Bay Area Fair Value Commuting
An FTA MoD Sandbox Demonstration Project

Why can't I have an Uber-like public transit user experience?

Steve Raney, Feb 12, 2017, Steve.raney@jointventure.org
Short URL for this google doc: http://bit.ly/UberTransitUX

ABSTRACT: In the face of disruption, there is an expectation and need for a more customer-centered public transit user experience, seamlessly managing challenging multimodal journeys. Envisioned are many nationwide apps with Uber-like user interface features vigorously competing to serve customers. Such app competition will futureproof the user experience, comprehending advances such as intelligent agents. To bring about works-anywhere apps, regional procurements could be replaced by an open, frictionless app marketplace with a commission-based business model. Marketplace prerequisites include: federal financial/political support, streamlined fare structure, transition to cashless, adoption-accelerating fare discrimination, contactless debit cards for the unbanked and tap-to-pay turnstiles.

1. What do you expect?

You use Uber/Lyft. You grok the no-brainer user experience (UX). You could design an iPhone/Android app to make public transit just as seamless. You expect an Uber-like UX. Disruption threatens public transit, so, to stay competitive, transit needs to meet your expectations.

Uber gets you where you want to go. Public transit stations & stops don't always line up with where you want to go. A seamless app needs to glue together public and private travel modes to get you to your destination - gaps have to be filled. In some markets, more than 20% of Uber/Lyft trips are complementary first/last mile to/from public transit.

2. Tough use case: San Francisco Mission District to downtown Sacramento via four travel modes

If an app can handle this use case, then it's well on its way to the hypothetical UX ideal.

Travel mode	Start location	End location	Cost
BART	5:35pm 24th St Mission Station, 2800 Mission, SF.	5:55pm 12th St. Oakland City Cntr, 1245 Broadway	$3.70
UberPool w/ human	5:57pm (walk + 1 min wait)	6:05pm Jack London Sq.,	$4.75

driver	1245 Broadway, Oakland	245 2nd St, Oakland	
Capitol Corridor Amtrak	6:10pm Jack London Sq	8:08pm Sacramento Station, 401 I St	$29
Sacramento Regional Transit District	8:16pm Sacramento Valley Station, 5th & H,	8:26pm Archives Plaza, 1500 11th St, Sacramento	$2.75

The app pays for each travel mode, there's no fumbling around for transit/credit cards or cash. Unintelligent cards cannot compete on UX with extremely smart phones. You zoom through the BART turnstile using NFC (near field communication) tap and pay.

While you travel through the BART Transbay Tube, the app ensures that UberPool is waiting at the end of the BART trip, making the transfer a no-wait, no-brainer. Stress-inducing "waiting under conditions of uncertainty" is eliminated for all modes as the person/vehicle rendezvous for each mode is depicted graphically on the phone.

The seamless app transmits public/private travel service fares (money) to those services. Fares are very complex, with variable discounts, etc. A transfer between Uber and Amtrak is beneficial to both services as well as the travelers, so a discount can be applied to both fares.

This journey crosses two governmental regions, the nine-county Bay Area and the six-county Sacramento region. You need a seamless trip that works everywhere, but some regions develop their own region-only proprietary app. The US should catch up to the more seamless Japanese experience: "Apple Maps launches support for transit in Japan with iOS 10. Apple Pay users can map out and pay for their entire commute, including major train, subway, ferry and national bus lines, on their iPhone 7, iPhone 7 Plus and Apple Watch Series 2, based on updated fare and schedule information" - (from Apple press release).
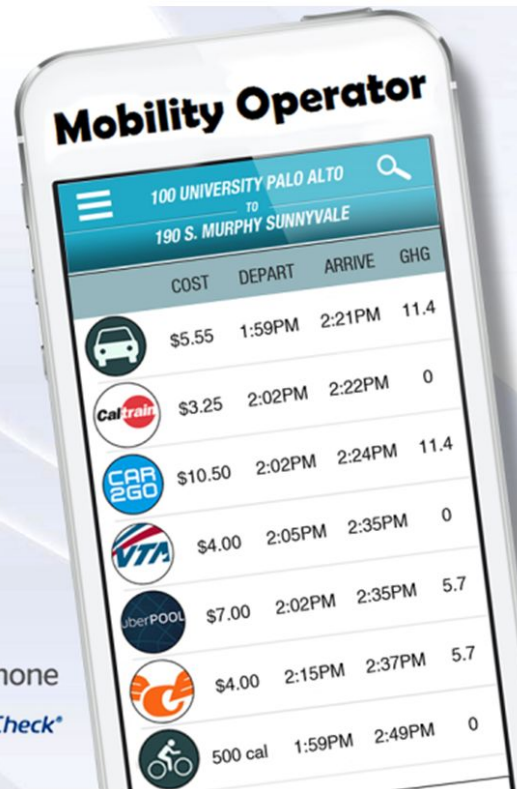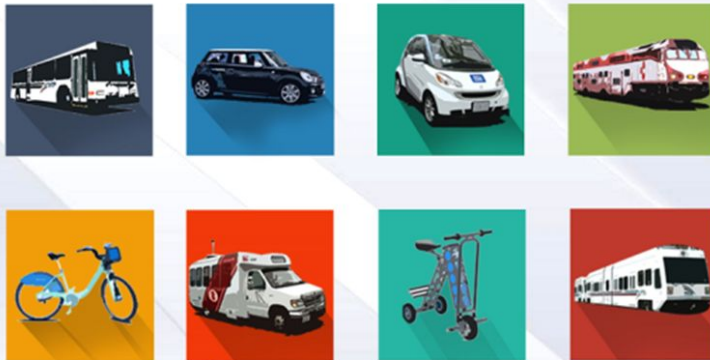
3. MobAgs

The app can be called a "MobAg," for **MOB**ility **AG**gregation app, providing multimodal trip planning/support with a seamless combination of public/private transit, bikeshare, rideshare, carshare, and parking, all with on-phone payment. Apps that are part-way along the path to the ideal include Moovel (Daimler), Urban Engines (Google), Whim, Moovit (BMW owns a piece), Transit App, TripGo, Swiftly, CityMapper, Chicago Ventra, Siemens, GoLA (Xerox/Conduent), Finland's MaaS.global, and Manchester's TravelSpirit. In the ideal, you sell your car and use the MobAg to get around, with a UX as brainless as driving.

Mobility Aggregation: app replaces your car
Moovel, Moovit, Xerox, Siemens, maas.global, travelSpirit, Swiftly, Transit App, TripIt, TripGo, Urban Engines, etc. Future Intelligent Agent contributions from: Google Now, Siri, and Cortana.

4. Future-proofing the UX

Intelligent agents {Siri, Google Assistant, Cortana} are beginning to act like your personal assistant, learning your quirks and looking out for you. These agents work "faster than real-time" because they can snoop your calendar to anticipate your needs before you do.

The public transit UX needs intelligent agent augmentation to achieve "as brainless as driving a car:"
- Ascertain if you get lost during a transfer between modes and then get you back on track.
- Wake you up so you don't miss your stop/station.
- Understand your context, like "traveling with toddler" versus "schlepping a heavy suitcase" and only suggest reasonable travel options.
- You took the red-eye to Atlanta, a city you've never visited. You should be 100% confident that the app can play it by ear for you. You don't have to look up travel options/directions before getting on the plane.
- Where appropriate, pre-book modes so you always have a vehicle/seat.
- At the end of the day at your desk, the app nudges you to pack up and ensures that you make your connections. It yells at you to sprint when needed (knowing from your wearable that you are a healthy, marathon-ready person).

For an app to work in San Francisco, Sacramento, and Atlanta, things are going to have to change. Some regions develop proprietary, region-specific apps that require a bruising six-year process to pick

a software vendor. Unfortunately, the "cycle time" for open private sector app updates is three months, not six years. Hence, six-year proprietary selection processes will need to evolve into an open, frictionless app marketplace with profits motivating active competition between many MobAgs. Further, to provide a compelling business case, the apps must access open public transit payment APIs and take a commission from each fare. Once the private sector is provided with this business case, then engineering talent will be applied with a vengeance.

5. Disruption in support of public transit expansion

As previously mentioned, some regions suffer lengthy software cycles to develop proprietary apps, whereas the private sector software landscape changes constantly, creating a public/private UX imbalance. Moving to a frictionless, future-proof marketplace allows public transit to keep up with disruptive UX breakthroughs.

Further, US public transit bus cost is about $1.01 per passenger mile. It seems likely that, beginning with small systems in about 2023, electric robovans (with robot drivers) will outcompete: ¼ the seats of a bus, $0.25 per passenger mile, 1/20 the vehicle cost, 4X the frequency, and flexible routing. If the average robovan revenue per passenger mile is $0.40, then we may see a "perpetual motion machine" of public transit growth.

Additionally, as part of a transport congestion/climate strategy, adopted California state policy calls for doubling transit ridership by 2040. Such growth requires a more-seamless UX.

Lastly, some regions have too many transit agencies to support rapid change/growth. For example, the Bay Area has 24. Because of looming disruption, agencies will need to work hard to deliver an improved UX, masking their inherent inefficiencies.

6. Stipulations

- Paying for transit with your phone is just like paying at Starbucks with an app. Proof of this occurred in Japan 15 years ago.
- From a software architecture standpoint, regional public transit apps (and payment system backends) are all about the same. Hence the architecture can be abstracted into open APIs, enabling nationwide apps. Regional governance should acknowledge this commonality between regions. Private sector app vendors can be motivated to create nationwide customer accounts. Proof of this is your own works-anywhere Uber account. The public sector org chart prevents national accounts.
- Regional app selections (procurements) stifle innovation, creating proprietary apps that can't keep up with the pace of innovation. Vendors spend more effort preparing bids and negotiating contracts than they do writing the code after they win.

7. Open, profitable, national, frictionless, future-proof public/private collaboration

To bring an Uber-like public transit UX about:

- Regions and vendors voluntarily enter an agreement supporting open standard transit payment. For example: Four regions (San Francisco Bay Area, Sacramento, Atlanta, and Phoenix) and three MobAg vendors (Xerox GoUSA, Daimler Moovel, and Google Urban Engines) voluntarily agree to a series of commitments to bring this about. Improved UX will drive further voluntary adoption.
- A fixed commission of, say, 8% is provided to certified vendors for each public transit payment transaction. The fixed commission eliminates regional procurements and negotiations. The fixed commission is the key enabler of the frictionless app marketplace.
- As a result, the MobAg space continuously improves, future-proofing public transit user experience. Competition for the fixed commission intensifies feature set innovation to create product differentiation.
- The public sector certifies the apps to meet important requirements, with the private sector funding that certification. Certification includes a) supporting the Interoperable Open Transit Data Standard, b) third party compliance certification of EU Data Protection Directive and Payment Card Industry Data Security Standard (PCI DSS) with regular audits, c) provision of anonymized trip data to the public sector at no charge.
- The public sector maintains turnstile hardware and provides open standard hardware APIs.
- The public sector simplifies and maintains public transit fare structure, providing an open fare structure dataset.

If regions are currently in the middle of a proprietary regional procurement, they can move part-way towards the ideal. They can rank vendor bids based on moving towards an open, national solution, rewarding proposals that support multiple MobAgs and that publish open APIs used by multiple vendors.

The Federal Transit Administration and other agencies could play a role in accelerating efforts towards this UX breakthrough, providing funding to improve transit data feeds and to upgrade hardware in exchange for supporting the frictionless app marketplace.

8. Challenging prerequisites for an Uber-like UX breakthrough
- It may take federal financial and political support to bring about a breakthrough. Further, participating regions need to have a timing window that allows for a breakthrough.
- Inertial local transit agencies will be politically wrangled towards this customer-centered UX. Industry disruption may help motivate transit agencies.
- Regions will pass "increase public transit competitiveness" laws to streamline fare structures. For example, the 24 transit systems in the Bay Area have a staggering 700 fare rules. Fare restructuring will result in some agencies losing a bit of revenue, hence regions will make up such losses in exchange for agencies streamlining.
- Regions will transition to cashless public transit payment. Boston is eliminating cash transit payment. New transit lines/routes in Pittsburgh do not accept cash. You'll refill your account on your phone, not by painfully waiting in line at an "add fare" ticket machine.
- Social equity for unbanked and phone-less will be achieved through provision of inexpensive prepaid Android phones and contactless debit cards. The debit cards are generic to US retail and are compatible with modern transit turnstiles. Contactless cards can be refilled online, at low-income service centers, and at retailers (Japan 20 years ago) and, alas, at

still-necessary-but-less-prevalent transit ticketing machines. Contactless cards are currently scarce in the US, but the open payments industry has a stated willingness to produce cards in exchange for a reduction in proprietary payment. A portion of the fixed commission could be used to ensure that unbanked / phone-less are expeditiously serviced. Also related to equity; 1) low-income travelers face more "extreme commutes" across two regions, so will benefit from works-anywhere apps, and 2) Seattle King County Metro's Orca-Lift provides a regional low-income public transit discount. This discount should be expanded to other regions.

- You will be an early adopter of next-generation MobAgs, but your neighbor Fred is a laggard. Fred is motivated by a) a fare difference in favor of new over old technology, and b) gradual removal of legacy ticket machine hardware (increased "add fare" ticket machine queue length). Fred-centric policies will be adopted. Transitioning from old to new is a hassle that may require dedicating a portion of the fixed commission to hardware upgrades - federal financial support may also be necessary.
- NFC tap and pay will get you quickly/reliably through the BART turnstile. No one wants the social stress of backing up the turnstile queue.
- In the event that a MobAg vendor goes bankrupt, a smooth customer transition will be ensured. Other risk management strategies will likely be needed.
- Pre-tax commuter transit purchase UX will be improved via MobAg.
- While MobAgs will provide national brands, plenty of screen space will be available within these apps for local public transit branding.

9. References

- [Transit and Contactless Open Payments](#): An Emerging Approach for Fare Collection, A Smart Card Alliance Transportation Council White Paper, Nov 2011.
  NFC tap and pay should reliably transact in 400ms at each BART turnstile, using a) Offline Data Authentication (ODA), b) pre-stored value on the phone (value is communicated to the turnstile) sufficient to pass through the gate, or c) vendor taking on "first tap" risk whereby the vendor makes the public transit agency whole for any for scofflaws. Article: [Tomorrow's Transactions](#): ODA is a good thing, and not only for transit operators (are you listening USA?)
- Please remember that smart CARDS are not intelligent like smart PHONES. [Metro Magazine](#): Shifting to Smart Cards: A Tale of Two Cities.
- "Open tokenization" enables electronic payment: "The concept of using a non-decryptable piece of data to represent, by reference, sensitive or secret data. In payment card industry (PCI) context, tokens are used to reference cardholder data that is managed in a tokenization system, application or off-site secure facility."
- [Roundup of Transportation Data Standards (and Gaps)](#): Aaron Antrim, Trillium.
- Conceptual diagrams of fare systems for fixed-route transit, http://bit.ly/2feE95y: Aaron Antrim, Trillium.
- Open standards effort: [GTFS-SUM](#) (General Transit Feed Specification - Shared Use Mobility) open data standard effort. Founding partners include: RideScout, TriMet, CUTR, Trillium Transit, IBI, Technology Association of Oregon.
- Open standards effort: RMI's [Interoperable Transit Data: Enabling Mobility as a Service](#).
- TRB's Transit Cooperative Research Program (TCRP) Report 177: Preliminary Strategic Analysis of Next Generation Fare Payment Systems for Public Transportation: explores attributes, implementation strategies, and applications of next generation transit fare payment (NGFP) systems. [TCRP 177](#)
- [Next Generation Transit Fare Payment System](#) : Account Based - Open Payment.

10. Comments

- I couldn't agree more with the gist of this effort. I have spoken to many transport agencies in the last few days who are stuck between a rock and a hard place with their existing ticketing systems. The huge investments in them cement the agency with a proprietary vendor and a certain technology that is state-of-the-art at the moment of procurement. As technologies are advancing (rapidly!) those new features don't get incorporated and neither do the new mobility services that are becoming available.
- Great vision. You were talking about Data Interoperability, from our experience one of the major obstacles today for your vision is Payments/Bookings Interoperability. Every vendor using their own (closed) system. Moreover every vendor wants 'to own' the customer and wouldn't like to share him/her with its competitor. Another challenge is NFC for iOS. For the best of my knowledge Apple don't allow 3rd party developers to access it and therefore it limits industry options of what can be done.
- We should begin by developing best practices for GTFS to ensure better source data. Some care should be taken in improving the GTFS standard to define **all** fixed route public/private transit fare models, including the comprehension of cross-operator transfer discounts. This GTFS definition of all fare models should be robust enough to be used by payment backends.
- It is not clear if private or public mobility will be thriving in five years. Uber is covering only 41% of their costs with fares. Some public transit fareboxes cover 70% of operating costs (capital costs ignored) while others cover only 13%: https://pbs.twimg.com/media/Ctida34UkAAKMjU.jpg. Should public transit form long-term alliances with money-losing private mobility that may not last?
- Additional compassionate use cases should be addressed for: former-drivers, seniors, eyesight-impaired, English language learners.
- The article should add an ecosystem map: MobAgs, private mobility services, payment backends, system integrators, payment systems (Android/Apple Pay, VISA, Mastercard, paypal, banks), intelligent agent platforms, MPOs, transit agencies, GTFS fare struct feed, GTFS-RT for vehicle location, etc. some vendors that are interested in regional payment procurements: Accenture, Cubic, Xerox (Conduit), Talus, Moovel, Siemens, Scheidt & Bachmann, First Data.
- The article melds the front end app, customer account, transportation service repository, and transactional back end. It might be helpful to have a "marketecture" diagram showing how this segmentation will function
- Does it make sense to be this prescriptive about the business model?
  - Response: Yes, rigidity in the business model unlocks the breakthrough and eliminates negotiation/procurement. But my viewpoint is far from the dominant paradigm.
- I think the bizmodel is too prescriptive. Google supports google maps with advertising. Perhaps the commissions aren't on transit transactions but other transactions.
  - Response: The overhead for public transit fare processing is somewhere between 5 and 20%. I have spoken to MobAg vendors about the biz model. They want "real money in the form of fare commission," not ads. There isn't another source of revenue that is compelling for them.
- Should a benefits-oriented descriptor replace "MogAg?" mobility agent? mobility butler? Easytravel? "MobAg" sounds awkward, and is reminiscent of unruly crowds, and aggravation or agriculture, bagginess.

11. Acknowledgements
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