Navigating the Transit Data Landscape

Nina Kin
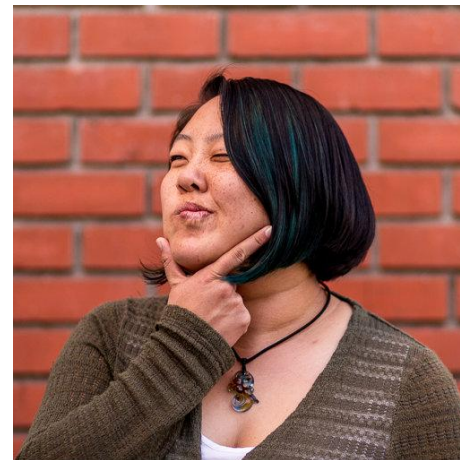
Who am I?

Nina Kin

———

**Tech Lead
Digital Experience Team
Customer Experience Department**

➢ Software engineer

➢ Public transit rider

➢ Urban explorer

➢ Civic tech nerd

➢ Multi-disciplinary crafter and musician

➢ Generally inquisitive person

Nina Kin

———

➢ **MaptimeLA** – Community for map enthusiasts interested in learning to use open source mapping tools. Contribute to open mapping projects like OpenSidewalks.
https://www.meetup.com/maptimela/

➢ **Data + Donuts LA** – Monthly breakfast lecture series highlighting local government tech and data projects.
https://datadonuts.la/
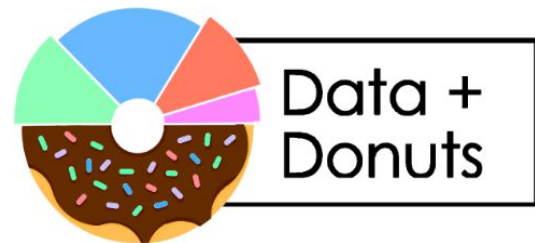
Nina Kin

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- ➢ **LA Arts Datathon** - Brings together members of the arts and tech communities. Coming soon! https://www.lacountyarts.org/learning/arts-datathon

- ➢ **International Humanitarian Mapathon** - Annual event teaching people how to contribute to humanitarian mapping efforts. April 23-25 https://mapathon.la/en/

- ➢ **Board of Directors, MobilityData** https://mobilitydata.org/

Nina Kin

– – –

2006 Berkeley EECS

13 years County of Los Angeles
LACOUNTY.GOV

4 years M Metro®

Nina Kin

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What I do:

➢ Advocate for rider information needs inside the agency.

➢ Improve the way digital information reaches riders.

➢ Advance data standards in the transit industry.

➢ Pilot more sustainable tech and data practices.

… with varying degrees of success! 😅

Nina Kin

———

I am...

➢ Not involved in operations!

➢ Not involved with the hardware or data infrastructure!

➢ Not involved with service or planning!

I DO like to ask questions, learn, and share!

"Transit Data"?

Schedule Data

— — —

207

Metro Local

Northbound to Hollywood
Southbound to Athens
via Western Av

metro.net
323.GO.METRO
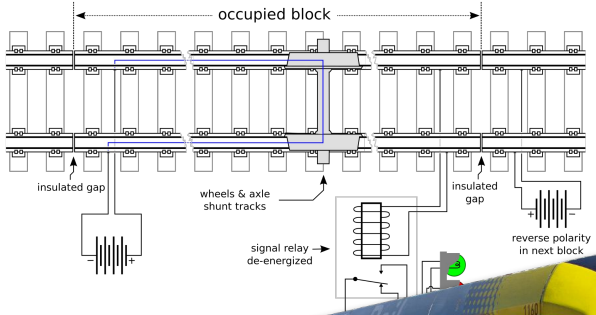Wheelchair Hotline
800.621.7828

Travel Info
511
California Relay Service
711

HOLLYWOOD — Hollywood/Western Station B Line

Wilshire/Western Station D Line

WESTERN

KOREATOWN

JEFFERSON PARK — Expo/Western Station E Line
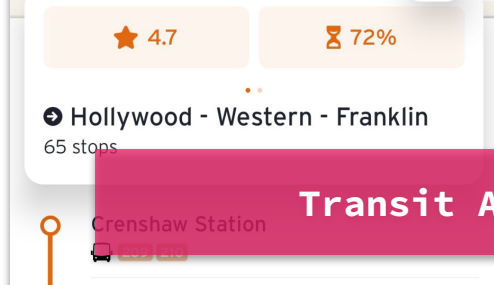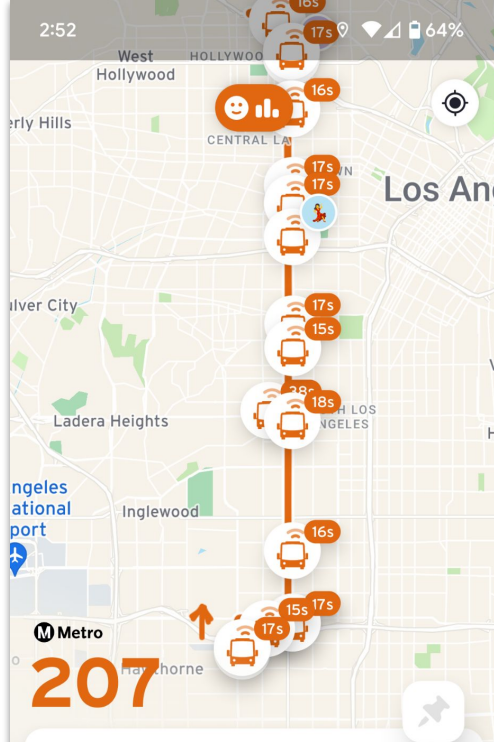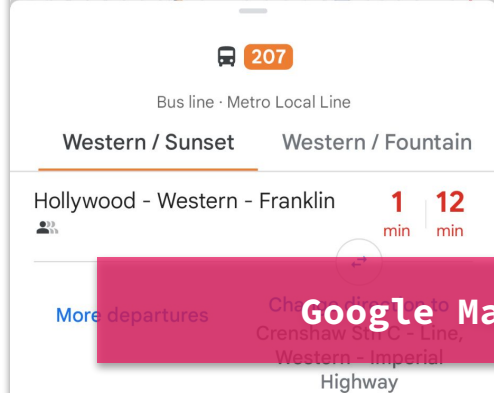
CHESTERFIELD SQUARE

ATHENS — Crenshaw Station C Line

M Metro

Subject to change without notice
Sujeto a cambios sin previo aviso

N

Eastbound (Approximate Times)					Westbound (Approximate Times)			
DOWNTOWN LOS ANGELES	LINCOLN HEIGHTS	ALHAMBRA	ROSEMEAD	EL MONTE	EL MONTE	ROSEMEAD	ALHAMBRA	LINCOLN HEIGHTS
7	5	4	3	2	1	1	2	3	4
Vignes & Cesar E. Chavez	Main & Griffin	Valley & Garfield	Valley & Rosemead	El Monte Station	El Monte Station	Valley & Rosemead	Valley & Garfield	Main & Griffin
5:23A	5:30A	5:49A	5:59A	6:08A	E 3:56A	4:04A	4:14A	4:30A
5:48	5:55	6:16	6:28	6:37	4:38	4:46	4:56	5:12
6:07	6:16	6:37	6:49	6:58	5:04	5:15	5:26	5:43
6:22	6:31	6:52	7:04	7:14	5:26	5:37	5:48	6:06
6:37	6:46	7:08	7:21	7:31	5:44	5:55	6:07	6:26
6:51	7:01	7:23	7:36	7:46	5:57	6:10	6:22	6:42
7:06	7:16	7:39	7:53	8:03	6:12	6:25	6:37	6:57
7:20	7:30	7:54	8:09	8:20	6:27	6:40	6:52	7:12
7:35	7:45	8:09	8:24	8:35	6:40	6:53	7:06	7:27
7:50	8:00	8:24	8:39	8:50	6:53	7:07	7:21	7:44
8:05	8:15	8:39	8:54	9:05	7:08	7:22	7:36	7:59
8:20	8:30	8:54	9:10	9:22	7:23	7:37	7:51	8:14
8:35	8:45	9:10	9:26	9:38	7:38	7:52	8:06	8:29
8:50	9:00	9:25	9:42	9:54	7:52	8:06	8:21	8:44
9:05	9:15	9:40	9:57	10:10	8:07	8:21	8:36	8:59
9:20	9:30	9:55	10:12	10:25	8:22	8:36	8:51	9:14
9:35	9:45	10:10	10:27	10:40	8:36	8:50	9:06	9:29
9:50	10:00	10:25	10:42	10:55	8:51	9:05	9:21	9:44
10:05	10:15	10:40	10:57	11:10	9:05	9:19	9:36	9:59
10:20	10:30	10:55	11:13	11:26	9:19	9:33	9:51	10:14
10:35	10:45	11:10	11:29	11:42	9:34	9:48	10:06	10:29
10:50	11:00	11:25	11:44	11:57	9:48	10:03	10:21	10:44
11:05	11:15	11:40	11:59	12:12P	10:03	10:18	10:36	10:59
11:00	11:20	11:30	11:55	12:14P	12:27	10:18	10:33	10:51	11:14
11:15	11:35	11:45	12:10P	12:29	12:42	10:33	10:48	11:06	11:29

Realtime Data

occupied block

insulated gap

wheels & axle
shunt tracks

insulated
gap

reverse polarity
in next block

signal relay
de-energized

IMPERIAL HWY

EAST LA

Data In Your Hands

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Google Maps

Transit App

This!

- - -

What happens here?

Lots… **LOTS**! There's so much.

First Stop: Generating the Data
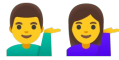
💁‍♂️💁‍♀️ Service Planners + Schedulers

———

Lots of factors go into planning & scheduling:

➢ Operator Safety and Experience — very high priority!

- Stops are in safe places
- Minimize the possibility of accidents
- Trip length
- Route familiarity
- Access to essential amenities (bathrooms!)

Operator is the preferred term!

🙋‍♂️🙋‍♀️ Service Planners + Schedulers

———

➢ Community

  ○ Feedback

  ○ Changing traffic patterns

  ○ Commercial/residential developments

  ○ How much we expect the route to be used.

  ○ How it connects to other existing routes (including from other agencies!)

➢ Physical Limitations

  ○ Street width

  ○ Turning angles at intersections

  ○ Length of buses used on a route
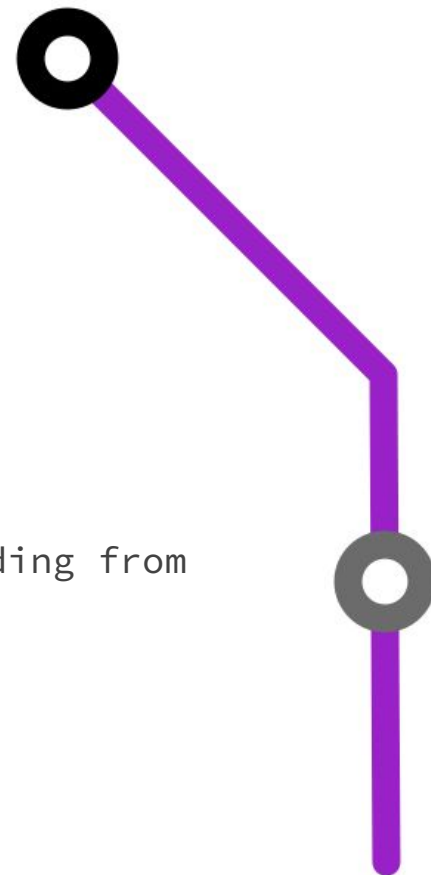
💁‍♂️💁‍♀️ Service Planners + Schedulers

___

➢ Efficiency

   ○ Optimizing for cost/benefit

   ○ Efficiently allocating resources - optimize time spent
     delivering service versus moving buses and staff around.

   ○ Run the most service for the least cost

   ○ Nearside vs Farside stops

➢ Jurisdiction

   ○ Cities have to agree to route, stop, and layover locations!

   ○ Layover locations and times need to be negotiated with other
     transit agencies that use them!
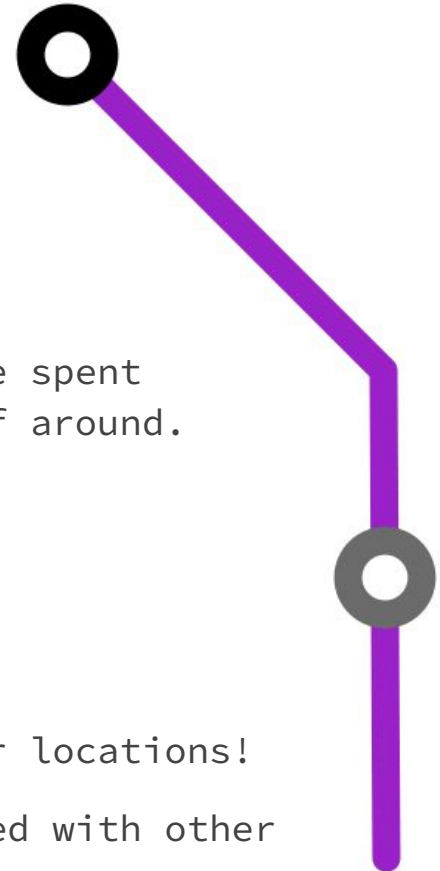
Scheduling System

HASTUS handles:

➢ Scheduling

➢ Operator Assignments

➢ Service Cancellations

➢ Cost Optimization

➢ Operator Payroll

➢ Long Term Planning

Exported as **GTFS** data

What is GTFS?

What is GTFS?

———

It is a…

➢ **Data Specification** – a set of rules defining what a dataset should look like for producers and consumers.

➢ **Representation of Transit Service** – a transit agency's service in a machine-readable format.

Why does GTFS exist?

———

➤ Without a data standard, everyone would publish their data differently and you'd have **chaos**.

➤ Consumers of the data would have to create custom code to account for every **single transit agency**.

➤ LA County alone has over **50 public transit** service providers.

Detour: Origins of GTFS

Google Maps in 2005

July 2005

TriMet 🤝 Google Partnership

"...make it just as easy to get transit directions as it is to get driving directions from anywhere in the world."

– Bibiana McHugh, TriMet

An Opportune Moment

———

Technological Barriers:

➢ **Machine-readable data already existed**

  ○ TriMet's service data already existed in their scheduling system as a set of tables.

➢ **Data was already accessible as a file export**

  ○ TriMet's scheduling system allowed for the data to be exported in CSV format.

An Opportune Moment

———

Business Barriers:

➢ **Agency already supported Open Source and Open Data**

- ○ TriMet already had a long history of supporting open source and open data.
- ○ TriMet was already publishing an open data feed used by outside developers.

➢ **Procurement policies already existed for Open Source**

- ○ TriMet already had an open source-friendly procurement policy in place for a decade.

➢ **Willing partner in private industry**

- ○ Google Maps was already interested in expanding to include transit.

Google Transit Launches in 2005

Google Transit Launches with TriMet Data

"As Google Transit went live for the first time… the number of hits to the site increased exponentially… the counts were reaching staggering numbers, even by Google standards."
– Bibiana McHugh, TriMet

GTFS is born! 🐤

GTFS

Google
Transit
Feed
Specification

Google Transit Expands

Key Early Decisions

———

➢ Keep the **CSV format** published by the scheduling systems.

  ○ Keeps GTFS as simple as possible to keep the barrier to participation low for smaller, less-resourced agencies.

➢ Keep the data specification **open and free**.

➢ Make the resulting data **free and publicly accessible**.

GTFS

~~Google~~ General
Transit
Feed
Specification

2010

Name Changed from "Google" to "General"

GTFS is widely popular!

But concerns are raised so name is changed to "General", reflecting GTFS usage outside Google products.

Development starting to splinter as unique flavors of GTFS pop up to account for different needs.

GTFS-realtime Extension Released

August 2011

GTFS-realtime Extension Released

GTFS-realtime extension created by Google and a consortium of transit agencies.

June 2015

Two-Day Workshop on Transit Data Interoperability

Hosted in San Francisco by the Rocky Mountain Institute (RMI), transit data interoperability is seen as a critical foundation for the future of transit.

Results in a recommendation to create Best Practices to grow the space.

Figure 5. Complex Data Flows Common at Transit Agencies

Courtesy of Community Transit

GTFS Best Practices Established
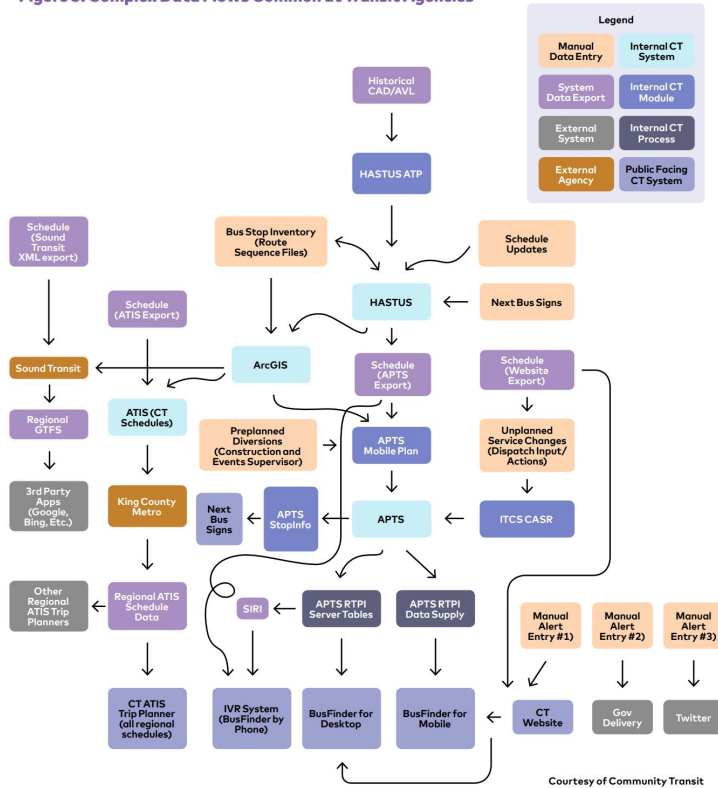
February 2017 — **GTFS Best Practices Published**

RMI convenes a working group to identify issues and improve GTFS.

The working group publishes the GTFS Data Best Practices.

October 2017 — **Interoperable Transit Data Workshop**

RMI and TransitCenter host a two-day workshop in New York to identify challenges and opportunities to improve transit data practices.

MobilityData Established 🎉

April 2019 — **MobilityData Established**

Grown out of the original working group, MobilityData is created as a non-profit to oversee the continued growth of GTFS.

2024 — **Today**

GTFS is used by over 10,000 agencies in over 100 countries.

MobilityData's work now covers:

➢ Public Transit data standards (GTFS)
➢ GTFS Data Platforms & Tools
➢ Shared Mobility data (GBFS)

Next Stop: GTFS-schedule

GTFS-schedule

———

For: **Planned Service**

Metro releases Bus & Rail as separate GTFS
datasets!

➢ Rail – https://gitlab.com/LACMTA/gtfs_rail

➢ Bus – https://gitlab.com/LACMTA/gtfs_bus
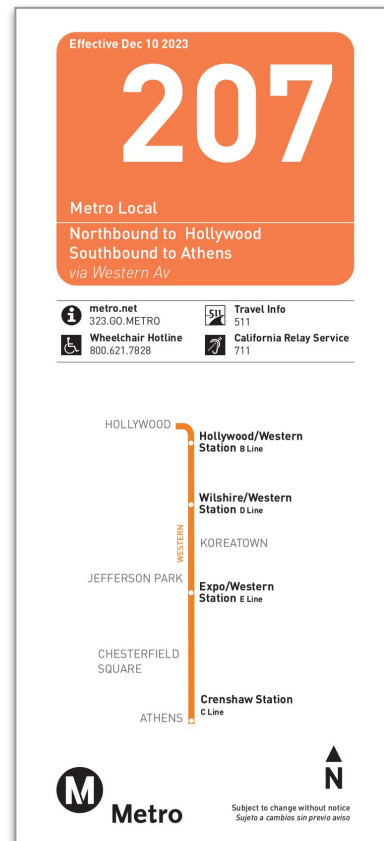
GTFS Update Frequency

———

➢ **Rail** – updated every weekday night!

➢ **Bus** – Updated during **Shakeups**. Usually twice a year (June, December). Minor updates rolled out weekly.

Shakeups:

➢ 2x a year in June, December

➢ Major service changes – major changes to routes and stops

➢ Bus operators' chance to bid on routes, which is why major changes don't happen outside of Shakeups

What does GTFS-schedule data look like?

———

gtfs.zip
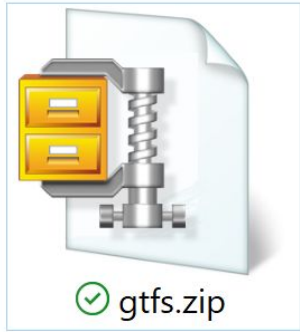
Zip File

Inside is a series of .txt files:

➢ **Agency.txt**

➢ **Calendar.txt**
  – and/or –
  Calendar_dates.txt

➢ **Routes.txt**

➢ **Stop_times.txt**

➢ **Stops.txt**

➢ **Trips.txt**

And more…

➢ Shapes.txt

➢ Fare_attributes.txt

➢ Fare_rules.txt

➢ Timeframes.txt

➢ Pathways.txt

➢ Transfers.txt

➢ Frequencies.txt

➢ Levels.txt

➢ Feed_info.txt

➢ Translations.txt

➢ Stop_areas.txt

➢ Areas.txt

Agency.txt

```
agency.txt ●
agency.txt > data
1    agency_id ,agency_name          ,agency_url           ,agency_timezone      ,agency_lang ,agency_phone
2    LACMTA    ,"Metro - Los Angeles" ,https://www.metro.net ,America/Los_Angeles  ,en          ,"(323)466-3876"
3
```

Primary key: **agency_id**
(not required in other files if only 1 agency)

Tells you what agencies are in this GTFS dataset

Routes.txt

≡ routes.txt ●

≡ routes.txt > 🗋 data

```
 1    route_id   ,route_short_name ,route_long_name      ,route_desc
 2    2-13172    ,2                ,Metro Local Line     ,WESTWOOD - EXPOSITION PARK VIA SUNSET-ALVARADO
 3    4-13172    ,4                ,Metro Local Line     ,DOWNTOWN LA - SANTA MONICA VIA SANTA MONICA BL
 4    10-13172   ,10/48            ,Metro Local Line     ,W HOLLYWOOD-DTWN LA -AVALON STA VIA MELROSE-AVALON
 5    14-13172   ,14/37            ,Metro Local Line     ,CEDAR SINAI-DTWN LA-WASH/FAIRFAX VIA BEVERLY-ADAMS
 6    16-13172   ,16               ,Metro Local Line     ,DOWNTOWN LA - WEST HOLLYWOOD VIA WEST 3RD ST
 7    18-13172   ,18               ,Metro Local Line     ,WILSHIRE WESTERN STA-MONTEBELLO VIA 6TH - WHITTIER
 8    20-13172   ,20               ,Metro Local Line     ,DOWNTOWN LA - SANTA MONICA VIA WILSHIRE BL
 9    28-13172   ,28               ,Metro Local Line     ,CENTURY CITY-DTW LA-VIA OLYMPIC
10    30-13172   ,30               ,Metro Local Line     ,PICO RIMPAU - DTWN LA - LITTLE TOKYO STA VIA PICO
11    33-13172   ,33               ,Metro Local Line     ,DOWNTOWN LA - SANTA MONICA VIA VENICE BL
12    35-13172   ,35/38            ,Metro Local Line     ,DOWNTOWN LA- WLA VIA WASHINGTON BL & JEFFERSON BL
13    40-13172   ,40               ,Metro Local Line     ,DOWNTOWN LA-SBAY GALLERIA VIA KING BL-HAWTHORNE BL
14    45-13172   ,45               ,Metro Local Line     ,LINCOLN HEIGHTS-DTWN LA-HARBR FWY STA VIA BROADWAY
15    51-13172   ,51               ,Metro Local Line     ,WESTLAKE/MCARTHUR PK STA DTWN LA CSU DH VIA AVALON
```

Tells you what routes are in this GTFS dataset

Stops.txt

```
≡ stops.txt        ●

≡ stops.txt > 🗋 data
    1    stop_id  ,stop_code ,stop_name                              ,stop_desc ,stop_lat   ,stop_lon    ,st
    2          1 ,        1 ,Paramount / Slauson                     ,          ,33.973248 ,-118.113113 ,
    3          3 ,        3 ,Jefferson / 10th                        ,          ,34.025471 ,-118.328402 ,
    4          6 ,        6 ,120th / Augustus F Hawkins              ,          ,33.924696 ,-118.242222 ,
    5          7 ,        7 ,120th / Martin Luther King Hospital     ,          ,33.924505 ,-118.240369 ,
    6         12 ,       12 ,15054 Sherman Way                       ,          ,34.201075 ,-118.461953 ,
    7         16 ,       16 ,Riverside / Los Feliz                   ,          ,34.116932 ,-118.271486 ,
    8         18 ,       18 ,1st / Eastern                           ,          ,34.036881 ,-118.173232 ,
    9         19 ,       19 ,Indiana / Olympic                       ,          ,34.018999 ,-118.192361 ,
   10         25 ,       25 ,226th / Norwalk                         ,          ,33.823987 ,-118.072255 ,
   11         29 ,       29 ,2nd / Santa Monica                      ,          ,34.015028 ,-118.497346 ,
   12         31 ,       31 ,3rd / Gardner                           ,          ,34.070240 ,-118.353264 ,
   13         33 ,       33 ,Balboa / Foothill West Jog              ,          ,34.322084 ,-118.495243 ,
   14         38 .       38 .5th / Colorado                          .          .34.013884 .-118.490199 .
```

Tells you what stops are in this GTFS dataset

This list doesn't represent all possible stops, just the active ones!

Calendar.txt

	service_id		monday	tuesday	wednesday	thursday	friday	saturday	sunday	start_date	end_date
1	service_id	,	monday	,tuesday	,wednesday	,thursday	,friday	,saturday	,sunday	,**start_date**	,end_date
2	DEC23-D01CAR-3_Sunday	,	0 ,	0 ,	0 ,	0 ,	0 ,	0 ,	1 ,	20231210	,20240616
3	DEC23-D01CAR-1_Weekday	,	1 ,	1 ,	1 ,	1 ,	1 ,	0 ,	0 ,	20231211	,20240621
4	DEC23-D01CAR-2_Saturday	,	0 ,	0 ,	0 ,	0 ,	0 ,	1 ,	0 ,	20231216	,20240622
5	DEC23-D02CAR-3_Sunday	,	0 ,	0 ,	0 ,	0 ,	0 ,	0 ,	1 ,	20231210	,20240616
6	DEC23-D02CAR-1_Weekday	,	1 ,	1 ,	1 ,	1 ,	1 ,	0 ,	0 ,	20231211	,20240621
7	DEC23-D02CAR-1_Weekday-KINGMS1	,	1 ,	1 ,	1 ,	1 ,	1 ,	0 ,	0 ,	20231211	,20240621
8	DEC23-D02CAR-1_Weekday-KINGMB0	,	1 ,	1 ,	1 ,	1 ,	1 ,	0 ,	0 ,	20231211	,20240621
9	DEC23-D02CAR-1_Weekday-KINGMA0	,	1 ,	1 ,	1 ,	1 ,	1 ,	0 ,	0 ,	20231211	,20240621
10	DEC23-D02CAR-1_Weekday-SANTHA0	,	1 ,	1 ,	1 ,	1 ,	1 ,	0 ,	0 ,	20231211	,20240621
11	DEC23-D02CAR-1_Weekday-SANTHB0	,	1 ,	1 ,	1 ,	1 ,	1 ,	0 ,	0 ,	20231211	,20240621
12	DEC23-D02CAR-1_Weekday-SANTHS1	,	1 ,	1 ,	1 ,	1 ,	1 ,	0 ,	0 ,	20231211	,20240621
13	DEC23-D02CAR-2_Saturday	,	0 ,	0 ,	0 ,	0 ,	0 ,	1 ,	0 ,	20231216	,20240622
14	DEC23-D03CAR-3_Sunday	,	0 ,	0 ,	0 ,	0 ,	0 ,	0 ,	1 ,	20231210	,20240616
15	DEC23-D03CAR-1_Weekday	,	1 ,	1 ,	1 ,	1 ,	1 ,	0 ,	0 ,	20231211	,20240621
16	DEC23-D03CAR-1_Weekday-LINCHS1-1011100	,	1 ,	0 ,	1 ,	1 ,	1 ,	0 ,	0 ,	20231211	,20240621
17	DEC23-D03CAR-1_Weekday-LINCHS1_0100000	,	0 ,	1 ,	0 ,	0 ,	0 ,	0 ,	0 ,	20231211	,20240621

Tells you the dates that service runs

Metro separates service into Weekday, Saturday, and Sunday!

Trips.txt

☰ trips.txt ●

☰ trips.txt > 🗋 data

	route_id	,service_id	,trip_id	,trip_headsign	,direction_id	,block_id	,shape_id	,trip_id_event
1	route_id	,service_id	,trip_id	,trip_headsign	,direction_id	,block_id	,shape_id	,trip_id_event
2	96-13172	,DEC23-D98-2_Saturday	,60096002500611-DEC23	,	,	0 , 0960100	,960250_DEC23	,58818043-DEC23-D98-2_Saturday
3	96-13172	,DEC23-D98-2_Saturday	,60096002500710-DEC23	,	,	0 , 0960200	,960250_DEC23	,58818044-DEC23-D98-2_Saturday
4	96-13172	,DEC23-D98-2_Saturday	,60096002500810-DEC23	,	,	0 , 0960100	,960250_DEC23	,58818045-DEC23-D98-2_Saturday
5	96-13172	,DEC23-D98-2_Saturday	,60096002500909-DEC23	,	,	0 , 0960200	,960250_DEC23	,58818046-DEC23-D98-2_Saturday
6	96-13172	,DEC23-D98-2_Saturday	,60096002501009-DEC23	,	,	0 , 0960100	,960250_DEC23	,58818047-DEC23-D98-2_Saturday
7	96-13172	,DEC23-D98-2_Saturday	,60096002501109-DEC23	,	,	0 , 0960200	,960250_DEC23	,58818048-DEC23-D98-2_Saturday
8	96-13172	,DEC23-D98-2_Saturday	,60096002501209-DEC23	,	,	0 , 0960100	,960250_DEC23	,58818049-DEC23-D98-2_Saturday
9	96-13172	,DEC23-D98-2_Saturday	,60096002501309-DEC23	,	,	0 , 0960200	,960250_DEC23	,58818050-DEC23-D98-2_Saturday
10	96-13172	,DEC23-D98-2_Saturday	,60096002501409-DEC23	,	,	0 , 0960100	,960250_DEC23	,58818051-DEC23-D98-2_Saturday
11	96-13172	,DEC23-D98-2_Saturday	,60096002501509-DEC23	,	,	0 , 0960200	,960250_DEC23	,58818052-DEC23-D98-2_Saturday
12	96-13172	,DEC23-D98-2_Saturday	,60096002501609-DEC23	,	,	0 , 0960100	,960250_DEC23	,58818053-DEC23-D98-2_Saturday
13	96-13172	,DEC23-D98-2_Saturday	,60096002501709-DEC23	,	,	0 , 0960200	,960250_DEC23	,58818054-DEC23-D98-2_Saturday
14	96-13172	,DEC23-D98-2_Saturday	,60096002501809-DEC23	,	,	0 , 0960100	,960250_DEC23	,58818055-DEC23-D98-2_Saturday
15	96-13172	,DEC23-D98-2_Saturday	,60096002510611-DEC23	,	,	1 , 0960200	,960251_DEC23	,58818056-DEC23-D98-2_Saturday
16	96-13172	,DEC23-D98-2_Saturday	,60096002510711-DEC23	,	,	1 , 0960100	,960251_DEC23	,58818057-DEC23-D98-2_Saturday

Tells you the trips that run on each route

A trip = 2+ stops during a specific time period, traveled by a single vehicle. The operator switch out for mid-trip relief.
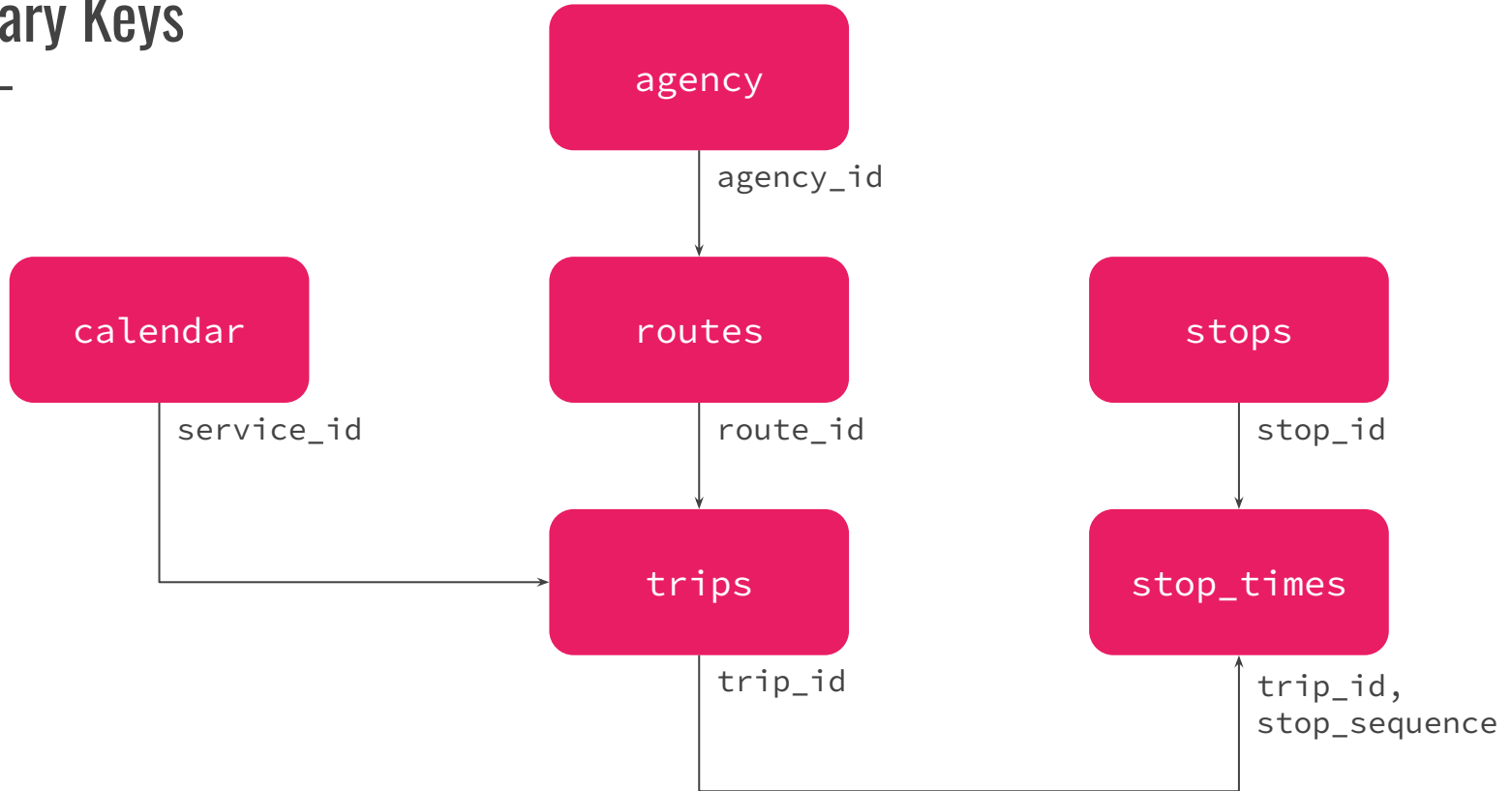
Stop_Times.txt

```
1   trip_id             ,arrival_time ,departure_time ,stop_id  ,stop_sequence ,stop_headsign     ,pickup_type ,drop_off_type ,route_code ,destination_code ,timepoint ,ba
2   10010007510530-DEC23 ,06:01:00    ,06:01:00    ,  11643 ,           39 ,48 - Melrose - Vine ,        0 ,            0 ,        48 ,Melrose - Vine   ,        0 ,
3   10010007510530-DEC23 ,06:02:00    ,06:02:00    ,  11646 ,           40 ,48 - Melrose - Vine ,        0 ,            0 ,        48 ,Melrose - Vine   ,        0 ,
4   10010007510530-DEC23 ,06:03:00    ,06:03:00    ,4800006 ,           41 ,48 - Melrose - Vine ,        0 ,            0 ,        48 ,Melrose - Vine   ,        0 ,
5   10010007510530-DEC23 ,06:04:00    ,06:04:00    ,4800001 ,           42 ,48 - Melrose - Vine ,        0 ,            0 ,        48 ,Melrose - Vine   ,        0 ,
6   10010007510530-DEC23 ,06:06:00    ,06:06:00    ,4800002 ,           43 ,48 - Melrose - Vine ,        0 ,            0 ,        48 ,Melrose - Vine   ,        0 ,
7   10010007510530-DEC23 ,06:07:00    ,06:07:00    ,   3121 ,           44 ,10 - Melrose - Vine ,        0 ,            0 ,        10 ,Melrose - Vine   ,        1 ,
8   10010007510530-DEC23 ,06:08:00    ,06:08:00    ,   5279 ,           45 ,10 - Melrose - Vine ,        0 ,            0 ,        10 ,Melrose - Vine   ,        0 ,
9   10010007510530-DEC23 ,06:10:00    ,06:10:00    ,   1131 ,           46 ,10 - Melrose - Vine ,        0 ,            0 ,        10 ,Melrose - Vine   ,        0 ,
10  10010007510530-DEC23 ,06:11:00    ,06:11:00    ,   5292 ,           47 ,10 - Melrose - Vine ,        0 ,            0 ,        10 ,Melrose - Vine   ,        0 ,
11  10010007510530-DEC23 ,06:13:00    ,06:13:00    ,  15778 ,           48 ,10 - Melrose - Vine ,        0 ,            0 ,        10 ,Melrose - Vine   ,        0 ,
12  10010007510530-DEC23 ,06:13:00    ,06:13:00    ,  15788 ,           49 ,10 - Melrose - Vine ,        0 ,            0 ,        10 ,Melrose - Vine   ,        0 ,
```

Tells you the times a vehicle *arrives at* and *departs from*, for each stop on each trip

This file is over 200MB unzipped for Metro's bus GTFS!

Relationships,
Primary Keys
— — —

A few things to be aware of...

GTFS Gotchas

— — —

> If **pickup_type == 1 && drop_off_type == 1**…
> This may be a layover or a terminal that passengers aren't allowed in.

In Bus **stop_times.txt**:

pickup_type	Enum	Optional	Indicates pickup method. Valid options are:
			0 or empty - Regularly scheduled pickup.
			1 - No pickup available.
			2 - Must phone agency to arrange pickup.
			3 - Must coordinate with driver to arrange pickup.
drop_off_type	Enum	Optional	Indicates drop off method. Valid options are:
			0 or empty - Regularly scheduled drop off.
			1 - No drop off available.
			2 - Must phone agency to arrange drop off.
			3 - Must coordinate with driver to arrange drop off.

GTFS Gotchas

———

In Rail **stops.txt:**

```
1   stop_id ,stop_code ,stop_name                                                    ,stop_desc ,stop_lat  ,stop_lon      ,stop_url ,location_type ,parent_station
2   80122   ,80122     ,7th Street / Metro Center Station - Metro A & E Lines        ,          ,34.04861  ,-118.258822 , ,              0 ,80122S
3   80122S  ,80122S    ,7th Street / Metro Center Station                            ,          ,34.04861  ,-118.258822 , ,              1 ,
4   80122A  ,80122A    ,7th Street / Metro Center Station - 7th & Figueroa Elevator  ,          ,34.04916  ,-118.25933  , ,              2 ,80122S
5   80122B  ,80122B    ,7th Street / Metro Center Station - 7th & Figueroa Entrance  ,          ,34.04936  ,-118.25966  , ,              2 ,80122S
6   80122C  ,80122C    ,7th Street / Metro Center Station - 7th & Flower Elevator    ,          ,34.0489   ,-118.25839  , ,              2 ,80122S
7   80122D  ,80122D    ,7th Street / Metro Center Station - 7th & Flower Entrance    ,          ,34.0487   ,-118.25856  , ,              2 ,80122S
8   80122F  ,80122F    ,7th Street / Metro Center Station - Elevator at the Bloc     ,          ,34.048113 ,-118.258228 , ,              2 ,80122S
9   80122G  ,80122G    ,7th Street / Metro Center Station - Entrance to the Bloc     ,          ,34.048127 ,-118.258310 , ,              2 ,80122S
10  80211   ,80211     ,7th Street / Metro Center Station - Metro B & D Lines        ,          ,34.048634 ,-118.258682 , ,              0 ,80122S
```

Metro's data currently does not have separate points for each side of the platform.

Metro's Bus GTFS - IDs Change

➢ **route_id** and **trip_id** are not persistent between Shakeups!

Metro's Bus GTFS - IDs Change

———

In **routes.txt**:

```
1   route_id      ,route_short_name  ,route_long_name
2   2-13172       ,2                 ,Metro Local Line
3   4-13172       ,4                 ,Metro Local Line
4   10-13172      ,10/48             ,Metro Local Line
5   14-13172      ,14/37             ,Metro Local Line
```

In **trips.txt**:

```
1   trip_id               ,arrival_time  ,departure_t
2   10010007510530-DEC23  ,06:01:00      ,06:01:00
3   10010007510530-DEC23  ,06:02:00      ,06:02:00
4   10010007510530-DEC23  ,06:03:00      ,06:03:00
```

Metro's Bus GTFS - IDs Change

___

Permanent trip_id

$$100100075 10530-DEC23$$

Day Type: 1

Weekday = 1
Saturday = 6
Sunday = 7

Line: 0010

4 Digits with Leading Zeros

Pattern: 00751

5 Digits with Leading Zeros

Start Time: 0530

HHMM, 36-hour clock

Shakeup: DEC23

Month + Year

Metro's Bus GTFS - Parent-Child Routes

———

➢ Some lines are "parent-child" routes and may not have their own **route_id.**

Metro's Bus GTFS - Parent-Child Routes

———

➢ This is why we use stop_headsign in stop_times.txt
  instead of trip_headsign in trips.txt:

	trip_id	,arrival_time	,departure_time	,stop_id	,stop_sequence	,stop_headsign	,pickup_type	,drop_off_type	route_code	,destination_code	,t
1											
2	10010007510530-DEC23	,06:01:00	,06:01:00	, 11643 ,	39	,48 - Melrose - Vine ,	0 ,	0 ,	48	,Melrose - Vine	,
3	10010007510530-DEC23	,06:02:00	,06:02:00	, 11646 ,	40	,48 - Melrose - Vine ,	0 ,	0 ,	48	,Melrose - Vine	,
4	10010007510530-DEC23	,06:03:00	,06:03:00	,4800006 ,	41	,48 - Melrose - Vine ,	0 ,	0 ,	48	,Melrose - Vine	,
5	10010007510530-DEC23	,06:04:00	,06:04:00	,4800001 ,	42	,48 - Melrose - Vine ,	0 ,	0 ,	48	,Melrose - Vine	,
6	10010007510530-DEC23	,06:06:00	,06:06:00	,4800002 ,	43	,48 - Melrose - Vine ,	0 ,	0 ,	48	,Melrose - Vine	,
7	10010007510530-DEC23	,06:07:00	,06:07:00	, 3121 ,	44	,10 - Melrose - Vine ,	0 ,	0 ,	10	,Melrose - Vine	,
8	10010007510530-DEC23	,06:08:00	,06:08:00	, 5279 ,	45	,10 - Melrose - Vine ,	0 ,	0 ,	10	,Melrose - Vine	,
9	10010007510530-DEC23	,06:10:00	,06:10:00	, 1131 ,	46	,10 - Melrose - Vine ,	0 ,	0 ,	10	,Melrose - Vine	,
10	10010007510530-DEC23	,06:11:00	,06:11:00	, 5292 ,	47	,10 - Melrose - Vine ,	0 ,	0 ,	10	,Melrose - Vine	,
11	10010007510530-DEC23	,06:13:00	,06:13:00	, 15778 ,	48	,10 - Melrose - Vine ,	0 ,	0 ,	10	,Melrose - Vine	,
12	10010007510530-DEC23	,06:13:00	,06:13:00	, 15788 ,	49	,10 - Melrose - Vine ,	0 ,	0 ,	10	,Melrose - Vine	,

Metro's Bus GTFS - Parent-Child Routes

———

In **stop_times.txt**:

➢ Non-standard **route_code**, **destination_code** fields.

	trip_id	,arrival_time	,departure_time	,stop_id	,stop_sequence	,stop_headsign	,pickup_type	,drop_off_type	,route_code	,destination_code	,t
1											
2	10010007510530-DEC23	,06:01:00	,06:01:00	, 11643	39	,48 - Melrose - Vine	, 0	, 0	, 48	,Melrose - Vine	,
3	10010007510530-DEC23	,06:02:00	,06:02:00	, 11646	40	,48 - Melrose - Vine	, 0	, 0	, 48	,Melrose - Vine	,
4	10010007510530-DEC23	,06:03:00	,06:03:00	,4800006	41	,48 - Melrose - Vine	, 0	, 0	, 48	,Melrose - Vine	,
5	10010007510530-DEC23	,06:04:00	,06:04:00	,4800001	42	,48 - Melrose - Vine	, 0	, 0	, 48	,Melrose - Vine	,
6	10010007510530-DEC23	,06:06:00	,06:06:00	,4800002	43	,48 - Melrose - Vine	, 0	, 0	, 48	,Melrose - Vine	,
7	10010007510530-DEC23	,06:07:00	,06:07:00	, 3121	44	,10 - Melrose - Vine	, 0	, 0	, 10	,Melrose - Vine	,
8	10010007510530-DEC23	,06:08:00	,06:08:00	, 5279	45	,10 - Melrose - Vine	, 0	, 0	, 10	,Melrose - Vine	,
9	10010007510530-DEC23	,06:10:00	,06:10:00	, 1131	46	,10 - Melrose - Vine	, 0	, 0	, 10	,Melrose - Vine	,
10	10010007510530-DEC23	,06:11:00	,06:11:00	, 5292	47	,10 - Melrose - Vine	, 0	, 0	, 10	,Melrose - Vine	,
11	10010007510530-DEC23	,06:13:00	,06:13:00	, 15778	48	,10 - Melrose - Vine	, 0	, 0	, 10	,Melrose - Vine	,
12	10010007510530-DEC23	,06:13:00	,06:13:00	, 15788	49	,10 - Melrose - Vine	, 0	, 0	, 10	,Melrose - Vine	,

Metro's Bus GTFS - Parent-Child Routes

—— —

Why do we do this?

➢ Some trips change route number mid-trip to avoid ending the trip where the route changes.

Why?

➢ At the end of a trip, the bus operator needs to be able to **layover** and access a **bathroom** (contractually, legally, and biologically!).

○ Some cities won't agree to let us layover on their streets.

○ We negotiate contractual agreements with businesses, but sometimes we can't find one that will allow our bus operators to use their bathroom.

○ Sometimes we have to build our own bathroom!

Next Stop: GTFS-realtime

GTFS-realtime

➢ **VehicleLocation**
Live vehicle locations

➢ **TripUpdates**
Arrival predictions,
delays, cancellations

➢ **Alerts**
Service disruption
descriptions

Some apps show you when their predictions use realtime vs schedule data!
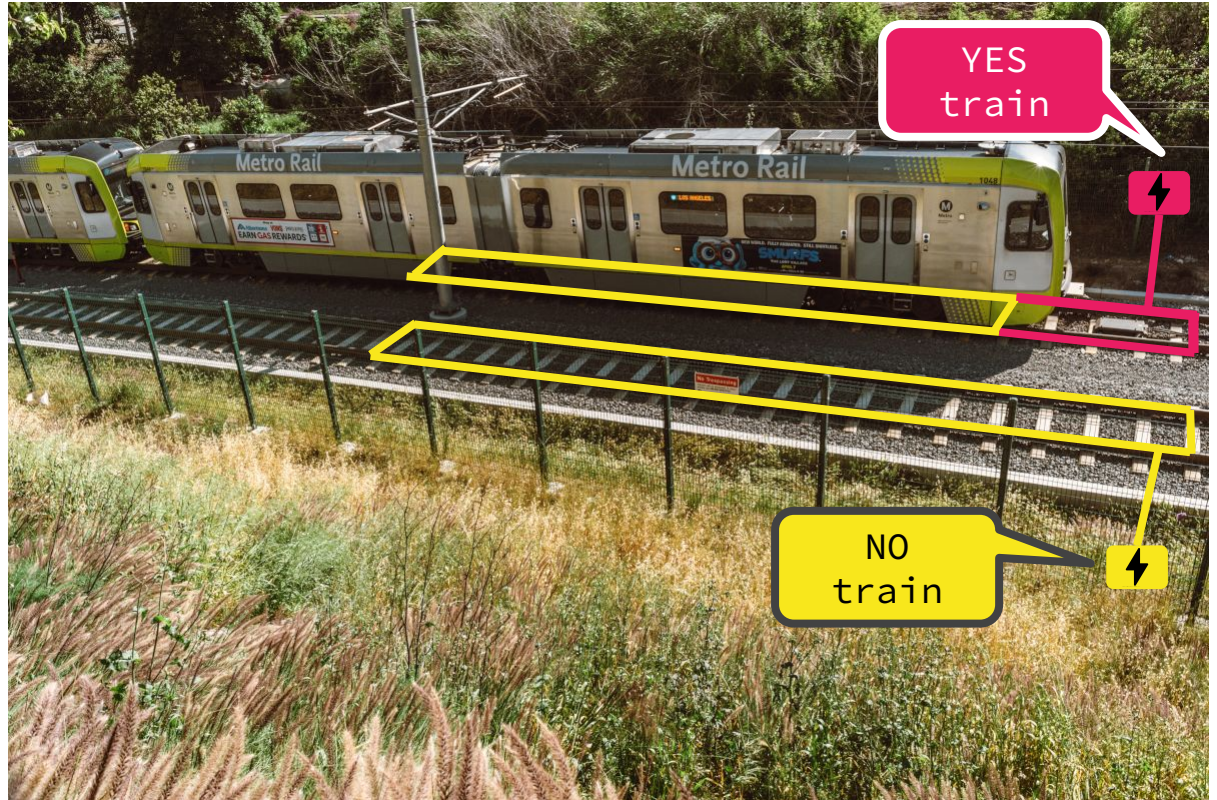
Detour!

Realtime Tracking - Bus

———

Two systems:

➢ **ATMS** – Advanced Transportation Management System

  ○ **AVL** – Automatic Vehicle Location

  ○ Transmits data via radio

  ○ Updates every **2-3 minutes**

  ○ Fully deployed **2006**

➢ **WiFi Routers**

  ○ Transmits data via cell towers

  ○ Updates every **2-5 seconds**

  ○ Fully deployed **2021**

Realtime Tracking - Rail

➢ Track Circuits

Realtime Tracking - Rail

———

➢ Supervisory Control and Data Acquisition (**SCADA**) system
  ○ Controls and monitors processes like train speed, switches, signals, etc.

GTFS-realtime

———

Format:

➢ **Protobuf** (Protocol Buffer) – a binary format created by Google to be more efficient when transferring lots of data.

➢ GTFS-realtime often provided as **JSON** as well.

GTFS-realtime

— — —

No trip assigned?

➤ Our Wifi Routers send location as long as the bus is powered.

➤ Vehicle may be traveling or waiting between trips.

➤ Vehicle could be replacing another vehicle without the trip being reassigned.

➤ ATMS might be down.

Remember: Trip tells us *what* times a vehicle arrives and departs *what* sequence of stops! This is essential for predictions.

```
204    {
205      "id": "5838",
206      "vehicle": {
207        "position": {
208          "latitude": 34.08453,
209          "longitude": -118.38158,
210          "speed": 0.044704
211        },
212        "timestamp": "1710309726",
213        "vehicle": {
214          "id": "5838",
215          "label": "5838"
216        }
217      }
218    },
219    {
220      "id": "5830",
221      "vehicle": {
222        "trip": {
223          "tripId": "10094002622207-DEC23",
224          "startDate": "20240312",
225          "routeId": "94-13172"
226        },
227        "position": {
228          "latitude": 34.166862,
229          "longitude": -118.2894,
230          "bearing": 311.0,
231          "speed": 13.4112
232        },
233        "currentStopSequence": 52,
234        "currentStatus": "IN_TRANSIT_TO",
235        "timestamp": "1710309725",
236        "stopId": "5867",
237        "vehicle": {
238          "id": "5830",
239          "label": "5830"
240        }
```

End of the Line: Where do we go from here?

MORE GTFS

GTFS is Constantly Growing!

———

Specification amendment process for:

➢ **Bus**

  https://gtfs.org/schedule/process/

➢ **Rail**

  https://gtfs.org/realtime/process/

GTFS Governance

———

Broadly speaking, new extensions require:

➢ 1 data producer

➢ 1 data consumer

➢ A production implementation

➢ A series of public votes on GitHub

GTFS Extensions - TripModifications

———

Detour shapes in GTFS-realtime! Voting closed 3/7!

https://github.com/google/transit/pull/403

gcamp commented on Sep 26, 2023 • edited ▾   Contributor   ···

Following the proposal of GTFS Trip-Modifications in February, we are now ready for the pull request stage!

As a reminder, Trip-Modifications are modifications done to a trip to modify its shape, remove stops that are not served anymore, and potentially add temporary stops. Trip-Modifications is mainly used in a detour use case.

Today, we're launching the detour feature in Transit for more agencies with Trip Modifications produced by Swiftly! Now that there is one producer and one consumer, the current PR is not an experimental field and actually removes the experimental tag for Shape , which has been in the spec for 2 years.

Feel free to ask questions, or give feedback!
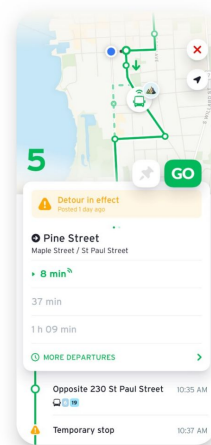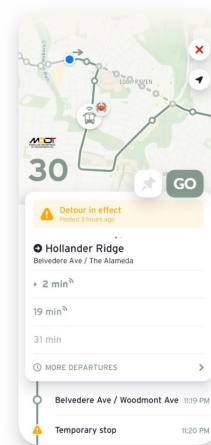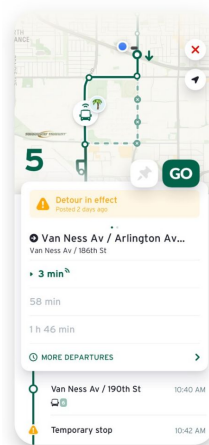
GTFS Extensions - Flex

———

Non-fixed route, on-demand, "flexible" transit.

September 2023 discussion reached consensus on using GeoJSON for zones!

https://github.com/google/transit/pull/433

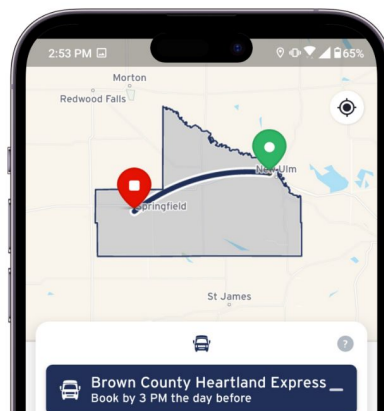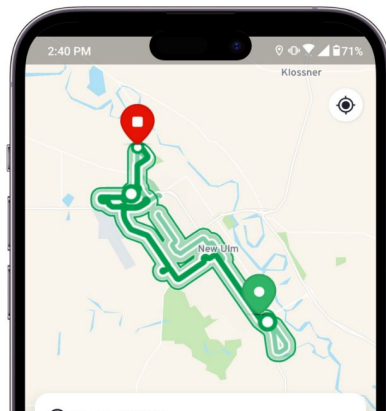tzujenchanmbd commented last week • edited ▾   [Collaborator] [Author] ⋯

Hello everyone,

Support resources from first adopters are ready.

- We have one producer: Trillium
- We have two consumers: Transit and OpenTripPlanner

Please refer to this adoption tracker for the fields adopted by each organization.

As per the GTFS Amendment process, the requirements to open a vote are met. We are opening a vote for adding GTFS-Flex.

Voting ends on 2024-03-18 at 23:59:59 UTC.

GTFS Extensions - Fares v2

———

Base implementation of v2 passed vote in May 2022!

https://github.com/google/transit/pull/286

Development continues!

MobilityData

MobilityData is Active!

➢ **Hiring**
   https://careers.mobilitydata.org/

➢ As of **March 4,** also home to:
   ○ Mobility Data Interoperability Principles (**MDIP**)
   ○ Transit ITS Data Exchange Specification (**TIDES**)
   ○ Transit Operational Data Specification (**TODS**)

➢ 2nd International **Mobility Data Summit**
   https://mobilitydata.org/international-mobility-data-summit/

MobilityData

Follow what's going on via:

➢ **Newsletter**
https://mobilitydata.org/contact-us/

➢ **GitHub**
https://github.com/mobilitydata

➢ **Slack**
https://bit.ly/mobilitydata-slack

Cal-ITP

Cal-ITP (Caltrans)

———

https://www.calitp.org/

Cal-ITP has 4 goals for their work:

1 invites travelers toward more efficient and sustainable modes of travel,

2 reduces operating costs for transit agencies,

3 simplifies every traveler's life, and

4 simultaneously welcomes every single person in this country to a seamless, user-friendly system—making paying for a transit ride just as easy as buying coffee.

Cal-ITP (Caltrans)

—––

What does that translate to?

➢ **Contactless Payments**
Making it easier for transit agencies to implement contactless payments so riders can tap with the debit card, credit card, or smartphone already in their pocket!

➢ **Benefits**
Automating customer discounts so riders instantly qualify for and receive discounts

➢ **GTFS**
Standardizing information for easy trip planning by expanding and beefing up the GTFS ecosystem

Mobility Data Interoperability Principles (MDIP)

MDIP

---

https://www.interoperablemobility.org/

➢ Effort started by Cal-ITP.

➢ Grown into an international coalition.

➢ A declaration that the industry needs interoperable data to advance.

➢ That means transit agency and transit vendor buy-in.

➢ That means creating a plan and providing resources.

➢ Recently rehomed to MobilityData to continue the work.

Metro

What is Metro doing?

———

Cal-ITP (CalTrans)

➢ Metro is a partner!

Mobility Data Interoperability Principles (MDIP)

➢ Metro is a co-author!

What is Metro doing?

———
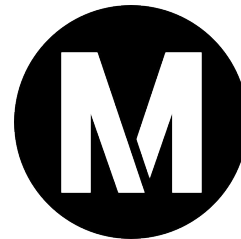
GTFS Extensions

➢ Looking for partnership opportunities, actively voting on the new extensions being developed.

Mobile App Consolidation Working Group

➢ Metro is pushing for GTFS-schedule and GTFS-realtime data to exist regionally

➢ Metro is advocating for expanding data standards in the industry.

More Resources for your GTFS Journey

Creating and Using GTFS

———

➢ **Intro to GTFS Video**
   https://www.youtube.com/watch?v=SDz2460AjNo

➢ **GTFS Best Practices**
   https://gtfs.org/schedule/best-practices/
   https://gtfs.org/realtime/best-practices/

➢ **California Transit Data Guidelines**
   https://dot.ca.gov/cal-itp/california-transit-data-guidelines

GTFS Catalogs

➢ **Cal-ITP - Monthly GTFS Quality Reports (California)**
   https://reports.calitp.org/

➢ **MobilityData - Mobility Database**
   https://mobilitydatabase.org/

➢ **Interline - Transitland**
   https://www.transit.land/

GTFS Tools

———

➢ **GTFS Studio**
   https://editor.gtfs.studio/

➢ **GTFS-schedule Validator**
   https://gtfs-validator.mobilitydata.org/

➢ **Software libraries in different languages**
   https://gtfs.org/resources/gtfs/

Open Source Projects/Apps that use GTFS data

———

➢ **OneBusAway**
   https://onebusaway.org/

➢ **OpenTripPlanner**
   https://www.opentripplanner.org/

➢ **TheTransitClock**
   https://thetransitclock.github.io/

➢ **Shoutout to local project: Catenary Maps**
   https://catenarymaps.org/

Metro's Data

———

➢ **Metro Open Data**
https://developer.metro.net/

➢ **Metro Bus GTFS**
https://gitlab.com/LACMTA/gtfs_bus

➢ **Metro Rail GTFS**
https://gitlab.com/LACMTA/gtfs_rail

Thank you to…

———

➢ **Rollin Baker**
   Director — System Projects (HASTUS)
   LA Metro, Operations

➢ **Monica Waggoner**
   Principal Transportation Planner — Gateway Cities
   LA Metro, Operations

➢ **Isabelle de Robert**
   Director of Product
   MobilityData

Reach out!

— — —

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Muffin

References

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- ➤ https://blog.google/products/maps/look-back-15-years-mapping-world/

- ➤ https://googlesystem.blogspot.com/2005/12/google-transit-trip-planner.html

- ➤ https://thecityfix.com/blog/introducing-google-transit/

- ➤ https://rmi.org/wp-content/uploads/2017/04/RMI-Mobility-InteroperableTransitData-FullReport-2.pdf

- ➤ https://azavea.gitbooks.io/open-data-standards/content/standards/domain_specific_standards/gtfs_realtime_gtfsrt.html

- ➤ http://ngtsip.pbworks.com/w/file/fetch/49201665/GTFS-RT_RTDP_Overview_v1.1.pdf

References

— — —

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➢ https://groups.google.com/g/gtfs-changes/c/ob_7MIOvOxU/m/zEScjv6VLBMJ?pli=1

➢ https://rmi.org/wp-content/uploads/2017/03/consortium_approach_to_ITD_report2016.pdf

➢ https://rmi.org/data-interoperability-enables-mobility-service/

➢ https://rmi.org/transit-directions-just-got-little-bit-better/

➢ https://transitcenter.org/wp-content/uploads/2018/12/TC_TransitData_Final_FullLayout_121718-1.pdf

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