Real-time Transit Information: Uses and Impacts

FTA Region 4 Conference | May 14, 2015

Dr. Kari Watkins and Simon Berrebi

With credit to Candace Brakewood, Aaron Gooze,
Landon Reed and Sarah Windmiller

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Benefits of Transit

- Societal Benefits
  - Congestion reduction
  - Reduced gasoline consumption
  - Reduced emissions
  - Mobility to non-drivers
  - Compact sustainable communities

- BUT to customer - transit must be fast, comfortable and reliable

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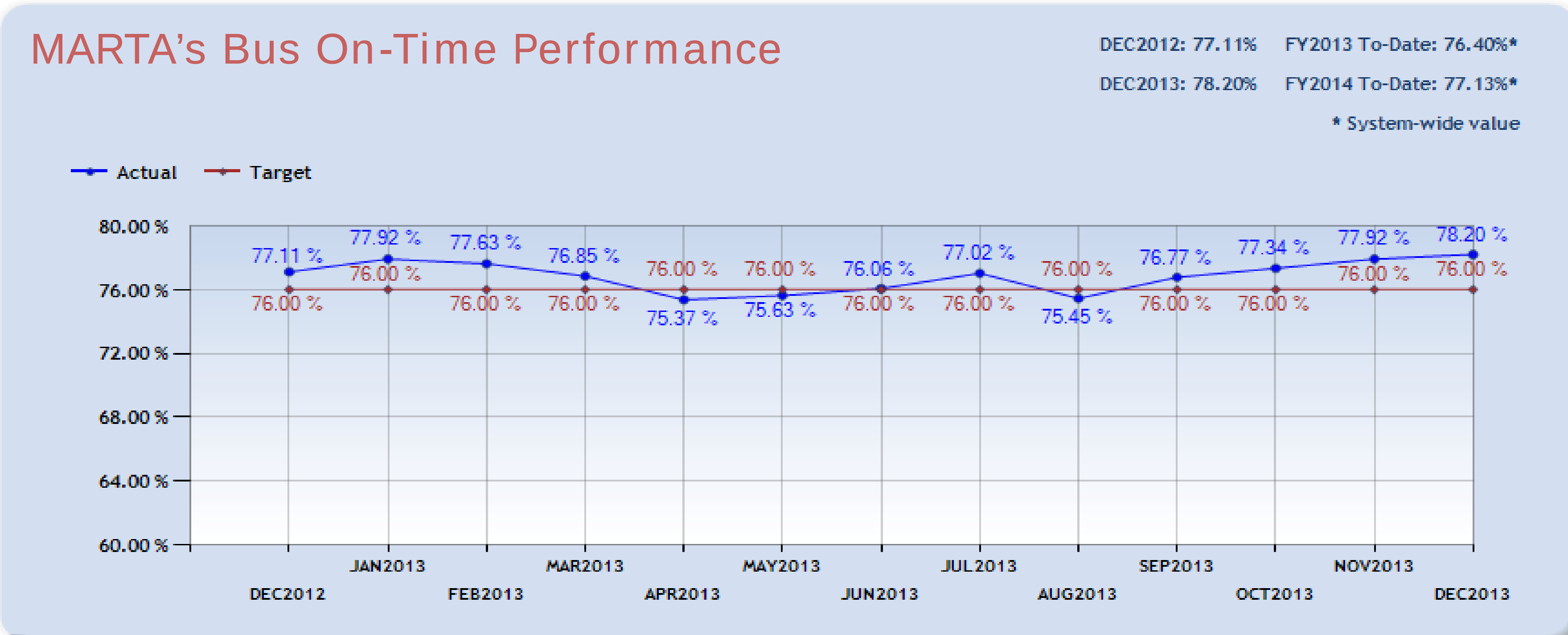
Problems with Transit

- Reliability is a key issue (Li et al. 2010; Walker 2012)



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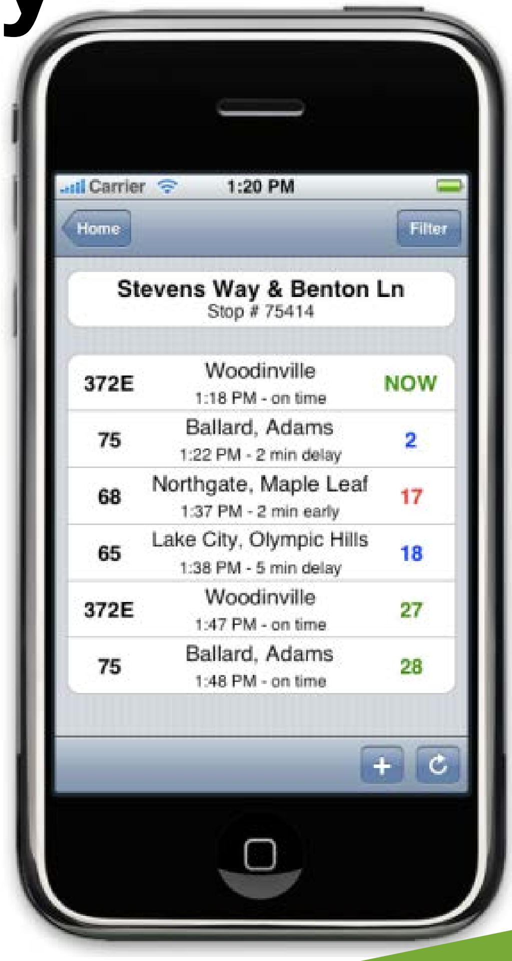
Strategies to Address Unreliability



- Traditional methods of improving reliability are expensive, supply-side approaches, including:
  - Dedicated right-of-way
  - Service planning
- An inexpensive, demand-side approach is providing riders with real-time information (Carrel et al. 2013; Schweiger 2011).

ENABLERS OF REAL-TIME ARRIVAL INFORMATION

Enablers

- Increasing use of Automated Vehicle Location (AVL)
- Prevalence of Mobile Devices
- Open Standardized Data

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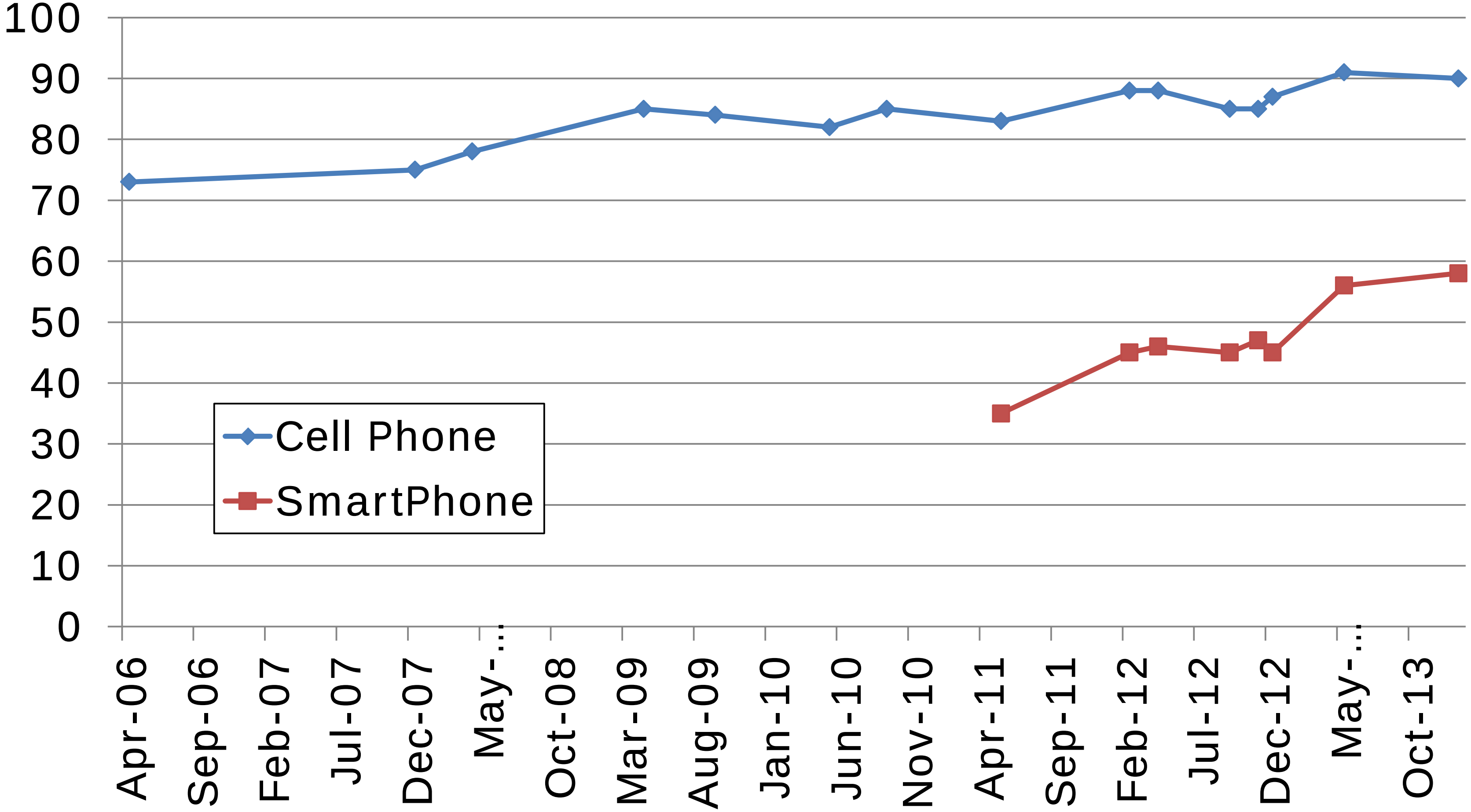
Phone Ownership



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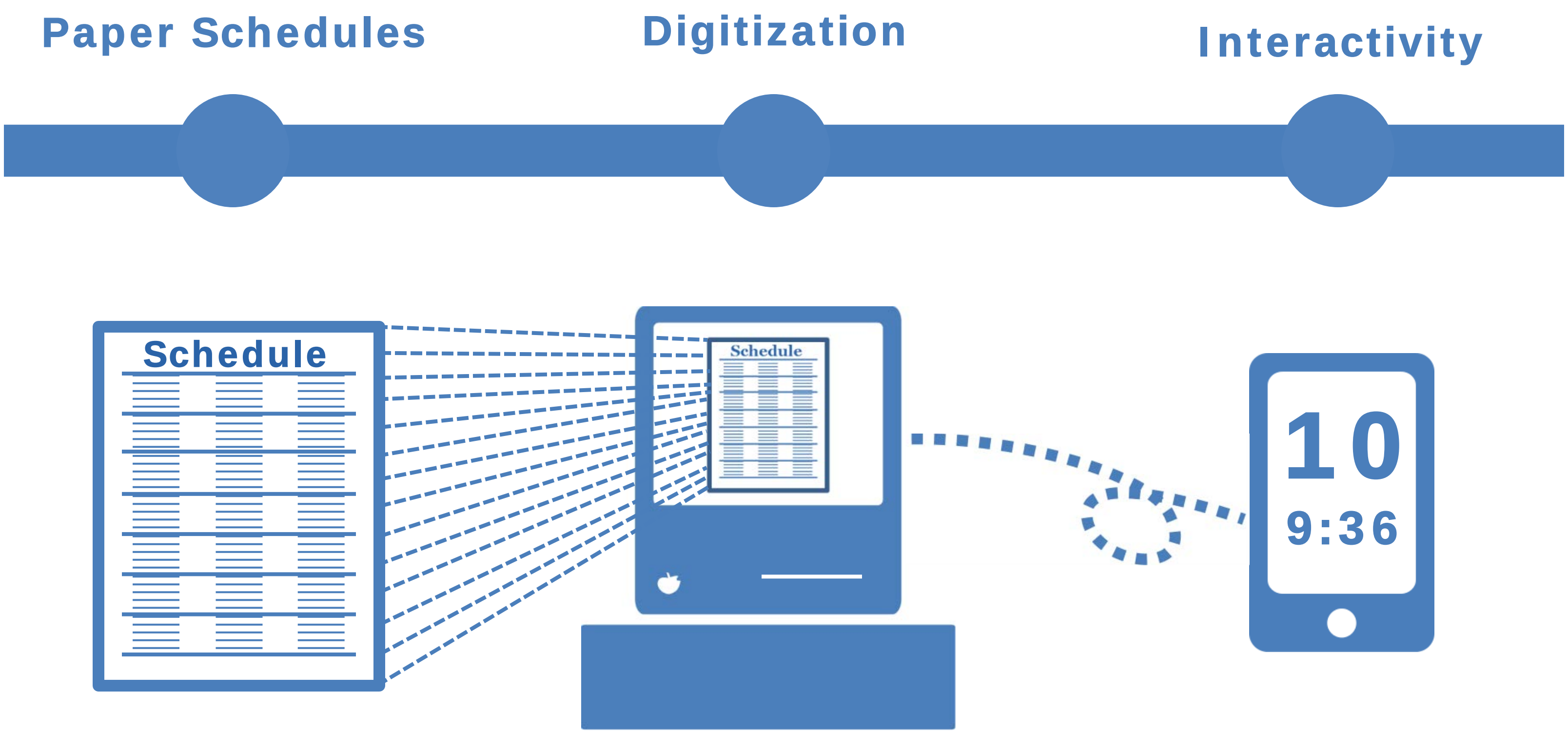
Transit Data Consumption



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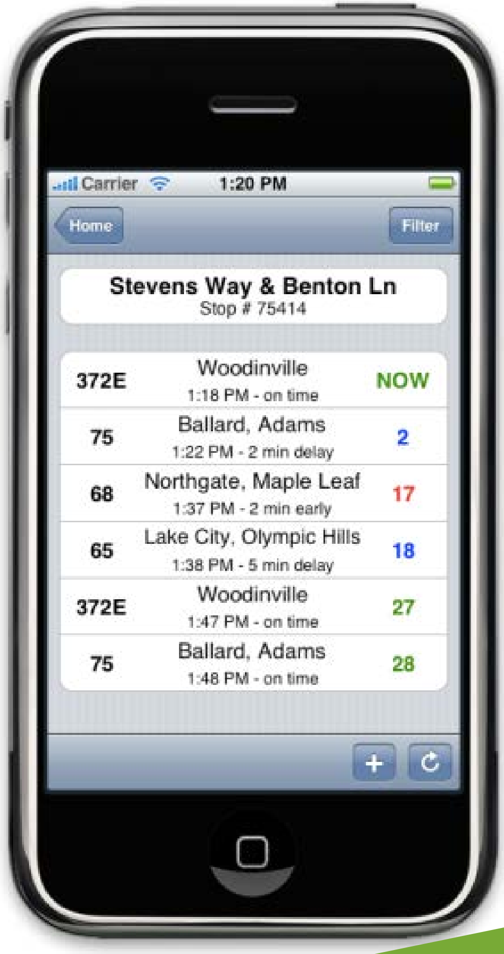
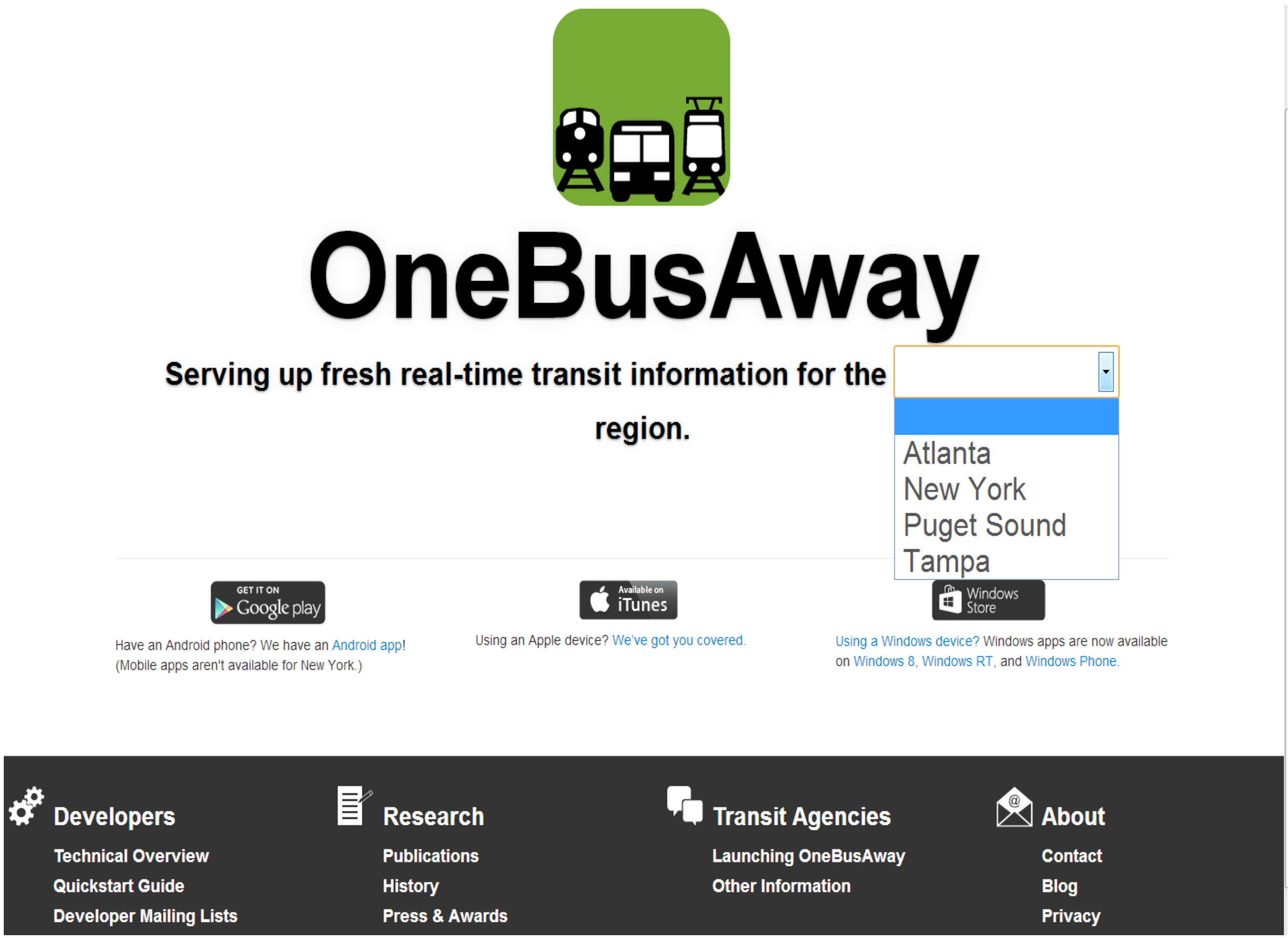
What is OneBusAway?

- **What?** Suite of tools that provides real-time bus/train tracking information
  - Open source software
  - API for developers
  - Free to riders
- **Why?** Make riding public transit easier by providing good information in usable formats
  - Research to evaluate the impacts

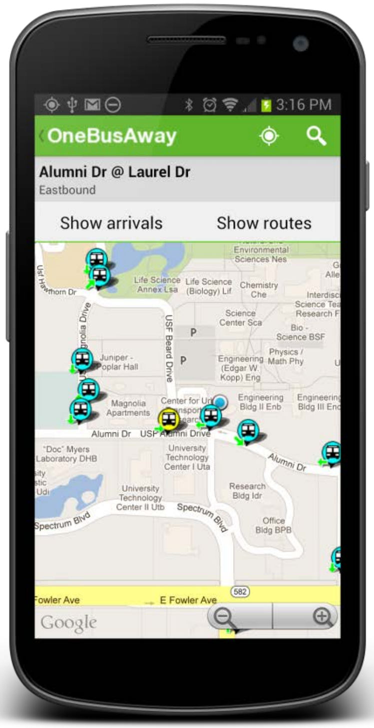


Website Interfaces

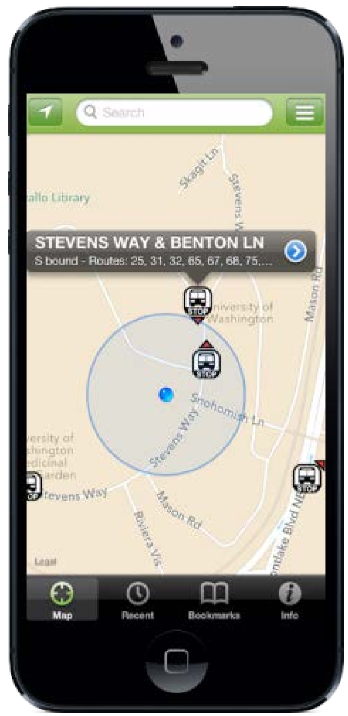


onebusaway.org

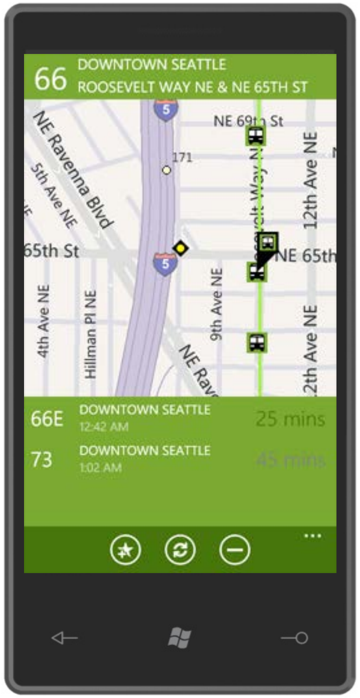
Mobile App Interfaces



Android



iPhone



Windows

Support user location, route, stop contextual/personalized information
All OPEN-SOURCE!

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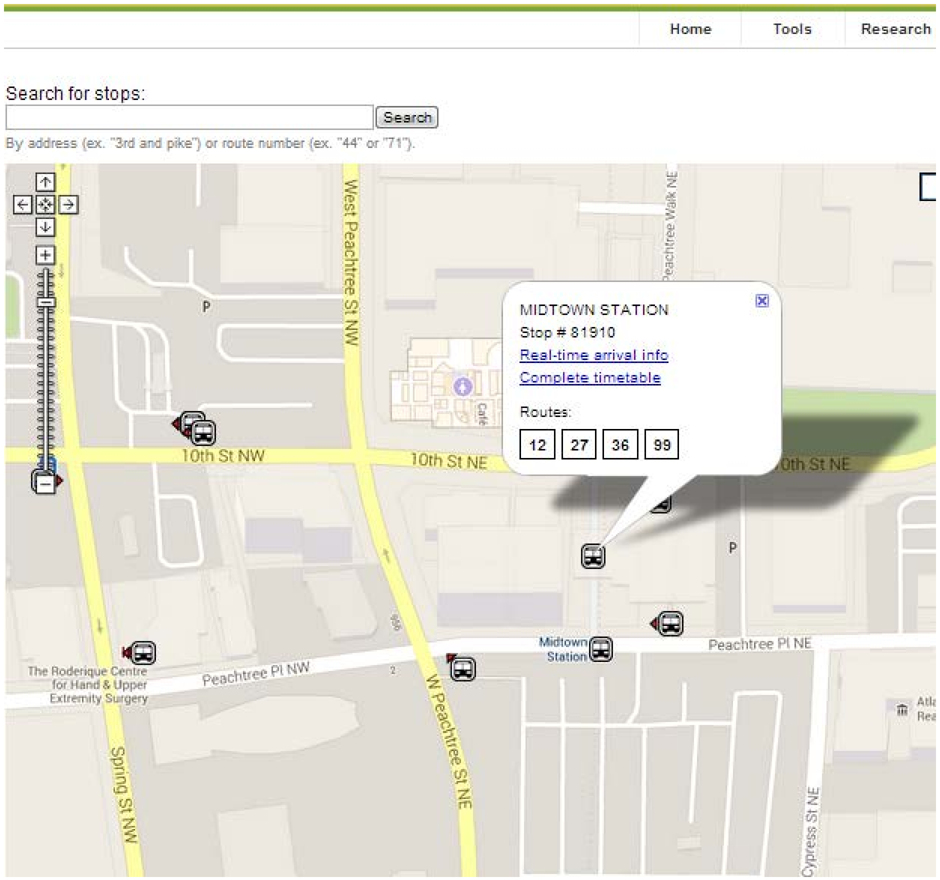
How to use OneBusAway



Home | Tools | Research

MIDTOWN STATION
Stop # 81910

route	destination	minutes
12	Route 12 - Cumberland Mall 02:15 - scheduled departure	NOW
99	Route 99- Georgia State Station 02:15 - departed 2 mins late	NOW
27	Route 27 - Lindbergh Station / Marta Headquarters 02:25 - on time	9
36	Route 36 Midtown Station 02:35 - 2 mins early	19
12	Route 12 - Cumberland Mall 02:35 - scheduled departure	19
99	Route 99 - Midtown Station 02:41 - on time	25
27	Route 27- Midtown Station 02:47 - on time	31
36	Route 36 - Avondale Station 02:47 - 2 mins early	31

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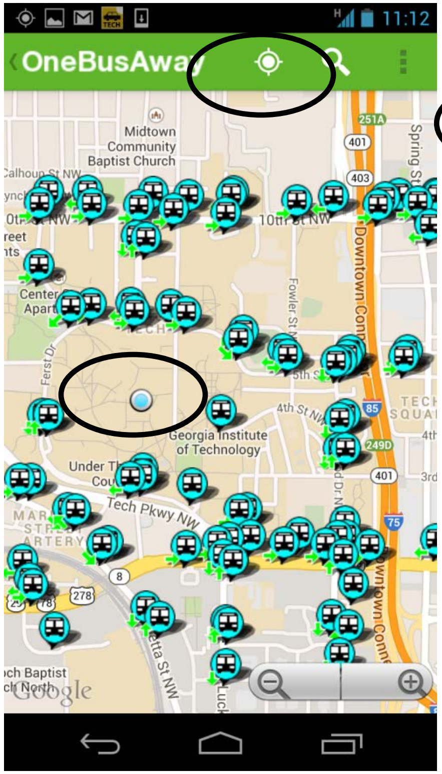
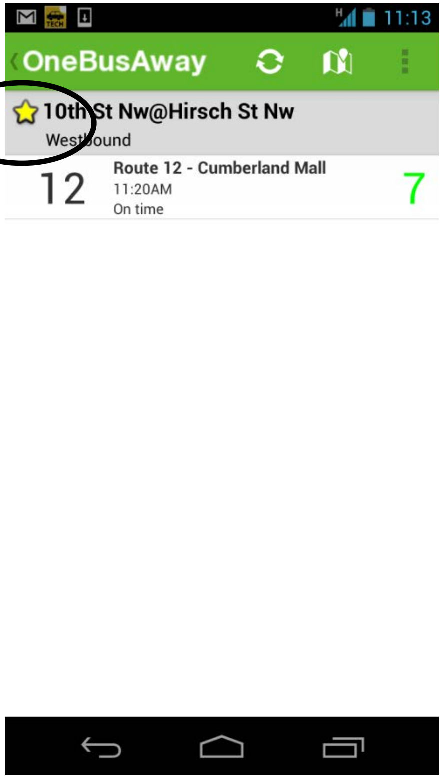
Mobile App Features

- Location-aware
- Bookmarking
- Service alerts
- Problem reporting

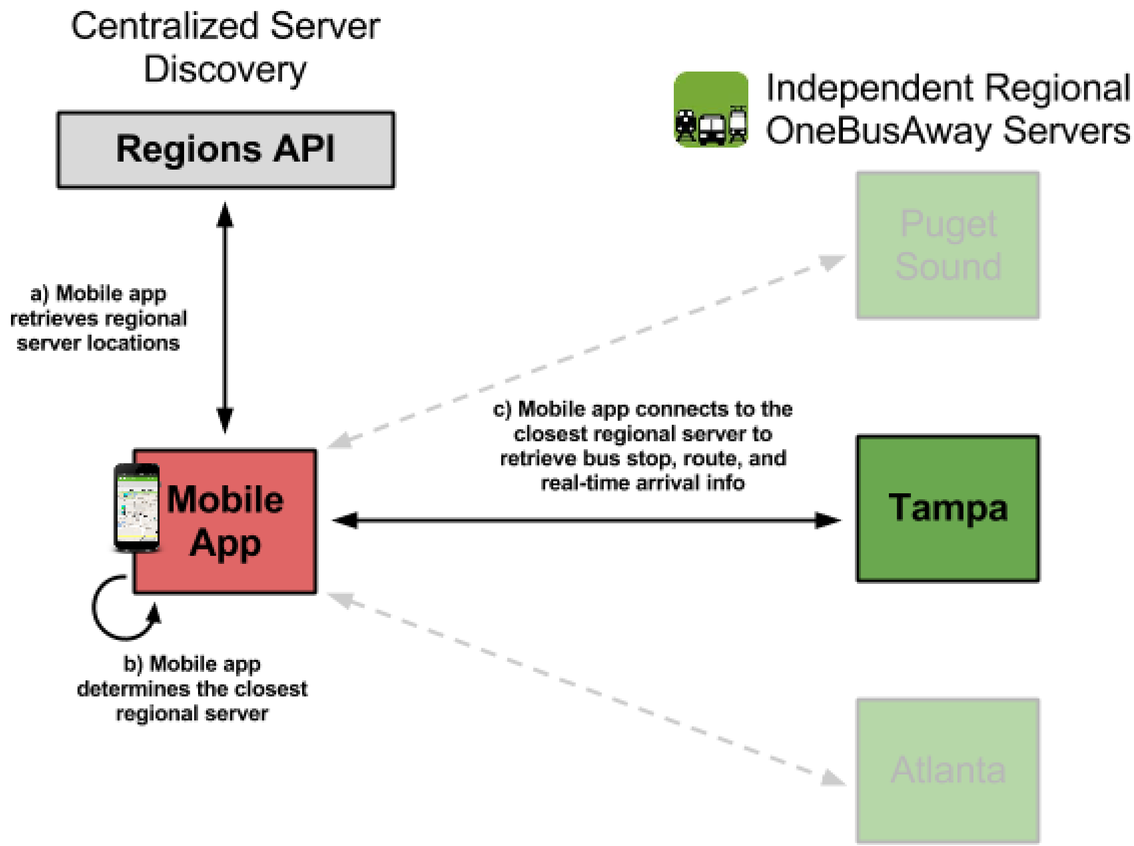




Android App

OneBusAway Multi-region

- Created centralized server directory
- Modified apps to find cities using directory
- Add a new city by adding a record in the directory



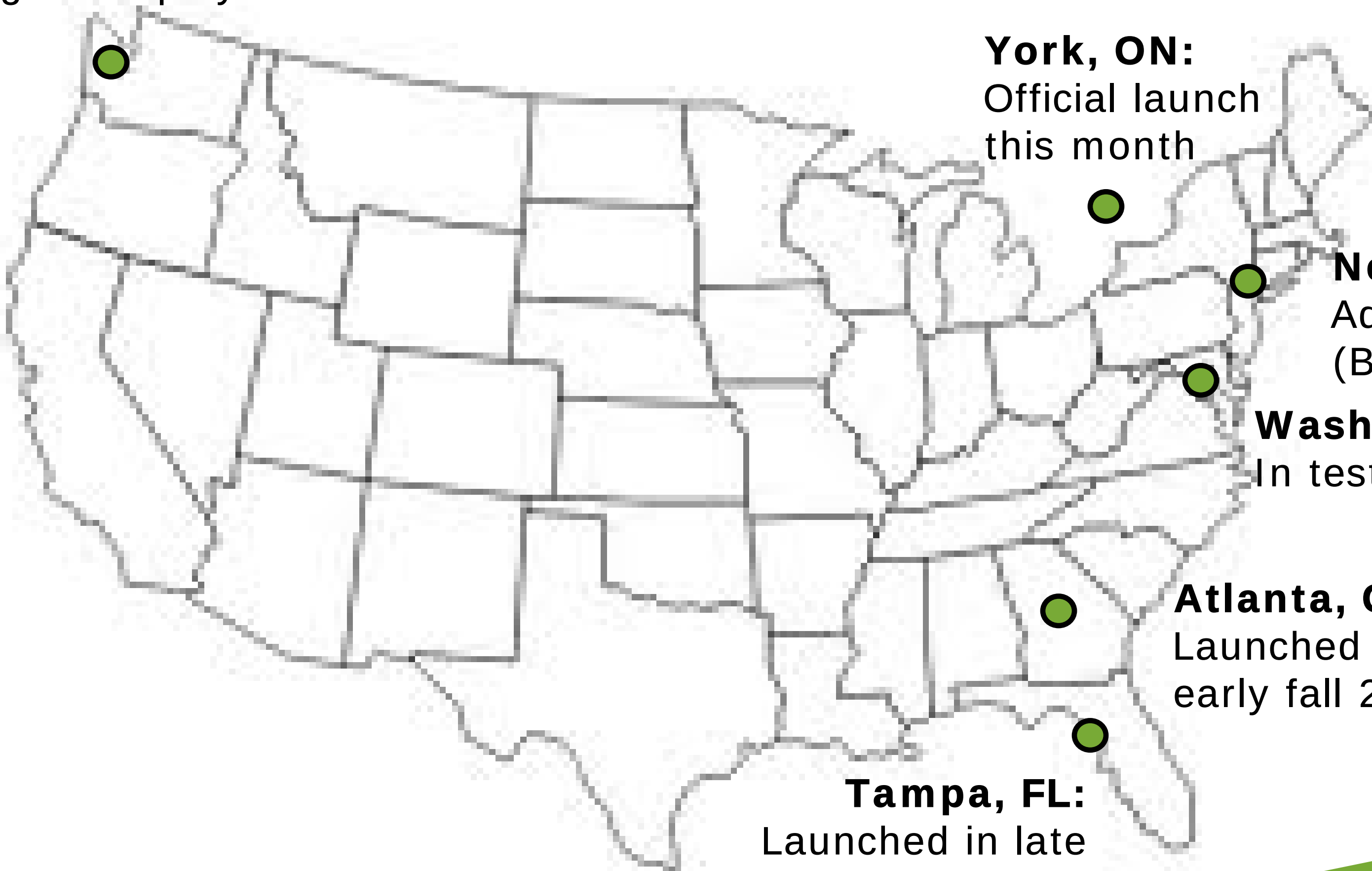
IMPACTS OF REAL-TIME ARRIVAL INFORMATION

Impacts

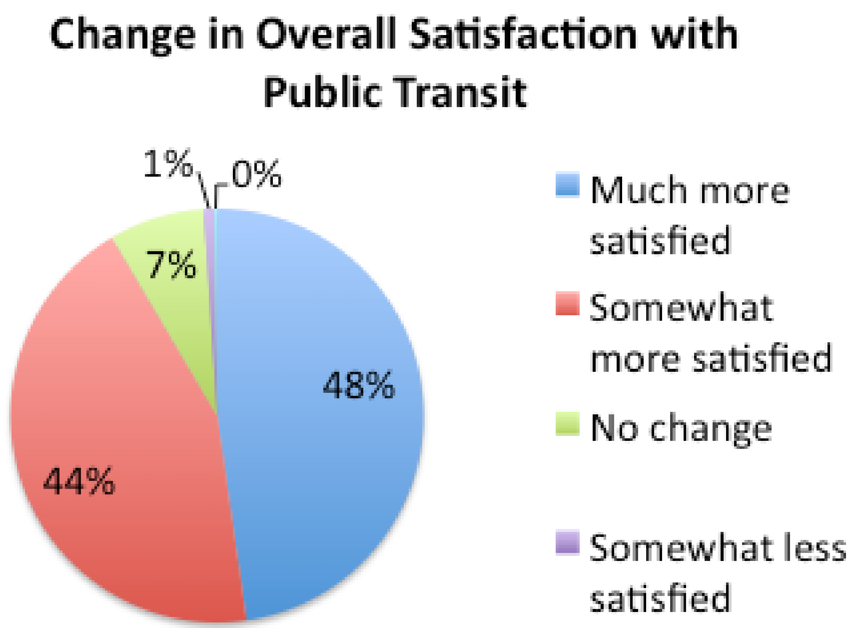
- Riders are more satisfied
- Riders feel safer
- Riders wait less time

- Do they take more transit trips?

Where is OneBusAway?



Change in Satisfaction



"I no longer sit with pitted stomach wondering where is the bus. It's less stressful simply knowing it's nine minutes away, or whatever the case."

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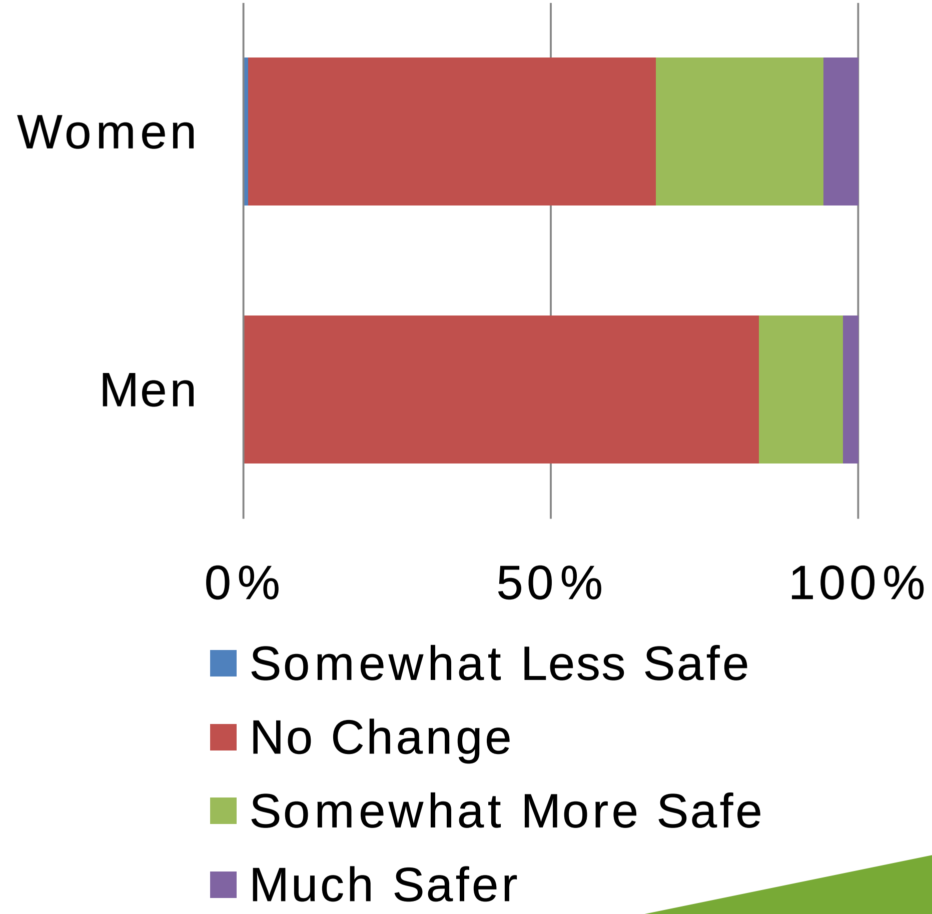
Perception of Safety

- Perception of Safety
  - 79% no change
  - 18% somewhat safer
  - 3% much safer
- Safety correlated with gender
  - χ^2=19.458
  - p-value=0.001



Wait Time

- Without real time, perceived wait > actual wait
- With real time, perceived wait = actual wait
- Value of real time >> more frequent service

Group	Real Time	Schedule	Difference	T-stat (p-value)
Mean Typical Wait	7.54	9.86	2.32	5.50 (0.00)
Aggravation Level	3.35	3.29	-0.05	-0.24 (0.81)
Actual Wait Time	9.23	11.21	1.98	2.17 (0.03)

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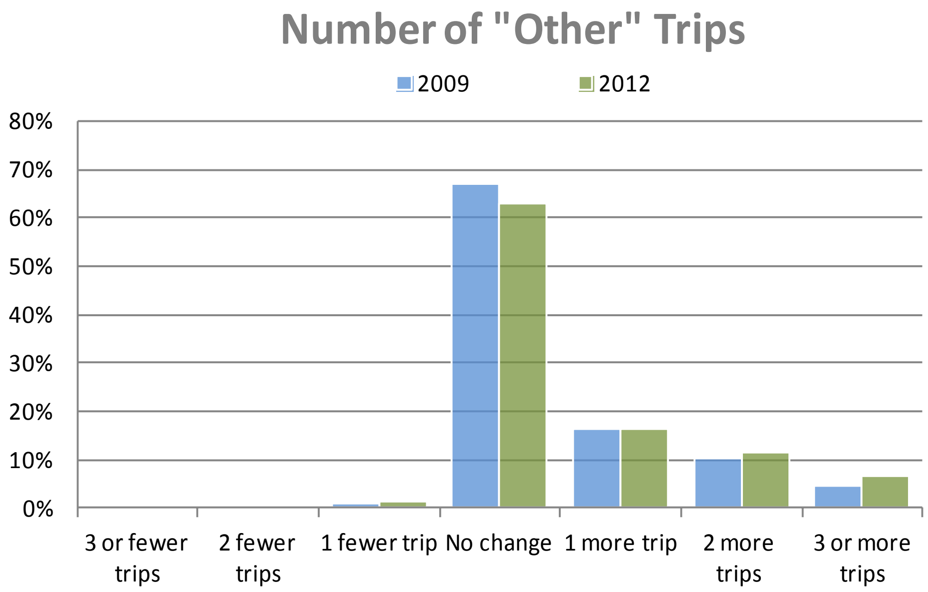
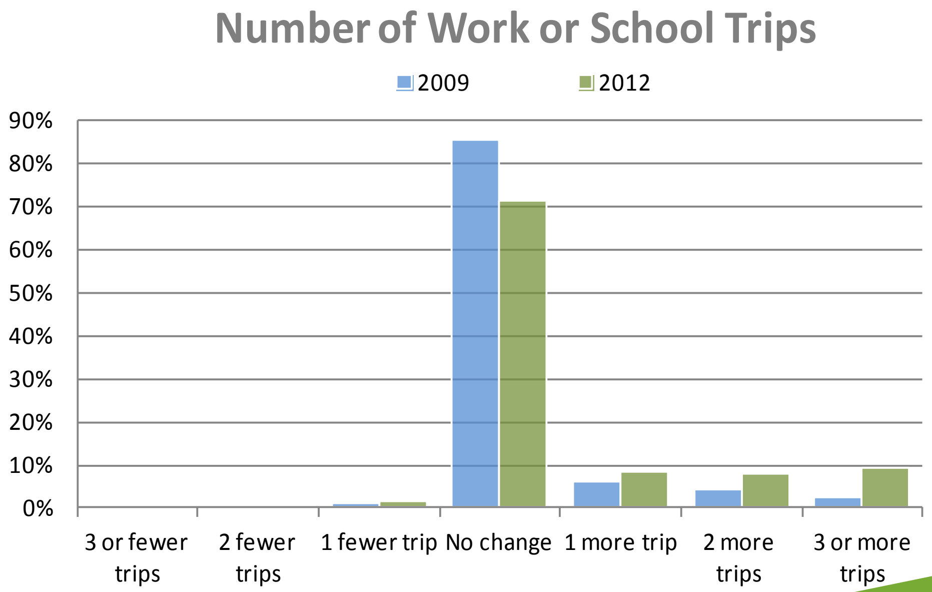
Increased Transit Usage





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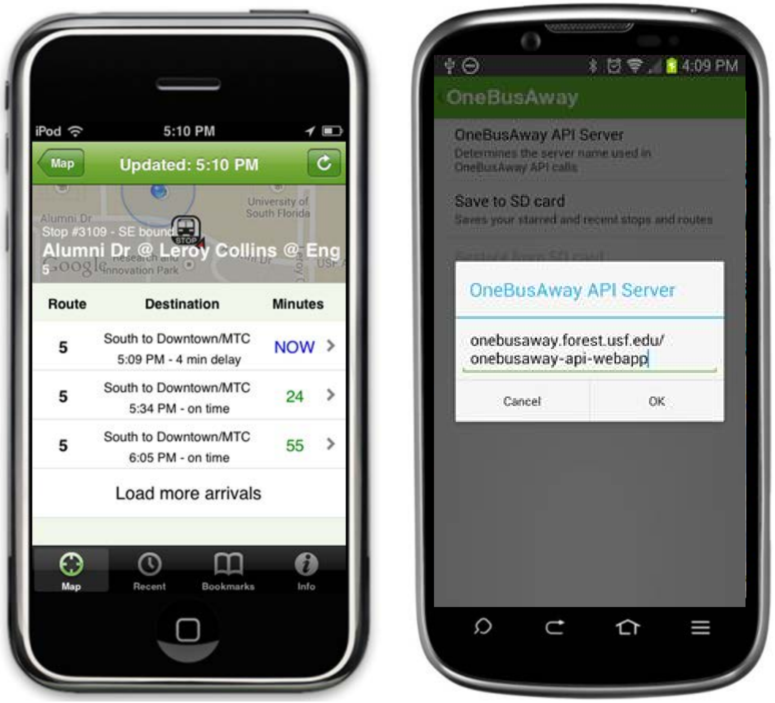
Tampa

Before-After Control Group Research Design

- **Motivation:** HART provided USF & Georgia Tech special access to real-time data
- **Recruitment:** HART website/email list (Incentive of 1 day bus pass)
- **Measurement:** Web-based surveys
- **Group Assignment:** Random number generator
- **Treatment:** OneBusAway

Limiting the Treatment: iPhone & Android Apps



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Tampa

- Significant improvements in the waiting experience
  - Decreases in self-reported usual wait times
  - Increases in satisfaction with wait times and reliability

- Little evidence supporting a change in transit trips
  - Approx. 1/3 of RTI users stated they ride the bus more frequently, perhaps because of:
    - Affirmation bias of respondents
    - Scale of measurement (trips per week)
  - Only riders within sphere of transit agency

New York City

MTA Bus Time®

Text / Mobile | About | Contact | Developers | Help

TIP: Enter an intersection, bus route or bus stop code.

Try these example searches:

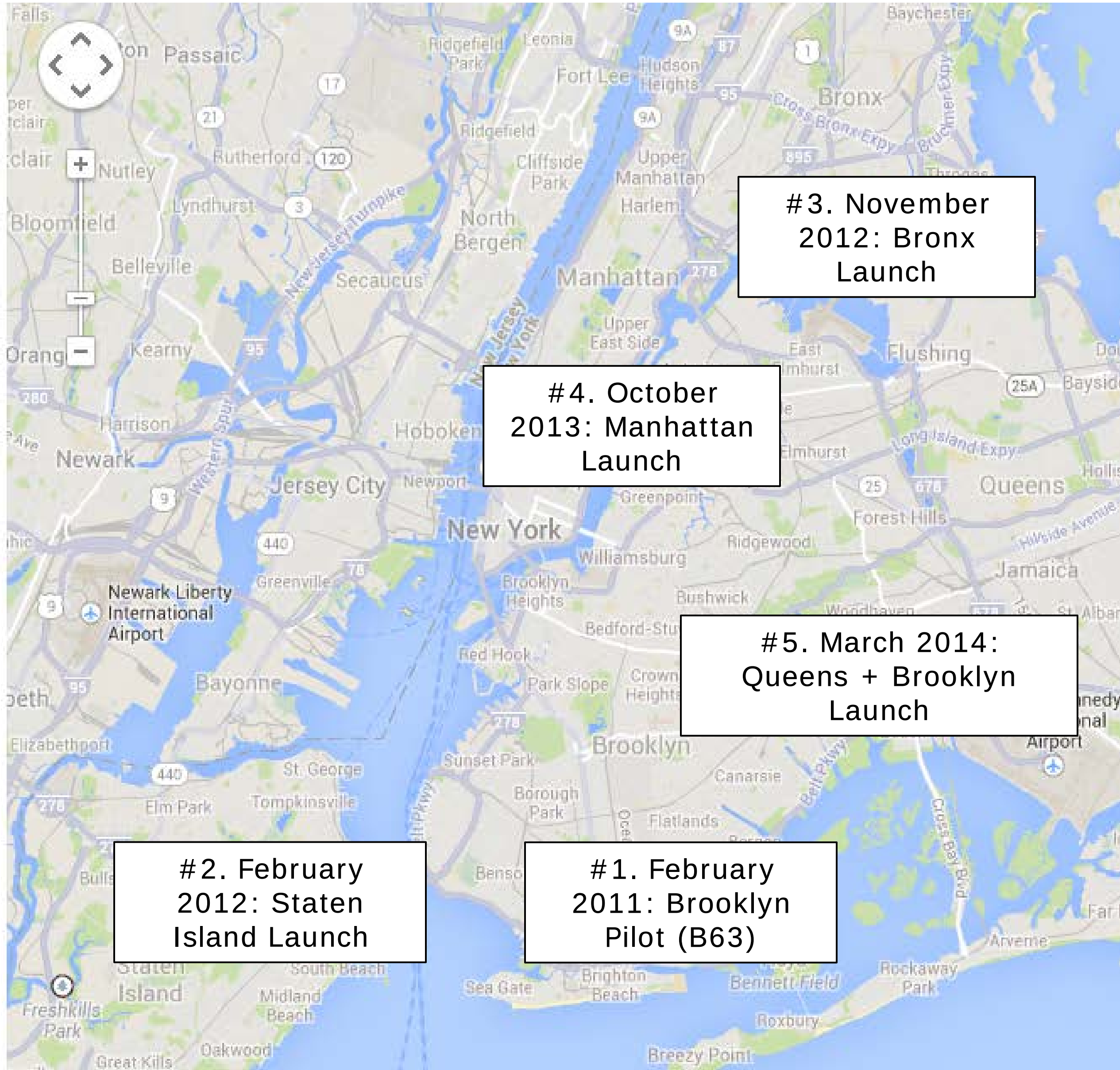
Route: B63 S62 X1

Intersection: Main St and Craig Ave

Stop Code: 200884

Location: 10304 Hylan Blvd

Click here for a list of available routes.



New York City

- **Method**
  - Comparison of multiple panel regression techniques in a well-suited natural experiment

- **Conclusions**
  - Real-time Information as a single variable
  - Average increase of ~115 rides per route per weekday (median of 1.6%), similar to previous Chicago study

  - Real-time Information by route size
  - Average increase of ~338 rides per weekday on the largest quartile of routes (median of 2.3%)

- **Limitations**
  - Short Timescale
  - Aggregate Analysis

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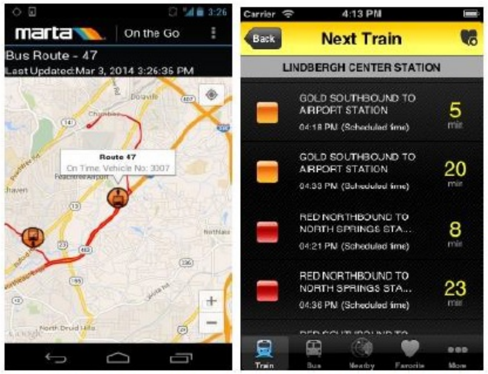
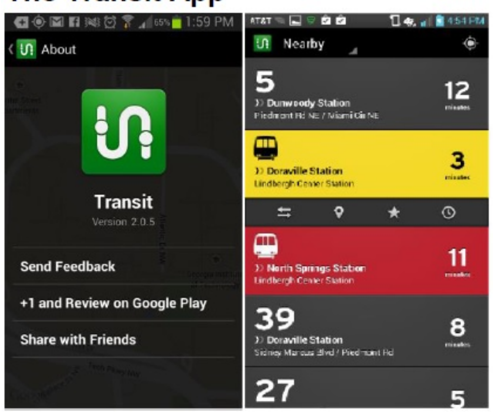
MARTA's On the Go Apps



Georgia Tech's OneBusAway Apps

The Transit App



Atlanta

*3. What is your 16-digit Breeze Card number?
Please do not enter spaces or dashes.

- **Data Collection**
  - Web-based survey conducted first week of May 2014
- **Recruitment**
  - Both real-time information (RTI) users and non-users
- **Matching with Smart Cards**
  - 669 participants entered survey software
  - 538 provided a 16 digit smart card number
  - 494 matched usable, active smart cards

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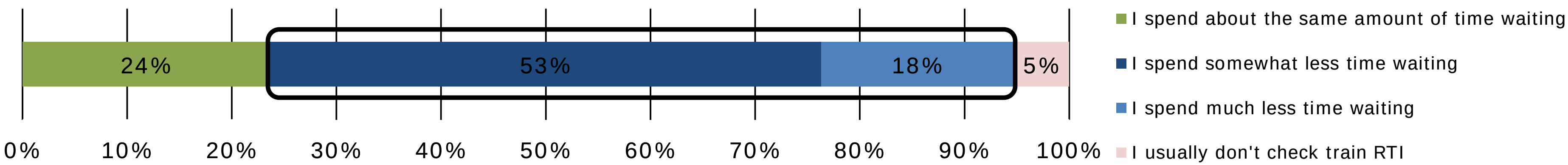
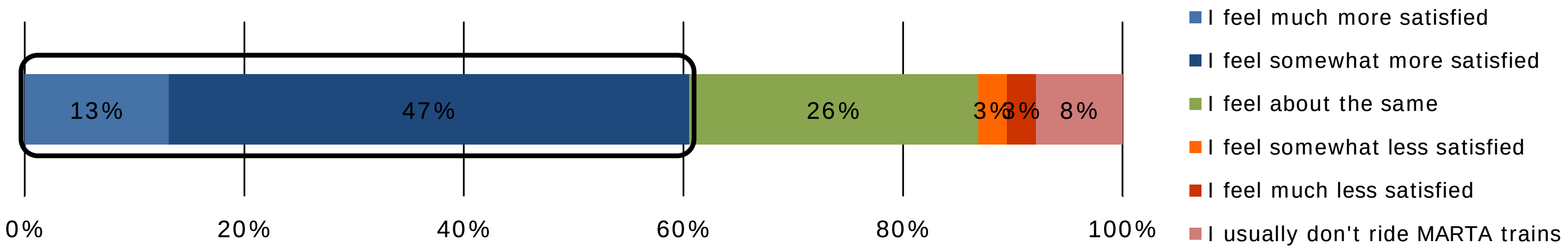
Atlanta

- Has using an app with real-time information changed the NUMBERS OF TRIPS that you take on MARTA TRAINS?*

- Has using an app with real-time information changed the amount of time you spend WAITING for MARTA TRAINS?**



- Has using an app with real-time information changed how SATISFIED you are with MARTA TRAIN service?



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Comparison of Key Findings

	New York City	Tampa	Atlanta
Transit Agency	MTA New York City Transit	HART	marta
Methodology	Natural experiment with panel regression	Behavioral experiment with a before-after control group design	Before-after analysis of transit trips
Key Finding	Average weekday route-level increase of ~115 rides (median of 1.6%); Average weekday increase of ~338 rides on the largest routes (median of 2.3%)	Little evidence supporting a change in bus trips; Significant improvements in the waiting experience, particularly wait times	Little evidence supporting a change in bus/train trips; Perceived improvements in wait times and overall satisfaction with MARTA

Simon Berrebi

USING REAL-TIME INFO TO PREVENT BUS BUNCHING

Content

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High-Frequency Route

- For passengers, high frequency = freedom
  - They can travel when they want
  - They can make spontaneous travel decisions
  - They don’t have to rely on a schedule
- Research shows random arrivals for headways < 12 minutes
- Transit agencies strive to minimize the waiting time of these passengers

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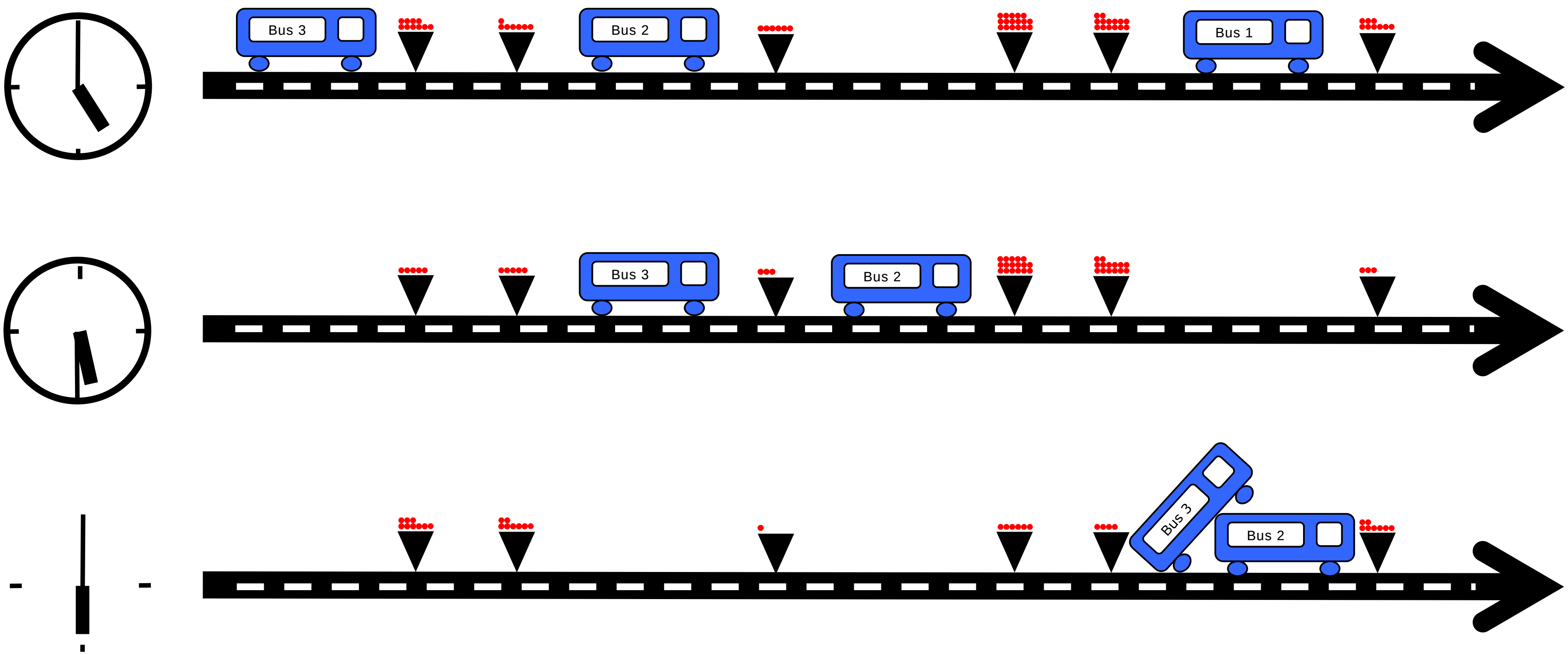
Unstable Headway Dynamics



- Passenger waiting
- Bus stop

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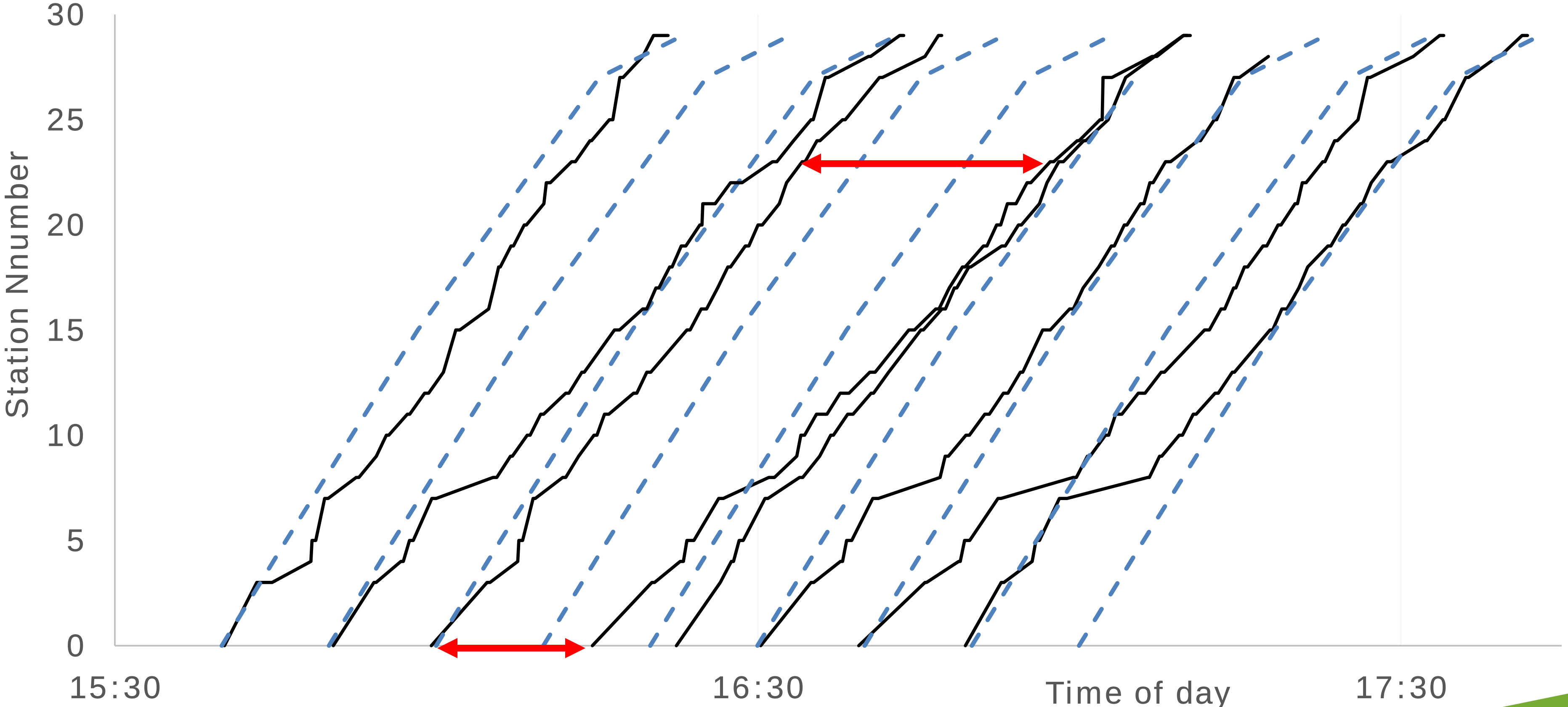
Offset of Bus Bunching



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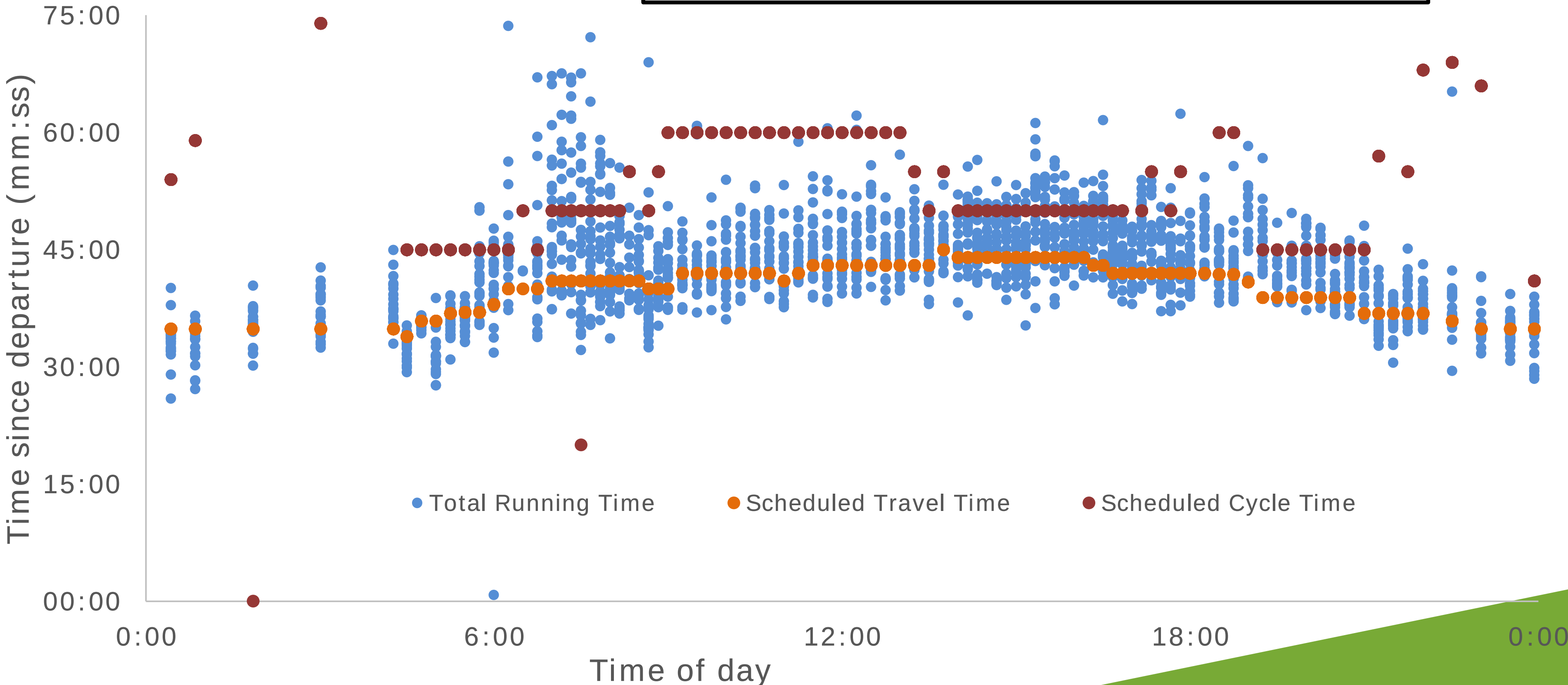
Schedules / Blocks

Tell operators when to start their route

- Help maintain stable headways
- Should include enough layover for buses to start on time

Cycle Time

Operator who finish too late will have to start next assignment **late** without break



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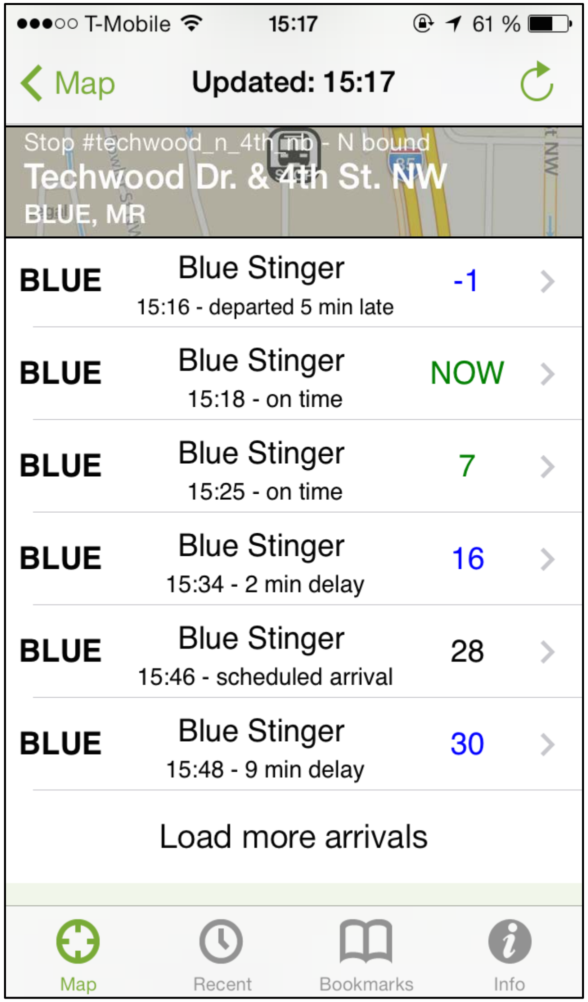
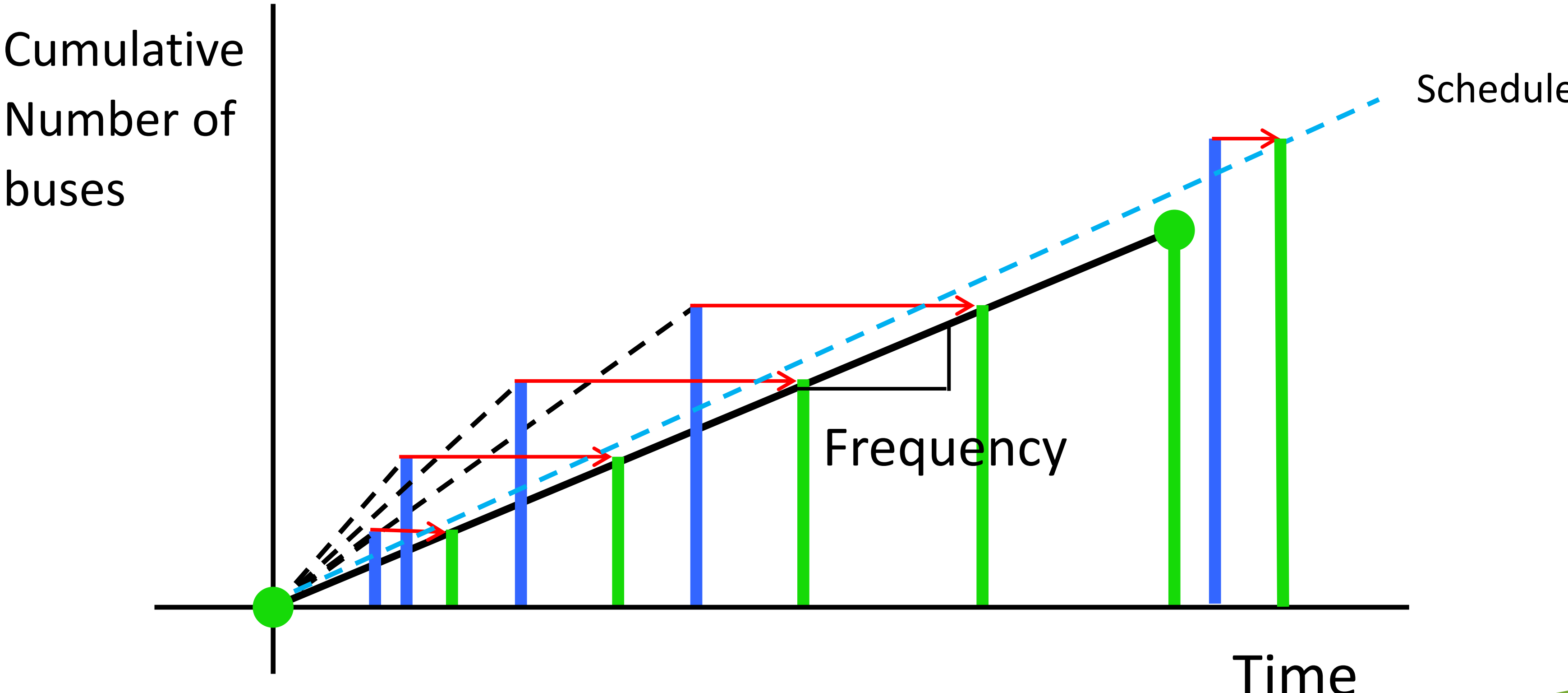
Real-Time Control



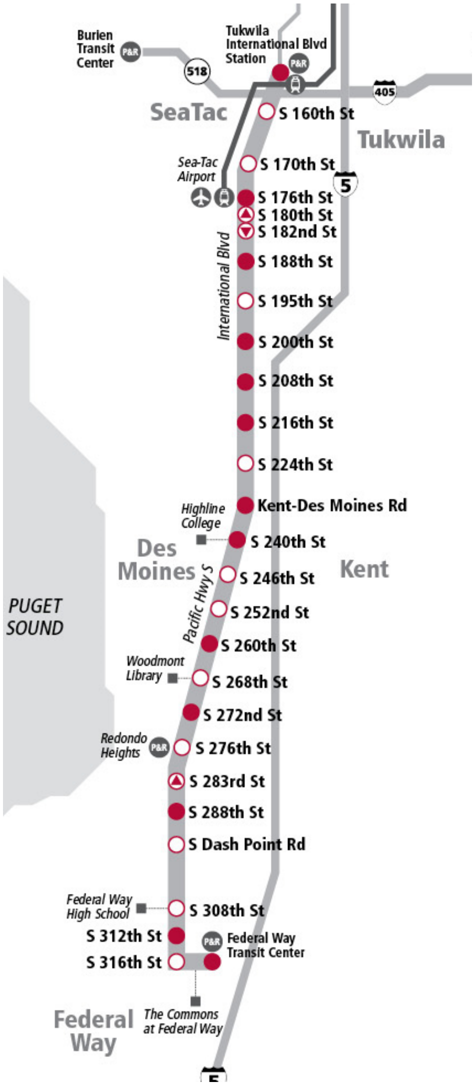
Using real-time information, it is possible to predict when buses will return late at the terminal

- We can *space out* departures to maintain stable headways

Proposed Policy



Simulation



We tested the real-time dispatching method on Line A in Seattle, WA

- 10 minute headways
- Repeated block in PM the afternoon (3-6 pm)
- Dedicated right-of-way

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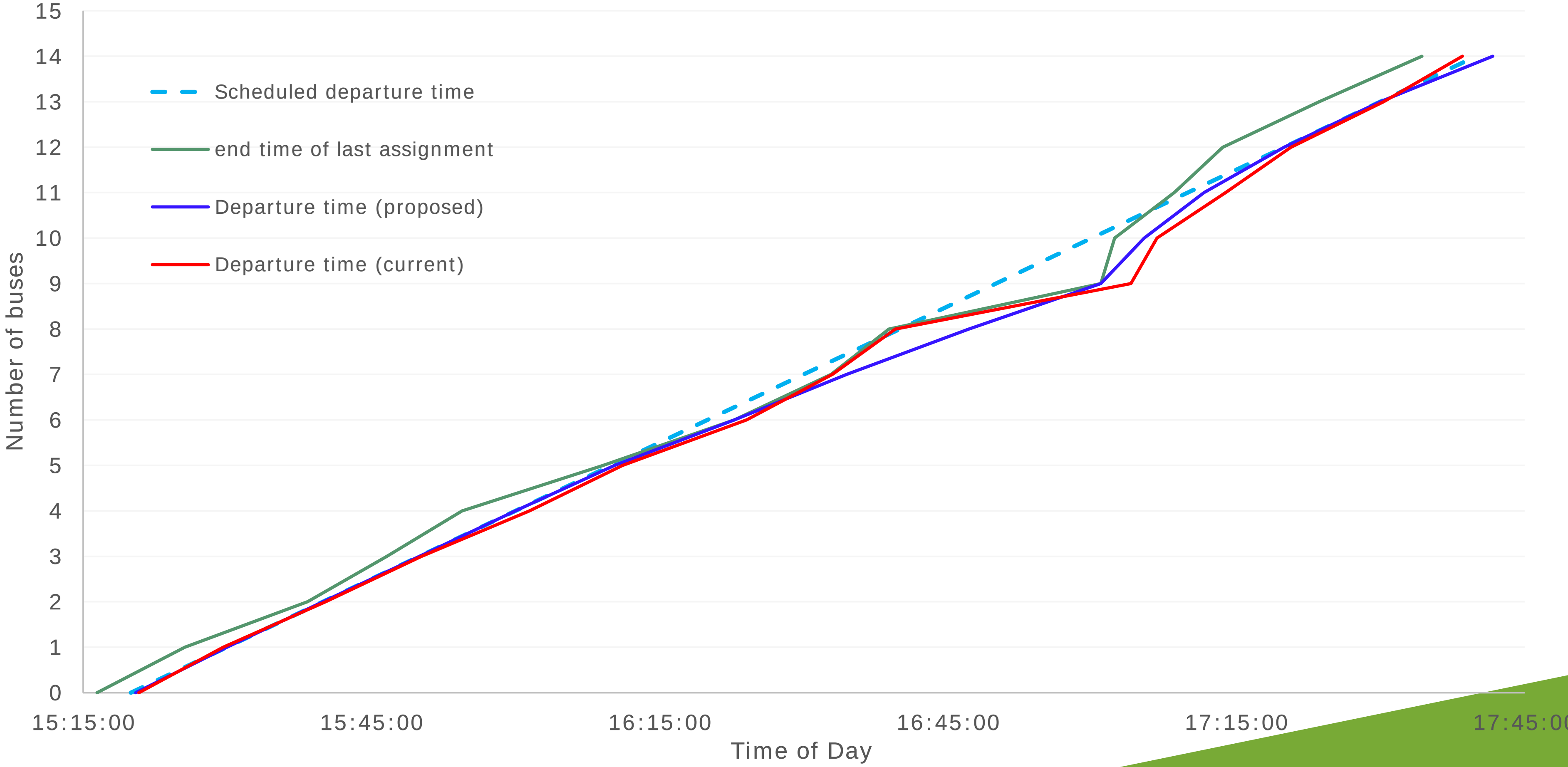
Number of Dispatches



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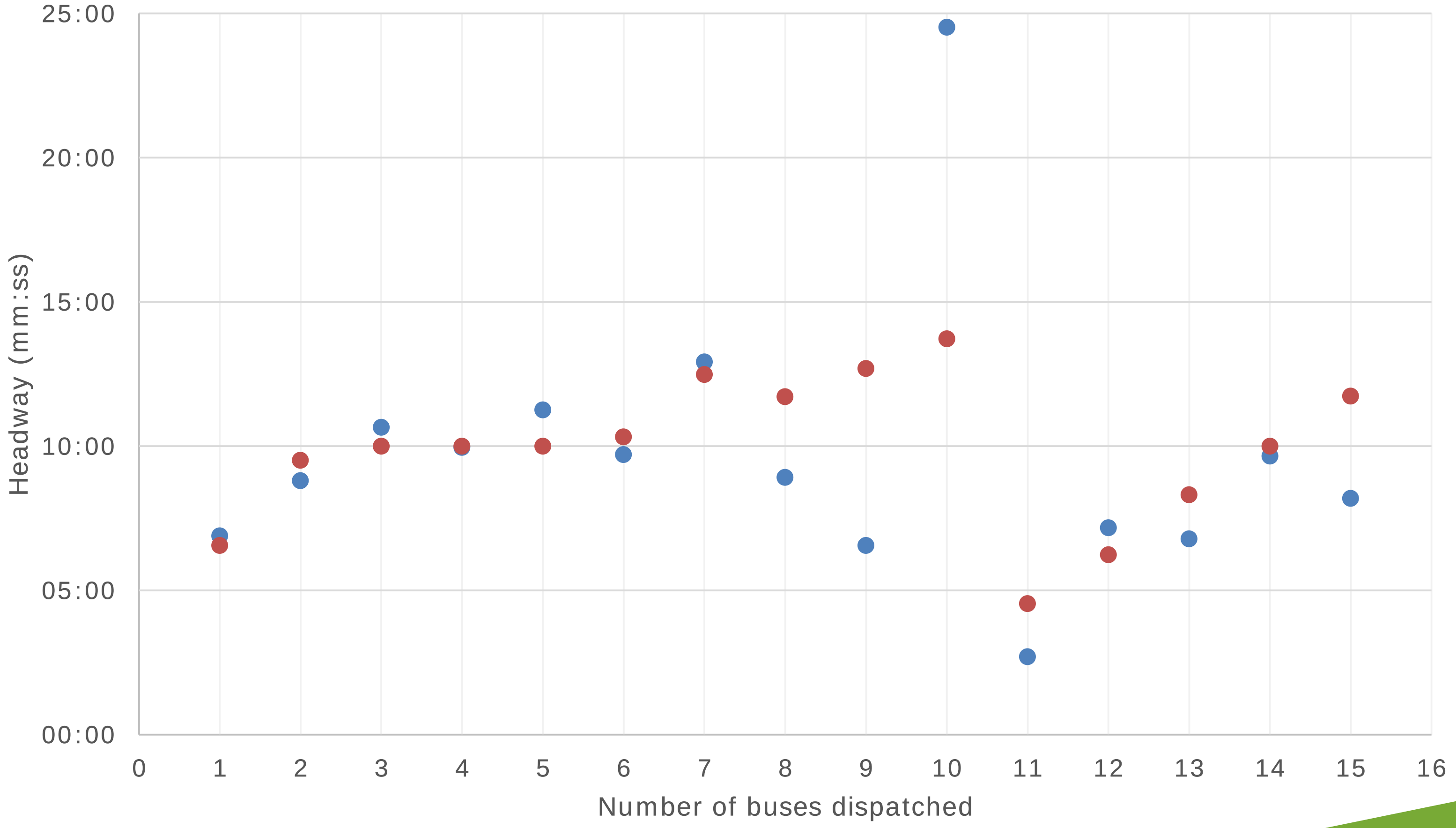
Headway Recovery



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Conclusion

- On high frequency routes, some passengers care more about headways then schedules
- Buses that start their route late often bunch because they get more passengers
- Using real-time information we can *space out* bus departures to keep stable headways

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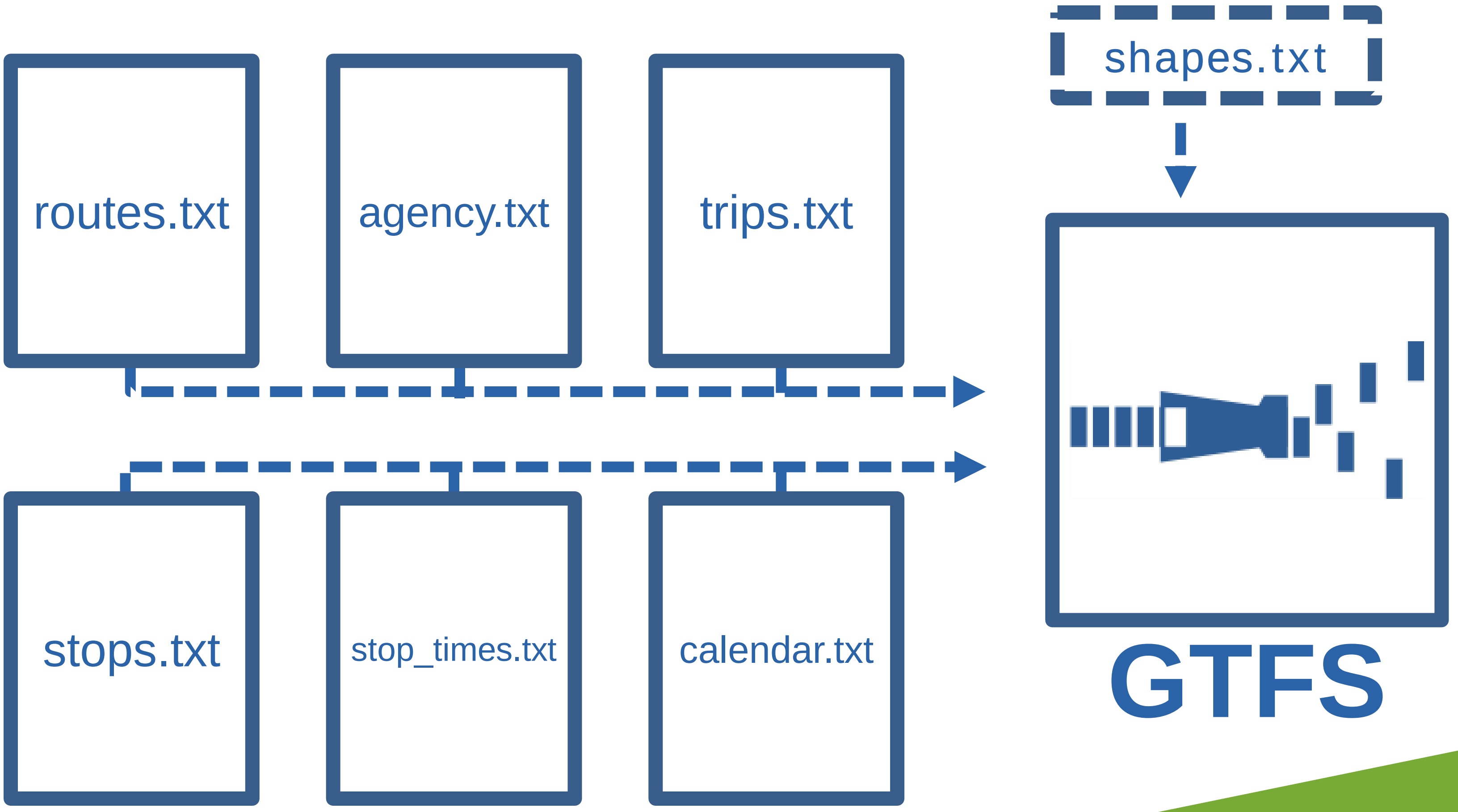
NEXT STEPS FOR YOU

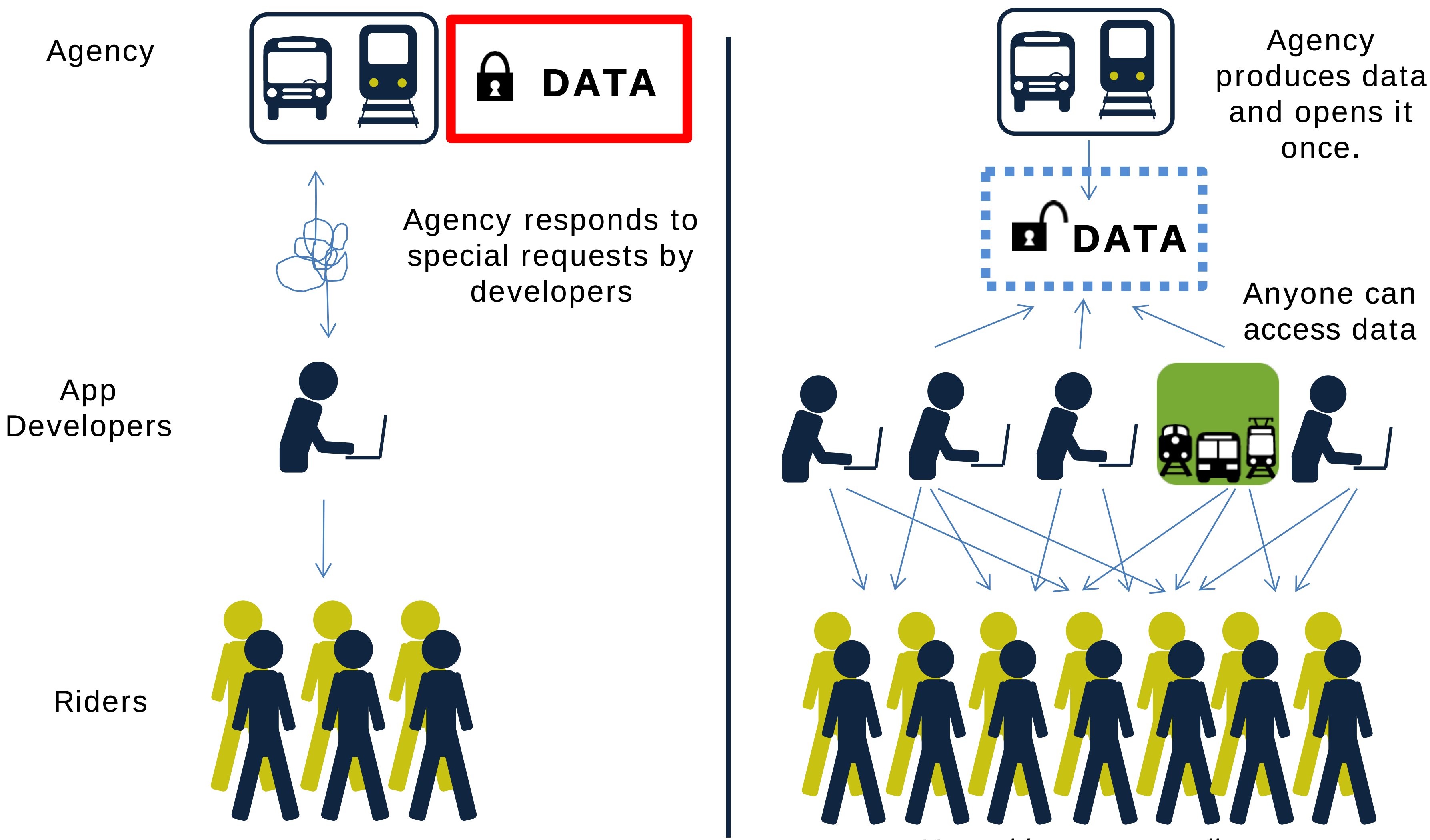
What can an agency do?

- Customer focus
- Consider installing AVL
- Convert schedule data to GTFS
- Open up data

General Transit Feed Specification



Open Data



Small subset of riders find this specific tool useful.

Many riders access a diverse market of tools powered by GTFS.

How to open your data?

From http://www.gtfs-data-exchange.com/how-to-provide-open-data:

1. Publish your schedule data as a GTFS feed. Google publishes instructions on how to create GTFS feeds.
2. Provide an official URL where your feed can be downloaded. This can be a URL on your agency site or a URL to a third-party authorized to host your feed. Note: a simple way to provide an official URL is to upload your feed to GTFS Data Exchange and use the provided url.
3. Send email to transit-developers@googlegroups.com with the URL of your feed. Note: this is a public mailing list.
4. Submit GTFS feed location for inclusion on GTFS Data Exchange. This helps developers find the URL where your data is published.

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THANKS!

http://onebusaway.org

- *Funding partners* = NSF, US DOT, NCTSPM, CUTR, GVU Center, IPAT
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- *Research partners* = Dr. Brian Ferris, Dr. Alan Borning (UW), Dr. Sean Barbeau (USF), independent developers

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