Passenger Counter Logic (APC)

1. On Journey (Trip)

Reports from every stop point where the vehicle has arrived

Reports are sent for all boarding, alighting and “Now onboard” for each departure from a stop point, after the latest information has been read from the APC system. In a normal “pass-by” situation, there are no APC reports as no doors were opened.

Counting of passengers outside the stop point area

Passengers boarding or alighting outside of a stop point area will be counted as part of the next stop point, whether or not the vehicle stops or does a pass-by.

Counting of passengers at the last stop point

After the arrival of the vehicle at the last stop point of a journey (trip), the system waits 60 seconds **after** the opening of the doors before adding all the **alighting** passengers and reporting them on the journey’s last stop point.

In a case where no door opening is detected, the system will wait a little longer before doing the reading, usually 150 seconds. If the door closes before the timer expires, the timer will be interrupted, and the passenger counting will be done automatically.

All **boarding** passengers at this stop point are reported on the **next** journey’s stop point if both conditions are fulfilled:

- The current journey’s last stop is the same as the next journey’s first stop.
- The next journey is scheduled to depart shortly.

If the delay between the two journeys is long, e.g. over 10 minutes, or if the journey starts from another stop point, then the boarding passengers will not be reported to any specific journey. However, they will still be reported and visible in the raw data reports.

2. To Reset or not to Reset

Resetting or not the onboard passenger counter in-between journeys (trips)

The reset always happens before the first journey of the day, when the vehicle arrives at the stop point for the journey start.

Depending on the configuration, the counter for the “Passengers onboard” can be reset between journeys. It can also be kept when two journeys tightly follow one another within the configurated time interval, as long as the next journey fulfil specific criteria.

This is the recommended configuration, which is the default for the system:

- Next journey begins withing 10 minutes of the previous journey,
- Next journey begins from the same stop area as the previous journey.

These additional conditions are part of the default configuration and can be activated. They are all turned off by default.

- Next journey must begin from the same stop point,
- Next journey must be on another line,
- Transfer is allowed from an empty run.

It is also possible to control the resetting of the passenger counter via traffic data, e.g. by specifying that a certain line should never reset between journeys.

Note: If the passenger count on a journey is flagged as “unsure” (see chapter 3), then the transfer of passengers between journeys is not allowed. In these cases, there is always a reset of the passenger count between journeys.

Note: Resetting the onboard counter between journeys means that passengers still onboard from a previous journey will not be counted in the next journey. This means that the total of alighting might exceed the total of boarding for this journey.

If there is a long time between the journeys (default is over 10 minutes), an additional reset will happen when the vehicle arrives to the first stop point of the next journey, before its start. Note that if the doors are already open, the vehicle is at the right stop point and there is 10 minutes left before planned departure, then there is no additional reset. The reason is that other types of transportation could have happened between the planned journeys, and even that the driver might have alighted and boarded the vehicle a few times between the journeys.

Other parameters affecting carry-over

It is also possible to set a parameter for when journeys have the same line number – so that no carry over will be made.

Another parameter is to allow carry-over if the first journey’s end point and next journey’s start point are:

- the same stop point,
- in the same stop area, or
- different.

3. Counting of Passengers

Counting of boarding and alighting between journeys (trips)

Boarding and alighting between journeys are not associated to any journey. They are reported at the next door closing. This applies until the vehicle has positioned itself at the first stop point before the next journey, if it departs within 10 minutes (configurable).

Whenever the vehicle leaves the first stop of a journey, an additional historical search is performed where we look for any passenger count flagged as “not on journey”, which might have happened nearby a stop point. We make a control of all the counts found within 30 minutes of the journey start and within a radius of 250 meter. If the total numbers of boarding is larger than the total number of alighting, we sum these counts together and attached them to the APC report for the first stop point.

When the vehicle is at a stop point for the next journey, the passenger counting sensors are read every 30 seconds to avoid any possible error due to an unexpected power failure or reset.

(The sensors can be reset if the voltage drops or if the bus has been switched off and restarted, leading to the boarding/alighting numbers since the last reading to not be counted. This is due to the sensors doing a reading only every 30 seconds as some counting systems are not counting optimally during the reading.)

Counting during dead runs

Dead runs, or empty runs, are treated exactly the same as if the vehicle was not assigned or was in-between journeys, with a long delay until the next journey. All door closing on a dead run are shown in the APC reports as being unaffiliated to any journey.

Counting marked as unsure

If any of the following errors have been active during a journey, the counting for this journey will be marked as unsure.

- APC sensor fault
- GPS error
- Door signal error
- Odometer error

To ensure that the counter values are associated to the right stop point, it is required for the sensors to be functional, which requires that the GPS, door signals and odometer signals are all working. If any of them is faulty, the link between the counting and the journey will be unsure, which is indicated in the vehicle's reports.

If a journey has been flagged as unsure, no transfer of counts if allowed for passengers "left onboard".

4. APC in Real-Time Plugins

If a vehicle has problem with the APC sensors, it will be marked as "Invalid" in the plugins and reports in TrafficStudio.

In the example below, the sensor/sensors do not communicate:

Passengers	Stop	Passengers data	Distance	System time	Sequence number	Event
Invalid 0 0 0	Benken	Invalid, Error: Uncertain total (Apc error), No Communication, Report Trigger:JourneyStopDepature	322	07:04:08	26910	Passenger Counter

Even if the sensors start communicating later during the journey, all APC reports on that specific journey will be marked as "Invalid" since we cannot be sure of the reliability of the total numbers for that journey, given that some data might be missing.

5. APC in Statistic Reports

Every night, the system runs a daily script to gather the statistical data for the APC reports.

The only APC report which does not require this process, and which can be run on the same day (i.e. today), is "***Vehicle Raw Data***".

This means that for the APC reports ***Lines, Routes, Journey*** and ***Vehicle,*** it is only possible to see statistics from yesterday and earlier.

The ***Vehicle Raw Data*** report is updated in real-time and shows the APC reports as soon as they are reported from the vehicle.

Do remember that if a vehicle has communication problems, the reports will be uploaded when communication is established again, and the missing data is uploaded (mlog).

Below is an example of how carry-over is visible in the **Line** Report:

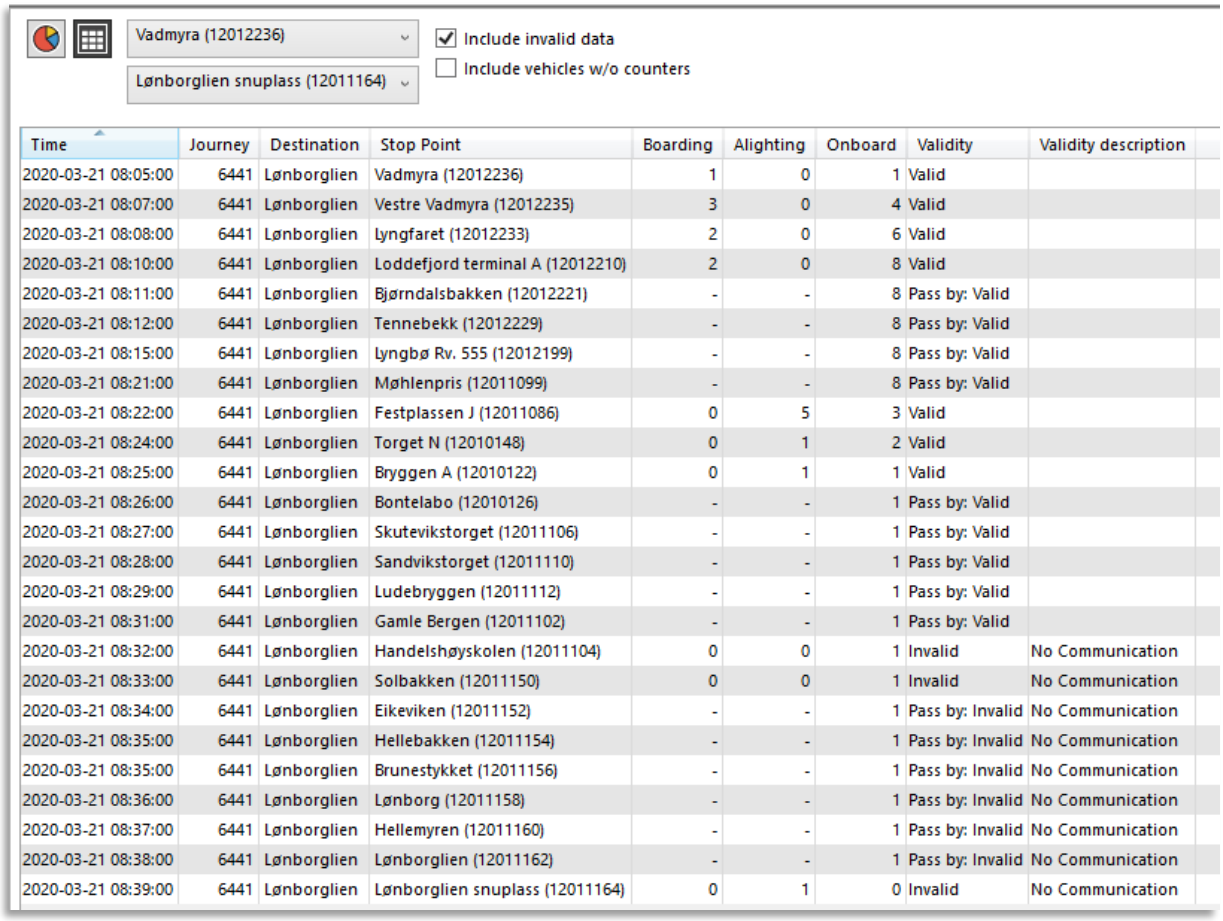
Vehicle	Date	Line	Journey	Destination	Journey start	Already Onboard	Total Boarding	Total Alighting	Left Onboard	Difference	Validity	Validity
3390123060	2020-03-03	A26	41	Sørlandssenteret Dyreparken-IKEA	2020-03-03 06:21	-	7	7	-	0	Valid	
3390123060	2020-03-03	M4	52	Hellemyr	2020-03-03 07:14	-	56	57	-	-1	Valid	
3390123060	2020-03-03	M4	91	Tømmerstø	2020-03-03 07:56	-	15	15	-	0	Valid	
3390123060	2020-03-03	19	161	Gimlekollen	2020-03-03 11:47	-	29	28	1	0	Valid	
3390123060	2020-03-03	19	182	Suldalen	2020-03-03 12:18	1	20	21	-	0	Valid	

The next image comes from the **Line** Report and shows a few examples where APC data has been marked invalid for some journeys.

Include invalid data
Include vehicles w/o counters

Time	Line	Route	Journey	Destination	Already Onboard	Boarding	Alighting	Left Onboard	Validity
2020-03-03 19:38:00	40 Boreal Kristiansand 3951040	Kristiansand rutebilstasjon -> Årosskogen, 32	521	Tangvall-Årosskogen o/Høllen	-	1	8		- Invalid
2020-03-03 19:50:00	200 Sørlandsruta 1070200	Mandal sentrum -> Kristiansand rutebilstasjon, 43	332	Kristiansand	-	3	1		- Invalid
2020-03-03 20:17:00	40 Boreal Kristiansand 3951040	Årosskogen -> Kristiansand rutebilstasjon, 31	522	Kristiansand	-	0	0		- Invalid
2020-03-03 20:25:00	260 Sørlandsruta Vest 3930260	Sira Prestmoen -> Flekkefjord rutebilstasjon, 24	142	Flekkefjord	-	0	0		- Invalid
2020-03-03 21:08:00	40 Boreal Kristiansand 3951040	Kristiansand rutebilstasjon -> Årosskogen, 32	551	Tangvall-Årosskogen o/Høllen	-	3	19		- Invalid
2020-03-03 21:15:00	200 Sørlandsruta 1070200	Kristiansand rutebilstasjon -> Mandal sentrum, 44	361	Mandal - Farsund	-	9	0		- Invalid
2020-03-03 21:47:00	40 Boreal Kristiansand 3951040	Årosskogen -> Kristiansand rutebilstasjon, 31	552	Kristiansand	-	3	2		- Invalid
2020-03-03 22:38:00	40 Boreal Kristiansand 3951040	Kristiansand rutebilstasjon -> Årosskogen, 32	581	Tangvall-Årosskogen o/Høllen	-	1	7		- Invalid
2020-03-03 23:17:00	40 Boreal Kristiansand 3951040	Årosskogen -> Kristiansand rutebilstasjon, 31	582	Kristiansand	-	1	2		- Invalid
2020-03-04 00:08:00	40 Boreal Kristiansand 3951040	Kristiansand rutebilstasjon -> Årosskogen, 32	611	Tangvall-Årosskogen o/Høllen	-	1	3		- Invalid
2020-03-03 04:30:00	FLY Boreal Kristiansand 3958001	Kristiansand rutebilstasjon -> Kjevik lufthavn, 31	1011	Flybuss Kjevik	-	2	3		- Valid
2020-03-03 05:00:00	35 Boreal Kristiansand 3951035	Kristiansand rutebilstasjon -> Brattvoll platå, 47	41	Kjevik - Brattvollsheia	-	2	1		1 Valid
2020-03-03 05:00:00	100 Setesdal Bilruter 3910100	Arendal bussterminal -> Kristiansand rutebilstasjon, 50	11	Kristiansand	-	24	24		- Valid
2020-03-03 05:16:00	M2 Boreal Kristiansand 3953002	Sørlandssenteret øst -> Møvig/Skonnertveien, 54	10	Voiebyen	-	12	12		- Valid

In the **Journey** Report, it is possible to see the validity from each stop as well as the reason for the invalidity.

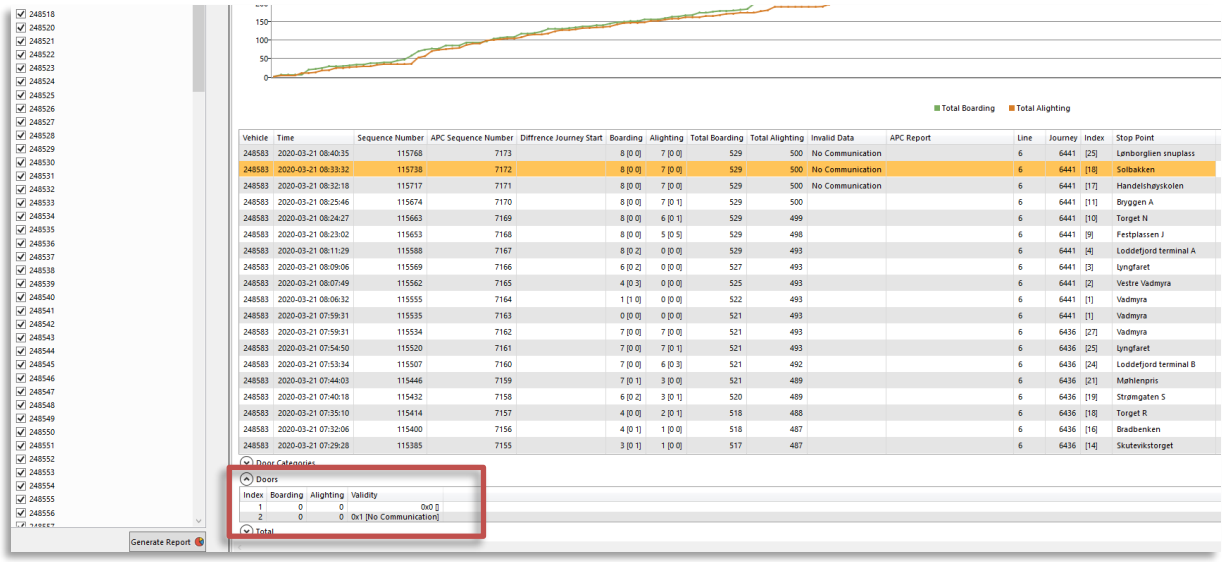


Time	Journey	Destination	Stop Point	Boarding	Alighting	Onboard	Validity	Validity description
2020-03-21 08:05:00	6441	Lønborglien	Vadmyra (12012236)	1	0	1	Valid	
2020-03-21 08:07:00	6441	Lønborglien	Vestre Vadmyra (12012235)	3	0	4	Valid	
2020-03-21 08:08:00	6441	Lønborglien	Lyngfaret (12012233)	2	0	6	Valid	
2020-03-21 08:10:00	6441	Lønborglien	Loddefjord terminal A (12012210)	2	0	8	Valid	
2020-03-21 08:11:00	6441	Lønborglien	Bjørndalsbakken (12012221)	-	-	8	Pass by: Valid	
2020-03-21 08:12:00	6441	Lønborglien	Tennebekk (12012229)	-	-	8	Pass by: Valid	
2020-03-21 08:15:00	6441	Lønborglien	Lyngbø Rv. 555 (12012199)	-	-	8	Pass by: Valid	
2020-03-21 08:21:00	6441	Lønborglien	Møhlenpris (12011099)	-	-	8	Pass by: Valid	
2020-03-21 08:22:00	6441	Lønborglien	Festplassen J (12011086)	0	5	3	Valid	
2020-03-21 08:24:00	6441	Lønborglien	Torget N (12010148)	0	1	2	Valid	
2020-03-21 08:25:00	6441	Lønborglien	Bryggen A (12010122)	0	1	1	Valid	
2020-03-21 08:26:00	6441	Lønborglien	Bontelabo (12010126)	-	-	1	Pass by: Valid	
2020-03-21 08:27:00	6441	Lønborglien	Skutevikstorget (12011106)	-	-	1	Pass by: Valid	
2020-03-21 08:28:00	6441	Lønborglien	Sandvikstorget (12011110)	-	-	1	Pass by: Valid	
2020-03-21 08:29:00	6441	Lønborglien	Ludebryggen (12011112)	-	-	1	Pass by: Valid	
2020-03-21 08:31:00	6441	Lønborglien	Gamle Bergen (12011102)	-	-	1	Pass by: Valid	
2020-03-21 08:32:00	6441	Lønborglien	Handelshøyskolen (12011104)	0	0	1	Invalid	No Communication
2020-03-21 08:33:00	6441	Lønborglien	Solbakken (12011150)	0	0	1	Invalid	No Communication
2020-03-21 08:34:00	6441	Lønborglien	Eikeviken (12011152)	-	-	1	Pass by: Invalid	No Communication
2020-03-21 08:35:00	6441	Lønborglien	Hellebakken (12011154)	-	-	1	Pass by: Invalid	No Communication
2020-03-21 08:35:00	6441	Lønborglien	Brunestykket (12011156)	-	-	1	Pass by: Invalid	No Communication
2020-03-21 08:36:00	6441	Lønborglien	Lønborg (12011158)	-	-	1	Pass by: Invalid	No Communication
2020-03-21 08:37:00	6441	Lønborglien	Hellemyren (12011160)	-	-	1	Pass by: Invalid	No Communication
2020-03-21 08:38:00	6441	Lønborglien	Lønborglien (12011162)	-	-	1	Pass by: Invalid	No Communication
2020-03-21 08:39:00	6441	Lønborglien	Lønborglien snuplass (12011164)	0	1	0	Invalid	No Communication

"Pass by" means that the vehicle did not stop at the actual stop point, but that it drove by, i.e. passed by.

To go into more details, you can use the ***Vehicle Raw Data*** Report to identify the sensor/ sensors with problems.

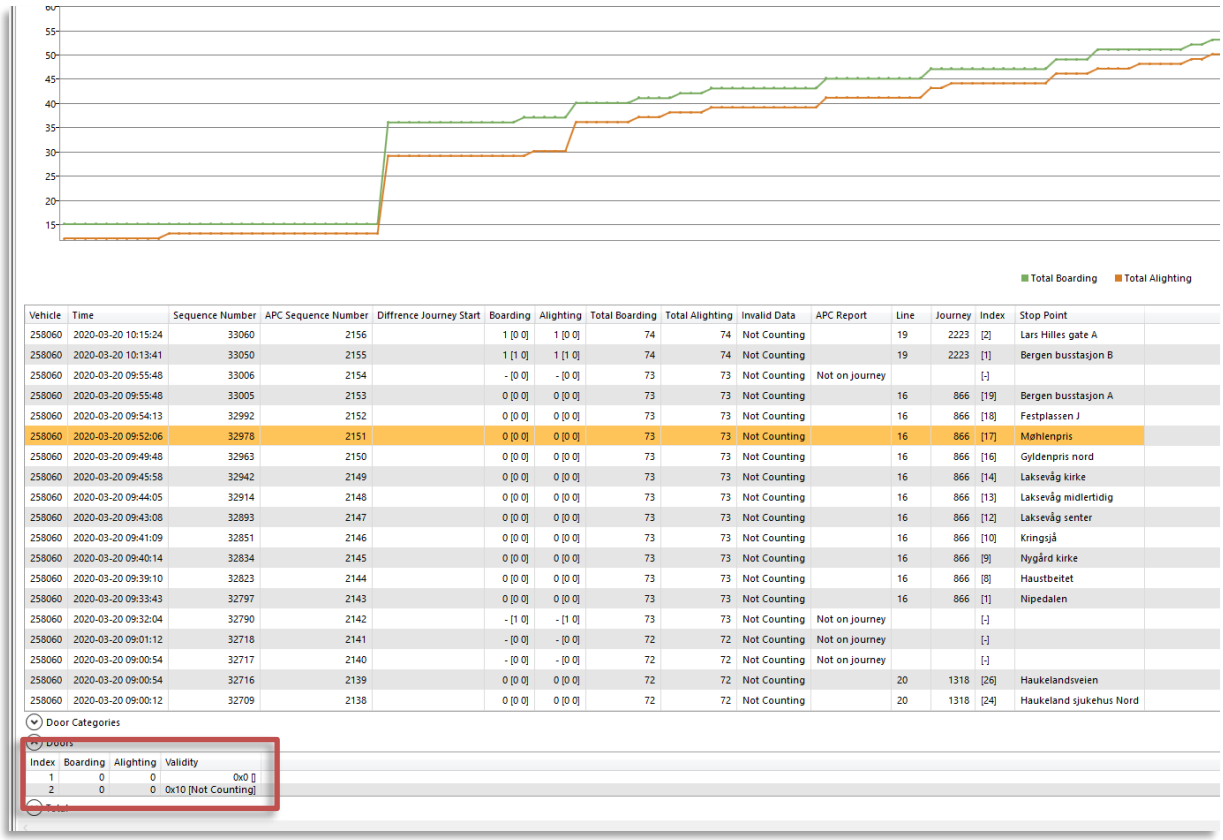
In the case below, the second sensor is the one with communication problems (logically, that would correspond to the doors at the back/middle of the bus).



Vehicle	Time	Sequence Number	APC Sequence Number	Diffrence Journey Start	Boarding	Alighting	Total Boarding	Total Alighting	Invalid Data	APC Report	Line	Journey	Index	Stop Point
248583	2020-03-21 08:40:35	115768	7173		8 [0 0]	7 [0 0]	529	500	No Communication		6	6441	[25]	Lønborglien snuplass
248583	2020-03-21 08:33:32	115738	7172		8 [0 0]	7 [0 0]	529	500	No Communication		6	6441	[18]	Solbakken
248583	2020-03-21 08:32:18	115717	7171		8 [0 0]	7 [0 0]	529	500	No Communication		6	6441	[17]	Handelshøyskolen
248583	2020-03-21 08:25:46	115674	7170		8 [0 0]	7 [0 1]	529	500			6	6441	[11]	Bryggen A
248583	2020-03-21 08:24:27	115663	7169		8 [0 0]	6 [0 1]	529	499			6	6441	[10]	Torget N
248583	2020-03-21 08:23:02	115653	7168		8 [0 0]	5 [0 5]	529	498			6	6441	[9]	Festplassen J
248583	2020-03-21 08:11:29	115588	7167		8 [0 2]	0 [0 0]	529	493			6	6441	[4]	Loddefjord terminal A
248583	2020-03-21 08:09:06	115569	7166		6 [0 2]	0 [0 0]	527	493			6	6441	[3]	Lyngfaret
248583	2020-03-21 08:07:49	115562	7165		4 [0 3]	0 [0 0]	525	493			6	6441	[2]	Vestre Vadmyra
248583	2020-03-21 08:06:32	115555	7164		1 [1 0]	0 [0 0]	522	493			6	6441	[1]	Vadmyra
248583	2020-03-21 07:59:31	115535	7163		0 [0 0]	0 [0 0]	521	493			6	6441	[1]	Vadmyra
248583	2020-03-21 07:59:31	115534	7162		7 [0 0]	7 [0 0]	521	493			6	6436	[27]	Vadmyra
248583	2020-03-21 07:54:50	115520	7161		7 [0 0]	7 [0 1]	521	493			6	6436	[25]	Lyngfaret
248583	2020-03-21 07:53:34	115507	7160		7 [0 0]	6 [0 3]	521	492			6	6436	[24]	Loddefjord terminal B
248583	2020-03-21 07:44:03	115446	7159		7 [0 1]	3 [0 0]	521	489			6	6436	[21]	Møhlenpris
248583	2020-03-21 07:40:18	115432	7158		6 [0 2]	3 [0 1]	520	489			6	6436	[19]	Strømgaten S
248583	2020-03-21 07:35:10	115414	7157		4 [0 0]	2 [0 1]	518	488			6	6436	[18]	Torget R
248583	2020-03-21 07:32:06	115400	7156		4 [0 1]	1 [0 0]	518	487			6	6436	[16]	Bradbenken
248583	2020-03-21 07:29:28	115385	7155		3 [0 1]	1 [0 0]	517	487			6	6436	[14]	Skutevikstorget

Index	Boarding	Alighting	Validity
1	0	0	0x0 []
2	0	0	0x1 [No Communication]

In the next case below, the second sensor is not doing any counting.



Vehicle	Time	Sequence Number	APC Sequence Number	Diffrence Journey Start	Boarding	Alighting	Total Boarding	Total Alighting	Invalid Data	APC Report	Line	Journey	Index	Stop Point
258060	2020-03-20 10:15:24	33060	2156		1 [0 0]	1 [0 0]	74	74	Not Counting		19	2223	[2]	Lars Hilles gate A
258060	2020-03-20 10:13:41	33050	2155		1 [1 0]	1 [1 0]	74	74	Not Counting		19	2223	[1]	Bergen busstasjon B
258060	2020-03-20 09:55:48	33006	2154		- [0 0]	- [0 0]	73	73	Not Counting	Not on journey			[-]	
258060	2020-03-20 09:55:48	33005	2153		0 [0 0]	0 [0 0]	73	73	Not Counting		16	866	[19]	Bergen busstasjon A
258060	2020-03-20 09:54:13	32992	2152		0 [0 0]	0 [0 0]	73	73	Not Counting		16	866	[18]	Festplassen J
258060	2020-03-20 09:52:06	32978	2151		0 [0 0]	0 [0 0]	73	73	Not Counting		16	866	[17]	Møhlenpris
258060	2020-03-20 09:49:48	32963	2150		0 [0 0]	0 [0 0]	73	73	Not Counting		16	866	[16]	Gyldenpris nord
258060	2020-03-20 09:45:58	32942	2149		0 [0 0]	0 [0 0]	73	73	Not Counting		16	866	[14]	Laksevåg kirke
258060	2020-03-20 09:44:05	32914	2148		0 [0 0]	0 [0 0]	73	73	Not Counting		16	866	[13]	Laksevåg midlertidig
258060	2020-03-20 09:43:08	32893	2147		0 [0 0]	0 [0 0]	73	73	Not Counting		16	866	[12]	Laksevåg senter
258060	2020-03-20 09:41:09	32851	2146		0 [0 0]	0 [0 0]	73	73	Not Counting		16	866	[10]	Kringsjå
258060	2020-03-20 09:40:14	32834	2145		0 [0 0]	0 [0 0]	73	73	Not Counting		16	866	[9]	Nygård kirke
258060	2020-03-20 09:39:10	32823	2144		0 [0 0]	0 [0 0]	73	73	Not Counting		16	866	[8]	Haustbeitet
258060	2020-03-20 09:33:43	32797	2143		0 [0 0]	0 [0 0]	73	73	Not Counting		16	866	[1]	Nipedalen
258060	2020-03-20 09:32:04	32790	2142		- [1 0]	- [1 0]	73	73	Not Counting	Not on journey			[-]	
258060	2020-03-20 09:01:12	32718	2141		- [0 0]	- [0 0]	72	72	Not Counting	Not on journey			[-]	
258060	2020-03-20 09:00:54	32717	2140		- [0 0]	- [0 0]	72	72	Not Counting	Not on journey			[-]	
258060	2020-03-20 09:00:54	32716	2139		0 [0 0]	0 [0 0]	72	72	Not Counting		20	1318	[26]	Haukelandsveien
258060	2020-03-20 09:00:12	32709	2138		0 [0 0]	0 [0 0]	72	72	Not Counting		20	1318	[24]	Haukeland sjukehus Nord

Index	Boarding	Alighting	Validity
1	0	0	0x0 []
2	0	0	0x10 [Not Counting]