

New Signal Code and MMI

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1 Functional Specification

1.1 Signal Codes

Signal codes (SC) describe type of passage and the result of the processing of the passage in CPE. Signal codes defined in an AutoPASS automatic tolling station are (other Signal codes exist but are no longer in use)

The column "MMI" got discarded.

Table 1 – Signal codes

Code	Image	Description	Type of Charge (IP)
02	No	Approved passage with OBE	OBE
08	No (*)	Passage with valid OBE but without corresponding vehicle detection.	OBE
19	Yes	Passage with valid OBE but there is also another approved OBE passage (with SC02) associated with the same vehicle detection. (There are probably more than one OBE with valid contract in the same vehicle).	No charge
21	Yes	Passage with valid OBE in OBU StatusFile where there is mismatch between LPN in OBU StatusFile versus result from ANPR from roadside. SignalCode 21 is only to be used when the ANPR results from the front and rear images match.	ANPR
22	Yes	Passage without detected OBE or an illegal OBE type (EFC Context Mark (EFC_CM) is not approved).	ANPR
23	Yes	Passage with OBE not defined in OBU StatusFile.	ANPR
25	Yes	Passage with legal OBE type but authentication failed.	ANPR
26	Yes	Passage with legal OBE type but access credential check failed.	ANPR
33	No (*)	(«Shadow SC» to SC23) OBE passage without vehicle detection and with OBE not defined in OBU StatusFile	No charge
35	No (*)	(«Shadow SC» to SC25) OBE passage without vehicle detection and legal OBE type, but authentication failed.	No charge
36	No (*)	(«Shadow SC» to SC26) OBE passage without vehicle detection and legal OBE type, but access credential check failed.	No charge
40	No	Passage in lane with modus "free of charge"	No charge
42	Yes	Passage in lane without charging equipment. To be used for passage in opposed lane or bus-bay.	ANPR

(*) Assumed that picture is not available

1.2 Man-Machine Interface (MMI)

Explanations of MMI (Man-Machine Interface) codes that are sent from CPE to OBE to give audible feedback to driver about the result of the processing of the passage:

- 0 = OK
- 1 = Not OK
- 2 = Contact Service Provider
- 255 = No Signaling

Check if the Access Credentials (AC keys) are OK?

- if the AC keys of the OBE transaction is not OK → 2
- if the AC keys are OK go forward in the flow chart

Check if the Authentication keys (AU keys) are OK?

- if no valid OBE transaction → 2
- if the AU keys are OK go forward in the flow chart

Check if the OBE is in the OBU status file?

- Yes → 0
- No → 1
- No OBU Status File available → 255

In case there are different errors within DSRC system like "processing error, attribute not available within OBE, etc." → 2

The OBU Status file syntax will remain as specified in the "SSA-V Appendix 1 annex 6 - AutoPASS Data Formats Appendixes "4.3 AutoPASS Formats - Appendix A5 – OBU Status File in Version 1.2. The LightSignalCode in the table body description will not be used for deriving any MMI Signal Codes.

All old and new OBE will be EN15509, only that standard need to be implemented and considered.

1.3 Signal Code Process diagram flow chart

Introduction of Signal Codes like 19, 25, 26, 33, 35 and 36 and handling of those are according to "AutoPASS Processing of Signal Codes" AP-1.4 version 3.0.

Figure 1 – Signal code process diagram flow chart

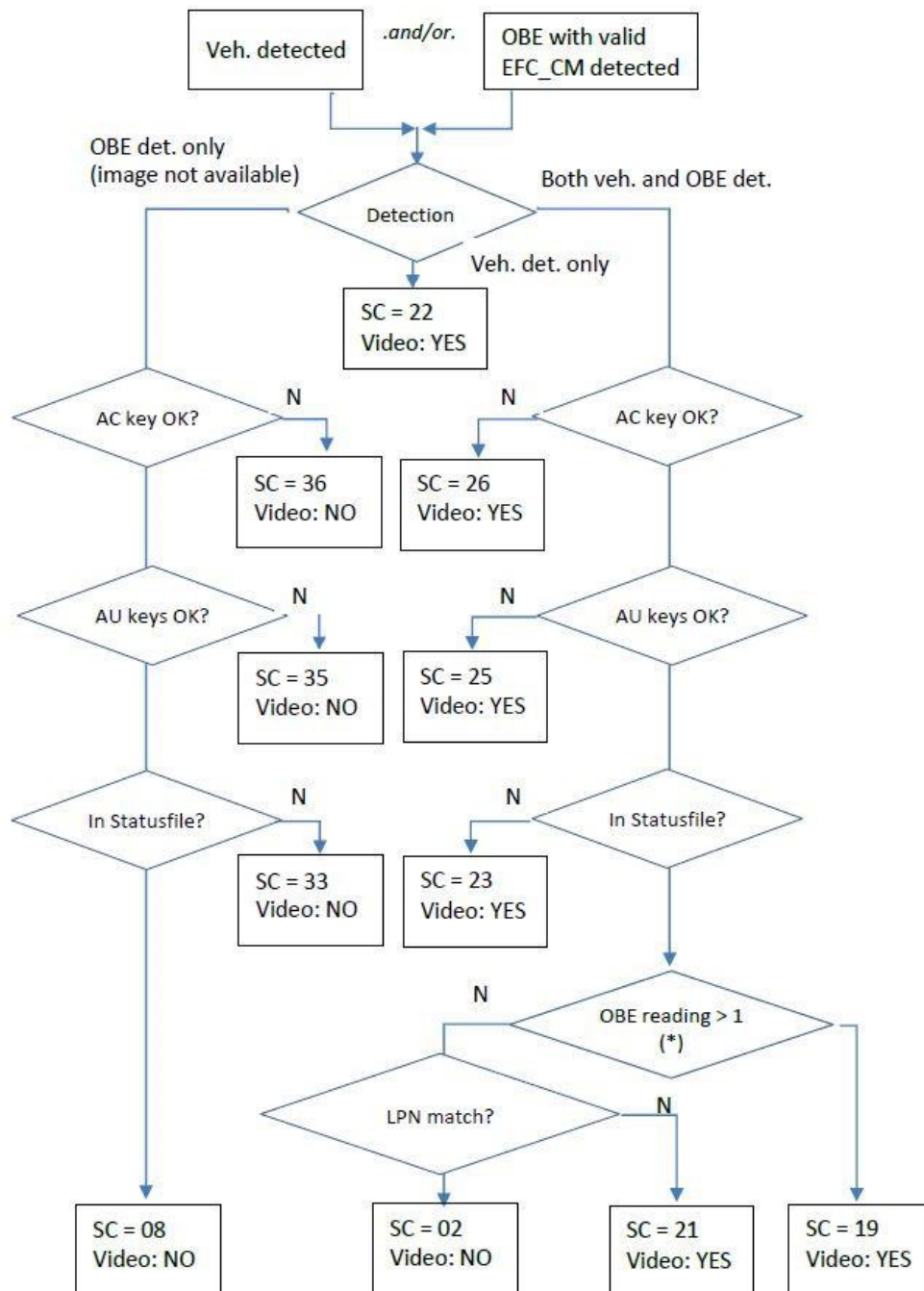


Figure 1: Flow chart of CPE logic

The diagram in Figure 1 shows the different verifications to be done to determine the signal codes and video enforcement of a passage. CPE Supplier should implement logic in CPE that is consistent with this diagram. CPE Suppliers may use different technology in their CPE equipment, especially when it comes to vehicle detection systems. The basic principle in the diagram is that both the OBE reader (antenna) and a vehicle detection system can trigger the processing of a passage. If there is an OBE detection there is normally also an associated vehicle detection, and the rightmost path of the flow chart shows the logic in this situation.

It is assumed in the diagram that only a vehicle detection triggers the video system to capture pictures (front and rear) of the vehicle. In some (often but not necessarily faulty) situations an OBE detection has no corresponding vehicle detection, and pictures are not available. An OBE reading without an associated vehicle detection should be accepted and will undergo the same verifications as if it was a normal OBE passage with both vehicle detection and OBE reading (ref. leftmost path of the flow chart). However, different signal codes will indicate whether pictures are missing.

(*) Explanation of check "OBE reading > 1" in flow chart: Quite often it occurs that there are more than one valid OBE in a vehicle. A basic principle is that there should never be more than one accepted "normal" OBE passage (with SC02) when there are more than one valid OBE in a vehicle. Therefore, it is checked whether the same vehicle detection is likely to also be related to a previously processed and accepted OBE reading. In this case subsequent accepted OBE readings will be assigned a special signal code SC19. If such OBE readings are not accepted, they may be assigned signal codes as eg. SC23. To avoid possible multiple charge of the passage the post processing of the passages in AutoPASS IP must then check the detection counter ("SeqEntryDetection") in the transaction record and discard transactions that have the same value in this field.

One of the signal codes in Table 2 does not appear on the flow chart, and that is SC42 to be used for passage in opposed lane or bus-bay. Figure 2 describes this situation, and this should be handled in the same way as a SC22 passage, i.e., with a corresponding video picture.

1.4 Signal Codes Overview

The following signal codes may occur when processing is triggered by the vehicle detection system and/or the OBE reading:

Table 2 – Signal codes overview

OBE	Detection system	Antenna system	Possible Signal codes	Comments
1. 	OK	OK	02,21,23, 25,26	Reading of legal OBE type in AutoPASS with a corresponding vehicle detection.
2. 	Not OK	OK	08,33,35, 36	OBE will have no matching vehicle detection.
3. 	OK	Not OK	22,42	Either a vehicle with no OBE, - or an OBE may be detected which is not of legal type in AutoPASS and therefore not processed. SC42 is passage in opposed lane or bus-bay.
4. 	OK	OK	OBE1: 02,21,23, 25,26 OBE2: 19,21,23, 25,26	As SC02 passage one should select the first processed valid OBE.
5. 	Not OK	OK	All OBE: 08,33,35, 36	Multiple OBE in one vehicle without a corresponding vehicle detection will result in OBE transactions with neglectable time difference. A filter should check this and write off the second OBE passage.

Comment to point 4. in the table above is not correct because if there are more OBE in one vehicle which are valid (AC key, AU key and on the status file) means that: OBE2 can not be a SC21 because it will turn to a SC19 according the flow chart (OBE reading > 1).

If there are more than 2 OBE's within a vehicle they will be handled in the same way as OBE2.

Additional Clarification:

SignalCode 21 is only to be used when the ANPR results from the front LPN and rear LPN is equal and deviates with the OBU status file LPN. If there is a missing LPN (front LPN or rear LPN) means the front and rear LPN are not equal and deviates with the LPN within the OBU status file and can not be a SC21.

2 Use Case

2.1 A vehicle passes a CP without an OBE

- within the Charging area → SC22
- without in the charging area e.g. bus lane, opposite lane or designated charging area (OBE's have no impact on this decision) → SC42

2.2 One OBE in a vehicle with detection(s) of the vehicle within charging area

A vehicle passes a CP with images and

- incorrect AC key → SC26
- correct AC key but incorrect AU key → SC25
- correct AC key and AU key but not in the OBU status file → SC23
- correct AC key and AU key and within the OBU status file and LPN matches (OBE LPN [from the status file] and vehicle LPN) → SC02
- correct "AC key" and "AU key" and "within the OBU status file" and "either front LPN or rear LPN match with the OBE LPN [from the status file]" → SC02
- correct "AC key" and "AU key" and "within the OBU status file" and "LPN does not match with OBE (front and rear LPN match, but are different to OBE LPN [from the status file])" → SC21
- correct "AC key" and "AU key" and "within the OBU status file" and "front and rear LPN are unequal and neither front LPN or rear LPN match with the OBE LPN [from the status file]" → SC02

Note: If the rear or front LPN is not available the plates are treated as not equal.

2.3 More OBU's in one vehicle with detection(s) of the vehicle within charging area

The most suitable OBU will be handled like just one OBU is within the vehicle. All other OBU's will be handled like below:

- incorrect AC key OBU → SC26
- correct AC key but incorrect AU key OBU → SC25
- correct AC key and AU key but not in the OBU status file → SC23
- correct AC key and AU key and within the OBU status file and LPN matches (OBU LPN and vehicle LPN) → SC19

2.4 One or more OBU's in a vehicle without detection(s) of the vehicle within charging area

- incorrect AC key OBU → SC36
- correct AC key but incorrect AU key OBU → SC35
- correct AC key and AU key but not in the OBU status file → SC33
- correct AC key and AU key and within the OBU status file → SC08

3 Potential risk

Loss of transactions between the switch from the old to the new specification.

4 To be adopted documentation

Front-end and Back-end documentation