

APC Troubleshooting

Traffic Studio - Reports

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Table of Contents

1. VEHICLE RAW DATA REPORT	4
1.1 # OF INVALID DATA	4
1.1.1. Vehicle 1182	5
1.1.2. Vehicle 4728	7
1.1.3. Vehicle 7709	7
1.2 DIFFERENCE BOARDING/ALIGHTING	8
1.3 INVALID APC REPORTS	9
2. NEGATIVE PASSENGER COUNTS	9
3. APC VALID VS INVALID	10
3.1 LINE REPORT	10
3.2 ROUTE & JOURNEY REPORTS	10
3.3 VEHICLE REPORT	10
4. GENERAL	11
4.1 NO COMMUNICATION	11
4.2 DRIVER BOARDING WHILE VEHICLE IS TURNED OFF	11
4.3 BOARDING WHILE VEHICLE IS TURNED OFF	11
5. JOURNEY REPORT (TRIP)	11

1. Vehicle Raw Data Report

The first step to identify vehicles with APC issues is looking into the raw data for the vehicles.

One thing to remember before delving into this, is that you should take the different values in combination with each other. An example is mentioned in the General chapter regarding driver boarding while the vehicle is turned off. Sometimes the issue is not with the sensors, but are related to traffic data, human habits, etc.

If you run the report over a month, you should aim to have more than 1000 in the Total Boarding column for the statistics to be more reliable and accurate.

1. Tools -> Statistics -> Passenger Reports.
2. In the **Selection** dropdown list, select **Vehicle Raw Data**.
3. Select the **date interval**.
 - a. Optional: Remove specific dates and/or specific weekdays.
 - b. Optional: Select a time interval.
4. Select **one or many** vehicles. All vehicles are selected by default.
5. Click on **Generate Report**.

1.1 # of Invalid Data

The first view, **Summary**, lists all selected vehicles with a summary as its first row. Sort the table by the column "**# of invalid data**" so that the highest numbers are in the top rows.

Summary

Details

Departures w/o any APC report

Q

25/25

☒ Include invalid data
 ☐ Search for departures w/o any APC report
 ☒ Include valid data

Vehicle	Total Boarding	Total Alighting	Difference	Difference boarding/alighting (%)	Invalid Data	No. of invalid data	No. of Missing Reports
All vehicles	44915	47309	2684	5.1%	No Communication	854	0

Vehicle	Total Boarding	Total Alighting	Difference	Difference boarding/alighting (%)	Invalid Data	No. of invalid data	Departures w/o any APC report
1182	1314 [100%]	1432 [100%]	118	8.2%	No Communication	423	
4728	138 [100%]	156 [100%]	18	11.5%	No Communication	249	
7809	2900 [100%]	3029 [100%]	129	4.3%	No Communication	142	
7958	2953 [100%]	3065 [100%]	112	3.7%	No Communication	17	
9202	2266 [100%]	2453 [100%]	187	7.6%	No Communication	5	
8669	2636 [100%]	2718 [100%]	82	3.0%	No Communication	5	
9087	2549 [100%]	2670 [100%]	121	4.5%	No Communication	4	
6844	1529 [100%]	1564 [100%]	35	2.2%	No Communication	3	
7957	2710 [100%]	2896 [100%]	186	6.4%	No Communication	2	
7152	1460 [100%]	1505 [100%]	45	3.0%	No Communication	1	
1193	2039 [100%]	2054 [100%]	15	0.7%	No Communication	1	
1191	578 [100%]	571 [100%]	7	1.2%	No Communication	1	
1184	578 [100%]	563 [100%]	15	2.6%	No Communication	1	
7963	1970 [100%]	2104 [100%]	134	6.4%			
7687	1641 [100%]	1733 [100%]	92	5.3%			
6622	1562 [100%]	1823 [100%]	261	14.3%			
4730	758 [100%]	635 [100%]	123	16.2%			
1714	2461 [100%]	2616 [100%]	155	5.9%			
1197	2067 [100%]	2412 [100%]	345	14.3%			

Having numbers in this column is quite normal. It is within the range of acceptability to have invalid data a few times a day. For the period of a month, anything below 100 is probably fine, though it is never wrong to look into it.

To investigate a vehicle further, **select it** in the table (orange highlight for its row) and then click on the **Details** tab.

Summary

Details

Departures w/o any APC report

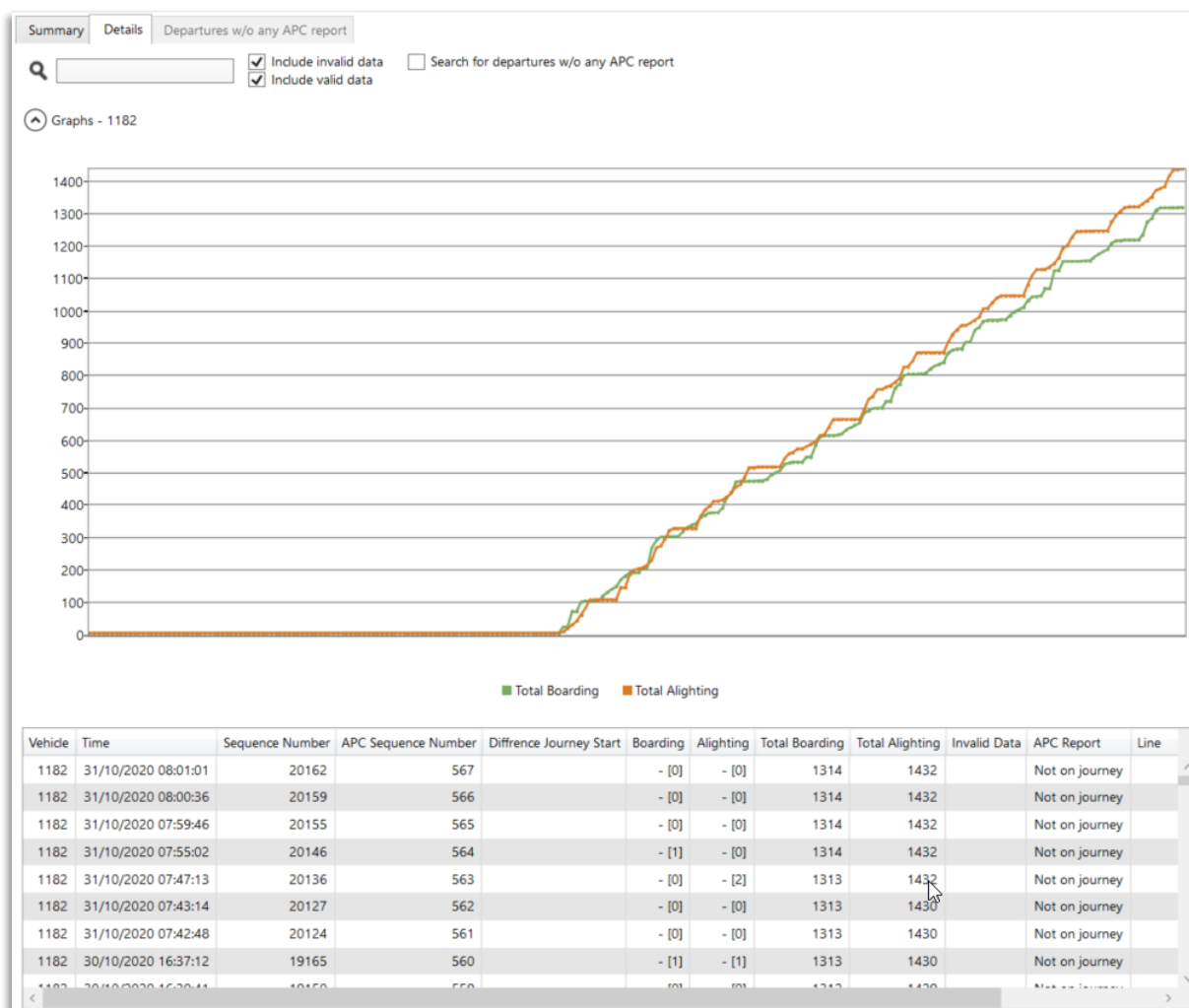
25/25

☒ Include invalid data
 ☒ Include valid data

Vehicle	Total Boarding	Total Alighting	Difference	Difference
All vehicles	44915	47309	2684	

1.1.1. Vehicle 1182

Vehicle 1182 has 423 invalid data reports. Looking at it in details, the graph gives us immediately a very good idea of what the problem can be for that month.



The flat lines are an obvious indication of something wrong. In this case, the issue is that there was no communication from the sensors.

Looking at the table, we find that the first time the sensors communicated was on the 21 October in the afternoon.

Clicking on the last “non communication” report and expanding the Doors section below, we also get the confirmation that the sensors were not communicating.

Vehicle	Time	Sequence Number	APC Sequence Number	Diffrence Journey Start	Boarding	Alighting	Total Boarding	Total Alighting	Invalid Data	APC Re
1182	21/10/2020 15:08:51	65	5		20 [0]	5 [3]	20	5		
1182	21/10/2020 15:07:19	54	4		20 [0]	2 [1]	20	2		
1182	21/10/2020 15:04:44	42	3		20 [20]	1 [1]	20	1		
1182	21/10/2020 15:00:23	29	2		- [0]	- [0]	0	0		Not on
1182	21/10/2020 14:55:52	16	1		- [0]	- [0]	0	0		Not on
1182	21/10/2020 14:55:39	12	0		- [0]	- [0]	0	0		Not on
1182	21/10/2020 09:06:08	4122	151		- [0]	- [0]	0	0	No Communication	Not on
1182	21/10/2020 08:46:34	4079	150		- [0]	- [0]	0	0	No Communication	Not on
1182	21/10/2020 08:46:34	4078	149		0 [0]	0 [0]	0	0	No Communication	Not on

Door Categories

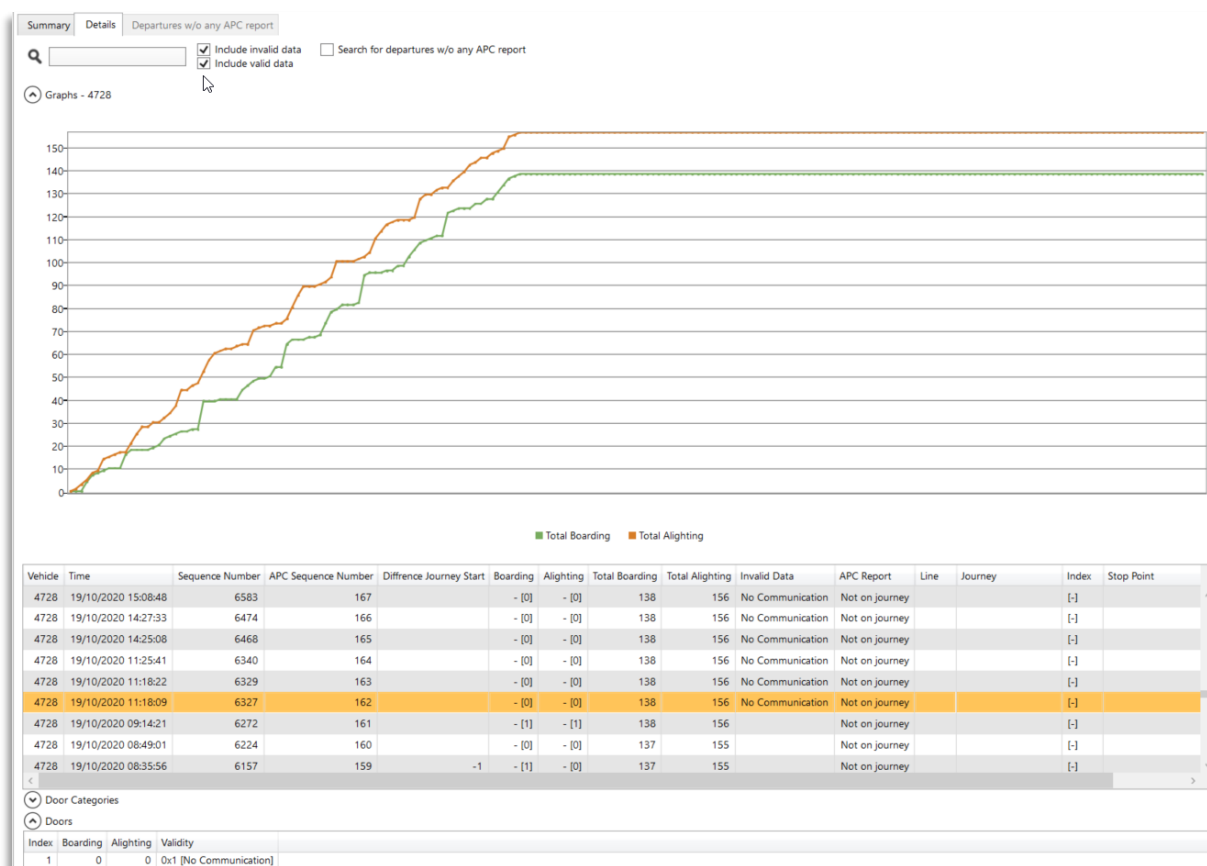
Doors

Index	Boarding	Alighting	Validity
1	0	0	0x1 [No Communication]

Total

1.1.2. Vehicle 4728

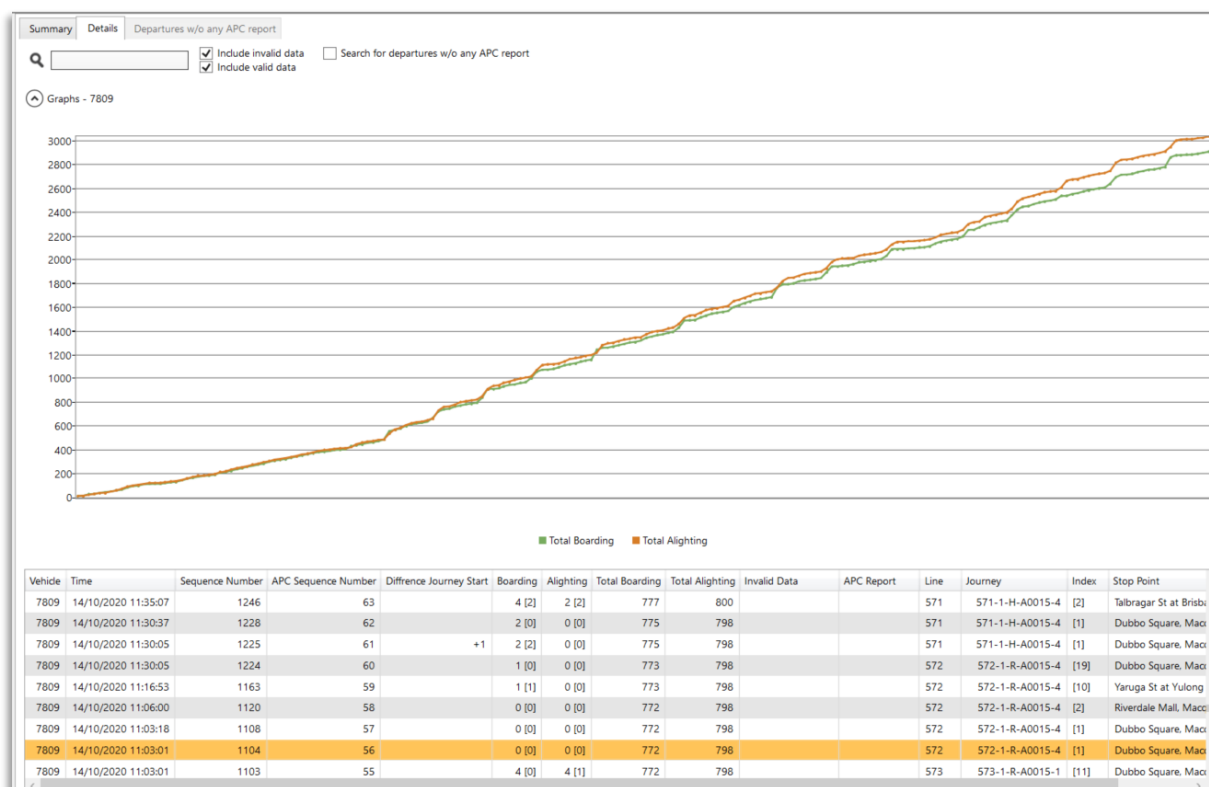
Vehicle 4728 has 247 invalid data reports.



In this case, we get the opposite situation of Vehicle 1182. The sensors were communicating until the 19 October in the morning.

1.1.3. Vehicle 7709

Vehicle 7709 has 142 invalid data reports. Its curves look less dramatic than the previous two, which can make the issue harder to identify.



The curves are quite similar at the start, but the difference increases over time. It is possible that the contact is loose. In such a case, it is recommended to check and test the APC sensors.

1.2 Difference boarding/alighting

Another interesting column is Difference boarding/alighting. In a normal system, the average should be **below 5%**. An average above 5% can be due to one or many of the following factors:

- The APC sensors are wrongly calibrated
- The driver.
 - If they board the vehicle before it was started, then the boarding is not counted.
 - However, the sensors are powered for a configurable time after turning off the vehicle (normally 15-30 minutes), meaning that it will count when the driver leaves the vehicle. That's already a difference of 1 for that day. Take it over a month, and you might have a default of 20 differences just because of that. For vehicles with few passengers, it can be misleading when only looking at the difference in % (see 4728 below).
- Passengers come on or off while the vehicle was not powered. This might be more common at terminals and schools, where the vehicle might be turned off while waiting for a long period of time.
- The sensors are wrongly mounted. It has happened before that the operator removed the sensors for maintenance / installing other equipment and mounted them back in a way that caused erroneous count due to light reflecting into the sensors.
- The cable is disconnected, so the sensor has no power.

Something to also keep in mind, is the number of passengers boarding and alighting. Let's compare 4728 and 1193 and pretend that one of the main reasons behind the difference is that the driver boarded the vehicle before turning it on every morning.

Vehicle	Boarding	Alighting	Difference	Difference %
4728	138	156	18	11.5%
1193	2039	2054	15	0.7%

Because 4728 has much fewer passengers over the month than 1193, the difference of 18 between boarding and alighting, compared to 15, looks much worse (11.5% vs 0.7%). In other words, you should never just look at the difference, but you should also take into account the values from boarding and alighting in order to make a good analysis.

1.3 Invalid APC Reports

Invalid APC reports may occur if the sensors and / or network on board have not yet started up after the ignition is switched on.

The following errors can be found in the Vehicle Raw Data report:

- APC error
- GPS error
- Door error
- Odo error (related to the odometer sensor)

If a vehicle has long breaks between its trips and that there are few passengers on those, there is a higher risk that the driver's boarding and alighting will affect the data accuracy (see **4.2 Driver Boarding While Vehicle is Turned Off**). Otherwise, that difference is negligible.

2. Negative Passenger Counts

A common reason for negative onboard passenger counts is when a trip automatically transfers its onboard counts to the next trip. This requires a few conditions to be fulfilled.

For example, if the time between the planned arrival time to the last stop point of a trip and the planned departure from the first stop point of the next trip, is up to 10 minutes. In that case, the onboard count is transferred from one trip to another. Else, it will be reset.

Other examples for conditions:

- Trips are on the same line
- Trips are on different lines
- Trips end/start at the same stop area/stop point
- Trips end/start at different stop areas/stop points.

Other reasons can be that passengers boarded the vehicle before the trip started, passengers boarded while the vehicle was still turned off (meaning the sensors are not powered). E.g. a vehicle at an airport terminal is affected by flight delays, so they might be turned off as to avoid excessive idling. In such cases, alighting will often be higher than boarding.

3. APC Valid vs Invalid

3.1 Line Report

This report shows all journeys (trips) for each selected line(s).

If there is at least ONE report with an active error, then the journey will be flagged as invalid.

3.2 Route & Journey Reports

These two reports present the information for each journey. If there is something wrong for any APC sensor, then the report is flagged as invalid. This can be that the sensor has an active error, or there is a consequential error between reports/journeys.

If the invalid flag comes from an active error from the sensors, even if that error is cleared during the journey, the rest of the APC reports will still be flagged as invalid for the remaining of that journey.

Any active error will be described in the Validity Description column from the Detailed tab (keep in mind that the report generates, by default, in the Summary tab. Press the table icon to reach the Detailed view).

3.3 Vehicle Report

This report lists all the APC reports from this vehicle, in the chronological order they were recorded.

If the value in the Validity column is valid, then all the reports have been valid.

Any report with an error will be flagged as invalid and the reason(s) will be described in the Validity description column. Examples of errors

- Missing report.
- If the first APC report in the trip is missing.
- If the last APC report in the trip is missing.
- No communication.
- Note that a mention of missing APC reports can mean that one or more reports are missing. It will not state how many.

Vehicle	Date	Line	Journey	Destination	Journey start	Already Onboard	Total Boarding	Total Alighting	Left Onboard	Difference	Validity	Validity description
4728	2020-10-21	S296	S29-6-1-R-A0015-1	Rabbit Bus - Wongarbo	2020-10-21 07:43	-	0	0	-	0	Invalid	No Communication
1182	2020-10-20	S270	S27-0-1-R-A0015-1	Squirrel Bus - Dubbo	2020-10-20 07:47	-	0	0	-	0	Invalid	No Communication
1182	2020-10-20	S283	S28-3-1-H-A0015-1	Hippo Bus - Eastridge	2020-10-20 15:00	-	0	0	-	0	Invalid	No Communication
7809	2020-10-17	S70	S70-1-H-D0015-2	Orana Mall	2020-10-17 11:45	1	5	5	1	0	Invalid	No Communication
4728	2020-10-16	S296	S29-6-1-H-A0015-2	Rabbit Bus - Dubbo	2020-10-16 15:05	-	2	10	-	-8	Valid	No passenger report on first stop point
4728	2020-10-16	S296	S29-6-1-R-A0015-1	Rabbit Bus - Wongarbo	2020-10-16 07:43	-	11	11	-	0	Valid	
4730	2020-10-16	S297	S29-7-1-R-A0015-2	Koala Bus - Narramine	2020-10-16 07:35	-	27	24	-	3	Valid	No passenger report on first stop point
4730	2020-10-16	S297	S29-7-1-H-A0015-1	Koala Bus - Dubbo	2020-10-16 15:10	-	21	24	-	-3	Valid	
1714	2020-10-16	S293	S29-3-1-H-A0015-1	Swan Bus - Firgrove	2020-10-16 14:55	-	123	132	-	-9	Valid	
9202	2020-10-23	S305	S30-5-1-H-A0015-1	Duck Bus - Peak Hill	2020-10-23 15:05	-	92	93	-	-1	Valid	No passenger report on first stop point. No passenger report on last stop point
1714	2020-10-16	S267	S26-7-1-R-A0015-1	Giraffe Bus - Dubbo S	2020-10-16 07:55	-	38	46	-	-8	Valid	
7809	2020-10-24	S75	S75-2-R-D0015-10	Dubbo CBD	2020-10-24 16:55	-	1	0	1	0	Valid	
1197	2020-10-16	S263	S26-3-1-R-A0015-1	Hippo Bus - Richmonds	2020-10-16 07:45	-	81	95	-	-14	Valid	No passenger report on first stop point
1196	2020-10-16	S374	S37-4-1-R-A0015-1	Monkey Bus - Dubbo S	2020-10-16 07:45	-	68	66	-	2	Valid	

4. General

We are looking at the APC data from Buslines in Dubbo, Australia, for the whole month of October 2020, i.e. 1st to 31st October.

4.1 No Communication

You should see this as a warning, not necessarily something to worry about. This can happen if the ignition has just been turned on as it can take a few seconds before the APC sensors are up and running. It is also possible that, on some vehicles, the power to the sensor is not connected to the delayed power switch off.

You can always check the Vehicle Raw Data in the Details view for the selected vehicle, then look closer into the Doors values to identify if this might be a specific sensor not communicating.

4.2 Driver Boarding While Vehicle is Turned Off

It is possible that some difference between boarding/alighting numbers are due to the driver. If they board the vehicle before it is turned on, then that boarding will not be counted as the sensors are not powered yet. However, if they leave the vehicle within 15 minutes of turning it off, then that will most likely count as one alighting as the APC sensors still remain active up to 15 minutes after shutting down.

Let's take a scenario where they drive 5 times a week and always alight right away after turning off the vehicle. In this case, you would have a default of 20 extra alighting a month. Now imagine if there is a break of 3 hours between each trip, and they drive 2 trips a day. We're now up to a difference of 40.

For a vehicle picking up thousands of passengers a month, that will be negligible. However, for a vehicle picking up a hundred, it will look much worse than it really is. See **1.2 Difference boarding/alighting** for a real-life example from October 2020.

4.3 Boarding While Vehicle is Turned Off

If the vehicle is shut down long enough for the sensors to be turned off, yet is still picking up passengers, all these boarding will not be registered. E.g. a school bus that might arrive ahead of time and park before the students are let out. The bus is not likely to be running until students are onboard and it is getting closer to departure time. This will also skew the difference with more alighting than boarding.

5. Journey Report (Trip)

Trips and APC Reports do not share their validity flags. This means that APC report can be valid even if they are recorded on an invalid trip. The opposite is also true, where valid trips can have invalid APC reports.

A trip flagged invalid in the Journey Report can still have valid APC reports. The validity flag is set to invalid as soon as one APC report is invalid. E.g. a trip with 17 stop points can have 16 valid APC reports, but only 1 invalid APC reports.

