

THE INFLUENCE OF E-TICKETING ON TRANSPORT INTEROPERABILITY

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Abstract: *Interoperability is the ability of a system or a product to work with other systems or products without any extra effort required from the customer. From the e-ticketing point of view, interoperability means that the same contactless card could be used in different public transport networks through shared applications. That has become a major issue for ticketing systems since a growing number of passengers both inside and outside European borders. Passengers like to travel in comfort and appreciate coherent services, simplified fare management and seamless transport changes without involving any special effort. Therefore, transport authorities and operators willing to set up an interoperable transport area (city, region or on nation level) and need to agree on many rules and regulations of their systems. The Calypso technology is able to satisfy the demands of interoperability while offering freedom and independence to each operator. The development of different environments using Calypso smart ticketing systems let appear the necessity of defining possibilities of interoperability between them as they use different, and therefore incompatible, sets of security keys. The paper will present possibilities of public transport interoperability with calypso technology and Brussels's MOBIB case study as a good example of the interoperable smart ticketing system commonly adopted for all the country.*

TECHNOLOGY, ORGANIZATION AND MANAGEMENT OF TRANSPORT

INTRODUCTION

A major role throughout the whole transport system playing the new system of electronic ticketing and for this reason it must be secure and reliable. One of the widespread eTicketing technologies is Calypso open technology which can be defined as a set of technical specifications describing a fast and secure contactless transaction between a terminal and a portable device. Main Objective is to maintain a set of open specifications addressing transit business needs in the context of developing contactless systems. A Calypso portable device was historically a microprocessor smart card, but, as technology moves on, it could now be one of the few type of devices, such as: traditional contactless smart cards, JAVA contactless cards, NFC mobile phones, USB key with a contactless communication interface (smart key) or any

other contactless customer media [1]. Calypso technology is able to satisfy the demands of interoperability while offering freedom and independence to each operator. Interoperability between suppliers increases the need for security, confidentiality and integrity. The key to an efficient interoperable system is technical compatibility by adhering to international standards and the sharing of data model implementation. Technical standard of Calypso contactless smart ticketing technology offers a time proven and operational interoperability at all requires interoperability levels: a common technical platform, a same ticketing application and a common fare management. This basic concept is followed by calypso technology and is compliant with many international standards such as ISO 14443, ISO 7816-4, EN 1545.

TRANSPORT INTEROPERABILITY WITH CALYPSO TECHNOLOGY

There are many definition of term interoperability, such as, interoperability is the ability of a system or a product to work with other systems or products without any extra effort required from the customer, or interoperability is the ability of content or systems to work together through the use of agreed standards and specifications, etc.

Interoperability has become a major issue for ticketing systems since a growing number of passengers both inside and outside European borders like to travel in comfort and appreciate coherent services, simplified fare management and seamless transport changes without involving any special effort.

Transport authorities and operators willing to set up an interoperable transport area, should it be at a city, at a region or at nation level, need to agree on many rules and regulations of their systems on few different levels:

- ◆ at the administrative level
- ◆ at the customer level
- ◆ at the fare management level
- ◆ at the technical level [2]

Interoperability at the administrative level means that transport authorities, operators and other public or private stakeholders must define the exact scope of their relationship, accept a common liability, agree on shared services and fares on financial issues (financial flows, money clearing, subsidy expectation, etc.).

Interoperability at the customer level means to consider issues such as make a passenger feel as if they are local everywhere, make easy to buy a transport contract, board a bus and validate the contract, to found out what management is expected, and the most important allowing for a seamless travel experience whilst also leaving some room for individual operator requirements.

Interoperability at the fare management level is also a marketing issue with two identifiable interoperability levels: the range of transport options available (multi-operator season tickets, integrated fares, etc.) and the setting of rates and pricings (based on the distance - zones, sections - or on time-variable according to the period, etc.). The creation of transport options common to several operators leads to fare integration, which may remain limited by some transport options, by some operators and in some areas.

Interoperability at the technical level concerns a wide range of devices: smart cards, vending machines, validators, control equipments.

The Calypso interoperability requires: the strict application of standards' rights: ISO 14443, ISO 7816-4, EN 1545, The use of the Calypso secured transaction (card commands), The use of the same data instantiation (strictly the same adaptation of the generic data model for all system partners), The same data model, The bringing into play of a common security architecture. Concerning an interoperable application, in the case of several operators, the data model and its position in the final central system, should be determined by a common architecture agreed by all various actors. To ensure interoperability, it is necessary for all

terminals sharing the use of the same cards to agree on these precise characteristics (definition and use, layout, organization in the card file system): this is defined in fact, by the agreed card Data Model. Calypso therefore offers a time proven and operational interoperability technical standard [3].

TRIANGLE 2 INTEROPERABILITY

TRIANGLE 2 interoperability proposes to solve the interoperability between smart ticketing systems by providing – on side of the local application supposed to cope with 90% of the demand – a parallel application specifically devoted to interoperability. This specific application will use shared secret keys and operational rules and will be able to cope both with regular customers having every days to “jump” over a frontier between fare basins, or with occasional customers visiting another destination for tourism or business purposes. TRIANGLE 2 interoperability allows to load locally a transport contract on a media non locally issued. It allows also to load locally on a locally issued media a transport contract that can be validated somewhere else, outside of the local fare basin issuing the media. Combining the local application and the TRIANGLE 2 interoperability, such media appears to its holder as universal [4].

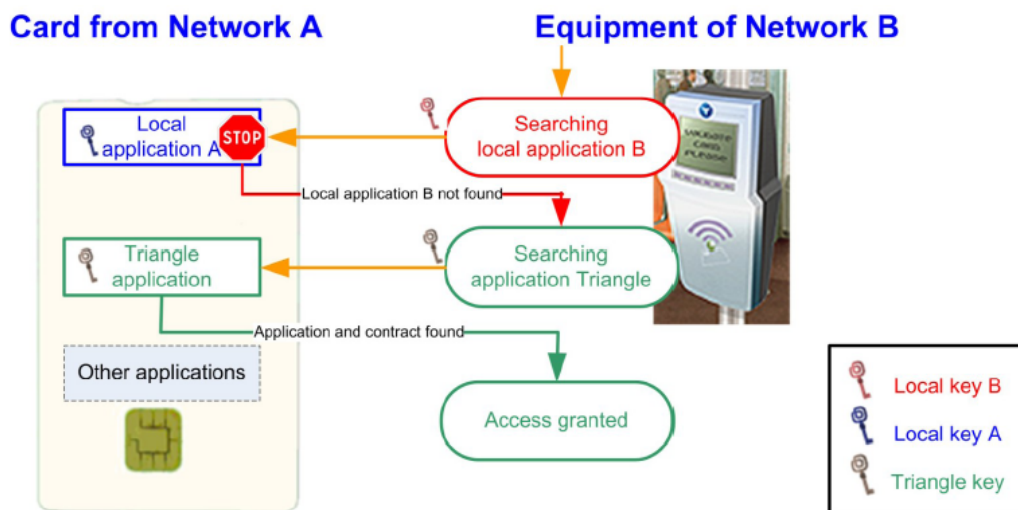


Fig.1 Validation outside the issuance area

TRIANGLE 2 interoperability requires that all kind of equipments must be able to detect, if no local application is recognized, TRIANGLE 2 application. Triangle 2 is Calypso application allowing the seamless use of ticketing media between regions and countries. The Triangle keys must be written in the master SAM (SAM-SP) of the local interoperable area during the key creation ceremony.

Calypso Revision 3 is latest release of the specifications of the open ticketing standard Calypso. Triangle 2 is compliant with these specifications. To deploy TRIANGLE 2 can be justified as two neibourg fare basins let observe valuable commuters daily traffic. But also important occasional passengers traffics to cities presenting strong economical or institutional attractivity, if not just tourism, make the use of TRIANGLE 2 interoperability relevant. As interoperability principles provided by TRIANGLE 2 are unique, any complementary use of it provides a “free of charge” advantage or a “domino effect” (Figure 2).

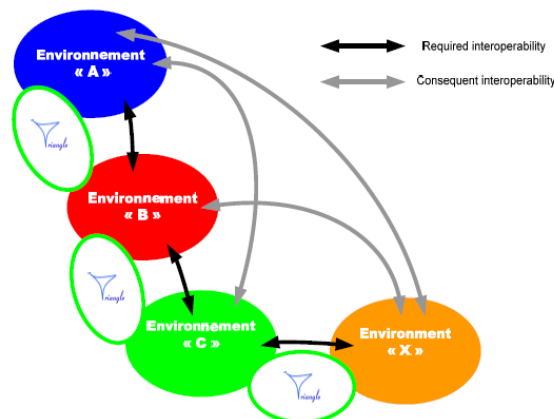


Fig.2 TRIANGLE 2 - “domino effect”

CALYPSO INTEROPERABILITY THROUGH THE TRIANGLE APPLICATION

The market for cross-region and cross borders mobility knows a rapid development. It mainly has to do with short, even one-day round trips between cities and calls for a combination of middle to long distance and urban travel, and the access to related services. The Triangle application addresses this market. It creates a unique contactless “Tool For Access” to long, medium or short distance transport facilities or to other services, without any necessity of a common back-office. The Triangle application is a Calypso application compliant with Rev. 3 and/or with Rev. 2.4 which can be present in any contactless portable object compliant with ISO 14443. Triangle vision of interoperability relies on three major principles:

- ◆ The shared use of a specific Triangle set of Keys by Triangle media issuers and product owners.
- ◆ The absolute respect of a standardized environment: accessible from all operators; defining the handling, interpretation and coding of the application data; defining the security system and the encryption for a secure accessibility of the application and the application data.
- ◆ The (re-)use of available technologies and existing (or under deployment) systems: Accepting only marginal and minor evolutions; Leaving the back-office untouched; Paving the way to bilateral and multilateral commercial agreements.

Through some adaptation at card structure level and at terminal level (additional set of Keys in Security Access Module), Triangle interoperability scheme creates a unique and universal mean of access to urban transport services and medium or long distance railways transport services associated to the possibility to buy other services or purchases [5][6].

BELGIUM MOBIB CASE STUDY

STIB (Société des Transports intercommunaux de Bruxelles) is the main transport operator in Brussels. It copes with 615,000 trips every working day and, annually, 170,000,000. Its activity represents 32 % of the market of motorized trips and 90 % of public transport trips. STIB operates three transport modes: underground, tramways and buses. STIB deployed its electronic fare management system MOBIB in 2008 and is about to complete its smart ticketing system this year. A working group has been created at national level to build an interoperable transport application involving all operators in Belgium. The working group has access to the Brussels application and benefits from the STIB experience creating the Belgian national transport application based on Calypso contactless technology. This national interoperable ticketing application may reside in the same support than other applications, enabling the management of other services in addition to public transport, such as: parking, park and ride, access to theatres, museums, etc. This card is based on the CALYPSO Revision 3 and applies

the CD21 CALYPSO structure on a 18k chip. The customer numbering based on the ISO 7812.2 norm extends its universality to all ticketless configuration [7].

As a consequence of the commonly adopted smart ticketing for all the country, a common daughter company called Belgian Mobility Card has been created with four times 25% of shares owned by the four here above mentioned PT operators in order to specify and coordinate the deployment of the MOBIB smart ticketing system. The basic principle is that each operator, and eventual partner issuers like INTERPARKING, issues MOBIB cards that can be used everywhere without any restriction. So, any MOBIB card may be loaded with transport contracts from any of the operators or partners. In case of multi-operators transport contracts or when using the transport e-purse, classical clearing is replaced by bilateral declaration for cash transfer, cost limited option that the limited number of operators makes possible. Two main characteristics of the MOBIB cards are to be mentioned the multi-application functions and the TRIANGLE interoperability:

- 1) The multi-application functions: the MOBIB card is not only a transport application card. It offers also some other services, each of them protected by specific keys, which are:
 - ◆ a T-purse or a dedicated e-purse to transport contracts, that can be used or reloaded by each of the operators, however the account is managed by the issuer
 - ◆ an interoperability file (see hereafter)
 - ◆ a parking file, specially fitted for public parking contracts
 - ◆ a multi-application file devoted to contracts other than transports or parking as access to events (sports, or culture) or season tickets for theatre etc.
 - ◆ a complementary mobility file devoted to other modes of transport (car sharing, bicycles etc.) (Figure 3)

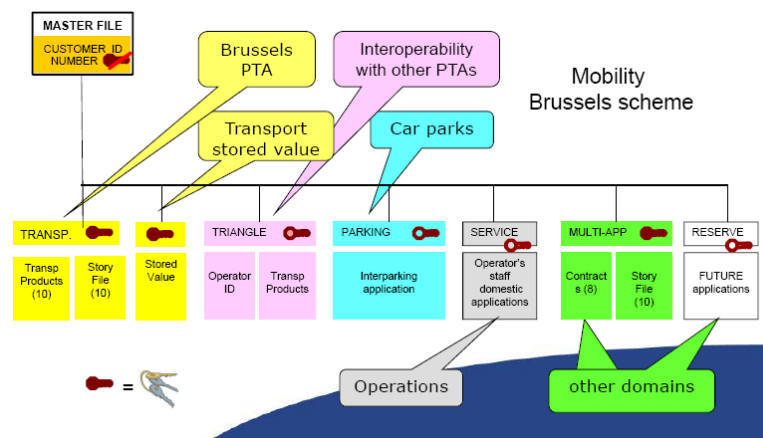


Fig.3 Brussels scheme open to multiplication contexts

- 2) The interoperability TRIANGLE 2 application which allows, through the use of a commonly shared security key to use the MOBIB card somewhere else where TRIANGLE 2 cards are accepted. This limits the necessity to use disposable memory contactless tickets.

The scheme hereafter shows the MOBIB card of new generation based on Calypso Revision 3 (Figure 4) [4].

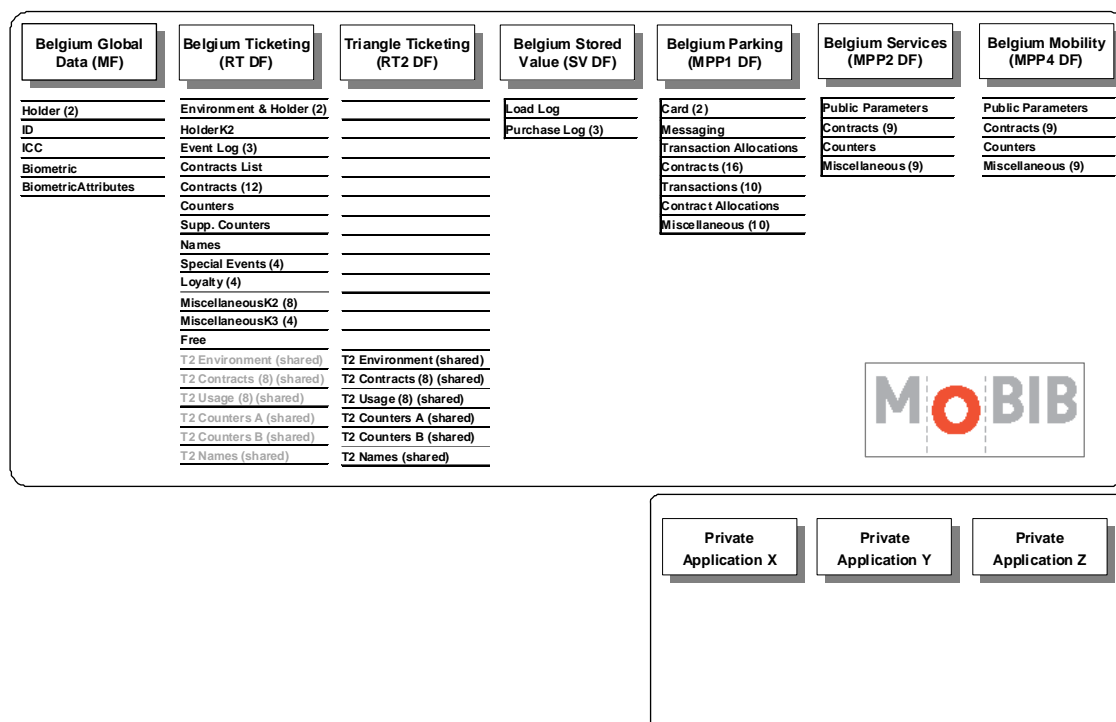


Fig.4 MOBIB card of new generation based on Calypso Revision 3

CONCLUSION

Interoperability is the response to the need for mass transport networks to work together within countries, regions or cities at the European level. Every sector keeps his competence, bank sector for payment and transport sector for specificity of ticketing aspect. Payment processes are no longer a barrier to the use of Public Transport across European Union. Seamless accessibility to different Public Transport Networks using the same Portable Media now is possible. Smart cards will have migrated to a Secure Element on a Portable Object (Mobile Phone, PDA, USB device etc.). Individual IFM Applications can co-reside in a multi-application environment. The MOBIB, as nation wide Calypso based smart ticketing for Belgium, may be considered as a perfect example of an universal interoperable media. TRIANGLE 2 is a strong way forward to realize easily interoperability. The Belgian non profit association Calypso Networks Association is owner of the TRIANGLE 2 security keys and of the specifications and make those available for free to any public transport operator or authority that wants to enter the interoperability world.

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ВЛИЯНИЕТО НА ЕЛЕКТРОННОТО ТАКСУВАНЕ ВЪРХУ ОПЕРАТИВНАТА СЪВМЕСТИМОСТ В ТРАНСПОРТА

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Ключови думи: *Електронно таксуване, Калипсо технология, оперативна съвместимост (triangle), tobiб карта*

Резюме: *Оперативна съвместимост е способността на дадена система или продукт да работи с други системи или продукти без никакви допълнителни усилия от страна на потребителя. От гледна точка на електронното таксуване, оперативна съвместимост означава, че една и съща безконтактна карта може да бъде използвана в различни мрежи на обществения транспорт чрез споделени приложения. Това се е превърнало в основен проблем на системите за таксуване поради нарастващия брой на пътници както в рамките на, така и извън европейските граници. Пътниците обичат да пътуват комфортно и оценяват кохерентните услуги, опростеното управление на таксите, безпроблемните промени в транспорт, без включване на специални усилия. Следователно, транспортните органи и оператори, които желаят да създадат оперативно съвместима транспортна зона (град, област или на национално ниво) и трябва да постигнат съгласие по много правила и регламенти на техните системи. Технологията Калипсо е в състояние да задоволи изискванията на оперативната съвместимост, като същевременно предоставя свобода и независимост на всеки оператор. Разработването на различни среди чрез използването на Калипсо интелегентни системи за таксуване позволява да се появи необходимостта от определяне на възможностите за оперативна съвместимост между тях, тъй като те използват различни и следователно несъвместими групи от ключове за защита. Статията ще представи възможностите за оперативната съвместимост на обществения транспорт с Калипсо технологията и Брюкселския казус MOVIB като добър пример за оперативно съвместима интелегентна система за таксуване общо приета за цялата страна.*