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Webinar: Meeting & Exceeding Mobility User Expectations with Real-Time Transit Information

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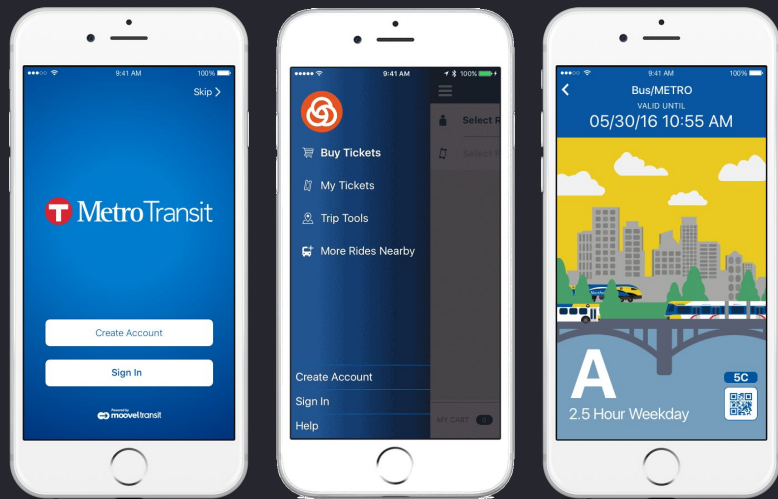
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GTFS - realtime

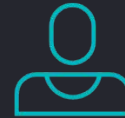
Derek Fretheim, Director Business Development
August 9, 2018

moovel builds award-winning white labeled mobility apps



Mobility convergence

Transit agencies and cities are finding ways to provide mobility within their community.



User

- Seamless access to a whole range of mobility services
- Booking & payment included
- Preferences showing real-time availability



Transit Agencies

- Operational data
- Route optimization
- New markets needs
- Focus on Customer Experience



Cities

- Insights into different mobility patterns
- Data for planning purposes
- How to manage and operate the urban mobility network



MSPs

- Dynamic data showing vehicle locations and availability
- Different mobility options

Aggregating mobility in one app

Karlsruhe KVV Transit App - Introduced in 2015, our first white-label MaaS app to power “look, book and pay” functionality across modes of transportation with multiple providers

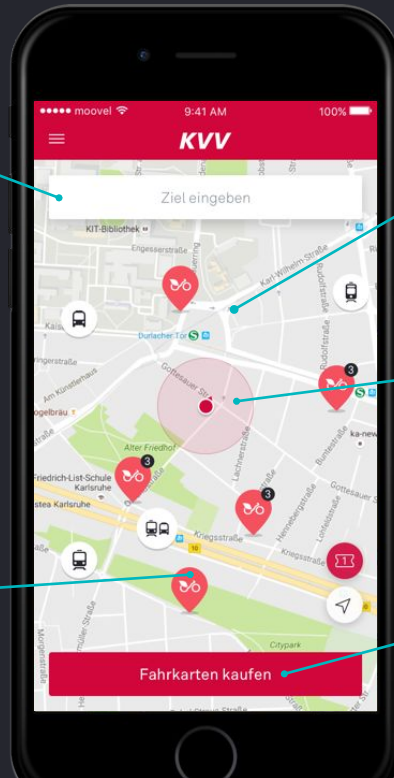
Places Search

Real-time public transit delays

Interactive map (Mapbox)

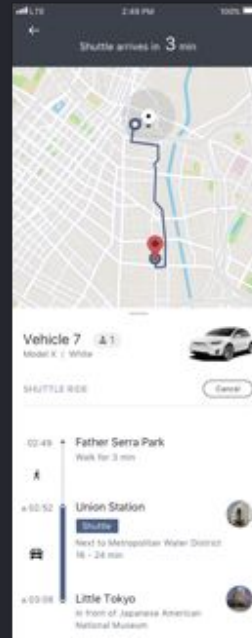
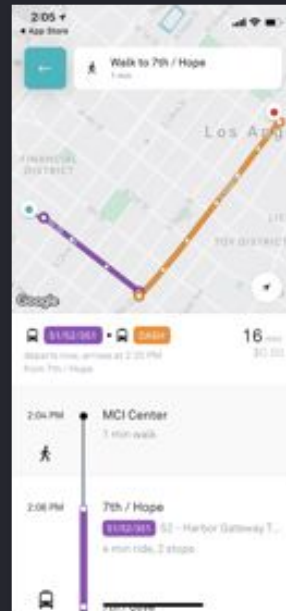
Search, book and pay capabilities for KVV and other integrated providers

moovel user account



Aggregating 24 providers in one app

FASTLink DTLA integrates 24 different transit providers in our Multimodal APP



Building a reliable Maas Solution with GTFS-RT

- GTFS-RT + ITS/real-time traffic data + MSP integration is challenging and complex
- Trip planning with MaaS requires reliable and accurately managed GTFS-RT data sources
- APP development using GTFS-RT requires data reliability, stability and standard formatting
- Customer satisfaction is 'sticky' when user preferences are aligned with real-time data



CUTR

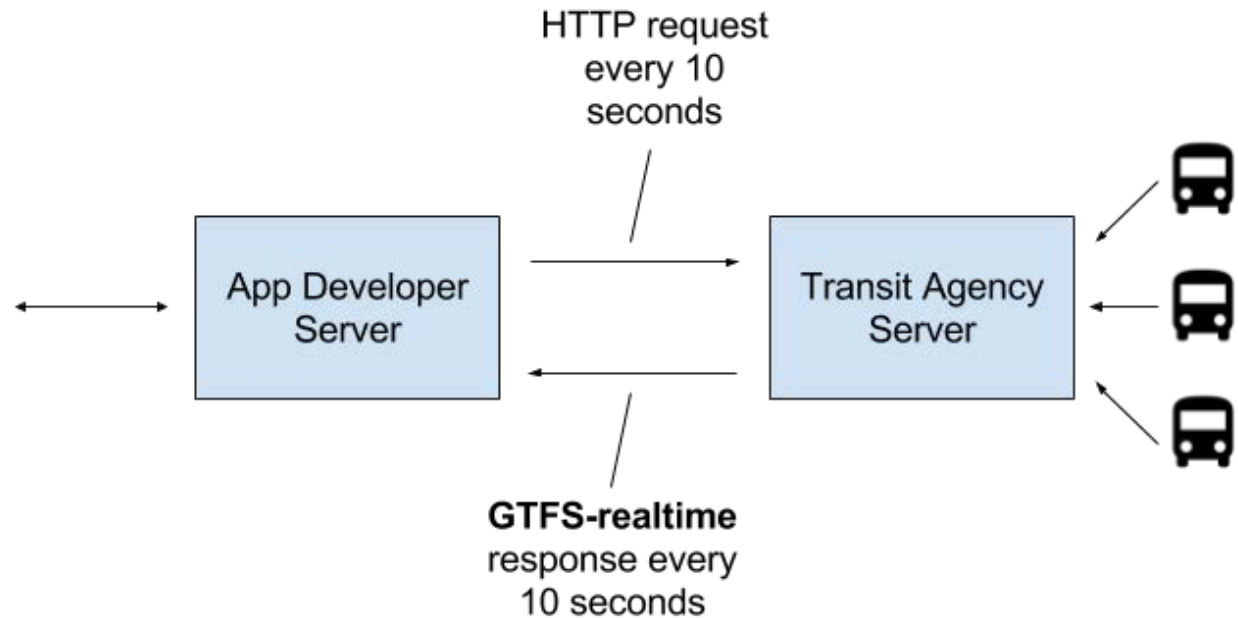
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GTFS-realtime v2.0

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Principal Mobile Software Architect for R&D
Center for Urban Transportation Research
University of South Florida



- [GTFS-realtime](#) is becoming de facto standard
 - [Over 50 agencies](#) now have GTFS-realtime feeds!

Quality is important!

- In one study, **9% of riders** said they took the bus **less often** due to errors in RTI^[9]
- GTFS-realtime v2.0 will help agencies produce better quality RTI



WHAT'S WRONG WITH GTFS-REALTIME V1.0?

Problem with GTFS-realtime v1.0

- GTFS-realtime includes:
 - Trip Updates (arrival predictions)
 - Vehicle Positions
 - Service Alerts
- A LOT of *optional* fields – 56 out of 63 (89%)
 - Quirk of Protocol Buffer docs (for details see <http://bit.ly/gtfs-realtime-2>)
- Leads to sub-optimal feeds
 - Poor data quality
 - Bad rider experience
 - Inaccurate analytics – garbage in, garbage out

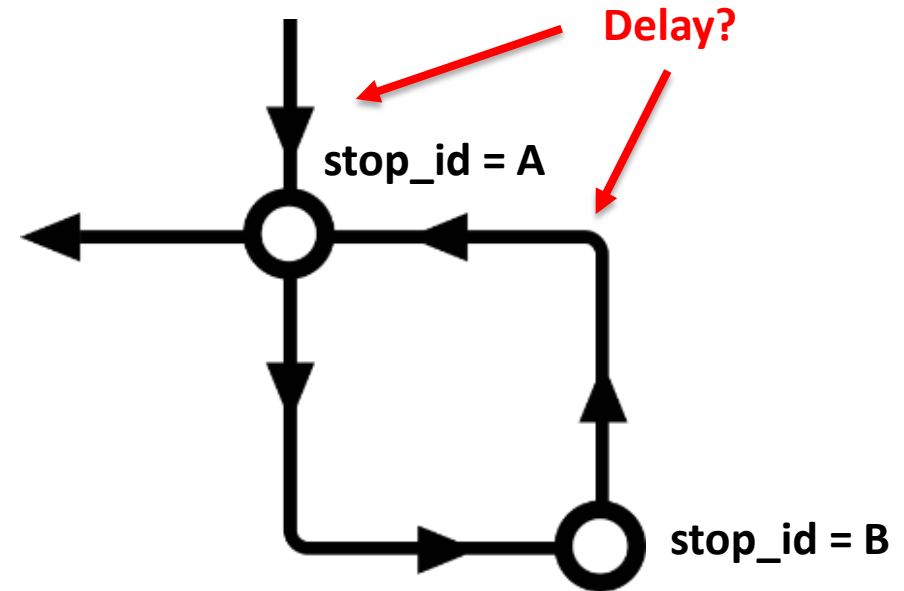
Example 1 – Vehicle Position

- All timestamps are *optional*
- When was position calculated?

```
header {
  gtfs_realtime_version: "1.0"
}
entity {
  id: "d131dd02"
  vehicle {
    position {
      latitude: 28.04265
      longitude: -82.45945
    }
  }
}
```

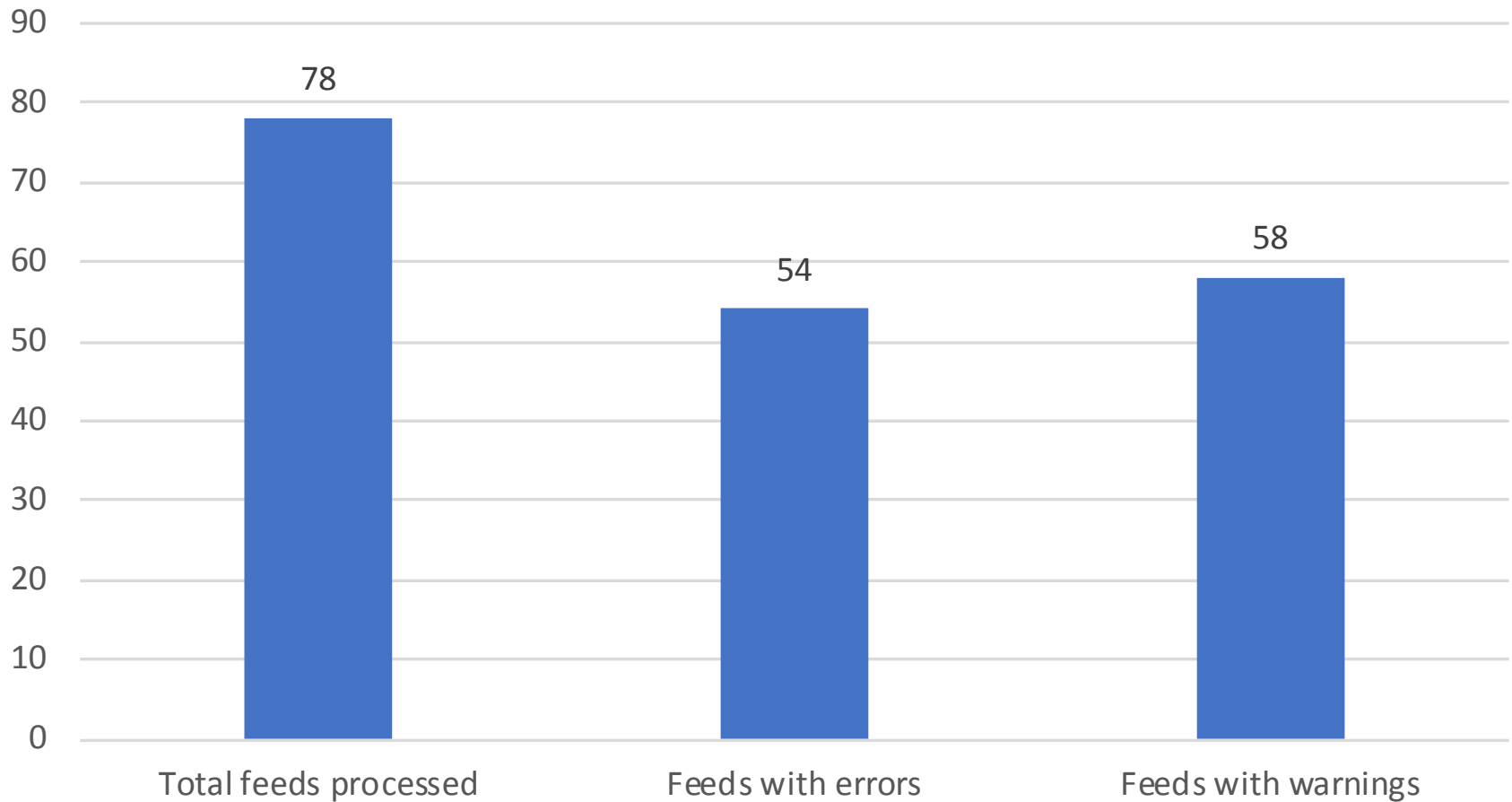
Example 2 – Loop route

```
trip {  
  trip_id: "277725"  
}  
stop_time_update {  
  arrival {  
    delay: 900 // 15 minutes  
  }  
  stop_id: "A"  
}
```

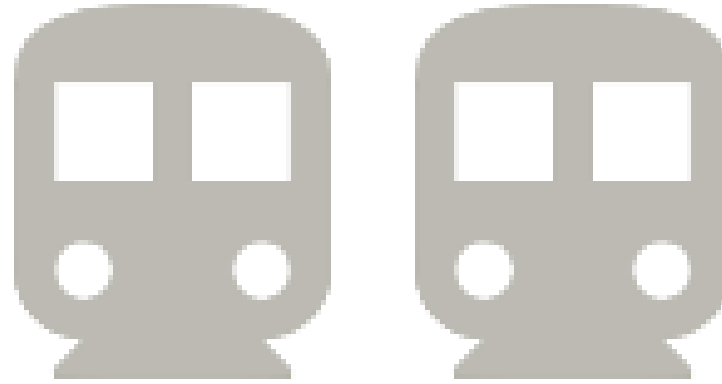


- stop_sequence field is *optional*
- Is 15 minute delay before or after stop_id B?

Industry-wide GTFS-realtime Feed Validation Results



- ~69% of feeds (54) we analyzed had errors



Clarifying what's really optional

GTFS-REALTIME V2.0

GTFS-realtime v2.0

- Defines new **transit-specific** requirements
- Each field is labeled as either:
 - *Required*
 - *Optional*
 - *Conditionally required*
 - See *Description* field for when this field is required

message StopTimeUpdate

Realtime update for arrival and/or departure events for a given stop on a trip. Please also refer to the general discussion of stop time updates in the [TripDescriptor](#) and [trip updates entities](#) documentation.

Updates can be supplied for both past and future events. The producer is allowed, although not required, to drop past events. The update is linked to a specific stop either through `stop_sequence` or `stop_id`, so one of these fields must necessarily be set. If the same `stop_id` is visited more than once in a trip, then `stop_sequence` should be provided in all `StopTimeUpdates` for that `stop_id` on that trip.

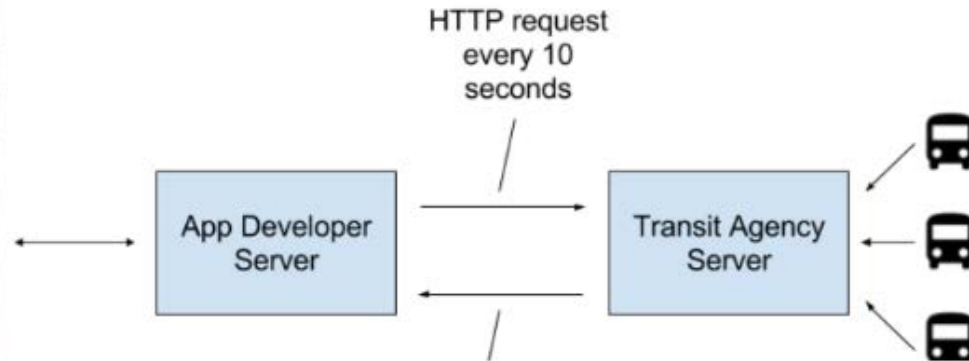
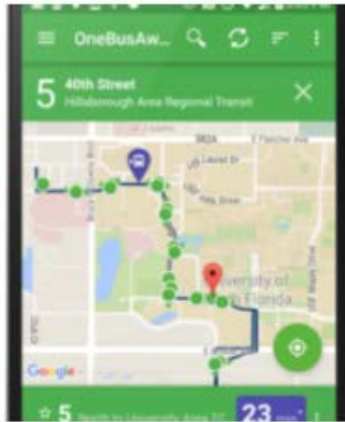
Fields

<i>Field Name</i>	<i>Type</i>	<i>Required</i>	<i>Cardinality</i>	<i>Description</i>
<code>stop_sequence</code>	<code>uint32</code>	Conditionally required	One	Must be the same as in <code>stop_times.txt</code> in the corresponding GTFS feed. Either <code>stop_sequence</code> or <code>stop_id</code> must be provided within a <code>StopTimeUpdate</code> - both fields cannot be empty. <code>stop_sequence</code> is required for trips that visit the same <code>stop_id</code> more than once (e.g., a loop) to disambiguate which stop the prediction is for.
<code>stop_id</code>	<code>string</code>	Conditionally required	One	Must be the same as in <code>stops.txt</code> in the corresponding GTFS feed. Either <code>stop_sequence</code> or <code>stop_id</code> must be provided within a <code>StopTimeUpdate</code> - both fields cannot be empty.



Sean Barbeau

Sep 25, 2017 · 10 min read



What's new in GTFS-realtime v2.0

Better quality real-time information

Read more...



44





Quick analysis of feeds

GTFS-REALTIME VALIDATOR

GTFS-realtime Validator

- Test your v1 and v2 feeds for errors
 - Open-source at <https://github.com/CUTR-at-USF/gtfs-realtime-validator>
 - See rules at <http://bit.ly/gtfs-realtime-rules>

Feed - <http://developer.mbta.com/lib/GTRTFS/Alerts/TripUpdates.pb>

Summary Http requests: 4
Unique responses: 3

ID	Title	Severity	Last iteration	Last time	Count	Show in log
E002	Unsorted stop_sequence	ERROR	2	05:49:25 PM (1494366565)	2	<input checked="" type="checkbox"/>
E022	Sequential trip stop_time_update times are not increasing	ERROR	3	05:49:34 PM (1494366574)	3	<input checked="" type="checkbox"/>
W001	Timestamp not populated	WARNING	3	05:49:34 PM (1494366574)	3	<input checked="" type="checkbox"/>

GTFS-rt Validator – View data & errors

Iteration 4 - 05:52:41 PM (1494366761) - http://developer.mbta.com/lib/GTRTFS/Alerts/TripUpdates.pb

```
{
  "header": {
    "gtfs_realtime_version": "1.0",
    "timestamp": 1494366761
  },
  "entity": [
    {
      "id": "1494366761_33636512",
      "trip_update": {
        "trip": {
          "trip_id": "33636512",
          "start_date": "20170509",
          "route_id": "1",
          "direction_id": 0
        },
        "stop_time_update": [
          {
            "stop_sequence": 1,
            "arrival": {
              "time": 1494367860
            },
            "departure": {
              "time": 1494367860
            },
            "stop_id": "64"
          },
          {
            "stop_sequence": 2,
            "arrival": {
              "time": 1494367915
            },
            "departure": {
              "time": 1494367915
            },
            "stop_id": "64"
          }
        ]
      }
    }
  ]
}
```

2 error(s), 2 warning(s)

E002 - Unsorted stop_sequence

OccurrenceId	Summary
1	trip_id 33409613 stop_sequence [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 15, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 25] is not sorted by increasing stop_sequence
2	trip_id 33409654 stop_sequence [1, 24, 25, 23, 22, 20, 21, 19, 15, 16, 17, 18, 14, 13, 12, 11, 10, 9, 8, 7, 5, 6, 3, 4, 2, 26] is not sorted by increasing stop_sequence
3	trip_id 33751219 stop_sequence [1, 2, 3, 4, 5, 6, 8, 9, 7, 10, 18, 11, 12, 13, 14, 15, 16, 17] is not sorted by increasing stop_sequence

...and 5 more

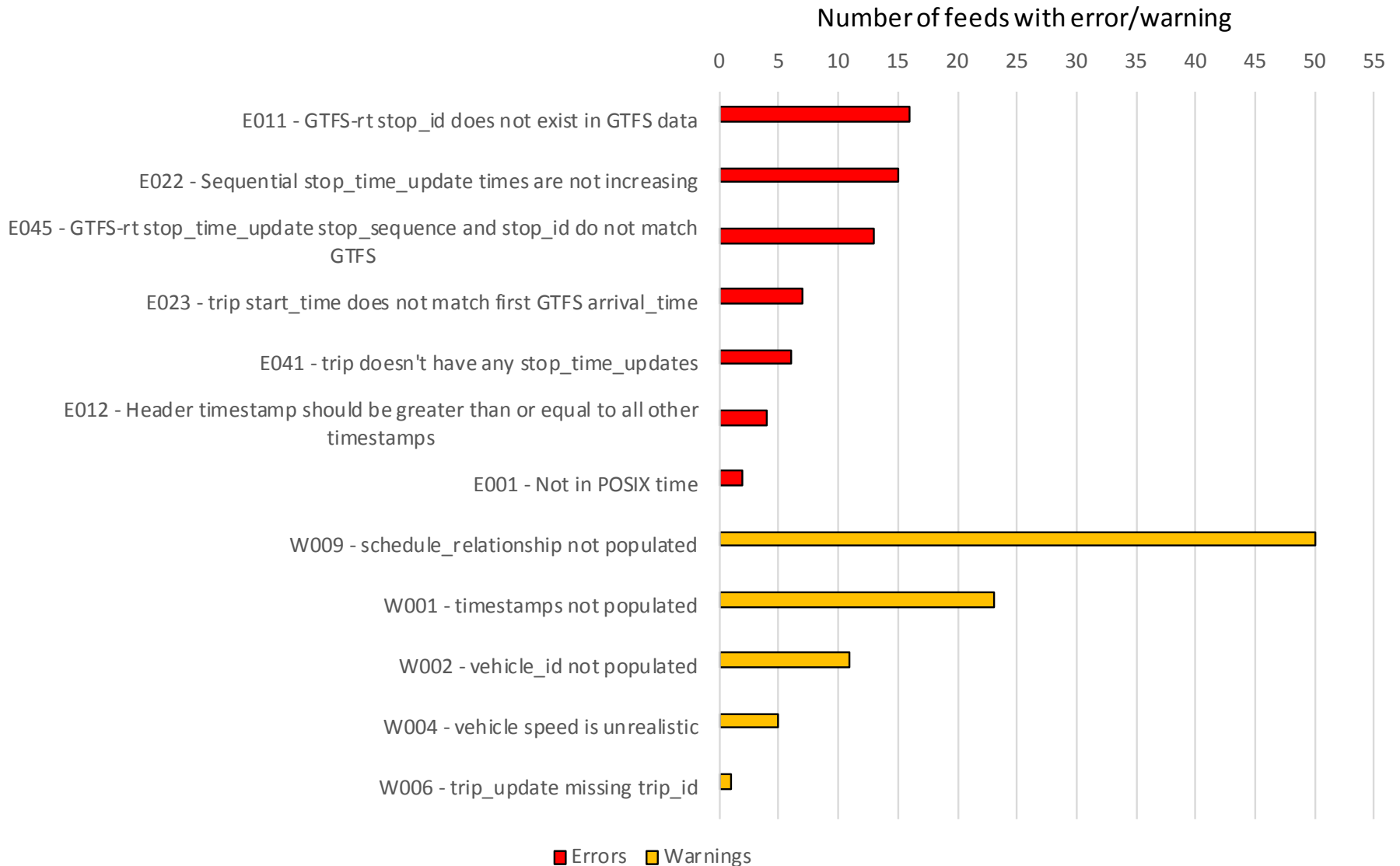
E022 - Sequential stop stop_time_update times are not increasing

OccurrenceId	Summary
1	trip_id 33409654 stop_sequence 10 arrival time 1494367915

Evaluation of industry feeds

- Created open-source tool to batch validate 78 out of 130 GTFS-realtime feeds catalogued on TransitFeeds.com
 - <https://github.com/CUTR-at-USF/transit-feed-quality-calculator>
- 69% (54) feeds had errors, and 74% (58) had warnings

Most Frequent Errors and Warnings in GTFS-realtime feeds



What's next for Transit Agencies?

- Require that all AVL vendors provide GTFS-realtime **v2.0** feeds (especially in RFPs)
 - Github is official new home of GTFS/GTFS-realtime specs - <https://github.com/google/transit>
- Run GTFS-realtime validator frequently
 - <https://github.com/CUTR-at-USF/gtfs-realtime-validator>
- Also require that vendors follow GTFS Best Practices
 - <http://gtfs.org/best-practices/>
- Communicate with other agencies and app developers
 - See <https://github.com/CUTR-at-USF/awesome-transit#community> for resources

What's next for GTFS-rt Community?

- Create GTFS-realtime Best Practices
 - “Warning” from GTFS-realtime validator^[1]
 - Proposals without unanimous agreement
 - Other community input
- Clarify more GTFS-realtime gray areas
 - See list at <http://bit.ly/gtfs-realtime-open-topics>
 - Either new proposals, or in best practices
- Better targeted documentation
 - More focused on use cases and features (e.g., ability to cancel trips)

[1] <http://bit.ly/gtfs-realtime-rules>

What's next for GTFS-rt Community?

- Continue to add new rules to GTFS-realtime Validator
 - <http://bit.ly/gtfs-realtime-rules>
- Hosting GTFS-realtime Validator as a service for agencies and vendors
- Tackle GTFS Services Changes use cases
 - Changes to network that happen frequently
- Develop additional open-source tooling for prediction generation
 - Including data warehousing & machine learning
 - Leverage TheTransitClock (formerly Transitime)
 - <http://thetransitclock.org>

Thanks!

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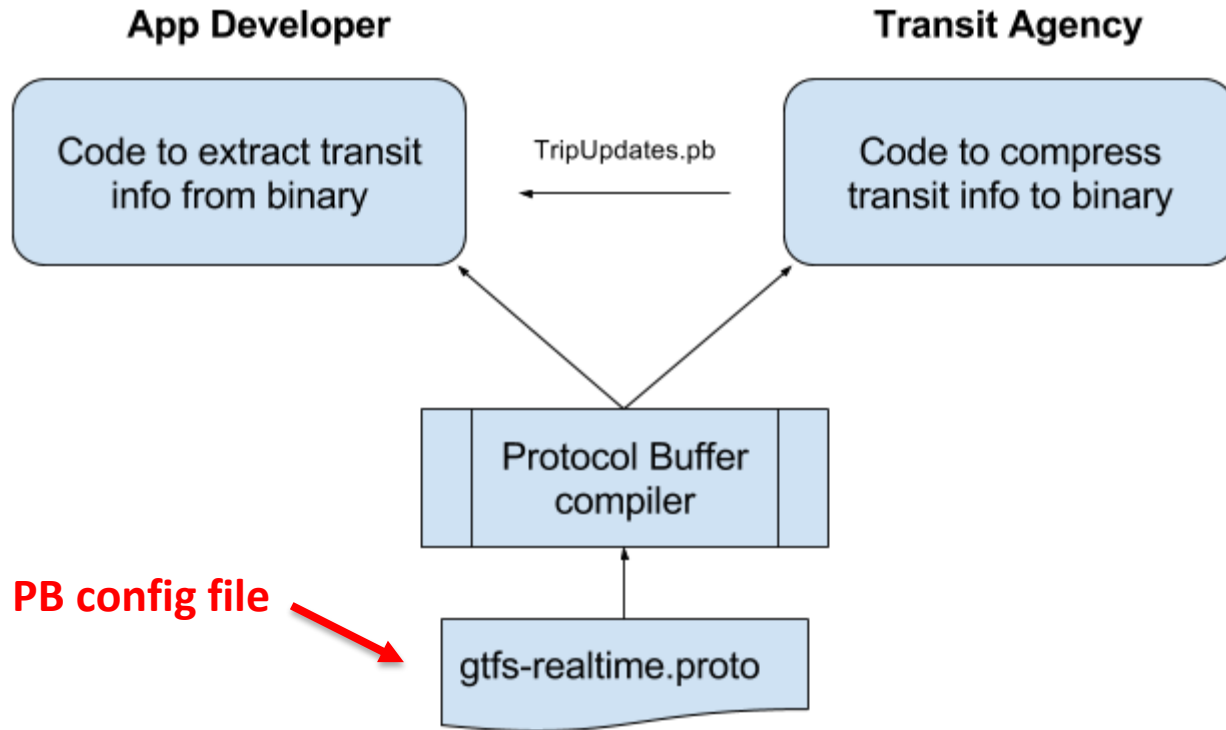


Funding from:



WHY SO MANY OPTIONAL FIELDS?



GTFS-rt uses Protocol Buffer (PB) format



- gtf-realtime.proto PB file defines elements to exchange

Protocol Buffers save space

- Compressed binary is around 6 times smaller than plain text

Name	Type	Size
 TripUpdates.pb	PB File	891 KB
 TripUpdates.pb.txt	Text Document	5,683 KB

PB required \neq transit required

- v1.0 - *Optional/required* for *Cardinality* field values were copied from .proto file

```
51 // Metadata about a feed, included in feed messages.
52 message FeedHeader {
53     // Version of the feed specification.
54     // The current version is 2.0.
55     required string gtfs_realtime_version = 2;
56
57     // Determines whether the current fetch is incremental. Currently,
58     // DIFFERENTIAL mode is unsupported and behavior is unspecified for feeds
59     // that use this mode. There are discussions on the GTFS Realtime mailing
60     // list around fully specifying the behavior of DIFFERENTIAL mode and the
61     // documentation will be updated when those discussions are finalized.
62     enum Incrementality {
63         FULL_DATASET = 0;
64         DIFFERENTIAL = 1;
65     }
66     optional Incrementality incrementality = 2 [default = FULL_DATASET];
67
68     // This timestamp identifies the moment when the content of this feed has been
```