Encompassing Payment for Heterogeneous Travelling

Design Implications for a Virtual Currency based Payment Mechanism for Intermodal Public Transport

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Abstract: As a result of a huge offering of different traffic modes, peoples mobility behavior is more and more characterized by multi- and intermodality. But this growing demand cannot be satisfied adequately yet. People have to use numerous separated software platforms and payment schemes to get access to these modes. Whereas some platforms already offer the access to few transport modes, an unconditional and comprehensive virtual payment scheme for intermodal travelling is not fully developed yet.

This work examines existing virtual payment mechanisms and projects them onto the setting of the mobility sector. First, mechanism design is determined by companies strategies, the competitive environment and the access to the providing software platform. Basis is a scenario of an open software platform that provides offerings of different independent market actors. Critical for developing a comprehensive mechanism is a functional integration of (private) vehicle sharing, the consideration of specific product characteristics and appropriate system restrictions.

1 INTRODUCTION

Innovations and technological development cause a growing number of alternative traffic modes. For example, electrification changes the urban landscape by impacting modes and infrastructure. Furthermore, peoples mobility behavior changed significantly over the past decade. They consider and support alternative transport modes, like car or bike sharing (Rehrl et al., 2007). People use these offerings and combine them to heterogeneous travel chains. This issue is becoming more and more urgent in our society (Yogesh Malhotra, 2000). But multi- and intermodal traveling is still uncomfortable to realize, because of a huge number of different software platforms, which provide access to these services.

Whereas intermodal traveling is a coherent activity for people, the software landscape to realize this is partially divided. There are already some intentions to consolidate the access to transport modes. One the one hand, providers establish in-house platforms, which offer access to their own product portfolio. On the other hand, comprehensive access to transport modes between different competitors is also developing.

Table 1 shows some examples of software plat-

forms and their functionalities across the German mobility sector. Common platforms, also called brokers, integrate different mobility modes, combine and present them concentrated. Across these platforms, the range of functions varies significantly. The frame for all following examinations is an open software platform, which integrates the offerings of independent market actors. In the following descriptions, "open" means the possibility to provide services on a platform, without discrimination by any superior instance.

Within this context, the payment via virtual currencies offers highly interesting possibilities. Cash payment is increasingly substituted through virtual currencies (Thomas Lammer, 2006). Electronic and mobile payments are emerging. Forecasts show a significant rise in global mobile transactions volume (Statista GmbH, 2013). Virtual currencies originally are designed as loyalty programs to bound customers to in-house services. A modified strategy is the cooperation scheme, also defined as coalition loyalty or cross loyalty, which describes the facilitation of loyalty cards at multiple, possibly competing, retailers (Buchinger et al., 2013b).

This work gives general design implications for an e-payment scheme for traveling via multiple trans-

Table 1: Broker Software Matrix.

Platform	Moovel[1] (Daimler Mobility Services)	DB Navigator[2] / bahn.de[3] (Deutsche Bahn AG)	quixxit.de[4] (Deutsche Bahn AG)
Region	urban region	national public transport	offerings in Germany
Functionalities	information, routing, navigation, ticketing	information, routing, navigation, assistance, ticketing	information, routing, navigation, assistance, ticketing
Modes	local public transport, taxi, car sharing, bike sharing	local public transport, taxi, car sharing, bike sharing	local public transport, taxi, car sharing, bike sharing (reduced functionalities concerning flight offerings, rental cars, ferry boats, ...)
User interfaces	web service, mobile application	web service, mobile application	web service, mobile application

port modes within one route. Therefore, the conceptual basis and the general requirements of the mobility sector are described in part two. The third part discusses the applicability of existing virtual currencies on intermodal urban public transport. Thereupon, some recommendations are stated to develop a constitutive framework of a virtual currency mechanism for intermodal travelling.

2 CONCEPTUAL BASIS

To establish a basic understanding, Figure Figure 1 defines the general scope of the context. Furthermore it pictures the relations between stated terms and definitions, used in the following.
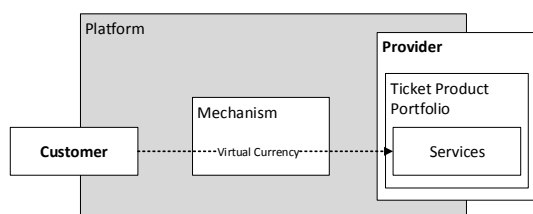

Figure 1: Conceptual Basis.

Transactions between customers and mobility service providers are enabled via an open software platform for multimodal transport services. A Virtual Currency (VC) is a fundamental instrument of payment, on which the constitutive mechanism relies. The virtual currency mechanism regulates the specific way of cash flows and transactions. Within this context certain interdependencies determine the design of each component. To develop a suitable and beneficial virtual currency based mechanism for intermodal travelling, it is essential to consider these interdependencies, especially in the mobility sector.

Because shared based transport modes are a growing part of intermodal travelling, integrating them is desirable, but challenging. Compared to traditional modes, car or bike sharing is distributed in a different way. The offerings vary significantly in terms of capacity, characteristic, location and price. Therefore, it highly depends on individual preferences. A virtual currency based mechanism has to project these individual preferences in an adequate way.

(Buchinger et al., 2013a) showed an inclusion of vehicle sharing into a theoretical concept of a virtual currency. It offers the possibility of a multimodal portability towards other transport modes. Figure 1 shows the systematical virtual currency flows under consideration of vehicle sharing. All activities are centralized in a personal digital wallet. This method is already practiced in various virtual currency based concepts, e.g. ClickandBuy[5]. Virtual currency funds can be received by exchange for cash money or by providing private vehicle capacities. Earned amounts of private car sharing can directly be reused for travellings via other transport modes.

This primer is not solely sufficient to develop a practicable currency scheme. Currency and in addition mechanism design are not only determined by transport mode specifications, but also by provider's product portfolio conditions. Within this work, products are defined as tickets, which authorize customers to use different services on certain prices. Obviously in the mobility sector, product characteristics diverge significantly compared to other industries. The consideration of this fact is a necessary enhancement of existing concepts. For example, some tickets have a time limited subscription towards the usage of special transport modes. This attribute impacts virtual currency flows substantially.

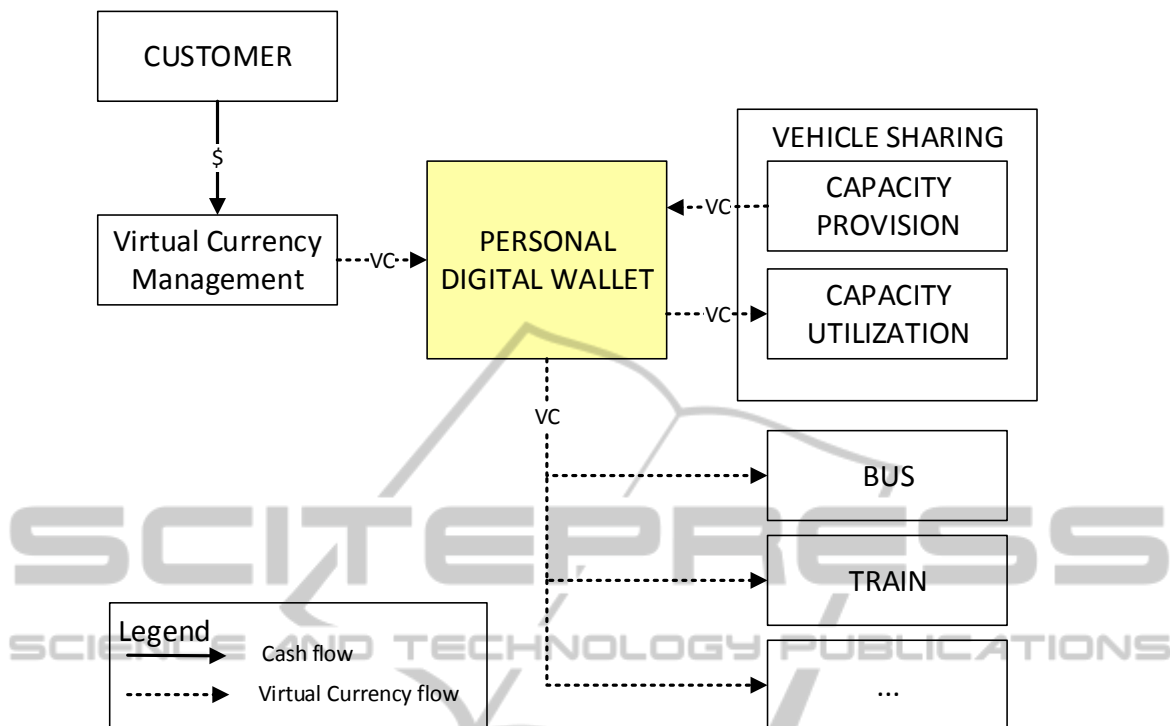[5]https://www.clickandbuy.com/DE_de/home.html

Figure 2: Multimodal Cash Flows.

3 VIRTUAL CURRENCY MECHANISMS IN CONTEXT OF INTERMODAL TRAVELING

There is a large variety of loyalty concepts on virtual basis. (Buchinger et al., 2013b) examined various virtual currency schemes in detail. This constitutive work, investigates especially the applicability of existing concepts, or components of them, to urban public transport.

3.1 Miles and More

The Miles and More program rewards customers with miles per flight with the German airline Lufthansa. Originally designed to raise customer loyalty towards the German airline, the program became extended: miles are now not only rewarded to customers, but also sold to third parties, e.g. banks, retailers and hotels. More concrete, the platform sells the ability to reward miles to third parties. Those miles expire at the end of a respective time period (Buchinger et al., 2013b).

Synergy effects enhance also third party services with additional value for the customer and for the primer platform service. As a drawback, the system favors a centralized service. Under certain circumstances cooperation between competitors is indeed possible, however only by subordination to a general instance and a favored service. Various mechanisms have this feature in common, because of strategical considerations by service providers. But this fact hinders the nonrestrictive integration of private car sharing and therefore it is not applicable to the reference scenario. In contrast to this, the constraint of exposing virtual currency funds is quite practicable in the context of urban public transport. Intensifying the incentives of the mechanism is one possibility and also feasible option.

3.2 Bahn.bonus

The bonus point system by the German mobility provider Deutsche Bahn, bahn.bonus[6], rewards customers for travelling with different transport modes. It refers to a multimodal offering, but is limited to in house modes only. Bonus points can be reinvested for travellings at discounted prices, or exchanged for other products, e.g. suitcases. Furthermore the system offers the possibility to classify customers into

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[6]http://www.bahn.de/p/view/bahncard/bahnbonus /bahnbonus.shtml

levels. There is another sort of points, called status points, which solely serve to upgrade a personal level. This enables customers to get access to additional services or other benefits. In other words, a personal bonus point deposit consists of two types of bonus points with diverging functions.

3.3 Facebook Credits

Facebook Credits support loyalty towards other service providers, but moreover create a source of revenue from the platform's customer basis. Third party developers are able to provide services, e.g. gaming applications, which can be used due to the platform. Facebook credits serve the virtual currency mechanism within this specific application. Facebook's currency is automatically converted to the currency, used in the application. This process is not recognized by the application users (Buchinger et al., 2013b).

Although this system is originally not operating in the mobility sector, its characteristics can fit to this area: the mechanism is suitable to consolidate different services hosted by independent providers. The key advantage is the function of keeping loyalty towards individual third party providers sustainable. Thereby the basic function of loyalty programs can be maintained towards separated companies.

3.4 Auctions

The offerings of car sharing are characterized by a large variety and complexity. People have individual and heterogeneous preferences which determine their decisions. A functional virtual currency mechanism has to be designed under consideration of these circumstances. In this context, the fact of conflicting preferences is critical. An auction seems to be adaptive to picture individual preferences and solve conflicts connected to them.

(Krempels, 2009) investigates different options of solving agent preference based conflicts. The stated auctions, where a secret bidding round occurs and the highest bid is the winning one, are called announcements. These announcement auctions can be modeled in different forms: first, only the winner has to pay his bid and all losing entities keep their amounts completely on their own. A second possibility is to distribute shares of the winning amount between all losing entities. An increase of funds across the loosing entities effects an improved preference conflict solving. In matters of this procedure, there a some possible variations stated. Simulation results showed that a predefined, time based decay of money added by auctions, is the most promising solution to solve these

conflicts. Diverse constraints ensure the stability of the overall system.

Despite these simulation results, such an e-payment concept could be problematical in terms of broad consumer acceptance. On the one hand, using this auction system might be less intuitive for customers. On the other hand, the system might be too complex to manage. In fact a simplified auction system should be considered.

4 CONCLUSIONS AND FUTURE WORK

Choosing the right design of a virtual currency based payment mechanism overall depends on companies strategies, the form of providing their services and the competitive environment. The rate of discrimination concerning a platform access determines these factors in large part. Therefore the way of cooperation between companies to provide intermodal traveling is essential. In this case, examinations focus on a scenario, within an open software platform, which provides offerings of different entities without discrimination. There are preliminary considerations about establishing a virtual payment scheme in this specific context (Buchinger et al., 2013b). This work advances these considerations by the following implications:

Product Portfolio Chracteristics

Central implication for designing a virtual currency based mechanism for intermodal traveling is the conceptual consideration of provider's product portfolio characteristics. Ticket products diverge significantly from products distributed in other industries. Many ticket products allow transport mode utilization through time limited subscriptions. An adequate virtual currency mechanism has to feature these conditions in a flexible way. This characteristic also aggravates the integration of vehicle sharing.

Vehicle Sharing Integration

The integration of a highly diverging modes is challenging but offers extensive value potentials. Combining traditional modes with vehicle sharing means to connect two different transaction methods altogether via a virtual currency based mechanism. Figure 3 shows a conceptual mechanism integration. Users' personal digital wallet consists of two components: The first components allows the unlimited participation on transport services in a certain time, based on a subscription agreement. Within this part,
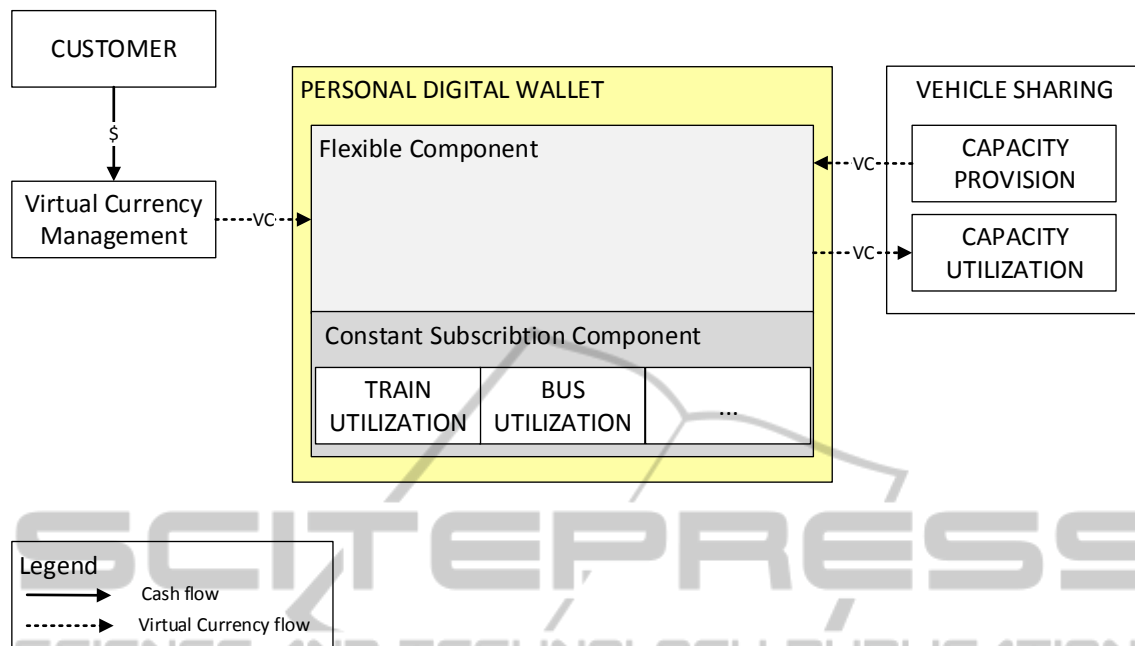
Figure 3: Compined Digital Wallet Scheme.

no virtual cash flows need to occur - depending on the certain ticket conditions. The second component includes a predefined amount of virtual coins. These coins can be earned for providing vehicle capacities and are reusable for car sharing or other services.

This combination allows the flexible integration of (private) vehicle sharing. Furthermore this scheme allows to model preferences via auctions. Compared to traditional transport modes, vehicle sharing depends substantial on specific vehicle attributes and individual customer preferences. An auction seems to be adaptive to reflect individual preferences and solve conflicts connected to them. In fact it could allocate more efficiently with regard to these conditions. Auctions can be constructed in diverse forms. These forms feature different potential of preference conflict solving, but consumer acceptance has to be considered in addition.

System Restrictions

This leads to another implication: an establishment of mechanism restrictions. Virtual currency mechanism restrictions are already approved in other areas. For example expiring currencies are well adaptive to the mobility context. Thus incentives regulate customer behavior and foster the system balance. Another adaptive restriction is a limitation of earned amounts by providing capacities of vehicle sharing. A concrete form is to avoid, that the earned currency

amounts exceeds a predefined starting budget. This prevents the systematic disadvantage of other transport modes.

4.1 Future Work

This investigation is intended to form a conceptual basis for a virtual currency mechanism on an open software platform for intermodal traveling. This mechanism is going to be modeled and technologically realized. Refering to this, there are already some reliable technical solutions connected to this area. For example concerning payment APIs or virtual currencies, which have to be considered as well. Subsequently, the procedures are going to be evaluated to examine the basic contributions.

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