ACCOUNT BASED TICKETING

FROM CARD BASED SYSTEM TO ABT

Ticketing systems have migrated from paper with or without magnetic stripes to smart cards. The intelligence of those schemes is in the couple card-validator. Now the trend is to move the scheme intelligence towards the back-end and so enable for more complex rules and more multi service integrations. That's ABT or Account Based Ticketing.

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EVOLUTION

Initially, tickets were on paper. On this kind of support, you can only have

passes or counters, punching a hole per journey:

The functionalities were strictly limited to counting the number of journeys. After that, paper tickets with magnetic stripe were introduced. This allowed some additional functionalities via to the capacity to read and write

information from / to the magnetic stripe. The major addition was the transfer between vehicles. By reading and writing information at each validation, transfer rights could be granted automatically based on a set of business rules. By just punching a hole, this was impossible.

The last evolution was the smart card or smart ticket. The extended memory and processing capability features more functionalities and security. For this reason, "Pay as you Go" has emerged on smart cards, like OV Chipkaart in the Netherlands or Oyster card in London. Pay-as-you-Go was always pre-paid. Pay-as-you-Go allows interoperable pricing schemes, sometimes requiring complex rules on a back-end system. Account Based Ticketing is the next step. In place of paying in advance, you receive a bill at the end of the month. At the same time, this allows more complex rules and multimodal services to be paid.

WHY THIS DOCUMENT

BMC has made a study concerning ABT. The full document is specific to Belgium.

Partners from different countries have helped and are also interested in the topic. The goal of this document is to share some elements and perhaps be an initiator for discussion and collaboration.

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VISION

Why to go to ABT

For the coming years, we see a development from card-based systems to account-based systems, simply because this allows public transport schemes to provide better services to trusted travelers. [1]

Card-based systems in public transport often use smart cards, or NFC enabled mobile phones, to store travel value, travel products (for example a monthly pass), discount rights (for example for students or the elderly), and tickets. Tickets can be pre-paid or Pay-As-You-Go (check-in check-out, or check-in only). Tickets are stored so they can be inspected.

Account-Based Ticketing (ABT) offers the opportunity for schemes and transport operators to move the fare calculation software and logic away from the card reader to the back office (or 'cloud') where the account of the traveler also resides. The back office can then aggregate the transactions, apply algorithms to calculate the appropriate fare and deduct this from a recognized and trusted account. This could be a bank account, a credit card account, or a pre-loaded account or ticket. As the account is online accessible, any online changes to this account are immediately in effect, removing the need for a physical sales and distribution infrastructure.

ABT has been made possible following the huge increase in the volume and speed of data communications over the air; computational improvements in card technology; and the rise of the account as the online representation of a customer. Neertheless, full online validation is not yet possible. For this reason, ABT still stays partially card based.

ABT will develop into Account-Based Travelling when it is integrated with other mobility services (such as rural transport services, taxi, bike rental and P+R parking), as well as with on-line journey planning/ticketing and real-time journey monitoring. It can also include CRM activities with the customer account and mobile interface being the source and springboard for other advisory and informational based services.

Pure Account Based Ticketing (ABT) for today is without interest. At least for two reasons:

- Today, 80 % of the journeys are done by persons with passes. This is true in Belgium but also applicable to public transport in most parts in the world. For the other part there is a big proportion of people without pass, but using frequently the same ticket for the same line. For those kind of travelers, ABT will not bring additional benefits. For the Public Transport Operators, ABT will not reduce the cost of sales for those passes and tickets. Today, the "closed loop" system, is still an answer to the current needs of this kind of travelers at a lower cost for operators. However, answering to the needs of new mobility players, such as bike rent, etc. requires a centralized, account based approach.
- The second reason is that installing an ABT will take between 3 and 5 years. If we take into account only the needs of today, it will be outdated when it will be in production. The timeline [2]

[1] See for complete text:
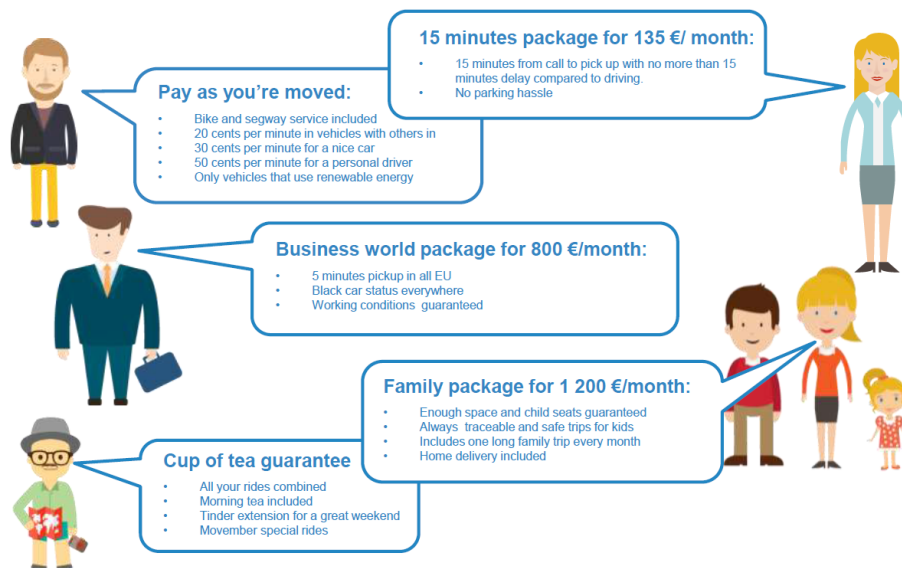http://www.europeantravellersclub.eu/Account-Based-Ticketing/

to implement such a system is not determined by technical issues. The problem is to define commercially the rules, find the way to finance and operate it.

If we decide to go to an ABT or other system to complement card based system, it has to be aligned with what we deem to be necessary in 5 years. On the other hand, the process is long. So, to have something delivered within 5 years, we must start early enough.

The common view for the future is "Mobility as a Service" (MaaS). MaaS is not only a unique account for all mobility services, it's also a payment scheme: A fixed price to cover mobility needs:

Mobility as a Service is the *Netflix* of transportation

Pay as you're moved:
- Bike and segway service included
- 20 cents per minute in vehicles with others in
- 30 cents per minute for a nice car
- 50 cents per minute for a personal driver
- Only vehicles that use renewable energy

15 minutes package for 135 €/ month:
- 15 minutes from call to pick up with no more than 15 minutes delay compared to driving.
- No parking hassle

Business world package for 800 €/month:
- 5 minutes pickup in all EU
- Black car status everywhere
- Working conditions guaranteed

Family package for 1 200 €/month:
- Enough space and child seats guaranteed
- Always traceable and safe trips for kids
- Includes one long family trip every month
- Home delivery included

Cup of tea guarantee
- All your rides combined
- Morning tea included
- Tinder extension for a great weekend
- Movember special rides

2

ABT will occur, the question is how?

A second aspect is that "ABT" will happen. It is unavoidable to have an ABT system in place to answer to the needs of mobility services. The question is "Who will do it? Operators or third parties?". In Belgium, companies like Olympus mobility, Touring or Proximus/B Mobile, are already working on it. They don't have the required B2B interfaces with operators to be fully operational, but they will push to have it. The choice is there:

- Option 1: Let third parties develop different systems and Operators provide B2B selling processes. The customer relation will be managed by the third party and no ABT is required at operator's side.
- Option 2: Develop an ABT system and keep the customer relation. The system will only have a chance compared to Option 1, if:
  - The ABT is unique for all Operators. Otherwise, Option 1 will be more convenient for the users and they will move to third parties systems;
  - The ABT must be open to additional mobility actors like bike & car sharing or carparks etc.

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2 https://en.wikipedia.org/wiki/Mobility_as_a_service_(transport)

Operators have unique advantages, USP (Unique Selling Points):

- The public transport is the basic structure, the back bone for alternative mobility;
- Operators can "categorize" accounts like 65+, students or families and can have trusted relation with public authorities to obtain the information and receive subsidiaries linked to these status;
- Operators are in a better trusted relation with public authorities for third parties payment, for example rules for P+R, where a part is paid by user and a part per the public authority.

The main question is "Will the operators be the central point for the customer relation for the mobility of tomorrow or will the role be limited to producing transport services only and letting the customer management to third parties?". This is specific also for Belgium where there is no real "supra-operator" authority for ticketing.

An ABT system is not a way to replace existing systems where the systems work fine. The ABT must be there to attract new customers and create new services, even if it can be used to reduce the cost of sales for occasional users. 80% of journeys paid by passes is perfect for a card based system. The goal is to attract new passengers, or sell new journeys in addition to existing ones.

The future is perhaps without ticket, without card or card emulation and even without validator. This is illustrated by what Google see (on the right). But in any case, a back-end calculation engine will be required. Something like the mediation platform for telco.

When we see what google can detect with only your phone in your pocket, validation or check-in check-out is no more necessary, but rather the platform to calculate "how much to pay?" an "who will receive the revenue?".

Services to offer

The goal of an ABT system is not to replace existing passes, but to offer new services for occasional users or to offer complementary services to people with passes.

Pricing is not in the scope of this study, but pricing is a main driver for passengers to adopt ABT . If we offer a system with a monthly capping equal to the price of a monthly pass, a number of users may migrate from monthly passes to ABT. Taking into account the Belgium situation with four existing back-ends for card based approach, PTOs may still offer card based monthly and yearly passes and passengers are free to choose what is most convenient to them: Card based or ABT. The cost of sales will be higher for the operator on ABT. The only interest to go to this option is if we want to phase-out card based back-ends.

ABT focusses on occasional users and new services.
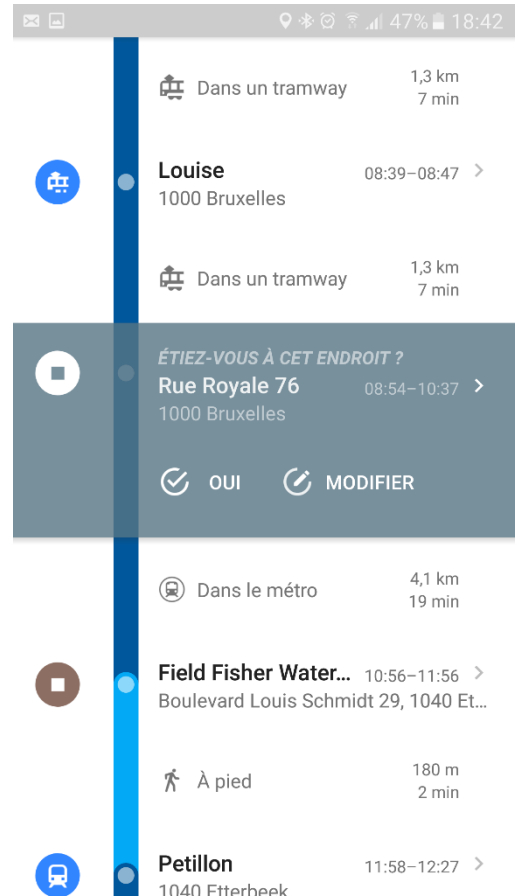
The main goal is to have an offer easy to understand and easy to use for the people. Normally, people want to know how much they will pay before buying. Pricing rules must be clear and simple. The proposed services must also have an added value

Those services include:

- Single ticket with daily capping and monthly capping, but as explained where capping must be/could be higher than daily and monthly passes price to preserve card based passes. This is a choice in the pricing strategy.
- "Pay-as-you-Go" with check-in / check-out. This is useful for operators where the fare depends on the distance or number of zones.
- Interoperable product based on mono-operable ones; not combined, interoperable. For example: for 'P+R' you pay your parking and your transport with a combined product which grants you a discount when used within a certain period. Same approaches may be implemented for train + local transport or bus + bike.

The "Account" approach includes:

- Unique account for all services. If the user has an account, it can be used for all services: In the first place the public transport, but also parking or shared vehicle, cars, scooter or bikes.
- Prepaid and postpaid accounts.

  o For prepaid, you load an amount to the account and associate an identifier, e.g. a MoBIB card, to the account. For tourists, it should be possible to have something like a smart ticket with a prepaid amount. Prepaid accounts can only give access to a limited set of services. The problem is that the amount will not cover for example the deposit for a bike. On the other hand, it is important to have a solution to avoid losing money when the lower limit is reached. Prepaid accounts are normally card based, even if complementary rules are implemented on the back-end.
  o For postpaid, the account can be linked to a credit card or to a bank account with an automatic debit. If in the future, a "global mobility budget" is developed to replace company cars, the account can be linked to such a budget.

- Anonymous accounts: This is only possible for prepaid accounts. You can link it to a card or a smart ticket.
- Third party payment, there are different approaches possible:

  o P+R approach: The parking receives 1. The transport receives 1. The user pays only 1,5 and the rest 0,5 is paid by the Public authority.
  o Bill split approach: A "global mobility budget" or the employer can pay up to a defined amount per month. The rest is paid by an automatic debit.

- Non anonymous account can be associated with special profiles like 65+, student or family. In this case, the fare can be adapted to the profile.
- Bills can be sent, allowing to reclaim VAT or to use it as justification in tax declaration.

Remark: For managing prepaid accounts with a server based approach, validators must be ideally online. This is probably not the best approach due to the fact that card based system preexist and validation time must remain very short. For this approach a "card based" Value contract is the easiest, perhaps with back-end rules to adapt the amount. With the P+R example. If we start with 50 on the card, 10 is deduced for the transport and 5 for the parking. At clearing 5 will be adjusted by the public authority. Anyway, a back-end must do the compensation between 'who has received and how much', 'who has to be paid and how much' and perhaps, 'where to go for third payers compensation'.

The secure identifiers can be:

- Transport card. This is the most suitable approach, certainly for persons combining that with a pass for the home-office journeys or with multi-tickets. In Belgium, there are already 5 million cards that can be used.
- Smart Tickets (TSC). This may be an easy way to provide global transport approach for tourists or business men on a short period, although the current SRI- and ST25TB-series are missing the appropriate security.
- Smartphone: An interesting approach is the Transport card emulation on smartphone. In one operation, it is possible to create an account and link it to a payment means by installing the application. Then you have the opportunity to buy classical tickets and passes or use ABT.
- Bank Card: The interest of the bank card is the combination of the identifier and the payment means. It is not necessary to create an account before using it. The main disadvantage is the cost. As discussed below in the document, the operator must have the validator PCI DSS certified, but also the complete chain or add dedicated validators and a separate payment back-office is necessary.

Other identifiers. The principle is to have a trusted, secure identifier that can be linked to an account or that is linked already to a payment means. For example identifiers used for an ABT system in neighboring countries, can be identifiers for our ABT, if a trust relationship is between the ABT back ends systems is established. Even if the e-ID, identity card, is from a contact-free technology, it can be used as identifier.

PROPOSED SERVICES

Pay-as-you-Go

Pay-as-you-Go is an expression used for different kinds of services, from tax to telecom including transportation. In transport systems, this expression is used for value contracts. It can be an ABT or a card based value contract.

This works mainly with pre-paid approach. Some money is put on the card or on an account. It may stay anonymous. The only needed information is the link between the identifier and the amount. For MoBIB, it is what have been foreseen for Value Contracts on a card based approach. Even with a centralized system, the amount may be associated to MoBIB Basic card.

Each time a transport is used, the fare is taken of the available amount. It can be used for different operators. It is also possible to implement simple rules like it is foreseen for Value Contracts. For a card based system, rules must be simple, like reduction if a transportation from another operator has been used recently. On a centralized system, more complex rules like monthly capping may be implemented.

Oyster Card in London or OV-Chipkaart in Netherland implement Pay-as-you-Go systems.

Pay-as-you-Go is a good base for adding EMV with complex rules.

USAGE WITH OTHER CONTRACTS
The Pay-as-you-Go or value contract is only activated if there are no others contracts that can be used. If on the card or centralized in the back-end, there is also a pass or ticket that can be used for the trip, those will be used first like in a standard "closed-loop" system. The priority can be set according business rules.

CAPPING

The capping are rules defining the maximum you will pay. It can be limited to one or two hours. The starting point is "each time you pass a validator, you pay". Some simple ticketing systems are implemented on this rule. The duration capping is based on the principle that a ticket is valid for a certain period. Whatever the number of validation in the period, you pay only once.

On top of this, you can have daily capping or monthly capping. The maximum you will pay for a day is the price of the daily pass and the maximum monthly paid is the pass for the month.

Capping may be extended to more complex rules, including multiple operators.

If period some capping can be implemented on card based value contracts, it is difficult to implement for daily cappings or monthly cappings.

ABT

On an Account Based Ticketing system, accounts are defined centrally. They are defined in a back-end system and smart cards or other devices are no more than an identifier of the account.

Along with this, the post-billing model (where the fare processing is moved away from devices onto host systems) allows more complex rules, certainly in interoperability

With this model, a variety of different payment models can be introduced including:

- Direct billing to a cardholder's bank account via a pre-paid or regular billing model (similar to mobile phone billing);
- Linked accounts where families may have a single account for all their family members paid for through a single payments interface;
- Extending the linked account model to institutions, such as a company that may provide travel cards to employees as part of their salary package, and the institution is billed monthly by the transit operator.

One of the benefits of an account-based system for transit operators or authorities is the ability to create a variety of attractive products and partnership opportunities. Account-based ticketing and payments schemes can link a variety of appropriately secured "travel rights" or tokens to a single account. This can enable the introduction of innovative new models of linked transport modes such as park-n-ride, where your car license plate might be linked to your account and recognized through an ANPR (Automatic Number Plate Recognition) system, thus allowing for integrated parking and travel discounts.

MaaS

MaaS is in the first place a distribution model for transport services. The customer's transportation needs are "met over one single interface and are offered by an integrated service provider in an eco-system made of infrastructures, different transportation services and operators, information and payment services. The distributer would design customized packages allowing different volumes of usage of the different transport modes including taxi services. Some examples of this type are being explored in Helsinki at the moment.

TECHNICAL ASPECTS

Card Usage

The card for a card based system is a unique wallet where tickets from different origins can be stored. Tickets can be from different types: Transport, Parking or International, but other kinds are possible too. Adding an ABT identifier on it is as simple as adding another ticket.

It is a unique identifier that can be used for different external "ABT" systems. When the card is used by external partners, they often use it as identifier and implement their ABT to manage the service.

It is nearly impossible now to have an on-line validation, verifying that after the identifier, there exists an account with a payment mean, or, for a prepaid account, that there is still enough cash to pay the journey. For those reasons, there must be more on the card than only the identifier.

However, the concept of having a Value Contract is still very much alive. It would be the perfect solution for Pay-as-you-Go. Value Contracts are foreseen in nearly all card based data models and just need to be instantiated in transport contracts. In fact, Value Contracts are the ideal solution in an interoperable system, allowing each PTO to have its own fare settings and discount rates. Especially in an interoperable system, it will allow defining the fare and business rules for transfer discounts, etc. So, the right approach (used almost everywhere in the world) is directly use the 'money' to pay the transport without other ticket. The back-end will implement the distribution of the revenue following payment schemes.

With a system based ABT, implementing a post-paid approach, the card is used as identifier like for parking or car sharing. However, it is also interesting to have a special contract to specify that a valid account is linked to this card. It may be with a validity period and even a counter. The approach will be then similar to a credit card.

EMV implementation

Normal EMV contactless usage foresees that the card has an authorization for a small amount, typically maximum 20 Euro and when it is used, the counter is decreased from the amount paid. The transaction can be done offline. When the amount is reached, an online connection and/or PIN transaction is necessary to authorize the payment and reset the counter.

This is not implemented like that in transportation. The counter is not decreased at the validation – if set so by the issuing bank - and no authorization is asked for the validation. It would take too long for a validation transaction and reset the counter with a PIN code is totally impossible. The information of the card seen, is sent to the backend for verification as soon as possible, typically within seconds. If it is the first time the card is seen or the authorization amount is reached, an authorization is asked to the payment organism. If the authorization is refused, the card is black listed and this information is sent to all validation units within the network. This has for consequence that the first usage is always allowed. The issuing bank will cover the cost of the very first trip, even when the account was blocked.

EMV, like other credit card process involves different actors:

- **Acquirer** : An Acquirer is an organization authorized by the payment schemes to enable merchants to process debit and (or) credit transactions. The acquirer establishes a contractual relationship with the merchant and assigns the relevant fees/discount rates for the merchant and ensures the merchant complies with all regulations stipulated by the card schemes.
- **Issuer** : The financial institution who issues the credit or debit card to the customer or consumer.
- **Cardholder** : The client, the person using the transport
- **Merchant**: For transportation, this role is assumed by the PTO's.
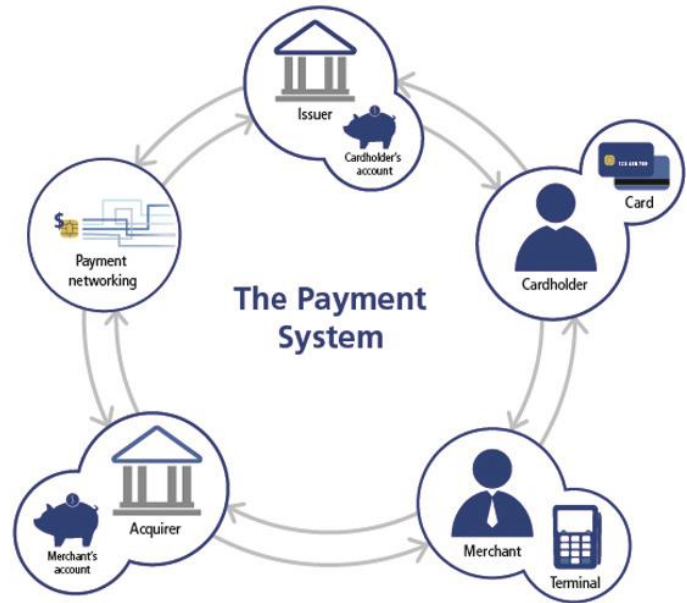
Interoperability

Bank notes, coins, credit or debit card can be used as unique payment means. The bus driver can sell a ticket, and you can pay a parking with coins. Unique payment does not mean interoperability.

"Interoperability" is used to describe using a card issued by one scheme for holding tickets issued by other schemes. These other tickets can be either for independent travel or as part of a single journey that crosses from one scheme into another. [3]

Inter-modality or **Multi-modality** are terms used for interoperability when not only public transport are involved but also other transports systems like shared bikes or cars but also park places.

In public transport the definitions may also be used as follows[4]

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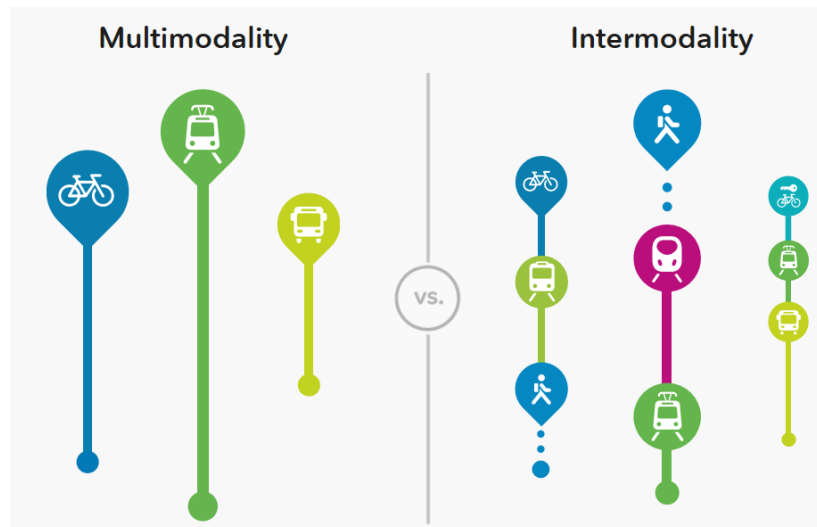
[3] Definition coming from STA (Smart Ticketing Aliance).
[4] https://www.qixxit.de/en/multimodality-and-intermodality/

Multi-modal mobility describes simply the possibility to choose for one specific route between different transport options. If you get offered variable means of transport for one route, for example you can choose between car and train, this offer is called multimodal. **Inter-modal** mobility describes on the other hand the use of different means of transport on one and the same route. If you combine various means of transport on one route, for example you change the train to a car sharing vehicle, you are already intermodal on your way.

ABT is foreseen to implement multi-modal and inter-modal approaches.

Customer Claims & Billing Aspects

Two important points require that information must be sent back to the operators back-ends: After sales and Billing. When a user has a problem with the payment of a service, he will contact the service provider's website or the issuing bank to file a charge back claim. For this reason, the ABT/EMV system must have the detailed information about transport consumption. This is the Customer Claim view. Globally the PTO wants to have control on the "Customer Relation". The goal is not to delegate that to a third party.

The other aspect is the billing. For a "nominative" Account Based Ticketing, it is possible to send a detailed bill. This has for the end-users two fiscal advantages:

- VAT can be recovered
- The bill can be used as expense note

But this can also be required by the company accounting system where transportation is an expense.

Inspection

A card based system can be easily controlled. The validator can write on the card. It is possible for the inspector to read on the card. If there is no validation on it, it is a "fraud" with two possible cases: does the user have a valid ticket or not. If he has a pass but no validation, it's a "lesser kind of fraud".

For an account based ticketing where the transport card is used as identifier, the same rule should apply. It's easy to verify if the card has been validated, otherwise, it's fraud.

For EMV as identifier, the problem is more complex. It is not possible to write on the card. Then the card only is not enough for control. There are two distinct cases: validator is in the vehicle, like for a bus. Or not, like in a metro station.

Under normal working conditions, the inspection device will establish an online connection with the central system to verify whether the card was validated properly according to the business rules. When there is no online connection, alternative scenarios must be foreseen.

FINANCE AND BUSINESS PLANS

Business Plan

Before implementing such a system, it's important to have a clear business plan. The elements to be evaluated are:

- The global cost. It is quite difficult to globally evaluate because it depends on the current system and the objective of the system to be installed.
- The expected revenues. Revenues can come from new business but also from cost reductions compared to existing costs of sales.

The business plan requires also to be able to estimate the volumes and the volumes in a timeline. This is difficult to do because comparisons with other countries are not always relevant.

Costs

The cost of such a system is based on 3 components:

- Setup cost
- Operational costs
- Marginal transaction costs

Transaction costs can be ignored, certainly for non EMV system. If a system is dimensioned for one million transactions and the reality is only hundred thousand, the global cost will be identical, except for payment costs. Marginal costs are only coming from payments.

Cost are very dependent of EMV or not. The impact of EMV is on the PCI DSS certification. The whole chain from validator over back-end to acquiring services has to be PCI DSS certified. This is only feasible if the whole EMV-related payment chain is segmented from the rest of the payment system.

The best way to have a cost estimation is to do an RFI and expect quotations from suppliers. In a too early stage, potential suppliers are not really interested to provide such information. If the provider of the current system has an ABT option, it is easier. Looking at experience in other countries, to add an ABT on top of an existing system will cost between 1 and 4 million EUR. The modification on the existing system is marginal and it can be implemented without modification on validators.
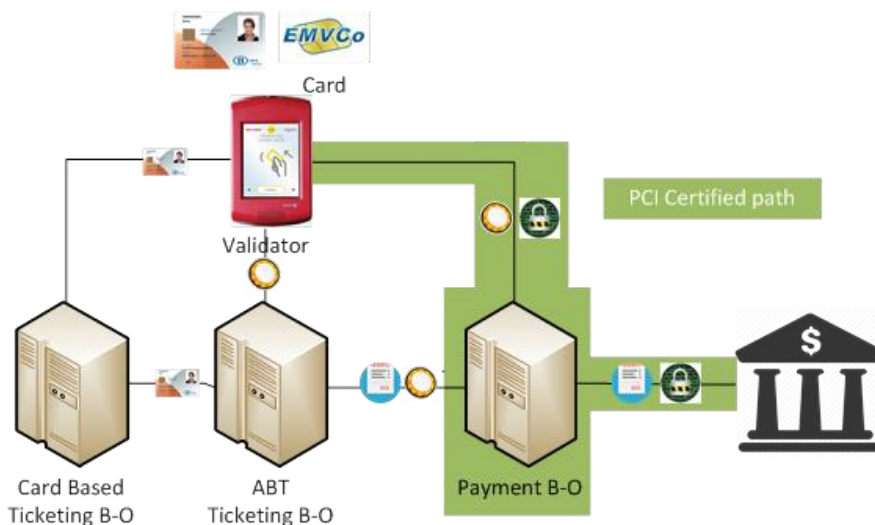
For the EMV part, a separate back-end must be foreseen for payment. The cost is relatively low but it is around 0,5 million. The reason is the PCI DSS certification.

For the validators, there are two options: Adapt the validator and certify it or add a separate PCI DSS certified validator.

A separate validator, dedicated to EMV has a cost of between 350 and 500 EUR. This means, installed, at least 1.000 EUR per validator. To adapt and certify the existing ones, the cost will depend on the existing material.

Revenues

The estimations must be based on

- Current situation
- Situation in other countries where ABT, EMV or Pay-as-you-Go is operational.

We can estimate that at the end of 5 years between 30% and 50% percent of current tickets and multi-tickets will be migrated to ABT. It is possible also to migrate a part of the passes business, but this is normally without interest: Cost of Sales of card based passes will remain lower than same business with ABT. The pricing scheme must be adapted to avoid that passes migrate to ABT.

For EMV, based on the London experience, we can expect that a maximum of 30% percent of ABT will be EMV. This covers part migrated and also new business.

Estimating new business is difficult. For single ticket, if we compare an ABT price of +/- 10 eurocent with the cost of a smart ticket, plus the distribution via Automatic Vending Machines or Point Of Sales with the worker cost to maintain and operate those systems it will certainly be a win. Put in a business plan the break even will be found between 1 and 3 years.

This is certainly not true for EMV with the cost of the validator, the payment back-office and the PCI DSS certification. Those cost are coming on top of normal ABT cost and a marginal payment cost must still be added. For this reason, EMV can normally be considered, from an economical point of view, only for special lines, like airport lines.

CONCLUSION

This document is not a reference document or whatever similar. It's only an extract of a study made in Belgium. It is shared with other Public Transport Operators with the objective to share information. Perhaps, it will lead to initiating a working group to share experience and even development to reduce the costs.

In any case, we are convinced that:

- Account Based Ticketing will certainly appear, because it is expected by the users. It will not be limited to public transport, but must include other, new mobility offers like shared bikes, cars or scooters, and like parking places with a P+R approach. And perhaps it can be extended to other public services.
- If a public operator will not do it, it will be done by private operators. The result may be less interesting for the users, because the private approach will probably limited to high revenue activities. Direct customer relationship will be also deteriorated.
- Going from magnetic ticketing systems to smart cards has add opportunities for interoperability. The step to ABT allows the growth of multi- & inter-modality.