Mobile Payment in Public Transport
A benchmark of functionality, user experience and technology

Research report, May 2017
Expertise Centre for E-ticketing in Public Transport

Diana Gonzalez
Mobile Payment in Public Transport

A benchmark of functionality, user experience and technology

Diana Lorena Gonzalez Sanchez
Student number: 4518675

Research report, May 2017
This report is part of the Expertise Centre for E-ticketing in Public Transport (X-CEPT)

Master Design for Interaction
Faculty of Industrial Design Engineering
Delft University of Technology
Delft University of Technology
This report is part of the Expertise Centre for E-ticketing in Public Transport (X-CEPT).

May 2017 (version 1.0)

**Author**
Diana Lorena Gonzalez Sanchez

**Project coordination**
Dr.ir. J.I. van Kuijk

**Project execution**
Diana Lorena Gonzalez Sanchez

**Academic supervisors**
Dr.ir. J.I. van Kuijk
# TABLE OF CONTENT

1. Introduction 6
   1.1. Research goal 6
   1.2. Research question 6
   1.3. Project context 7
   1.5. Method 7

2. About e-ticketing in public transport 9
   2.1. Definition 9
   2.2. Application in public transport 9

3. Inventory of e-ticketing systems in public transport worldwide 13
   3.1. Method 13
   3.2. Selection criteria 14
   3.3. Services catalogue 14
   3.5. Selection for further analysis 17

4. Service and user experience analysis 19
   4.1. Method 19
   4.1. MBTA, commuter rail Massachusetts 20
   4.2. Octopus, Hong kong 25
   4.3. DB Navigator, Germany 30
   4.4. Apple and Android pay, London 36

5. Discussion 42
   5.1. Reflection 42
   5.2. Limitations 43

6. Conclusions 45
   6.1. Conclusions 45
   6.3. Further research 46

7. Appendix 47
   7.1. Services catalogue details 48
   7.2. Services quantitative evaluation 68

References 70
Colophon 71
1. Introduction

This study benchmarks international mobile ticketing systems in public transport. Mobile payment in public transport comprises both pay-as-you-go options in which the mobile phone serves as a wallet (such as e.g., Apple Pay in London) and actual ticketing, where travellers buy and authenticate tickets on their mobile phone (such as, e.g., Ruter in Norway).

Public transport operators in the Netherlands are considering to implement mobile payment options (Reference to ‘Visie OV-Betalen’), and knowledge of existing systems can improve successful introduction of such a system in the Netherlands.

Mobile payment can become a valuable addition for public transport, because for travelers it can make it easier to pay for trips, and for service providers it can reduce the costs for distribution of tickets and subscriptions.

The daily and extensive use of public transportation systems, with great numbers of people traveling everyday, a user-centered implementation of mobile payment in this sector can be a considerable improvement of the service, with the potential of drawing more people to public transport.

As mobile payment is likely to be a key feature of Dutch public transport in the (near) future, the user experience of this part of the service should of high quality. An important first step in creating a service with a high level of user experience is understanding the workings of existing systems. Different technologies are available and applied in different transportation systems worldwide, an analysis of which can show the strengths and weaknesses of these systems in terms of user experience.

Therefore, this study benchmarks the functionality, user experience and technological platform of 20 systems for payment in public transport worldwide, and analysis the user experience of four of those systems in more detail.

1.1. RESEARCH GOAL

Provide insight into the user experience of mobile payment systems for public transport around the world.

1.2. RESEARCH QUESTION

- Which mobile payment service for public transport are available worldwide?
- What functions do these services have?
- How do people experience the mobile payment service (features, payment process)?
- Which technological platforms are available nowadays to provide mobile payment services?
1.3. PROJECT CONTEXT

This study is done as part of the Expertise Center for E-ticketing in Public Transport (X-CEPT) of the faculty of Industrial Design Engineering at TU Delft. Through research-intensive design projects X-CEPT develops user-centered solutions for ticketing and payment in public transport, with a focus on the Dutch OV-chipkaart system. This study is used as input for a user-centered design project in which TU Delft and Translink explore the possibilities of introducing mobile phones for payment in the OV-chipkaart ecosystem.

1.5. METHOD

The study had two main stages:

Inventory:
An online review was conducted to identify mobile payment services worldwide. Sources included among others tech magazines, tech blogs, news, forums, public transport providers official websites, Google Play and app store.

User experience:
User experience is characterized by its intangible interactions and multiple users perspectives, consequently it is a challenge to heuristically recognize patterns and draw conclusions. To that end of each of the selected services a customer journey was created, thus facilitating the analysis of the usage of the system by categorizing and visualizing the steps of the travel from an human centered design perspective. For each of the steps in the customer journey, it was assessed how travelers experienced these through comments made on forums, in reviews, etc.

The information that the customer journey was based upon was retrieved from user self reports online, specifically social media, blogs, reviews. In social media the search keywords included the name of the service, system, app or card. (See Figure 1)
Apple pay in the tube, London
2. About e-ticketing in public transport

2.1. DEFINITION

Mobile payment is essentially a financial transaction authenticated, authorized and confirmed it by using a mobile device, for instance mobile phones, tablets or smart watches. (Changsu, Mirsobit and Lee, 2009). Notably the market of mobile payment has grown considerably in recent years and the forecast for the market tends to be positive.

Several technologies and service models have been developed to provide mobile payment service in different context, among others, mobile wallet, carrier billing (SMS), and of course Contactless payments with NFC (Near Field Communication) technology.

2.2. APPLICATION IN PUBLIC TRANSPORT

Specifically in the context of public transport, different technologies have been adapted to create new services models that respond to the challenges of this sector. The technology is also intrinsically related with the service structure, the options are: pay as you go, fixed tickets (from specific station of another) and subscriptions.

2.2.1 Self ticketing:

This is so far the most popular technology given the easiness of the implementation. Only by using an app the user is able to buy tickets from a specific departure to a specific ending station, which means that the travel route is fixed. The result of the transaction is a QR or barcode code that is visualized in the mobile phone. Depending on the public transport infrastructure there are two options for the execution of this service model:

Open stations:
When stations do not have gates or when boarding vehicles, the ticket must be activated before boarding. At that moment the ticket starts to display an animated background that the driver can easily check during the boarding. In most of the services there is an extra verification on board by an inspector.

Figure 2. QR Ticket example
Closed stations:
In stations with gates the challenge is to open the doors with the mobile device, for that end the gates are usually equipped with QR scanners.

2.2.2. Near Field Communication (NFC):

“It’s a method of wireless data transfer that detects and then enables technology in close proximity to communicate without the need for an internet connection. It’s easy, fast and works automagically.” (Faulkner, 2015). It means that two devices are able to transfer data to another without either been connected to wifi nor use pairing code (as in bluetooth). Due to the encryption protocol, the chips embedded in most of the high tech smartphones are secure enough to be used in payments as a contactless card, this might eventually lead to the digitalization of the cards.

NFC is nowadays the most used technology in general mobile payment in physical stores and other services. However the implementation of this technology has major challenges that directly affect the opportunities in public transport. According to the RFID Journal (Will NFC Dominate Mobile Payments?, 2011) the biggest challenge is related related with the slow adoption process due to the lack of infrastructure, complex ecosystem of stakeholders and standards. Several NFC service models had been developed to adapt the technology to the specificities of public transport.

NFC + Sim card:
Most of current poles and gates are not equipped with NFC readers, because they have been put in the field before NFC emerged as a standard. Furthermore, there is a wide variety of encryption systems according to the different mobiles models. That is why this solution proposes SIM-card plus NFC chip which emulates the protocol of the chip that is built into the gates and poles. Then, it is possible to open the gates and keep track of the user’s transactions as a normal transport card, as well as to top it up with an app. This model is currently used in Hong Kong and will be further explained later.

NFC to scan the card:
In this case given the limited infrastructure in the readers, the NFC is used to scan the service card (e.g OV-chipkaart or Octopus Card) and to top it up through an app transaction.

Mobile wallet:
This is so far the most widespread use of the NFC for mobile payment because of the launch of Apple pay and Android pay in a number of countries. By the use of an app that stores credit and debit card information the a smartphone can be used as the payment medium instead of the physical card.

Two other technologies not widely used were identified:

Hop on:
This technology was developed by an Israeli start-up as an alternative way to pay public transport with the cellphone. The technology sends information by ultrasonic sound waves transmitted from the
cellphone to the reader. It claims to be secure, low cost and fast.

**GPS tracking:**
Applied in Germany by the service “Touch and Travel”, in this case GPS is used to keep track of the user’s journey. Users are required to check in and out in the app when getting on and off.

In conclusion, different technologies respond to different needs in terms of infrastructure, scope and stakeholder involvement. Moreover each technology has remarkable opportunities and drawbacks. With this in mind, we will explore the impact of those in user experience.
1. MBTA

Massachusetts region

The Massachusetts Bay Transportation Authority, often referred to as the MBTA or "The T", is the public operator of most bus, subway, commuter rail, and ferry routes in the greater Boston, Massachusetts area.

Lines: 12 (commuter rail), 4 (heavy rail), 5 (light rail), 4 (trolleybus), 4 (ferryboat), 183 (bus)

Stations: 123 (commuter rail), 57 (heavy rail), 74 (light rail), 250 (bus)

---

MBTA mTicket

Self ticketing QR

The MBTA mTicket app is now available for all Commuter Rail and Ferry Lines. Purchase MBTA Commuter Rail and Ferry Single Ride, Round-Trip, 10 Ride, and Monthly tickets

Services:

- Secure ticket purchasing with your credit or debit card
- Your smartphone is your ticket
- Never lose your ticket -- tickets can be easily transferred if your phone is lost or stolen
- Check Commuter Rail schedules, maps, and service alerts
- Allow fare reduced fare ticket and multiple tickets purchase

Technology:

You should activate your mobile ticket immediately before boarding your Commuter Rail train. Conductors will usually inspect tickets visually by checking the color changing ticket screen, but a conductor may occasionally ask to scan the barcode on your activated ticket.

---

Google Play - Android

Update: November 29, 2013
Installs: 100,000 - 500,000

App store - iOs

Update: Sep 10, 2015
Current version: ★ ★ ★ ★ ★

Video URL: https://www.youtube.com/watch?v=C11SMwrhR3c
3. Inventory of e-ticketing systems in public transport worldwide

This chapter includes the process and results of the first step of the research, which aims to produce an overview of mobile payment services in public transport worldwide. Firstly, the method of research is detailed, followed by the selection method that lead to the initial selection (‘long list’) of services. Secondly, an overview of these services and their primary properties is given. Finally, the method of selection of services considered most relevant to analyze further is presented.

3.1. METHOD

As it was mentioned in the introduction, the first step of the core research was to research mobile payment services around the world. To this end an online survey was performed by using the following keywords in combination with either “public transport” or “transport.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>KEY WORDS VARIATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Mobile payment</td>
</tr>
<tr>
<td></td>
<td>Mobile ticketing</td>
</tr>
<tr>
<td></td>
<td>e-ticketing</td>
</tr>
<tr>
<td>App related</td>
<td>App ticket</td>
</tr>
<tr>
<td></td>
<td>App payment</td>
</tr>
<tr>
<td>Technology related</td>
<td>NFC</td>
</tr>
<tr>
<td></td>
<td>QR</td>
</tr>
<tr>
<td></td>
<td>Self ticketing</td>
</tr>
<tr>
<td></td>
<td>Apple pay</td>
</tr>
<tr>
<td></td>
<td>Android pay</td>
</tr>
</tbody>
</table>

Finally, a number of the companies responsible for the design of those systems were looked into.

This process produced a list of 55 services, usually with a related app. This initial overview only included the name of and some general information about each service, and therefore in the next step more information was collected in order to select a range of services that would be documented in more detail. Of each service that was initially identified the following aspects were documented:

- Location: Geographical area covered by the system (either country, region or city).
- Public transport system size: measured by lines, stations, ridership.
- Technology used
- App that supports the service (if applicable)
- User satisfaction of the service’s app in both Google play and App store
- Amount of installs on Android phones (information not available for iPhone)
- Transport modalities included in the service (e.g bus, ferry, commuter rail)

Thus we finally arrived at an overview of 20 mobile payment systems in public transport (See 3.3. Services catalogue). As this is a qualitative study, meant to produce insights into the advantages and disadvantages of existing systems, the process of choosing and analysing apps was stopped when multiple cases of all technology types had been identified.
3.2. SELECTION CRITERIA

A primary selection criterion was the coverage of the systems, taking into account that Dutch public transport is a countrywide system, complex and multimodal services were preferred. Furthermore the goal was to examine a wide variety of technologies to gain preliminary insights into the technological opportunities and drawbacks. The process stopped when getting to the saturation level, that is to say that no new relevant information was found.

Language barriers also played an important role in the selection process, since only services with enough online information in English could be assessed (See 5. Discussion).

3.3. SERVICES CATALOGUE

A format was established for presenting this ‘long list’ of mobile ticketing services. This provides information about the app that supports the payment, since most of the systems adopted apps as part of the service model. An overview of the selected mobile ticketing services is presented in Table 1. Details of each service can be found in the Appendix 1 (Services catalogue details).
<table>
<thead>
<tr>
<th>Transport system</th>
<th>Location</th>
<th>App</th>
<th>Technology</th>
<th>Android</th>
<th>iOS</th>
<th>Installs</th>
<th>Modalities</th>
<th>Coverage area</th>
<th>Ridership (per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MBTA</td>
<td>Massachusetts area</td>
<td>MBTA mTicket</td>
<td>Self ticketing QR</td>
<td>4.2</td>
<td>2.5</td>
<td>100,000</td>
<td>2</td>
<td>Regionwide</td>
<td>1.3 millions</td>
</tr>
<tr>
<td>2 TriMet</td>
<td>Portland</td>
<td>TriMet</td>
<td>Self ticketing QR</td>
<td>3.2</td>
<td>2.5</td>
<td>100,000</td>
<td>4</td>
<td>Regionwide</td>
<td>319,700</td>
</tr>
<tr>
<td>3 METRORail</td>
<td>Houston</td>
<td>Q-ticketing</td>
<td>Self ticketing QR</td>
<td>3.9</td>
<td>3</td>
<td>5,000</td>
<td>1</td>
<td>Citywide</td>
<td>43,900</td>
</tr>
<tr>
<td>4 MTA LIRR/MNR</td>
<td>New York area</td>
<td>MTA eTix</td>
<td>Self ticketing QR</td>
<td>2.8</td>
<td>2</td>
<td>10,000</td>
<td>4</td>
<td>Regionwide</td>
<td>637,700</td>
</tr>
<tr>
<td>5 Rutter</td>
<td>Oslo and Akershus/Norway</td>
<td>RuterBillett</td>
<td>Self ticketing QR</td>
<td>3.7</td>
<td>-</td>
<td>500,000</td>
<td>6</td>
<td>Regionwide</td>
<td>300,000</td>
</tr>
<tr>
<td>6 SFMuni</td>
<td>San Francisco</td>
<td>MuniMobile</td>
<td>Self ticketing QR</td>
<td>2.9</td>
<td>2.5</td>
<td>10,000</td>
<td>4</td>
<td>Citywide</td>
<td>679,800</td>
</tr>
<tr>
<td>7 BVG</td>
<td>Berlin</td>
<td>BVG FahrInfo Plus</td>
<td>Self ticketing QR</td>
<td>3.7</td>
<td>3.5</td>
<td>1,000,000</td>
<td>6</td>
<td>Regionwide</td>
<td>1,390,000 U-Bahn</td>
</tr>
<tr>
<td>8 Deutsche Bahn</td>
<td>Germany</td>
<td>DB navigator</td>
<td>Self ticketing QR</td>
<td>4</td>
<td>4</td>
<td>10,000,000</td>
<td>6</td>
<td>Countrywide</td>
<td>2.5 millions</td>
</tr>
<tr>
<td>9 Chiltern Railways</td>
<td>London</td>
<td>Chiltern Railways</td>
<td>QR with gate scanners</td>
<td>3.8</td>
<td>-</td>
<td>50,000</td>
<td>1</td>
<td>Regionwide</td>
<td>-</td>
</tr>
<tr>
<td>10 NS Nederlandse Spoorwegen</td>
<td>The Netherlands</td>
<td>NS Reisplanner Xtra</td>
<td>QR with gate scanners</td>
<td>4.1</td>
<td>3</td>
<td>1,000,000</td>
<td>1</td>
<td>Countrywide</td>
<td>1,200,000</td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>Country</td>
<td>Technology</td>
<td>Frequency</td>
<td>Users</td>
<td>Regionality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>------------------</td>
<td>-------------------------------------</td>
<td>-----------</td>
<td>-------------</td>
<td>-----------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>NS International</td>
<td>The Netherlands</td>
<td>NS International app</td>
<td>3.3</td>
<td>10,000 50,000</td>
<td>Several countries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Deutsche Bahn</td>
<td>Germany</td>
<td>Touch and Travel</td>
<td>3.6</td>
<td>10,000 50,000</td>
<td>Regionwide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Opal Card</td>
<td>Sydney area</td>
<td>Opal travel</td>
<td>3.5</td>
<td>100,000 500,000</td>
<td>Regionwide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Metra, CTA, Pace</td>
<td>Chicago</td>
<td>Ventra</td>
<td>3.4</td>
<td>100,000 500,000</td>
<td>Citywide 1,2 millions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Snapper card</td>
<td>New Zealand</td>
<td>Semble</td>
<td>4</td>
<td>50,000 100,000</td>
<td>Countrywide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Transport for London</td>
<td>London</td>
<td>Android Pay bPay Mobile Wallet</td>
<td>4</td>
<td>-</td>
<td>Citywide 1.8 millions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>EZ-Link Card</td>
<td>Singapore</td>
<td>EZ-Link</td>
<td>2.7</td>
<td>100,000 500,000</td>
<td>Countrywide 3 millions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>EZ-Link Card</td>
<td>Singapore</td>
<td>My EZ-Link Mobile NFC + Simcard</td>
<td>3</td>
<td>10,000 50,000</td>
<td>Countrywide 3 millions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Octopus Card</td>
<td>Hong Kong</td>
<td>Octopus Card</td>
<td>3.3</td>
<td>1,000,000 5,000,000</td>
<td>Countrywide 5 millions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>HopOn</td>
<td>Israel</td>
<td>HopOn</td>
<td>3</td>
<td>50,000 100,000</td>
<td>Regionwide</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.5. SELECTION FOR FURTHER ANALYSIS

A second selection process was performed to, from the 21 apps in the services catalogue, select those for analysis that would provide the most relevant insights for applying mobile ticketing in the Dutch public transport sector. To that end selection criteria and a weighing scheme were developed.

3.5.1. Selection criteria

In the criteria weighing scheme (Table 2) three levels were assigned to each selection criterion, which allowed for scoring services and then sorting out the most relevant ones to study in detail.

3.5.2 Selected services

From the quantitative evaluation four services were selected for a thorough user experience analysis.

- Germany: DB navigator
- Hong Kong: Octopus Card
- Massachusetts area: MBTA
- London: Underground Android Pay and ApplePay

BVG was not selected for further exploration given the potential barrier language during the user self report research. More details of the selection process are presented in the Appendix 2 (Services quantitative evaluation).

---

Table 2, Selection criteria

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
<th>Android</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>App satisfaction</td>
<td>Shows the quality of user experience. We assume that higher satisfaction means a better experience</td>
<td></td>
<td>3.6-3.7</td>
<td>3.7 - 4</td>
<td>4.1 - 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iOS</td>
<td>2.5-3</td>
<td>3-3.5</td>
<td>3.5-4</td>
</tr>
<tr>
<td>Amount of installs</td>
<td>As an indicator of the maturity of the service (app) as well as the popularity. More people using it means more user self-reporting information online to evaluate user experience</td>
<td></td>
<td>100,000 - 500,000</td>
<td>500,000-1,000,000</td>
<td>1,000,000-5,000,000</td>
</tr>
<tr>
<td>Modalities</td>
<td>Multimodal transport systems have an special relevance given the Dutch transport system. If the service is multimodal means that it has overcame challenges associated with this complex service. Also will show opportunities in that matter.</td>
<td></td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Size of the system</td>
<td>Coverage area is an indicator of the transport system size and is directly related with the ridership</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ridership, as the ridership increases so do the possible issues with the different technologies, then providing valuable insights on the massive use of the service.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ticket not accepted
Please go to the
Customer Service Centre
4. Service and user experience analysis

In this chapter the user experience is analysed by constructing a customer journey for the following services: Massachusetts commuter rail, the Hong Kong Octopus card, DB Navigator in Germany and Apple/Android Pay in London. First, the method is presented, followed by an analysis of each service analysis and ending with the conclusions, tips and tops for mobile payment.

4.1. METHOD

To evaluate the user experience it was crucial to have a clear understanding of the service steps and how those steps were perceived by the users, hence a customer journey was used to visualise the service model structure. Applying a customer journey also makes possible to analyse in which steps the experience tends to be positive as well as negative and why.

Firstly, the customer journeys were structured according to the travel experience stages used in previous evaluations of the Dutch transport services (Joppien, Niks, Niermeijer & v. Kuijk 2013): purchase, pre-travel experience, travel experience and post-travel experience. However, due to the differences in technology and service structure applied in the services under investigation, the steps inside those stages were significantly changed. The services steps were defined based on information from official websites, popular (technology) press, and online forums.

Once the service steps were clear, the collection of self-reported experiences from the users of these services started. The raw data was collected from user self reports online found in social media, more specifically Facebook, Twitter and Reddit, and app reviews in both App store and Google play. The keywords included: The name of the app or service alone, and the name plus “mobile payment”. The collected self-reports were then located in a specific step of the customer journey.

Based on the collected self-reports an analysis of both the positive and negatives aspects of the service steps was performed.

<table>
<thead>
<tr>
<th>Phases</th>
<th>Purchase</th>
<th>Pre-travel experience</th>
<th>Travel experience</th>
<th>Post-travel experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps</td>
<td>Orientation Purchase</td>
<td>Activation Loading</td>
<td>Check in Station</td>
<td>Traveling Interchange</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Check out Evaluation</td>
</tr>
</tbody>
</table>

Figure 5, Customer journey stages (Joppien et al., 2013)
4.1. MBTA, COMMUTER RAIL MASSACHUSETTS

4.1.1. Description

Transport system:
The MBTA Commuter Rail system serves as the commuter rail arm of the Massachusetts Bay Transportation Authority’s transportation coverage of Greater Boston in the United States. The system is the sixth-busiest commuter rail in the U.S. Commuter Rail fares depend on the distance of traveled (zones).

Ridership levels on the Commuter Rail have grown since late 1960s, with overall average weekday ridership growing from 29,500 in 1969 to 76,000 in 1990 and 143,700 in 2008.

"#MBTA #mTicket mobile ticketing has hit over $35 million in sales since its intro in November 2012 #MBTAbyTheNumbers"  
-MBTA Twitter account-

Mobile payment service:
It is a self-ticketing service model with open gates, the payment is done through the “MBTA mTicket” app, which gives the users a QR e-ticket. The ticket must be activated before boarding the train, so the driver is able to easily check it. It is important to notice that the app only offers tickets for commuting rail and ferry routes. During the research not relevant information regarding ferry use was found, consequently commuting rail is the focus and scope of this analysis.

The app uses the JustRide mobile ticketing platform, that includes a cloud based data management, pre-defined app design and the QR technology for validating the tickets. The system was designed and implemented by Masabi, a company well known for providing mobile ticketing solutions.

4.1.2. App interface

The app was explored to gain insights into interface design and user experience. The “MBTA mTicket” is available for both Android and iOS devices and it includes extra services besides the e-tickets: Rail map and schedule.

The following section explains the app’s main screen, the services provided, and the task flow for purchasing a ticket.
4.1.3. Customer Journey

The customer journey includes the conclusions drawn from user self-reports by stating the positive and negative aspects of the service that impact the user experience.

4.1.4. Insights

*Positive aspects*

- The convenience and easiness of paying with the app is positively perceived and deeply appreciated. The convenience is specially enhanced by not needing cash.

  “It gets me peace of mind, knowing that if I need to get somewhere I can do it on my phone”
  - Retrieved from Youtube-

  “@MBTA_CR just tried your mTicket app. Simple and easy. Great job.”
  - Retrieved from Twitter-

- The use of e-tickets instead of printed ones, gives users a sense of environmental friendliness
- The process of purchase is perceived as simple and fast.

  “I like that I can store my credit card, it remembers me my train stops, couple of clicks and I am done”
  - Retrieved from Youtube-

- The special feature for event tickets is considered convenient

*Negative aspects*

- The app does not provide accurate and timely information about the schedule. This inaccuracy causes mistrust.

  “The way schedules are displayed is bizarre. They write “04:25” for 4:25pm, which suggests the developers are just as bad at understanding the nature of time as they are at app navigation”
  - Retrieved from Google play-

- The frequent technical issues negatively impacts user experience, causing uncertainty whether it will work or not

  “Glitch Two times I clicked on a certain stop and it glitched to another stop. Resulted in 2 tickets that I couldn’t use. Either be careful or don’t use it”
  - Retrieved from Google play-

  “Purchasing tickets is nominally functional, but everything else is awful. The UX is pretty awful, with every screen displaying a “please wait” mask until you dismiss it.”
  - Retrieved from Google play-

- The interface does not consider that users have to access the ticket in different stages of the travel, therefore the screen should be the one the user is expecting (e.g ticket ) and not the home screen.
- The app’s interface does not provide shortcuts and filters for the schedule searching process
- The use of a personal account for managing the tickets is prefered by the users.
- There should be a refund option, the lacking of it causes hesitation and makes users afraid of making mistakes, some might even be upset.
- The app provides few multiple payment methods.
- When allowing monthly tickets in self-ticketing systems the app should alert the user in cases of inactivity.
## CUSTOMER JOURNEY MBTA COMMUTER RAIL

### STAGES

<table>
<thead>
<tr>
<th>PURCHASE</th>
<th>PRE TRAVEL</th>
<th>TRAVEL</th>
<th>POS TRAVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getting the app</td>
<td>Preparation</td>
<td>Station</td>
<td>Activate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Buy tickets</td>
<td>Get on</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Travel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inspection</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Get off</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reflection</td>
</tr>
</tbody>
</table>

### STEPS

- **Search**
- **Install**
- **Check map (route)**
- **Check trip planner**
- **From home to station**
- **Arrive at station**
- **Select station from/to**
- **Select train**
- **Select payment**
- **Validate**
- **Ticket**
- **Look for platform**
- **Activate**
- **Move to the driver**
- **Travel**
- **Show to the inspector**
- **Reflection**

### CURRENT EXPERIENCE

<table>
<thead>
<tr>
<th>POSITIVE</th>
<th>NEGATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Conveniency to not miss the train when the users are in a hurry</td>
<td>- Non-real-time system status function (e.g., schedule/irregular). Increasing uncertainty.</td>
</tr>
<tr>
<td>- Stores card information and frequently-used train stops</td>
<td>- Unlikely to see the schedule. Did not foresee the user needing to look up a specific day and hour.</td>
</tr>
<tr>
<td>- Multiple types of tickets available (one way, 10 times tickets, round trip, monthly)</td>
<td>- No reliable/stable schedule function, it does not load at times.</td>
</tr>
<tr>
<td>- Easy, fast, simple and convenient</td>
<td>- The time format is not easy to understand.</td>
</tr>
<tr>
<td>- Savvy, fast, simple and convenient</td>
<td>- App is not consistent with Apple OS.</td>
</tr>
</tbody>
</table>

### EMOTIONAL CURVE

- **Positive**
- **Negative**

Does not support support reduced fare (ex. senior citizens) with web information about the app.

- The ease of the process of payment is not clear for the users, therefore creating mistrust.
- The user is forced to contact customer service in case of reinstalling the app, but the callphone or on-change, because the lack of account feature.

**WBTA is very convenient and easy to use when the train is available for the next day.** You will receive information about your card status as soon as the mobile phone is on. In the case of a meeting, you can receive a reminder to check your card status. It is easy, simple, and very convenient.
“@MBTA @MBTA_CR First of September. Forget to switch out monthly pass. Conductor charges me for minor lapse. Not a great customer experience.”
- Retrieved from Twitter-

- The service does not include all the potential users (e.g. seniors, students)
- The service might be complemented with a feature to top up the card (this is already available in other systems)
- Integrate the app services with other MBTA public transport as metro and buses.

4.1.5. Conclusions

- It is clear that mobile payment positively impacts the traveling user experience in comparison with paper tickets. In this case no needing cash, the flexibility of buying the ticket in any step of the travel and the easiness (linear menu) to buy the tickets in the app are appreciated.

- Even though the system has a high satisfaction in Android with a 4.2 score, several complaints were identified. Inaccuracy and technical issues are the most common factors that create mistrust. This is complemented with the inability of the app to correct user mistakes (e.g. through a refund option).

- From a user interface and information architecture perspective, the fact that the app does not foresee user needs negatively impact the user experience. For example, it does not provide filters for the schedule searching or shortcuts, it always return to home screen independently of the step of the travel, and finally it does not alert the user on the inactivity of monthly tickets.
4.2. OCTOPUS, HONG KONG

4.2.1. Description

Transport system:
Hong Kong has a broad transit system, including Mass Transit Railway (MTR), tramways, buses, light buses and ferries. It is known for having the highest rate of daily journeys (90%) in public transport worldwide (Lam & Bell, 2002). This is a multimodal system similar to the Dutch one, and has interesting technological proposals for mobile payment. However, Hong Kong is equipped with a fully gated system while OV-chipkaart is semi-open.

Mobile payment service:
The public transport payment in Hong Kong is based on the Octopus card. This is a reusable contactless card launched in 1997 to replace paper tickets (which had magnetic strips) in the transit system, and has increased its scope since then to retailer shops, parking meters, convenience stores, fast food and online payments, among others. The system is ‘pay as you go’ and works in buses, trains, ferries, and minibuses. The card can be purchased in any station of the Mass Transit Railway (MTR).

To introduce mobile payment options to this system, in October 2013 a pilot of the Octopus mobile SIM card was launched, with the support of Sony and PCCS. The SIM card has both Octopus card and mobile operator services and only can be used in mobile phones with NFC (Near Field Communication). The SIM is exclusively sold in Seven Eleven stores and mobile operators and it is available in 3 different SIM sizes. The SIM card must be paired with an app for checking the balance and topping up if required, the app is also essential for online payments.

It is important to highlight that even if the mobile phone is equipped with NFC, only tested devices by the operator are ensured to work in the gates. Due to the restriction of NFC encryption for iOS devices it is not possible to use iPhone or Apple Watch with the SIM. In addition to the initial Android-only app, in August 2016 Octopus launched a special app for topping up the card, on iPhones this requires an especial extra device called Octopus card reader.

4.2.2. App interface

The app seems to be designed more for electronic payments in general than for paying in public transport specifically. This might be due to the multiple features of the Octopus card and its extensive use in daily payments. In the following section the main functions are presented as well as the activation process of a SIM card for Android devices.
Octopus

Set up SIM card

Check the detection area of the mobile device

Enable the required system functions for using the "Octopus" App

Tap the "Register Octopus" icon at the top right corner

Click on the Octopus Mobile SIM entry at the top of the list

Click "Enquiry"

Register

Please register your Octopus to receive more information

Octopus
HKD 38.4
30/6/2015 18:22

Additional services
- Consult balance in Octopus card with NFC
- Collect online payment refund
- Online payment
- Automatic add value service
4.2.3. Customer Journey

Notably, the mobile payment service do not directly provide pre-travel preparation support such as a map or schedules, it is more focused on money transfer services.

4.2.4. Insights

The interface shows the multiple payment services, besides public transport. This makes it challenging to evaluate the user experience,

The overall user experience of the app is determined by much more than just the experience of payments in public transport.

**Positive aspects**
- The wide availability and easy access to the SIM card (online, seven eleven) plus the free trial might increase the user’s willingness to try the new service.
- The overall service is perceived as easy, simple and convenient. This might be due to the efficiency of just tapping the cellphone at the gates, as well as the prevention of card clash (gates detecting multiple RFID-enabled cards).
- The extensive adoption of the Octopus card itself make the mobile payment service more visible to users; it is a well-established brand.
- The transactions inquiry are straightforward showed in the app by the use of widgets. This make the access to that information effortless.

“Works like a charm. Payment and inquiry are all on point.”
- Retrieved from Google play-

- Even with the implementation of a rather new technology (SIM card) and the weakness of the NFC, no comments were found with regard to the duration of validating at the gates (tapping the phone), which is remarkable considering remarks found in this area for Apple Pay and Android Pay.

**Negative aspects**

The overall user satisfaction is not high with a 3.3 score in Android and 1.5 in iOS. This might be due to some of the following issues.

- NFC technology is restricted to only high technology devices, and to ensure their use each one should be tested first, thus restricting even more the use of specific mobile phones.
- The technical issues when launching the app or reading the card at the gates, besides the compatibility problems (Android version, second sim card) are the most common complaints. These issues cause mistrust, making users perceive the system as unreliable.

I upgraded to Android 5.0.1. Then I discovered AFTER the upgrade that this app and the Octopus SIM won’t work with the second generation of Samsung S5 (otherwise known as the SM-G906).

- Retrieved from Google play-

- Because of the limitations of the communication through NFC, some of users experience the payment as unreliable.
- The in-app advertisements are considered annoying, its elimination might lead to a most genuine and trustful experience

Why advertisement Easy to use. But why use advertisement in their own company product?
- Retrieved from Google play-

- The User Interface colors could be improved to provide a smoother experience.

The white on orange UI makes it very difficult to read.
- Retrieved from Google play-

4.2.4. Conclusions

- Octopus is a well-established brand with multiple services and widespread use, nevertheless its focus is not solely on payment in public transport, but on payment services in general (e.g. online payment).

- Even though the purchase and pre travel experience are long and require some effort to be done, this effort is compensated with a very simple and effective daily use. No comments were found regarding the check-in time at the gates.

- The lack of a preparation step to search travel details and schedules does not seem to negatively impact the user perception of the system. This might be due to other apps fulfilling this need.

- In terms of user interface design, the use of widgets to show the balance immediately provides easy access to the most relevant information to the user but on the other hand the chosen colors do not provide a smooth experience.

- On the negative side, NFC technology is reduced to high-end devices and to phones running Android (for iOS devices a separate card reader is needed), thus limiting the potential user base.

- Finally, the technology itself is perceived as unreliable given the frequent technical issues in the app and the reading process of the SIM card either by the mobile phone or the gate reader.
4.3. DB NAVIGATOR, GERMANY

4.3.1. Description

Transport system:
Deutsche Bahn AG (abbreviated as DB, DB AG or DBAG) is a German railway company. It is the second largest transport company in the world and the largest railway operator in the world with a ridership of 1.8 billions passengers a year (“Facts and figures 2016 | Deutsche Bahn,” n.d.). Depending on infrastructure and location the company offers different services, namely:

- Fernverkehr (long distance trains)
- ICE (Intercity-Express) for high-speed rail services between major cities and regions
- IC (InterCity) for long-distance trains connecting regions with each other. If the trains cross international boundaries, they are usually called EuroCity (EC). There are also EuroCity services in Germany operated by foreign state railways
- Nahverkehr (local trains)
- IRE (Interregio-Express) serves regions and connects cities. There are IRE trains only in Baden-Württemberg and a Hamburg-Berlin service
- RE (Regional-Express) serves regions and connects cities
- RB (Regionalbahn) stops at all stations and is the most basic train service
- S (S-Bahn) are rapid transit and most of the lines stop at all stations.

Providing mobile payment for this complex system arises different challenges that might be relevant for the Dutch transport.

Mobile payment service:
Through a self-ticketing approach DB Navigator provides QR tickets for all DB railways services in Germany. The users are able to choose the most convenient ticket in the app and pay afterwards. The app pays substantial support for the pre travel experience by providing complete maps, different ways of searching for tickets, regional tickets and real time information (delays and cancellations). It is also possible to save favourite routes, places and itineraries, what which speeds up booking for frequent users. Finally, based on those favourites the user can activate delay alarms. For long travels the QR ticket is purchased for a specific journey so there is no need to for it to be activated, it is scanned by an inspector on board.

4.3.2. App interface

The app is available for iPhone, Apple Watch, Android mobile phones and tablets, and Windows phones. This offers users different options to plan the trip according to the user’s specific interests and needs. If the price is more important than time of departure there is a menu option for save fares, the same applies for real time information, favorites, and regional tickets, among others. It is remarkable that the app includes shortcut accesses to the most used features (trip planner, favourites and history, my tickets, and real time information “my trip”)
4.3.3. Customer Journey

The self ticketing is designed for an open system (without gates). The emphasis of the system is on the preparation step, which might be due to the multitude of services that is provided, from intercity services to internationals travels. Different features are provided to respond to different user needs and concerns.

4.3.4. Insights

Positive aspects:
- The app is perceived as easy to use, reliable and convenient for both long distance and short journeys. The tickets can be purchased anywhere and at any time, making it a life saver for both frequent users and tourists.

“Easy all in one app Perfect for planning your trip, booking and keeping track of your tickets”
- Retrieved from Google play-

“DB Navigator iPhone app is awesome, bought my first mobile train ticket and showed matrix code on iphone to conductor”
- Retrieved from Twitter-

- Planning the trip as core function of the experience is perceived as reliable and therefore trustful.

“Fantastic DB ticket management Great tool for all your tickets, timetables,... You name it. Now it saves your BahnCard too.”
- Retrieved from Google play-

- It has mapped out most of the stations and routes in Germany in a reliable way, this countywide approach is deeply appreciated.

“A Lifesaver The best public transit app I have ever used. I am a foreigner living in Germany, and I don’t know what I would have done without this. I now feel like a master of the buses and trains here, even though I speak 0 German.”
- Retrieved from Google play-

- Besides the trip planner and maps, it provides information about other one-shop stores, ATM and travel information among others.
- It is possible to log into an account, this provides connectivity between tickets bought in the computer or smartphone, as well as the possibility to manage personal tickets, store favorites and activate notifications if the transport is delayed.
- Various services are interconnected in one app in what seems to be a consistent manner.
- Widgets are provided for easy access to the most used functions, which contributes positively to the experienced usability.
“A minor miracle. How comprehensive is this app! Even minor rail stops in remote places are covered. With all the info given to plan even the most complicated rail trip this app must be considered a true public service. Brilliant!”
  - Retrieved from Google play-

- It is connected with Apple Wallet to facilitate the access to tickets.

- When buying long distance tickets from city to city, the trip can start in any station of the city, thus making it quite flexible.
- The app runs on multiple devices (iPhone, iPad, Android Phones and tablets, Apple Watch). Apple Watch seems to be appealing to some users due to its novelty value.
- Notably, there are no comments related to ticket inspection.

“the DB navigator app is foreal a life saver”
  - Retrieved from Twitter-

I honestly think this is the only way I’ve caught so many @DB_Bahn_Italia trains without problem
  - Retrieved from Google play-

“Perfect it’s almost hard to find a possible improvement. One of the best, most reliable apps of its kind. Easier and faster than the full website on a desktop.”
  - Retrieved from Google play-

Negative aspects:
- Frequent technical issues decrease user confidence and trust in the system.

@Wileyfox since the cm13 upgrade, DB Navigator crashes immediately when started. Can this be an iOS issue? It’s my single most important App.
  - Retrieved from Twitter-

Freezes during the booking process (after choosing ‘to offer selection’. I mainly use the app to book tickets, so in its current state it is useless to me.
  - Retrieved from Google play-

- Some User Interface details as the lack of user error messages, the non-intuitive use of the back button (due to the side menu), and the problems to load schedules creates a negative perception of usability. This make the app seem slow.

Low usability The app is capable of alot but it’s neither intuitive nor well integrated. For example: If I buy a ticket I should automatically receive notification when I need to change or when my train is delayed. In this app you have to set both things up individually.
  - Retrieved from Google play-

- Even thought the rail domain is the core part of the services, the trip planner includes buses and trams, though some routes and stations of those might be missing.
Stupid DB Navigator app is not displaying connecting busses anymore. Instead just doesn’t find anything at all. @DB_Info #fb
- Retrieved from Twitter-

- The real time feature information is only available for future journeys and not for keeping track of the current journey.
- Data consumption is high.

Just for one search take more than 2 mb. And also I think it takes data even when this app not in use. Crash sometimes.. Not opening search results in the 1st search. I had to go back and search again please fix this
- Retrieved from Google play-

- The Windows version of the app does not support mobile tickets purchase
- Real time trip feature might provide delayed information, hence creating mistrust.

@seatsixtyone shame it doesn’t normally tell you with the same amount of accuracy how late your train is!
- Retrieved from Twitter-

Oh no Will be late for #duth because of train delay. Worst thing: I could have been in the right ICE if #dbnavigator would have let me know
- Retrieved from Twitter-

- The most notable date on the virtual ticket is the data of purchase and not the date of travel, which leads to confusion.
- It is not possible to activate notifications for the journey. Making this possible would provide travelers with more guidance while traveling, thus increasing user confidence that the trip is proceeding correctly.
- The app at times conflicts with other Android apps (by the same developer)
- There is not an offline schedule, without data access this app feature became useless.

4.3.5. Conclusions

- Overall the service is positively evaluated with the highest score among the four analysed services. It is also the one with the most accepted device including Apple Watch and tablets.

- The core service of planning journeys creates a strong positive bond with the users given the daily use, as well as the multiple services for both short and long travels and the accuracy of schedules.

- Contradictory opinions were found regarding the accuracy of the mapping. Some users found it highly reliable in terms of routes and stations while others complain about the lack of information. This duality is also identified with the real time information feature.

- The use of widgets and shortcuts in the interface, plus the side menu and multiple options for searching provide a rich experience that aligns with the preferences that different users might have.

- Aspects of the app that are highly appreciated by users are the ability to store favorites (journeys, stations and routes), as well as the easy access to information about the current trip. However users are expecting even more “smart” and real time features as reliable and accurate alerts.

- Frequent technical issues, especially during booking and searching, is the most common negative concern.
4.4. APPLE AND ANDROID PAY, LONDON

4.4.1. Description:

Transport system:
Operated by Transport for London (TfL) the London transport system includes, among others various rail networks including the London Underground, London Overground, Docklands Light Railway and TfL Rail, and London’s trams and buses. The Underground (or ‘Tube’) is by far the most used service with a ridership of 4.8 million a day and 11 lines that connect Greater London and some nearby counties. TfL uses a zonal fare system to calculate fares as well as variation between peak and off-peak hours, however for contactless payment and Oyster cards fare can be reduced by using pay as you go.

TfL has developed a contactless payment system, including contactless payment cards (Visa, American Express, Mastercard and Maestro), Apple Pay, Android pay and Barclaycard. All contactless work with pay as you go fare, therefore there is no need to top up or buy a ticket in advance, besides users can benefit from daily and weekly capping, this means a limit in a single day or week cost regardless of the number of trips.

Mobile payment service:
Mobile payments are mostly done through Apple and Android Pay. Both Apple and Android pay work by providing a mobile wallet for a bank card and since the system is already set for contactless payment it is possible to check in and out with the cellphone as a card. To that end the user must tap in and out at station gates. Mobile payments are available for the following services: Tube DLR, London Overground, TfL Rail, Emirates Air Line and Thames Clippers River Bus.

The service is restricted to only card issuers with a previous agreement with both Apple and Android. It is essential to use always the same payment method (mobile or card) because even if the card is the same in the mobile wallet, when using it the system recognizes a specific card and not a specific mobile device, and if users check in with one virtual card (on their phone) and check out with another, extra charging will occur for incomplete travels. Another possible issue is related with the battery, because when running out of battery the gates are not able to recognize the payment device, again exposing the user to incomplete journey and thus extra fees.

Finally, the mobile wallet can be connected with an contactless and Oyster account, allowing the user to check the trips, get email alerts and apply for refunds.

Figure 15, The tube map

Figure 16, Apple pay advertisement
4.4.2. Customer Journey

Similarly to the Octopus service in Hong Kong, the Oyster mobile payments service does not provide any support for preparation in pre travel experience. There are some additional apps that can be used as complementary services for trip planner and map consultation.

4.4.3. Insights

Positive aspects:
- It is easy to setup and use. It is convenient as there is no need for cards or cash. Life saving when leaving the wallet at home, resulting in a positive experience.

Saw an add for Barclaycard Apple Pay on the tube. While leaving the station I set it up and within 5 minutes I paid for a coffee.
- Retrieved from Twitter-

I’ve used it every day I commute for just over a month, and it’s great. Works exactly as intended.
- Retrieved from Reddit-

Finally can use Android Pay now @santanderuk has been added. I’m so excited for this. So much easier on the tube, cafes ect.
- Retrieved from Twitter-

- It is intuitive to use and the visual feedback is clear.
- It is possible to use it in multimodal systems of transport.
- Users enjoy to be part of the innovative technology, it is experienced as novel and exciting, and therefore a reason to show off and proudly promoting.

Left wallet in office yesterday. Oyster, bank and credit cards all in safe hands of @DominicPreston Used Apple Pay for tube. Love. It.
- Retrieved from Twitter-

- The mobile payment can be connected with an account, which allows users to have more detailed information about their journey.

@TfL ok thanks. I like how each tap in/out shows up inside the Android Pay app initially as pending then grouped under the final charge
- Retrieved from Twitter-

- For Android Pay, the process of opening the gates might be faster than Apple Pay, since Android Pay does not require fingerprint validation.
- Especially for frequent travellers the ‘pay as you go’ fare system (with daily or weekly capping) can make commuting cheaper.

Negative aspects
- The services is limited to certain mobile phones, and to banks with agreement with the mobile wallet (Apple/Android Pay), therefore restricting the use to a certain target group.
- Users face some financial risks some risks when using the mobile payment system. Using a different card virtual card to check in and out, not having a data connection while checking in/out, and running out of battery all might lead to higher fares or fees. Even though these issues can be circumvented by the user, prevention is the complete responsibility of the user, there are no system failsafes in place.-

Using apple pay for the tube is all fun n games until your phones about to die and you didn’t bring an Oyster card out
- Retrieved from Twitter-

- The most common complaint is related to the gate opening time. It
is definitely perceived as longer than an Oyster card, and for users without experience and with old mobile phone models might even increase. This is not an issue only for the person paying but also for the people waiting in the queue, which makes the social experience awkward and embarrassing.

- I use Apple Pay on the Tube. I’m also one of the top ten most hated people currently at large in the capital today.  
  - Retrieved from Twitter-

- Used Apple Pay on tube for first time today. Delay is crazy - I was milliseconds later than I should have been!! Thought contactless was bad  
  - Retrieved from Twitter-

- @TfLTravelAlerts any tip on how to make Android Pay work better on tube gates? I’m very happy about it but it still takes ages to open gates  
  - Retrieved from Twitter-

- Gate readers are located on the left, thus Apple Watch users are must tap on that side regardless of the side they use the watch, this interaction might be inconvenient and cumbersome.  
- The process of opening the gate can fail for different reasons, either the reader or mobile phone might encounter a technological issue, this makes the service unreliable, especially in busses where users often reported that the readers are weak.

- Apple Pay, you do choose not to work and embarrass me on the tube at the worst moments!  
  - Retrieved from Twitter-

- @TfL many contactless machines seems to show error msg while using android pay. Need some fix  
  - Retrieved from Twitter-

- The latter leads to one of the most serious issues, the user might be caught up into the station because it was possible to check in but not check out, leading to frustration given the fee for incomplete journey.

- AAARGH use Android pay on @TfL all day yesterday and this morning, works fine. Fails on way home, have to use my card and pay more.  
  - Retrieved from Twitter-

- This morning none of the gates at Chancery Lane worked when I tried to exit. The guy just let me through but I now have an unfinished journey to get a refund for. Not a great experience using android pay  
  - Retrieved from Twitter-

- The fare is cumulative so the final fare is shown at the end of the day, making hard to follow up the cost of the journey. However some users seem to appreciate how the information is presented at the end of the day.

4.4.3. Conclusions

- The user experience might be affected by the complete service of the mobile wallet, that allows not only payments in the public transports but also in stores.

- Both Apple and Android Pay are easy to configure and use, the steps for purchase and configuration are short as well as the check in and check out.

- The novelty of the technology positively influences the experience, the users feel proud.

- Similar to Hong Kong service, this is limited to certain high end
mobile phones. Secondly, the technology can fail at the gates for different reasons (weakness of the reader or NFC). The latter might lock the user inside the station or increase the fee for an incomplete journey.

- The most common complaint is related to the time it takes to check in or out. It is slightly longer than the oyster card, this is not only affecting the user checking in, but also the people in the cue behind him/her, thus creating an awkward social experience.
5. Discussion

5.1. REFLECTION

Even with some clear limitations, online users self-reports on social media, forums and blogs seems to be a convenient and useful source of information for a preliminary user experience evaluation. This also might give a design team a much needed overview in case of limited resources for engaging in a actual field research.

The initial overview of mobile payment systems provided in this study provides a clear overview of how the different mobile payment technologies have been adapted to create specific service models that respond to the requirements of the context. The current infrastructure and the sociocultural context seem to have a strong influence on how the mobile payment is designed in each country, region or city. For instance, DB Navigator, which is a self-ticketing based service, is possible in Germany given the open stations and in contrast Octopus in Hong Kong has had to create a complex purchase process to be able to open the gates.

Different business models lead to different customer journey steps. Even though the stages are the same, some services put more emphasis on either the pre travel experience or on the purchase process. However it is complicated to determine how those differences are affecting the user experience given that in each location (country, region or city) users have different expectations of public transport and mobile payment services. Interestingly, lacking a preparation step for searching the schedule and tracking the map does not seem to detrimental per se to the user experience of the service.

Nevertheless differences are not only found between technologies. Even between systems that shared the same technological platform, considerable differences were identified in terms of interface design, menu structure, advertisement, available services, and accuracy and reliability of the service. Those details can certainly change the user experience. Therefore, all the details should be carefully designed to actually respond to user concerns. In the case of DBNavigator the multiple options for searching are a good example of how a complex menu is perceived as simple and easy to use because aligns with what is important to the user.

For the design of a positive experience there are two words that constantly pop up along all the research, technical issues and reliability. All the services and technologies have their own flaws, the consequences of those directly impact the user perception and willingness of using the service. With the check in and out time Apple and Android Pay are a clear example of how an apparent
small flaw can be perceived as a massive inconvenience, and not only personally but socially. On the other hand, design can help to counter those flaws and therefore grant a more positive experience, that is specially notable between MBTA and DB Navigator which are even based on the same technology but have a different user satisfaction, in which the latter tends to be more positive.

In conclusion, awareness of how differences in the context of use can and should impact how a service is designed is essential for the future design of the Dutch mobile payment service. Moreover it is essential to assess the advantages and disadvantages of technological platforms that are considered, as this choice seriously impacts user experience of the designed service. The examples of service structures represented in the customer journey of the analysed services, as well as the overview of issues per service, can form valuable input when designing services for mobile payment in public transport.

5.2. LIMITATIONS

The presented results were collected through online desk research, therefore some limitations apply.

Language barrier:
Really interesting and potentially insightful services were not thoroughly investigated because of the limitation to access information in English (e.g mobile T-money in South Korea).

Cultural tendency to social media sharing:
Clearly an exploration of any kind with a worldwide approach is affected by cultural preferences and habits. In this case, the disposition of an specific culture to self-report on social media (e.g complaint and congratulate) impacted the amount of available information. For instance, more comments were found for services located in United States than in Hong Kong, regardless of the maturity of the services

Social media:
Because social media and online reviews were the main source of information, the information collected may have been biased because the sample of informants may not have been representative for the whole traveller population, for example in terms of age, level of education and access to Internet.

Searching location:
Internet searching is influenced by the location of the connection, and it should therefore be noted that most of the research done for the inventory was performed with a connection in United States, which may have influenced the services identified.
6. Conclusions

6.1. CONCLUSIONS

The chosen technological platform for a service for mobile payssible to see how the features and design in each step can change the user experience in either positive or negative way. This means that even services that share the same technology can offer a completely different user experience.

The conditions for which the service is designed, the socio-cultural context, the current infrastructure, the type of public transport services, and the type of payment are primary factors influencing the service structure, steps, stages and all the customer journey.

The preparation step (checking map and/or trip planner) is not essential for providing a positive experience, however it might be able to strengthen the brand customer relationship on a daily basis if in this step an accurate and reliable service is provided.

Reliability is essential for a positive experience as a reliable system promotes trust. Being able to trust the service is deeply appreciated, on the other hand unreliable systems are strongly criticised. Basically any technical issue has the potential of travelers forming a bad opinion of the service.

Given the fast development of technology nowadays users expect even “smarter” systems that foresee their needs and provide them with required information at the right time. In the case of preparation specifically, real time accurate information is imperative (e.g alerts). Also the use of favorites or autocomplete functions are appreciated.

The user interface design (e.g. menus structure, interaction gestures, colors, error messages) are crucial for providing a smooth usey experience of the app.

Having a deep understanding of the user concerns in each step of the travel process is indispensable for offering a simple and easy going experience. For instance, a feature that allows the user to undo mistakes (e.g refund) might reduce the perception of risk and consequently increase the willingness of using mobile payment.

Some features that are appreciated are:
- Personal log in with ticket management, allowing the user to check transactions, and history.
- Widgets for instantly checking information, as well as shortcuts for accessing the most relevant features.
- Multiple methods of payment.

Technologies based on NFC are limited to certain types of mobile phones, hence reducing the target group potential user base. Secondly, users of mobile payment services seem to often encounter technical issues, which may be due to the novelty of the technology.

The main conclusions might be that all details are crucial, user experience in mobile payment is complex and does not depend on one specific feature or step. Traveling start way before check in in the station or boarding the train, and it therefore transcends the physical interaction at the gate. Mobile payment in public transport is definitely about more than opening a gate or obtaining an e-ticket.
All the small decisions in the interface design, the check in time, the feedback, the access to information, the reliability of the information - among others - are interconnected and together form what we call user experience.

6.3. FURTHER RESEARCH

Due to its setup (online desk research) this study has limitations in uncovering certain aspects of the user experience, and it is unknown how the information retrieved differs from what might be found through in situ user research. Therefore field research is recommended for confirming the results and gaining more insights into the user experience of mobile payment user experience in public transport.
APPENDIX

7.1. Services catalogue details
7.2. Services quantitative evaluation
1. MBTA

Massachusetts region

The Massachusetts Bay Transportation Authority, often referred to as the MBTA or "The T", is the public operator of most bus, subway, commuter rail, and ferry routes in the greater Boston, Massachusetts area.

Lines: 12 (commuter rail), 4 (heavy rail), 5 (light rail), 4 (trolleybus), 4 (ferryboat), 183 (bus)

Stations: 123 (commuter rail), 51 (heavy rail), 74 (light rail), 22 (BRT)

Ridership: 1.3 millions riders per day

---

MBTA mTicket

Self ticketing QR

The MBTA mTicket app is now available for all Commuter Rail and Ferry Lines. Purchase MBTA Commuter Rail and Ferry Single Ride, Round-Trip, 10 Ride, and Monthly tickets

Services:

- Secure ticket purchasing with your credit or debit card
- Your smartphone is your ticket
- Never lose your ticket -- tickets can be easily transferred if your phone is lost or stolen
- Check Commuter Rail schedules, maps, and service alerts
- Allow fare reduced fare ticket and multiple tickets purchase

Technology:

You should activate your mobile ticket immediately before boarding your Commuter Rail train. Conductors will usually inspect tickets visually by checking the color changing ticket screen, but a conductor may occasionally ask to scan the barcode on your activated ticket.

---

Google Play - Android

Update: November 29, 2013
Installs: 100,000 - 500,000

App store - iOS

Update: Sep 10, 2015
Current version: ★★
28 Ratings

All versions: ★★★
211 Ratings

Video URL: https://www.youtube.com/watch?v=C1SmwHlR3c
2. TriMet

Portland

More formally known as the Tri-County Metropolitan Transportation District of Oregon, is a public agency that operates mass transit in a region that spans most of the Portland metropolitan. Transit type: Local bus, Light rail, Commuter rail, Streetcar.

Lines: Bus: 78, MAX Light Rail: 5, Commuter Rail: 1, Portland Streetcar: 2

Stations: Light rail: 97, Commuter rail: 5

Ridership: 319,700 riders per day

TriMet Tickets

Self ticketing QR

The App lets you purchase and use tickets and passes instantly on your phone—anywhere, anytime. Register your debit/credit card in our secure system, and you’re ready to go.

Services:
- Buy and use fares instantly using a debit/credit card.
- Store multiple tickets on your phone for future use.
- Pay a single fare or multiple fares for a group of riders.
- Register your debit/credit card(s) in our secure system.
- Purchase tickets on your phone or on any computer via our website.

Technology:
You should activate your mobile ticket immediately before boarding, QR for inspectors

Google Play - Android

Update: June 17, 2016
Installs: 100,000 - 500,000

App store - iOS

Update: May 09, 2016
Current version: ★ ★
33 Ratings
All versions: ★ ★ ★
389 Ratings

Video URL: https://www.youtube.com/watch?v=XjlbhLaIbG0
3. METRORail

Houston

METRORail is the 15.2-mile (24.5 km) light rail system in Houston, Texas (USA). After Dallas' DART Light Rail, METRORail ranks as the second most-traveled light rail system in the Southern United States and the 12th most-traveled light rail system in the United States.

Lines: 3 (5 planned)
Stations: 37 open 2 under construction
Ridership: 43,900 per week day, 11.3 million year

Q-Ticketing

Self ticketing QR

Ticketing app that lets you purchase and use your METRO fares and passes instantly on your phone. Mobile tickets can only be used on local bus & rail at this time.

Services:
- Buy and use fares instantly using a debit/credit card or PayPal.
- Store multiple tickets on your phone for future use.
- Pay a single fare or multiple fares for a group of riders.
- Register your debit/credit card(s) in our secure system.
- Purchase tickets on your phone or on any computer via our website.

Technology:
Show the activated ticket to a bus operator, ticket inspector or METRO Police Officer when asked to present your ticket.

Google Play - Android

Update: May 31, 2016
Installs: 5,000 - 10,000

App store - iOs

Update: Sep 10, 2015

All versions: ★★★
11 Ratings

Video URL: https://www.youtube.com/watch?v=FQOmeCJlC
4. MTA LIRR / MNR

**New york area**

Long Island Rail Road Company is a commuter rail system in southeastern New York, stretching from Manhattan to the eastern tip of Suffolk County on Long Island. Metro-North, is a suburban commuter rail service of the state of New York.

Lines: LIRR: 2 lines / MNR: 5 lines

Stations: LIRR: 124 / MNR: 124

Ridership: LIRR 337,800 riders per weekday
MNR 298,900 riders per weekday

**Self ticketing QR**

The MTA eTix app currently supports only the MNR Hudson and Harlem Lines and the LIRR Port Washington Branch. Additional lines on both railroads will be made available in August

Services:

- Take your ticket with you when you upgrade your phone
- Get a refund for unused mobile tickets, request receipts and manage payment information.
- Check train schedules and service statuses
- Tickets can be one-way, 10-trip, weekly or monthly. The ticket is saved in an electronic ticket wallet in the app.

Technology:

- 'Punch' your own ticket just before you board
- Riders should have the ticket displayed on their phone when the conductor comes to ask for tickets. Conductors will use a handheld device to scan mobile tickets.

**Google Play - Android**

Update: July 27, 2016
Installs: 10,000 - 50,000

![Google Play - Android Rating](image)

**App store - iOS**

Update: Sep 10, 2015
Current version: ★★
9 Ratings

All versions: ★★★
59 Ratings

Planning to install readers in the future
5. Ruter

Oslo and Akershus

Ruter provides services for: Oslo Metro, Tramway, Commuter rail, Bus, and Ferry.

Lines: Metro 6, Tram 6, commuter rail 8

Stations: Metro: 101, tramway 99, commuter rail 128

RuterBillett

Self ticketing QR

Ruter's mobile app lets you buy your ticket before you get on board. The ticket is valid on the Metro, buses, trams, ferries and trains in Oslo and Akershus.

Services:
- You can buy a ticket just for yourself or for a group travelling together.
- You can buy tickets in advance, and you can change the start time for your ticket
- For additional security, you can change the fare limit for which a password is required when buying tickets.
- Your receipt will be sent via e-mail.

Technology:
Activate the QR ticket before boarding

Google Play - Android
Update: June 27, 2016
Installs: 500,000 - 1,000,000

App store - iOs
Update: Jun 27, 2016

All versions: -

Video URL: https://www.youtube.com/watch?v=_8q1NS3h3uM
6. SFMuni

San Francisco

The San Francisco Municipal Railway (SF Muni or Muni) is the public transit system for the city and county of San Francisco, California. In ridership Muni is the seventh largest transit system in the United States. Transit type: Bus, trolleybus, light rail, streetcar, cable cars

Lines: 82
Ridership: 679,800 per day

MuniMobile

Self ticketing QR

MuniMobile lets you buy tickets instantly through a credit/debit card or PayPal account. Buy Muni tickets and passes in advance or for the whole family from one smartphone.

Services:

Ability to purchase, store and use single or multiple Muni fares on one mobile device
Ability to pay for single-ride fares, cable car rides, and one-day, three-day and seven-day passports
Industry-leading security to protect personal information and payment
Trip planner integration

Technology:

Riders should purchase and activate their tickets before or while on the boarding platform. Inspector personnel have been trained in verifying these tickets.

Google Play - Android

Update: May 20, 2016
Installs: 10,000-50,000

2.9

App store - iOS

Update: May 20, 2016

Current version: ⭐⭐
10 Ratings

All versions: ⭐⭐⭐
48 Ratings
The Berliner Verkehrsbetriebe (German for Berlin Transport Company) is the main public transport company of Berlin, the capital city of Germany. It manages the city’s U-Bahn underground railway, tram, bus, replacement services (EV) and ferry networks, but not the S-Bahn urban rail system.

### BVG FahrlInfo Plus App

#### Self ticketing QR

It allows you to use your mobile phone as a ticket and find out about connections or save favourite routes and call them up at the tap of a finger. In addition, you can display the locations of available car club vehicles from Car2go with an interactive area view.

**Services:**
- Purchase possibility of following mobile tickets, valid for all transport in VBB by credit card or direct debit for the tariff zones Berlin AB, BC and ABC: see the play store for the details
- Integrated timetable information for all connections in the VBB
- Stop departure board
- Individual settings: travel history, reminders for departures and connection, access to contacts
- Connection with Car2go
- Offline maps

**Technology:**
- QR. Show the inspection staff your smartphone with QR.

---

### BVG

**Berlin**

<table>
<thead>
<tr>
<th>System</th>
<th>Stations/Lines/Net length</th>
<th>Passengers per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-Bahn</td>
<td>170 / 9 / 145 km</td>
<td>457 million</td>
</tr>
<tr>
<td>S-Bahn</td>
<td>166 / 15 / 331 km</td>
<td>376 million</td>
</tr>
<tr>
<td>Tram</td>
<td>398 / 22 / 192 km</td>
<td>171 million</td>
</tr>
<tr>
<td>Bus</td>
<td>2627 / 147 / 1,626 km</td>
<td>407 million</td>
</tr>
<tr>
<td>Ferry</td>
<td>14 / 6 / -</td>
<td>-</td>
</tr>
</tbody>
</table>
8. Deutsche Bahn

Germany

Deutsche Bahn AG (abbreviated as DB, DB AG or DBAG) is a German railway company. Headquartered in Berlin. It is the largest railway operator and infrastructure owner in Europe. It carries about two billion passengers each year.
- **ICE** (Intercity-Express) for high-speed rail services between major cities and regions
- **IC** (InterCity) for long-distance trains connecting regions with each other. If the trains cross international boundaries, they are usually called EuroCity (EC).
- **IRE** (Interregio-Express) serves regions and connects cities
- **RE** (Regional-Express) serves regions and connects cities
- **RB** (Regionalbahn) stops at all stations and is the most basic train service
- **S** (S-Bahn) are rapid transit and most of the lines stop at all stations.

### DB Navigator

**Self ticketing QR**

“*My journey*” contains all of your travel details a glance, such as timely notification of an upcoming train transfer. Push notifications actively provide you with information such as your departure time, when you need to change trains, and what the arrival time is. This section also contains real-time information such as delays and gives you direct access to alternative connections if you need them.

**Services:**
- My journey: with all of your information at a glance
- Regional offers: can be booked directly
- Travel planning: incl. S-bahn (local trains) and U-Bahn (underground trains), trams and buses
- Real-time information with current departure and arrival times
- Door-to-door route planner including GPS positioning and footpath mapping
- Registration for Delay Notification as a push message, can also be used by commuters
- Smartphone ticket save function/download, booking, cancellation, management
- Saver fare finder on your smartphone

**Technology:** QR tickets

---

**Google Play - Android**

Update:
Installs:

![App rating](image)

**App store - iOS**

Current version:
9 Ratings

All versions: ★★★
59 Ratings
9. Chiltern Railways

London

It is a British train operating company. It operates commuter/regional rail passenger services from its Central London terminus at London Marylebone along the M40 corridor to destinations in Buckinghamshire, Oxfordshire and Warwickshire, as well as long-distance services to the West Midlands along two routes.

Stations called at: 62
Stations operated: 32

Chiltern Railways

QR with gate scanners

Use our free app to purchase Chiltern Railways barcode tickets as well as paper tickets for all other train companies to destinations throughout the UK. The Chiltern Railways App has no booking fees and is a quick and easy way to check times and pay for tickets.

Services:
- Get your ticket instantly as a barcode for journeys on Chiltern Railways
- New customers don’t need to visit our main website to sign up in the app, you can log in with account details already in use for the main website
- Recent journeys and details are securely maintained in the app for quick and easy repurchasing
- Live departure boards showing platform numbers
- You can buy tickets for any other train company nationwide using this app and collect them at your chosen station with a self-service ticket machine.
- Barcodes are stored in the app’s ticket wallet and available offline
- If picking up tickets from a ticket machine, reference numbers are stored in the ticket wallet and available offline to view when collecting tickets.

Technology: London Kings Cross, London Marylebone, London Victoria, Gatwick Airport, Cambridge are equipped with barcode gate readers, barcode read-times at 250-500ms

Google Play - Android

Update: 5 July 2016
Installs: 50,000 - 100,000

3.8

Video URL: https://www.youtube.com/watch?v=V8m0PqXKnOs

Video URL: https://www.youtube.com/watch?v=JCGrOE3uMls
10. Nederlandse Spoorwegen

The Netherlands

The Dutch rail network supports predominantly passenger transport and also most distance travelled on Dutch public transport is done by rail and Berlin.

Stations: 108

Ridership: 438 million per year

NS Reisplanner Xtra

QR with gate scanners

Reisplanner Xtra is the official planning application for the Dutch Railways.

Services:
- Realtime journey planner
- Timetable of departing trains per station
- Summary of Planned work and disruptions
- Station specific information regarding facilities and shops
- Notifications regarding delays of a saved trip

Purchase a one-way or return ticket online. Order a one way or return ticket online. When you see the delivery option, select ‘E-ticket’ and you can print it out or download it to the Reisplanner Xtra app.

Technology:

The gates are equipped with scanners for the QR ticket

Google Play - Android

Update: August 10, 2016
Installs: 1,000,000 - 5,000,000

App store - iOs

Updated: 04-08-2016

All versions: ★★★
49 Ratings
11. NS International

The Netherlands

NS International business makes sure you can travel from any Dutch train station to over 3300 destinations throughout Europe. You may book your tickets for the Thalys, ICE International, Eurostar and TGV high-speed trains, as well as the intercity trains to Brussels and Berlin.

NS International app

QR with gate scanners

Have your ticket close hand and you will always be informed of the most up-to-date information regarding your trip. The app show the departure and arrival times and will tell you from which platform the train leaves. Moreover, you will be informed of relevant news and interesting deals.

Services:
- Fast and easy planning of train trips. A clear overview of connections helps selecting the best trip.
- Trip details have been redesigned, are realtime and now also include ticket prices. Book your ticket through the mobile website.
- Booking in the app. For selected destinations the mobile tickets have been expended with (realtime) trip details.
- An easy to setup monitoring service.

Technology:
You must show the mobile ticket through the NS International App (version 4 or higher). QR with readers only apply in equipped stations.

Google Play - Android
Update: May 12, 2016
Installs: 10,000 - 50,000

3.3

App store - iOS
Updated: 04-08-2016
All versions: ★★★
107 Ratings

Video URL: https://www.youtube.com/watch?v=RJOmec1Lc
12. Deutsche Bahn

**Germany**

Deutsche Bahn AG (abbreviated as DB, DB AG or DBAG) is a German railway company. Headquartered in Berlin. It is the largest railway operator and infrastructure owner in Europe. It carries about two billion passengers each year.

- **ICE** (Intercity-Express) for high-speed rail services between major cities and regions
- **IC** (InterCity) for long-distance trains connecting regions with each other. If the trains cross international boundaries, they are usually called EuroCity (EC).
- **IRE** (interregio-Express) serves regions and connects cities
- **RE** (Regional-Express) serves regions and connects cities
- **RB** (Regionalbahn) stops at all stations and is the most basic train service
- **S** (S-Bahn) are rapid transit and most of the lines stop at all stations.

---

**Touch and Travel**

**GPS tracking**

Touch and travel was an complementary service to DB Navigator, however it has been recently closed because of its lack of use.

**Services:**

Just one swipe at your departure station is all you need to do before you jump aboard. You decide when to get off. Check out at your destination station, the Touch&Travel App automatically calculates your price.

**Technology:**

The user can log in in an specific spot by typing a code, GPS, NFC (only some phones) or scanning a QR. It is required to log out in the final destination. The cost will be displayed and the final bill will arrive home or can be automatically debited.

---

**Google Play - Android**

Update: January 19, 2016
Installs: 10,000 - 50,000

**App store - iOS**

Updated: Sep 10, 2015
Current version: ★★★★★
89 Ratings

All versions: ★★★★
595 Ratings

Video URL: https://www.youtube.com/watch?v=81F7QdCrN_xQ
13. Opal card

Sydney Area

Opal is a contactless smartcard ticketing system for public transport services in the greater Sydney area of New South Wales, Australia.

Opal is valid on Transport for New South Wales bus, rail, light rail and ferry services that operate in Sydney and the neighbouring Central Coast, Hunter Region, Blue Mountains and Illawarra areas. It is also accepted on train services in the Southern Highlands.

Opal travel

NFC for card scan

An app. No tickets. Just pull out. Touch & Travel is the smart, paperless alternative for bus and train.

Services:

• Trip planner with fare estimates
• Top up or set auto top up
• Check your balance, history and Weekly Travel Reward progress
• See public transport service disruptions
• Find nearby Opal retailers

Technology:
If you have a compatible NFC-enabled Android device, you can also scan your Opal card to check your balance, last tap details and Weekly Travel Reward progress.

Google Play - Android

Update: April 17, 2016
Installs: 100,000 - 500,000

3.5 ★★★☆☆
1,226 total

App store - iOS

Updated: Sep 10, 2015

All versions: ★★★☆☆
5 Ratings
14. Metra, CTA, Pace

**Chicago**

Metra is a commuter railroad in the Chicago metropolitan area. CTA (Chicago Transit Authority), is the operator of mass transit in Chicago, Illinois and some of its surrounding suburbs, including the trains of the Chicago "L" and CTA bus service. Pace is the bus division to commuter and paratransit services.

- Lines: Metra 11, CTA Rail 8 + Bus 140 routes
- Stations: Metra 211
- Ridership: Metra 292,000 weekday, CTA Bus: 872,090, Rail: 787,430, per day. Pace 39.925 million riders in 2013.

**Ventra**

**Mobile wallet + Self ticketing QR**

Use transit in and around all of Chicago: It’s easy to manage and pay your fare on CTA, Metra and Pace buses and trains with the Ventra app. Find all the features you’re used to on the Ventra website and more, including mobile ticketing for Metra trains!

**Services:**
- Check your balance and available passes in your Ventra Card’s transit account.
- Instantly load value or passes to your Ventra Card’s transit account.
- Switch autoload for transit value or passes on and off.
- Buy and use Metra mobile tickets to ride any Metra train.
- Use transit value you’ve loaded to buy a Metra ticket.
- Get real-time account notifications so you know when it’s time to load more fare.
- Get real-time arrival/departure information from CTA, Metra and Pace all in one app—by picking a stop, using favorites or looking at service near where you’re standing.

**Technology:** Ventra payment system includes several options of payment, including a contactless smart card powered by RFID, a single day or use ticket powered by RFID, any personal bank-issued credit card or debit card that has an RFID chip, and a compatible Mobile phone.

**Google Play - Android**

Update: August 1, 2016
Installs: 100,000 - 500,000

![3.4 rating](image)

**App store - iOS**

Updated: Aug 02, 2016
Current version: ★★
8 Ratings
All versions: ★★★
214 Ratings
15. Snapper card

New Zealand

The Snapper card is a contactless electronic ticketing card used to pay for bus fares and other everyday items, such as taxis, food and coffee, in New Zealand. Buses of the following operators: CityLink Whangarei, Airport Flyer, GO Wellington, Runcimans, Valley Flyer, mainly in Wellington. New Zealand does not have an integrated card for all the transport system.

There are more than 4000 places you can use your Snapper. Whether you want to, cab across town, commute to work, university or school using the Cable Car or Bus, Snapper’s got it covered.

Google Play - Android

Update: April 20, 2016
Installs: 50,000 - 100,000

4.0

Snapper

NFC for card scan

Using your Android smartphone with near field communication (NFC), the Snapper Mobile app is the essential companion to your Snapper + card or Semble SIM.

Services:
- Log in
- Check your balance
- Top up
- Buy a travel pass
- Check transaction history
- Save payment details
- View card information

Semble

Mobile wallet

To provide mobile payment Snaper made an alliance with Semble a mobile wallet app. The mobile payment was implemented by using a SIM card, it was available during almost a year but now Semble has removed the app, it is possible for the users to use the mobile payment but only for Snaper, not other cards.
16. Transport for London

London

TFL has responsibility for London’s network of principal road routes, for various rail networks including the London Underground, London Overground, Docklands Light Railway and Tfl Rail, for London’s trams, buses and taxis, for cycling provision, and for river services.

Lines: Tube 11
Stations: Tube 270
Ridership: Tube 1.3 billions a year

Contactless payment

Mobile wallet

You can use contactless for pay as you go travel on bus, Tube, tram, DLR, London Overground, Tfl Rail, Emirates Air Line, River Bus and most National Rail services in London.

Services:
The following methods of contactless payment are currently accepted:
- Android Pay
- Apple Pay
- Barclaycard and Barclays Contactless Mobile
- bPay
- EE Cash on Tap

Technology: The independent mobile wallets load the bank cards and then those can be used for paying.

Video URL: https://www.youtube.com/watch?v=ruyG5yNbutc
17. EZ-Link card

Singapore

The card is commonly used in Singapore as a smartcard for paying transportation fees in the city-state’s Mass Rapid Transit (MRT), Light Rail Transit (LRT) and public bus services.

Lines: MRT 8, LRT 3

Stations: MRT 154, LRT 43

Ridership: MRT 2.879 million, LRT 152,000 daily

---

EZ-Link

NFC for card or SIM card scan

The official EZ-Link app comes with an array of services in one easy to use app; use it to manage your ez-link cards and your EZ-Link NFC SIM with ease.

Services:
- Check transaction history
- Check purse balance value
- Sign up for Activate! card blocking and card protection service
- Register up to 3 cards on Activate!
- Deregister cards on Activate!
- Top-up EZ-Link NFC enabled SIM (for NFC certified mobile only)

Technology:
Top-up and manage your EZ-Link NFC SIM with the in-app functions

---

Google Play - Android

Update: July 12, 2016
Installs: 100,000 - 500,000

2.7

Video URL: https://www.youtube.com/watch?v=0kKhFAvCAo
18. EZ-Link card

Singapore

The card is commonly used in Singapore as a smartcard for paying transportation fees in the city-state’s Mass Rapid Transit (MRT), Light Rail Transit (LRT) and public bus services.

Lines: MRT 8, LRT 3
Stations: MRT 154, LRT 43
Ridership: MRT 2.879 million, LRT 152,000 daily

My EZ-Link

NFC + Sim card

My EZ-Link Mobile is a free mobile application developed for NFC (Near Field Communication) enabled mobile phones. The application allows you to transform your phone into a personal EZ-Link top up terminal for all EZ-Link issued CEPAS cards.

Services:
- Top up ez-link cards* using Visa / MasterCard / American Express Cards
- Activation of EZ-Reload (Auto Top-up)
- View card details and transaction history
- Save credit card details securely for future top ups
- Manage up to 10 ez-link cards

Technologoy:
Since 2012, EZ-Link has offered the EZ-Link NFC SIM via mobile network operators for payments at ez-link retail acceptance points. From 29 March 2016 onwards, EZ-Link is offering the new EZ-Link NFC SIM via mobile network operators for payments for both public transit as well as retail acceptance points.

Google Play - Android

Update: July 27, 2016
Installs: 10,000 - 50,000

3.0 ★★★★☆
2,630 total

TO GET STARTED, YOU WILL NEED:
- An approved NFC-enabled mobile phone model.
- An EZ-LINK NFC SIM!
- You are now ready to go!

For optimal performance, users should tap their handset at the readers with their handset screen facing upwards (back of handset should be facing the reader).
19. Octopus

Hong Kong

It is a reusable contactless stored value smart card for making electronic payments in online or offline systems in Hong Kong. It is used as payment for all public transport, many retail shops, convenience stores, supermarkets, fast-food restaurants, on-street parking meters, car parks, to other point-of-sale applications such as service stations and vending machines. From 1997.

Lines: MTR Heavy 10, MTR light 12, Tramways 6

Stations: MTR Heavy 87, MTR light 12, Tramways 120

Ridership: MTR, approx. 5 millions per day, Tramway 180,000 per day.

NFC + SIM card

It is the official application developed by Octopus Cards Limited and is a free application for NFC (Near Field Communication) enabled Android mobile devices and applicable to Octopus with 9-digit Octopus number (including eight digits plus one single digit inside the bracket).

Services:
- Check Octopus’ remaining value, latest transaction records and other information
- Make Octopus Online Payment at designated online merchants
- Conduct Incomplete transaction refund enquiry and collection
- Activate Octopus Automatic Add Value Service (AAVS)
- Receive refund and AAVS activation notification, When using Octopus Mobile SIM, you can enjoy the convenience of checking the remaining value using the Home Screen widget.

Technology: The Mobile SIM consists of both Octopus function and mobile telecommunication function for use on NFC (Near Field Communication) enabled mobile phones as tested by Octopus.

Google Play - Android

Update: June 29, 2016
Installs: 1,000,000 - 5,000,000

3.3

App store - iOS

Updated: 28 July 2016

Current version: ★★★★
9 Ratings

Video URL: https://www.youtube.com/watch?v=1Wc8Vn063I
20. HopOn

Israel

The HopOn system is already in use with more than 7 public transport operators in Israel installed on a total of more than 2,000 vehicles, including buses, BRT, LRT and bike rental stations.

HopOn

HopOn is a mobile platform for payment and validations through public transit, that changes the ticketing experience.

Services:
- Take your ticket with you when you upgrade your phone get a refund for unused mobile tickets, request receipts and manage payment information.
- Check train schedules and service statuses
- Tickets can be one-way, 10-trip, weekly or monthly. The ticket is saved in an electronic ticket wallet in the app.

Technology:
“HopOn Beacon” transfers data over ultrasonic sound waves to the passenger’s phone, enabling us to support multiple, simultaneous validations and payments. The technology automatically detects all the necessary information in order to generate a valid boarding pass soon as the passenger boards, without any other passenger intervention.

Google Play - Android

Update: July 24, 2016
Installs: 50,000 - 100,000

App store - iOs

Updated: Sep 10, 2015

All versions: ★★★
33 Ratings

Video URL: https://www.youtube.com/watch?v=5FYhX8xXs
## 7.2. SERVICES QUANTITATIVE EVALUATION

Table 3, Quantitative selection

<table>
<thead>
<tr>
<th>Transport system</th>
<th>Location</th>
<th>App</th>
<th>Technology</th>
<th>App satisfaction</th>
<th>Installs</th>
<th>Modalities</th>
<th>Coverage area</th>
<th>Ridership (per day)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MBTA Massachusets area</td>
<td>MBTA mTicket</td>
<td>Self ticketing QR</td>
<td>4.2</td>
<td>100,000 - 500,000</td>
<td>2</td>
<td>Regionwide</td>
<td>1.3 millions</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>TriMet Portland</td>
<td>TriMet</td>
<td>Self ticketing QR</td>
<td>3.2</td>
<td>100,000 - 500,000</td>
<td>4</td>
<td>Regionwide</td>
<td>319,700</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>METRORail Houston</td>
<td>Q-ticketing</td>
<td>Self ticketing QR</td>
<td>3.9</td>
<td>5,000 - 10,000</td>
<td>1</td>
<td>Citywide</td>
<td>43,900</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>MTA LIRR / MNR New York area</td>
<td>MTA eTix</td>
<td>Self ticketing QR</td>
<td>2.8</td>
<td>10,000 - 50,000</td>
<td>4</td>
<td>Regionwide</td>
<td>637,700</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Rutter Oslo and Akershus/ Norway</td>
<td>RuterBillett</td>
<td>Self ticketing QR</td>
<td>3.7</td>
<td>500,000 - 100,000</td>
<td>6</td>
<td>Regionwide</td>
<td>300,000</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>SFMuni San Francisco</td>
<td>MuniMobile</td>
<td>Self ticketing QR</td>
<td>2.9</td>
<td>10,000 - 50,000</td>
<td>4</td>
<td>Citywide</td>
<td>679,800</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>BVG Berlin</td>
<td>BVG FahrInfo Plus</td>
<td>Self ticketing QR</td>
<td>3.7</td>
<td>100,000 - 50,000</td>
<td>6</td>
<td>Regionwide</td>
<td>1,390,000 U-Bahn</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>Deutsche Bahn Germany</td>
<td>DB navigator</td>
<td>Self ticketing QR</td>
<td>4</td>
<td>10,000 - 50,000</td>
<td>6</td>
<td>Countrywide</td>
<td>1.8 millions</td>
<td>17</td>
</tr>
<tr>
<td>9</td>
<td>Chiltern Railways</td>
<td>Chiltern Railways</td>
<td>QR with gate scanners</td>
<td>3.8</td>
<td>50,000 - 100,000</td>
<td>1</td>
<td>Regionwide</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>NS Nederlandse Spoorwegen</td>
<td>NS Reisplanner Xtra</td>
<td>QR with gate scanners</td>
<td>4.1</td>
<td>1,000,000 - 50,000</td>
<td>1</td>
<td>Countrywide</td>
<td>1,200,000</td>
<td>13</td>
</tr>
<tr>
<td>No.</td>
<td>Service Provider</td>
<td>Country</td>
<td>Application Name</td>
<td>Features/Scanning Methodology</td>
<td>Rating</td>
<td>Version</td>
<td>Number of Users</td>
<td>Area Covered</td>
<td>Notes</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------</td>
<td>-------------</td>
<td>------------------</td>
<td>-------------------------------</td>
<td>--------</td>
<td>---------</td>
<td>----------------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>11</td>
<td>NS International</td>
<td>The Netherlands</td>
<td>NS International app</td>
<td>QR with gate scanners</td>
<td>3.3</td>
<td>2</td>
<td>10,000 - 50,000</td>
<td>Several countries</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>Deutsche Bahn</td>
<td>Germany</td>
<td>Touch and Travel</td>
<td>GPS track NFC QR scanners</td>
<td>3.6</td>
<td>3.5</td>
<td>10,000 - 50,000</td>
<td>Regionwide</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>Opal Card</td>
<td>Sydney area</td>
<td>Opal travel</td>
<td>NFC for card scan</td>
<td>3.5</td>
<td>2.5</td>
<td>100,000 - 500,000</td>
<td>Regionwide</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>Metra, CTA, Pace</td>
<td>Chicago</td>
<td>Ventra</td>
<td>NFC QR Apple pay Android pay</td>
<td>3.4</td>
<td>2.5</td>
<td>100,000 - 500,000</td>
<td>Citywide</td>
<td>1,2 millions</td>
</tr>
<tr>
<td>15</td>
<td>Snapper card</td>
<td>New Zealand</td>
<td>Semble</td>
<td>NFC card scan, Mobile wallet</td>
<td>4</td>
<td>-</td>
<td>50,000 - 100,000</td>
<td>Countrywide</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>Transport for London</td>
<td>London</td>
<td>Android Pay ApplePay bPay</td>
<td>Mobile Wallet</td>
<td>4</td>
<td>-</td>
<td>50,000,000 - 100,000,000</td>
<td>Citywide</td>
<td>3.6 millions</td>
</tr>
<tr>
<td>17</td>
<td>EZ-Link Card</td>
<td>Singapore</td>
<td>EZ-Link</td>
<td>NFC to top up and check</td>
<td>2.7</td>
<td>-</td>
<td>100,000 - 500,000</td>
<td>Countrywide</td>
<td>3 millions</td>
</tr>
<tr>
<td>18</td>
<td>EZ-Link Card</td>
<td>Singapore</td>
<td>My EZ-Link Mobile</td>
<td>NFC + Simcard</td>
<td>3</td>
<td>-</td>
<td>10,000 - 50,000</td>
<td>Countrywide</td>
<td>3 millions</td>
</tr>
<tr>
<td>19</td>
<td>Octopus Card</td>
<td>Hong Kong</td>
<td>Octopus Card</td>
<td>NFC + Simcard</td>
<td>3.3</td>
<td>1.5</td>
<td>1,000,000 - 5,000,000</td>
<td>Countrywide</td>
<td>5 millions</td>
</tr>
<tr>
<td>20</td>
<td>HopOn</td>
<td>Israel</td>
<td>HopOn</td>
<td>HopOn</td>
<td>3</td>
<td>3</td>
<td>50,000 - 100,000</td>
<td>Regionwide</td>
<td>-</td>
</tr>
</tbody>
</table>
References


Author
Diana Lorena Gonzalez Sanchez did her bachelor in Industrial Design in the National University of Colombia, currently is studying Design for Interaction Master of Science at the Delft University of Technology. This report is part of a research elective project.

Supervisors
Jasper van Kuijk is assistant professor in user-centered innovation at the faculty of Industrial Design Engineering of the Delft University of Technology. He has a PhD and Master’s degree in Industrial Design Engineering.