INVITED STUDENT PAPER:
A Comparison of Transit Mobile Ticketing Applications in the United States and Europe

Word Count: 3,895 (text) + 250*8 (figures and tables) + 214 (references) = 6,109

Submission Date: November 15, 2016

Nahla Ali (Corresponding Author)
Grove School of Engineering
City College of New York
160 Convent Avenue, New York, NY 10031
Phone: (347)-233-9890
Email: nali09@citymail.cuny.edu

Marion Touret
École Nationale des Travaux Publics de l'État
3 Rue Maurice Audin, 69518
Vaulx-en-Velin cedex, France
Phone: +33 6 49 28 66 61
Email: marion.touret@entpe.fr

Candace Brakewood, PhD
Grove School of Engineering
City College of New York
160 Convent Avenue, New York, NY 10031
Phone: (212)-650-5217
Email: cbrakewood@ccny.cuny.edu

Robert Paaswell, PhD
Grove School of Engineering
City College of New York
160 Convent Avenue, New York, NY 10031
Phone: (212) 650-8072
Email: paaswell@utrc2.org

ABSTRACT

Many transit agencies have recently deployed mobile ticketing applications (apps) to let passengers purchase tickets on their smartphones, and many of these apps now include additional features beyond ticketing. Because this is an area of rapid change in the transit industry, this qualitative research aims to document and compare the current state of transit mobile ticketing in America and Europe. Case studies were conducted by downloading publicly available transit apps. The following five American regions were chosen for this research: Portland, Boston, Austin, Chicago, and New Jersey. Similarly, five European regions were chosen: Vienna, Rome, Frankfurt, Stockholm, and Edinburgh. The apps were compared on various dimensions, including the features in the app, use of location services, and the privacy policy. This comparison led to a number of key findings. First, transit apps in the United States and Europe are similar in terms of the overall app structure and functionality. Second, the most common features beyond ticketing found in many transit apps are trip planners, real-time vehicle location information, and transit service alerts. Third, numerous transit apps use 'location services' to detect the user's location, and this is primarily to assist riders in finding the nearby stops and stations, such as for trip planning and vehicle location features. Fourth, the privacy policies in some of the European apps stated the reasons for detecting the location of the user. The results of this case study analysis can help other transit agencies who are considering deploying or expanding their mobile ticketing apps.

INTRODUCTION

Many transit agencies are utilizing mobile ticketing applications (apps) to improve the riders' transit experience *(1)*. Over the last decade, several transit agencies have implemented mobile ticketing systems in order to simplify the ticket payment process *(2)*. Many of these transit agencies are developing user-friendly apps to meet modern ticketing demands *(3)*. While ticket purchases are the primary features in most of these apps, developers are increasingly integrating additional features such as coupons, offers, route maps, and schedules. Since this is an area of rapid change in the transit industry, this research aims to document and compare mobile ticketing apps in the United States and Europe and focuses on the features beyond ticket purchases. A case study analysis will be utilized that examines a select number of transit apps in detail.

This paper is structured as follows. First, a brief literature review pertaining to mobile ticketing transit apps is presented. Next, the research objectives and methodology are discussed. After that, general background information about the selected American and European transit apps is presented. Subsequently, three dimensions of this case study are analyzed: features in the app, use of location services, and privacy policy, respectively. The paper concludes with a comparison between the American and the European transit apps.

LITERATURE REVIEW

There are various ways for transit riders to purchase their tickets. Traditional methods of ticket purchase are cash payment, tokens and paper tickets. Over the past twenty years, smart cards and magnetic stripe tickets have become common in the transit industry *(4)*. Even more recently, transit agencies have taken a different path for payment methods: open payment systems and mobile ticketing *(4)*. An open payment system is a payment system that can be processed using an outside entity's card, such as debit or credit cards *(5)*. Mobile ticketing is a payment option in which the user can purchase a ticket and validate it using a smartphone *(6)*.

Because mobile ticketing is considered to be a relatively new technology in the transit industry, there is limited literature pertaining to it. This analysis aims to conduct a detailed comparison between leading American and European mobile ticketing apps to begin to fill this gap in the literature. This work can help to inform other transit agencies who would like to implement or expand mobile ticketing apps in the future.

OBJECTIVES

This research aims to address the following specific questions:

1. What are the similarities and differences between American mobile ticketing apps and European mobile ticketing apps?
2. What features are found within each app? What is the purpose of such features?
3. Is the user's location being detected by each of the selected apps?
4. What important information can be grasped from each app's privacy policy?

METHODOLGY

In order to choose American transit apps for this research, the top 40 transit agencies in terms of size (unlinked passenger trips) in the United States from the American Public Transportation Association (APTA) fact book were considered *(7)*. The top 40 transit agencies were filtered down based on the availability of mobile ticketing, and then five transit agencies offering mobile ticketing in different areas of the United States were selected. Similarly, the top 25 largest transit agencies in Europe were narrowed down to five European apps, which were chosen based on the

availability of mobile ticketing and geographic region. Additionally, the selection for both the American and European apps considered different app developer companies, since features are likely to be similar across agencies hiring the same developer.

In this case study analysis, the primary method of documentation was downloading publicly available transit mobile apps. The apps were downloaded from iTunes and analyzed on an iPhone 6. All apps were briefly compared to Android phone apps in order to ensure that there are no significant differences.

The upcoming sections cover the dimensions of this case study analysis. First, general background is given about the selected apps. Then, the features found in each app are discussed. This is followed by an analysis of the use of location services in each app. After that, the key points of each app's privacy policy are discussed. Finally, an overall comparison between the American and the European transit apps is presented.

BACKGROUND INFORMATION ON CASE STUDIES

This section contains general information about the American and European transit agencies and their apps. All of the selected apps are introduced and briefly described in terms of their available features and their release dates. Since app developers regularly make changes and release new app versions, Tables 1 and 2 also include the names of the company and the versions used in this case study.

Background on the American Case Studies

The five selected American transit agencies are as follows: TriMet (Tri-County Metropolitan Transportation District of Oregon) in Portland, the MBTA (Massachusetts Bay Transportation Authority) in Boston, CapMetro (Capital Metropolitan Transportation Authority) in Austin, the CTA (Chicago Transit Authority) in Chicago, and NJ TRANSIT (New Jersey Transit) in New Jersey. Boston was the first of these agencies to launch a mobile ticketing app, and this occurred in 2012. They were followed by New Jersey and Portland in 2013, Austin in 2014, and most recently, by the Chicago in 2015 *(8)*.

The home screen of each American app is shown in Table 1. There are many similarities between the features displayed on each app's home screen. For example, Austin's app and New Jersey's app include numerous additional features on their home screen, such as trip planning and departure information. As shown in Table 1, Portland's app and Chicago's app have a similar homepage layout, which only has an option of creating an account without revealing other features yet.

All five American apps provide mobile ticketing to the users. When making a ticket purchase, some transit apps require the user to make an account, while other apps can treat the user as a guest. New Jersey's app and Austin's app are the only two American apps that require the user to create an account in order to purchase a ticket. The other three apps only require credit card information in order to process a ticket payment.

Background on the European Case Studies

The five selected European transit agencies are as follows: the Wiener Linien in Vienna, RMV (Rhein-Main-Verkehrsverbund) in Frankfurt, ATAC (Azienda Tramvie ed Autobus del Comune di Roma) in Rome, SL (Stockholms Lokaltrafik AB) in Stockholm, and TFE (Transport for Edinburgh) in Edinburgh. Frankfurt's app and Vienna's app were launched in 2010 and 2011, respectively. Edinburgh released its mobile app, m-ticket, in 2013. In 2014, Stockholm launched

its app, SL tickets, and Rome's app was launched in 2015. The home screen of each European app is shown in Table 2.

Once the app is downloaded on the user's smartphone, Rome, Vienna, Stockholm, and Edinburgh's apps ask the user to accept their terms and conditions before they proceed to the app's homepage. When making a ticket purchase, some transit apps require the user to make an account, while other apps can treat the user as a guest. Rome's app, Vienna's app, Stockholm's app, and Edinburgh's app require registration in order for any user to make a ticket purchase. On the other hand, Frankfurt's app users can purchase tickets without registering.

FEATURES INCLUDED IN THE APPS

In addition to ticket purchases, many of the transit apps provide additional features for customers. In this case study, 'features' is defined as any tool found within the app that enhance the user's experience beyond ticketing. Features can be transit-related, such as schedules and maps, or can be unrelated to transit, such as coupons and nearby event information. These features could increase the user's interests in the transit app and encourage them to use it more frequently.

Features in the American Apps

In the American transit apps, all additional features can be accessed within the app, except Portland and Boston's apps, which direct the user to a web browser in order to view the app's features, as shown in the screenshots in Table 3.

There are many similarities that were found in the features of the American transit apps. The most common transit app feature is real-time information. Real-time information provides up-to-date information about vehicle departure and arrival times. Real-time information is called 'next departure' in Austin's app, 'transit tracker' in Portland's mobile website, 'departure vision' in New Jersey's app, and 'transit tracker' in Chicago's app.

Another useful feature found in many of these apps is trip planning. Trip planners typically ask for the user's location and desired destination to find the fastest route between the two locations. A trip planner was found in Portland's mobile website, Austin's app and New Jersey's apps.

Two of the apps (Portland and Austin) include 'service alerts,' which contain transit announcements about delays, detours, or sudden changes in the transit system that may affect the user. Service alerts found in Austin's app are referred to as 'latest advisory'.

There are also unique features found in only a few transit apps. Austin's app provided maps for the routes it serves. New Jersey's app has a 'police' tab, which serves as a tool to report any suspicious activity. Boston's mobile website provides a 'social media' tab which contains access to the agency's Facebook, Twitter, and Instagram. Portland has an option of 'More Rides Nearby' which must detect the user's location in order to provide transportation alternatives, such as bike-sharing (BIKETOWN), ride-hailing (Lyft) and car-sharing (car2go).

1 **Table 1. Background Information on the selected American Transit Apps**

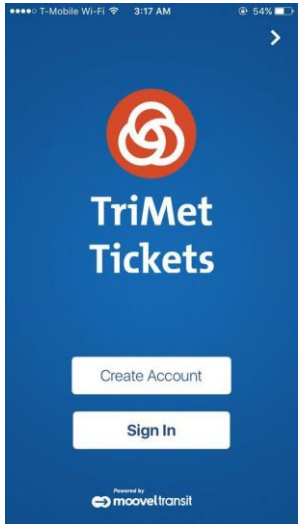
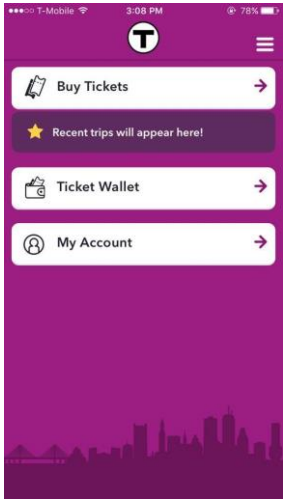
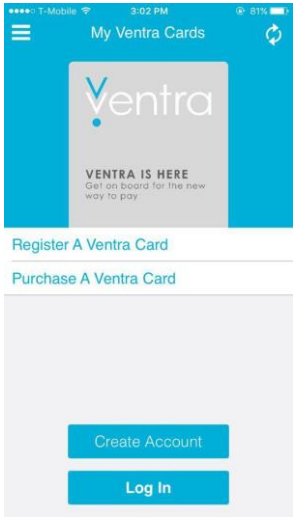
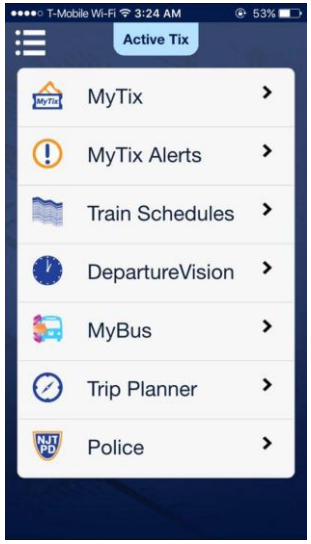
Region	**Portland**	**Boston**	**Austin**	**Chicago**	**New Jersey**
Agency	TriMet	MBTA	CapMetro	CTA	NJ TRANSIT
Screenshot					
iPhone App Link	https://itunes.apple.com/us/app/trimet-tickets/id687943985?mt=8	https://itunes.apple.com/us/app/mbta-mticket/id560487958?mt=8	https://itunes.apple.com/us/app/capmetro/id787315615?ls=1&mt=8	https://itunes.apple.com/us/app/CTA/id1005645256?mt=8	https://itunes.apple.com/us/app/nj-transit-mobile-app/id589549928?mt=8
Launch Year	2013	2012	2014	2015	2013
Version	1.7.1	3.2.3	1.158	1.3.1	2016.2.0
Developer	Moovel	Masabi	Bytemark, HaCon	Cubic, Moovel	Xerox

Table 2. Background Information on the selected European Transit Apps

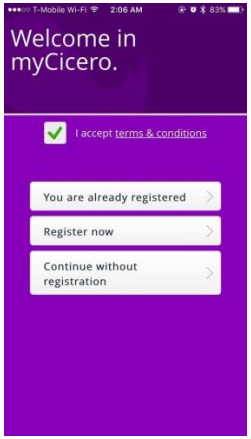
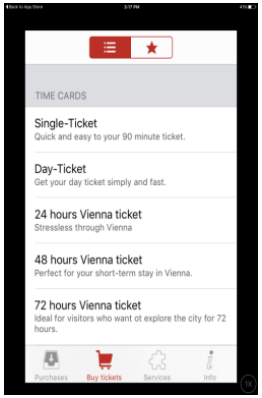
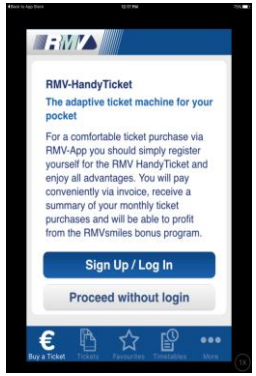
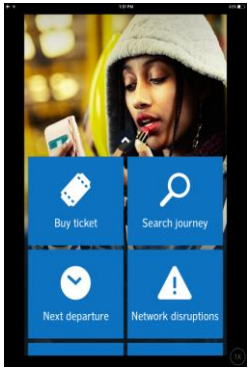
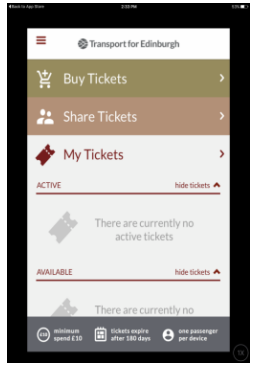
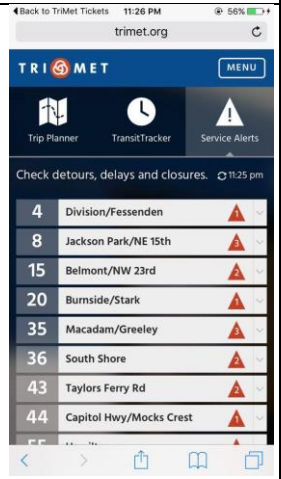
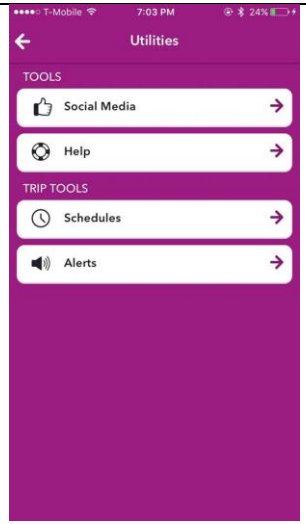
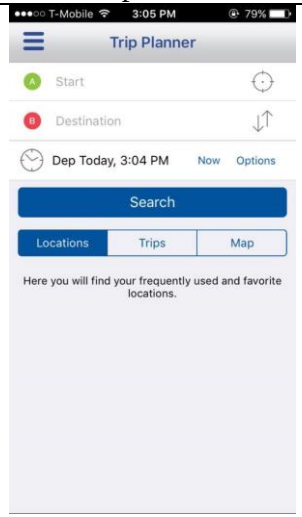
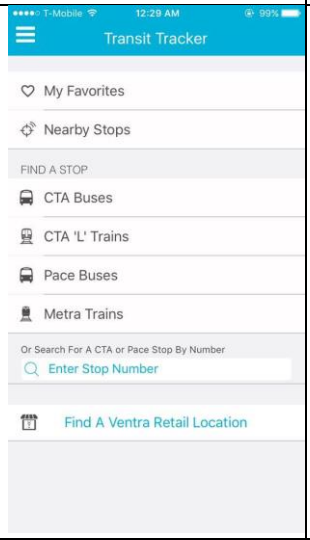
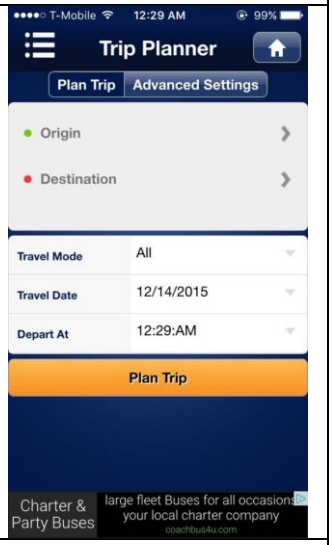
Region	Rome	Vienna	Frankfurt	Stockholm	Edinburgh
Agency	ATAC	Wiener Linien	RMV	SL	TFE
Screenshot					
iPhone App Link	https://itunes.apple.com/it/app/ATAC/id595700208?mt=8&ign-mpt=uo%3D4	https://itunes.apple.com/us/app/wiener-linien/id417941668?mt=8	https://itunes.apple.com/us/app/rmv/id382594207?mt=8	https://itunes.apple.com/se/app/sl-tickets/id918418291?l=en&mt=8	https://itunes.apple.com/gb/app/transport-for-edinburgh-lothian/id570435211?mt=8
Launch Year	2015	2011	2010	2014	2013
Version	5.5.14	3.5.1	1.91	4.0.0	3.101
Developer	Pluservice S.r.l.	eos.uptrade GmbH	Cubic Transportation Systems	Klarna	Corethree Ltd.

Table 3. Features in the American Transit Apps.

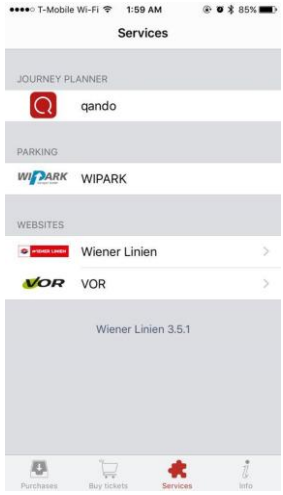
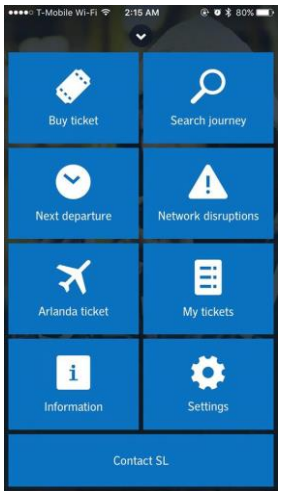
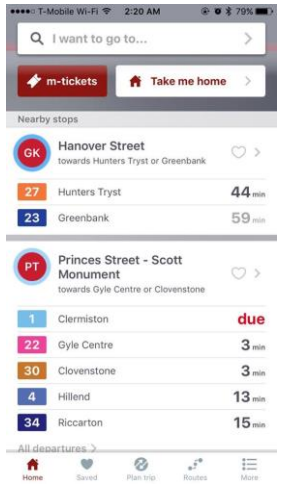
Region	Portland	Boston	Austin	Chicago	New Jersey
Agency	TriMet	MBTA	CapMetro	CTA	NJ TRANSIT
Screenshots of selected features					
Trip Planner	Yes, on agency website	No	Yes	No	Yes
Service Alerts	Yes, on agency website	Yes, on agency website	No	No	No
Police/ Emergency	No	No	No	No	Yes
Real-time Information	Yes, on agency website	No	Yes	Yes	Yes
Offers	No	No	No	No	No
Maps	No	No	Yes	No	No
Other	More Rides NearbyMore	Social Media	None	None	None

Features in the European Apps

Table 4 shows screenshots of some of the features found within each European app. Three of the apps (ATAC in Rome, RMV in Frankfurt, and SL in Stockholm) include trippers and real-time information. Additionally, two of those three (ATAC in Rome and RMV in Frankfurt) have transit service alerts. However, Wiener Linien app in Vienna provides no features other than mobile ticketing, and therefore, it asks the user to download another app to view other features. This other app is known as Qando, as shown in Table 4. Similarly, TFE m-tickets in Edinburgh functions solely for purchasing tickets; to use other features, it's recommended for the users to download a different app, TFE.

There are multiple unique features within each app that should be pointed out. Rome's app provides various features to the user that may not necessarily relate to transit, such as tabs for public parking, nearby places, and events. The public parking feature allows users to pay for parking tickets by using their smartphone. The events tab gives information about current cultural events, and the places tab gives information about noteworthy places nearby the user's location. Frankfurt's app implemented a unique feature known as RMVsmiles. RMVsmiles works as a loyalty program that saves every ticket the user purchases and turns it into points that can be transformed in discount vouchers. Frankfurt's app also provides a 'more' tab that gives access to information about Frankfurt events and parking available nearby. Moreover, the 'mobility services' tab in Frankfurt's app provides information about the different modes accessible in the network and links for other services such as car-sharing.

Table 4. Features in the European Transit Apps.

Region	Rome	Vienna	Frankfurt	Stockholm	Edinburgh
Agency	ATAC	Wiener Linien	RMV	SL	TFE
Screenshots of selected features					
Trip Planner	Yes	No	Yes	Yes	No
Service Alerts	Yes	No	Yes	Yes	No
Police/Emergency	No	No	No	No	No
Real-time Information	Yes	No	Yes	Yes	No
Offers	No	No	Yes, with smiles	No	No
Maps	Yes	No	Yes	No	No
Other	Parking Tickets, Municipal Services, Events Information	Other apps linked for further services	Car sharing rental, Electric car rental, Parking Tickets, City Tour, Events	None	Other app linked for further services

USE OF LOCATION SERVICES

Location services is a term that refers to the ability of a mobile app to detect the user's location. If a user gives an app the permission to detect his/her location, the app will be able to track the user's movement using GPS or a similar technology. Some users prefer to keep their location private and disable this feature from the app. Other users find it easier for the app to automatically determine their location instead of manually inputting that information.

Location Services in the American Apps

TriMet in Portland, CapMetro in Austin, CTA in Chicago, and NJ TRANSIT in New Jersey have implemented location services in their apps. The user has the option of turning location services on and off from the phone settings. Additionally, all ticket purchasing could be processed without location services for all these apps. Boston's app, on the other hand, does not use location services at all.

As Table 5 shows, three of the apps (Portland, Austin and Chicago) have very similar layout for the location service pop-up window. This pop-up window shows up if the user has turned off location services on their electronic device. It re-directs the user to the phone settings in order to turn on location detection. New Jersey's app has an unblocked tab for location services, which can be 'never' or 'while using' depending on the preference of the user. On the other hand, the screenshot of Boston's app shows a blocked tab for the location, which says 'never,' confirming that this app does not use any location detection.

Location Services in the European Apps

Location services is activated in some of the selected European transit apps. The Wiener Linien app in Vienna and the TFE m-tickets in Edinburgh app do not ask the user for permission to detect their location. The user has access to make a ticket purchase without being asked to give away any location information. On the other hand, ATAC in Rome, RMV in Frankfurt, and SL in Stockholm ask for the user's permission to detect their location. Rome's app asks to access the location even if the user is not using the app, while Frankfurt's app and Stockholm's app only need permission for location detection while the app is being used. However, the user has the option of purchasing a transit ticket without activating location services. The only issue is that the user will need to manually input their current location. Therefore, some users prefer to leave location services on for the sake of convenience. Table 6 shows the pop-up windows that the European apps show in order to ask for permission to detect the user's location.

PRIVACY POLICY

A privacy policy is a written statement that clarifies to the user how personal information is being used, collected, and protected. Many people skip reading the privacy policy and move on to using the app right away. The information given in the privacy policy may have an impact on whether the rider would want to use the app or not. Therefore, it is important to take a close look at the selected apps and their privacy policies.

Privacy policies provide critical information about the type of data that the app may have access to, which could include the user's photos, messages or contacts. In the case of transit apps, the data collected may fall into the categories of location detection, credit card information, and any personal information requested while creating an account. Previous studies of smartphone users have shown that 54% of smartphone users avoid installing an app when they

discover the type of personal information it may collect; however, these studies have not been conducted in a transit context *(9)*.

Privacy Policies for the American Apps

Table 7 summarizes the main points found in the privacy policy of the selected American transit apps. The first row of Table 7 shows how one can access the privacy policy. The second row shows if the privacy policy includes some form of reassurance for users; the CTA in Chicago and NJ TRANSIT in New Jersey assure the user that the personal information is kept safe and private. However, they also state that hacking and fraud activity is possible, for which they cannot take any responsibility. Portland and Austin have similar statements regarding responsibility for hacking and security in their privacy policies. Table 7 also shows the types of data that may be collected from the apps, which vary between agencies. One last noteworthy items is that Chicago's privacy policy states that it may share aggregate information with third parties, which is used for statistical purposes without exposing any personal information. Last, the privacy policy specific to Boston's app could not be found; however, the MBTA has a general privacy policy on their website, and this is summarized in Table 7.

Privacy Policies for the European Apps

Table 8 summarizes the main points found in the privacy policy of the selected European transit apps. The first row of Table 8 shows how one can access the privacy policy. All of the selected European apps provide a 'privacy policy' and a 'terms and conditions' that must be accepted before using the app. All of the privacy policies for the selected apps are provided in their native language and in English, except SL in Stockholm, which is only available in Swedish. Additionally, Stockholm's app's privacy policy is written by Klarna, which is in charge of the payment process in the app. Table 8 also shows the types of data that may be collected from the apps, which vary between operators. The following personal data will be collected by all the European apps that ask that user to create an account: the user's name, mobile phone number, and email address. All apps save the user's credit card information, except the Wiener Linien app in Vienna, which does not store credit card data for security reasons.

Table 5. Use of Location Services in the Selected American Transit Apps

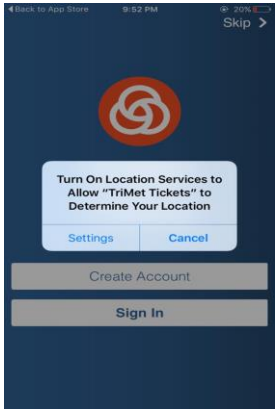
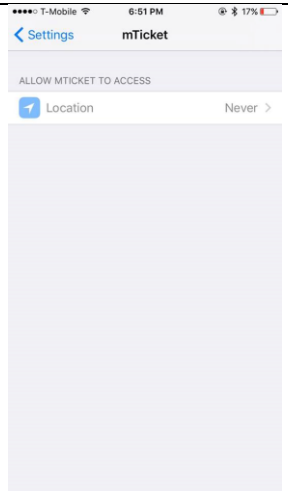
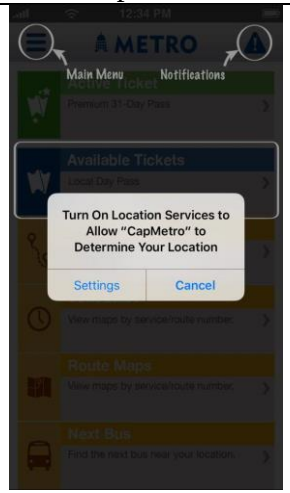
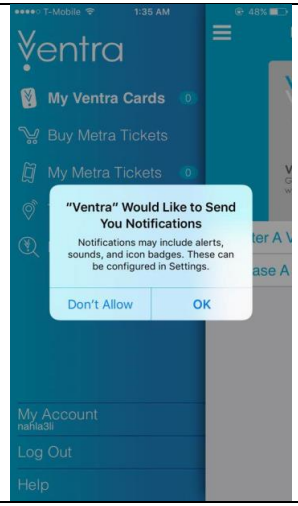
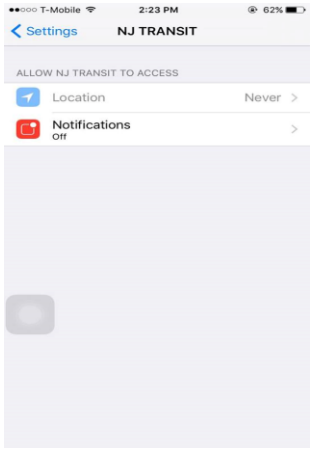
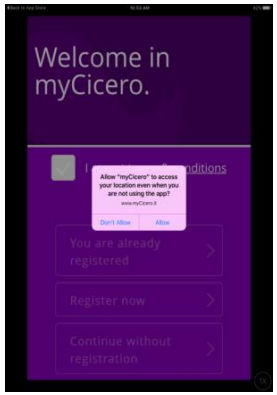
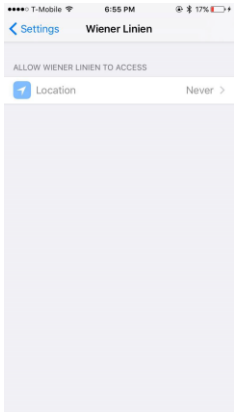
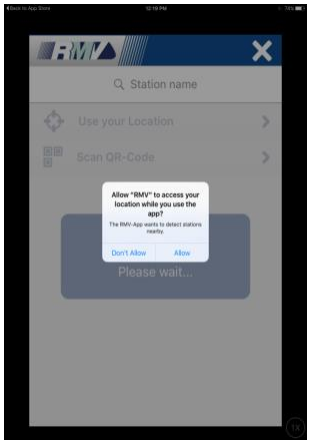
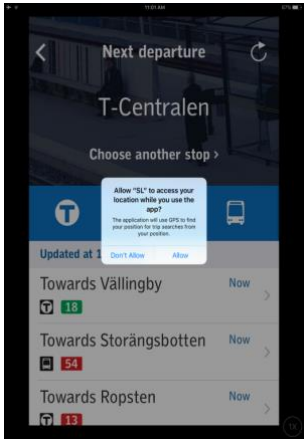
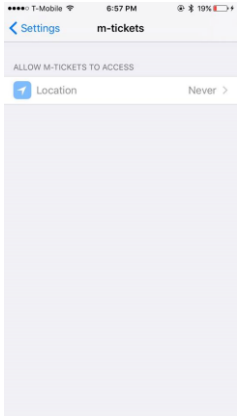
Region	Portland	Boston	Austin	Chicago	New Jersey
Agency	TriMet	MBTA	CapMetro	CTA	NJ TRANSIT
Location Detection Screenshot					

Table 6. Use of Location Services in the Selected European Transit Apps

Region	Rome	Vienna	Frankfurt	Stockholm	Edinburgh
Agency	ATAC	Wiener Linien	RMV	SL	TFE
Location Detection Screenshot					

1
2
3

Table 7 Privacy Policy of the Selected American Transit Apps.

Region	Portland	Boston	Austin	Chicago	New Jersey
Agency	TriMet	MBTA	CapMetro	CTA	NJ TRANSIT
How to view the privacy policy	Go to the app store, download the app, read through the Terms of Service, and then find the link for the privacy policy	Found on MBTA's Customer Support website	Privacy policy can be accessed from the app store, before even downloading the app	Privacy policy must be browsed online; it is not accessible from the app or the app store	Privacy policy is available at every point that personally identifiable information may be requested
Reassuring the app users	None	None	None	"We do not sell your personal information" "We carefully protect the personal data you provide" "We do not request location data when you're not using the app"	"NJ TRANSIT maintains the following Privacy Policy to protect the personal information, including the information you upload to the App"
Responsibility for hacking or fraud to the user's personal information.	"However, given the nature of the Internet and the fact that network security measures are not infallible, we cannot guarantee the security of your information."	"We cannot provide, and disclaim, assurance that the information you provide to us will remain free from loss, misuse"	"We cannot promise that your use of our sites will be completely safe"	"The Ventra Agencies are not responsible for any data obtained in an unauthorized manner"	"NJ TRANSIT is not responsible or liable for the security of information transmitted via the Internet."
Data collected	GPS location and the device's unique identifier	Location of use, cookies, email address, phone number	Phone number, email address, gender, age, credit card information, and GPS location	Device ID, the IP address, the type of mobile operating system	The smartphone's URL, IP address, and cookies
Privacy policy link	http://trimet.org/legal/privacy.htm	http://www.mbta.com/customer_support/privacy_policy/	https://www.bytemark.co/privacy-policy	https://www.ventrachicago.com/privacy-policy/	http://www.njtransit.com/tm/tm_servlet.srv?hdnPageAction=CopyrightTo#MYT

Table 8. Privacy Policy of the Selected European Transit Apps.

Region	Rome	Vienna	Frankfurt	Stockholm	Edinburgh
Agency	ATAC	Wiener Linien	RMV	SL	TFE
How to view privacy policy	Conditions of use can be accessed for the app store before even downloaded the app and from the website. Precise privacy notice is accessible only when the user creates an account.	Data privacy can be accessed from the app store before even downloading the app, from the website, and also directly from the app.	Privacy policy can be accessed from the app store, before even downloading the app, from the website and is also accessible directly in the app.	SL tickets privacy policy can be accessed from the app store, before even downloading the app and also from the app. To create an account, Klarna's privacy policy also has to be checked.	Directly in the app, in the section 'Terms and Conditions'.
Reassuring the app users	None	"Attention will be paid to the greatest possible security in the transfer of your data"	None	None	None
Responsibility for hacking or fraud to the user's personal information	None	None	None	None	None
Data collected	Personal Data, Email address, Phone number, Card Number	Personal Data	Personal Data, GPS Data	Personal Data, Information on Travel History	Personal Data, GPS Data, Information about the use of the app, Payment card details
Privacy Policy Link	http://www.mycicero.it/romatpl/	https://shop.wienerlinien.at/index.php/cms/privacy_policy/0	http://www.rmv.de/en/Rechtliches/34380/Datenschutz.html	http://botshop.nu/villkor-eng/	http://lothianbuses.com/privacy-policy

COMPARISON

The following is a brief comparison of the American and European apps. The European apps have more diversified features than the American apps, such as information about events, parking spaces, and other available transportation modes. American apps, on the other hand, primarily have transit-related features, such as real-time information and trip planners. What stands out as the most interesting feature is from RMV in Frankfurt: RMVsmiles. It works like a loyalty program, which collects points for the user and uses these points for future discounts. This feature was not implemented in any of the American apps, even though it could make the user's experience more fun and perhaps encourage the user to utilize the app more frequently.

The use of location services was the second characteristic of the apps considered in this case study analysis. Most of the European and American apps use location services in a similar manner. They both ask the user for permission to detect location once the app is downloaded. Then, location services is typically used to find the nearest transit station and/or nearby coupons, deals, and events. Moreover, in most of the American and European apps, the user is able make a ticket purchase while disabling the option of location services.

Last, the privacy policies were compared between the American and the European transit apps. Some of the American privacy policies discuss fraud and hacking activity. They inform the user that the transit agencies are not responsible of any hacking to the system that may collect users' personal information.. On the other hand, none of the European apps mention any information about fraud activity. Rather, the European privacy policies explain thoroughly to the user the type of personal data being collected and why it is collected.

CONCLUSIONS AND FUTURE RESEARCH

This case study analysis compared transit mobile ticketing apps in America and Europe. It specifically looked at five American transit agencies (Portland, Boston, Austin, Chicago, and New Jersey) and five European operators (Rome, Vienna, Frankfurt, Stockholm, and Edinburgh). The case study focused on other features in transit mobile ticketing apps beyond the actual ticketing implementation. One of the key findings is that both the European and American apps have similar layouts; however, the features in the European apps are more diverse than the American apps. The European apps includes features such as parking, events, and nearby places whereas the features in the American apps were primarily transit-related features. Regarding use of location services, most American and European transit apps implemented location services to locate the nearby transit stops or stations based on the user's location. In terms of privacy policies, the American apps include the possibility of hacking, while the European apps focus on the reasons for detecting the user's location.

This case study analysis makes an important first step toward documenting the current state of transit mobile ticketing; however, there is always room for future research. For example, this case study analysis could be expanded by including additional case studies of American and European transit agencies. It could also be beneficial to interview transit agency staff to understand why they included or excluded certain features in their apps.

In summary, this research can help to inform policy-makers and planners at other transit agencies who are considering deploying or expanding mobile ticketing applications in their regions.

ACKNOWLEDGEMENTS

This paper has been submitted through the TRB's Minority Fellows Program. This research has also been supported in part by the University Transportation Research Center (UTRC) and New Jersey Department of Transportation (#2014-15-09). The authors would like to acknowledge the contribution of Subrina Rahman, a graduate student at the City College of New York.

REFERENCES

1. Tavila, Commuting Gets a Little Easier with Transit Mobile Payments. Federal Reserve Bank of Boston. Boston, 2016.
2. Quigley, Georggi, Barbeau, Joslin, Brakewood. Assessment of Mobile Fare Payment Technology for Future Deployment in Florida. Florida Department of Transportation. Florida, 2016.
3. Bernstein. A Business Model Analysis of Mobile Ticketing Partnerships. MTA Metro-North Railroad. New York, 2014.
4. Anders, Brakewood, and Watkins. A Case Study Analysis of New Fare Payment Systems in Public Transit. Proceedings of the 93rd Annual Meeting of the Transportation Research Board, Washington D.C., 2014.
5. Wallischeck, Weisenberger, Berthaume, and Dinning. Preliminary Strategic Analysis of Next Generation Fare Payment Systems for Public Transportation. The Federal Transit Administration. TCRP Report, 177. Washington D.C., 2015.
6. Brakewood, Rojas, Robin, Sion, and Jordan. Forecasting Mobile Ticketing Adoption on Commuter Rail. *Journal of Public Transportation*, Vol. 27, No. 1, 2014, pp.1-19.
7. Neff, Dickens. American Public Transportation Association (APTA). American Public Transportation Association. Washington D.C., 2014.
8. Sion, Brakewood and Alvarado. Planning for New Fare Payment Systems. An Equity Analysis of Smartphone, Credit Card, and Potential Mobile Ticketing Adoption by Bus Riders in Nassau County. Proceedings of the 95th Annual Meeting of the Transportation Research Board, Washington D.C., 2015.
9. Boyles, Smith, Madden. Privacy and Data Management on Mobile Devices. Pew Research Center. 2012.