masabi

A to B is Easy With Masabi

NEORide

RFI 2017-01 Mobile Fare Technology

October 2017

justride

Industry leading Fare Collection-as-a-Service Platform

Table of Contents

Cover Letter

October 13, 2017

NEORide Attn: Dean Harris
1 Park Centre Drive Wadsworth, Ohio 44281
RE: NEORide Mobile Fare Technology RFI

To whom it may concern,

It is with pleasure that I submit this RFI response on behalf of Masabi in response to NEORide's Mobile Fare Technology RFI. This letter also verifies and attests that all information submitted herein is true and correct. Where designated, Masabi has noted the sections that are confidential and should be treated as such.

Masabi looks forward to next steps as NEORide continues to hone its scope and issue its procurement for its next generation fare collection system. Should NEORide have any questions with regards to the information submitted herewith, please don't hesitate to reach out.

Best,

Zachary Ascher

Zach Ascher
Business Development Manager, North America
404 5th Avenue, Suite 6024
New York, New York 10018
zach.ascher@masabi.com
914-715-4948

A. Executive Summary - BYOT and Outcome Based Procurement

Masabi firmly believes that the future of fare collection is Bring Your Own Ticket, and is excited to submit this RFI response for the consideration of NEORide as a solution for their Mobile Fare Collection system.

Masabi's JustRide platform is the ideal solution for NEORide to deploy to enhance rider experience and further integrate the four regional services. Moreover, the JustRide platform will enable NEORide to take the first step towards mobile-first, account-based ticketing, thereby building the foundation to allow passengers to Bring Your Own Ticket. In this response, Masabi aims to communicate the following key points for NEORide to consider as it proceeds with next steps in the procurement of its Mobile Fare Technology.

Industry Leading Mobile Platform:
The JustRide platform is the industry-leading mobile first fare collection platform by number of deployments and transactions through the application. Masabi has deployed the JustRide platform to over 30 agencies across the world including the Boston MBTA, the New York MTA Metro North Railroad and Long Island Rail Road, the Las Vegas RTC, and Los Angeles Metrolink. With each agency, the platform has continued to grow and it is now on pace to process over $1 billion dollars a year in transactions. Through over 10 years delivering mobile ticketing solutions to transit agencies, Masabi has developed unparalleled experience and applies this experience to continue to deliver world-class software in a best-in-class way.

Proven Inter-Agency Solution:
For the New York MTA, Masabi developed the JustRide platform to deploy the MTA eTix application so that passengers have one singular application across two sub-agencies: the Long Island Rail Road and the Metro North Railroad. To facilitate this, each agency has a separate back-office environment for their own reporting, customer service, and clearing. This functionality will allow NEORide to offer their passengers one application for seamless inter-agency travel, while allowing each agency their own contained back-office environment for system management should NEORide choose to structure the deployment this way.

How to Deliver It?
The evolution of technology towards a Software-as-a-Service (SaaS) world means that technology buyers no longer need to purchase a form of technology that is already obsolete by the time that they implement it. Instead, the beauty of SaaS is that it constantly grows and evolves and that agencies get to benefit from the constant improvements in the platform. For this reason, Masabi is a full proponent of phased deployment solutions; launching quickly and iterating. To support an evolving software platform, Masabi recommends proposes NEORide, Masabi installs multi-format ticket validators installed on board vehicles or on the platform utilizing Masabi's JustRide account based ticketing platform for fare processing to validate rider tokens (QR codes, EMV contactless, ISO 14443, etc.).

Best-in-breed Partnerships and Open Architecture:
As a company, Masabi maintains its pioneering status at the forefront of innovation in fare collection by staying laser-focused on delivering solutions that makes it easier for transit agencies to collect fares and for passengers to ride.

This means two things. First, it means that Masabi is not in the business of locking agencies into proprietary hardware or closed architecture solutions and then making money off of costly change orders or maintenance contracts. That's the old way of doing business that constrains agencies and limits innovation. Instead, Masabi is building a platform that provides agencies flexibility and utilizes Commercial-off-the-Shelf hardware, such as Android and iOS phones as well as the Access-IS Val-100, which is a Linux-based system with multi-form factor compatibility (the ability to read not just QR codes, but also other form factors so agencies are insulated from technological obsolescence).

Second, our focus on fare collection means that Masabi has built the Justride platform to enable best-in-breed partners to leverage our expertise and for Masabi to leverage their's. In a rapidly evolving space, where terms like mobility-as-a-service are becoming ubiquitous, Masabi feels that it is of paramount importance to not lose sight of the company's value proposition and continue to serve transit agencies the most innovative fare collection solution in the market.

That is why Masabi has invested in facilitating best-in-breed collaborations and integrations. At the 2017 APTA Expo, Masabi announced the integration of its Software Development Kit (SDK) within Transit, North America's leading journey planning application. This means that Masabi's industry leading mobile ticketing technology is embedded within the TransitApp.

Lastly, Masabi has engineered it's datamart so that the entire dataset is wrapped in RESTful API's so that agency partners can pull data from the JustRide platform into their preferred reporting software.

Mobile First Account-Based Ticketing:
Masabi has built the JustRide platform to be the foundation for a BYOT world. The account-based nature of the platform means that all fare policy is calculated in the back office and is associated with an individual account. This will enable transit agencies to reduce their fare collection burden and allow passengers to pay for transit using their preferred fare media, whether that be their phone, a smartcard, or eventually their contactless EMV credit card. No matter which form of fare media a passenger chooses, it is associated in the back office to an individual account. The back-office is also responsible for calculating appropriate fares, which allows for fare capping and innovative post-pay fare policy, so all a rider has to do is just ride, without needing to deal with the complexity of choosing a fare.

Outcome Based Procurement:
Masabi urges NEORide to consider a new way to best procure for fast rollout, good value, and avoid technological obsolescence.

Traditional procurement processes target the build out of bespoke solutions, often times mandating technological innovation be anchored to technologies and processes that will quickly

become legacy, thereby inhibiting the outcomes for the passenger and the agency. The reality is, with technology changing so fast, often while the project is mobilizing and when agencies prescribe the exact solutions that an agency desires, vendors are required to price in extra risk inherent in the uncertainty of delivering that bespoke solution.

Instead, Masabi advocates for outcome based procurements, where the agency procures and pays for the desired outcome, establishing key metrics for a successful deployment and allowing vendors to propose their best solutions to meet these goals. Legacy procuring requires vendors to fix and define the technological solution upfront, in the wording of the original contract, ultimately leading to and requiring continual change orders in order to adapt to meet the ever evolving requirements. Instead, outcome based procurement allows for thoughtful and innovative technical solutions to adapt over time, taking full advantage of changes taking place in technology, to best incorporate into and achieve the outcome the agency seeks.

B. Vendor Information

Masabi launched its first mobile ticketing service with Chiltern Railways in 2007 and has been designing, implementing, and operating mobile ticketing applications for transit agencies and their riders ever since. Our mass transit specific experience is informed by our foundational experience at the cutting edge of mobile and financial payments application development. For example, Masabi designed the open standards for barcode (AKA QR Code/Aztec Code) ticketing used by the UK's national rail network in 2008. We also developed, and still serve today, the mobile ticketing systems for ten of the UK's twenty-two rail operators, which collectively serve approximately 520 million passengers annually.

Since the beginning, Masabi has continued to maintain its foundation at the cusp of fare collection innovation.

Masabi launched the first mobile ticketing deployment in the United States in November of 2012 with the Massachusetts Bay Transit Authority (MBTA). Today, over 70% of MBTA commuter rail tickets are now bought via the MBTA JustRide mobile ticketing platform. Since then, Masabi has continued to grow, reaching both coasts of the US and globally with the deployment of LA Metrolink and delivering multi-modal (bus, metro, tram) ticketing city-wide in the Greek capital, Athens and in New Orleans.

The JustRide platform has continued to evolve with each of the 30 agencies that use the platform. With each deployment, the platform has grown from that agencies' contributions. The result is a product that is consistently industry leading and a team that is more experienced than anyone in the industry at meeting deadlines and deploying on time. Recently, Masabi deployed the JustRide platform for Fire Island Ferries in 23 days from contract signature to app go-live.

The beauty of the JustRide product is that it is rapid to deploy *and* that it is robust to allow for phased growth. In 2016, RTC Las Vegas, launched visual validation initially and has expanded to deploy over 600 on-board bus validators across the system. The RTC application provides reduced fare products and also resort fare promotions. Masabi assisted with all aspects of the hardware extension including vendor reviews, site inspections and pilot trials. This deployment serves as a model deployment for how Masabi could handle the NEORide deployment: launching with visual validation to start and expanding to electronic validation when ready.

Masabi is also the proud provider to the largest system transportation system in the US, New York's MTA, delivering mobile ticketing for the Metro North and Long Island Railroads. Recently, the railroads sold more than 1 million tickets through the application in a single month. To deploy for these agencies, Masabi had to further evolve its platform so that each agency could have separate back-office environments for clearing and customer service, under one front-end passenger application. This same functionality enable NEORide to offer a seamless passenger experience across the four regional agencies.

Ultimately, Masabi is committed to delivering the best fare-collection platform for transit agencies. Over 10 years Masabi has worked with transit agencies of varying sizes and complexity

to deliver superior technology and manage on-going system flexibility and performance. The company's experience at the forefront of innovation is unparalleled and with this experience, Masabi is excited to continue pioneering innovation for transit agencies with it's newest evolution of the platform: Account Based Ticketing (ABT).

C. Product Service Information

JustRide – Masabi's Fare Collection Platform

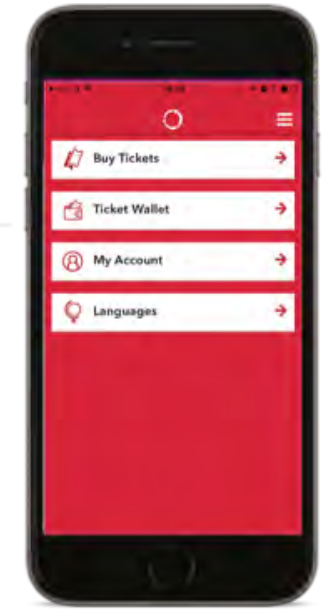
Masabi is the global leader in mobile ticketing, having spent the last 10 years building the JustRide platform to be a world-class, sophisticated end-to-end solution that is rapidly deployable and designed specifically for public transit agencies.

Masabi has engineered its platform with feedback from our agency partners and Masabi is excited about including NEORide in this platform, offering our expertise to NEORide, while also engaging with NEORide staff to keep improving our platform so that it continues to be cutting edge.

JustRide is made up of three primary platform modules – ***Retail*** (iOS and Android applications), ***Hub*** (reporting, analytics, customer service) and ***Inspect*** (validation). These components are backed-up by a range of services which ensure secure creation, delivery and management of tickets, a PCI DSS *certified* payment system and a scalable account-based system.

Retail

JustRide Mobile Applications



Masabi's JustRide applications for iOS and Android allow NEORide customers to purchase and use virtually any ticket from their smartphone. Our tried and tested application allows secure ticket purchase in seconds and can be branded to reflect the NEORide visual identity.

For NEORide, Masabi will deliver a fully-branded application, managing the fare, payments, ticket delivery and security.

The JustRide Retail app allows riders to purchase and use tickets directly from their smartphone and is able to service customers who purchase tickets in advance of travel or at the time of travel, with rapid ticket purchases through their mobile devices. The Retail mobile app is designed to complete mobile ticket purchases, with minimal taps, and store passenger's payment details for rapid repeat transactions and can be integrated with a range of payment options – all without requiring user-registration.

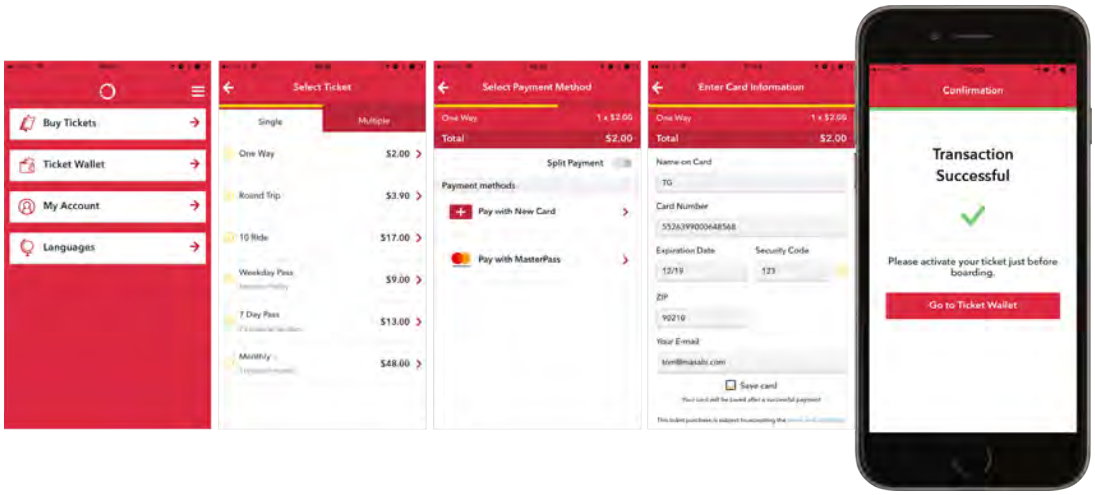
All JustRide purchases are encrypted using bank-grade security, and Masabi's PCI DSS certified systems (audited on an annual basis) were the first to be operational on Amazon's Cloud on both sides of the Atlantic. The platform tracks a range of known payment fraud patterns to ensure that users attempting to defraud the system are rapidly flagged and prevented from doing so.

The ticket purchase process allows customers to select their chosen ticket type, select a payment option and confirm payment.

Please try the Las Vegas RTC mobile ticketing app, which can be found by going to http://www.rtcsnv.com/ridertc/ on your mobile device.

Select and Pay

JustRide offers the fastest ticket purchase of any mobile ticketing platform in the US, with intelligent design minimizing the number of taps a user needs to purchase a ticket:



Tickets (customers may purchase singles, multiples, or multi-rider options) are then delivered to the Ticket Wallet where they are stored offline for future usage. When the customer is ready to ride they select the ticket they wish to use and then activate it.

Activate and Ride

Purchased tickets are delivered to the Ticket Wallet where they are stored offline for future usage. When a customer is ready to ride, they can activate tickets, including the activation of multiple tickets, directly from the ticket wallet. Previously used tickets also remain stored within the history section of the My Tickets screen, for the rider's reference.

When the customer is ready to ride they select the ticket they wish to use and then activate it - the user will be warned that activation is a one way process.

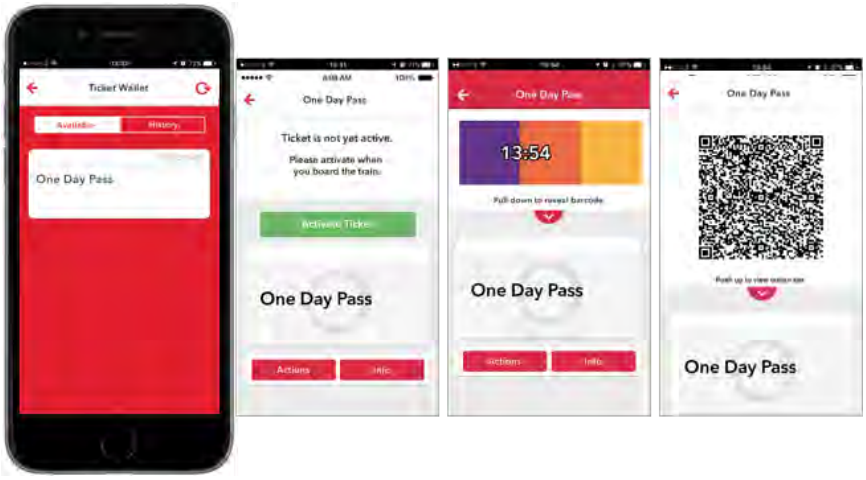
Ticket Activation

When riders choose to use a mobile ticket they simply have to 'activate' it. Activating the mobile

ticket 'stamps' the ticket, which prevents it from being re-used. As part of the activation process, customers are asked to confirm activation to prevent duplicate activations.

If a customer goes to activate a ticket while another ticket is already active, they will be asked to confirm their desire to activate another ticket.

Once activated the ticket displays the secure dynamic visual validation animation, while incorporating an interactive component that releases the QR code (another measure to protect against screengrabs or video recordings). Tickets prominently display their expiration time to ensure that customers are aware of when they must complete their trip.



Offline Functionality

The system is able to perform ticket activation offline to ensure that riders can still travel with their purchased tickets even when a network connection is unavailable – critical in a transit scenario, where the user is often in a poor coverage area or a busy area with significant contention for signal.

This is one of the key distinguishing components between Masabi's JustRide platform and other mobile ticketing providers, which cannot work offline, and this serves to highlight the level of detailed system architecture that has gone into the JustRide platform.

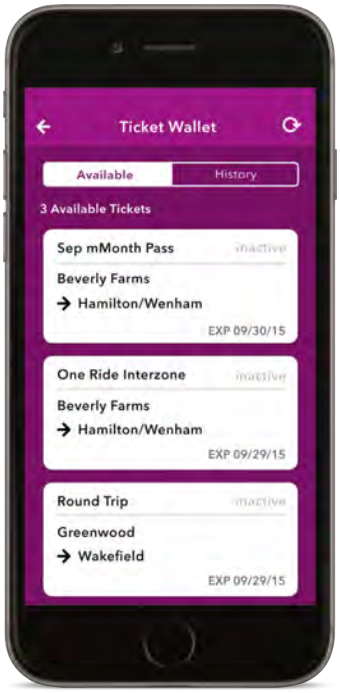
Masabi has engineered the JustRide platform to be secure and protect against fraudulent activity while still being functional in a transit environment.

Ticket Wallet Security

As described above, the transit environment requires tickets to be available offline – Masabi has seen on numerous occasions that cellular signal strength on transit networks is not consistently reliable enough to enforce a mandatory connection back to the server before a pre-purchased ticket can be used. To try to do so would result in significant customer problems.

However, offline tickets present a potential vector for fraud. JustRide apps implement a

sophisticated multi-layer security approach to eliminate the main avenues for fraud – distributing tickets to multiple devices, manipulating the ticket data to change validity, and preventing ticket activation notifications from reaching the server.

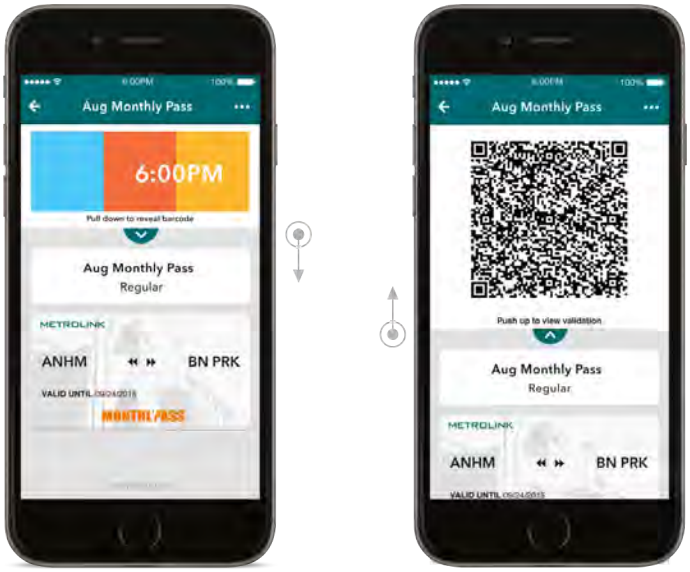


First, JustRide incorporates a custom secure ticket vault, that locks tickets to a specific mobile handset in a tamper proof encrypted store. This relies on a number of cryptographic layers to render ticket data unreadable when moved to any other device, alongside digital signatures that prevent users modifying tickets to change their validity.

Second, JustRide provides robust security against various attacks that can be attempted against offline ticket usage. The server limits the number of times tickets can be moved between devices - or restored onto the same device after an application is reinstalled - to handle genuine cases of handset loss or upgrade without opening up a systemic fraud vector. On iOS, persistent storage is also used to ensure that even after a reinstall on the same device all offline activation records are processed and sent to the server; Android does not have similar built-in functionality, but makes best effort to achieve the same protections.

Ticket Design

Tickets are potentially complex screens, but JustRide simplifies the ticketing screen, supporting a standard flexible design:



The tickets incorporate our visual validation mechanism and are dynamic and interactive to prevent screengrabs and video recordings. Masabi embeds our secure QR code within the interactive component of the tickets even for visual validation deployments to provide an extra

layer of security -- the credible threat of inspection.

JustRide mobile tickets contain a section of the screen that emulates paper tickets, including custom symbols based on ticket type. Key editable components of tickets that are supported are:

- A rectangular section of screen supports configurable elements that can bring in design cues from the paper tickets, including custom symbols based on ticket type, thereby supporting customer and staff adoption.
- A choice of information to display from what is contained within the ticket.
- Text color, style and sizing for the ticket information.

The Customer Account

Masabi takes a unique approach to the Customer Account to both optimize the customer's purchase flow and maximize flexibility for the agency.

Masabi has learned through its 10 years of delivering mobile ticketing services that the optimal customer experience for a first-time user is to select the fare, pay and ride. Signing up for an account with personal details during that flow is a barrier to purchase, and puts many off. That said, the benefits of having an explicit account tied to the customer's e-mail address are obvious - access across devices, stored payments, better data for customer services management, etc.

The customer account within JustRide is unique, in so far as Masabi is able to achieve all of these things without riders creating a username and password, with Implied Accounts.

In principle, a rider does *not* need to create an account to purchase a ticket, thus enabling a convenient and easy purchase experience for the passenger without the hassle of mandatory sign-in .

A mobile ticketing user is able to purchase a ticket, store their card details, have customer services manage their tickets - all using Implied Accounts. In fact, what is happening is that JustRide uses the device ID and customer details to create a dedicated and secure account for the customer without a username and password. This is different to a 'guest checkout' as an account is still created for riders.

When customers create a username and password, they will be able to move tickets between devices in a secure manner, are provided a unique Account ID, are fully identifiable by Customer Service agents through a wide range of identifiers and have all the tools necessary to manage their account, such as password reset, card management and ticket history - even refund requests.

Realtime Information, Deeplinking, and Integrated Mobility

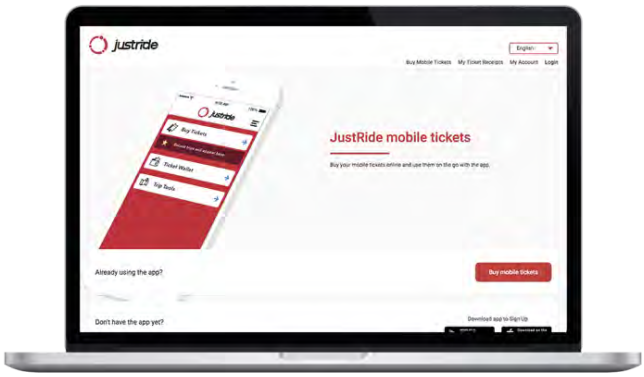
JustRide applications can contain a flexible range of content, including embedded external web content, links out to other applications as real time bus information and locally cached maps.

Additionally, Masabi can utilize deeplinks to connect to other best-in-breed

Mobility-as-a-Service apps from within the mobile ticketing functionality. For instance, Masabi has partnered with industry leading journey planning application, Transit, to deeplink between apps in Las Vegas so that passengers can see real time information and plan their journeys using Transit's interface and purchase tickets through the JustRide application seamlessly.

At the 2017 APTA Expo, Masabi and Transit announced that Transit will be integrating Masabi's JustRide Software Development Kit (SDK) within the Transit journey planning front-end application. This will allow passengers to plan and book multi-modal journeys on NEORide right alongside ridesharing and bikesharing journeys in the same application. Utilizing this solution, NEORide can launch their own branded application while simultaneously launching the SDK within Transit to sell NEORide tickets from within the Transit journey planning application for integrated, mobility-as-a-service.

Web Portal



In addition to the mobile retail front-end for purchasing tickets and the SDK, NEORide can also deploy the JustRide Web Portal which allows passengers to purchase tickets from their computers and send those tickets to their phones. The Web Portal will reflect NEORide's branding and is designed to match the agency branding of the Retail App.

This is a perfect way for parents to purchase tickets for their children. This will also evolve to allow for passengers to be able to manage their account from the Web Portal.

See the LA Metrolink Web Portal here: https://tickets.metrolinktrains.com/

Validation

Masabi's visual validation is designed to be simple for drivers to quickly validate tickets without having to memorize images and words and without the use of gimmicky animations.

However, one of the key benefits of deploying the JustRide platform is that NEORide could deploy first with visual validation and then can seamlessly expand the deployment to implement electronic validation at any point without interruption. Masabi's Inspect suite will allow NEORide to electronically validate tickets using a secure QR payload embedded in each passenger ticket.

Visual Validation

Masabi has spent the last five years working with drivers and revenue protection staff, including multiple user experience sessions. We learned some key points about making mTickets easy to

validate:

- Use familiar layout & symbols: minimizes training, and avoids staff needing to mentally task switch when riders have a mix of paper and mobile tickets.
- Block common fraud: still & video screengrabs, replica apps, phone clocks being changed, etc.

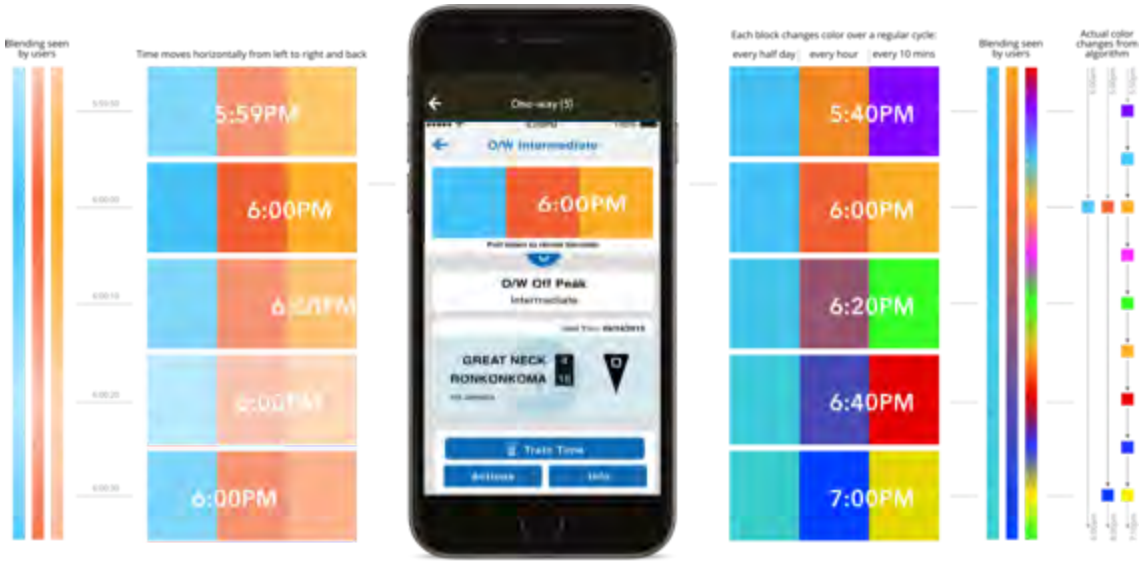
A number of mobile ticketing apps on the market fail to follow these lessons, favoring gimmicky animated graphics over well designed anti-fraud measures that are easy to visually confirm and difficult to replicate. These can be replicated flawlessly by hackers in very little time. A simple color or image of the hour/day is easily copied by riders shoulder surfing or deliberately sharing, and it is very simple to replicate even the most complex graphics and animation in a fake app – as occurred in Toronto where an app cloning the official mobile tickets was made available within a few days of launch.

Masabi's visual validation mechanism has several layers that together make visually validating a ticket simple for the driver and extremely secure.

The first layer of security are the dynamic elements of the ticket such as the scrolling timestamp which bounces across the top of the ticket displaying the correct date and time as well as the pulsing colors at the top of the screen.

Uniquely, Masabi tickets incorporate a visual watermark of animated elements following a cryptographically derived unpredictable sequence of colors, which can be used by staff to gain confidence in the authenticity of tickets without the need to resort to barcode scanning.

The fundamental tri-color bar mechanism displays the same three colors across all active tickets at any given point in time.



A driver viewing many tickets over a few hours should see a continuous but changing sequence

of colors on valid tickets, and will immediately be able to spot any ticket that is wrong because the colors will not follow the sequence, e.g. because the clock has been deliberately changed or the sequence shown is a recording of an earlier ticket.

This technology was designed so that it is easy for a driver to quickly validate tickets of multiple people boarding at once. Because all active tickets have the same three colors displayed, a driver can quickly validate tickets referentially.

Color sequences make use of a time-based pRNG sequence combined with random binary seeds, rotated regularly over time, which are attached to ticket data in a secure obfuscated way to enable offline ticket usage. Because colors blend over time, the system is tolerant of legitimate small differences in user's clocks (ie. a minute or two early or late) and differences in screen color rendering – the driver just looks for the glaring differences. The underlying keys driving the colors are changed regularly to minimize fraud potential.

Finally, interactive elements are placed on the ticket so that a conductor, suspicious a ticket might be a video, can request that the user taps on the interactive elements, which then dynamically change to prove the ticket is a real application that the user is interacting with.

In Masabi's standard ticket format, this interactive component displays the QR code, which is used for barcode scanning. We recommend that this is kept as the interactive item on the ticket during the initial visual validation roll-out of NEORide's mobile ticketing solution to keep the credible impression of a threat of inspection, which adds further security.

JustRide Inspect - Electronic Validation

Visual validation is an excellent way to rapidly verify a large number of tickets, with minimal investment in hardware. However, the most secure way of implementing mobile ticketing is by electronically validating tickets.

Masabi has the technical capacity and experience to support NEORide if and when they are ready to expand service to include electronic validation and can support this expansion without any disruption to the Retail application.

This secure payload is essentially a short piece of digitally signed and encrypted data, representing an entitlement to travel. This is currently displayed as an Aztec or QR 2D barcode by the mobile application, to allow easy machine-to-machine reading by the Inspect validation suite; however, it can as easily be transferred over BluetoothLE, NFC, or any other appropriate medium

once these technologies are appropriately reliable and widespread.

The digital signature authenticates the source of the ticket and prevents manipulation of the contents. It is designed to allow secure offline validation.

Masabi's JustRide Inspect is a barcode validation service aimed at running on a wide range of validation devices, sharing data through an open framework, with approaches to suit virtually any operating environment.

Barcode payloads are read by the validation hardware then passed to Inspect, which decrypts the barcode, runs the fields in the decrypted payload against a set of validation rules to determine if the barcode represents a valid ticket in the current context (date, location etc.) and then checks if the ticket has already been seen or cancelled (using the 'Deny List', a list of already scanned tickets).

Regardless of whether the ticket is considered valid or not, a Scan Record is stored in a local database, including the ticket payload and any actions taken by Inspect, for uploading to the JustRide Hub.

Once scanned, the validation device provides the customer or driver with a validation response – valid; valid with a warning (e.g. concession ticket); or invalid, and action should be taken – the exact way the ticket information is shown to the driver can be customized, but the status is conveyed using a clear traffic light system.

Inspect runs a number of processes to allow for a comprehensive anti-fraud validation solution. This comprises of a database of scanned records, the Deny List, synchronization modules for the management of data between devices and a central database comprising scan records and ticket rules, the Ticket Validation Database (TVD). The TVD is the central store of ticket records which also manages the logical distribution of records to devices to ensure system wide coverage of already seen tickets.

Masabi's Inspect functionality will allow NEORide to deploy with electronic validation from the start or seamlessly expand their mobile ticketing offering to electronic validation without any interruption to mobile application.

Onboard Ticket Validator (Access IS VAL 100)

The JustRide Inspect Validator software products are designed to accommodate transit fare payment needs now *and* in the future, so as to support evolving technologies and ever-changing passenger expectations.

Masabi has collaborated with a Access IS to support units which are open at their core and expandable for the future, running the core Inspect Validation Module inside a Linux Operating System.

The Access IS VAL 100 has been designed to support the scanning and validation of virtually any fare media in less than 350 milliseconds. Further, these validators have been designed to provide a common experience across all fare media types. This approach ensures that once customers have learned to use one media type they also know how to use others over time. Masabi has invested heavily in optimising the user interaction ergonomics in order to minimize passenger fumble time. The system works in combination with the Ticket Validation Database and is therefore able to provide a robust validation service in both online and offline conditions with the latest deny list sourced from the back-office.

The JustRide Inspect Validator application is built in Java, enabling the application to be run on a variety of third party hardware solutions. The application has been designed in a way that enables it to be easily integrated with any hardware solution that is capable of running Java.

Linux-based Operating System

Masabi have built a custom Linux distribution that is geared towards this environment. This includes capabilities such as attempting to retain an online connection, with fallback and retry if connections aren't available, and automatically running filesystem checks upon boot to ensure unit stability. This Linux Operating System has the capacity to be remotely updated without requiring the presence of a field engineer. The operating system also provides regular feedback to Masabi of any problems it encounters in the field. These features result in a stable environment on top of which the validation application can be run.

Back-Office - Service Management System

JustRide Hub: Data and Reporting

Masabi will capture considerable data around use of the services it offers including total number of trips taken, bus route, stop ID/location, payment method, time of day, service type, fare type etc.

The JustRide Data Warehouse, which is an immutable (unchanging) archive of event-based data, tracks all important events occurring anywhere in the system - for example ticket purchases, account logins, and ticket scans by Inspect.

As articulated previously, data is encrypted at rest, within multiple redundant backed up databases which are firewalled from the Internet, guaranteeing data privacy. In addition, all data is scrubbed of PCI-sensitive data before being sent to the Warehouse, with PANs reduced to first 5 / last 4 digits; most tables use anonymised keys for accessing rather than personally identifiable information. A Data Policy document is available on request outlining Masabi's full policy, including a field-by-field breakdown; Masabi guarantees conformance with both US and European data protection laws.

There are three ways to access this data through the back office Hub – via regular reports, via interactive analytics and via API.

Sub-brand Delineation

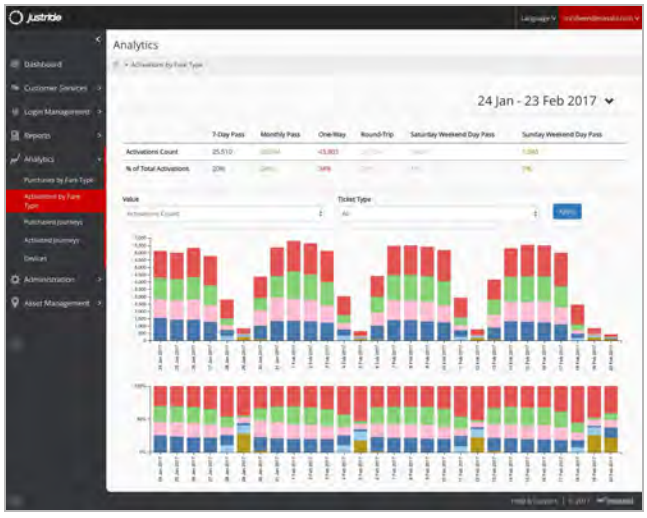
The architecture of JustRide provides the flexibility to delineate between sub-brands. This allows customers to be able to select any fare product available to them irrespective of which sub-brand is offering that product, while distinguishing between the associated sub-brand in the back office.

This sophisticated design enables the lifecycle of every fare product purchased to be inherently tied to the sub-brand specific agency. All reports, analytics views and data downloads, when requested from the sub-brand level, are isolated to display only those fare products belonging to that sub-brand. This keeps the financial aspects of each sub-brand isolated.

While providing that level of delineation, the sub-brand capacity has also been engineered to allow agencies to see their customers behavior across sub-brands as a tool to help capture trends of any potential customer misbehavior which might be obscured if visibility was limited. To ensure transparency, all staff activities pertaining to customer service are logged and available for all to see within that customer's history and through reporting.

Regular Reports

Customer users with privileges to view reports will be able to download a range of CSV and XLS format reports – all stored safely in the Hub for easy access at any time.



The system comes configured with a default set of daily, weekly and monthly reports for Financials, Journeys, Validation, Hardware State and Hub Usage. Custom reports can be made available on request.

Access to all reports are tracked in the secure audit trail, and all mandate secure HTTPS connections to download. System administrators can control who access which reports at will.

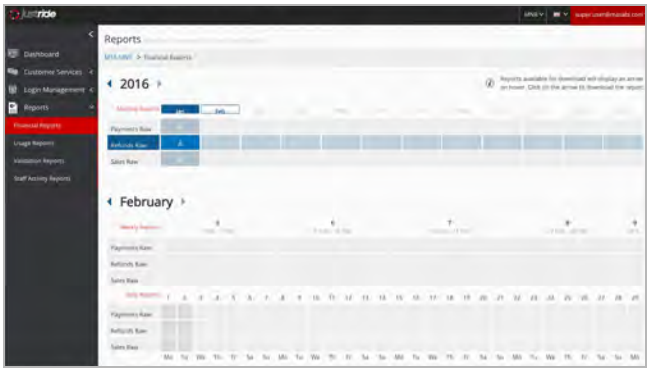
Interactive Analytics

Key numbers are presented on a live dashboard, giving an overview of activity updated in realtime. Headline figures are presented alongside historical ones on the front page, in order to easily identify trends in usage, best practices or issues.

The JustRide Hub also provides staff with clear and sleek ways to follow purchases and activation trends over time, with interactive charts on finances, route information etc that allow users to understand data trends in new ways.

Masabi interfaces are always thought through with user experience as the key priority – coupling

detailed and relevant information with a straightforward and intuitive interface. This is not only true for the JustRide customer app, but also for products used by all customer staff, such as the Hub data analytics tools.



Additionally, the JustRide platform has the capacity to associate individual fare types with the specific agencies to which they correspond so that funds can be appropriately cleared to the various NeoRide agencies.

In addition, the full set of raw Data Warehouse data is exposed through a set of RESTful APIs in both JSON and CSV format. This can be used by an Extract Transform Load system to import data into any existing Data Warehouse that NeoRide uses. All API access is over HTTPS again, and authenticated using credentials which NeoRide administrators can set up and maintain within the Hub.

The JustRide Data Warehouse, which is an immutable (unchanging) archive of event-based data, tracks all important events occurring anywhere in the system - for example ticket purchases, account logins, and ticket scans by Inspect.

Data is encrypted at rest, within multiply-redundant backed up databases which are firewalled from the Internet, guaranteeing data privacy. In addition, all data is scrubbed of PCI-sensitive data before being sent to the Warehouse, with PANs reduced to first 5 / last 4 digits; most tables use anonymised keys for accessing rather than personally identifiable information. A Data Policy document is available on request outlining Masabi's full policy, including a field-by-field breakdown; Masabi guarantees conformance with both US and European data protection laws.

The system comes configured with a default set of daily, weekly and monthly reports for ticket Sales, Activation and Validation.

Default reported Sales data:

- Purchase date/time stamp
- Ticket/pass type
- Payment method
- Payment card type
- Sales value
- Refund value
- Origin and destination information
- Unique identifiers

Default reported Staff Activity data:

- Refunds

Default reported Ticket Activation data:

- Ticket activation time
- Ticket activation time since purchase
- Ticket/pass type
- Origin and destination information
- Unique identifiers

Default reported Ticket Validation data:

- Ticket scan date/time stamp
- Ticket scan location stamp
- Scan types

- Complimentary tickets issued
- Ticket migrations between accounts
- Blocking and unblocking of customers
- Customer notes added
- Reports downloaded

Default ABT Credit Ledger data:

- Credit value made to or debits from stored value accounts
- Credit/debit date/time stamp
- Credit/debit reasons
- Unique identifiers

- Ticket/pass type
- Geolocation data
- Unique Identifiers

Default ABT Tap Activity data:

- Tap event date/time stamp
- Tap location
- Journey direction
- Provisioned product details
- Unique identifiers

Reports are generated using a sophisticated report template engine that can be used to create new and/or customized reports on a paid-for basis, in a variety of formats.

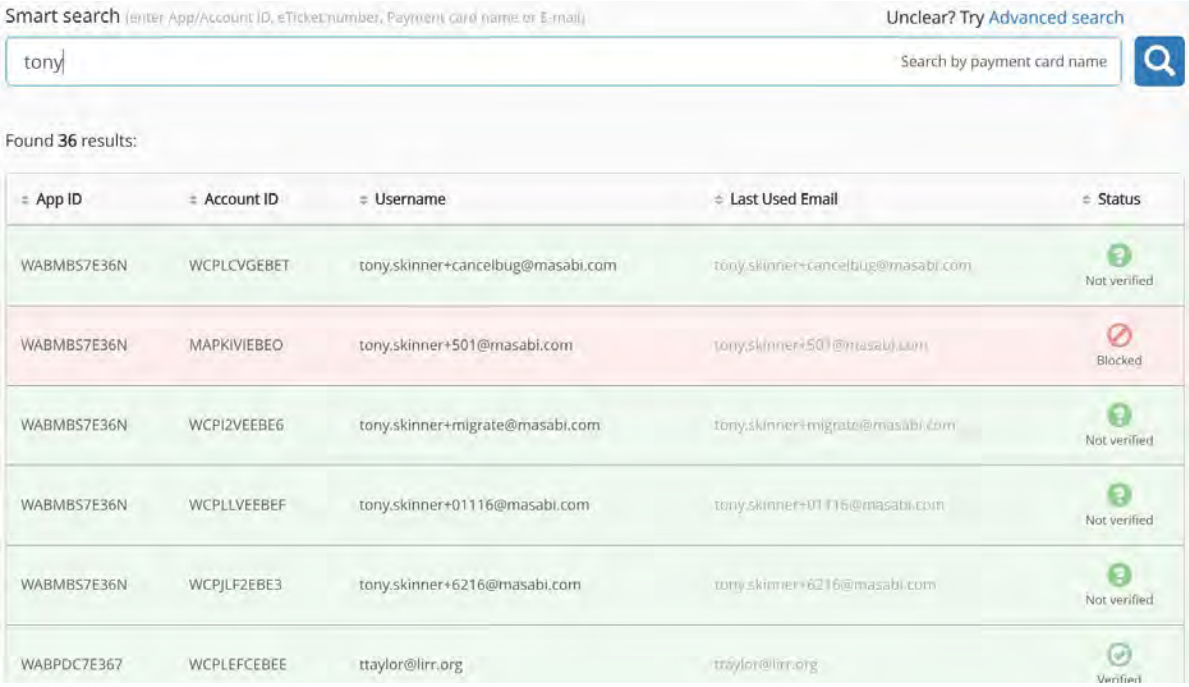
In addition, the full set of raw DataWarehouse data is exposed through a set of RESTful APIs in both JSON and CSV format. This can be used by an Extract Transform Load system to import data into any existing Data Warehouse that NEORide uses. All API access is over HTTPS again, and authenticated using credentials which NEORide administrators can set up and maintain within the Hub.

Support of Customers

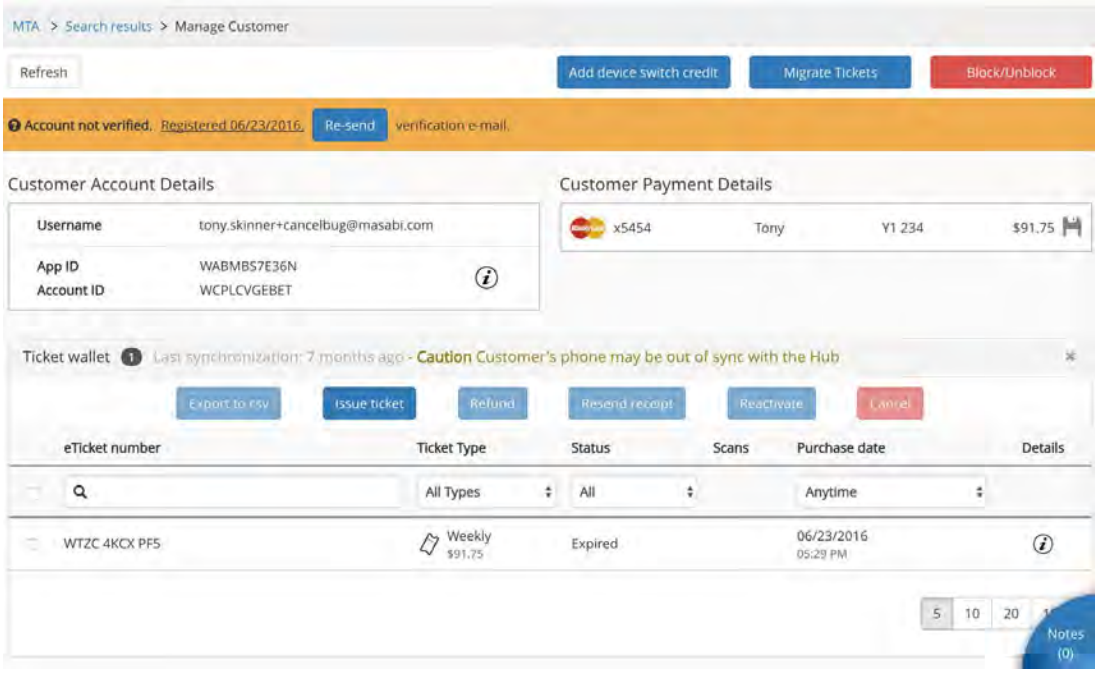
The Hub Customer Service module allows authorized staff to handle multiple actions to be performed in order to help customers. The interface specification for looking up a customer and performing an action is outlined below.

A typical process for managing a customer service request, using Masabi's tools, will begin with a rider contacting NEORide's first-line support. The Customer Service Agent will then be able to search for the rider using a variety of fields, including (but not limited to) Card Name, E-mail, Account ID, Ticket ID:

This will return a list of users with their current account status:



Once a rider has been uniquely identified within the Hub, the customer's summary page is shown listing their personal details, tickets, the payment cards they have used, and their history of interactions with NEORide staff:



A variety of actions may be performed on the customer and their tickets at this point, if the Customer Services Agent has sufficient privileges in the Hub: they can be blocked if they are suspected of fraud; their tickets can be refunded, canceled or reactivated; receipts can be resent;

customers can be issued a complimentary ticket; the Agent can review their transaction history and break down how many successful and failed purchases they have made on each card (useful when identifying card fraudsters using the app). Any action on the user is accompanied by a descriptive comment from the Agent, and at any point Agents can also attach free text notes to the customer's account which will be displayed to all Agents looking up this customer in future.

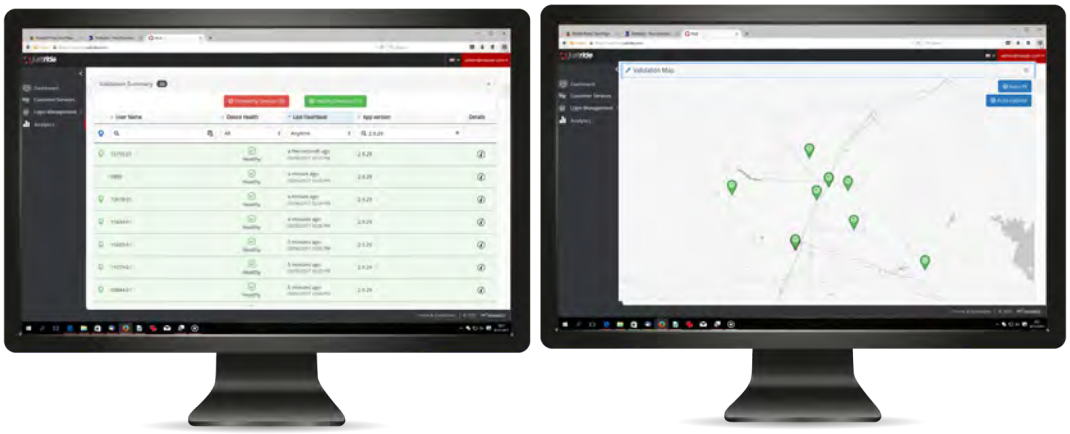
Personal identifiable information stored within the system is kept to a minimum for two reasons - to avoid unnecessary data entry for the customer, and to minimize data privacy concerns. Customer Service Agents will see an email address (required for receipts and as an account name), and a subset of payment information considered acceptable under PCI-DSS rules (PAN last 4 digits plus the card name) without compromising payment card security. All actions in the log are tracked in the Hub audit trail, so it is possible for managers to identify which customers were looked up by which Agents.

Issues may be escalated to more senior NEORide members, or to Masabi for action. All incidents raised to Masabi are managed through an incident management tool.

Easy to use and with customer relevant functionalities, the Hub gives staff the ability to handle customer requests quickly and conveniently. Masabi will collaborate closely with NEORide to make sure all staff members are fully trained in using these tools – along with developing a "Train-the-trainer" program, to make sure the knowledge level is consistent throughout time.

Asset Management

JustRide Embedded software running on the on board validation processor also collects telemetry data allowing the JustRide system to automatically alert and monitor the health and performance of barcode processing on any vehicle and across the network. An asset management web view visualising vehicle geolocation station layout and reader settings and statuses in near real time (below). Allowing staff in the control centre or on site to easily visualise status, locate issues and quickly make decisions that allow them to then manage passenger traffic or deploy staff to investigate issues.



Data collected and displayed by the asset management tool empowers staff to inspect the:

- Operational mode of the reader tracking maintenance jobs audit location and status of reader equipment.
- Reader unit performance intercepting failures early on via reader health check reporting. A red amber green status based on heartbeat and a mixture of selected parameters.
- Reader configuration including firmware versions, boot count, location and network settings stored on the validation processor drive.
- Deviation from average performance throughput providing more advanced insights into scanner usage patterns to identify dirty/broken units and/or network issues.
- Insights from scans - fraud, traffic flow, performance
- Alarm system automatically triggers messages when predetermined criteria are met. E.g. reader unit failing to report heart beats.
- Deliver software updates to selected units to enable controlled rollout of changes

Platform Architecture, Security and Privacy

The JustRide platform is hosted by Masabi within the Amazon EC2 Virtual Private Cloud service (part of Amazon Web Services - http://aws.amazon.com/vpc/), so it does not need to be deployed to an authority hosted location. This gives it the following advantages:

- Masabi SLA to 99.9% uptime
- PCI DSS level 3.2 Certified
    - Masabi provides attestation of PCI Merchant compliance, and conducts regular QSA-approved scans and audits.
- Multiple redundant app servers
    - Handles failure transparently across three physically separate data centers with the full software and hardware stack duplicated in each centers.
- Multiple redundant databases
    - Provides secure geographically independent encrypted backups.
- Independent firewalled zones
- Segregation of payment processing
    - Minimizes the PCI interface, allowing all PCI sensitive data to be sent and stored within a fully separate server instance.

As part of ongoing performance monitoring, Masabi upgrades the JustRide cloud servers as required to maintain optimal performance for riders, and pro-actively upgrades system topography based on the latest PCI guidelines. Software is kept up-to-date to avoid security vulnerabilities.

Security

Payment Security

The JustRide platform is fully PCI DSS level 3.2 compliant, formally audited

on an annual basis and assessed by Masabi's QSA on a monthly basis.

All releases into the live environment are accompanied by formally tracked code reviews, static analysis and a full suite of vulnerability scans. All Masabi staff are trained frequently in PCI requirements, encompassing the full OWASP top 10 vulnerabilities and other appropriate sources of vulnerability information.

Data Security

Masabi maintains a Data Inventory documentation (available on request) tracking at a field level what data is stored in what parts of the system. Conformance to all US and European data privacy laws has been built in from the start, and effort is made to store data in an anonymised format wherever operationally viable.

All databases are encrypted at rest within Masabi's firewalled Virtual Private Cloud in Amazon AWS, with live redundant copies across multiple locations and multiple daily offsite backups.

PCI-DSS rules are strictly adhered to - the Card Data Environment is kept as small as possible, with plaintext card numbers visible only to one service directly handling payments. Card payment details themselves are never stored within Masabi servers, with only tokens stored locally; tokenization occurs with our 3rd party provider TokenEx, also PCI-DSS certified. All data sent outside of the CDE is scrubbed to ensure full PANs are not included - first 5 / last 4 digits are sent to the Data Warehouse, and only last 4 are shown to Customer Services Agents.

All connections to JustRide servers - via API or through the Hub UI - are HTTPS conforming to the latest TLS 1.2 protocols, ensuring secure transit of all personal data, and authentication is managed using secure JSON Web Tokens.

D. References

Reference 1: MBTA

- **Contract Period:** From: July 2012 To: 2015 (Pilot); From: 2015 Present/Still in use (Full contract)
- **Geographic Area Serviced:** Greater Boston Area (and suburbs)
- **Scope of Work:** Visual Validation Mobile Ticketing for the MBTA Commuter Rail and Ferry
- **Name:** Maryellen Moran
- **Title:** Contracts Administrator
- **Address:** 10 Park Plaza, Boston, MA
- **Telephone:** 617-222-5000
- **Email:** mmoran@mbta.com

Masabi launched the first mobile ticketing deployment in the United States in November of 2012 with the Massachusetts Bay Transit Authority (MBTA). Today, over 70% of MBTA commuter rail tickets are now bought via the MBTA JustRide mobile ticketing platform.

Reference 2: MTA LIRR/MNR

- **Contract Period:** From: Jan 2014 To: Present/Still in Use
- **Geographic Area Serviced:** Greater New York City including Long Island and Connecticut
- **Scope of Work:** Mobile Ticketing for Metro North and Long Island Railroad Commuter Rail service
- **Name:** Zulma Rosario
- **Title:** Assistant Director
- **Address:** Grand Central New York NY, Jamaica Queens, NY
- **Telephone:** 212-340-3023
- **Email:** Zrosario@mnr.org

Masabi deployed the JustRide platform for largest system transportation system in the US, New York's MTA in the summer of 2016, delivering mobile ticketing for the Metro North and Long Island Railroads. Recently, the railroads sold more than 1 million tickets through the application in a single month.

Reference 3: Nevada RTC / Las Vegas

- **Contract Period:** From: Nov. 2015 To: Still in use
- **Geographic Area Serviced:** Great Las Vegas
- **Scope of Work:** Bus service - Mobile ticketing started with visual validation moving to on board electronic validation with pole mounted readers.
- **Name:** Scott Mazick

- **Title:** Director of IT
- **Address:** 600 S. Grand Central Parkway Suite 350, Las Vegas, NV, 89106
- **Telephone:** 702-676-1573
- **Email:** Mazicks@rtcsnv.com

In 2016, RTC Las Vegas, launched visual validation initially and has expanded to deploy over 600 on-board bus validators across the system. The RTC application provides reduced fare products and also resort fare promotions. Masabi assisted with all aspects of the hardware extension including vendor reviews, site inspections and pilot trials.

Reference 4: Nassau Inter-County Express

- **Contract Period:** From: 2013 To: Still in use
- **Geographic Area Serviced:** Nassau County,New York
- **Scope of Work:** Mobile ticketing solution for bus
- **Name:** Jack Khzouz
- **Title:** Chief Administrative Officer at Transdev Services
- **Telephone:** 516-296-4152

Masabi deployed with Nassau Inter-County Express in 2013. NICE was actively looking for a way to reduce dwell times and sought to provide passengers with a way to purchase tickets before boarding. The agency only had a small number of TVMs throughout their system, so many passengers were paying with coins upon boarding the bus. The solution to this problem was mobile ticketing, which channel shifted those infrequent passengers that previously paid with coins (or didn't board for lack of change) now had another way to buy tickets and ride the service.

Reference 5: Fire Island Ferries

- **Contract Period:** From: 2017 To: Still in use
- **Geographic Area Serviced:** Ferry and Water taxies services on Fire Island, NY
- **Scope of Work:** Mobile ticketing solution for water taxi service in NY
- **Name:** Anthony Bonventre
- **Title:** Head of Technical Development
- **Telephone:** 631-665-3600
- Email: anthony@fireislandferries.com

Fire Island Ferries is a ferry operator that operates just outside of New York City. They sought to deploy a solution for their passengers to buy tickets on their phones in an effort to reduce the burden of their reconciliation processes and to increase passenger convenience. However, they needed to deploy by the beginning of their season. To meet these needs they turned to the JustRide platform, which Masabi deployed in just 23 days from contract signature to app go-live.