2015

Ütopia

A technical solution to unifying the Boston Taxi mobile applications

The creation of Ütopia brings a universal approach to mobile taxi booking in the city of Boston. This single taxi app will merge the 7 current mobile booking apps into one system. Our solution will give the both the city of Boston and taxi dispatch companies the ability to provide fast, reliable service to passengers throughout the Greater Boston area.

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EXECUTIVE SUMMARY

The Client

The city of Boston Hackney Carriage Unit - part of the Boston police department - is responsible for regulating all taxi operations in Boston including the issuing of permits (often referred to as "medallions"). These medallions are issued to individuals who wish to run a licensed taxicab via radio dispatch; by city regulation, all medallion owners must be affiliated with a dispatch operator. Taxi dispatch in the city of Boston is administered by six independent companies: Metro Cab, Boston Cab, City Cab / Top Cab, ITOA, 617-TAXI CAB and Tunnel Taxi. The city of Boston is representing these dispatch operators as well as the drivers to whom a medallion has been issued.

The Problem

A **transportation network company** (**TNC**) is a company that uses an online-enabled platform to connect passengers with drivers using their personal, non-commercial vehicles. TNCs have become an extremely disruptive force in the taxi industry. With little to no regulation, a flexible workforce and all the inherent power of a social networking platform, companies such as Uber have had a noticeably negative impact on traditional taxi business revenue. Under current regulation Boston Medallion taxi are required to join one of the six taxi dispatching associations that distribute the volume of taxi requests within the boundaries of city. The internal competition among taxi dispatching associations in Boston has been fierce: each continually markets itself as the premier taxi service in the city. Due to the focus on this competition the dispatching associations failed to recognize the threat presented by the TNCs. The "old" monolithic taxi operating model in Boston, which has been in place since 1950, cannot compete against the "new" crowdsourcing model that Uber provides. A healthy taxi industry means a more vibrant city and greater opportunities for economic growth.

Recognizing the threat, a few dispatching associations have launched their own independently operated mobile application for smartphones and tablets in an attempt to challenge Uber; these attempts have failed to impress riders or improve response times for traditional taxi vs. a ride sharing alternative. Internal division and external competition has allowed encroaching TNC companies to seriously harm traditional taxi ridership, as well as push Medallion owners – many of whom paid significantly for their licensure – into the waiting arms of Uber. This means significant loss of revenue for the city of Boston which collects taxes for taxi ridership in addition to fees associated with purchasing a medallion.

Proposed Solution

In an effort to keep up with the new technology trends and more importantly to provide the taxi industry the business capabilities to compete with TNC companies, we propose to the city of Boston a universal taxi mobile dispatch application. With TNC companies raising the standards on ride share mobile booking applications, we have benchmarked certain features of its application interface and adapted it to meet riders' needs. Our proposal will bring the six competing booking systems that independently operate in the city of Boston under one enterprise resulting in a universal taxi app.

BUSINESS CASE

A passenger arranging a ride with a TNC company uses their smartphone mobile application to partner with a TNC driver who provides a prearranged ride for hire. A passenger has an existing account on file and at the conclusion of each ride a fee is processed to the passenger's credit card through the mobile application. TNC companies do not own the vehicles or have an employee/employer relationship; as such TNC Companies (and their driver partners) are not beholden to existing state and municipal laws that govern ride for hire services. TNC Companies have become extremely popular for the following reasons:

- Convenience of the mobile app
- Extremely low wait times
- Accessibility and reliability – one app works the same regardless of metro area
- Competitive rates
- Hospitality and a high level of service

There are several TNC companies currently operating in the United States. They vary in price, style of vehicle, and the amenities offered. The most prolific of these companies by far is Uber, which offers a variety of ride options that include uberX (smaller vehicles with lower-cost rides), uberBLACK (high-end sedans), uberSUV (with seating for up to six), and uberLUX (Uber's most expensive rides in luxury cars). Uber is currently available in more than 45 countries and more than 100 cities and or regions within North America alone. Other commonly known TNC Companies include Lyft, and Sidecar which differentiates itself by allowing drivers to set their own prices.

Criticisms of TNC Companies include the argument that they unfairly compete with traditional taxicab services and are stealing taxi customers while the countless municipal regulations that apply to taxis - making it impossible for them to provide similar service. As a result, local governments struggle to balance technological innovation and a disruptive business model while at the same time protecting the revenue the traditional taxi service provides to the city.

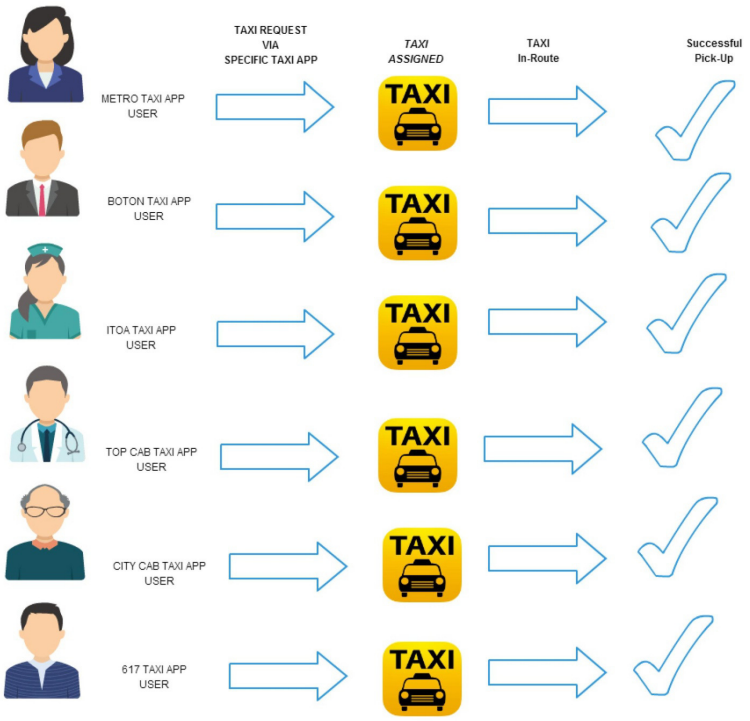
Business Requirements

KEY BUSINESS OBJECTIVES

The Ütopia Enterprise solution has the following objectives:

- Increase taxi ridership by streamlining the booking process
- Decrease the average response time for taxi pickups requested from a mobile app
- Increase incentives for medallion owners to deliver high customer service
- Reduce the number of taxi cabs sitting idle

AS-IS



There are 1,825 taxis licensed in the city of Boston. The method of licensing is called a medallion. The city of Boston requires that medallion owners affiliate with one of the seven radio associations; some of the radio associations currently have their own exclusive and individually operated mobile booking applications. To book a taxi using your smartphone you must have your preferred radio association's mobile app downloaded to your smartphone. As a rider, this makes for a highly disjointed and inconsistent booking experience.

FIGURE 1 - AS IS

TO-BE

Ütopia brings a universal approach to mobile taxi booking in the city of Boston by providing a single taxi app that will merge the 7 current mobile booking applications into one system that will match the closest taxi to the request. Ütopia will give riders access to Boston's 1,825 taxi medallions under one mobile app, greatly streamlining the booking process and promoting a better riding experience.

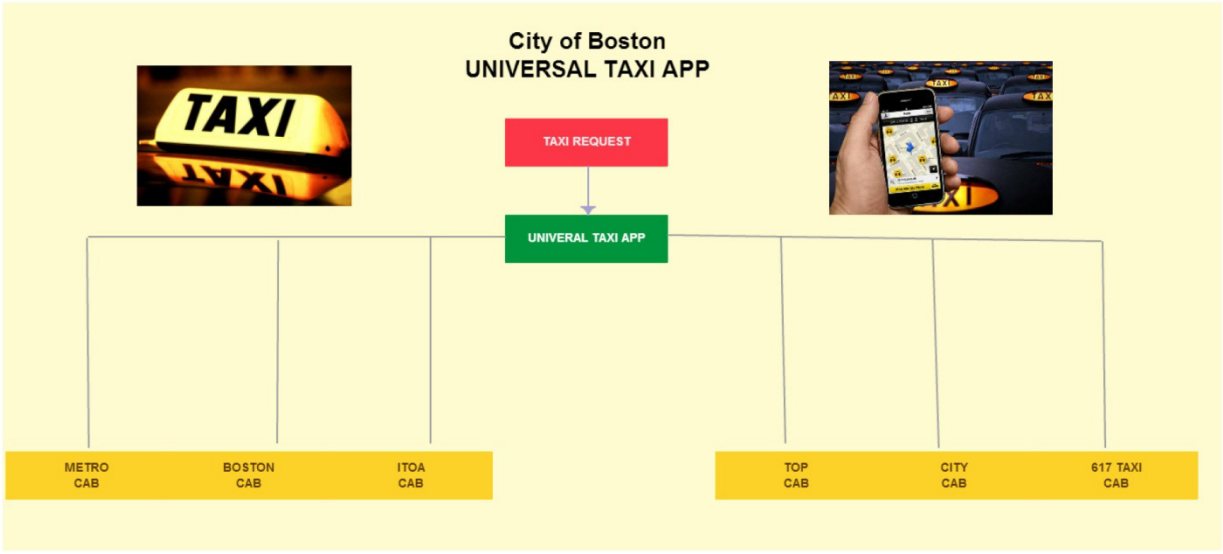


FIGURE 2 - TO BE

Required Functionality

In order to be competitive with other TNC's Ütopia must allow for the following:

For Riders:

- A mobile application component and a web frontend component are required - riders may choose between an IOS, an Android mobile app or an HTTPS web-based interface
- The software must allow users to register for an account from either the mobile app or web frontend; account registration will capture at a minimum the user's full name, user's email address, and an application password
- The software must be able to assist a user in recovering account information or resetting a forgotten password
- The software must be able to track the location of mobile application users via GPS so users can hail the nearest geographic cab based on GPS distance
- The software must provide a method for users to specify a pickup location manually by supplying an address
- By law, users must be able to request a taxi by type (handicap, van, voucher and wagon).
- The software must provide an estimated fare and travel time, taking into account traffic, tolls, and fees
- The software must provide the ability for users to schedule a pickup in advance, as well as re-schedule or cancel a previously scheduled pickup

- The software must provide the ability for users to access a list of the drivers they have used in the past and request a specific driver they have previously used
- The software must provide a facility for users to provide feedback for a completed fare via the mobile application or web based interface

For Dispatch:

- The software will provide an administrative interface via a web frontend that allows dispatch operators to modify system parameters and add/remove/change cabbie accounts
- The software will allow for multi-tenancy access control, i.e., each dispatch operator should be allowed access to their own system parameters and users but have no visibility or access to the administrative frontend of other dispatchers
- The software must track the location of participating cabs using GPS information captured from a mobile device and maintain this data in a central location
- The software needs to maintain a bi-directional interface into the scheduling systems of participating dispatch operators, with sufficient permission to create, modify, delete, and view scheduled dispatches
- Existing dispatch software must be made to work with the Ütopia platform, i.e. no changes to the dispatch operator systems will be made
- The software must allow dispatches to review captured analytical data and generate reports and heat maps based on analytics data via their administrative frontend

For Drivers:

- The software must integrate with an external GIS provider API (Google, Bing, or similar) to provide address geocoding, reverse geocoding, and mapping functionality
- The software must capture relevant analytical data including time spent idle / time spent driving / time spent in traffic, number of pickups during a shift, and locations of pickups and drop-offs

Competition with TNC's is a multi-faceted challenge. As the proposed solution is technology-focused and intended for a highly regulated environment, the following traditional taxi functions will remain as they are today:

- Taxi stands and hailing a cab will still be available to consumers
- Payments will be handled using existing process: either cash or CMT credit card system (future integration is a possibility but will not be addressed at this time)

Justification and Benefits

The following metrics will be used to justify the costs associated with adopting the proposed solution:

- Increased information regarding taxi behavior, heat maps, and analytical data
- Decreased wait time for taxi drivers
- Increased transactions for dispatch companies

The Ütopia platform will provide a piece of what must become a citywide solution to the competition represented by Uber and other TNCs. The benefits to the city will include increased revenue, a more effective taxi system, and the availability of a safe and thriving transportation network. A healthy taxi industry is a critical piece of metropolitan infrastructure; without it, revenue-generating opportunities – such as Boston's bid to host the 2024 Summer Olympics – are far less likely.

Success Metrics

Average Passenger Wait time using our app to be less than 5 minutes

Wait time for Uber and other TNCs is closely guarded and not available to the public. The Nelson Nygaard report notes that the Average Passenger wait time a taxi stands in Boston is less than a minutes and that Haileo (an on line dispatch system used by some drivers) had response times between 2 and 5 minutes. A UC Berkley Working paper suggests up to 90 percent of TNC customers were picked up in under 10 minutes, and most waited less than 5 minutes. (Rayle et al. 2014) Our targets must be similar in order to meet the new expectations of riders.

Percentage of Dispatch Requests Served above 95%

The Nelson Nygaard report states that during the time of the study a 78% response rate to dispatch requests was noted. This low standard of service allows TNCs to gain market share with very little effort. One of the first steps to reclaiming customers is have a high response rate; Ütopia will remove technical barriers to notification and enable dispatch companies and drivers to respond to ride requests with greater speed.

Taxi Utilization above 40%

According to the Nelson Nygaard report taxi utilization on 3 days measured in 2013 averaged 32%. Ütopia will allow taxicabs to focus on the times of day and areas where demand is greatest, driving the percentage of utilization up.

Average total ridership to increased 5% per year for the next 5 years

As a natural consequence of improved customer experience, appropriate user education and a layered implementation approach we aim for increased ridership in the Boston taxi system. Boston taxicabs fulfil approximately 40,000 rides each day. TNCs keep their ridership information classified as proprietary and therefore exact numbers are unavailable at this time – however, an annual increase of five percent is an achievable short term goal.

ARCHITECTURAL APPROACH

Overview

The Ütopia product functions as a service aggregation and federation gateway which brokers access to multiple dispatch provider systems from a single pane of glass. The platform is designed to augment existing dispatch scheduling systems, not replace them; present systems will function as they do today except that an additional booking channel to increase ridership, Ütopia, will be available.

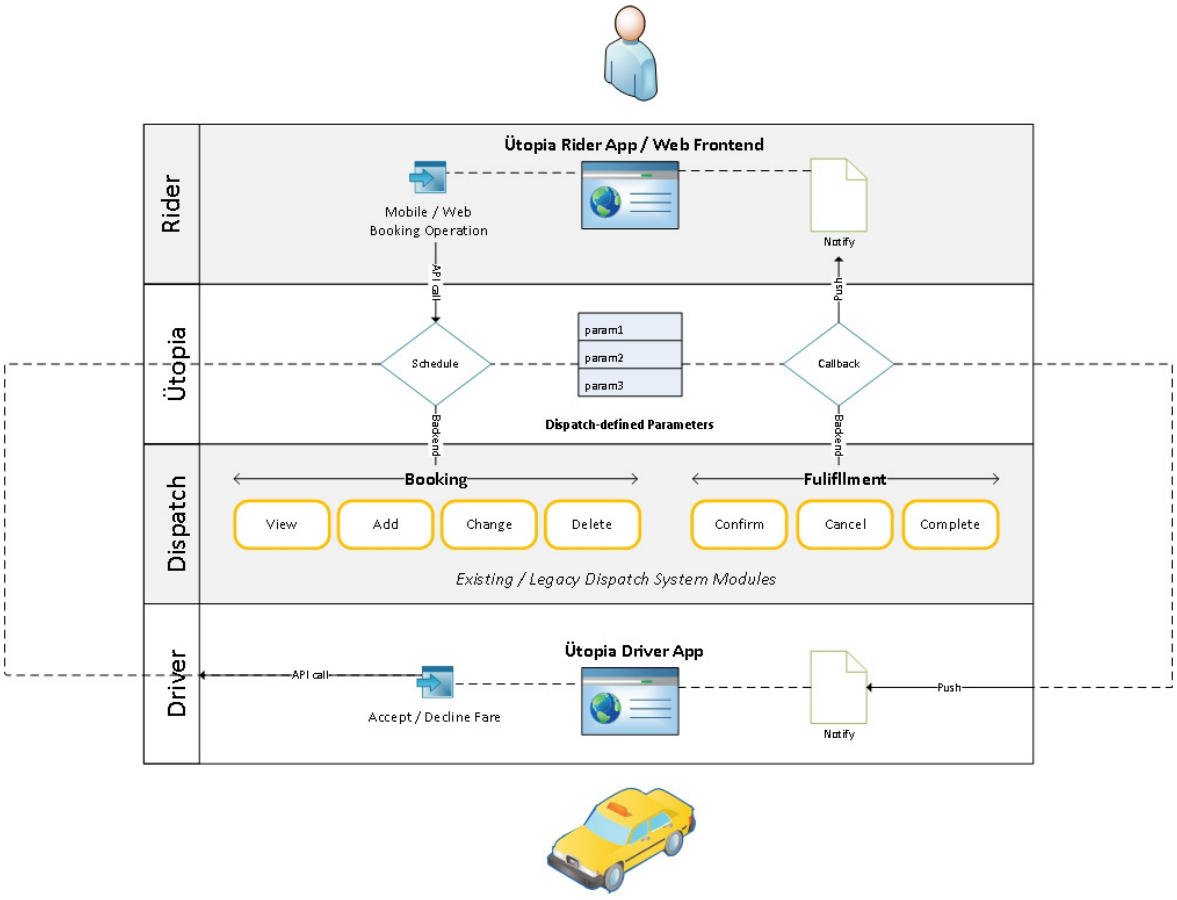


FIGURE 3 - ÜTOPIA BUSINESS CONTEXT PROCESS FLOW

Software Solutions

Ütopia integrates several third-party web service APIs and SaaS services to deliver its core functionality; the platform itself lives in the Amazon cloud and is offered as a SaaS solution. The basic components of the platform are described below:

1. **Application Frontend: Amazon EC2 Instance (CentOS 7)**
   Amazon EC2 will power the frontend components; Apache HTTP Server on CentOS 7 will be used as the web services platform. Linux OS was selected for the obvious cost difference between the Windows operating system as well as its open development standards. CentOS was chosen over Amazon Linux to reduce lock-in and give the platform greater agility should future infrastructure needs change. Standardizing on CentOS grants flexibility to move on premises, to another cloud such as Microsoft Azure, or to enable hybrid-cloud infrastructure at a future date.
2. **Backend Database: Amazon RDS (PostgreSQL)**
   Amazon RDS provides the backend database services; PostgreSQL will be used as the database engine. PostgreSQL was selected as an inexpensive open-source alternative to Oracle that is highly standards compliant yet fully supports Atomicity, Consistency, Isolation and Durability (ACID); in addition, as it rigorously adheres to ANSI/ISO SQL standards, future portability to another database engine is made less cumbersome.
3. **GIS Service: Google Maps**
   An API subscription to Google Maps provides access to real-time feeds on traffic conditions and gives Ütopia mapping and geocoding functionality. Google Maps was chosen over other GIS feeds like Bing Maps for its maturity and extremely well-documented API.
4. **Booking Interface Engine: Cabforce API**
   The Cabforce API provides integration services with legacy dispatch systems and exposes a single web service API to Ütopia. Cabforce was selected over an in-house software development effort to significantly decrease time to market and reduce the overall complexity of the solution architecture by leveraging the expertise of an experienced partner.
5. **Reporting Platform: iDashboard Cloud**
   The iDashboard Cloud reporting solution provides inexpensive yet rich reporting functionality which is fully customizable and easily connected to the RDS PostgreSQL instance. iDashboard was selected over competing report portals for its aggressive price structure (almost half the cost of Cognos) and ease of integration with multiple data sources.

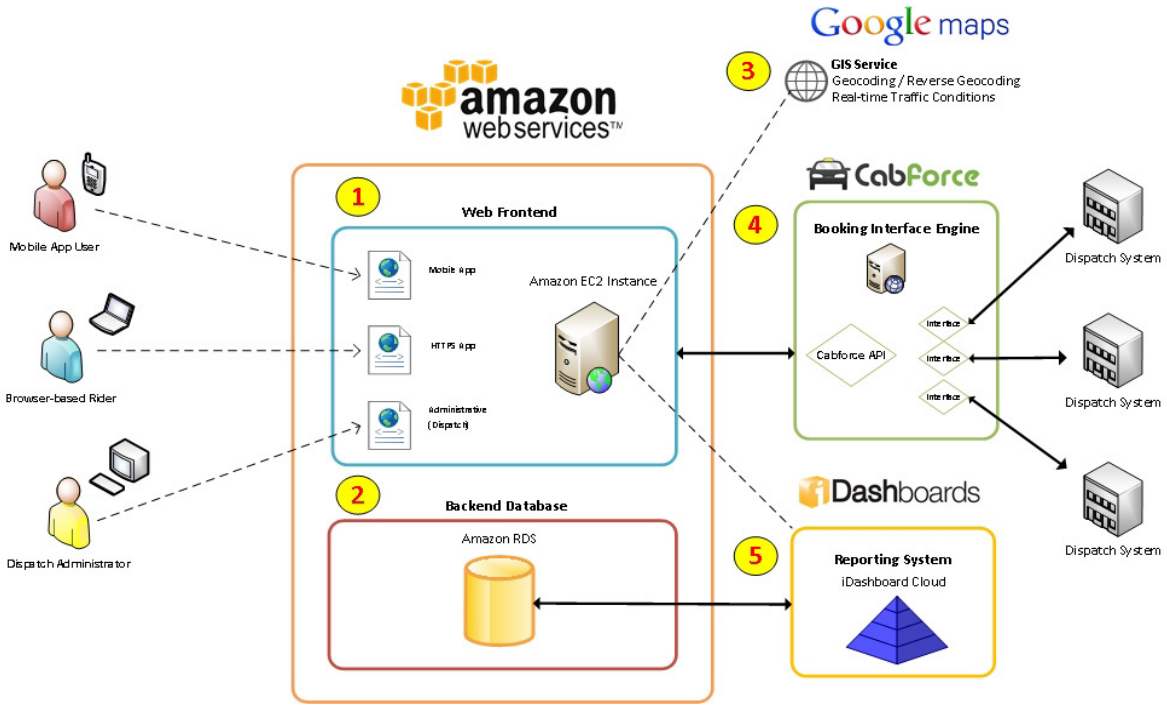


FIGURE 4 - ÜTOPIA ARCHITECTURE

System Metrics

Ütopia's infrastructure will be sized to accommodate data and transactional volumes as follows:

TABLE 1- SYSTEM METRICS

Metric	Value	Justification
Number of Rider Accounts	300,000	*Current number of individual dispatch app users today + 15%*
Number of Driver Accounts	3,000	*Boston Taxi Driver Census*
Number of Medallions	1,825	*Fixed number*
Transactional Volume (Rides/Day)	13,200	*33% of total 40,000 rides, assuming 1/3 flow through Ütopia when it is deployed*
Initial Data Volume Size (GB)	3.24GB	*303,020 initial rider / driver / admin account (4KB ea.), 1,825 Medallion records (2KB ea.), approx. 80MB of system tables and 2GB of record whitespace for trip data*
Daily Data Growth Rate (MB)	206.25MB	*13,200 trips at 16KB / trip*
Total Storage for First 3 Years (GB)	223.79GB	*3.24GB + (207.25 x 365 x 3)MB*

- **Number of Rider Accounts: <u>300,000</u>**
  There are approximately 255,000 existing users across the 7 dispatcher mobile applications today and our system must be sized to accommodate these users. To account for increased

ridership - the goal of the project - the system will be sized to accommodate a 15% increase in its user base. This is an aggressive number but appropriate due to sensitivity around application responsiveness and its role in driving user adoption.

- **Number of Driver Accounts: 3,000**
  There are approximately 3,000 cab drivers today, give or take a hundred. This is not expected to increase significantly, so system sizing will account for approximately 3,000 driver accounts.
- **Number of Medallions: 1,825**
  There are a fixed number of medallions issued by the city of Boston.
- **Transactional Volume (Rides per Day): 13,200**
  Based on the Nelson Nygaard report Boston taxicabs reported an average of 40,000 rides per day in 2012; though this number has decreased significantly in succeeding years, the system will be sized to accommodate this average under the assumption that Ütopia will account for 1/3rd of total ridership after it is deployed.
- **Initial Data Volume Size (GB): 3.24GB**
  This value is derived by calculating 303,020 initial rider, driver, admin accounts with an expected record size of 4KB each, 1,825 medallion records with an expected size of 2KB each, 80MB of system tables and 2GB of record whitespace for trip data.
- **Daily Data Growth Rate (MB): 206.25MB**
  This value is derived by multiplying the expected number of rides per day (13,200 trips) with the average expected record size for each ride (16KB)
- **Total Storage for First 3 Years (GB): 223.79GB**
  Based on the above metrics, the total storage required for the first three years of Ütopia's operation is approximately 224GB.

Integration with Existing Systems

After evaluating several methods to integrate booking with legacy systems, the Cabforce Booking Engine API was selected as the interface engine. Available at https://developer.cabforce.com Cabforce is offered as a SaaS taxi booking engine with configurable flow, address, and partner parameters; using deep links Cabforce is able to work transparently with an existing mobile application. Cabforce will aggregate backend connections to individual dispatch operator systems, and Ütopia will retrieve this data from Cabforce's exposed API - likewise Ütopia will utilize the Cabforce callback mechanism to send messages into an existing dispatch system. This outsources the burden of establishing and translating the disparate dispatch systems to Cabforce - Ütopia will only need to interface with the well-documented Cabforce API for booking functions. Integration will be limited to booking information as described in Figure 5.

Booking parameters

Parameter	Purpose	Example
date	Pickup date. yyyy-mm-dd	2013-04-15
time	Pickup time or flight landing time. hh:mm	16:30
flight	Flight number	AY1234
email	Email of the passenger	john.passenger@example.com
name	Name of the passenger	John Passenger
phone	Phone number of the passenger	358401234567
company	Company of the passenger	Company Ltd
country	Country of residence of the passenger. ISO 3166-1 alpha-2 or alpha-3 code. (FI or FIN).	GB
notes	Additional information for the taxi company. Free text.	Lots of luggage
reference	Internal reference. Free text.	Travel conference 2013
plus	Airline bonus card number	123456789
promo	Promotional code	abcdef

FIGURE 5 - CABFORCE BOOKING PARAMETERS

Dispatch operators within the city of Boston each have an existing mobile application offering, the majority of which are SaaS solutions. An architectural challenge will be how to handle identity management between the Ütopia platform and the existing dispatch backend. During the migration phase, extracts of existing user information will be taken from each legacy system and loaded into Ütopia by an ETL (Extract, Transform, and Load) process; Ütopia user IDs will be established and linked to an existing record in each legacy system. Data available from three existing mobile applications suggests this process will be straightforward; the following data elements are present in the three currently available mobile apps (note: only three dispatches in Boston currently offer a mobile app)

Metro Cab

No login / password in app

Field	Data Type	Example
Name	Varchar	Tyler Durden
PhoneNumber	Varchar	555-555-0178

Boston Cab

Thirdparty turn-key app

Field	Data Type	Example
EmailAddress	varchar	tdurden@paperstreet.com
Password	varchar	1Bca2MVK
Name	varchar	Tyler Durden
PhoneNumber	varchar	555-555-0178

ITOA *Thirdparty turn-key app*		
Field	**Data Type**	**Example**
EmailAddress	Varchar	tdurden@paperstreet.com
Password	Varchar	1Bca2MVK
Name	Varchar	Tyler Durden
PhoneNumber	Varchar	555-555-0178

TABLE 2 - ETL DATA ELEMENTS

Owing to the relative simplicity of the data elements involved, the ETL process can be handled in-house by the Ütopia development team. Mappings will be maintained by Ütopia and the native user ID will be passed to the legacy system via the “edata” callback parameter available in the Cabforce API, establishing a link to the customer identity between Ütopia and the legacy dispatch system.

Partner parameters

Parameter	Purpose	Example
eid	"External System ID". If the booking is originating from another external system, this field can be used to store an identifier of the corresponding booking or trip in the external system. This is not visible in any passenger messages or user interfaces. The value of eid is sent back to the external system in any messages or callbacks.	126fe28ae5qabb5
edata	"External System Data". If the booking is originating from another external system, this field can be used to store any data in the external system. This is not visible in any passenger messages or user interfaces. The value of edata is sent back to the external system in any messages or callbacks. edata must be base64 encoded	dGhpcyBpcyB0ZXN0IGV4dGVybmFs

Pickup from London Heathrow Airport (LHR), no destination defined:

```
https://www.cabforce.com/booking/new/?fai=LHR&date=2013-09-23&time=16:45&flight=AY123
```

FIGURE 6 - CABFORCE PARTNER PARAMETERS

Data Design and Management

The PostgreSQL database will need to contain the following data elements:

- End-user (riders) account information, including name, email address, telephone number, and password
- Taxi (driver) account information, including name, email address, telephone number, MA driver’s license number, password, and associated medallion record

- Medallion (vehicle) information, including the medallion number, VIN number, type of vehicle, vehicle's start of service date, and associated dispatch record
- Dispatch information, including the name, address, and telephone number of the dispatch
- Historical data for reporting: past fares including dates, times, locations of pickup and drop off
- Table space to store GPS data that is checked in from various drivers so that the rider app can display GPS location of nearby taxies
- Parameters table that the system can use to adjust process for specific dispatch agencies

Figure 7 shows how the Ütopia front end will work with the Cabforce booking engine and the existing dispatch system. Feedback from the backend will be filtered through Ütopia to present a unified interface to the user.

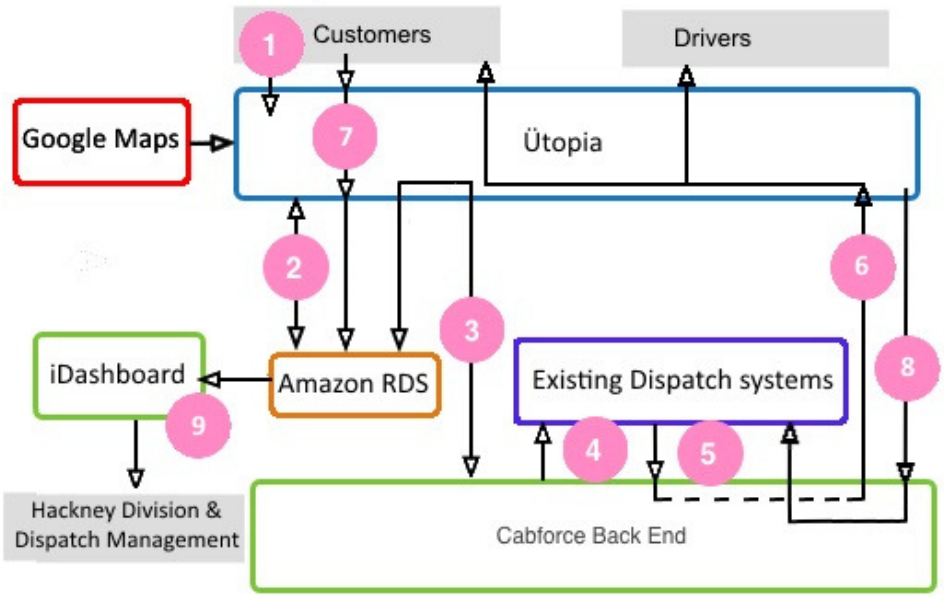


FIGURE 7 - INTEGRATION

1. A rider visits the Ütopia website or launches the Ütopia mobile app to request a taxi; Ütopia is linked to Google Maps to perform geocoding/reverse geocoding of the rider's GPS location and desired destination address and provide real-time traffic information about the proposed route.
2. Ütopia accesses the Amazon EC2 RDS backend to retrieve the GPS location of participating taxis closest to the pickup location; it also retrieves specific user parameters such as a "favorite" driver.

3. When the rider confirms their booking, Ütopia stores the information in the Amazon RDS instance and contacts the Cabforce backend API to forward the booking request to a specific dispatch operator for fulfillment.
4. The Cabforce backend packages the booking request in a dispatch-specific format and forwards it to the existing dispatch system over an established interface.
5. The existing booking system processes the booking request using its native process; a callback is sent from the dispatch system to Cabforce with the status of the fare (accepted, rejected, canceled).
6. Cabforce digests the callback from the legacy system and forwards it to Ütopia – the rider is notified of the status of their ride, and the driver is notified of a new fare via the Ütopia mobile app.
7. When fulfilment is complete, the rider is given the opportunity to provide feedback; Ütopia updates the RDS backend with the updated fare information including feedback, distance, and time.
8. Ütopia sends notification to the legacy dispatch system via Cabforce of the fare disposition (closed or canceled) and closes the fare.
9. The iDashboard platform interfaces with the Amazon RDS backend for report generation.

Data Reporting

iDashboards Cloud is a hosted dashboard solution that will allow us to create custom analytic dashboards for each dispatch company or for the entire city of Boston; this will allow the city and the dispatch companies to more efficiently predict ridership and demand. Owing to its cloud based framework, access is URL based and comes with support for iPhone, iPad and Android tablets allowing dispatch management to view relevant data from anywhere.

Our team considered IBM Cognos, Chartio and iDashboards as platforms for reporting. iDashboards was selected for their aggressive pricing ($360/user per year vs. $637/user per year for IBM Cognos) and mature support and integration model versus Chartio. iDashboards is the preferred solution for our purposes due to the ability to easily customize dashboards at the account level which will allow the different dispatch companies to view their own customized data in a way that aligns with their business goals.

Software Demonstration

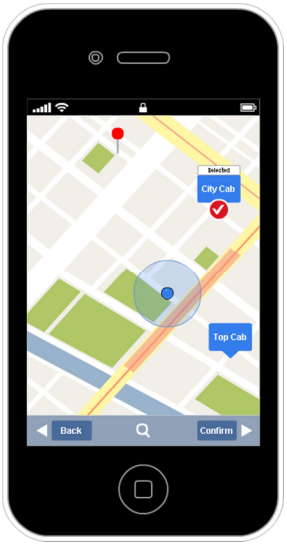


FIGURE 9 - TAXI SELECTION DEMO

A key component for success will be the ease of use of the website and mobile applications. An intuitive application for both drivers and customers that simplifies the booking process is essential. The application must be easy to use, and deliver the information that the rider or driver needs at the appropriate time.

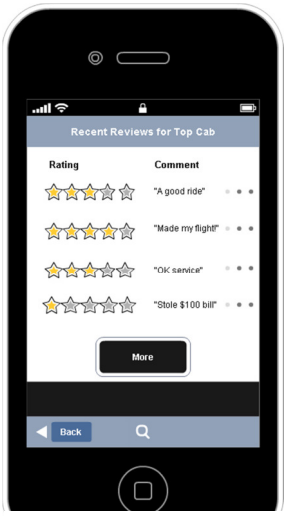


FIGURE 8 - FEEDBACK VIEW MOBILE APP MOCKUP

After signing in to the app a rider will be able to hail a cab using their current location if they are on a mobile app and have allow GPS position sharing. They can also manually enter an address or schedule a future pickup. The view which a rider uses to select a cab will show information such as the location of current cabs and their affiliated dispatch company. From this view a rider will be able to choose a taxi and request a pickup. This triggers the booking process which allows the driver to accept the fare and complete the ride.

IMPLEMENTATION PLAN

Solution Development

APPROACH

Ütopia's implementation will utilize cloud-based infrastructure and SaaS services wherever possible, making collaboration between teams critical to the success of the project. An internal pilot program will be used for final development ensuring the most useable product makes it to market. This program will only include a small group riders recruited from a pool of active users of existing booking apps along with a carefully selected group of drovers. Mass deployment will occur in phases thereafter, targeting specific dispatch offices one at a time. Deployment includes training, technical integration services and post-deployment support. After the phased deployment effort, existing mobile apps will be gradually pulled back and retired while redirecting riders to download the new Ütopia app. Once all dispatch operators have been moved to the system and existing mobile applications have been pulled back, the deployment will be considered complete. Vigorous support and engagement by stakeholders at all organizations will be necessary for the overall success of the project. Involvement of the Hackney Division, the dispatch associations and the Medallion owners is required to ensure the Ütopia meets the needs of the city of Boston and its guests.

SCOPE

The Ütopia project will provide a public mobile application and web site enabling hail or forward-schedule taxi pickups within the city from any dispatch operator; the project will also provide data integration and reporting to both the dispatch operators as well as the city. The scope will include data design and validation, infrastructure services, application development, application support, end-user training, pilot and go-live activities including communications and user support during launch. The application is expected to be ready for launch between 6 and 8 months after approval by the Project Sponsor and formation of the Steering committee and is expected to cost of between $700k and $1.5M.

The following items are not included in the scope of the project: Ütopia will not process payments of any type and as such will not store any credit card or banking information. There will be no way to capture street hails, airport pickups, or cab stand pickups using the Ütopia interface and reports generated will be limited to rides initiated using the Ütopia application and are intended to augment any reporting systems already in place. Outside of notification to legacy mobile app users, marketing, advertising, communication will be coordinated by the city of Boston. Finally, the project will not provide hardware for taxi drivers: drivers are expected to provide their own mobile phone with a wireless data plan.

PROJECT TEAM

The Project team will include members from Boston Hackney Unit, the dispatch associations, medallion owners and the Ütopia product team. The collaboration among these groups will be an important part of the success of the project. Involvement across organizations will insure that user feedback is integrated into the design so that the technological solution will meet the needs of the target user community. A steering committee will be formed from members of the project team in order to advise the Project Sponsor in strategic decisions.

Specifically the Project Team requires a sponsor and champion from the Hackney carriage unit; change leaders from the dispatch organizations to build momentum and confidence in the project; a systems engineer to deploy and configure infrastructure components; a usability test coordinator to gather feedback and coordinate testing with drivers and dispatch associations; a pilot program coordinator to run the pilot program on behalf of the city; a technical consultant to assist with integration and data migration; and an operations manager for eventual handoff.

The following roles are required to support the project:

‡ indicates member of steering committee

Role	Responsibility	
Project Sponsor & Champion ‡	Primary stakeholder for the Utopia project and executive sponsor	Hackney Carriage Unit
Change Leader - Top Cab ‡	Leads change effort in their association	Dispatch Associations
Change Leader - Boston Cab ‡	Leads change effort in their association	
Change Leader - I.O.T.A ‡	Leads change effort in their association	
Change Leader - City Cab ‡	Leads change effort in their association	
Change Leader - Metro Cab ‡	Leads change effort in their association	
Change Leader - Tunnel Taxi ‡	Leads change effort in their association	
Change Leader - 617TaxiCab ‡	Leads change effort in their association	
Medallion Owners Representative‡	Acts as a liason between the Ütopia project and Medallions owners; advocates for owners needs as part of the steering committee	Medallion Owners
Usability Test coordinator	Identifies test team of drivers, collects feedback and interfaces with Utopia	Hackney Carriage Unit
Pilot Program Coordinator	Coordinates Pilot program across all dispatch associations and the	

	Hackney Carriage Unit	
Technical Consultant	Manages the integration of Utopia data and communications with existing systems.	
Operations Director	Accepts handoff from Ütopia team and transitions into long term maintenance.	
Project Manager ‡	Manages all project activities and resources for Ütopia	Ütopia
Integration Architect ‡	Integrates existing systems and products into the Ütopia system	
Ütopia Development Lead ‡	Manages the software developers creating the Ütopia interface	
UX consultant	Works with developers for Ütopia and the Testing and Usability Test coordinator to develop an easy to use interface for drivers and riders	
QA Lead	Creates a test suite developed around user requirements and technical specifications. Works with the Test Coordinator, the UX consultant and the Change Management consultant to develop and implement user acceptance tests and improvement suggestions	
Change management consultant	Works with Change leaders, the QA lead and the Pilot Program Coordinator to strategically prepare staff and riders about upcoming changes in processes and technologies	
Training consultant	Works closely with the Pilot program coordinator to develop training programs for drivers and dispatch operators as needed	
Systems Engineer	Responsible for all aspects of infrastructure including EC2 instances, databases, SSL certificates, and DNS	
Cabforce specialist	Understands the requirements for interfacing Ütopia with cabforce	
iDashboards specialist	Creates templates for dashboards and data reporting for all stakeholders	

TABLE 3 - PROJECT TEAM

The responsibility matrix in RACI format (Responsible, Accountable, Consulted, and Informed) for project team members during the major phases of the project is displayed below.

Role	Planning & Definition									Implementation & Execution													Handoff & Closure					
R - Responsible **A - Accountable** **C - Consulted** **I - Informed**	Project Plan	Project Schedule	Project Budget	Scope of Work	Regulatory Requirements	Reporting Requirements	Training Plans	Ongoing Maintenance Plan	Support Scope and Definition	Technical Specification	Integration Specification	System Architecture	Data Specification	Software Development	Report Design	Interface Development	Data Quality Testing	Change Management	System Testing	User Acceptance Testing	User Training	Pilot Testing	Solution Deployment	Solution Support	Solution Documentation	Training Materials	Administrator Training	Onsite Administrator Handoff	Project Closure
Project Sponsor	A	A	A	A	R	R	I	A	A	I	I	I	I	I	A	C	A	I	C	A	C	C	C	C	I	I	I	I	A
Change Leaders	C	I	C	C	C	C	A	C	C	I	C	I	C	I	A	C	A	A	A	A	A	A	C	C	I	I	I	C	C
Useability Test Coordinator	I	I	I	I	I	I	C	I	I	I	I	C	I	I	I	A	I	I	A	R	A	A	I	I	I	I	I	I	C
Pilot Program Coordinator	I	I	I	I	I	I	C	I	I	I	I	I	I	I	I	C	I	I	C	A	C	R	I	I	I	A	I	I	C
Technical Consultant	C	I	I	I	I	C	C	C	C	A	A	R	A	A	C	C	C	C	A	C	I	I	A	A	A	A	C	A	C
Operations Director	C	C	C	I	A	A	C	R	A	C	C	C	A	I	C	C	C	C	C	C	I	I	C	C	I	I	I	R	C
Project Manager	R	R	R	R	I	C	C	I	R	C	C	C	I	C	C	C	I	A	C	C	I	I	C	I	I	C	I	I	R
Integration Architect	C	C	I	C	I	C	I	C	C	A	R	A	R	A	A	R	A	A	A	C	I	I	A	A	A	C	C	I	C
Ütopia Development Lead	C	I	I	I	I	C	C	C	C	R	A	A	A	R	C	A	A	A	A	C	I	I	R	R	R	C	A	A	C
UX Consultant	I	I	I	I	I	I	C	I	I	C	I	C	I	C	I	I	I	C	C	C	I	I	C	I	I	C	I	I	C
QA Lead	I	I	I	I	I	I	I	C	I	C	C	C	C	A	I	C	R	C	R	A	I	I	C	C	C	C	I	I	C
Change Management Consultant	C	C	I	C	I	I	I	A	I	C	C	C	I	C	I	C	I	R	C	I	I	I	A	C	I	C	I	I	C
Training Consultant	C	I	C	I	I	I	R	C	I	I	I	I	I	I	I	I	I	I	I	C	R	A	I	A	C	R	R	A	C
Cabforce Specialist	C	I	I	I	I	C	I	C	C	A	A	A	A	A	A	A	A	A	A	C	I	I	A	A	A	A	C	C	C
iDashboards Specialist	C	I	I	I	I	C	I	C	C	A	I	C	C	A	R	I	C	C	A	C	I	I	A	A	A	A	A	C	C

FIGURE 10 - RACI MATRIX

DELIVERABLES AND TIMELINE

PHASE 1: PLANNING & DEFINITIONS (19 DAYS)

In this phase project kickoff occurs; communication is distributed to stakeholders including the Hackney Carriage Division, dispatch employees, and medallion owners. A high level of involvement by the Project Sponsor and the entire steering committee is crucial at this point. Communication includes an introduction to the Ütopia platform, its objectives, business rationale, development process and goals. Internal teams are formed and a formal project plan and project schedule are developed. Testing and training plans are developed with input from the change leaders at each dispatch and a scope of work is validated.

DELIVERABLES: Scope of work document, project charter, formal project schedule, testing and training plan

PHASE 2: IMPLEMENTATION AND EXECUTION (82 DAYS)

This phase includes the acquisition of infrastructure, licensing, and other assets necessary to deploy the platform. Ütopia's Systems Engineer in conjunction with the Cabforce and iDashboards specialists deploy the CentOS application servers, backend database, and establish connectivity to Google Maps. Development of the Ütopia application frontend and relational database begins in this phase concurrent with infrastructure deployment, headed by the Ütopia development lead; the UX consultant and QA

lead are heavily involved during the initial software development phase. In addition, the Cabforce specialist begins working with Cabforce support to establish permanent connectivity to the booking API. The Cabforce specialist also begins the initial data discovery necessary to connect the city of Boston dispatch systems. Software testing will occur continuously as part of this phase and stakeholder feedback is needed periodically between development iterations. During feedback sessions training plans will be revisited and updated as needed.

Deliverables: Mobile and web applications, preliminary iDashboard reports.

PHASE 3: SYSTEM TESTING AND IMPROVEMENT (95 DAYS)

When Cabforce integration has been established between all Boston dispatchers and Ütopia, data integration testing will begin – this includes simulated booking flows from all dispatch systems to and from Cabforce, as well as booking flows between Ütopia to Cabforce. End-to-end booking flow unit tests are conducted and the Cabforce specialist tunes interfaces as required. In this phase, training materials and feedback tools are created and recruitment for the internal pilot program begins. Drivers are selected from a pool of existing mobile application users, selecting the most active mobile app users as pilot candidates who will be notified via email of their invitation to participate in the pilot. A percentage of drivers from each dispatch office will be selected at random to participate in the pilot. Both drivers and riders will be provided with the prototype application, as well as surveys and other feedback tools. The pilot program will be run in at least two iterations to allow for improvements to be made and tested again. Retention of drivers and riders for the duration of the pilot program will provide more useful feedback and lead to a higher success rate.

DELIVERABLES: Preliminary training materials, data Interfaces between Ütopia and dispatch, completed iDashboard reports

PHASE 4: HANDOFF & CLOSURE (120 DAYS)

Phase 4 begins with the final User Acceptance Test. The application will be demonstrated for the steering committee by Ütopia and reports from the internal pilot program will be addressed. Once the product has been accepted training materials will be prepared and distributed. A training session will be provided for marketing personnel in preparation for launch. The training sessions will be provided to the dispatch associations and rolled out to drivers, one association at a time, as their systems are completely integrated with the Ütopia system – the schedule for roll out is displayed below. This final phase also includes technical support and documentation in preparation for the final handoff to operations.

Dispatch	Total Medallions	User Training	Integration (Cabforce)	Deployment Support
City Cab	223	15 days	5 days	15 days
Boston Cab	473	20 days	5 days	20 days
617-TAXI Cab	57	5 days	5 days	15 days
Metro Cab	527	25 days	5 days	20 days
ITOA	303	15 days	5 days	15 days
Top Cab	203	15 days	5 days	15 days
Tunnel Taxi	32	5 days	5 days	15 days

TABLE 4 - DISPATCH ROLLOUT PLAN

DELIVERABLES: Training materials, solution documentation

See Appendix A for partial view of the Gantt chart for the project.

RISKS

Managing risk will be an ongoing part of the Ütopia implementation strategy. A risk management plan will be put in place in conjunction with the communication plan in order to continually evaluate and address risks throughout the lifecycle of the Ütopia project. Each risk will be evaluated on a probability scale as well as an impact scale of 1 to 10 to give the Project Manager and the Steering Committee a better understanding of how to effectively mitigate risks in a resource effective manner.

Here is a sample of initially identified risks and their classification:

Risk	Area of Impact	Probability	Impact
Slow adoption by drivers	Implementation	High (8)	High (10)

Mitigation Strategy: Begin information session early in the process. Make the value proposition very clear and compelling. Carefully select Pilot program drivers who have an impact in their community and will create excitement around the new program. Incorporate user feedback in development sprints and be clear that their suggestions are being used. Engage Change Leaders within the dispatch organizations to prepare the community for behavioral shifts.

Risk	Area of Impact	Probability	Impact
Cabforce ceases operation	Execution and Integration	Low (1)	High (7)

Mitigation Strategy: Initial research has provided less appropriate but functional alternatives to Cabforce. A budget contingency should be set aside to account for increased costs in a case such as this, but other measures are not needed at this time due to the low probability of this risk.

Risk	Area of Impact	Probability	Impact
Data Quality in dispatch centers may cause issues with migration	Data migration and integration	Med (5)	Med (6)

Mitigation Strategy: Early analysis of the data from the dispatch centers will inform the migration strategy. A budget contingency should be prepared for this risk and a schedule lag will be built in. There is sufficient time in the schedule for this as data migration is not on the critical path.

Solution Deployment

Ütopia addresses the technical issues as a part of a broader strategy of the medallion owners and dispatch companies to remain competitive as new players enter the local market. As Ütopia will be providing "bolt-on" functionality to the existing dispatcher systems it can be deployed incrementally after integration testing is complete. Existing booking process will remain in place with Ütopia providing an additional channel for booking flows, automatically registering fares in the dispatch system with "no touch" from the operator – transactions are direct between Ütopia riders and Ütopia drivers.

INFRASTRUCTURE AND SOFTWARE

Amazon EC2 instances are spun up and DNS hostnames are registered for use with the platform. Licensing agreements with Cabforce and iDashboards are purchased, and the web platform / backend databases are developed.

LEGACY DATA MIGRATION

An interface between each dispatch and Cabforce is established and connected to the infrastructure which will allow booking flows between Ütopia and the legacy system. Data migration will be limited to user information from existing mobile applications, if one exists. This information is extracted and normalized using an ETL process - the resulting master data file is imported into the solution backend in preparation for rollout to the general public. This will happen concurrently with the software development. Given that the existing apps share common data elements today (phone number and email address), linking records across the existing mobile apps should be straightforward and will be handled by the development team. Some bad data such as unique users having multiple email addresses or phone numbers across systems is expected; the QA lead and Integration Architect will take ownership of data quality during the ETL process to ensure consolidated records are as accurate as possible.

INTERNAL TESTING AND SOLUTION PILOT

Internal unit testing and data validation is conducted; this process is iterated until minimal operational functionality is achieved. After testing has occurred, pilot users on the taxi side are selected from each dispatch company based on statistics available from the Hackney Carriage Division of the city of Boston; riders are invited to participate in an open Beta. The city of Boston will engage in a full-fledged

marketing campaign to promote the launch of their new unified app which includes print ads, billboards, airport posters, and social media presence.

GO-LIVE (PHASED)

After the pilot phase has completed successfully, a full go-live event will occur. This involves a phased approach in which an individual dispatch company is fully provisioned, trained, and on-boarded.

OPERATIONAL READINESS

With the inter-workings and essentials identified and explained there are yet a few aspects of the operations to explain.

NON-FUNCTIONAL COMPONENTS

There are several non-functional components of Ütopia, two of the most apparent are the administration web application and iDashboards. The administration portal provides a high-level view of the individuals - the customer, taxi drivers, dispatch companies, and administrators, - who are involved with Ütopia, as well as the ability to drill down and see more specific information. Although this user administration application is extremely important to Ütopia it is in fact a non-functional component. Another non-functional component within Ütopia is iDashboard. This application allows for a very accurate view into the data that is available in our database. While the administration portal was available to a wide variety of individuals involved in Ütopia iDashboards is only available to the Hackney Division.

OPERATIONS

Once Ütopia is in production the ownership of this project will rest with the internal IT group Desktop Engineering (DE). DE is the highest tier of support within IT in the city of Boston and manages several internal applications. Desktop Engineering is responsible for keeping Ütopia up and running that includes patch management & change and incident management. As seen earlier Ütopia has many technical processes and services required to operate. This results in many service patches and upgrades that need to be done on both the software and hardware side. The city of Boston is no stranger to managing applications and has a change control process in place that creates a process for these changes to be implemented in a mature way. Desktop Engineering currently has a monthly change control created within this process for the expected changes, for example, a Cent OS upgrade or a Cabforce fix.

Additionally, the service desk is also utilized in the support of Ütopia. For issues with the system or access to portions of the service desk tickets will need to be created that will work up the chain, if

needed, to be resolved by the Desktop Engineering team. For example, if an employee at the city of Boston requires access to the administration web application they will need to submit a ticket to request access. This ticket will move up the change to tier two who has the ability to grant access to this web application. Another example would be one of the dispatch statistic pages within iDashboards is not working properly, a ticket would need to be created by the employee having access and this ticket would work its way up to Desktop Engineering who would have to resolve this issue because the service desk does not have the ability to work on iDashboard.

There are performance requirements for Ütopia. As will all applications within the city of Boston there is a 99.999% uptime requirement. Additionally there are response time requirements for all customer interaction applications including iDashboard, the user administration web portal, and the mobile application. Finally, there are support options on both the administration web portal and the mobile application for users to voice their opinion on what they like and dislike which will help the city of Boston determine satisfaction.

Service-level agreements (SLAs) are an important requirement for Desktop Engineering and have been set up with Amazon, PostreSQL, Cabforce, and Dashboard. Each SLA with the various companies mentioned are not the same but look extremely similar. One of the biggest differences between each SLA is the level of support, a much greater support was finalized with Cabforce than with Dashboard for example. These SLAs will allow Desktop Engineering to support these services and processes with help from the vendor.

User enablement

There are several parts of Ütopia that will be used by riders. One is the user administration page, another is the iDashboard page, and finally the mobile application. The mobile application can be simply downloaded by any customer through a phone's app store. Both the user administration page and the iDashboard page will require access which will be granted by the service desk as discussed above. For external users, such as administrators at the dispatch companies who need to access the user administration page, they will be given Desktop Engineering's email address to contact for access.

Communication, training, and knowledge management is something that is currently in place within the city of Boston. There is an internal portal in the city of Boston that contains these documents. Desktop Engineering has been tasked with created knowledge based articles for accessing these three customer facing applications discussed above.

Success metrics

- Average Passenger Wait time using Utopia to be less than 5 minutes

- Percentage of Dispatch Requests served above 95%
- Taxi Utilization above 40%
- Average total ridership to increase 5% per year for the next 5 years

The aforementioned metrics listed above will serve as Utopia's measurement of success. Creative Mobile Technologies (CMT) and Verifone are the two primary credit card processing vendors, which through contracts with the six radio dispatching associations, provide in-vehicle equipment capable of recording trip data (e.g., can number, trip date, pick-up location and time, drop-off location and time, mileage, fare, fees, tips, etc.) on all trips, and not just the trips paid for by credit cards. Both CMT and Verifone have given the Hackney Carriage Unit permission to access this data. Utopia will also utilize this existing infrastructure to evaluate the success metrics set forth above. Data that is used from this existing technology will allow Utopia to analyze taxi availability, taxi productivity, spatial and temporal demand, and as input for future reviews. In addition to utilizing this existing data, Utopia will establish a Key Performance Indicator (KPI) culture within the six dispatching associations to track adoption of Utopia at multiple levels:

- Individual medallion owner adoption
- Individual driver adoption and usage
- Overall Dispatch Association adoption

Dispatching Association leaders will be required to submit this KPI data along with their financials in a weekly and monthly report. The KPI's will become crucial in driving adoption, but also in continually incorporating feedback and improving the mobile application. Utopia will conduct internal reports each quarter and generate a report every six months that will be distributed to the City of Boston, Hackney Division and each of the six dispatching associations.

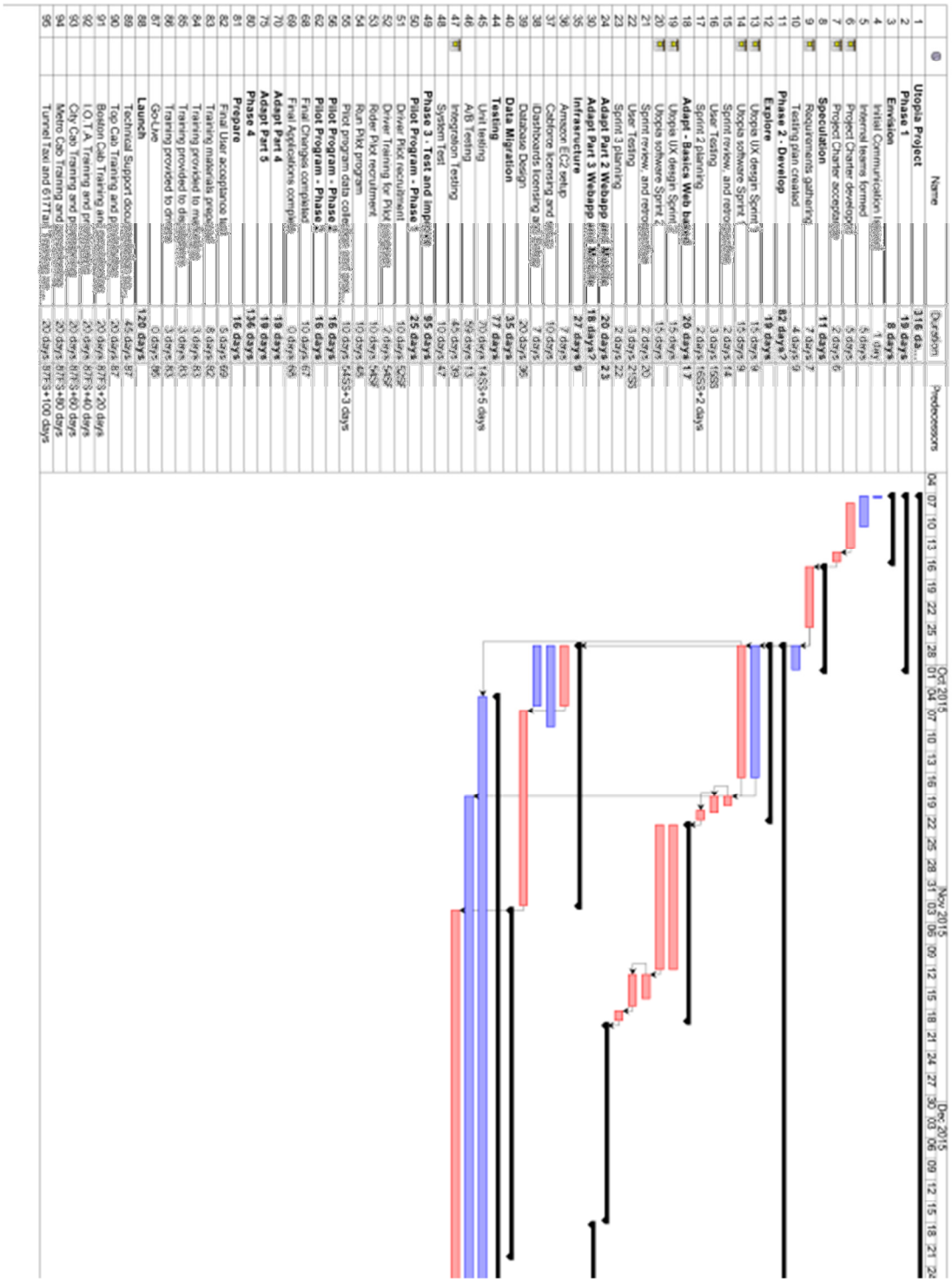
Utopia will also establish a Taxi Advisory Committee (TAC) to establish more collaboration among Utopia users, taxi professionals, as well as establish more communication with municipal policy makers. TAC representatives from the taxi industry will be chosen by their peers, and all representatives must be approved by the Mayor of Boston. The primary function of TAC, which will meet quarterly, will be to make suggestions from Boston taxi professionals, stakeholders and users of Utopia in an effort to enhance Utopia's platform in a highly collaborative manner. TAC will be an inclusive 17 member committee with representatives from each of the following groups:

TAXI ADVISORY COMMITTEE

- Large medallion owners
- Small medallion owners
- Shift drivers

- 3 Radio associations
- City of Boston Transportation Department
- City of Boston Office of Neighborhood Services
- City of Boston Commission for Elder Affairs
- Boston College Student President
- Boston University Student President
- Northeastern University Student President
- Harvard University Student President
- Massport
- MBTA Accessibility Office
- Massachusetts Convention Center Authority

APPENDIX A – GANTT CHART



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