

Performance Measurements Using Real-Time Open Data Feeds: The MBTA-performance system



2017 Fare Collection/Revenue Management & TransITech Conference

Ritesh Warade, Associate Director, IBI Group

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Agenda

Introduction

Boston MBTA's challenge

Approach

The MBTA-performance system

Questions?



Multi-disciplinary professional services firm

2,500+ staff / 75+ offices including Boston

Core expertise in transit / rail service planning and operations analysis

Extensive experience in Transit Technology

Increasing focus on Transit Data



IBI's Transit Data practice focuses on helping transit agencies:

Manage their data end-to-end

Provide high-quality information to passengers

Analyze and measure the quality of service provided to and experienced by customers

Boston MBTA's Challenge



Size: 5th Largest Agency in the US, 1.3 million Passengers Daily

Multimodal: Subway, Light Rail, Bus, Boat, Commuter Rail

Goal: Provision of Real-time Passenger Information

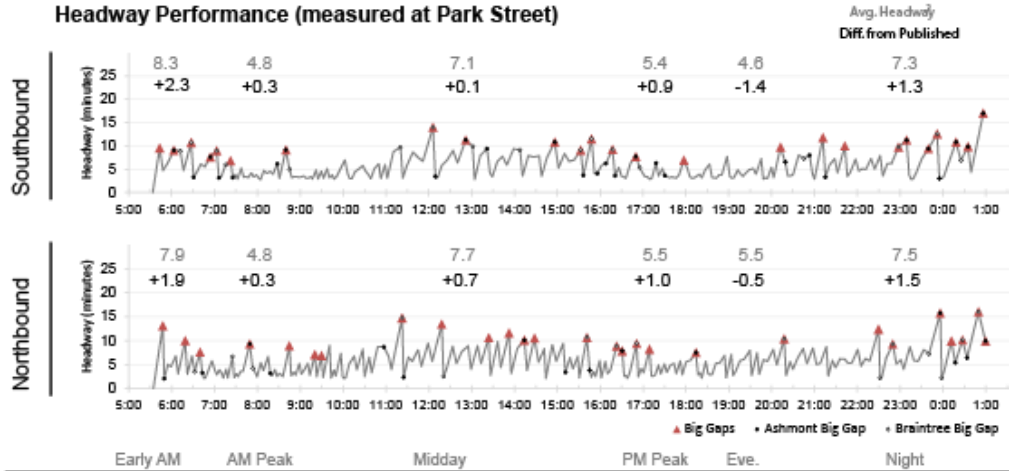
Passengers Waits			Passenger Travel Time²	
87%	97%	100%	96%	100%
< Headway	< Big Gap	< 2X Headway	delayed < 3 min.	delayed < 6 min.
Goal: 90%*	Goal: 98%*	Goal: 100%*	Goal: TBD	Goal: TBD

Comparison to range for each metric over prior 6 months (red bar is today, dark grey is worse than median, light grey is better)

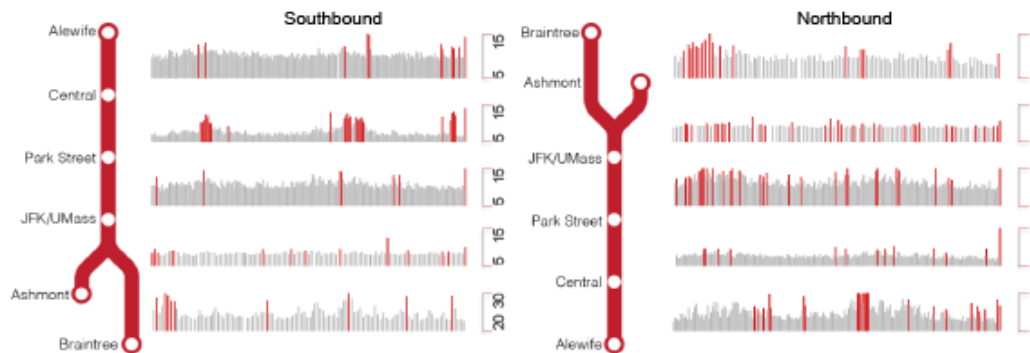


* Goals are tentative, may be changed

Headway Performance (measured at Park Street)



Running Time Performance by Segment



Highlighted times are 15% higher than the median for the period

1. The standard for a big gap is either 1.5 times or 3 minutes greater than the scheduled headway, whichever is lower.
2. Passenger travel time is based on average passenger demand rates per period. I.e. 18000 people entering a station during the peak is a demand rate of 6000/hr or 100/min, which are further divided by destination. The rate is multiplied by the headway of a train to get the number of people boarding that train. If a train takes more than 3 minutes more than normal between any two points, the passengers on that train are considered delayed. It does not account for people not being able to board a train due to crowding.
3. Weighted average headway accounts for the fact that fewer people end up experiencing a short headway than a long headway, since fewer passengers arrive between trains.

Passengers Waits

87%

< Headway

Goal: 90%*

97%

< Big Gap

Goal: 98%*

100%

< 2X Headway

Goal: 100%*

Passenger Travel Time²

96%

delayed < 3 min.

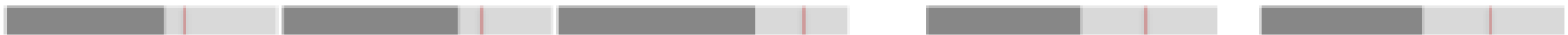
Goal: TBD

100%

delayed < 6 min.

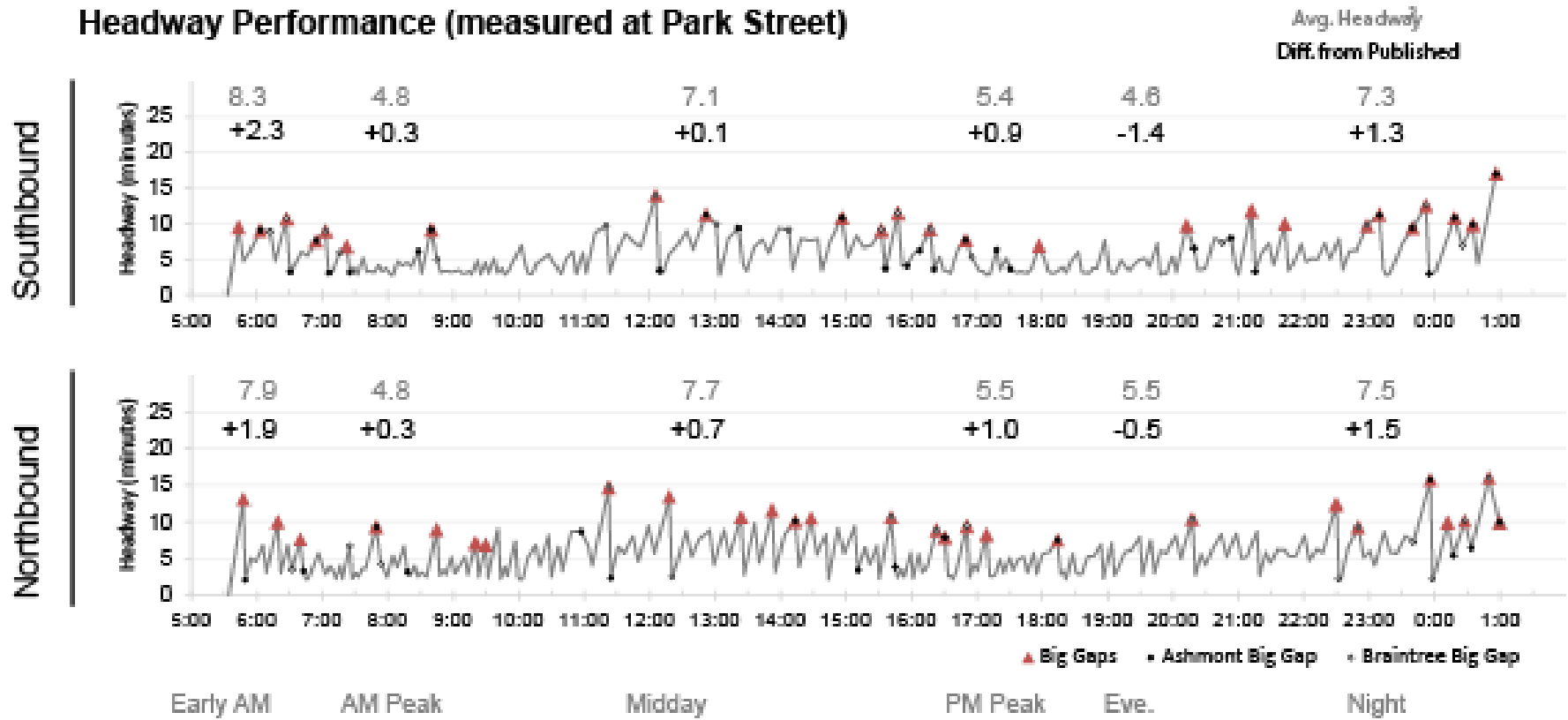
Goal: TBD

Comparison to range for each metric over prior 6 months (red bar is today, dark grey is worse than median, light grey is better)



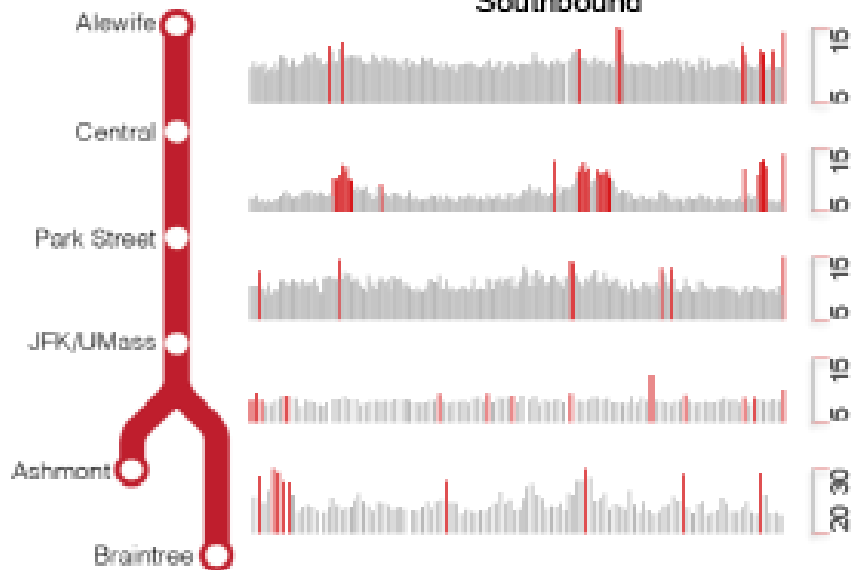
* Goals are tentative, may be changed

Headway Performance (measured at Park Street)

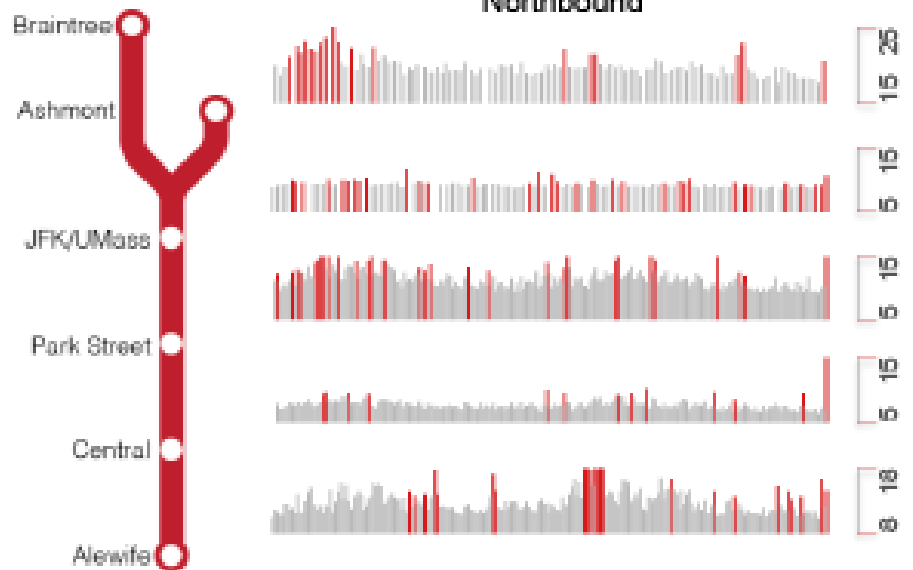


Running Time Performance by Segment

Southbound



Northbound



Highlighted times are 15% higher than the median for the period

1. The standard for a big gap is either 1.5 times or 3 minutes greater than the scheduled headway, whichever is lower.
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3. Weighted average headway accounts for the fact that fewer people end up experiencing a short headway than a long headway, since fewer passengers arrive between trains.



Challenges

Tied to the source of data

Train Tracking

Bus CAD/AVL

Replicating for other modes / agencies

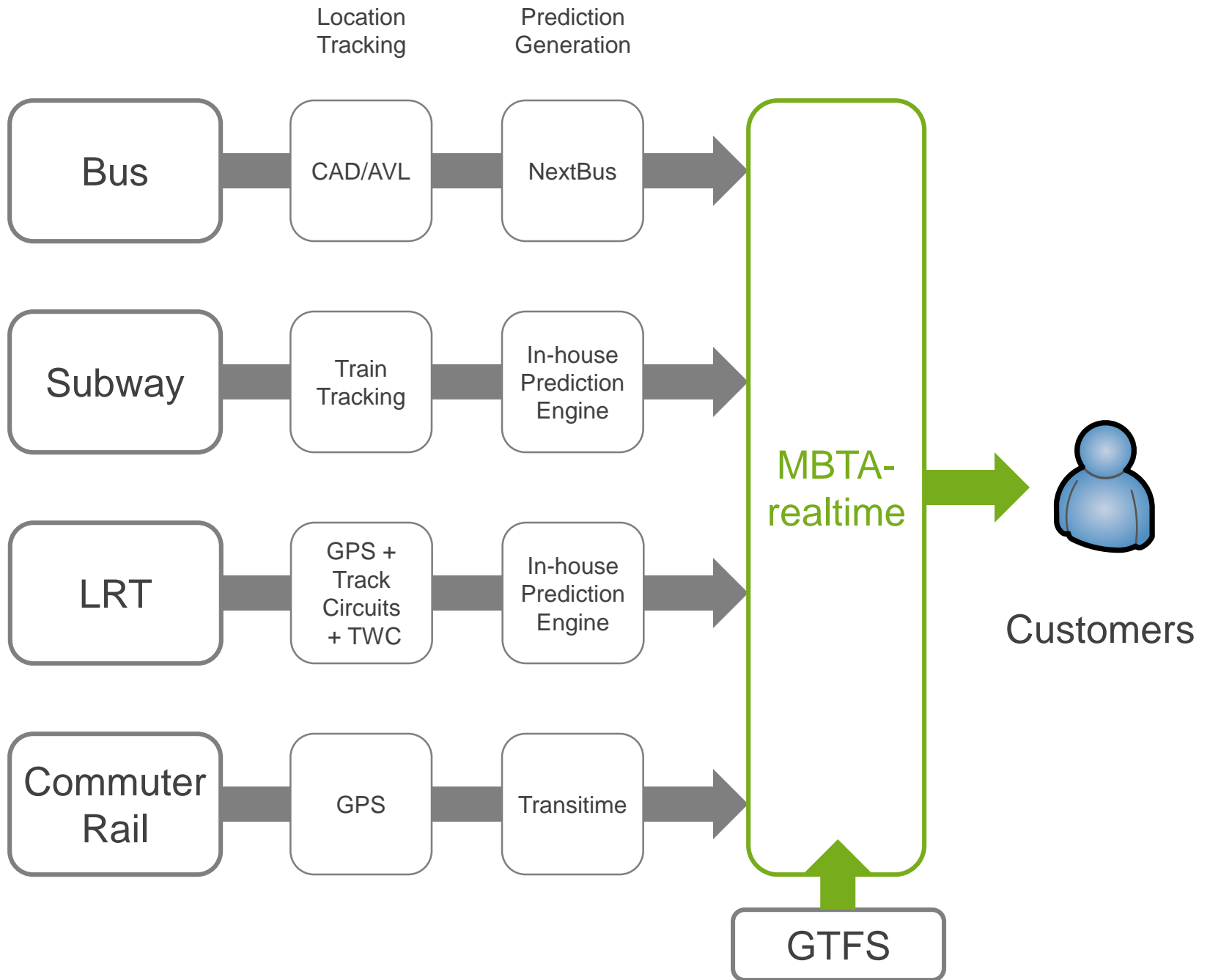
Not real-time

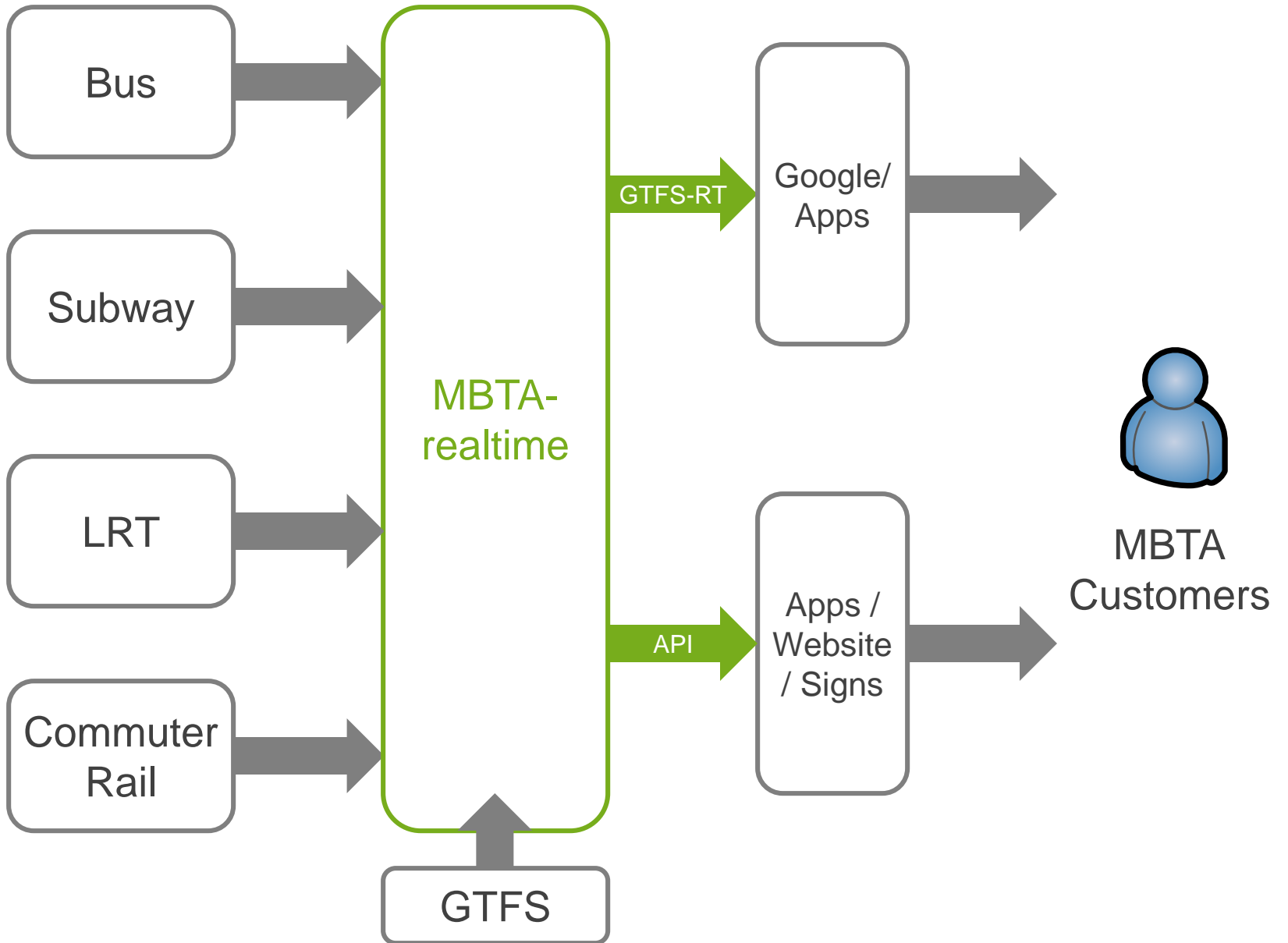
Approach

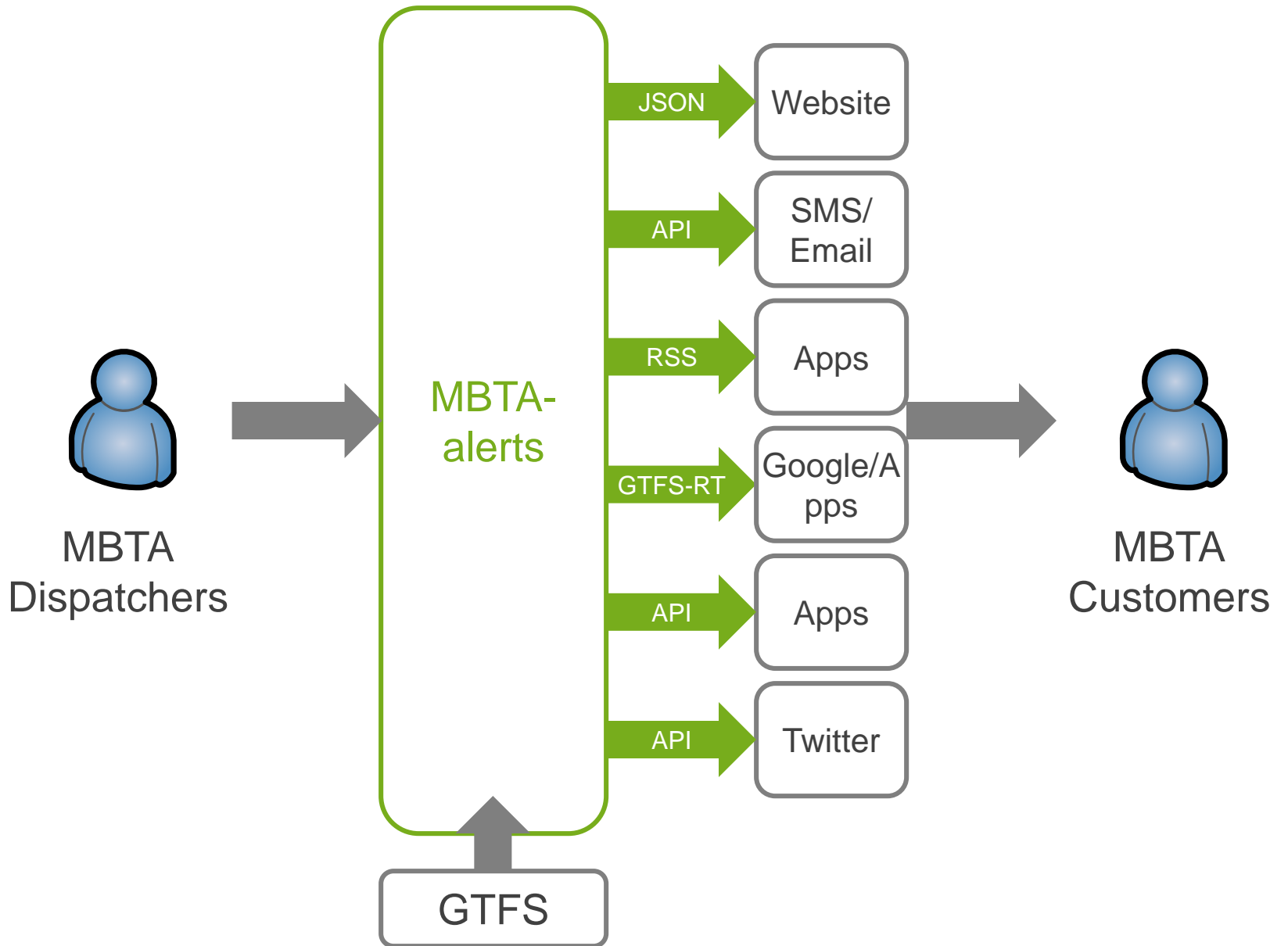


Could We

Leverage Open Data
GTFS-realtime feeds









GTFS-RT

Trip Updates

Vehicle Positions

Service Alerts



Provide real-time data to customers

Updated frequently 5-15 seconds

All modes / services

Well documented

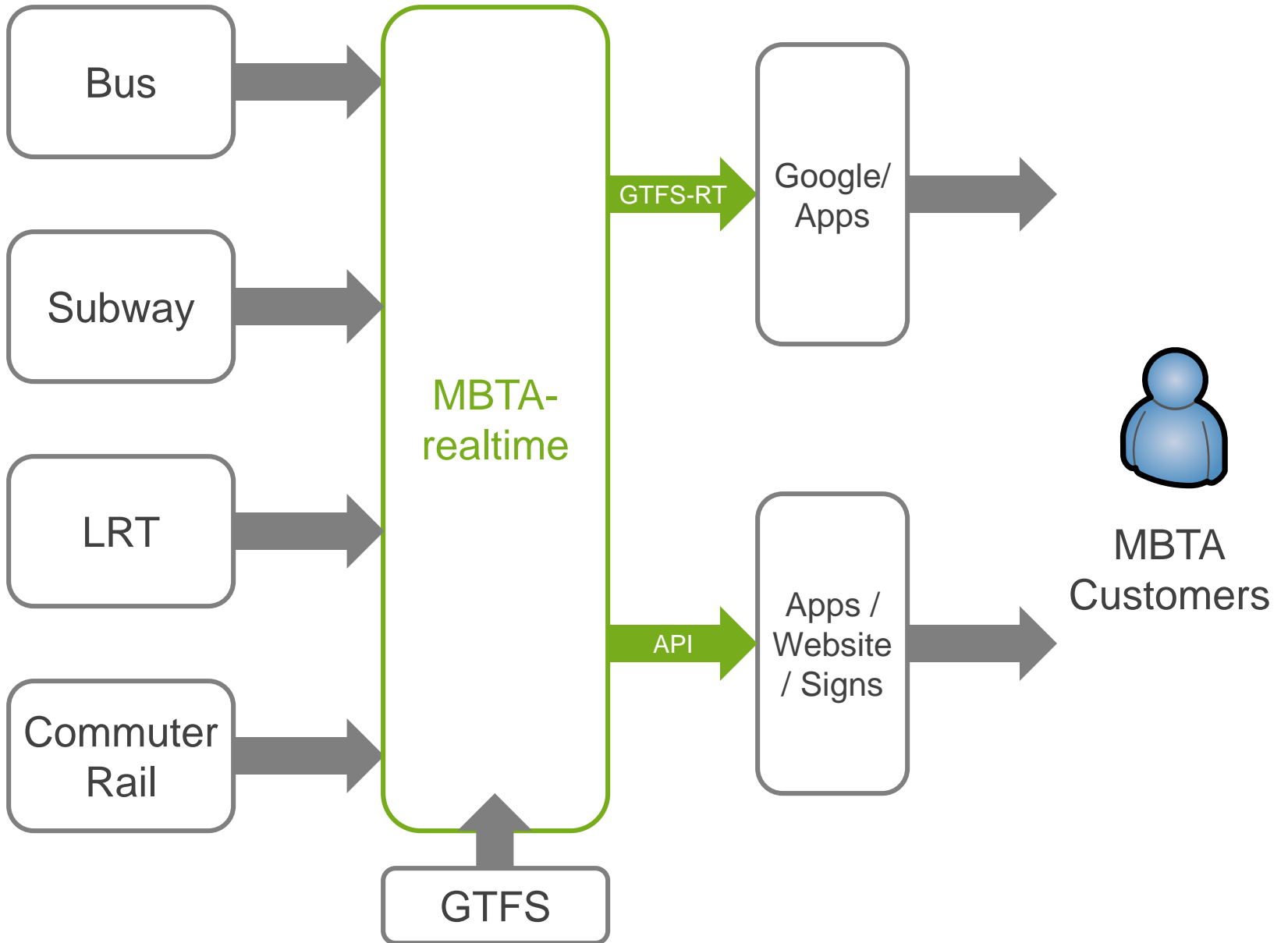
Widely adopted

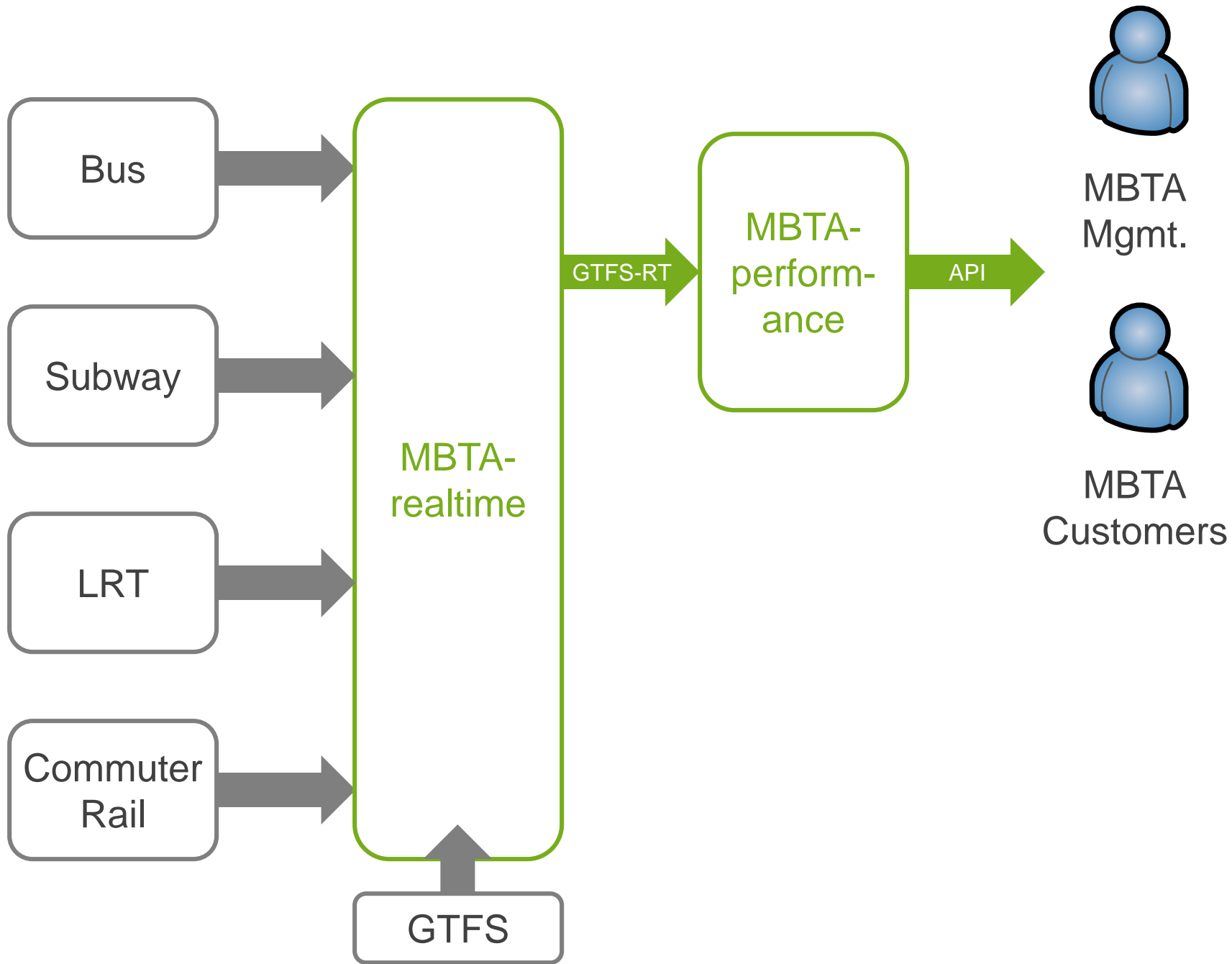
Strong incentive to maintain

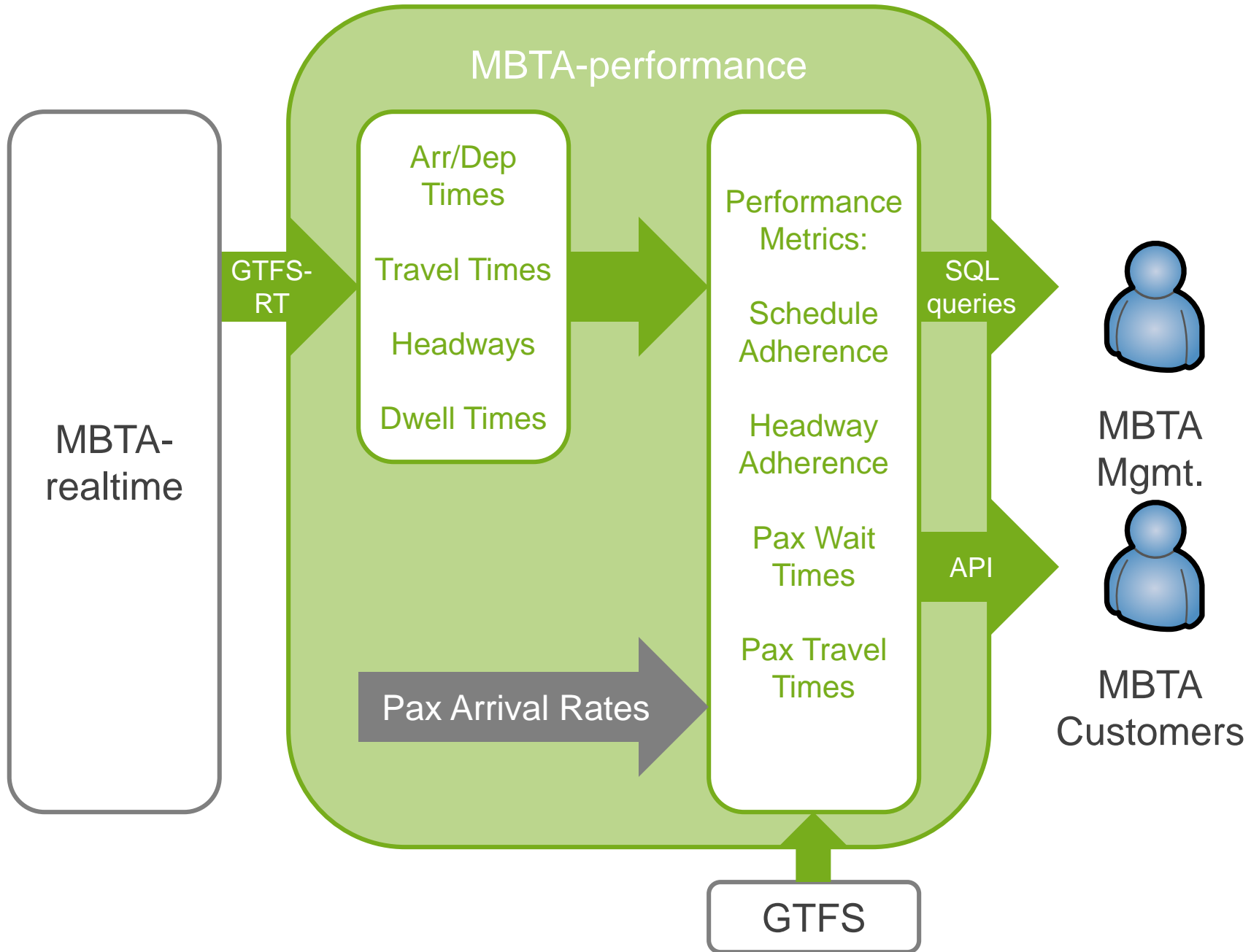
Ensure up-time

As systems change

The MBTA-performance System









Beginning of day:

- Check for and load latest GTFS, config files, and passenger rates

- Set up schedule and benchmarks for next day

Continuously (every 5 seconds)

- Download and process GTFS-realtime vehicle positions, trip updates, and service alerts feeds

- Generate actual arrival/departure, prediction, and alert events

- Calculate headways, travel time, dwells, schedule adherence

Every 5 minutes:

- Combine with passenger loading data

- Generate metrics for past hour, and day-so-far

End of day:

- Reprocess entire day

- Generate metrics for entire day

- Write to history

- Archive data



Actual arrival and departure times

Actual dwell times

Actual travel times

Actual headways

- For all routes at a stop

- For same route at a stop

- For all routes serving an o-d pair

Actual schedule adherence

Percentage of trips that meet or exceed a set threshold

Percentage of people adversely affected beyond a set threshold



API Calls

[Travel Times](#)

[Headways](#)

[Dwell Times](#)

[Schedule Adherence \(in test\)](#)

[Daily Metrics](#)



API Calls

```
▼ {  
  ▼ "travel_times": [  
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      "route_id": "Red",  
      "direction": "1",  
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      "arr_dt": "1457454099",  
      "travel_time_sec": "136",  
      "benchmark_travel_time_sec": "180"  
    },  
    ▼ {  
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      "direction": "1",  
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      "arr_dt": "1457454546",  
      "travel_time_sec": "145",  
      "benchmark_travel_time_sec": "180"  
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    ▼ {  
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      "arr_dt": "1457455016",  
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      "benchmark_travel_time_sec": "180"  
    },  
  ],  
}
```



API Calls

```
▼ {  
  ▼ "headways": [  
    ▼ {  
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      "prev_route_id": "Red",  
      "direction": "1",  
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      "previous_dep_dt": "1457453965",  
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      "previous_dep_dt": "1457454455",  
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}
```



Internal

Operations Management

Service Planning

Management

External

Customers

Third Party Developers

Internal Dashboard

Daily Performance

Red Line

Thursday, March 23, 2017

Headways On-Time

Last Hour

84%

Today

76%

Passenger Waits

Last Hour

92%

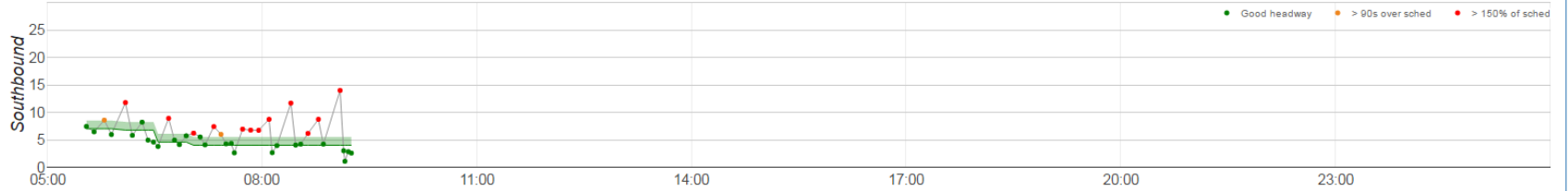
Today

91%

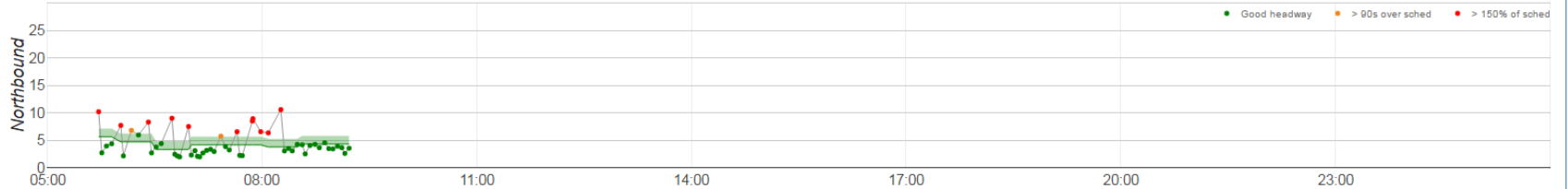
Headway Chart

[Big Gaps Table](#)

Harvard - Inbound



Broadway - Inbound



Internal Dashboard

Daily Performance

Red Line

Thursday, March 23, 2017

Headways On-Time

Last Hour

75%

Today

76%

Passenger Waits

Last Hour

92%

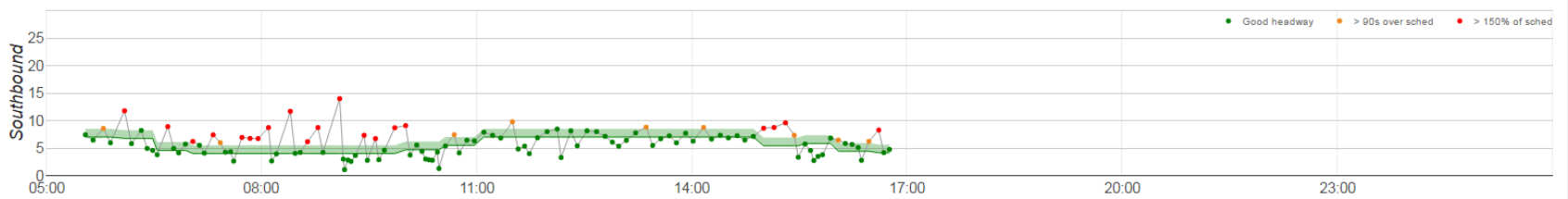
Today

92%

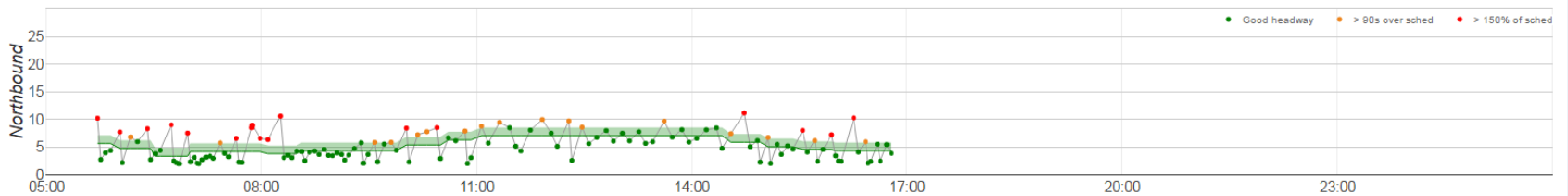
Headway Chart

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Internal Dashboard

Daily Performance

Red Line

Thursday, March 23, 2017

Headways On-Time

Last Hour

--

Today

77%

Passenger Waits

Last Hour

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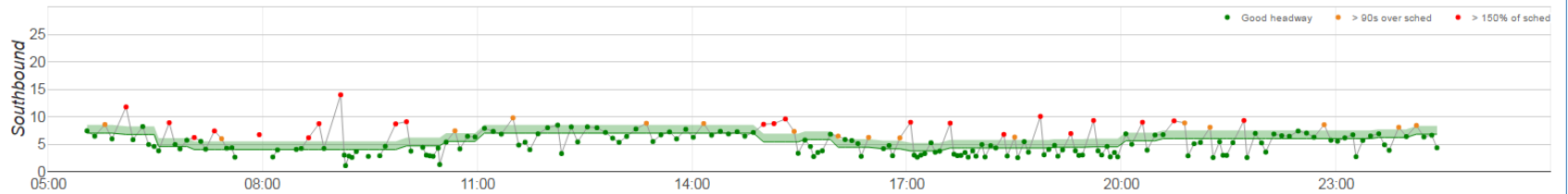
Today

93%

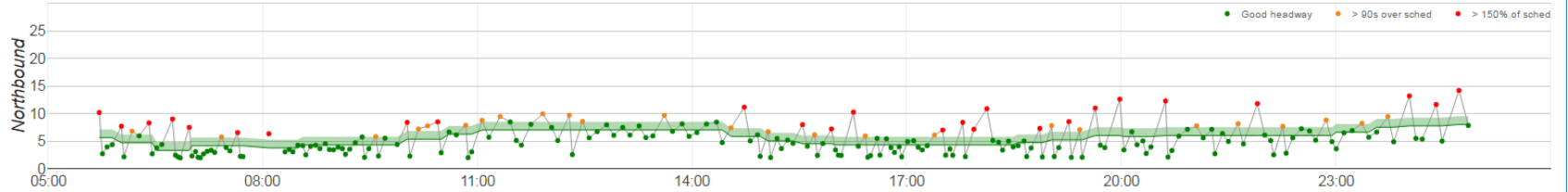
Headway Chart

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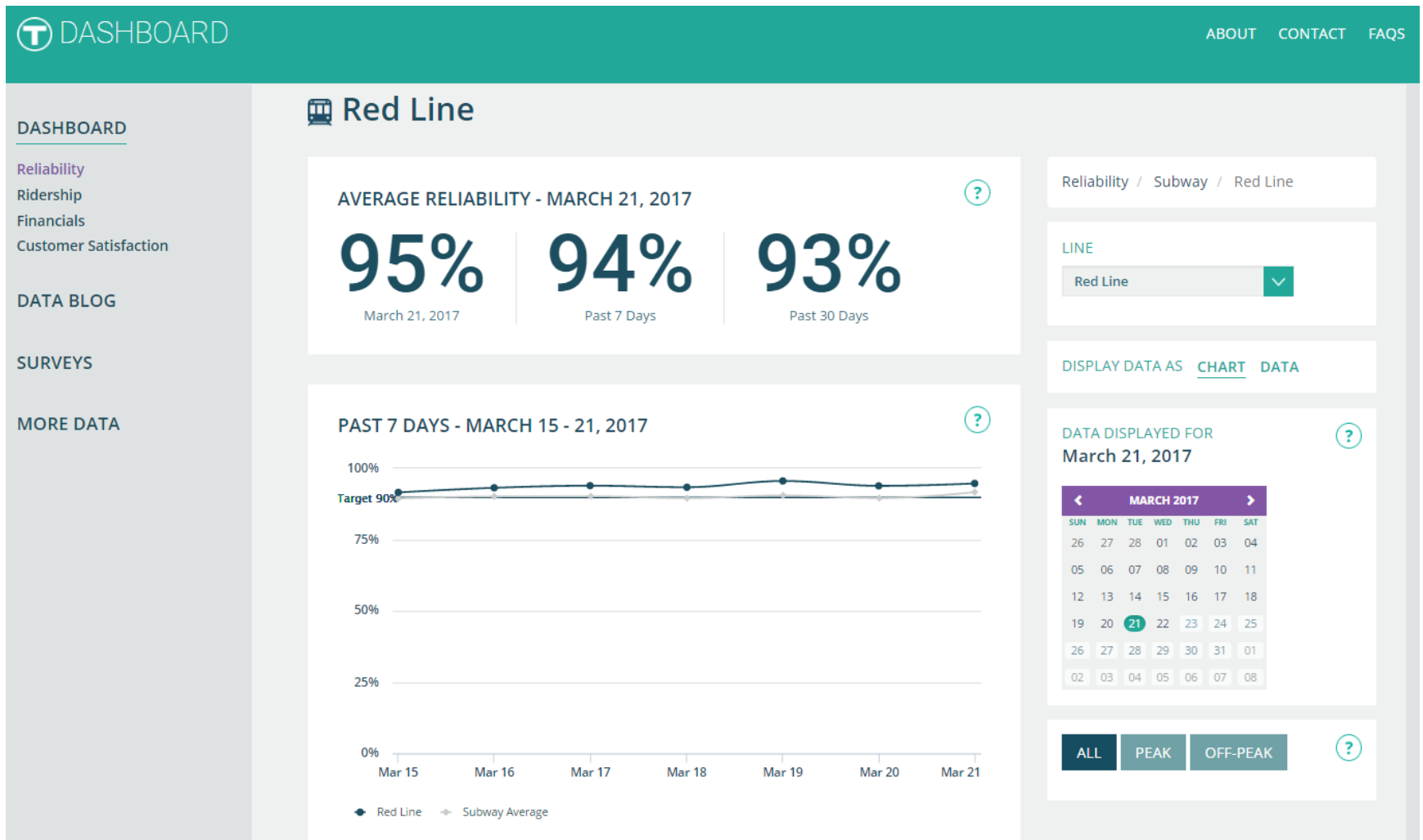
Harvard - Inbound



Broadway - Inbound



Public Facing Dashboard (<http://mbtabackontrack.com/>)





Roadmap

In operation since June 2015:

- Subway and light rail

- Headway, dwell time, travel time tracking

- Passenger weighted metrics

- Daily and real-time

In test:

- Commuter rail

- Schedule adherence

In development:

- Bus (2017)

- Prediction quality analysis (early 2017)

- Service alerts integration (early 2017)



Roadmap

Open Source the system

Thank You,

Questions?



ritesh.warade@ibigroup.com | 617.699.9544