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# Next Generation eTicketing

Innovative Near-Field Communication technology combined with a new commercial ecosystem leads to a revolution in customer convenience for public transport passengers

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## Introduction



Despite technological advances over the past ten years, paper-based tickets are still reality in public transport outside the airline world. Regardless of potential benefits for public transport operators and missed opportunities for customer service improvements, eTicketing has not yet been able to live up to its expectations. But now, with the next generation of eTicketing, a break-through is near: NFC (Near-Field Communication) technology allows a sustainable business case for operators in public transport—taking customer convenience to the next level.

For many years, players in the public transport market (mass transit, rail, etc.) have been looking for ways to replace paper tickets by electronic media or eTickets. Most of the approaches analyzed and piloted so far have been smartcard-based. When mobile phones were beginning to provide functionalities beyond the pure telephony (MMS, Java, etc.), they have been more frequently deployed in eTicketing applications over the recent years. On a nation-wide scale there have yet only been a very few successful smartcard-based implementations—although a wide variety of technology assessments, feasibility studies and cost-benefit evaluations have been conducted.

The predominant reason for the lacking implementation of smartcard or mobile phone based eTicketing solutions are the high one-time investment and ongoing operating costs for the required highly-complex multi-layered, mobile-technology infrastructure, consisting of check-in / check-out devices at stations and in vehicles, smartcards, back-end systems, and communication infrastructure. For

## Exhibit 1

Smartcards and mobile phones are converging technologies in electronic ticketing

	Electronic Ticket	Automatic Fare Collection
 Smartcard	<ul style="list-style-type: none"> <li>Monthly pass on smartcard</li> <li>Single-Ride ticket on smartcard</li> </ul>	<ul style="list-style-type: none"> <li>Check-In / Check-Out with contactless smartcard</li> </ul>
 Mobile phone	<ul style="list-style-type: none"> <li>Single ride ticket on mobile phone (SMS, JAVA, 2D Barcode/MMS)</li> <li>NFC based single-ride ticket on mobile phone</li> </ul>	<ul style="list-style-type: none"> <li>Check-in / Check-out via NFC mobile phone</li> <li>LBS route tracking using mobile phone</li> </ul>

1) NFC – Near Field Communication 2) LBS – location based services

example, the investments have been estimated at €1-1.2 bn for a nation-wide implementation in Germany alone.

Several business case calculations have shown that these implementation and operating costs would not be outweighed by the reduction in ticket distribution costs. On the other hand, the majority of public transport practitioners doubt that there will be significant revenue increases directly associated with the introduction of electronic ticketing and thereby not justifying the massive investment.

Beside the pure financial aspects there were other reasons which prevented prior approaches from being implemented successfully:

- Lack of mass market feasibility—in particular for open, non-gated transportation systems

**Exhibit 2**

Causes for the lacking implementation of smartcard-based eTicketing solutions

Financial issues	Complexity issues	Technology issues
<ul style="list-style-type: none"> <li>▪ Huge investment required for smartcard-based AFC<sup>1)</sup> systems</li> <li>▪ Lack of robust business cases</li> <li>▪ Risk of decreasing revenues</li> <li>▪ Lack of public funding</li> </ul>	<ul style="list-style-type: none"> <li>▪ Federal system with large number of players and diverging interests</li> <li>▪ Heterogeneous structure with urban and regional network</li> <li>▪ Lack of experience in projects of similar size</li> </ul>	<ul style="list-style-type: none"> <li>▪ Technology innovation cycles shorter than decision-making processes and duration of implementation</li> <li>▪ Volatile business and co-operation models between technology and service providers</li> </ul>

1) AFC - Automatic Fare Collection

- Heterogeneity of the various eTicketing approaches across different regions
- Incompatibility issues, e.g. between transportation modes and / or sales channels
- High dependency on single providers (e.g. one telecommunications operator)

Additional reasons for the pending situation in most European countries are the following:

- Complexity of a national eTicketing program with regards to the governance required in such federated public transport markets
- Coexistence of rural and metropolitan areas with structural differences
- Lack of experience with programs similar in size and in terms of the number of heterogeneous participants.

Furthermore, applicable technologies have been advancing faster than the typical decision cycles on the public transport authorities and share holder side—continuously causing decision stages lagging behind actual technology developments.

Successful smartcard-based eTicketing implementations in Europe or in other regions of the world (e.g. London or Hong Kong) mostly had starting positions not transferable to national eTicketing schemes in Europe. E.g. gated stations had already been established and the replacement of the aging magnetic strip technology drove the business case.

As exhibit 3 shows, the decisions in favor of national electronic ticketing implementations in the Netherlands or in Denmark were reached under circumstances also not applicable to most other countries (e.g. security improvements, large scale funding from UMTS license sales).

### **Cross-industry collaboration will make nation-wide eTicketing possible**

To overcome the challenges of existing smartcard or mobile phone based eTicketing schemes, a new approach towards eTicketing for public transport is required.

An unmatched form of cross-industry collaboration leveraging existing infrastructures, in combination with an innovative technology, could lead the way towards a new business ecosystem and a win-win partnership for all players.

The players in this new ecosystem are the public transport industry, the telecommunications operators and the financial services industry.

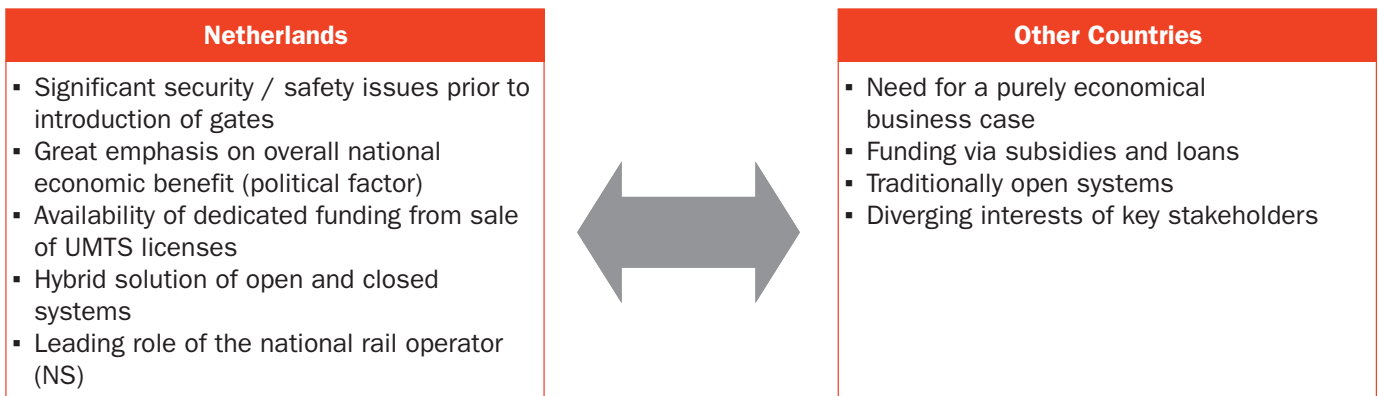
But how could this new ecosystem create advantages for all participants and help to overcome the current barriers to eTicketing in public transport?

**Public transport** players are interested in minimized distribution cost through self-service solutions, in greater transparency in customers' mobility patterns as well as in higher customer convenience and an easy-to-use public transport system.

**Telecommunications operators** are interested in additional traffic on their existing network infrastructures and in binding customers through value-added services, requiring so-called “killer applications”.

**Exhibit 3**

Unique conditions in the Netherlands are not transferable to most other European countries



- Similarly, pure metropolitan solutions like in London or Hong Kong do not apply to a national transport system with a mixed urban and regional network

The **financial services industry** (such as banks, credit card organizations, mobile payment providers) are looking for additional subscribers to their various forms of payment solutions—all based upon technology infrastructures implemented with significant investments and waiting for customers. Recently the evolvement of multiple forms of mobile payment solutions created an additional market dynamic with various new entrants in that space.

As such, the core competencies and existing assets of these providers exactly match the two core steps in Automatic Fare Collection in public transport:

**Step 1:** Collecting passengers' time and location based trip data and communicating them to a central back-end system perfectly fits the business model and infrastructure capabilities of telecommunication providers.

**Exhibit 4**

Business applications for NFC technology



1) NFC – Near-Field Communication  
Source: Philips Semiconductors

**Step 2:** Collecting micro-payment fares on a real-time basis suits the financial services industry mPayment offerings.

### NFC technology is the key enabler for next generation eTicketing

The technology enabling a new eTicketing approach in this ecosystem is Near-Field Communication (NFC). This advancement of RFID technology used in contactless smartcards so far has just left the research and feasibility phase, and is looking for a mass market deployment. Commuter transit systems in Europe and a number of Asian countries have already launched initial trials with NFC-compatible contactless technologies for ticketing purposes.

NFC provides all the features which make it a valid technology for mass public transport ticketing: contactless transactions at high speed, stability, security, simplicity, and fault tolerance. The NFC chip can either be attached to the hardware shell of a mobile device or become an integral part of the SIM card. It is basically a micro-computer which can process data, store data and communicate with other NFC devices or RFID tags in a 10-30 cm range using a high-frequency transmission.

Built into a mobile device, it can also establish a long-distance communications link for ticket or payment data transfer and application updates using the mobile device's GSM / UMTS functionality. The NFC technology

is applicable to all relevant forms of electronic ticketing in public transport, i.e. single-ride tickets and commuter passes both in mass transit and long-haul passenger rail traffic.

Analysts forecast quick market penetration, sponsored by the telecommunications operators, in particular if a mass market application like public transport ticketing evolve. According to these forecasts, by 2010 the market for NFC-enabled handset shipments will have increased by about +300% year over year to about 400-440 million devices worldwide (see exhibit 5).

NFC-enabled products allow holders of mobile devices to carry out secure contactless payment transactions—simply by holding their mobile phone close to a terminal. Due to high market penetration of mobile phones as well as their ease-of-use NFC-enabled mobile payment has a great potential to replace cash and traditional card payment schemes. Public transport tickets could be purchased or validated simply by bringing an NFC enabled mobile device into the vicinity of an NFC tag.

Thereby, contactless tickets will revolutionize the speed and ease with which passengers can use public transport, especially in rail and mass transit. With NFC enabled mobile phones, passengers can buy tickets, receive them electronically “over the air,” and then pass through fast track gates—reducing waiting times at the counter / ticket machine. After a trip, passenger can check their account balance via a mobile connection.

Travelers will find it easier to get around in an NFC-enabled world. Foreign visitors can use an NFC equipped kiosk to get information in their local language on their phone's display screen. Visitors to an unfamiliar location can receive train schedules departures, arrivals and routing instantly by bringing their phones close to a signboard.

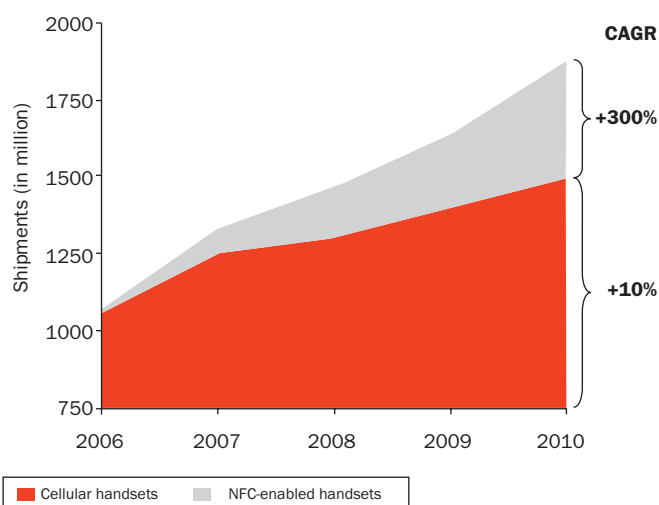
### Next generation eTicketing brings down investment cost by 75-80%

Business cases show that with this new form of eTicketing the major hurdle of all preceding approaches could be overcome as the initial investment could be reduced by up to 75-80% (see exhibit 7).

This is due to the paradigm shift NFC technology is introducing to eTicketing. All previous electronic ticketing approaches have been built upon the concept of

#### Exhibit 5

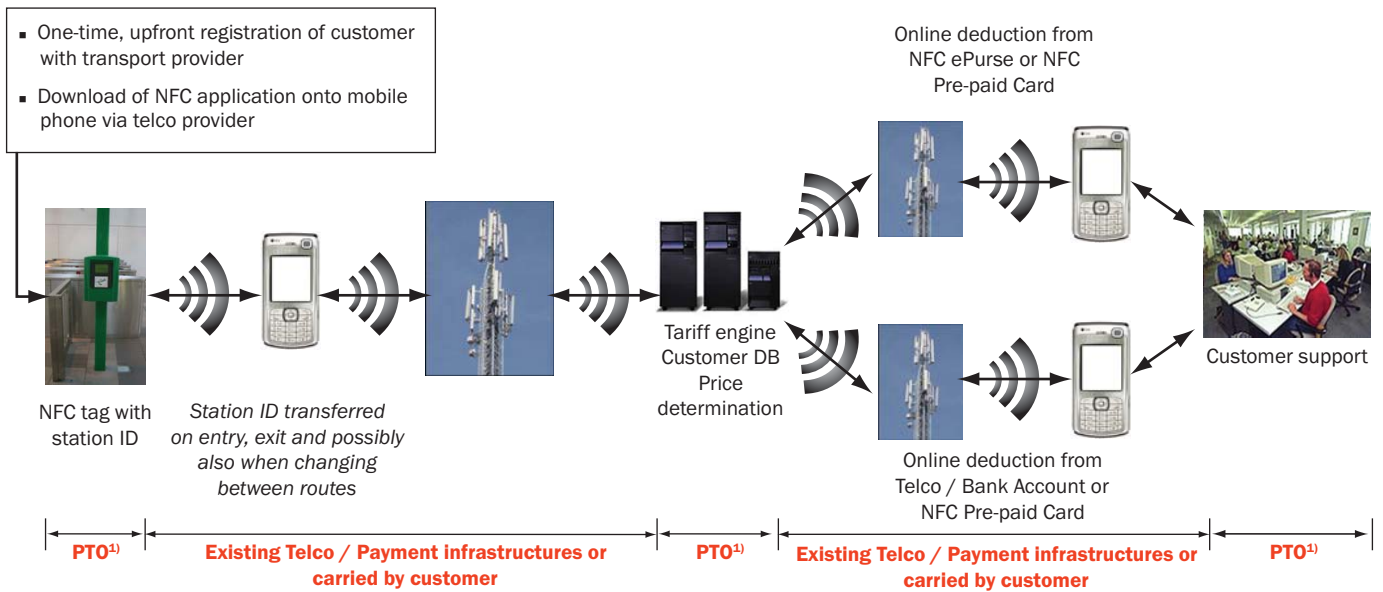
Market Forecast for NFC-enabled devices (2006 – 2010)



Note: CAGR = Compound Annual Growth Rate  
Source: Booz Allen Hamilton Industry Analysis

**Exhibit 6**

How "Active NFC"-based Automatic Fare Collection in mass transit works



1) PTO - Public Transport Operator

passive passenger devices (e.g. smartcards) "checking-in" to an active infrastructure that is provided by the public transport operator. Next generation eTicketing turns this traditional concept upside-down. It is built upon the paradigm of passive public transport devices "checking-in" to an *Active NFC* infrastructure provided by passengers and telecommunications operators.

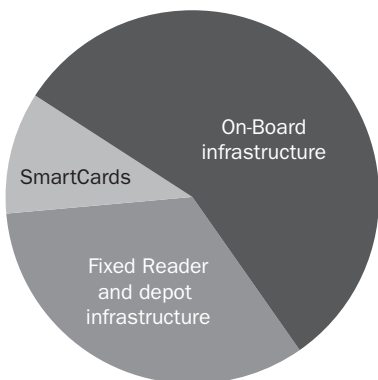
As a result, in an NFC based eTicketing system, costly active electronic devices (e.g. check-in/check-out readers at train stations, bus stops or in vehicles) can be replaced

by passive, low-cost RFID tags at stops and stations only. Smartcards are not required—instead the passenger downloads a public transport owned piece of software onto his NFC enabled mobile device. Additionally, public transport operators (PTO) do not need to set up own data-communication systems to transmit check-in / check-out data to a central back-end system. Instead, the already existing infrastructures of mobile phone operators will be re-used. Payment transactions for ticket purchase will be executed in cooperation with financial service providers again using existing mPayment infrastructures.

**Exhibit 7**

"Active NFC"-based eTicketing reduces investments by 75-80%

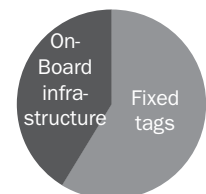
**Comparison of investment for national eTicketing infrastructure<sup>1)</sup> (excluding central data processing)**



**SmartCard Check-in / Check-out**



- No smartcards required
- Passive tags instead of active readers
- Communication via existing telco networks
- NFC-enabled devices for ticket inspectors

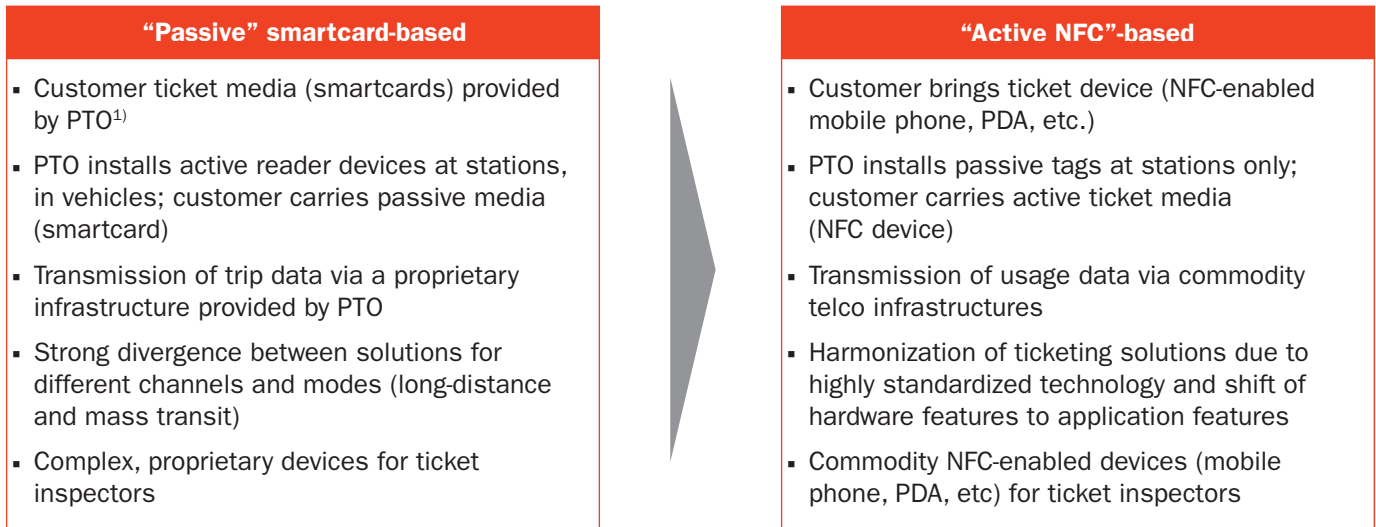


**"Active NFC"-enabled Check-in / Check-out**

1) Estimated infrastructure cost for nationwide eTicketing in Germany

**Exhibit 8**

Comparing smartcard-based and “Active NFC”-based eTicketing schemes



1) PTO – Public Transport Operator

Public transport compensates the usage of this infrastructure on a variable cost basis per transaction rather than having the full up-front investment plus ongoing cost in the approaches considered so far.

However, detailed financial arrangements taking into account for instance today’s flat rate tariffs are still subject to further negotiations between the transportation industry and the telecommunications providers.

**Benefits to all industry players and transport passengers**

The tremendous benefits of this next generation eTicketing concept make it a approach superior to all existing ones. Those benefits are evenly distributed between the various industry players and public transport passengers:

**Public transport**

- Significant reduction in initial investments
- Variabilization of cost

- Mass market proven technology
- Fraud security
- Harmonized and relatively cheap conductor devices across all forms of public transport including long-haul rail
- Flexible migration scenarios.

**Telecommunications operators**

- NFC-enabled eTicketing is a “killer application” generating a tremendous amount of additional GSM / UMTS transactions (e.g. an estimated 18-20 bn incremental transactions in Germany alone).

**Financial services providers**

- Also for mobile payment providers, NFC-enabled eTicketing provides a strong upside potential for additional transactions (e.g. an estimated 0.5 bn incremental mobile payment transactions in Germany).

**Public transport passengers**

- Detailed tariff knowledge and often cumbersome pre-trip ticket purchase becoming obsolete (in case of “Active NFC” eTicketing)
- No additional device / smartcard in purse required
- As a result, NFC-enabled eTicketing leads to consistent processes and experiences across sales channels generating a significant increase in customer convenience.

Additionally, the NFC technology facilitates fast processing times with high security and significant user-friendliness:

- Extremely fast connection (<0.1s)
- Contactless transactions
- Hardware-based security mechanisms
- Public transport as application owner
- Constant “over the air” application update
- Multi-application feature

Clearly this new paradigm does not overcome all challenges preceding eTicketing approaches have been facing. Issues like passengers not checking-out, open vs. closed vs. hybrid systems, the need for eTariffs, coexistence of traditional and new ticketing forms for non-registered users like tourists still need to be solved. For these questions, similar answers as in traditional

eTicketing solutions with known pros and cons do apply. Evolvement of technology will also help to overcome new issues like interruption of the mobile phone power supply.

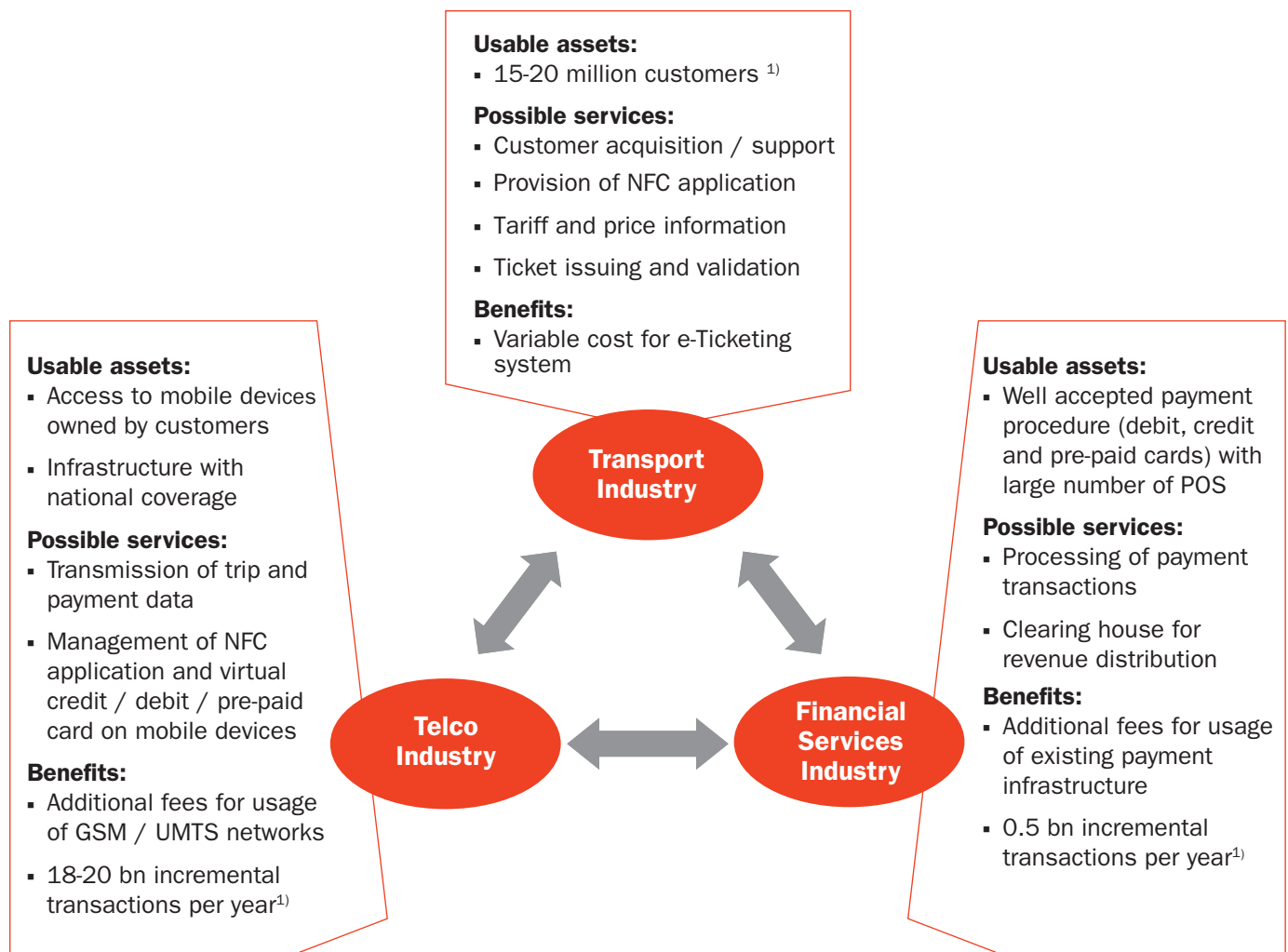
### Conclusion

The new ecosystem for next generation eTicketing powered by NFC technology, as layed-out in this document, is set to allow for the take-off and breakthrough of electronic ticketing in public transport by being both affordable and value adding.

The key success factor for bringing this new ecosystem to life is a partnership between the three industries of public transport, telecommunications and financial services, rather than between single enterprises in these industries.

### Exhibit 9

Win-win partnership in the new ecosystem for electronic ticketing



<sup>1)</sup> Estimated volumes for nationwide e-Ticketing in Germany

Similar to existing approaches, next generation eTicketing solutions need to be developed from a market, customer and business case perspective, not from a technology perspective. However, on the technology side, a paradigm shift needs to be adopted by the current public transport actors, leaving behind the conviction that the complete ticketing infrastructure must be proprietary and under public transport's ownership.

To make such a collaborative system happen will require the resolution of some remaining questions. The involved industry players do in particular have to agree on a mutually sustainable commercial model within this new ecosystem. However, recent developments across Europe show rapid progress in the formation of these industry partnerships. For example, early in 2007 three large telecom providers have started a cooperation with the most important national transportation operators to build a national NFC enabled eTicketing system in France.

In Germany several key players in the transportation market are also ready to move forward with NFC eTicketing.

In any case, all processes, contractual relationships and technology solutions must ensure that the public transport providers control and own the relationships with their customers, including their trip and mobility pattern data.

Deploying NFC technology in combination with a cross-industry collaboration model appears to allow for the break-through of nation-wide eTicketing schemes in Europe. Now is the time to act for all parties—for public transport operators, telecommunications companies and financial service providers. Only first movers will be able to participate in the large market potential NFC technology will offer in the years to come.

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