, costs for resolving passengers disputes (especially in the first year of operation)	Better price differentiation, e.g. flexible fare structure depending on the mode and time of the day
Costs for outsourcing clearinghouse functions for the fare and data collection system, for marketing and distribution	Better transport statistics for planning purposes and thus for a better exploitation of the network capacities
	Multi-application potential for a better integration with other services
	Reputation as a modern enterprise

Costs apply that can be easily quantified, e.g., investment and operation costs. Setting up an e-ticketing scheme can be relatively expensive because of the initial one-time investments (e.g., readers, software and consultancy on the scheme design). Integrated schemes appear to be particularly cost intensive, as different applications need to be connected (Wood, Downer, Toberman, 2011). Additionally running costs for marketing, maintenance and replacement need to be considered. Of course, this varies heavily, as framework conditions are different, especially the technology and the existing infrastructures of the schemes. Costs that apply because a new technology has been introduced, e.g., for training staff or to resolve passenger disputes, also need to be taken into account. Costs for setting up a (regional or even national) clearing house responsible for a centralised data and fare collection as well as costs for marketing and distribution need to be considered as well. However, once a system and its corresponding infrastructure have been set up, further services can be introduced with much lower costs. It seems that there are more costs to be taken into account which are not effectively quantifiable, most of them related to the risks and uncertainties of adopting new technologies and to inter-actor coordination. The fear of outsourcing expertise and responsibilities in ticketing to third-party suppliers remains a worry to public transport operators (Turner & Wilson, 2010). Some smaller operators do not want to lose control or fear a reallocation of their funding to larger entities. Technical problems that cannot be foreseen and political issues are concerns of operators as well (Iseki et al., 2008), and the risk of path dependency is a serious concern for public transport operators. Investing in a technology bears the risk of sticking to this particular technology or contract, which could prove to be the market loser in the long run (Turner & Wilson, 2010).

The benefits for operators are hard to quantify, as the main aim of e-ticketing is an improved service quality. According to Huomo (2009), there is sometimes a lack of understanding of the pros and cons

of e-ticketing. Stroh et al. (2007) go even further, saying that 'several business case calculations have shown that these implementation and operating costs would not be outweighed by the reduction in ticket distribution costs.' (Stroh, Schneiderbauer, Amling & Kreft, 2007:3). However, this assumption is based on smart-card technology; the authors additionally argue that NFC technology allows a beneficial business case for public transport operators. E-ticketing enables a better integration of alternative services into the scheme, making it more attractive for customers to use it. Another important benefit relates to the operator's reputation, as it appears as a pioneering enterprise. The larger Asian schemes have succeeded in setting up a brand (e.g., Octopus in Hong Kong) that enjoys great popularity. However, the benefits are to a large extent an element of uncertainty (PricewaterhouseCoopers, 2011). Nonetheless, some of the benefits can be monetised. The reduction of costs related to reductions in boarding times and thus a better throughput can reduce costs, especially in high-demand areas. But this is also possible only when enough users adopt this technology. A reduction in fraudulent travel can be quantified as well. Due to accurate data on passenger flows, e-ticketing might also help to better exploit the network's capacities and to improve the user experience by setting up tailor-made services for individual passengers.

Iseki et al. (2008) reviewed three smart-card systems in the United States and determined that individual transport operators bear the majority of the deployment costs. According to them, the main beneficiaries of smart-card systems are individual operators and the end users. But they also note that each scheme creates different costs and benefits, depending heavily on the public transport characteristics of the given region (e.g., whether a single operator or multiple operators are involved, government subsidy structures, existing ticketing infrastructure, etc.). Cheung (2006) comes to the conclusion that large operators are likely to have a better cost-benefit ratio than other companies involved in the system. Iseki et al. (2008) conclude that smart and integrated ticketing systems hold tremendous promise for bringing benefits to operators (and users), but cause substantial costs as well. However, Welde (2012) concludes in his study on the smart-card ticketing system for the city of Trondheim that 'it often takes time before all challenges are overcome and benefits can be realized' and that, from a purely economic point of view, investments in public transport are only seldom profitable. In line with this, the Australian Department of Finance and Deregulation (2008) states that only a few of the existing schemes are 'designed to return a direct profit to the scheme owner'.

Data security: challenges and controversies

E-ticketing systems are able to automatically identify, track and store information about the way customers use the system (Reid, 2007). Usually the user's name and address, age, gender and bank details are recorded, as well as accurate data on the passenger's travel behaviour (e.g., boarding times and dates, locations, route profiles, frequencies and preferences).

However, the collection of personal data is subject to some controversy. On the one hand, the captured data can be very useful for operators. Data can be used for strategic long-term planning, tactical planning and operational planning. On the strategic level a better understanding of users' behaviour permits a better operation and exploitation of the transport network. Tactical planning can be improved, because accurate data knowledge allows – for instance – the posting of different schedules for each day, which better take into account users' needs. On the operational level data can be used to calculate precise performance indicators of the network (e.g., schedule adherence, vehicle kilometres etc.) (Pelletier et al., 2011). The key benefits of data collection are 'long-term cost reductions, flexibility in pricing options, potential information sharing, and better revenue management' (Pelletier et al., 2011:562). The customer can expect lower prices, more efficient services and time savings through not queuing at ticket counters.

On the other hand, data collection raises major privacy concerns, in the same way as other tracking technologies (such as credit cards or mobile-phone communication) (Michael & Clarke, 2013;

Pelletier et al., 2011). Concerns relate to the risk of the misuse of personal data. It is potentially possible to cumulatively gather information about a single person (piece by piece) For instance, multi-application smart cards even make it possible to link public transport usage and trip purpose, allowing a precise analysis of individuals' travel intentions (Chakirov & Erath, 2011). According to Reid (2007), no communication network is completely secure. Although exchanges between cards and terminals are usually encrypted, the most vulnerable part is the centralised storage database (Pelletier et al., 2011). Furthermore, it is possible to create an accurate picture of a person's spending habits (Reid, 2007). All in all, it is possible for enterprises to "create, maintain and update a long-term detailed profile of individual habits" (Reid, 2007:54). This information is highly valuable for marketing purposes. Another serious concern relates to the possibilities offered by standardised technology; unauthorised organisations could obtain personal data every time an individual carrying a smart card comes close to a smart card terminal. According to Reid (2007), the potential threats to individuals include 'identity theft, informational inequality where the collecting body is more powerful than the data subject, loss of the right to control information about oneself and the invisible nature of data collection' (Reid, 2007:54).

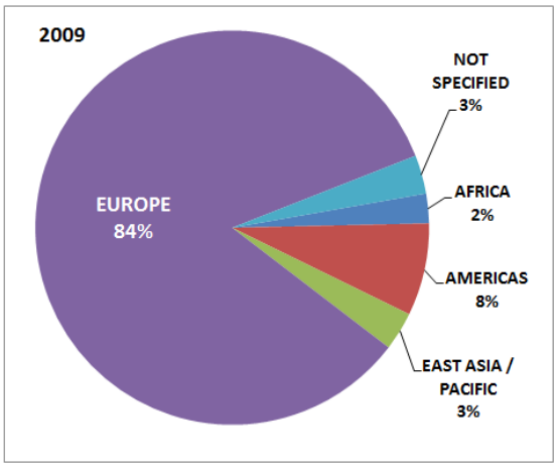
Market developments in ICT may evolve faster than standardisation and legislative processes. Particularly in the transport sector, where an ongoing network digitisation process of all modes and services can be noted, emphasis should be placed on the development of coherent regulatory standards to ensure privacy for the 'traveling public' (Fries, Gahrooei, Chowdhury & Conway, 2012). Actually, commercial organisations want data-protection laws to provide legally binding regulations that all stakeholders must fulfil (Reid, 2007). Experts recommend producing a Privacy Impact Assessment (PIA) to enable organisations to anticipate and address potential privacy risks (AECOM, 2011). The Urban ITS Expert Group, which was set up by the European Commission to promote the deployment of ITS (Intelligent Transport Systems), has proposed guidelines for smart-ticketing applications. There is general agreement that sensible and detailed personal information – which could potentially be gathered and used by participating operators or third parties – has to be protected. The authors note that a low level of data protection might damage citizens' acceptance of engaging in the implementation and that it should be punished as a violation of the law. They additionally introduce several principles that smart ticket privacy should follow. Among these are the possibility of anonymous accessibility as well as the protection of personal data against abuses in the media itself and abuses by companies' staff (including back offices) and against an uncontrolled dissemination of data, for instance, by hacking or marketing tools (Urban ITS Expert Group, 2013).

5.3. Tourism sector

Europe is the world's most frequently visited destination, with a high density and diversity of tourist attractions. Therefore, tourism has become a cornerstone for economic growth and employment in Europe (European Commission (CEC), 2010). The urban tourism market is one of the fastest growing tourism sectors in the world. Especially for Europe's agglomerations, tourism forms a basis for urban development, supplying the needs of visitors and providing for the well-being of residents (European Commission, 2000). In 2011 Europe accounted for more than half of all international tourist arrivals, but figures indicate a slight decrease (World Tourism Organization (UNWTO), 2012). The European tourism market is characterised by domestic tourism: more than three out of four trips were domestic (84% of the arrivals in Europe are by EU citizens). In 2011 the top destinations for all EU27 member states were neighbouring or nearby countries (Eurostat, 2012). According to the European Travel Commission (2013) long-haul markets will initially drive growth in 2013, with increasing growth from the US. However, emerging markets are also playing an increasingly important role, with China being the leading player (TOURISMlink Consortium, 2012). For domestic trips, around 70% of holidays were

spent at private accommodations and less than 20% at hotels or similar establishments (Eurostat, 2012).

Figure 5: Origin areas for European tourism



Source: TOURISMlink Consortium (2012).

The two most popular ways of going on holidays are the car and the airplane. Over three quarters of the respondents of the Flash Eurobarometer 334 "Europeans' attitudes towards tourism" stressed that they used a car or motorbike to reach a holiday destination at least once. Especially people aged 25–54 are more likely to go by car or motorbike (European Commission, 2012a). Unlike the car, public transport is not significantly associated with leisure time (Gronau, W. & Kagermeier, M., 2007). However, at some point of their journey, tourists arrive at their destination and need mobility. A minority decide to hire private transport; many decide to take public transport. Tourists want to immerse themselves in their destination; it can be observed that, from a transport perspective, tourists behave like locals. This means that in urban areas, where alternatives to private transport usually exist, tourists show a high degree of non-motorised transport usage. In London, for example, nearly all visitors use public transport at some point in their journey, with the Underground being the main mode of transport once London has been reached (TNS Travel & Tourism, 2008). In 2003 the International Association of Public Transport stated in their core brief on leisure and tourism that the rising demand for public transport due to tourism and leisure activities represents a real opportunity for this sector. Tourism could allow better occupancy rates during off-peak hours and holidays, and thus the use of infrastructures could be optimised and the overall image of public transport could be enhanced; public transport rejecters could become occasional users. However, public transport authorities need to adapt to possible developments in demand by developing attractive tourism products, such as door-to-door services and flexible and tailor-made offers (International Association of Public Transport, 2003). Gronau & Kagermeier (2007) conclude that the tourism sector could strengthen the position of public transport, as tourists are important multipliers and disseminators of information. Tourist attractions could also gain from cooperation. Combined tickets could bring additional advantages for both sides, such as increased numbers of public transport users and visitors.

While the most popular regions for domestic tourism are the coastal regions, urban tourism is also an important form of tourism. According to the Flash Eurobarometer 370, 22% of the respondents said that culture and 20% said that city trips were their main reasons to go on holidays in 2012 (European Commission, 2013). Many cities in Europe actively promote their attractive potential and have indeed experienced spectacular growth rates in city tourism (Albalate & Bel, 2010). For many European cities, their cultural heritage is a central touristic resource, which includes historic places and buildings, monuments and artefacts, but also social values, traditions, artistic expressions and practices (Paskaleva, 2010). Cultural tourism is becoming increasingly popular and includes journeys to

exhibitions, performances, festivals and other cultural attractions. Culture tourists are very interesting for the tourism sector, as they generally have a high level of income and education; they do not travel with children and are not dependent on the tourism season. They also show a high level of respect for the culture and customs of a destination (Pechlaner & Abfalter, 2005). However, people travel not only during their holidays, but for business and employment reasons as well. Not as much data is available for this area on a European level. However, data from individual countries indicates that business travel should not be ignored. In the UK, for instance, 3% of all domestic trips were work-related (Lyons, 2013). These so-called 'briefcase travellers' can be categorised into two groups: only 5% travel between major capitals, such as Paris, London, Berlin, etc. The majority, consisting of 95%, are cross-border or cross-regional travellers, e.g., between Maastricht – Aachen – Liege or the three-border region in Luxembourg (Berry, 2012).

ICT has dramatically changed the tourism sector; the way tourism providers design, shape, promote and sell their products and services has changed radically. The European Union expect that tourism demand is changing from mass tourism to more tailor-made services for individual travellers. Modern ICT systems enable tourism providers to care for their guests before, during and after their journey. They also make it possible to increase visitor traffic, attract suitable market segments and create efficient networks (Pechlaner & Abfalter, 2005). Many of the big tourism companies have reacted to this development and offer global reservation and distribution networks that connect tourism suppliers with tourism distributors. Still, in particular, small enterprises have trouble affording the high investment costs (monetary and organisational) necessary for ICT applications. For them it is important to concentrate on niches, in order to differentiate their products from those of the big players. Building good and reliable cooperation is crucial to them (TOURISMlink Consortium, 2012)

Marketing destinations is an extremely difficult task, as the relationships between the stakeholders who develop and produce tourism products appear to be highly complex. In particular, private leisure and tourism enterprises are not used to cooperation, and there seems to be a certain reluctance (Gronau, 2013). Tourism facilities and services often do not belong to individuals; instead they belong to businesses and investors, tour operators, intermediaries and interest groups that present a whole range of professional and personal interests. Tourists perceive the destination as a brand, or as an integrated product (Buhalis, 2000). The more services and products that tourists actually experience, the more likely they are to return to this destination (Pechlaner & Abfalter, 2005). Tourists' experiences are composed of different elements, such as public transport, hotels, bars and restaurants, tourist offices, local attractions and events. Each of these elements is usually managed and produced by individual players that are most often competing with each other (Buhalis, 2000). In this heterogeneous and geographically diffuse environment, the demand side and the supply side are linked by intermediaries, who sell different services to the customer (TOURISMlink Consortium, 2012). Consensus and cooperation among the involved stakeholders is needed in order to develop joint strategies, objectives and activities for keeping in touch with visitors. In other words, integrated strategies need to be developed.

5.3.1. Destination cards

One possibility for destinations to market and manage their products as an integrated package is to set up a so-called destination card (or city card or welcome card). According to European Cities Card, 40 cities in Europe offer these kinds of cards. Before the appearance of destination cards, there was no medium that combined all touristic attractions and services on a single card in a consistent and clear manner. Destination cards are often smart cards valid for a specific period, but usually without a payment function. They are mostly dedicated to specific cities and usually include discounted prices for major attractions and events; sometimes cards include access authorisation (e.g., to a hotel room), and they often allow the card holder to jump the queues. The most successful destination card systems

offer free or discounted prices for public transport. That way, not only are the touristic products combined on the card, they are physically connected through the most relevant transport services in the given region. Empirical data shows that combined tickets have a reasonable effect on public transport usage, even among car users. Gronau & Kagermeier (2007) as well as Lumsdon, Downward & Rhoden (2006), discovered that high shares of the users of such tickets had a private car available but used public transport because of the availability of a combined ticket. It seems to be important to visually prepare information about the transport infrastructure in order to help visitors understand the network. Some systems try to lure customers with bonus programmes for using public transport at off-peak hours. Experts have identified this approach as not very promising, as customers today have a variety of bonus programmes to choose from. A more promising approach seems to be to connect card systems with information services. Card holders could receive information on the current transport situation (e.g., traffic jams, parking places, waiting times, etc.) at highly frequented tourist sites (Weidlich, 2005).

Destination cards are issued by touristic stakeholders within a region or a city (Beritelli & Humm, 2005). The participating partners usually receive a fixed amount of money for each destination card that has been sold. The main objective is to bundle the products and services available at a destination without the need for booking and buying in advance and thus to foster higher concentration of participation in cultural activities and public transport usage (Pechlaner & Abfalter, 2005). That way, less visited attractions can increase in value and tourist flows can be redistributed. As with the public transport smart cards, tourist experiences can be tracked and providers can offer tailor-made services. An additional objective of destination cards is to increase the length of stay of tourists, as they become aware of the available attractions. If a destination card does not unite a broad variety of attractions and services, the card fails in marketing the destination (Beritelli & Humm, 2005).

Different designs are possible and usually each city offers various types of cards to choose from. The most common offers are for 24-hour or three-day, but some cities offer cards that can be used for up to a year. This market segmentation has led to the fact that residents also use the card in some cases. The cards are either date stamped or contain an intelligent chip. Cards with a chip are usually activated the first time they are used (European City Cards, n.d.). Examples from Germany and Austria show that tourists seem to visit more attractions if they have a destination card at their disposal and that they perceive the region as more attractive. Kuhn (2000) found that 92% of 945 users stated that they would not have visited as many attractions as they finally did. Schmalz (2000) arrived at similar results for the Kärnten Card. A study among 80,000 card holders came to the conclusion that the card makes Carinthia an attractive tourist destination and that the availability of the card had a decisive influence on tourists' choice of holiday destination and on their judgement of their overall holiday experience.

However, as in the case of public transport smart cards, the main problem in establishing a destination card system is the allocation of revenues. Pechlaner & Abfalter (2005) call it 'the free-rider problem'; it is apparent that all providers of services need to know which of their services are actually being used in order to know which revenue share they deserve. A critical mass of service providers, including the most important attractions and services as well as a number of other features, is needed to set up a successful scheme. However, too many partners are not expedient either. It may be necessary to limit the number of participating partners to a manageable number. The smart card infrastructure needs to be robust, user-friendly and widely accessible, meaning that readers need to be installed at all participating services. This can be cost intensive; in particular, small providers might require assistance from public partners (Pechlaner & Abfalter, 2005). Zoltan & Masiero (2012) aimed to profile tourists who could be interested in purchasing destination cards for the Swiss canton of Ticino. The authors found that tourists who are coming to the region for the first time, who have a lower to middle range budget and who have a high consumption of culture and nature activities consider these

card requirements as important. Additional features, such as entertainment, sports and social activities, are only of minor importance, but can be used for marketing purposes. The authors further conclude that cards need to be accompanied by brochures or free, downloadable mobile apps for additional information on the attractions included in the card. The technology behind the system seems to be only a means to an end, meaning that not only the technologically most innovative application makes the run, but also applications that bear their own distinctive (regional) character. The central element of a destination card is not the medium itself (book of vouchers, multi-application smart card or a mobile phone app): it is the promise of the experiences that can be had at a destination (Weidlich, 2005).

5.3.2. Smart cards in the tourism sector

Smart cards offer the tourism sector the chance to combine several applications on one card. They can support the entire process of a trip, starting with planning and booking and comprising the buying of services during the journey and their processing afterwards. Possible applications include the possibility of allowing users to receive desired personal information, for example, on bonus-mile programmes (air and train). Tourism smart cards can also record past and current travel information queries in order to accelerate booking procedures or to provide tailor-made information. After booking, ticketing information and vouchers can be stored on the card, e.g., free public transport for the last mile. As a further benefit, additional services at the destination could be booked, such as theatre tickets, hotel accommodation or local tours (Fleck, 1998). However, a nationwide or even transnational standardised infrastructure would be needed to exploit the maximum potential of this technology. Only then would customers be enabled to book a trip, reach the destination by their preferred means of transport, check in to a hotel, receive travel documents for a rental car, book a guided tour and pay museum entry fees – all with a single card and independently of the location. It seems that smartphone-based applications are more promising, as they do not require large infrastructure investments.

5.3.3. NFC-based services for tourists

NFC technology (see chapter 3.2.3) provides several interesting opportunities for the tourism sector. Especially the possibility of integration into the mobile devices increasingly used by tourists before, during and after trips offers potential to influence the touristic experience. Even though many of the applications are not created for the sake of tourism, they could have an impact on tourism (Guttentag, 2010). The mobile phone could become a multipurpose tourist guide built on NFC-based services and combined with other technologies, such as GPS and SMS, which allow their users to get access to site-specific information and/or to share their experiences in social networks (Reddman, Preuß & Weigt, 2009). Furthermore, NFC bears the possibility of offering additional services to users, such as automated payment and ticketing.

For the tourism sector several applications exist:

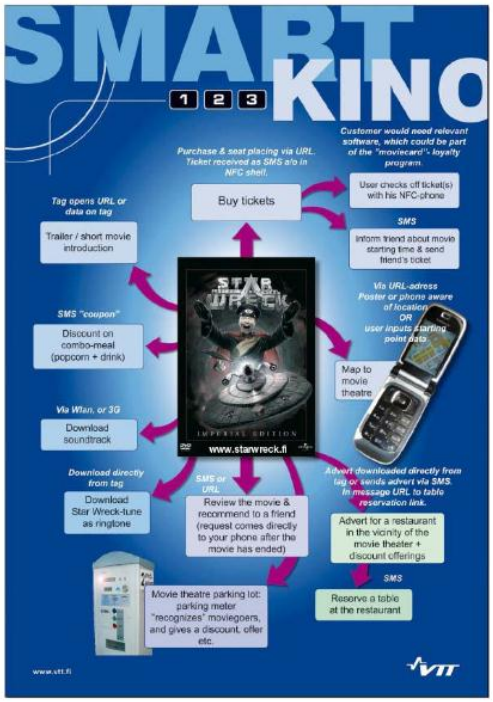
- *Smartphone guided city tours:* As outlined above, the tourism sector is changing from mass tourism to tailor-made services. Smartphone guided city tours offer the possibility of individually exploring a city. An NFC-tag infrastructure enables users to simply swipe the phone over a reader to receive multimedia information on their mobile devices. Such an NFC-based travel guide could offer different thematic routes and guide tourists to main attractions, such as local restaurants, events or meeting points. Different functions could be included in the travel guide. Besides navigation, users could look at pictures or read stories related to a site, as well as receive event dates (Madlmayr & Scharinger, 2010; Reddman et al., 2009).

Figure 6: NFC City-Guide including NFC advertising boxes

Source: VTT Technical Research Centre of Finland (2009).

- *Access to services:* Users could gain easy access to certain points of interest (such as congress rooms, pools or saunas), their hotel room or a rental car that they have already booked in advance (Madlmayr & Scharinger, 2010; Öztayşi et al., 2009).
- *Location-based services*: Location-based services are services that are offered via customers' mobile phone and based on their actual location by making use of the geographical position of the mobile phone (only generated when carrying a mobile phone with positioning technology). Since a city usually offers more than one event per day, it is difficult for tourists to make choices about which event to attend. It is possible to recommend events that are either geographically close to the mobile phone holder, making ad-hoc visits possible, or to recommend those events that are most popular among residents (Quercia, Lathia, Calabrese, Di Lorenzo & Crowcroft, 2010). It is also possible to integrate a social component into the NFC services. The snowboarder community platform 'All-I-Touch' is a service that provides product information at the point of sale and allows users to post status updates within social networks (Facebook), such as where they have been, who they have met or what they have bought by simply waving their phones over NFC tags placed on products, places and people (Kneissl, Rottger, Sandner, Leimeister & Krcmar, 2009).
- *Smart poster:* If information and actions are triggered by an NFC tag on a poster it can be called a 'smart poster'. This means the poster can store additional information about itself. A poster advertising a movie could, for example, include a 'buy tickets' tag that would open a web browser to purchase a ticket when an NFC-enabled phone is swiped over it – also allowing a seat reservation. It could also store additional background information about the movie, e.g., the trailer opening up on the display when the corresponding button is touched or the possibility of downloading the soundtrack (Tuikka, 2009). The use of smart posters is also interesting for museum exhibitions, theatres or other events.

Figure 7: Smart poster



Source: VTT Technical Research Centre of Finland (2009).

All the above-mentioned applications could potentially be integrated into one application and turn the smartphone into a multipurpose travel companion (Reddman et al., 2009). Before starting a holiday, the companion could be used to plan the trip and receive detailed information about the destination and specific points of interest. The information can be received through the travel diaries, tips and pictures that other people place in social networks. During the trip a map provided with NFC tags or kiosks located at key points (such as car parks or train or bus stations) could be used to download all relevant tickets and information from the respective websites and links connected to the NFC tags (Baldo, Benelli & Pozzebon, 2010). Tourists could engage themselves personally and write their own travel diaries or upload pictures related to that location for the information of future tourists. After the trip, the travel companion could function as an online travel diary for the tourist and his friends (Reddman et al., 2009).

NFC technology is potentially interesting for tourism providers, especially with regard to branding and marketing possibilities (Pesonen & Horster, 2012). However, destinations need to agree on one application that harmonises all NFC services. Using the same logo could help to avoid confusion (Madlmayr & Scharinger, 2010). The NFC travel companion outlined here could offer another possibility for harmonising services within a city or a region. However, high roaming charges present a serious drawback for entirely Internet-based services, especially with regard to international tourists. Moreover, smartphone usage is increasing, but at present, older generations remain less likely to download applications (Zoltan & Masiero, 2012).

5.4. Intermediaries

It is likely that, in the future, ticketing applications will evolve to be integrated into bank cards and/or NFC-enabled smartphones. According to a consultation of practitioners, ticketless payment systems will become widespread and the technology behind it will be driven by NFC-enabled mobile phones (AECOM, 2011). Prepaid smart cards will then become obsolete. Instead users will pay with their phone bill or by credit card. This would move the cost-intensive card-reader infrastructure to back-

office computers and open up the benefit of universal payments that are compatible with other systems in any other city or region. However, while on the one hand this development will lead to reduced one-off costs for the corresponding infrastructure; it will on the other hand bring even more stakeholders on board, making it harder to reach agreement.

Summarised under the term 'intermediaries', telecommunications operators' and financial service providers' role in integrated ticketing will be illustrated in the following discussion. Of course, there are also several other intermediaries who have important roles to play (such as equipment suppliers, ticket issuers, service suppliers, deal brokers). For the purpose of this study, however, we will take a closer look only at the above-mentioned stakeholders, as these are the ones who could bring the development an important step forward.

5.4.1. Financial service providers

As banks start issuing contactless cards, using bank cards to pay for public transport at specific access points will become an issue. The consultation of the practitioners' panel within the AECOM (2011) study indicated that financial service providers (e.g., Visa and MasterCard) need to be brought on board, as they are already pursuing contactless payment standards, business models and solutions which could be used Europe-wide. Apparently, the financial service sector is continuing with the roll-out of contactless technology and is considering the e-ticketing market as a future business option for their services. The AECOM (2011) study also conducted a separate consultation with financial service providers. This consultation made it evident that they view their platform and business models as something upon which public transport operators could build their services and that this would deliver the greatest benefits for all (consumers, financial service providers and public transport operators). The fragmented nature of integrated ticketing markets across Europe was mentioned as an opportunity to introduce their services in the ticketing environment, in order to enable systems to be interoperable – with the long-term goal of achieving global interoperability. It is believed that the European Commission's approach of a Single Euro Payments Area should be taken in relation to smart ticketing. The key driver for the financial institutions is the replacement of small cash transactions with e-payments. As the (public transport) ticketing market is traditionally a market with small cash transactions, this would be a good starting point. A lack of open data on global fare collection and the presence of some 'ticketing traditionalists' (AECOM, 2011:91), who are not open for new technologies, were mentioned as major hindrances. Another major barrier is the implementation costs that the financial service providers would have to pay (e.g., issuing contactless cards and corresponding promotion campaigns) (AECOM, 2011).

Table 17: Costs and benefits for financial service providers

Costs	Benefits
Implementation costs: issuing contactless cards; promoting services to end-users and public transport authorities)	Ticketing offers a well-established market segment and thus a strong potential for additional transactions
	Pushing forward the general acceptance of e-payment; replacing small-cash transactions and thus reducing cash handling costs

5.4.2. Telecommunications operators

Telecommunications operators are also entering the market as NFC chips are increasingly being built into mobile devices, and market analysts are forecasting an even quicker market penetration if a mass-market application like e-ticketing should evolve (Stroh et al., 2007). In this case, the telecommunications operators would bring in the necessary access to the customers' mobile devices. They would probably also be responsible for the development and management of NFC applications on the devices. According to Turner & Wilson (2010), nine out of ten trialists were happy using NFC technology during a trial of Nokia handsets featuring an Oyster application (London). Telecommunications operators are interested in the additional use of their networks infrastructure. They are also in need of additional services for attracting additional customers and retaining existing ones. NFC-enabled e-ticketing is said to be a so-called 'killer application', generating an increasing amount of GSM/UMTS transactions (Stroh et al., 2007).

Table 18: Costs and benefits for telecommunications operators

Costs	Benefits
Implementation costs: building NFC chip into mobile devices, possibly promotion campaigns to motivate customers to use NFC	Ticketing offers a well-established market segment and thus a strong potential for additional GSM/ UMTS transactions
Costs for the development and management of NFC applications for ticketing	Additional services generated by NFC technology might attract and retain customers

5.5. Existing and potential end-users

To provide an overall socio-economic perspective on integrated ticketing, existing and potential end users need to be taken into consideration in more detail. They are particularly important, as they are the ones who ultimately need to purchase the product, based on their preferences and willingness to take part. Traditionally, using public transport has required a lot of 'inside knowledge', e.g., regarding tariffs and available ticket options, but also on how to handle a ticket machine (Maertins & Schmöe, 2008). According to Eisenkopf (2013), the main barrier for multimodal travelling is a lack of seamless options and the highly complex transport networks. The attractiveness of public transport therefore increases as it becomes easier to use. Modern check-in/check-out systems accept mobile phones (or smart cards) as access mediums to automatically calculate the 'right ticket', and they could thus free potential customers from difficult purchase decisions. According to Iseki, Demisch, Taylor & Yoh (2008) end users are the main beneficiaries of integrated ticketing. A consultation of scheme operators came to the conclusion that smart ticketing brings a variety of benefits to users. Smart ticketing is considered 'to be a lot more reliable, convenient, faster and easier to use' (AECOM, 2011:10). It also aims to offer greater flexibility within tariff structures. It was explicitly stressed that it brings greater flexibility for users if personalised travel costs can be offered, e.g., tailored to the most frequent journeys. However, it needs to be emphasised that this is the operators' point of view; in this study no users were asked about their personal opinions of or experiences with the systems. Other studies analysing the effects of smart card implementation usually point out that the most direct benefit for end users is time saved in purchasing tickets (Welde, 2012; Cheung, 2006; Iseki et al., 2008; McHardy et al., 2005). Wood, Downer & Toberman (2011) conclude that users may also enjoy improved access to the services that are combined on the card, while they only need to register once to access all available services. In some systems, users can also make cashless payments without the need to have a bank account. The authors also point out that cards offer the possibility of tailor-made services and that

users may benefit financially through retail or other service discounts. However, all benefits come at a cost. Introducing a new fare medium means a burden in using it, and it requires time to learn handling it. The highest cost that users must pay, although this cannot be monetised, is the personal information they need to divulge (such as age, gender, frequency of travel and travel preferences) – often without knowing to whom (see textbox on page 57 for detailed information on data security).

Table 19: Costs and benefits for end-users

Costs	Benefits
Burden of using new fare medium; time needed to learn handling of the new medium	Improved convenience: no (exact) tariff knowledge needed (if automatic price calculation is available), no need to take card out of the wallet (if contactless); online top-up usually possible; no need to have cash
Costs for purchasing the card	Time savings due to faster fare processing
Need to divulge personal information	Cost savings due to loyalty programmes and individually targeted services (if existing)
	Improved access to and integration with other services
	Improved availability of real-time service information (especially when mobile phones are used)

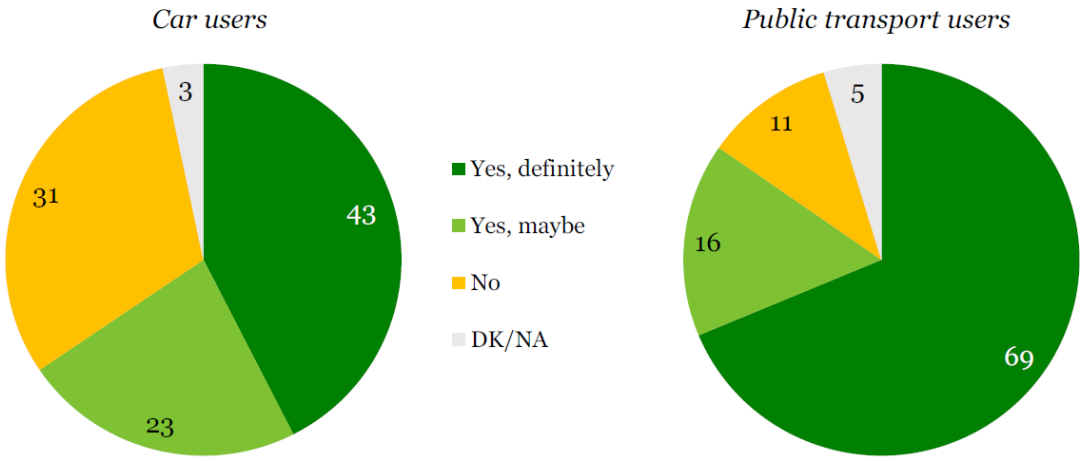
The tremendous growth in the number of mobile handheld devices, such as Internet-capable phones, tablets or PDAs promises faster take-up rates for mobile ticketing. There are two main reasons for this: On the one hand, increased use of customers' mobile phones could free issuers of integrated ticketing systems from the (often financial) burden of setting up an infrastructure (e.g., for ticket machines or access control systems) (see chapter 5.2). On the other hand, customers perceive their mobile phones as 'part of their private sphere', which provides a 'feeling of familiarity and instant availability' (Maertins & Schmöe, 2008:82). Additionally, using individual (familiar) devices increases feelings of affinity and trust towards new and unfamiliar surroundings, and it allows individualised access to public transport (Maertins & Knie, 2008).

Indeed, smartphone penetration is growing continuously, being most popular among 25–34 year olds. Additionally, QR codes (see chapter 3.2.1) are frequently used; in December 2011, between 10.1% and 15.6% of members of this age group in the EU5 countries (Germany, France, Italy, Spain, UK) scanned a QR code with their phone, primarily to receive product information. Almost one third of the scans resulted in a coupon or offer, and almost a quarter of the users received event information (comScore, 2012). Results of an empirical study on user acceptance of m-payment show that those users who can be described as early adopters and who have significant knowledge of m-payment do not have difficulties in adapting to m-payment. Primarily, perceived ease of use and perceived utility were found to be significantly correlated with the use of m-payment (Kim, Mirusmonov & Lee, 2010). For public transport ticketing, only very few studies exist that explicitly take into account user needs and expectations regarding integrated ticketing:

- Results from the Flash Eurobarometer 'Future of transport' (European Commission, 2011) indicate positive expectations for a European integrated-ticketing scheme, and there seems to be

considerable potential for motivating car drivers to engage in modal shift. The survey carried out telephone interviews in the 27 EU member states. A total of 25,570 interviews were conducted. Citizens were asked about their transport habits and their views on various transport policies. One set of questions dealt with the introduction of a Europe-wide single ticket covering all transport modes. One in two EU citizens said they would definitely use public transport more frequently if a single ticket for their complete journey were available. Especially 15–24 year olds, students, metropolitan residents and non-working respondents were more likely to give this answer. Interestingly, about 43% of car drivers said they would definitely use public transport more frequently if a single ticket for all means of transport existed. Figure 8 indicates that a smart ticketing scheme was more attractive to existing public transport users than to car users. The method used in this survey was a stated preference method, which is seen critically among opinion survey practitioners. It is the nature of these kinds of surveys that they are hypothetical. Hypothetical questions are often answered with an upward bias that arises when a question is asked with which the respondent has no market experience. There is often a significant divergence between stated and actual behaviour. The stated intention of using public transport more often in the case of having the ability to use a single card could therefore be estimated too optimistically by the respondents. In the literature on opinion surveys, a common explanation for this is that respondents want to please the interviewer. Another explanation is that the standard form of a contingent valuation question does not offer the chance to discuss and interact with others (Hausman, 2012). The results presented should therefore not be seen as future predictions, but rather as a positive evaluation of the hypothetical possibility of having a Europe-wide integrated ticketing scheme.

Figure 8: Would respondents consider using public transport more frequently if it would be possible to buy a single ticket covering all possible transport modes?



Source: European Commission (2011).

- According to AECOM (2011), end users' reactions regarding the possibility of having additional payment options embedded in bank cards or mobile phones for the use of public transport range from 'quite positive to slightly sceptical' (AECOM, 2011:12), at the same time, serious concerns also exist regarding security risks (especially risks of theft and loss). Research has showed that there seems to be latent public support for public transport smart cards and a ticketing system that is easy to understand. In particular, those who use public transport on a regular basis and those who are not familiar with all available ticket options, such as tourists, are most likely to use smart ticketing media. According to AECOM (2011), technological awareness is not especially relevant as long as the interface is simple and intuitive to use. However, the authors emphasise that the availability of different payment options seems to be important for users: they want to be

able to decide whether it is more comfortable for them to use smart cards, bank cards, mobile phones or paper-based tickets.

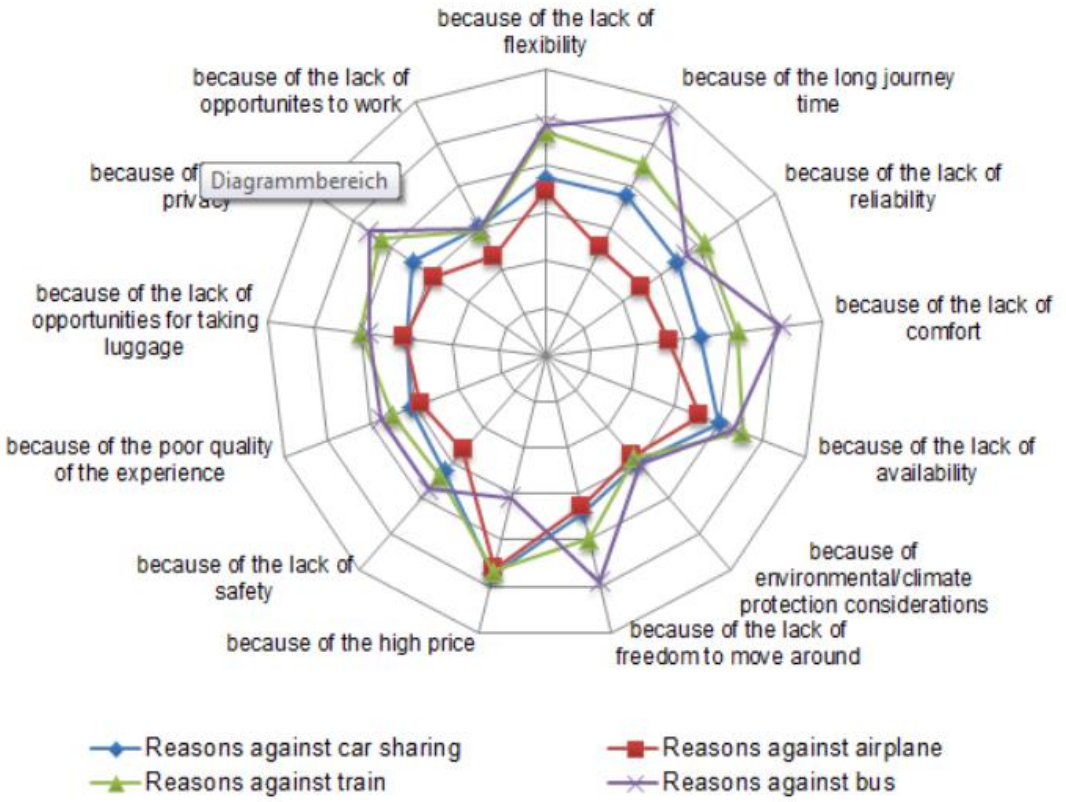
- A 'friendly user trial' was initiated for the Ring & Ride services for trips with Berlin's public transport. Ring & Ride was a field trial in Berlin for testing the desirability and feasibility of a multipurpose mobile ticketing scheme for public transport. A total of 90 people took part in the trial, which conducted more than 2500 trips. Fifty-two of the trialists were interviewed further after the trial. Almost all trialists said that Ring & Ride was an interesting option for purchasing tickets and that it was innovative and modern; around half of them said that they would use the service without hesitation under real conditions. Interestingly, regular customers and those in possession of period tickets said that they did not have concrete plans to use the scheme. In particular, young and middle-aged people living in cities that emphasise flexibility and independency were attracted by the approach. All trialists reported that they had to get used to check-in/check-out procedure[4] and to the automatic billing afterwards. Those who use public transport regularly and hold a monthly or annual pass found it more difficult to adjust to the new procedure. For the customers, the automatic billing meant a loss of control over ticket choice and fares, which could be seen as positive for those not at all familiar with local tariffs (such as tourists), but the trial showed that this loss of control could mean a burden for cost-sensitive users and those who use public transport only occasionally. Additionally the trial demonstrated that confidence in the technology and company is of crucial importance for the success of the scheme. This confidence can be earned through a maximum level of transparency and additional possibilities for individual control (Maertins & Knie, 2008; Maertins & Schmöe, 2008).
- Another field trial has been reported from London. It has already been mentioned that telecommunications operators are increasingly embedding NFC chips in their products. However, the acceptance of NFC-based applications is of the utmost importance for the success of integrated ticketing systems based on this technology. In a field trial by O2 and London's transit card system, 'Oyster' (see chapter 4.1), users of NFC-enabled handsets were allowed to pay for their Oyster card and small purchases in shops by swiping their phone over a reader. O2 reports that 90% of the trialists were content with the technology and 22% reported increased usage of public transport (Turner & Wilson, 2010). In another trial at a university campus in Hagenberg, Austria, 74 people who were particularly interested in the technology were able to try out different services, such as building access and payment functionalities, or use an information terminal with their NFC-enabled phones. A total of 83% of the trialists were satisfied or fairly satisfied with the functionalities. Compared to card-based systems, the NFC technology was perceived as 'cooler' (97%), more convenient (92%) and more user-friendly (89%) (Madlmayr & Scharinger, 2010).

However, some less positive examples also exist. In the Netherlands, there are the unpublished figures on passenger development since the introduction of the OV chipkaart (see chapter 4.9): Veolia reports a passenger decline of 10% (Pro Bahn, 2013). Other examples have been reported from Germany: contrary to expectations, the system in Münster (PlusCard) has showed only moderate success. The system in Hanau is going to be suspended due to lesser revenues than expected. In particular, heavy public transport users in Germany do not seem to accept the systems (Pro Bahn, 2013). Nevertheless, passenger organisations argue that there are still inadequacies in the implementation of integrated ticketing schemes. Their attitude towards these schemes can be described as 'positively critical'. It is emphasised that innovative e-ticketing schemes could entail the potential to enhance the quality and attractiveness of public transport. However, there are still some critical points that need some attention (Pro Bahn, 2013; Verkehrsclub Deutschland, 2013):

[4] There is no access control for public transport in Berlin.

- The automatic calculation of fares implies a general confidence in the pricing policy of the public transport operator, and it is not always clear how to achieve this.
- There need to be some sort of regulations about how to deal with difficulties, for instance, if users forget a check-out validation or if the billing shows irregularities.
- The same applies for the cases of users who forget or lose their smart card, of unauthorised use occurring or of technical problems.
- Furthermore, integrated ticketing should be voluntary, meaning that people who do not want to use that system or who do not have a bank account require different options for paying for public transport in the future.
- The introduction of integrated ticketing schemes often goes along with major cost reductions, including reductions in the number of service points. This is inacceptable from the passenger associations' point of view.
- A more flexible use of modes and easy interchanges are undoubtedly beneficial for end users, but the most striking characteristic of end users is that they are not a homogenous social category. They represent a 'multiplicity of perspectives, ideas, social backgrounds, and life histories, not to mention wants and needs' (Rose, 2001:68). User transport habits and preferences change depending on the circumstances. Transport behaviour depends on individual trip purposes (e.g., daily trip or leisure time trip), travel distances and the area passengers are going to (rural or metropolitan). Moreover, habits, attitudes and preferences play a decisive role in transport behaviour (STOA, 2012). The majority of EU citizens use a car on a daily basis and 22% use public transport. These numbers vary depending on the country, e.g., in the Czech Republic 37% and in Cyprus only 5% use public transport on a daily basis (European Commission, 2011). For reaching holiday destinations, the car or motorbike is seen as the most likely means of transport for the majority of Europeans (European Commission, 2012a).
- This leads to the question of what kinds of improvements in public transport are most likely to encourage people – and predominantly car users – to get in touch with public transport. Many studies have been published that examine customer satisfaction with public transport. These studies reveal that several service aspects need to be addressed in order to improve perceptions about public transport. The most common attributes include service aspects (e.g., reliability, minimal waiting times, punctuality, simplicity of information), comfort (e.g., cleanliness of vehicles, availability of seats, staff behaviour) and the perceived value for money (Diana, 2012; Fellesson & Friman, 2012; Lai & Chen, 2011; Cantwell, Caulfield & O'Mahony, 2009; Tyrinopoulos & Antoniou, 2008; Friman & Gärling, 2001). According to the All Ways Travelling Consortium, the primary reasons for not choosing a bus were the long journey time, but also the lack of comfort, flexibility and availability (Eisenkopf, 2013) (see figure 9).

Figure 9: Reasons for not choosing certain modes



Source: Eisenkopf, A. (2013)

Many car drivers perceive public transport as inconvenient. Integrated ticketing aims to rectify this perception. A lot of research has addressed the question of why car users do not use public transport. It seems that for people who are unfamiliar with public transport use, 'a lack of information and motivation, and incorrect perceptions of the alternatives to the car' (Brög, Erl, Ker, Ryle & Wall, 2009:281) are key barriers. In keeping with this, the previously mentioned Flash Eurobarometer study concludes that most of the car users felt that public transport was not as convenient as a car and that low frequencies prevented them from using it. Almost half of the respondents said that public transport was too expensive and that there was a lack of information (European Commission, 2011). Redman, Friman, Gärling & Hartig (2013) use a qualitative systematic research review[5] to assess which quality attributes of public transport are most likely to attract car users. Seven quality attributes are considered to be important:

- *Reliability* is one of the most frequently addressed attributes and refers basically to infrastructure improvements, such as new bus lines or priority lanes.
- *Frequency* of public transport services is also highlighted as a significant factor; it also includes the reduction of waiting times between services.
- *Pricing* refers to incentives such as periods of free public transport, transferable ticketing, reduced ticket prices or attempts to combine price attributes with customer loyalty and cooperation with service providers.
- *Speed* also refers to infrastructure improvements such as additional public transport lanes, but also to reduced waiting times.

[5] 74 studies were analysed.

- *Access* is determined by the density and location of public transport nodes. This notion of access also refers to infrastructure improvements.
- *Comfort* is understood in terms of improved standards for vehicles and stations, such as low-floor buses, new bus shelters, vehicle cleanliness, security and improved complaints handling.
- *Convenience* refers to the ease and simplicity of paying for and planning a public transport trip.

The authors conclude that quality improvements can indeed motivate private car users to use public transport, but exactly which improvements are necessary and promising depends heavily on the context and the individuals' motivation for using a car. In some cases it might be enough to improve only one of the mentioned attributes, but in other circumstances a whole package of improvements would need to be applied to reach significant increases in ridership levels. Of these seven attributes, only two – convenience and pricing – can be addressed directly through integrated e-ticketing. The research review reveals that all studies dealing with integrated tariff systems induced notable levels of success. Reduced fare promotions, a feature that is often referred to as something that smart ticketing can offer, are indeed able to succeed in encouraging car users to try out public transport services. However, other attributes, such as accessibility or reliability, must be present to actually sustain the shift from car to public transport (Redman et al., 2013).

As already outlined above, in urban areas, tourists seem to behave similarly to locals from a transport perspective (Dominicus, 2013; Gronau, 2013). It can be observed that tourists see using public transport as a part of the experience of visiting a destination (Gronau, 2013; Ruggles-Brise, 2009; Thompson & Schofield, 2007); public transport is 'considered as an additional tourism product' (Le-Klähn, 2013:77). Thompson & Schofield (2007) examine the relationship between public transport performance and tourist satisfaction and come to the conclusion that ease of use has a greater impact on satisfaction than efficiency and safety. Other studies show that, besides ease of use, comfort (e.g., cleanliness, seat availability) and a better value for money (e.g., ticket price, provision of information) contribute to tourists' satisfaction with public transport (Werner Gronau, 2013; Le-Klähn, 2013; Ruggles-Brise, 2009; TNS Travel & Tourism, 2008). Integrated ticketing might support some of the above-mentioned dimensions of tourists' satisfaction with public transport. However, while transport seems to be a major factor influencing the 'experience' of a destination, Ruggles-Brise (2009) discovered for London that the experience of public transport would not affect their decision to return to the destination.

To better understand which benefits can be expected when introducing integrated ticketing schemes, it is helpful to take a closer look at already established ticketing schemes. In an effort to shed light on passenger choices in a recently introduced ticketing system, Graham & Mulley (2012) examined the ticket purchasing behaviour of the passengers of a private bus operator in northern Sydney before introducing a new prepaid scheme and after the introduction of the 'My Zone' product. My Zone tickets can be used across operators and modes throughout the Sydney metropolitan region. Previously, all operators had their specific prepaid tickets, which could not be used for other operators. The ticketing reform created two different prepaid tickets: an unlimited ride, multi-mode ticket and a pay-as-you-go ticket, which allows passengers ten trips within a specified number of zones and with discounts relative to the equivalent cash fare. The results of the study show 'that there are significant differences in the markets for multi-modal versus pay-as-you-go tickets, and that this difference is driven largely by age, income and whether or not the journey involved interchange" (Graham & Mulley, 2012:70). They conclude that a supply-side-oriented 'one size fits all product' does not sufficiently address user needs. Instead, the ticketing system 'needs to respond to the journey needs and the characteristics of different users and any new "smart" ticketing will still have to offer multiple broad product types, which appeal to these groups.' (Graham & Mulley, 2012:75). Another

example for the importance of taking user needs into consideration also comes from Australia. Wilson (1999) outlines the change in Melbourne, Australia, from a simple manual system (the Travelcard) to an automated public transport ticketing system (the Metcard), which has been criticised heavily. Users perceived the existing system as effective, while the government and the management perceived this system to be labour-intensive and ineffective and therefore decided to introduce the new system. Apparently, the introduction of the Metcard was accompanied by major delays due to technical details that needed to be fixed; this changed the initially positive expectations into negative ones. For its users, the introduction of the automated ticketing system appeared to complicate the relatively simple and convenient ticketing system that was already in place. Wilson emphasises that it therefore needs to be very simple to explain the change to a system to all involved stakeholders: '[m]anagement of stakeholder expectations in a change process is of paramount importance to the eventual outcome' (Wilson, 1999:23).

The AECOM (2012) study also emphasises the appreciation of end users' perceptions. The authors conclude that smart cards are interesting primarily to the younger generation and to frequent users of public transport. But the older generation is also likely to adopt smart ticketing if they can be shown that it is easier to use than manual systems. A variety of features for increasing acceptability have been identified: the card should combine all operators and modes on one card, top-up should be as convenient as possible, the readers installed should show the remaining balance and the tickets should be flexible (permitting both period tickets and a pay-as-you-go option); they also should not expire and they should allow registration to prevent misuse. Nice-to-have features could include loyalty reward programmes, additional modes (such as bike or car sharing), the capacity to overdraft and the ability to pay for other peoples' tickets. The incorporation of particular attractions into the schemes might encourage those users to try out the new technology that usually prefer more human interaction than smart cards provide (AECOM, 2011).

However, technology adoption rates depend not only on the availability and reliability of the technology itself, but also on factors that can vary across different countries or regions. This can be due to the degree of government intervention, economic power, lifestyles or geographic disparities (Jing & Rong, 2010). Technologies, notably innovations, need to fit into certain social contexts in order to be accepted. These contexts comprise economic, social and cultural factors, as well as lifestyles and epochal mentalities. Innovations are successful not because they are dictated politically as a factual constraint, but because they convince through quality, service and price and because they fit into the socio-economic contexts of their time (Grunwald, 2012). It needs to be considered that people use ICT in various social contexts and in various roles. More information is needed on users, on how e-ticketing solutions are used – when, by whom and why.

Table 20: Possible role and benefits of the different actors involved

	Possible role	Possible benefits
	**Public transport operators**	
	Offer a well-established market segment (either existing users or additional passengers who will be attracted through the new medium); information about tariffs and prices	Increased revenue if passenger levels increase; faster throughput of passengers; reduced operating costs; reduced transaction costs; acquisition of accurate data on passengers
	**Tourism sector**	
	European cities - as main touristic destinations and major centres of entertainment activities - offer a well-established market segment	Provide innovative branding and marketing opportunities; acquisition of accurate data on tourists' behaviour; additional features possible (e.g. smartphone-guided city tour, location-based services)
	**Telecommunications operators**	
	Provide access to customers' mobile devices; development of NFC applications for these devices	Additional services generated by NFC technology might attract and retain customers; ticketing offers strong potential for additional fees for GSM/ UMTS transactions
	**Financial service providers**	
	Develop interoperable application software; access to technical assistance and expertise; issuing contactless cards and promoting them to end-users	Pushing forward the general acceptance of e-payment; replace small cash transactions and thus reduce cash handling costs; ticketing offers a well-established market segment and thus a strong potential for additional transactions
	**Government and other administrative authorities**	
	Provide strategic leadership (e.g. provide incentives, encourage use of standards); support the roll-out (e.g. through additional funding); engage in the integration of existing schemes and coordination of stakeholders	Reduction of congestion and car-based emissions; providing identity to the community; improved economic conditions for companies
	**Existing and potential end-users**	
	Purchase the product they require based on their preferences and willingness to become involved	Enhanced ease of use, more flexible mode choice and easier interchange; saved time and money

6. STOA WORKSHOP

The aim of the workshop was to present a comprehensive picture of integrated e-ticketing solutions combining public transport and touristic features and to discuss the potential of these schemes for the transport and tourism sectors as well as for end users. As in this report, the focus lay on the different actors that are important for a successful implementation and on their views regarding future developments. Presentations included the interim results of this STOA project as well as an assessment of the current state of the art by representatives and experts from the transport and tourism sector.

The workshop was chaired by Antonio Cancian, MEP on the Transport and Tourism Committee; it included five presentations. Every presentation focussed on a different actor and their specific views on the future development of an integrated ticketing scheme and was followed by an open round-table discussion. Approximately 30 people participated in the event.

The main conclusions of the workshop can be summarised as follows:

- Especially from politicians' point of view, two challenges need to be addressed: how to maintain customers' privacy and ensure effective data protection and how to avoid cartels or monopolies.
- Data security is a highly relevant issue. It is not clear how potential users will react to tracking technologies and if these would mean a hindrance to implementation.
- Tourists want to 'experience' their destination, including public transport. This makes them an ideal target group for integrated ticketing. Data shows that, from a transport perspective, tourists often behave like locals. However, their expectations regarding public transport often differ from those of locals. Ease of use, available information and a good cost-benefit ratio are seen as important aspects.
- Combined offers encourage tourists to use public transport and to see and do more. The example of Amsterdam shows that, after some time and with appropriate offers, visitors prove ready to expand their activities into the region.
- The additional income that tourists bring to public transport companies can help to lower the operational costs of public transport and to extend peak times.
- Integrated ticketing is just one aspect of high-quality public transport; other attributes must be kept in mind as well.
- All involved stakeholders need to cooperate in order to find new solutions and to develop appropriate business models. In the case of integrated ticketing, a combination of scheme interoperability, the travel information market and third-party involvement should be sought. It needs to be ensured that small- and medium-sized companies are considered sufficiently.
- A one-size-fits-all solution is neither feasible nor desirable. Local solutions and integrations seem more realistic.

7. POLICY IMPLICATIONS

Several studies have been published that give clear policy implications/ recommendations, for policies at the European level as well. These studies emphasize that there is no universal "optimal ticketing system", as legal framework conditions for governing a public transport network are distinctive (see e.g. Urban ITS Expert Group, 2013b; AECOM, 2011). Before deciding on the exact nature of a smart ticketing system it needs to be considered what kind of existing infrastructures are currently in place or how funding is organised. The importance of the local level is emphasized explicitly by the Urban ITS expert group: "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" (Urban ITS Expert Group, 2013b:24). Also the recently established smart ticketing alliance promotes the idea of compatibility, rather than identical commercial structures (see chapter 2.2.1). Local stakeholders have a better overview of local issues, for them it is easier to identify which services to take on board and how to finally design tariff models. With respect to end-users, a one-size-fits-all solution appears hard to communicate. For example, explaining customers that special offers (such as special prices for group tickets) are no longer available, because it is neither available elsewhere, seems not very reasonable. As a first step, it seems advantageous to develop consistent branding signs or logos to simplify access to public transport; e.g. that a day pass receives the same logo in Berlin and in Brussels.

Even though studies emphasize the importance of the local level, this does not mean that there is no need for European policy to become engaged in this matter. Mutual learning through exchanges of experiences is seen as an important step towards successful integrated e-ticketing schemes that is best organised on a European level. In line with the idea of compatibility, the Urban ITS Expert Group published a collection of best practices of urban Intelligent Transport Systems (ITS) applications in order to support "cross-fertilisation among stakeholders" (Urban ITS Expert Group, 2013a:3). AECOM recommends to support demonstrating projects on European level, to set up quality indicators and proven cost-benefit analysis in order to help in making the benefits for each stakeholder more transparent (AECOM, 2011). The socio-economic perspective on the ticketing environment reveals that networking between stakeholders is fundamental to a successful implementation. Not only technological challenges need to be solved - even though they are undoubtedly important to clarify. Renewing a system that involves many stakeholders and that represents a novelty to the consumers needs to go beyond the level of technical components. Integrated ticketing schemes gain in attractiveness as more partners are involved, because this means more opportunities for the customers. The challenge for policy makers is to coordinate this cooperation among diverse stakeholder groups and to manage the stakeholders' expectations. According to Wilson (1999), dissent and debate among stakeholders are key to success and should thus be strived for, as only negotiations disclose the different expectations and lead to agreement. Before starting the roll-out, it must be clear how much it will cost and how it will benefit each participating stakeholder. Case studies should be made available that clearly demonstrate the length of time and the resources required. This also includes the systematically evaluation of failures in implementation and accompanying research to record user needs and expectations.

The composition of the public transport customers is crucially important when setting up an e-ticketing scheme. End-users are no homogenous group; they have different transport demands, depending on their travel purposes (e.g. tourists, daily commuters, occasional users). An e-ticketing scheme that aims at gaining additional customers needs to define their target group clearly and to develop a ticketing strategy that matches the needs of this group. Research is needed on the social dynamics and contexts linked to the introduction of smart ticketing schemes. More information is needed on potential end-users, on developing and desired transport patterns, expectations and

demands as well as on how to best integrate a ticketing scheme into users lives. Before setting up a ticketing scheme, it should be evaluated whether or not users desire a change and if so, what it should look like.

It can be concluded that the context of an implementation process, especially the composition of stakeholders that participate in the process, is heavily important. For a successful implementation it is fundamental to capture the stakeholders' expectations, preferences and priorities in order to understand their diverse interests and possible inter-relations. The development of joint visions can help in structuring and managing these expectations. Roadmaps can help to agree collectively on actions. Furthermore, user needs are particularly important. It should be considered that users are not a homogenous social category. It is especially important to cluster user needs according to the target group they belong to. Digital natives certainly have different demands than elder people, and likewise do tourists desire different products than daily commuters.

8. CONCLUSIONS

There seems to be a considerable demand, and thus a potential for integrated e-ticketing in Europe. According to the Flash Eurobarometer 312, one in two citizens of the EU-27 would use public transport more often if a single ticket for all means of transport was available. Of course, this number cannot be taken for granted, as the question was hypothetical and responses are therefore likely to be upward–biased. Still, it shows the positive attitude Europeans have towards integrated ticketing solutions. Moreover, the recently completed STOA study on eco-efficient transport involved a consultation of stakeholders and scientists from the transport sector. The results show that a large majority of the survey respondents see a very high degree of desirability in setting up an interoperable electronic ticketing application for public transport. Studies on peoples' perceptions of public transport show that some aspects perceived negatively by car drivers could be targeted by integrated ticketing solutions (convenience and pricing) and could help to make car drivers try out public transport. Still, additional service improvements would be necessary to actually sustain modal shift. The socio-economic perspective of the study reveals that particularly tourists would profit from integrated ticketing schemes, as they usually seek for local experiences. Public transport can be a part of this experience, especially in urban contexts.

Various cities and regions all over Europe are setting up e-ticketing schemes with different scopes and focuses. The most highly developed systems in terms of technology and number of users, but also in terms of scientific analysis, can be found in the public transport sector. On the one hand, most public transport operators have a long history of experimenting with various forms of automatic fare collection systems. On the other hand, public transport is attractive for intermediaries who are becoming increasingly involved in the area of smart ticketing. The intermediaries that are coming on board are financial service providers and telecommunications operators, for whom ticketing offers a well-established market segment. Financial service providers bring in technical expertise and see a strong potential for additional transactions and hope that e-ticketing pushes forward the general acceptance of e-payment. For telecommunications operators e-ticketing (provided by phone based payments) offers a strong potential for additional fees for GSM/ UMTS transactions, while they provide access to their customers' mobile devices.

Most experts agree that multiple services, such as those for purposes of tourism or leisure or e-payment, seem to have a considerable attractiveness for the public transport sector, as this means added value for their customers. One of the most important benefits for the public transport sector, as well as for other stakeholders, is the large amount of accurate data that can be secured through e-ticketing systems. This data collection makes it possible to create a precise picture of people's travel behaviour, spending habits and preferred places to be. This information can be used to better exploit the network's capacity, to offer personalised advertising, or to run loyalty programmes. Customers can expect lower prices, more efficient services and time savings. However, this bears the risk of misuse, either through unauthorised parties or through the enterprises themselves. Potential threats also relate to informational inequality, because the information a person obtains could be filtered according to his or her travel characteristics and preferences. Since data collection occurs mostly invisibly, individuals could feel that they are losing data privacy and the right to control information about themselves. It is not clear to what extent users will be willing to take part in the implementation without strong data protection regulations.

Nevertheless, the most successful e-ticketing schemes in Asia are characterised by the large range of services offered to their customers; smart cards can be used to access buildings, as a means of payment at retailers and at vending machines or for leisure activities. Target-group-specific and locally well-integrated schemes seem to be most successful. Tourists are without a doubt a promising target group. In Europe, the tourism sector seems to offer great potential for the public transport sector, as

European cities are major tourist destinations and major centres of entertainment. Changes in lifestyles have caused tourism- and leisure-related mobility to become an important market segment for public transport. Especially city trips lasting a few days, unique cultural or sport events and leisure activities lasting a few hours have become an interesting field of operation for public transport and allow for additional passenger volumes. However, user numbers will certainly not take off by themselves: they require proper investments and quality improvements to address public transport rejecters, as well.

For the tourism sector, involvement in the public transport e-ticketing environment literally means a physical connection to the most remarkable points of interest, and it offers innovative branding and marketing opportunities. The already widespread destination cards, which many cities and regions offer, usually unite the most important tourist attractions and are an important marketing tool. However, in the case of destination cards, the technology behind the schemes seems to be of minor importance; the central element of a destination card is not the medium itself, but the promise of the experiences to be had at a destination. Nevertheless, ICT is playing an increasingly important role in tourism and particularly smaller companies need to find their niches in attracting travellers. E-ticketing and additional services might be an interesting opportunity to do so.

Regarding public transport, there is at least one reason to doubt that the introduction of integrated e-ticketing will have a large effect on modal shift. There is evidence that car drivers can be attracted to public transport by quality improvements. Indeed, integrated e-ticketing solutions mean greater convenience for users, especially in terms of a more flexible mode choice and easier interchanges, in terms of money and time saved, and in terms of the better availability of real-time information. And indeed, several long-term studies prove that integrated services can produce changes in travel behaviour. However, other improvements designed to increase reliability, speed or frequency play a decisive role as well. It is therefore likely that an e-ticketing system alone is not sufficient to attract car users, and that it needs to be accompanied by further quality improvements, such as those mentioned above. For existing public transport users, integrated e-ticketing could, however, remarkably enhance the quality of their experience. It is important to note that end-users are not a homogenous group of people, which makes it difficult to speak about the demand of 'the end users'. People travel for different purposes, to different destinations and with different frequencies. Moreover, perceptions and attitudes are an important aspect of modal choice. All of these different user groups have different requirements on the refinement of an e-ticketing system. Before setting up a complex ticketing architecture, stakeholders should agree on the target-group they aim to address.

E-ticketing applications in the field of tourism might offer a great potential. Tourists experience a destination as an integrated product, including public transport, accommodation, restaurants and local attractions. Additionally, the tourism sector is moving from mass tourism to more tailor-made services for individual travellers. Integrated e-ticketing solutions might considerably enhance the user's experience, as they can integrate tailor-made services and offers into a consistent and marketable product. It is not easy to assess whether tourists choose a destination explicitly because of the availability of such integrated destination cards; however, they might be an important reason for returning to a destination. This can be supported by a product's own 'regional touch', which ensures a unique travel experience.

Most experts agree that NFC is the smart technology of the future and that phone-based applications will become increasingly important. NFC applications can integrate several independent services and hold the promise of freeing single operators from the need to set up a cost-intensive infrastructure of check-in/check-out devices. Instead, the users - with their mobile phones or with their contactless bank cards - provide a large portion of the necessary infrastructure. Modern contactless (be-in/be-out) technologies in public transport, for example, do not even require the passenger to actively register at the ticket gate. Instead, a tag at each station or in each vehicle automatically detects and registers new

passengers when they enter, during the trip and at the end to automatically calculate the most favourable fare. However, experts agree that customers want to have a choice among different payment options and that phone-based applications will not appeal to everyone. Therefore, different payment options should remain available. At present and in the medium term, smart cards offer an attractive medium to connect payment options in public transport with additional services – however, they require operators for larger investments in access control infrastructures. In either case, a change in the ticketing environment must be accompanied by a communication strategy explaining the change in detail, and emphasising its benefits for all actors that are involved in the process. For the tourism sector, NFC bears a considerable potential as well. NFC tags placed at points of interest can provide tourists with general or location-based information. Smart-phone guided city tours offer the possibility of individually exploring a destination, and NFC-enabled phones could function as a key providing access to hotel rooms, pools or hire cars booked in advance.

However, experiences with integrated e-ticketing systems prove that implementation requires great efforts, since many stakeholders need to agree on standards, overall arrangements, interfaces and designs, overall purpose, and revenue sharing. This is a difficult task in multi-actor contexts, and including further stakeholders in an environment that is already very difficult to govern does not necessarily simplify the implementation process. Each of the stakeholders has a different role to play, and for each of them, drivers or restraints apply in the decision to participate in the process or not. The case studies provided in chapter 4 shows that the context of implementation differs across different cities and regions. The exact nature of stakeholder arrangements, as well as the geographic, socio-economic and technical preconditions, are not transferrable from one case to the other. A one-size-fits-all solution does not seem desirable and feasible. Instead, a user interface is needed that is compatible with other applications, but takes into account the diversity of contexts. It should offer different payment options, include local fare policies, respect data privacy requirements, and it should be open to further development.

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This report deals with the development of integrated e-ticketing systems for public transport and touristic sites in cities. While technologies are already available and ready to meet multi-function requirements, e-ticketing has not yet been implemented on a wider scale in Europe. The implementation of an integrated e-ticketing system is a complex process that requires the synchronised activity of heterogeneous actors. Public transport operators and authorities, financial service providers, telecommunications operators, and the tourism sector need to work together to combine their products on a single card. Besides technological characteristics, legal and economic aspects play a decisive role. Stakeholders that are involved in the implementation of an integrated ticketing system need to agree on technical specifications as well as on institutional and governance issues.

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