General Transit Feed Specification Workshop

By EACOMM Corporation

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Introductions

About EACOMM Corporation

- EACOMM Corporation is a Knowledge and Technology Services company that has been providing innovative and customized solutions to its clients since 2001.
- EACOMM is focused on providing custom-made web and mobile applications for clients that include Fortune 500 Companies, Government Agencies, Educational Institutions, and small and medium scale companies across the globe.
- EACOMM has been developing GTFS feeds since 2012, having been contracted by Google to develop the GTFS feed for Metro Manila.
- Since then, EACOMM has been working closely with the likes of the Department of Transportation and Communications of the Philippines as well as the Land Transport Authority of Singapore in helping develop GTFS feeds for various Public Transit Systems.

About the Facilitators

- Mike Torres
  - Project Lead - Static GTFS Feeds for the Philippines
  - Project Lead - Static and real time GTFS Feeds for Singapore
  - Software Architect – DOTC Bus Management Information System
- Raphael Warren
  - Senior Developer – DOTC Bus Management Information System
  - Senior Developer – Real time GTFS Feeds for Singapore

The GTFS and its Uses

What is GTFS?

- The General Transit Feed Specification (GTFS) is a standard format for public transit schedules and geographical information.
- Developed by Google and Portland TriMet for the public transportation system of Portland, USA and was launched on December 7, 2005.
- Consists of multiple CSV (comma-separated values) files contained in a single zip file.
- Key information encoded in GTFS includes: transit agency information, route information, trip schedules, stop locations, route shapes, etc.
- GTFS has quickly been adopted as the most accepted standard in formatting transit information in a way that can be easily shared across multiple applications.

Uses of GTFS

- Best way to share your Transit Information to the General Public as it is supported by a number of transit planning and mapping applications such as:
  - Google Maps, Apple Maps, Open Trip Planner, Moovit, rome2rio, etc.
- Can be used internally for transit planning and route visualization.
- Can be used to develop maps and timetables that can be posted in stops or shared online.
- Increase ridership in public transportation by making it easier for commuters to plan their trips.
- Encourages tourists to take public transportation and allows them to plan their trips even before arriving to your city.

GTFS in Detail

The Feed Files

- The GTFS Reference: https://developers.google.com/transit/gtfs/reference
- Required Files:
  1. agency.txt – info on one or more agencies
  2. stops.txt – info on the various stops
  3. routes.txt – various routes available in the feed
  4. trips.txt – various trips per route
  5. stop_times.txt – arrival and departure time per stop per trip
  6. calendar.txt – weekly service schedule

The Feed Files

- “Optional” Files (Required by Google Maps)
  7. calendar_dates.txt – exemptions to calendar.txt
  8. shapes.txt – drawing of the route on a the map
- Optional Files
  9. frequencies.txt – headway information for repeating trips
  10. fare_attributes.txt – fare information
  11. fare_rules.txt – rules for applying fares
  12. transfers.txt – rules for making connections at transfer points
  13. feed_info.txt – additional feed information

File Requirements

- All files are comma delimited.
- First line contains field names.
- All field names are case-sensitive.
- Field values may not contain tabs, carriage returns or new lines.
- If value includes commas or quotation marks, these should be enclosed in quotation marks for example:
  - Data: 1,2,3
  - CSV representation: “1,2,3”
  - Data: “quotes”
  - CSV representation: ““quotes””
- HTML tags are not allowed
- No Spaces between fields or field names
- End each line with CRLF or LF linebreak character
- Files should be in UTF-8
- Feed Submissions are in Zip format

1. agency.txt

- https://developers.google.com/transit/gtfs/reference#agency_fields
- Fill up as much information as possible. Agency URL and Agency Phone are displayed in Google Maps.
- Example:

agency_id	agency_name	agency_url	agency_timezone	agency_phone	agency_lang
lrta	Light Rail Transit Authority	http://www.lrta.gov.ph/	Asia/Manila	+632 8530041	en

2. stops.txt

- https://developers.google.com/transit/gtfs/reference#stops_fields
- Note that stops can be used by *multiple routes.*
- Google Maps supports stations with multiple stops and multiple entrances (location_type=2).
- Example:

stop_id	stop_name	stop_desc	stop_lat	stop_lon	zone_id	location_type
2lrt1	EDSA	Passengers looking to transfer to the MRT-3 train line should disembark on this station and walk via covered walkway or through the Metropoint Mall to the MRT-3 Taft Avenue Station.	14.5389	121.0006	lrt1-2	0

3. routes.txt

- https://developers.google.com/transit/gtfs/reference#routes_fields
- Route color should represent 'real world' color assignments. Pay attention to contrast of route_text_color and and route_color.
- Example:

route_id	agency_id	route_short_name	route_long_name	route_desc	route_type	route_color
lrt1	lrta		LRT Line 1	"The LRT Line 1 Traverses Metro Manila from the North in Quezon City to Baclaran, Pasay City in the South. The line is currently 20.7 kilometers long."	0	FFFF00

*Note Quotes on route_desc

4. trips.txt

- https://developers.google.com/transit/gtfs/reference#trips_fields
- Use the direction_id to indicated bi-directional trips of a route (as oppose to creating 2 routes).
- For loop routes, it is advisable to use stop_headsign (in stop_times.txt) to change headsigns to indicate next stop.
- Make sure you assign a shape to every trip.
- Example:

route_id	service_id	trip_id	trip_headsign	direction_id	shape_id
lrt1	ss1	lrt10	Roosevelt	0	lrt11_shp
lrt1	ss1	lrt11	Baclaran	1	lrt1_shp

5. stop_times.txt

- https://developers.google.com/transit/gtfs/reference#stop_times_fields
- If time spans over the next day, indicate a time >24. i.e. 25:00:00 for 1am the next day.
- Example:

trip_id	arrival_time	departure_time	stop_id	stop_sequence
lrt10	5:00:00	5:01:00	1lrt1	1
lrt10	5:02:00	5:03:00	2lrt1	2
lrt10	5:05:00	5:06:00	3lrt1	3
lrt10	5:07:00	5:08:00	4lrt1	4
lrt10	5:09:00	5:10:00	5lrt1	5

6. calendar.txt

- https://developers.google.com/transit/gtfs/reference#calendar_fields
- Be aware of end_dates as the routes will stop showing after this date.
- Example:

service_id	monday	tuesday	wednesday	thursday	friday	saturday	sunday	start_date	end_date
ss1	1	1	1	1	1	0	0	20120405	20180405
ss2	0	0	0	0	0	1	1	20120405	20180405

7. calendar_dates.txt

- https://developers.google.com/transit/gtfs/reference#calendar_dates_fields
- Google requires that this file is present. Useful for holidays such as Christmas or Chinese New Year where the service might change regardless of day of the week.
- Example:

service_id	date	exception_type
ss1	20170413	2
ss1	20170414	2
ss2	20170415	2

8. shapes.txt

- https://developers.google.com/transit/gtfs/reference#shapes_fields
- Required by Google. The most time-consuming file to create. Automate as much as possible!
- Example:

shape_id	shape_pt_lat	shape_pt_lon	shape_pt_sequence
lrt1_shp	14.65752	121.0212	0
lrt1_shp	14.65761	121.0205	1
lrt1_shp	14.65765	121.0202	2
lrt1_shp	14.65742	121.0037	3
lrt1_shp	14.65715	120.9855	4

9. frequencies.txt

- https://developers.google.com/transit/gtfs/reference#frequencies_fields
- Used to model trips that repeat. Can be used to vary headways depending on time of day.
- Example:

trip_id	start_time	end_time	headway_secs	exact_times
lrt10	5:00:00	7:00:00	300	1
lrt10	7:00:01	9:00:00	180	1
lrt10	9:00:01	17:00:00	300	1
lrt10	17:00:01	19:00:00	180	1
lrt10	19:00:01	22:00:00	300	1

10. fare_attributes.txt

- https://developers.google.com/transit/gtfs/reference#fare_attributes_fields
- Example:

fare_id	price	currency_type	payment_method	transfers	agency_id
lrt1-1-to-2	15	PHP	1	0	lrta
lrt1-1-to-3	15	PHP	1	0	lrta
lrt1-1-to-4	15	PHP	1	0	lrta
lrt1-1-to-5	15	PHP	1	0	lrta
lrt1-1-to-6	15	PHP	1	0	lrta

11. fare_rules.txt

- https://developers.google.com/transit/gtfs/reference#fare_rules_fields
- Example:

fare_id	origin_id	destination_id
lrt1-1-to-2	lrt1-1	lrt1-2
lrt1-1-to-3	lrt1-1	lrt1-3
lrt1-1-to-4	lrt1-1	lrt1-4
lrt1-1-to-5	lrt1-1	lrt1-5
lrt1-1-to-6	lrt1-1	lrt1-6

- More Examples: https://code.google.com/archive/p/googletransitdatafeed/wikis/FareExamples.wiki

12. transfers.txt

- https://developers.google.com/transit/gtfs/reference#transfers_fields
- Example:

from_stop_id	to_stop_id	transfer_type
2lrt1	3lrt2	0

13. feed_info.txt

- https://developers.google.com/transit/gtfs/reference#feed_info_fields
- Example:

feed_publisher_name	feed_publisher_url	feed_lang
EACOMM Corporation	http://www.eacomm.com	en

Updates on GTFS

- GTFS is an *evolving standard*. New features and variables are added on a regular basis. Some of these features are already supported by Google and other GTFS providers.
- To keep up to date visit:
  - https://support.google.com/transitpartners/answer/2450962?hl=en
  - https://developers.google.com/transit/gtfs/changes

GTFS Feed Examples

Download the Following

- Download the Transit Feed Validator and Schedule Viewer:
  - https://github.com/google/transitfeed/releases/tag/1.2.15
  - Click on the link transit-feed-windows-binary-1.2.15.zip
  - Extract the zip file in a new directory.
- Download the Sample GTFS Feed:
  - http://c4.eacomm.com/gtfs-workshop/gtfs-sample.zip

Viewing/Editing GTFS Files

- Extract the contents of the gtfs-sample.zip to a folder. It should contain 11 .txt files.
- Two options to view:
  - Click on each txt file to view in Notepad or similar text editor.
  - Open excel or other spreadsheet software and import as comma delimited file.
- The contents of gtfs-sample.zip are the GTFS files of the three elevated train lines in Metro Manila: MRT, LRT1 and LRT2. It is the live GTFS Feed being used in Google Maps.
  - For are an example of a much larger file try downloading the World Bank project GTFS feed for Metro Manila: http://c4.eacomm.com/gtfs_dotc.zip

Visualizing Routes using schedule_viewer

- Drag gtfs-sample.zip to the schedule_viewer application.
- Point your browser to localhost:8765

Creating a GTFS Feed and using Validation Tools

Suggested sequence in GTFS Feed Creation:

1. agency.txt
2. routes.txt
3. trips.txt
4. stops.txt
5. stop_times.txt
6. calendar.txt

Simple GTFS

- agency.txt

  agency_id,agency_name,agency_url,agency_timezone,agency_phone,agency_lang

  eacomm,EACOMM Corporation,http://www.eacomm.com,Asia/Manila,6324382986,en

- routes.txt

  route_id,agency_id,route_short_name,route_long_name,route_desc,route_type,route_color

  eac1,eacomm,EAST,Eastwood Shuttle,Circular Shuttle Route,3,FF0000

- trips.txt

  route_id,service_id,trip_id,trip_headsign,direction_id

  eac1,sked1,trip1,Third Stop,0

  eac1,sked1,trip2,First Stop,1

Simple GTFS

- stops.txt
  - Use maps.google.com or www.latlong.net to determine coordinates of your desired stops.

```
stop_id,stop_name,stop_desc,stop_lat,stop_lon,location_type
stop1,Stop 1,The First Stop,-6.223287,106.798308,0
stop2,Stop 2,The Second Stop,-6.224615,106.798345,0
stop3,Stop 3,The Third Stop,-6.225836,106.798345,0
```

Simple GTFS

- stop_times.txt

  trip_id,arrival_time,departure_time,stop_id,stop_sequence

  trip1,05:00:00,05:01:00,stop1,1

  trip1,05:05:00,05:06:00,stop2,2

  trip1,05:10:00,05:11:00,stop3,3

  trip2,05:15:00,05:16:00,stop3,1

  trip2,05:18:00,05:19:00,stop2,2

  trip2,05:25:00,05:26:00,stop1,3

- calendar.txt

  service_id,monday,tuesday,wednesday,thursday,friday,saturday,sunday,start_date,end_date

  sked1,1,1,1,1,1,0,0,20160201,20170201

Validating Your Feed

- Once all 6 files are finished, archive the files as gtfs.zip.
- Drag the gtfs.zip file to your copy of feedvalidator.exe
- A validation report will be generated showing any errors you might have made.
- Once the validation report contains no more errors you can use schedule_viewer.exe to visualize your new GTFS feed.

Uploading your GTFS Feed to Google

Partner dashboard

- Contact Google for access to the Transit Partner Dashboard.
- Google will provide you a Partner Dashboard account and a feed to where you can preview your GTFS and/or publish live to Google Maps.
- From Partner dashboard you can configure the feed to be automatically updated by accessing your own server, or manually upload updates directly to the Partner Dashboard.
- A more detailed validation report and visualization tools are also available via the Partner Dashboard.

Partner dashboard

- Once you have uploaded your feed without error, contact Google's Transit Partners support team so that they can independently validate your submission.
- They will provide advise and comments on your feed which you will have to address before they approve your feed for inclusion to Google Maps.

Challenges and Best Practices

Challenges in developing GTFS Feeds

- **Accuracy of stop_times.txt** - Gathering data for stop_times.txt is a challenge especially for road-based transportation that have to deal with the hourly and daily changes in road traffic.
- **Creating shapes.txt** - Shapes.txt is a *requirement* if you want your data to be shown in Google Maps. While relatively straight forward, the process of plotting an accurate shape file can be very time consuming and labor intensive especially for longer routes.
- **Defining stops.txt** - Obtaining geolocation data for stops.txt can prove difficult if data is not yet readily available.
- **Including Fare Data** - The current GTFS Fare specifications have limited capability in modeling various fare implementations. For example, there is no straightforward way to define distance-based fares.

Best Practices

- **Process Automation** – The 'ideal' method of developing GTFS files is to *automate* as much of the process as possible.
  - **Use GPS transponders/Smartphones** – Gather data in the field using mobile phones or GPS transponders that can automate the creation of shape files, the definition of stops, and determination of travel time between stops. One example of this is TransitWand from Conveyal.
  - **Use Software Tools in creating GTFS –** There are a number of open source and proprietary tools that can be used to make it easier to develop GTFS routes. Examples:
    - – EACOMM's shape/stop builder for internal use.
    - http://mjcaction.com/MJC_GTFS_Public/GTFS_Builder_2015.zip - Excel-based GTFS maker

Best Practices

- **API for direct publishing GTFS**
  - If your organization already has a fleet/bus management system, the ideal method of deriving GTFS data is to have an API that will translate the data from the fleet management system to static and real-time GTFS data (Ex. DOTC Bus Management Information System and Singapore LTA).
- **Open Trip Planner**
  - Open Trip Planner allows you to debug and preview your GTFS feed at your own leisure before submitting to Google and other 3rd party providers.
  - OTP also allows you to feature your GTFS feed on your own website and provide API access to third parties to develop their own websites and mobile apps around your data easily.
  - Example: DOTC OTP Server

Best Practices

- **Maximize use of Optional Fields/Files** - Provide as much information as available by maximizing use of optional fields such as:
  - Add Agency contact number and url so that they can be contacted by users.
  - Add Fare information if feasible
  - Route coloring that corresponds to real life route colors/branding
  - Use transfers.txt to ‘force’ the use of specific transfer options.
  - Use calendar_dates.txt to add trip exemptions such as special trips/schedules on holidays.
  - Use shapes.txt to make rendering smooth.
  - Use frequencies.txt for trips with regular intervals.

Best Practices

- **Keep you Data up-to-date** – Google updates the GTFS Feeds on a weekly basis. Try to provide up to date information that would be valid for the medium to long term. For critical updates (i.e. changes/outages due to a special event) at least two weeks in advance to ensure that the data is in Google Maps by the time the event takes place.
- **Use Scheduled Fetching –** In the partner dashboard you can schedule when Google should fetch your GTFS feed. For automated or semi-automated GTFS feed creation, an automated feed update to Google Maps would be more advisable.