Communication specifications for IBSEM Interface

Real-time Communication and Scenarios between MCS and OHT

Version v1.4.8

Document Revision History

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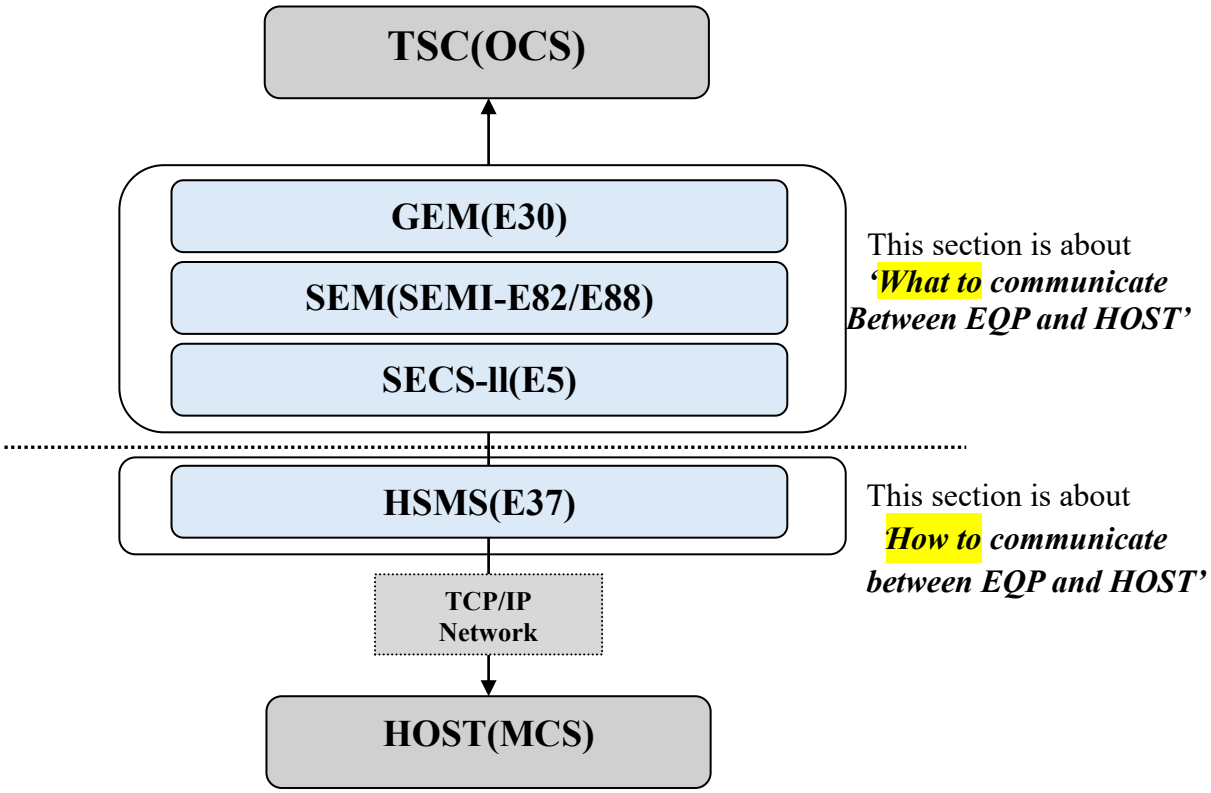
1. Introduction to SEMI E30 GEM

SEMI E30 GEM, also known as the Generic Equipment Model, is a communication standard designed to facilitate consistent and reliable interaction between semiconductor equipment and host software. The following section outlines its scope and the goals it aims to achieve.

1.1. Scope

The SEMI E30 GEM(GENRIG EQUIPMENT MODEL) standard focuses on defining how semiconductor equipment behaves when communicating over a link with a host system. While the SEMI E5 (SECS-II) standard defines the structure and types of messages exchanged between the host and equipment, GEM specifies which SECS-II messages to use, when to use them, and how the equipment should respond to these messages.

Importantly, GEM does not define how the host should behave; the host can initiate any communication at any time, and the equipment must react according to GEM's rules.



1.2. Intent

GEM establishes a standardized implementation of SECS-II specifically for semiconductor manufacturing equipment. It provides a common set of behaviors and communication features to support factory automation for device manufacturers.

- Equipment suppliers can add extra SECS-II features beyond GEM as long as these additions don't conflict with the GEM standard. Examples include new message types, alarms, commands, or state variables tailored to specific equipment types like etchers or steppers.
- Device manufacturers benefit from having a consistent interface across different equipment, which simplifies software development and reduces integration costs.
- The standard helps both suppliers and manufacturers save money and improve factory automation efficiency.
- GEM also provides enough flexibility for manufacturers to implement custom automation solutions while remaining within an industry-wide framework.

The GEM standard aims to specify:

- A behavioral model for semiconductor equipment within a SECS-II communication environment.
- Essential control and information functions required in semiconductor manufacturing.
- The basic communication capabilities that all semiconductor equipment should support using SECS-II.
- A unified method for executing actions when SECS-II allows multiple approaches.
- Standard message sequences (dialogues) to enable effective communication.

1.3. Communication State

The equipment's communication state model, as defined in SEMI E30, is divided into two main states:

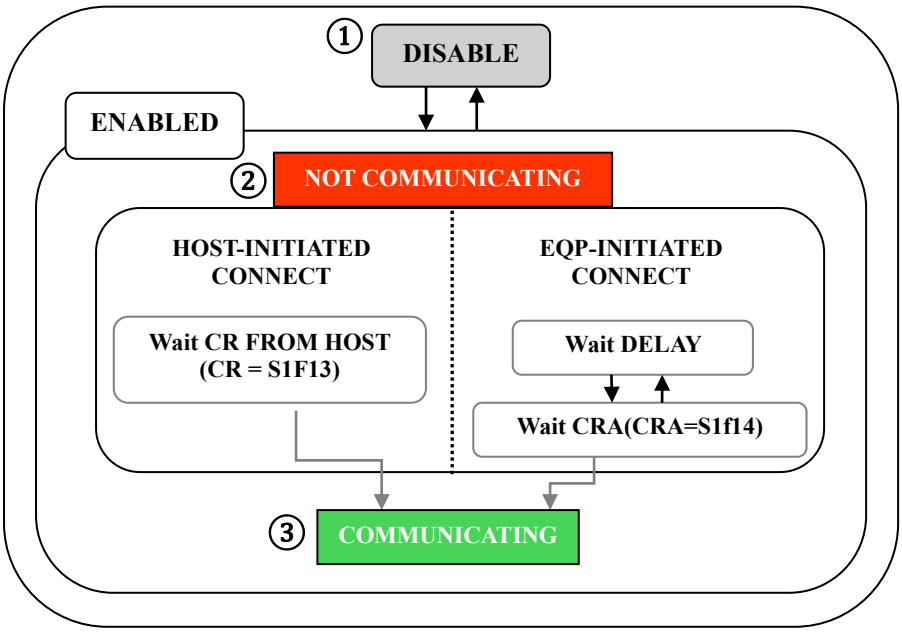
- DISABLED
- ENABLED

When ENABLED, it includes two substates:

- NOT COMMUNICATING
- COMMUNICATING

1.3.1. Communication State Diagram

Communication State Diagram shows how the equipment and host establish and maintain SECS-II communication.



① DISABLED

In this state SECS-II communication with a host computer is non-existent. If the operator switches from ENABLED to DISABLED, all SECS-II communications must cease immediately. Any messages queued to send shall be discarded, and all further action on any open transactions and conversations shall be terminated.
4 Handling of messages currently being transmitted is an issue for lower level message transfer protocols and is notaddressed in this standard.
The DISABLED state is a possible system default.

② ENABLED / NOT COMMUNICATING

No messages other than S1,F13, S1,F14, and S9,Fx shall be sent while this substate is active. The equipment shall discard any messages received from the host other than S1,F13 or S1,F14 (Establish CommunicationsAcknowledge). It shall also periodically attempt to establish communication with a host computer by issuing an S1,F13 until communications are successfully established. However, only one equipment-initiated S1,F13 transaction may be open at any time.

This state has two concurrent (AND-type) substates:

- EQUIPMENT-INITIATED CONNECT: The equipment tries to connect.
    - WAIT CRA: Waiting for the host to respond (after sending S1,F13).
    - WAIT DELAY: Waiting before retrying after a failure.
- HOST-INITIATED CONNECT: The host attempts connection.
    - WAIT CR FROM HOST: The equipment waits for an S1,F13 from the host and replies with S1,F14.

③ ENABLED / COMMUNICATING

- Communications have been established.
- The equipment may receive any message from the host, including S1,F13
- When the equipment is COMMUNICATGING, SECS communications with a host computer must be maintained.
- If either side sends another S1,F13, the other should respond with S1,F14 (COMMACK = 0).
- If a communication fault occurs (e.g., timeout), the system returns to NOT COMMUNICATING.

⚠ Even if both sides send S1,F13 simultaneously, either successful transaction will transition the system into COMMUNICATING. The other transaction remains open until it finishes normally.

1.3.2. SECS/GEM Communication – Connection Mode Overview

In SECS/GEM communication, establishing a TCP/IP connection involves two distinct roles, determined by the connection mode configuration:

① Active Mode

- This entity is responsible for initiating the TCP/IP connection.
- It actively attempts to establish a session by sending a connection request to the remote counterpart.
- The Active Mode Entity does not wait for incoming connections — it starts the process by reaching out to the Passive Mode Entity.

② Passive Mode

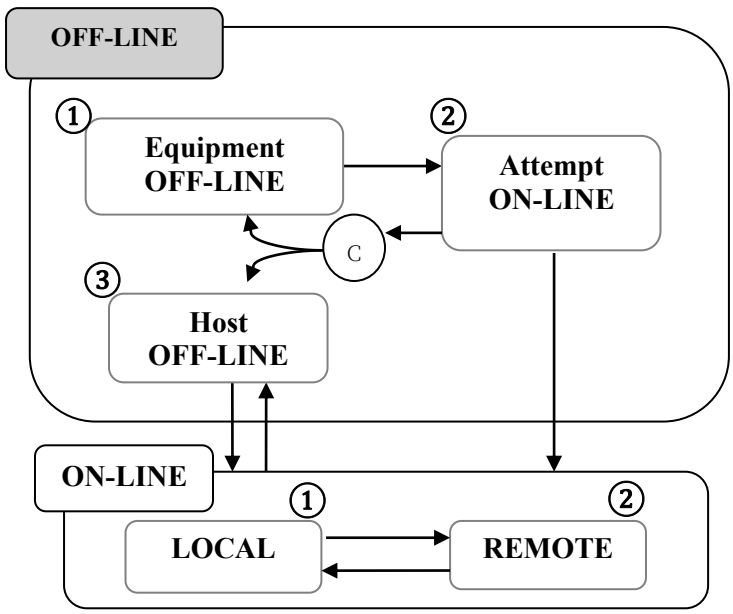
- This entity operates in listening mode.
- It waits for an external connection request, typically from an Active Mode Entity.
- The Passive Mode Entity keeps a server socket open and remains ready to accept incoming connections initiated by an external client.

1.4. Control State

- CONTROL state model defines the level of cooperation between the host and equipment
- Unlike the COMMUNICATIONS model, which covers whether messages can be exchanged, this model addresses whether the equipment will act on received messages.
- There are three levels:
    1. **REMOTE** – Full host control over equipment
    2. **LOCAL** – Host has information access but limited control
    3. **OFF-LINE** – No host control, minimal information access
- CONTROL and COMMUNICATION states do not directly affect each other, but if COMMUNICATION is NOT COMMUNICATING, then messages (and therefore control) won't work effectively.

1.4.1. Control State Diagram

Control State Diagram explains the equipment's operational control modes (e.g., Offline, Online Local, Online Remote)



1.4.2. Control State: OFF-LINE

When the OFF-LINE state is active, operation of the equipment is performed by the operator at the operator console. While the equipment is OFF-LINE, message transfer is possible. However the use of messaging for any automation purpose is severely restricted. While the OFF-LINE state is active, the equipment will only respond to those messages used for the establishment of communications or a host request to activate the ON-LINE state.
While OFF-LINE, the equipment will respond with an Sx,F0 to any primary message from the host other than
S1,F13 or S1,F17.No message spooling occurs in this state. OFF-LINE consists of three substates:

① OFF-LINE / EQUIPMENT OFF-LINE

- While this state is active, the system maintains the OFF-LINE state
- It awaits operator instructions to attempt to go ON-LINE..

② OFF-LINE / ATTEMPT ON-LINE

- Operator has initiated an ONLINE attempt.
- Equipment sends S1,F1 to the host.
- Operator cannot switch states manually during this substate.

③ OFF-LINE / HOST OFF-LINE

- the operator's intent is that the equipment be ON-LINE. However, the host has not agreed.
- While this state is active, the equipment shall positively respond to any host's request to go ON-LINE (S1,F17)..

1.4.3. Control State: ON-LINE

SECS-II messages may be exchanged and acted upon. Capabilities that may be available to the host should be similar to those available from the operator console wherever practical. The use of Sx,F0 messages is not required while the ON-LINE state is active. Their use is discouraged in this case. The only allowed use is to close open transactions in conjunction with message faults.

① ON-LINE / LOCAL

- The host shall be prohibited from the use of remote commands that cause physical movement or which initiate processing. During processing, the host shall be prohibited from the use of any remote command that affects that process.
- During processing, the host shall be prohibited from modifying any equipment constants that affect that process. Other equipment constants shall be changeable during processing. The host shall be able to modify all available equipment constants when no processing is in progress.

- The host shall be capable of initiating the upload and download of recipes to/from the recipe storage area on the equipment. The host shall be capable of selecting recipes for execution so long as this action does not affect any currently executing recipe.
- The host shall be able to configure automatic data reporting capabilities including alarms, event reporting, and trace data reporting. The host shall receive all such reports at the appropriate times.
- The host shall be able to inquire for data from the equipment, including status data, equipment constants, event reports, Process Recipe directories, and alarms.The equipment shall be able to perform Terminal Services as defined in GEM.

② ON-LINE / REMOTE

- For equipment which supports the GEM capability of remote control (see § 4.4), while the REMOTE state is active, the host shall have access, through the communications interface, to the necessary commands to operate the equipment through the full process cycle in an automated manner. The equipment does not restrict any hostcapabilities when REMOTE is active. The degree of control executed by the host may vary from factory to factory.
- In some cases, the operator maybe required to interact during remotely controlled processes. This interaction may involve set-up operations, operator assist situations, and others. This state is intended to be flexible enough to accommodate these different situations**.**

To support the different factory automation policies and procedures, it shall be possible to configure the equipment to restrict the operator in specific non-emergency procedures. These restrictions shall be configurable so that the equipment may be set up to allow the operator to perform necessary functions without contention with the host. The categories for configuration shall include (but are not limited to):

- change equipment constants (non-process-related),
- initiate Process Recipe download,
- select Process Recipe,
- start Process Recipe,
- pause/resume Process Recipe,
- operator assist,
- material movement to/from equipment, and
- equipment-specific commands (on a command-by-command basis if needed).

No capabilities that are available to the operator when the LOCAL state is active should be unconditionally restricted when the REMOTE state is active. The supplier may provide for configurable restriction of operator capabilities not included in the list above if desired. No configurability is necessary for any operator functions not available to the host.

1.5. Reference & Verbs

No.	Abbreviation	Full Name	Description
1	MCS	Material Control System	A system that manages and controls material handling equipment.
2	AMHS	Automated Material Handling System	Equipment used for storage and transport of materials within a factory.
3	GEM	Generic Equipment Model	SEMI-defined standard for generic semiconductor equipment operation.
4	Stocker-SEM	Specification for AMHS Storage Specific Equipment Model	SEMI standard for operating stocker-type storage systems.
5	IB-SEM	Specification for Interbay / Intrabay AMHS SEM	SEMI standard for operating transport equipment like AGV, OHS.
6	SC	Stocker Controller	Manages data and controls devices within a stocker.
7	TSC	Transport System Controller	Controls transport equipment such as AGVs and OHS.
8	AGV	Automated Guided Vehicle	Automatically delivers materials to destinations by following guide lines.
9	RGV	Rail Guided Vehicle	Moves along fixed rails to transport materials.
10	OHS	Overhead Shuttle	Ceiling-mounted shuttle that transports materials along overhead rails.
11	Lift	(Vertical Transport Unit)	Transfers materials between different floor levels.
12	LP	Load Port	Port for loading materials for processing or stocker input.
13	OP	Output Port	Port for dispatching materials for external transport.
14	BP	Buffer Port	Temporary port for intermediate or special-purpose material storage.
15	Port	(General Port Interface)	Generic term for LP, OP, BP – material load/unload interface points.
16	Unit	(Logical/Physical Unit)	General component of AMHS such as crane or shelf.
17	Crane	Crane Unit	Moves materials horizontally and vertically inside a stocker.

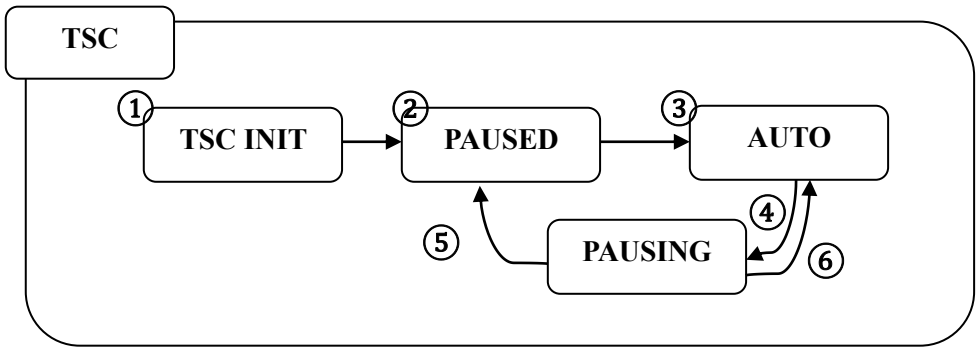
2. OHT Control Specification (reference to *IBSEM* and *STOCKERSEM*)

This section is based on the standardized equipment interface concepts defined in IBSEM and STOCKERSEM, which extend the SEMI E30 GEM standard with additional behaviors and characteristics specific to OHT-to-Equipment and OHT-to-Stocker communication.

2.1. TSC State Model

The purpose of the Transport System state model is to provide information to the host regarding the overall status of the Transport System. The TSC state model is valid when the SEMI E30 (GEM) state is ON-LINE. The TSC state model is **not** valid when the SEMI E30 (GEM) state is OFF-LINE. Since a transport system may consist of many components (e.g., vehicle, robot arm, ID reader, etc.), it may be possible to continue ON-LINE operation when the operation mode of some transport components (as viewed by the TSC) is a manual state

2.1.1 TSC State Model Diagram



① TSC INIT

TSC initialization of TS components is occurring. This is a nonoperational state

- No commands from the host will be processed or queued.
- The system will not move out of this state if there are vehicles actively loading or unloading carriers at ports.
- The event *S6F11 TSCAutoInitiated* is sent to the host when entering this state.

② PAUSED

No vehicles are in the process of loading or unloading a carrier at a port, but vehicles may still be moving. TRANSFER commands are accepted and queued

- The event *S6F11 TSCPaused* is sent to notify the host

.

③ AUTO

System is in the normal operational state. Commands are actively processed.

- Stopped Vehicles will resume normal motion.
- The event *S6F11 TSCAutoCompleted* is sent upon entering this state.

④ PAUSING

Vehicles that are stopped stay stopped.

- Vehicles that are moving stop at the next logical point without proceeding.
- The event *S6F11 TSCPauseInitiated* is sent to the host.

⑤ PAUSED (after PAUSING)

System will accept and queue new commands but will not execute them. No new acquires or deposits will occur. Outstanding acquires and deposits will complete.

- The event *S6F11 TSCPauseCompleted* is sent to the host when this transition is completed.

⑥ AUTO (after RESUME)

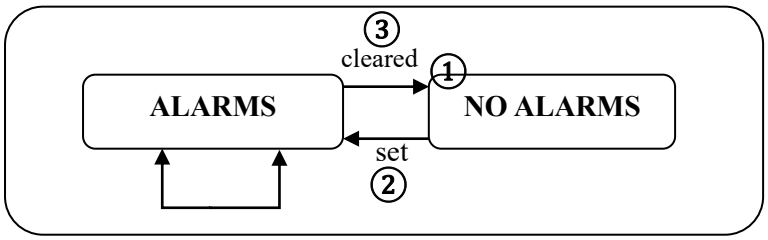
System will now perform all commands. Stopped Vehicles will resume normal motion.

- Again, the event S6F11 TSCAutoCompleted is sent.

2.1.2. TSC State Transition Table

No.	Previous State	Trigger	New State	Actions	Comments
1	None	TSC Initiation	TSC Init	S6F11 TSCAutoInitiated	
2	TSC INIT	System started up successfully. All Cassette movement stopped	PAUSED	S6F11 TSCPaused	
3	PAUSED	RESUME command	AUTO	S6F11 TSCAutoCompleted	
4	AUTO	PAUSE command	PAUSING	S6F11 TSCPauseInitiated	
5	PAUSING	RESUME command	AUTO	S6F11 TSCAutoCompleted	
6	PAUSING	All Cassette movement has competed	PAUSED	S6F11 TSCPauseCompleted	
7	NO ALARMS	Alarm Set	ALARMS	S6F11 AlarmSet	
8	ALARMS	All Alarms cleared	NO ALARMS	S6F11 AlarmCleared	
9	ALARMS	Alarm Set	ALARMS	S6F11 AlarmSet	

2.2. Alarm State Model



① NO ALARMS

The system is in a normal state with no active alarms.

- All equipment and operations are functioning properly.

② ALARMS (after Alarm Set)

System can process normally for transport components that are unaffected by the alarm

- The *S6F11 AlarmSet* event is sent to the host when an alarm is raised.
- If additional alarms occur, the same message may be sent multiple times.

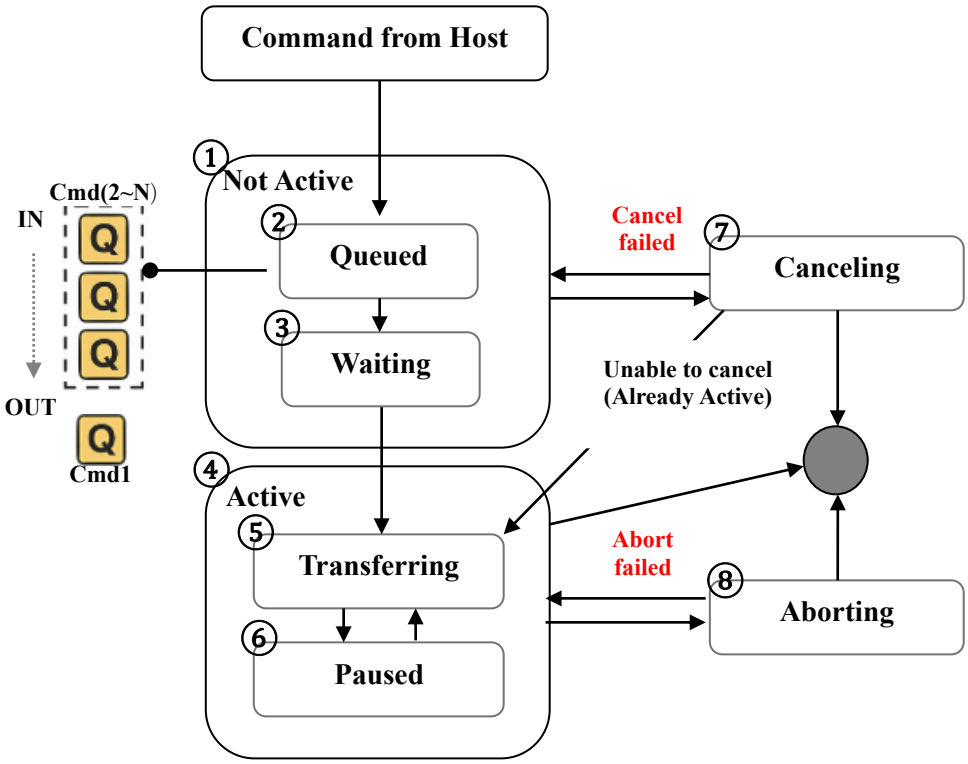
③ NO ALARMS (after Alarm Clear)

All previously set alarms have been cleared, and the system returns to the normal state.

- The *S6F11 AlarmCleared* event is sent to the host upon clearing all alarms.

2.3. Transfer Command State Model

2.3.1. Transfer Command State Model Diagram



① Not Active

The transfer unit is not involved in the physical aspect of the TRANSFER command.

- This is the initial or idle state before any action is taken.
- No vehicle is currently assigned to execute the transfer.

② Queued *(Sub-state of Not Active)*

TSC has acknowledged and queued the TRANSFER command. TRANSFER command has not been initiated.

③ Waiting *(Sub-state of Not Active)*

The TRANSFER command has been initiated by the TSC.

- For Vehicle based systems: A vehicle is on its way to the source location to acquire the transfer unit.

④ Active

The transfer unit is involved in the physical aspect of the TRANSFER command.

⑤ **Transferring** *(Sub-state of Active)*

The transfer command is actively being executed by the transport equipment.

- The acquire of the first carrier of the transfer unit begins..

⑥ **Paused** *(Sub-state of Active)*

The transfer command is not actively being executed by the transport equipment.

- It is an important distinction to make that the TRANSFER command is paused even though the vehicle may not be.
- The TSC pauses execution of the TRANSFER command due to an anomaly condition..

⑦ **Canceling**

The TRANSFER command cancel procedure is being performed to terminate a transfer command which never entered the ACTIVE state (either QUEUED or WAITING). This state is entered via a CANCEL remote command.

- Host issued cancel for the TRANSFER command is accepted by the TSC.
- A CANCEL remote command was issued to terminate a TRANSFER command that has not entered the physical aspect of the command.

⑧ **Aborting**

The TRANSFER command abort procedure is being performed to terminate a transfer command which has entered the ACTIVE state. This state can only be entered via an ABORT remote command.

- Host initiates an abort of a TRANSFER command.
- An ABORT remote command was issued to terminate a TRANSFER command.

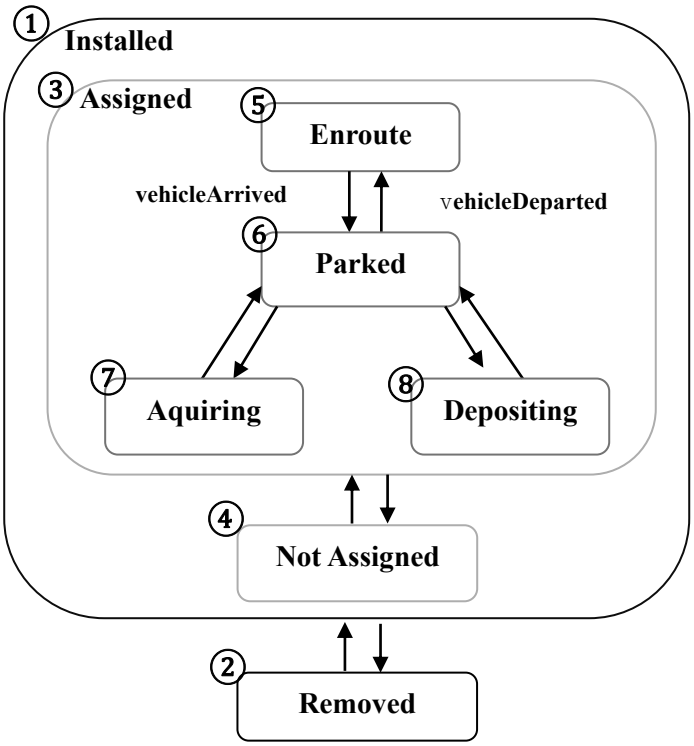
2.3.2. Transfer Command State Transition Table

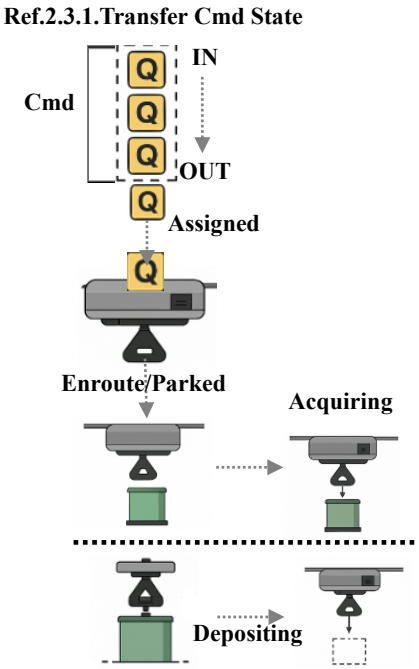
No	Previous State	Trigger	New State	Actions
1	None	The Host generated TRANSFER command is successfully acknowledge by the TSC	QUEUED	
2	QUEUED	The TRANSFER command has been initiated by the TSC	WAITING	S6F11 TransferInitiated
3	WAITING	The acquire of the first carrier of the transfer unit begins	TRANSFERRING	S6F11 Transferring
4	NOT ACTIVE	Host sends CANCEL command for a specified TRANSFER command to TSC	CANCELING	S6F11 TransferCancelInitiated
5	CANCELING	Transport system is unable to cancel the TRANSFER command	Previous NOT ACTIVE sub state	S6F11 TransferCancelFailed
6	CANCELING	The cancel procedure for the TRANSFER command has completed by the transport system and TSC	None	S6F11 TransferCancelCompleted
7	TRANSFERRING	The TSC resumes execution of the TRANSFER command due to an anomaly condition	PAUSED	S6F11 TransferPaused
8	PAUSED	The TSC resumes execution of the TRANSFER command since the anomaly condition has been cleared	TRANSFERRING	S6F11 TransferResumed
9	ACTIVE	Host initiates an abort of TRANSFER command	ABORTING	S6F11 TransferAbortInitiated
10	ABORTING	The abort procedure for the TRANSFER command has completed by the transport system and TSC	None	S6F11 TransferAbortCompleted
11	ACTIVE	The TRANSFER command has completed by the transport system and SC (either successfully or unsuccessfully)	None	S6F11 TransferCompleted sent to Host with ResultCode=0 : successful nonzero : unsuccessful
12	ABORTING	Transport system is physically unable to abort the TRANSFER command	Previous ACTIVE substate	S6F11 TransferAbortfailed
13	CANCELING	Transport system is unable to cancel because the transfer is now ACTIVE	TRANSFERRING	S6F11 Transferring

2.4. Vehicle State Model

The purpose of the vehicle state model is to provide information to the host for use of transport vehicle information and metric tracking (i.e., the Host will not control vehicles). Each vehicle must individually comply with the vehicle state model. Implementation of this state model, along with associated events and variables, is not a requirement for Transport Systems which do not have vehicles. The Host should not be dependent on any events from the vehicle state model.

2.4.1. Vehicle State Model Diagram





① Installed

The vehicle is available or being used for TRANSFER commands. All enabled collection events and alarms will be sent to the Host for vehicles in this state.

- Vehicle is installed for use of transfer commands.

② Removed

The vehicle is not available for Host initiated TRANSFER commands. No collection events or alarms will be sent to the Host for vehicles in this state.

- Vehicle is removed from use of transfer commands..

③ Assigned

The Vehicle is allocated to a TRANSFER command.

- A task is officially allocated to the vehicle.

④ **Not Assigned**

Vehicle is not allocated to a TRANSFER command. The vehicle may contain a carrier as the result of a command being aborted.

- This could be the result of the command being completed or aborted.
- It could also be the result of the TSC scheduling algorithms assigning this vehicle to another command and/or another vehicle being assigned to this command.

⑤ **Enroute**

The vehicle is on its way to a transfer port. This is the default entry into the ASSIGNED state since it must be entered for the host to track vehicle metrics completely and adequately

- TransferPort may be an internal transfer port.
- Vehicle departs a transfer port associated with an ACTIVE transfer command.

⑥ **Parked** *(sub-state of Active)*

The vehicle is stationary, usually in one of the following scenarios:

- It has arrived at a location (e.g., source or destination port) and is waiting before initiating any mechanical action.
- It is waiting for a departure command but is ready and positioned at a valid track or parking zone.
- Used as a transitional or buffer state to synchronize with other equipment or control logic.

⑦ **Acquiring** *(sub-state of Assigned)*

This state occurs when the vehicle is in the following conditions:

- After the arrival of the vehicle is completed and before the action of the transfer agent is started.
- After the action of the transfer agent has completed and before the departure of the vehicle.
- After continuous actions of the transfer agent (e.g., acquire/acquire and deposit/deposit) are completed.

⑧ **Depositing** *(sub-state of Assigned)*

The vehicle is currently involved in carrier deposit (one or more carriers possible depending on vehicle limitations).

- The carrier handoff parallel I/O completes for the vehicle to acquire (load) the transfer unit and starts for the vehicle to deposit (unload) the carrier.
- Completion of this step marks the near end of the transport cycle.

2.4.2. Vehicle State Transition Table

No.	Previous State	Trigger	New State	Actions
1	ENROUTE	Vehicle arrives at a transfer port associated with an ACTIVE transfer command	PARKED	S6F11 VehicleArrived
2	PARKED	Vehicle departs a transfer port associated with an ACTIVE transfer command	ENROUTE	S6F11 VehicleDeparted
3	PARKED	The carrier handoff parallel I/O starts for the vehicle to acquire (load) the transfer unit	ACQUIRING	S6F11 VehicleAcquireStarted
4	ACQUIRING	The carrier handoff parallel I/O completes for the vehicle to acquire (unload) the transfer unit	PARKED	S6F11 VehicleAcquireComleted
5	PARKED	The carrier handoff parallel I/O starts for the vehicle deposit (unload) the transfer unit	DEPOSITING	S6F11 VehicleDepositStarted
6	DEPOSITING	The carrier handoff parallel I/O completes for the vehicle to deposit (unload) the transfer unit	PARKED	S6F11 VehicleAcquireComleted
7	ACQUIRING	The carrier handoff parallel I/O completes for the vehicle to acquire (load) the transfer unit and starts for the vehicle to deposit (unload) the carrier	DEPOSITING	S6F11 VehicleDepositStarted
8	DEPOSITING	The carrier handoff parallel I/O completes for the vehicle to deposit (unload) the transfer unit and starts for the vehicle to acquire (load) the carrier	ACQUIRING	S6F11 VehicleAcquireStarted
9	ASSIGNED	Vehicle is no longer being utilized for the specified command	NOT ASSIGNED	S6F11 VehicleUnassigned
10	NOT ASSIGNED	Vehicle is allocated to TRANSFER command	ASSIGNED	S6F11 VehicleAssigned
11	INSTALLED	Vehicle is removed from use of transfer commands	REMOVED	S6F11 VehicleRemoved
12	REMOVED	Vehicle is installed for use of transfer commands	INSTALLED	S6F11 VehicleInstalled

2.5. Carrier State Model

The carrier has been loaded onto an OHT vehicle and is now managed by the OHT Controller (OHTC).

- The OHTC registers the carrier in its database.
- The carrier is now under OHT system control.

2.5.1. Carrier State Model Diagram



2.5.2. Carrier State Transition Table

No.	Previous State	Trigger	New State	Actions
1	None	A TSC database entry is created for the carrier	INSTALLED	S6F11 CarrierInstalled
2	INSTALLED	A TSC database entry is removed for the carrier	None	S6F11 CarrierRemoved

3. SECS Messages Specification(SECS-II)

SECS-II, short for SEMI Equipment Communications Standard – Low-Level protocol, defines the low-level rules and procedures for transmitting messages between a semiconductor equipment (tool) and a host computer (usually MES or CIM systems).

It is essentially the transport layer that ensures reliable delivery of SECS-II messages.

3.1. Stream Function Definitions

3.1.1. Stream1

Messages	Direction	Description
SxF0	H<->E	Abort Transaction
S1F1	H<->E	Are You There Request (R)
S1F2	H<->E	On-line Data (D)
S1F3	H -> E	Selected Equipment Status Request (SSR)
S1F4	H <- E	Selected Equipment Status Data (SSD)
S1F13	H<->E	Establish Communication Request (CR)
S1F14	H<->E	Establish Communication Request Ack. (CRA)
S1F15	H -> E	Request OFF-LINE(ROFL)
S1F16	H <- E	OFF-LINE Ack. (OFLA)
S1F17	H -> E	Request ON-LINE(RONL)
S1F18	H <- E	ON-LINE Ack. (ONLA)

3.1.2. Stream2

Messages	Direction	Description
S2F31	H -> E	Date and Time Set Request (DTS)
S2F32	H <- E	Date and Time Set Ack. (DTA)
S2F41	H -> E	Host Command Send (HCS)
S2F42	H <- E	Host Command Ack. (HCA)
S2F49	H -> E	Enhanced Remote Command
S2F50	H <- E	Enhanced Remote Command Ack.

3.1.3. Stream5

Messages	Direction	Description
S5F1	H <- E	Alarm Report send (ARS)
S5F2	H -> E	Alarm Report Acknowledge (ARA)
S5F3	H -> E	Alarm Valid/Invalid Setting
S5F4	H <- E	Alarm Valid/Invalid Setting Acknowledge
S5F5	H -> E	Alarm List Request
S5F6	H <- E	Alarm List Request Acknowledge

3.1.4. Stream6

Messages	Direction	Description
S6F11	H <- E	Event Report Send(ERS)
S6F12	H -> E	Event Report Acknowledge(ERA)

3.1.5. Stream9

Messages	Direction	Description
S9F1	H <- E	Unrecognized Device ID
S9F3	H <- E	Unrecognized Stream Type
S9F5	H <- E	Unrecognized Function Type
S9F7	H <- E	Illegal Data
S9F9	H <- E	Transaction Timer Timeout

3.1.6. Stream10

Messages	Direction	Description
S10F3	H -> E	Terminal Display
S10F4	H <- E	Terminal Display Ack.

3.2. Event Report Definition

3.2.1. Controller State Event

CEID	NAME	STATE	
		OLD	NEW
1	OFFLINE	LOCAL, REMOTE	OFFLINE
2	LOCAL	OFFLIN,REMOTE	LOCAL
3	REMOTE	OFFLINE, LOCAL	REMOTE

3.2.2. OHTC State Transition Event

CEID	NAME	STATE	
		OLD	NEW
1201	OHTC Auto Initiated	None	TSC Init
1202	OHTC Auto Complete	Paused, Pausing	Auto
1203	OHTC Pause Initiated	Auto	Pausing
1204	OHTC Pause Completed	Pausing	Paused
1205	OHTC Paused	TSC Init	Paused
1301	Alarm Set	No Alarms	Alarms
1302	Alarm Clear	Alarms	No Alarms
1303	Unit Alarm Set	No Alarms	Alarms
1304	Unit Alarm Clear	Alarms	No Alarms

3.2.3. Transfer Command Transition Event

CEID	NAME	STATE	
		OLD	NEW
1201	OHTC Auto Initiated	None	TSC Init
1202	OHTC Auto Complete	Paused, Pausing	Auto
1203	OHTC Pause Initiated	Auto	Pausing
1204	OHTC Pause Completed	Pausing	Paused
1205	OHTC Paused	TSC Init	Paused
1301	Alarm Set	No Alarms	Alarms
1302	Alarm Clear	Alarms	No Alarms
1303	Unit Alarm Set	No Alarms	Alarms
1304	Unit Alarm Clear	Alarms	No Alarms

3.2.4. Transfer Command Transition Event

CEID	NAME	STATE	
		OLD	NEW
3101	Transfer Initiated	QUEUED	WAITING
3102	Transfer Completed	ACTIVE	NONE
3103	Transfer Paused	TRANSFERRING	PAUSED
3104	Transfer Resumed	PAUSED	TRANSFERRING
3105	Transferring	WAITING	TRANSFERRING
3201	Transfer Abort Initiated	ACTIVE	ABORTING
3202	Transfer Abort Completed	ABORTING	NONE
3203	Transfer Abort Failed	ABORTING	ACTIVE
3301	Transfer Cancel Initiated	QUEUED	CANCELLING
3302	Transfer Cancel Completed	CANCELLING	NONE
3303	Transfer Cancel Failed	CANCELLING	QUEUED

3.2.5. Vehicle State Transition Event

CEID	NAME	STATE	
		OLD	NEW
4101	Vehicle Arrived	Enroute	Parked
4102	Vehicle Acquire Started	Parked	Acquiring
		Depositing	Acquiring
4103	Vehicle Acquire Completed	Acquiring	Parked
4104	Vehicle Departed	Parked	Enroute
4105	Vehicle Deposit Started	Parked	Depositing
		Acquiring	Depositing
4106	Vehicle Deposit Completed	Depositing	Parked
4201	Vehicle Installed	Removed	Installed
4202	Vehicle Removed	Installed	Removed
4203	Vehicle Assigned	Not Assigned	Assigned
4204	Vehicle Unassigned	Assigned	Not Assigned
4205	Vehicle State Change	previous state	new state
4206	Vehicle Moving	Parked, Moving	Moving

3.2.6. Carrier State Transition Event

CEID	NAME	STATE	
		OLD	NEW
5101	Carrier Installed	None	Installed
5102	Carrier Removed	Installed	None

3.2.7. Port State Transition Event

CEID	NAME	STATE	
		OLD	NEW
5201	Port Info Change	Inservice	OutService
		OutService	Inservice

3.2.8. Operator Event

CEID	NAME	STATE	
		OLD	NEW
6101	Operator Init Action		

3.2.9. ~~Zone Status Transition Event~~

~~CEID~~	~~NAME~~	~~STATE~~	
		~~OLD~~	~~NEW~~
~~7101~~	~~ZoneCapacity Change~~		

3.2.10. Scheduled Data Collection Event

This event reports vehicle operation data **once per day**.
The reporting time and included data items **can be adjusted through mutual agreement**.
(차량 운행 정보를 **하루에 한 번 보고하는 이벤트**입니다.
보고 시점과 포함 항목은 상호 협의에 따라 조정이 가능합니다.

CEID	NAME	STATE	
		OLD	NEW
8101	Vehicle Operation Summary		

3.3. Variable Data Items

3.3.1. Basic VID

VID	Name	Class	Format	Details
1	TSC Name	SV/DV	A[64]	
2	Control State	SV/DV	U2	1=offline/equipment offline, 2=offline/going to offline 3=offline/host offline , 4=online/local 5=online/remote
3	TSC State	SV/DV	U2	1=SC Init 2=Paused 3=Auto 4=Pausing
4	Active Carriers	DV/SV	L,n <CarrierInfo>	VID=50
5	Active Transfers	DV/SV	L,n <TransferCommand>	VID=51
6	Active Vehicles	DV/SV	L,n <VehicleInfo>	VID=54
~~7~~	~~Active Alarm~~	~~DV/SV~~	~~L,n~~ ~~<AlarmInfo>~~	~~VID=55~~
8	Active Unit Alarms	DV/SV	L,n <UnitAlarmInfo>	VID=56
9	Active Ports(STB)	DV/SV	L,n 1. <Port Info> … n. <Port Info>	VID=58
~~10~~	~~Active Zones~~	~~DV/SV~~	~~L,n~~ ~~<ZoneInfo>~~	~~VID=59~~
50	CarrierInfo	DV/SV	L,3 <A[64] CarrierID> <A[64] VehicleID> <A[64] CarrierLoc>	

51	TransferCommand	DV/SV	L,2 <CommandInfo> <TransferInfo>	
52	CommandInfo	DV/SV	L,3 <A[64] CommandID> <U2[1] Priority> <U2[1] Replace>	Priority:0~99
53	TransferInfo	DV/SV	L,3 <A[64] CarrierID> <A[64] SourcePort> <A[64] DestPort>	
54	VehicleInfo	DV/SV	L,3 <A[64] VehicleID> <U2[1] VehicleState> <A[64] VehicleLocation>	VehicleState 1=Removed 2=Not Assigned 3=Enroute 4=Parked 5=Acquiring 6=Depositing 7=Error
~~55~~	~~AlarmInfo~~	~~DV/SV~~	~~L,3~~ ~~<B[1] AlarmCode>~~ ~~<U4[1] AlarmID>~~ ~~<A[128] AlarmText>~~	~~Current Alarm~~
56	UnitAlarmInfo	DV/SV	L,3 <A[64] VehicleID> <U4[1] AlarmID> <A[128] AlarmText>	Current Alarm
57	PortInfo	DV/SV	L,3 <A[64] Port ID <U2[1] Port State <U2[1] Port Status ~~<A[64] ZoneName~~	
~~58~~	~~ZoneInfo~~	~~DV/SV~~	~~L,3~~ ~~<A[64] ZoneName>~~ ~~<U2[1] MaxCapacity>~~ ~~<U2[1] ZoneCapacity>~~	

3.3.2. Transfer & Device VID

VID	Name	Class	Format	Details
101	AlarmCode	SV/DV	B	bit 8 = 1 Alarm enabled bit 8 = 0 Alarm disabled
102	AlarmID	SV/DV	U4	* Unique ID * **No duplicate alarms per vehicle when reporting.** **Example:** When reporting from MCS, combine AlarmID+VehicleID : • Alarm 100, Vehicle No. 3 → **30100** • Alarm 20, Vehicle No. 2 → **20020** • Alarm 104, Vehicle No. 15 → **15104** This is defined within the controller using values within the **U4 range**
103	AlarmText	SV/DV	A[128]	
~~104~~	~~ErrorID~~	~~DV~~	~~A[64]~~	~~SourcePIO~~ ~~DestPIO~~ ~~Others~~
105	CarrierID	DV	A[64]	
106	CarrierLoc	SV/DV	A[64]	
107	CommandID	DV	A[64]	
108	PortID	SV/DV	A[64]	* STB Only
109	Port State	SV/DV	U2	* STB Only 1: OutofService 2: Inservice
110	Port Status	SV/DV	U2	* STB Only 1: Empty 2: Occupied(Full)
111	SourcePort	SV/DV	A[64]	
112	DestPort	SV/DV	A[64]	Destination Port
113	Priority	SV/DV	U2	
114	Replace	DV	U2	
115	TransferPort	SV/DV	A[64]	

116	VehicleID	DV	A[64]	Unique ID
117	VehicleState	DV	U2	VehicleState 1=Removed 2=Not Assigned 3=Enroute 4=Parked 5=Acquiring 6=Depositing 7=Error 8=Charge
118	VehicleLocation	SV/DV	A[64]	BCR ID
~~119~~	~~ZoneName~~	~~SV/DV~~	~~A[64[~~	~~ZoneName~~
~~120~~	~~MaxCapacity~~	~~DV~~	~~U2~~	~~Max Capacity~~
~~121~~	~~ZoneCapacity~~	~~DV~~	~~U2~~	~~Current Capacity~~
122	ReportTime	DV	A[14]	A text string indicating the time of an event, which encodes time in the following format = YYYYMMDDHHmmss (20250101010000)
123	Reports	DV	L,4 <A[64] VehicleID <U2[1] TransferCount <U2[1] TravelDistance <U4[1] TravelTime	
124	TransferCount	DV	U2	Number of Commands Executed
125	TravelDistance	DV	U2	Vehicle Travel Distance(m) : Meter
126	TravelTime	DV	U4	Vehicle Travel Time(s) : Second

3.3.3. Option & Error Code

VID	Name	Class	Format	Details
201	Result Code	DV	U2	0=Successful 3=Abnormal Completed 5=Deposit PIO-Error 6=Pick-Up PIO-Error
202	Command Type	DV	A[20]	'TRANSFER' 'CANCEL' 'ABORT'
203	Carrier Type	DV	A[64]	‘FOUP’ ‘CASSETTE’ ‘MAGAZINE’ ‘FOSB’
204	ReOrder	DV	U2	0=NONE 1=After Abort, Request Dest

3.4. Remote Command Definitions

CEID	CPNAME(Parameters)	Description	COMMENT
ABORT	“COMMANDID”	Requests termination of a specific **active transfer command** identified by COMMANDID. Execution depends on the equipment's current state.	TransferAbortCompleted
CANCEL	“COMMANDID”	Requests cancellation of a specific **queued transfer command** identified by COMMANDID. Can be executed regardless of the equipment's state.	TransferAbortFailed
PAUSE	NONE	Requests the equipment to switch to **Pause** mode	TransferAbortInitiated
RESUME	NONE	Requests the equipment to switch back to Auto mode from Pause.	TransferCancelCompleted
TRANSFER	“COMMANDINFO” “TRANSFERINFO” “CARRIERTYPE”	Typically used instead of S2F41; requests the transfer of a cassette from a specific source to a designated destination.	TransferCancelFailed
~~UPDATE~~	~~“COMMANDINFO”~~ ~~“TRANSFERINFO”~~	~~Requests an **update to a transfer command** without requiring an abort, allowing dynamic command changes.~~	~~TransferCancelInitiated~~

3.5. Stream Function Details

3.5.1. S1F1-Are you there

Stream	Function	Description	Wait bit	Direction
1	1	Establish if the equipment is on line	True	H<->E
HEADER ONLY.				

Stream	Function	Description	Wait bit	Direction
1	2	Data signifying that the equipment is alive	False	H<-E
< L, 2 < A[64] MDLN> * Model Number of the equipment < A[64] SOFTREV> * Software Revision				

Stream	Function	Description	Wait bit	Direction
1	2	Data signifying that the host is alive	False	H->E
< L, 0				

3.5.2. S1F3-Selected Equipment Status Request

Stream	Function	Description	Wait bit	Direction
1	3	HOST QUERY AMHS EQ INFO	True	H->E

<L,6
<U2[1] 2> // Control State
<U2[1] 4> // Active Carriers
<U2[1] 5> // Active Transfers
<U2[1] 6> // Active Vehicles
<U2[1] 9> // Active Ports(STB)
<U2[1] 8> // Active Unit Alarms
~~<U2[1] 10> // Active Zones~~

Stream	Function	Description	Wait bit	Direction
1	4		False	H<-E

<L, 6>
<U2 1> //Control State
<L, n> //Active Carriers
<L, 2>
<A 64> //CARRIERID
<A 64> //VEHICLEID
<A 64> //CARRIERLOC

<L, n> //Active Transfers
<L, 2>
<L, 2>
<A 64> //COMMANDID
<U2 1> //PRIORITY
<U2 1> //REPLACE
<L, 3>
<A 64> //CARRIERID
<A 64> //SOURCEPORT
<A 64> //DESTPORT

<L, n> //Active Vehicles
<L, 3>
<A 64> //VEHICLEID
<U2 1> //VEHICLESTATE
<A 64> //VEHICLELOCATION

<L, n> //Active Ports
<L,3
<A,64 PORTID
<U2,1 PORTSTATE
<U2,1 PORTSTATUS
~~<A,64 ZONENAME~~

<L, n> //Active Unit Alarms
<L, 3>
<A 64> //VEHICLEID
<U4 1> //ALARMID
<A 128> //ALARM TEXT

~~<L, n> //Active Zones~~
~~<L, 3>~~
~~<A 64> //ZONENAME~~
~~<U2 1> //MAXCAPACITY~~
<U2 1> //ZONECAPACITY

3.5.3. S1F13-Establish Communication Request

Stream	Function	Description	Wait bit	Direction
1	13	Initialize communications at a logical application level both on power-up and following a break in communications.	True	H<->E

E->H
<L 2
<A[64] MDLN>
<A[64] SOFTREV>

H->E
<L 0

Stream	Function	Description	Wait bit	Direction
1	14	Accept or deny Establish Communication Request	False	H<->E

E->H
<L, 2
<B[1] COMMACK>
<L, 2
<A[64] MDLN>
<A[64] SOFTREV>

H->E
<L, 2
<B[1] COMMACK>
<L 0

3.5.4. S1F15-Offline Request

Stream	Function	Description	Wait bit	Direction
1	15	The Host requests that the equipment transaction to the OFF-LINE state.	True	H->E

Header Only

Stream	Function	Description	Wait bit	Direction
1	16	Acknowledge or Error.	False	H<-E

<B[1] OFLACK

3.5.5. S1F17-Online Request

Stream	Function	Description	Wait bit	Direction
1	17	The Host requests that the equipment transaction to the ON-LINE state.	True	H->E

Stream	Function	Description	Wait bit	Direction
1	18	Acknowledge or Error.	False	H<-E
<B[1] OFLACK				

3.5.6. S2F31-Date and Time Request

Stream	Function	Description	Wait bit	Direction
2	31	Useful to synchronize the equipment time with the host time base.	True	H->E
<A[16] TIME				

Stream	Function	Description	Wait bit	Direction
2	32	Acknowledge the receipt of time and date.	False	H<-E
<B[1] TIACK				

3.5.7. S2F41-Host Command Send(Cancel)

Stream	Function	Description	Wait bit	Direction
2	41	The Host Requests the Equipment perform the specified remote command with the associated parameters.	True	H->E

```
< L, 2
      < A[64] RCMD > * CANCEL
      < L, 1
            <L, 2
                  <A[64] CPNAME > * COMMANDID
                  <A[64] CPVAL >    * CommandId
```

3.5.8. S2F41-Host Command Send(Abort)

Stream	Function	Description	Wait bit	Direction
2	41	The Host Requests the Equipment perform the specified remote command with the associated parameters.	True	H->E

```
< L, 2
      < A[64] RCMD > * ABORT
      < L, 1
            <L, 2
                  <A[64] CPNAME > * COMMANDID
                  <A[64] CPVAL >    * CommandId
```

3.5.9. S2F41-Host Command Send(Pause)

Stream	Function	Description	Wait bit	Direction
2	41	The Host Requests the Equipment perform the specified remote command with the associated parameters.	True	H->E

```
< L, 2
      < A[64] RCMD > * RESUME
      < L, 0
```

3.5.10. S2F41-Host Command Send (Resume)

Stream	Function	Description	Wait bit	Direction
2	41	The Host Requests the Equipment perform the specified remote command with the associated parameters.	True	H->E

```
< L, 2
      < A[64] RCMD > * RESUME
      < L, 0
```

3.5.11. S2F41-Host Command Send (Install) / STB

Stream	Function	Description	Wait bit	Direction
2	41	OHTC DB Update By Carrier ID	True	H->E

```
< L, 2
      < A[64] RCMD > * INSTALL
      < L, 3
            <L, 2
                  <A[64] CPNAME > * CARRIERID
                  <A[64] CPVAL >    * CarrierID
            <L, 2
                  <A[64] CPNAME > * CARRIERLOC
                  <A[64] CPVAL > * CarrierLoc
            <L, 2
                  <A[64] LOTID> * LOTID
                  <A[64] CPVAL > * LotID
```

3.5.12. S2F41-Host Command Send (Remove) / STB

Stream	Function	Description	Wait bit	Direction
2	41	OHTC DB Delete By Carrier ID	True	H->E

```
< L, 2
      < A[64] RCMD > * REMOVE
      < L, 3
            <L, 2
                  <A[64] CPNAME > * CARRIERID
                  <A[64] CPVAL >    * CarrierID
            <L, 2
                  <A[64] CPNAME > * CARRIERLOC
                  <A[64] CPVAL > * CarrierLoc
            <L, 2
                  <A[64] LOTID> * LOTID
                  <A[64] CPVAL > * LotID
```

3.5.13. S2F42-Host Command Acknowledge

Stream	Function	Description	Wait bit	Direction
2	42	Acknowledge Host command or error. If command is not accepted due to one or more invalid parameters.	False	H<-E

No Error
< L, 2
    < B[1] HCACK > 0
    < L, 0
Some Error
< L, 2
    < B[1] HCACK > 3
    < L, n
        <L, 2
            <A[64] CPNAME > Command Parameter Name
            <B[1] CPVAL > Control Parameter Ack Code
            ...
        <L, 2
            <A[64] CPNAME > Command Parameter Name
            <B[1] CPVAL > Control Parameter Ack Code

3.5.14. S2F49-Transfer

Stream	Function	Description	Wait bit	Direction
2	49		True	H->E

```
< L, 4
    < U2 DATAID>
    < A[64] OBJSPEC>
    < A[64] RCMD> * TRANSFER
    < L ,3
        <L, 2
            <A[64] CPNAME >    * COMMANDINFO'
            <L, 3
                <L, 2
                    <A[64] CPNAME >       *‘COMMANDID’
                    <A[64] CPVAL >         * CommandID
                <L, 2
                    <A[64] CPNAME >       *‘PRIORITY’
                    <U2[1] CPVAL >         * Priority
                <L, 2
                    <A[64] CPNAME >       *‘REPLACE’
                    <U2[1] CPVAL >         * Replace
        <L, 2
            < A[64] CPNAME > * 'TRANSFERINFO’
            <L, 3
                <L, 2
                    <A[64] CPNAME >     * 'CARRIERID’
                    <A[64] CPVAL >       * CarrierID
                <L, 2
                    <A[64] CPNAME >     * 'SOURCEPORT'
                    <A[64] CPVAL >       * Port or Vehicle
                <L, 2
                    <A[64] CPNAME >     * 'DESTPORT'
                    <A[64] CPVAL >       * Final Location
        <L, 2
            <A[64] CPNAME >       * ‘CARRIERTYPE’
            <A[64] CPVAL >         * CarrierType
```

3.5.15. S2F50-Enhanced Remote Command Acknowledge

Stream	Function	Description	Wait bit	Direction
2	50	The equipment acknowledge Enhanced Remote Command or reports any error(s). If the command is not accepted due to one or more invalid parameters, (i.e. HCACK=3), then a list of invalid parameters will be returned containing the parameter name and reason for being invalid.	False	H<-E

No Error
< L, 2
< B[1] HCACK > 0
< L ,0
Some Error
< L, 2
< B[1] HCACK > 3
< L, 2
<L, 2
<A[64] CPNAME > Command Parameter Name
<B[1] CEPACK > Control Parameter Ack Code
.....
<L, 2
<A[64] CPNAME > Command Parameter Name
<B[1] CEPACK > Control Parameter Ack Code

➢ Request HCACK= 5 for the same command

- 0 : Acknowledge, command has been performed
- 1 : Command does not exist
- 2 : Cannot perform now
- 3 : At least one parameter is invalid
- 4 : Acknowledge, command will be performed with completion signaled later by an event
- 5 : Rejected, Already in Desired Condition
- 6 : No such object exists
- 7 : Other Error (Catch-All)
- 11 : Source port does not exist
- 12 : Source port access is restricted (Unused status by TSC)
- 13 : No Carrier in Source port (only STB)
- 14 : The PIO of the source port is unused (TSC standard)
- 21: Destination port does not exist
- 22 : Destination port access is restricted (Unused status by TSC)
- 23 : Another carrier is already present at the destination port
- 24 : The PIO of the destination port is unused (TSC standard)
- 31 : Carrier is already in transfer
- 32 : Carrier location mismatch (STB only)
- 41 : No available route
- 42 : A route exists but is currently unavailable

3.5.16. S5F1-Alarm Report

Stream	Function	Description	Wait bit	Direction
5	1	This message reports a change in or presence of an alarm condition.	True	H<-E

< L, 3
< B [1] ALCD> * Alarm Code
< U2 [1] ALID> * Alarm Id
< A[1024] ALTX> * Alarm Text

Stream	Function	Description	Wait bit	Direction
5	2	Acknowledge or error.	False	H->E

< B [1] ACKC5>

3.5.17. S5F3-Alarm Valid/Invalid Setting

Stream	Function	Description	Wait bit	Direction
5	3	Enable/Disable Alarms	True	H->E

< L, 2
< B [1] ALED> * Alarm Valid/Invalid Code
< U2 [1] ALID> * Alarm Id

Stream	Function	Description	Wait bit	Direction
5	4	Acknowledge to Alarm Valid/Invalid Setting	False	H->E

< B [1] ACKC5>

3.5.18. S5F5-Alarm Report

Stream	Function	Description	Wait bit	Direction
5	5	This message reports a change in or presence of an alarm condition.	True	H<-E

< L, n
< U2 [1] ALID> * Requested Alarm Id
.....
< U2 [1] ALID> * Requested Alarm Id

Or

<L, 0 : All Alarm Request

Stream	Function	Description	Wait bit	Direction
5	6	Acknowledge to Alarm List Request	False	H->E

<L, n
< L, 3
< B [1] ALCD> * Alarm Code
< U2 [1] ALID> * Alarm Id
< A[1024] ALTX> * Alarm Text
.....
< L, 3
< B [1] ALCD> * Alarm Code
< U2 [1] ALID> * Alarm Id
< A[1024] ALTX> * Alarm Text

3.5.19. Event Report Send (TSC State)

Stream	Function	Description	Wait bit	Direction
6	11	The equipment send event	True	H<-E

```
< L, 3
      < U2 [1] DATAID>    * Data ID
      < U2 [1] CEID>      * Collection Event ID
      < L, 1
            <L, 2
                  <U2    RPTID> * Report ID=1
                  <L, 3
                        <A[64] TSC Name>          * TSC Name    <VID:1>
                        <U2[1] Control State>     * Control State    <VID:2>
                        <U2[1] TSC State>         * TSC State     <VID:3>
```

CEID	Event Name
1101	OFFLINE
1102	LOCAL
1103	REMOTE
1201	Auto Init
1202	Auto Complete
1203	Pause Init
1204	Pause Complete
1205	Paused

3.5.20. Event Report Send (Vehicle State)

Stream	Function	Description	Wait bit	Direction
6	11	The equipment send event	True	H<-E

```
< L, 3
    < U2 [1] DATAID>    * Data ID
    < U2 [1] CEID>      * Collection Event ID
    < L, 1
        <L, 2
            <U2    RPTID> * Report ID=3
            <L, 1
                <L, 3       * Vehicle Info    <VID:54>
                    <A[64]    VEHICLEID>
                    <U2[1]    VEHICLESTATE>
                    <A[64]    VEHICLELOCATION>
```

CEID	Event Name
4205	Vehicle State Change
4201	Vehicle Installed
4202	Vehicle Removed
4206	Vehicle Moving

3.5.21. S6F11-Event Report Send (Transfer)

Stream	Function	Description	Wait bit	Direction
6	11	The equipment send event	True	H<-E

```
< L, 3
    < U2 [1] DATAID>    * Data ID
    < U2 [1] CEID>      * Collection Event ID
    < L, 1
        <L, 2
            <U2   RPTID> * Report ID=4
            <L, 3
              <L, 3                    * COMMAND INFO <VID:52>
                <A[64] COMMANDID>
                <U2[1] PRIORITY>
                <U2[1] REPLACE>
              <L, 3                    * CARRIER INFO <VID:50>
                 <A[64] CARRIERID>
                 <A[64] VEHICLEID>
                 <A[64] CARRIERLOC>
              <U2[1] REORDER>        * <VID:204>
```

CEID	Event Name
3101	Transfer Initiated
3103	Transfer Paused
3104	Transfer Resumed
3105	Transferring
3201	Transfer Abort Initiated
3202	Transfer Abort Completed
3203	Transfer Abort Failed
3301	Transfer Cancel Initiated
3302	Transfer Cancel Completed
3303	Transfer Cancel Failed

3.5.22. S6F11-Event Report Send (Transfer Complete)

Stream	Function	Description	Wait bit	Direction
6	11	The equipment send event	True	H<-E

```
< L, 3
    < U2 [1] DATAID>    * Data ID
    < U2 [1] CEID>      * Collection Event ID
    < L, 1
        <L, 2
            <U2    RPTID> * Report ID=5
            < L, 4
                <L, 3                   * COMMAND INFO <VID:52>
                    <A[64] COMMANDID>
                    <U2[1] PRIORITY>
                    <U2[1] REPLACE>
                <L, 3                   * TRANSFER INFO <VID:53>
                    <A[64] CARRIERID>
                    <A[64] SOURCEPORT>
                    <A[64] DESTPORT>
                <A[64] CARRIERLOC>      * <VID:106>
                <U2[1] RESULTCODE>      * <VID:201>
```

CEID	Event Name
3102	Transfer Completed

3.5.23. S6F11-Event Report Send (Vehicle 1/2)

Stream	Function	Description	Wait bit	Direction
6	11	The equipment send event	True	H<-E

```
< L, 3
    < U2 [1] DATAID>    * Data ID
    < U2 [1] CEID>      * Collection Event ID
    < L, 1
        < L, 2
            <U2 RPTID> * Report ID=6
            <L, 3
                <A[64] COMMANDID>       * <VID:107>
                <A[64] TRANSFERPORT>    * <VID:115>
                <L, 3                   * <VID:50>
                    <A[64] CARRIERID>
                    <A[64] VEHICLEID>
                    <A[64] CARRIERLOC>
```

CEID	Event Name	
4101	Vehicle Arrived	: TransferPort [SOURCEPORT]
4102	Vehicle Acquire Started	: TransferPort [SOURCEPORT]
4103	Vehicle Acquire Completed	: TransferPort [SOURCEPORT]
4104	Vehicle Departed	: TransferPort [SOURCEPORT]
4105	Vehicle Deposit Started	: TransferPort [DESTPORT]
4106	Vehicle Deposit Completed	: TransferPort [DESTPORT]

3.5.24. S6F11-Event Report Send (Vehicle 2/2)

Stream	Function	Description	Wait bit	Direction
6	11	The equipment send event	True	H<-E

```
< L, 3
      < U2 [1] DATAID>    * Data ID
      < U2 [1] CEID>       * Collection Event ID
      < L, 1
            < L, 2
                  <U2 RPTID> * Report ID=7
                  <L, 2
                        <A[64] COMMANDID>          * <VID:107>
                        <A[64] VEHICLEID>          * <VID:116>
```

CEID	Event Name
4203	Vehicle Assigned
4204	Vehicle Unassigned

3.5.25. S6F11-Event Report Send (Carrier)

Stream	Function	Description	Wait bit	Direction
6	11	The equipment send event	True	H<-E

```
< L, 3
      < U2 [1] DATAID>    * Data ID
      < U2 [1] CEID>       * Collection Event ID
      < L, 1
            < L, 2
                  <U2 RPTID> * Report ID=8
                  <L, 1
                      <L, 3                        * CARRIER INFO1 <VID:50>
                          <A[64] CARRIERID>
                          <A[64] VEHICLEID>
                          <A[64] CARRIERLOC>
```

CEID	Event Name
5101	Carrier Installed – CarrierLoc : Vehicle or STB ID
5102	Carrier Removed – CarrierLoc : Vehicle or STB ID

3.5.26. S6F11-Event Report Send(Operator Action)

Stream	Function	Description	Wait bit	Direction
6	11	The equipment send event	True	H<-E

```
< L, 3
    < U2 [1] DATAID>    * Data ID
    < U2 [1] CEID> * Collection Event ID
    < L, 1
        < L, 2
            <U2 RPTID> * Report ID=9
            <L, 1
                <L, 3
                    <L, 3                       * COMMAND INFO <VID:52>
                        <A[64] COMMANDID>
                        <U2[1] PRIORITY>
                        <U2[1] REPLACE>
                    <L, 3                       * TRANSFER INFO <VID:53>
                        <A[64] CARRIERID>
                        <A[64] SOURCEPORT>
                        <A[64] DESTPORT>
                    <A[20] COMMANDTYPE>    * TRANSFER, CANCEL, ABORT
```

CEID	Event Name
6101	Operator init action

3.5.27. S6F11-Event Report Send (Unit Alarm)

Stream	Function	Description	Wait bit	Direction
6	11	The equipment send event	True	H<-E

```
< L, 3
      < U2 [1] DATAID>    * Data ID
      < U2 [1] CEID>       * Collection Event ID
      <L, 1
            < L, 2
                  <U2 RPTID> * Report ID =11
                  <L, 2
                        <L, 3                          * Unit Alarm Info    <VID:56>
                              <A[64]    VEHICLEID>
                              <U4[1]    ALARMID>
                              <A[128] ALARMTEXT>
                        <A[64]    VEHICLELOCATION>    * VID:118
```

CEID	Event Name
1303	Unit Alarm Set
1304	Unit Alarm Cleared

3.5.28. S6F11-Event Report Send (Port Info Change - STB)

Stream	Function	Description	Wait bit	Direction
6	11	The equipment send event	True	H<-E

```
< L, 3
    < U2 [1] DATAID>    * Data ID
    < U2 [1] CEID>      * Collection Event ID
    <L, 1
        < L, 2
            <U2 RPTID> * Report ID =12
            <L, 1
                <L, 3
                    <A[64] PORTID>            * <VID:108>
                    <U2[1] PORT STATE>        * <VID:109>
                    <U2[1] PORT STATUS>       * <VID:110>
```

CEID	Event Name
5201	Port Info Change

~~3.5.29. S6F11-Event Report Send (ZoneCapacity Change) *~~

~~Stream~~	~~Function~~	~~Description~~	~~Wait bit~~	~~Direction~~
~~6~~	~~11~~	~~The equipment send event~~	~~True~~	~~H<- E~~

```
~~< L, 3~~
~~    < U2 [1] DATAID>    * Data ID~~
~~    < U2 [1] CEID>      * Collection Event ID~~
~~    <L, 1~~
~~        < L, 2~~
~~            <U2 RPTID> * Report ID =12~~
~~            <L, 1~~
~~                <L, 3     * <VID:58>~~
~~                    <A[64]   ZONENAME>~~
~~                    <U2[1]   MAXCAPACITY>~~
~~                    <U2[1]   ZONECAPACITY>~~
```

~~CEID~~	~~Event Name~~
~~7101~~	~~ZoneCapacity Change~~

3.5.30. S6F11- Event Report Send (Vehicle Operation Summary) *

Stream	Function	Description	Wait bit	Direction
6	11	The equipment send event	True	H<-E

```
< L, 3
     < U2 [1] DATAID>    * Data ID
     < U2 [1] CEID>       * Collection Event ID
     <L, 1
          < L, 2
               <U2 RPTID> * Report ID =13
               <L, 2
                    <A[12]    REPORTTIME>
                    <L, n
                         <L, 4
                              <A[64]    VEHICLEID>
                              <U2[1]    TRANSFERCOUNT>
                              <U2[1]    TRAVELDISTANCE>
                              <U4[1]    TRAVELTIME>
```

CEID	Event Name
8101	Vehicle Operation Summary

```
[S6F11 CEID 8101 - Sample Format]

07-25 13:56:49.912 1    INFO    D0 RPT13:S6F11 W [0]
                         <L 3
                              <U2 [1] DATAID '0'>
                              <U2 [1] CEID '8101'>
                              <L 1 RPTIDCOUNT
                                   <L 2
                                        <U2 [1] RPTID '13'>
                                        <L 2 VCOUNT
                                             <A [8V] REPORTTIME '20250725'>
                                             <L 2 VEHICLE_COUNT
                                                  <L 4 DATA
                                                       <A [5V] VEHICLEID 'VEH01'>
                                                       <U2 [1] TRANSFERCOUNT '100'>
                                                       <U2 [1] TRAVELDISTANCE '1000'>
                                                       <U4 [1] TRAVELTIME '10000'>
                                                  <L 4 DATA
                                                       <A [5V] VEHICLEID 'VEH02'>
                                                       <U2 [1] TRANSFERCOUNT '102'>
                                                       <U2 [1] TRAVELDISTANCE '1200'>
                                                       <U4 [1] TRAVELTIME '12000'>
```

3.5.30. S6F12-Event Report Acknowledge

Stream	Function	Description	Wait bit	Direction
6	12	Acknowledge or error.	False	H->E

<B1 ACKC6>.

3.5.31. S9F1/3/5/7/9-Transaction Error

Stream	Function	Description	Wait bit	Direction
9	1	Unrecognized Device ID	True	H<-E
< MHEAD B[10]>				

Stream	Function	Description	Wait bit	Direction
9	3	Unrecognized Stream Type	True	H<-E
< MHEAD B[10]>				

Stream	Function	Description	Wait bit	Direction
9	5	Unrecognized Function Type	True	H<-E
< MHEAD B[10]>				

Stream	Function	Description	Wait bit	Direction
9	7	Illegal Data	True	H<-E
< MHEAD B[10]>				

Stream	Function	Description	Wait bit	Direction
9	9	Transaction Timer Timeout	True	H<-E
< MHEAD B[10]>				

3.5.32. S10F3-Terminal Display (Single)

Stream	Function	Description	Wait bit	Direction
10	3	Terminal Display, Single	True	H<-E
< L, 2 < B [1] TID> * Terminal Id < A[1024] TEXT> * Terminal Text				

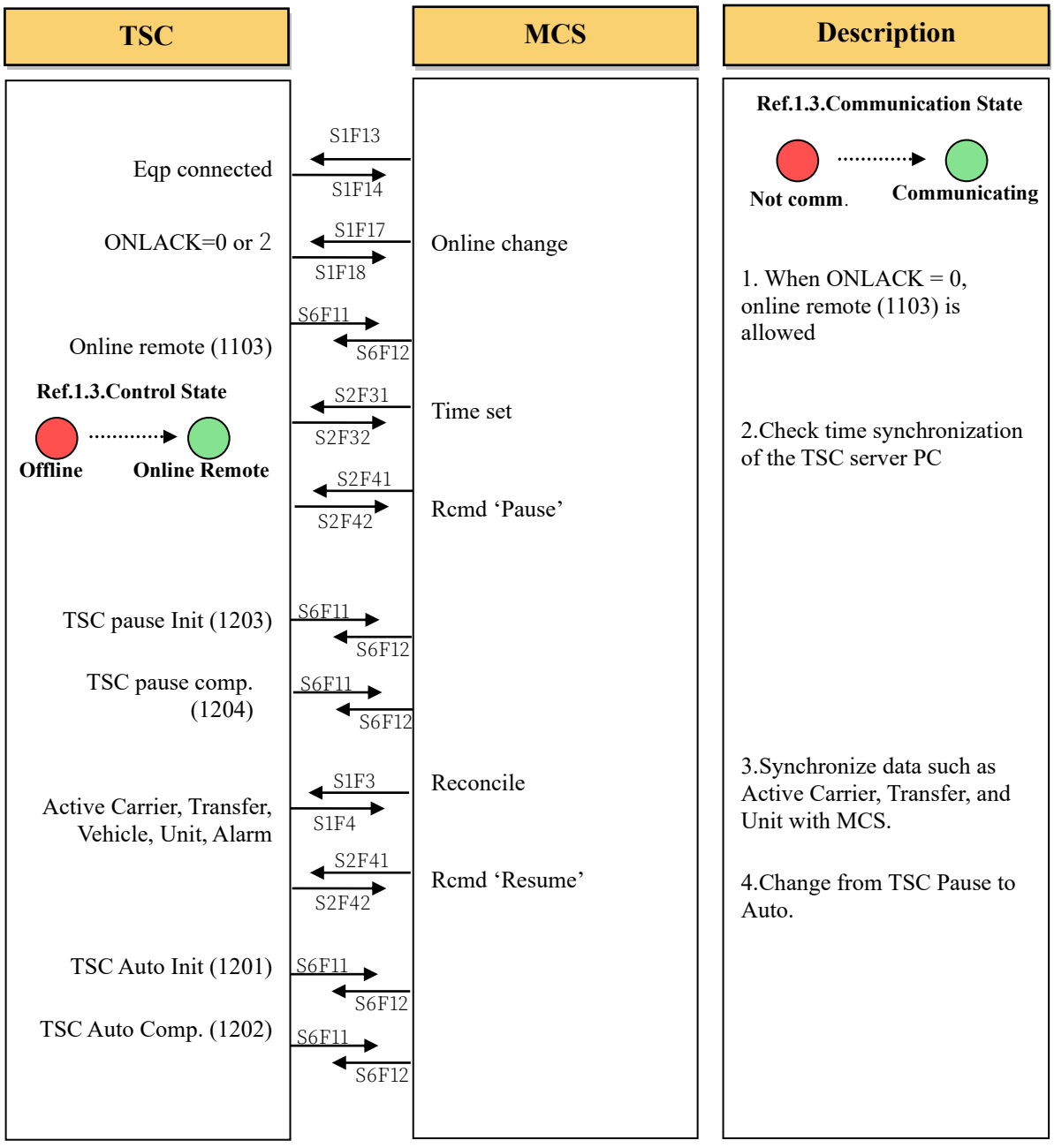
Stream	Function	Description	Wait bit	Direction
10	4	Acknowledge or error.	False	H->E
< B [1] ACKC10>				

4. Scenario

4.1. Initialize

4.1.1.Initialize On Connect

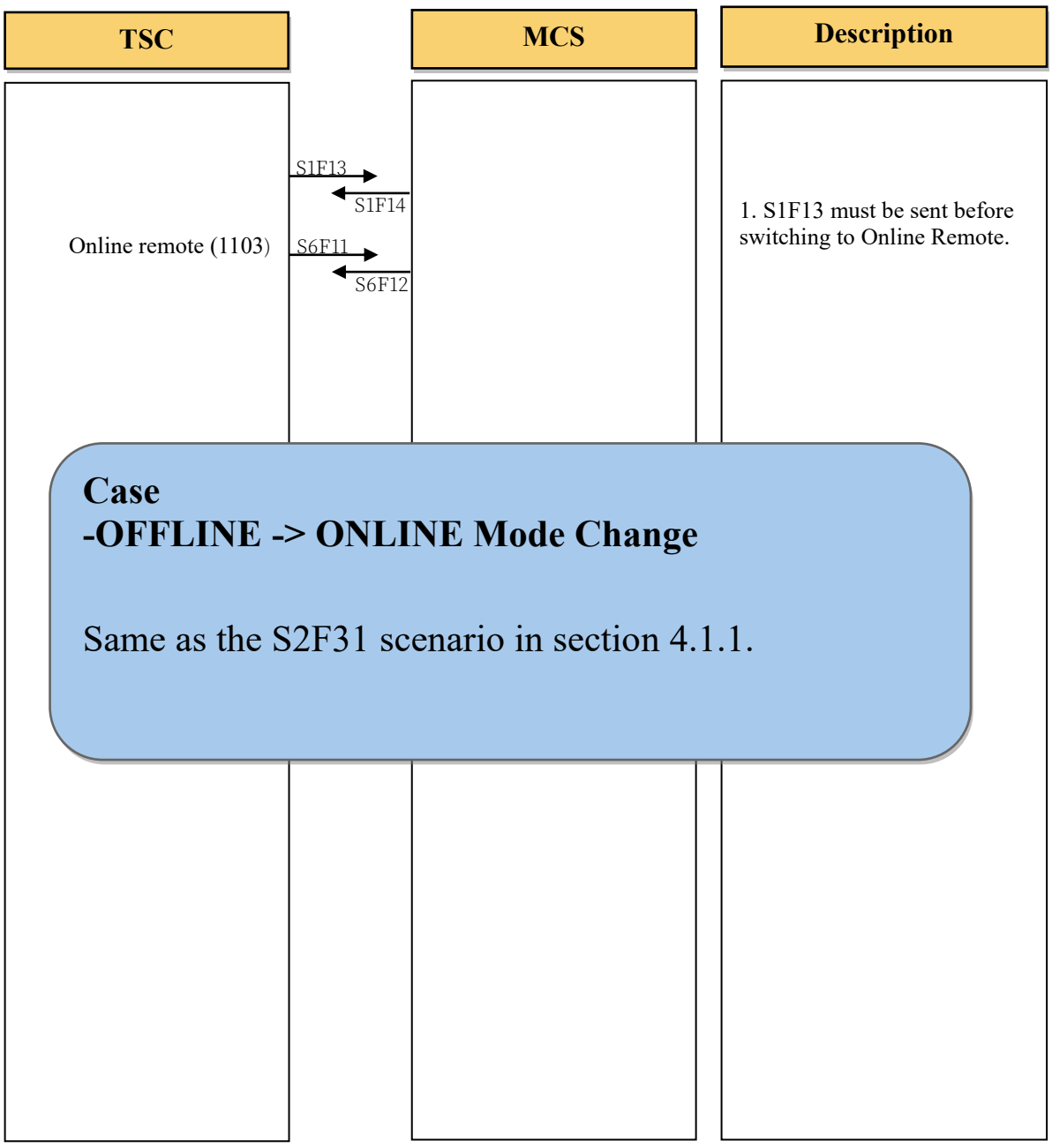
The **TSC Initialization Scenario** describes the sequence of events that occur when the **TSC** establishes communication with the host and transitions into automatic operation mode.



4.2. Mode Change

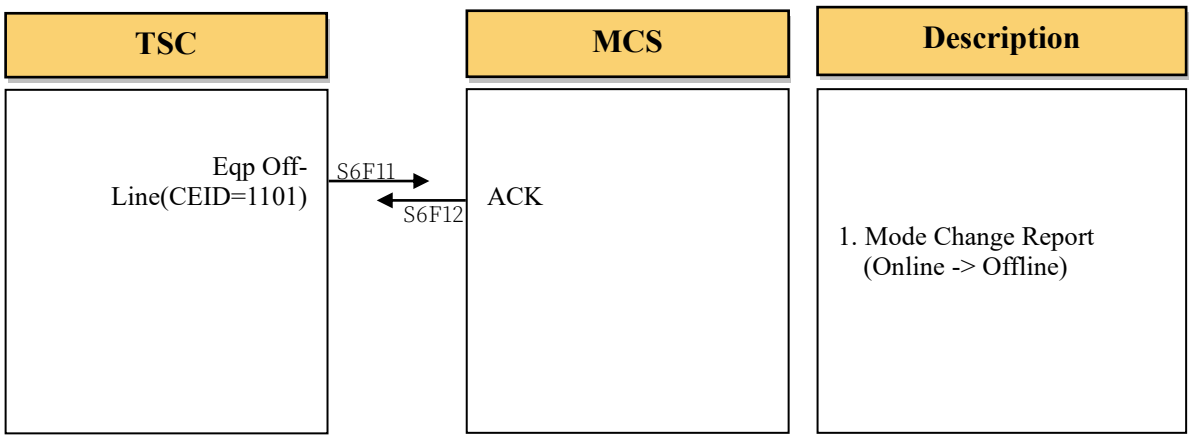
4.2.1.Initialize By TSC Offline -> Remote

The "Initialize by TSC" scenario describes the process in which the Transport Controller (TSC) transitions itself from Offline to Online Remote mode.



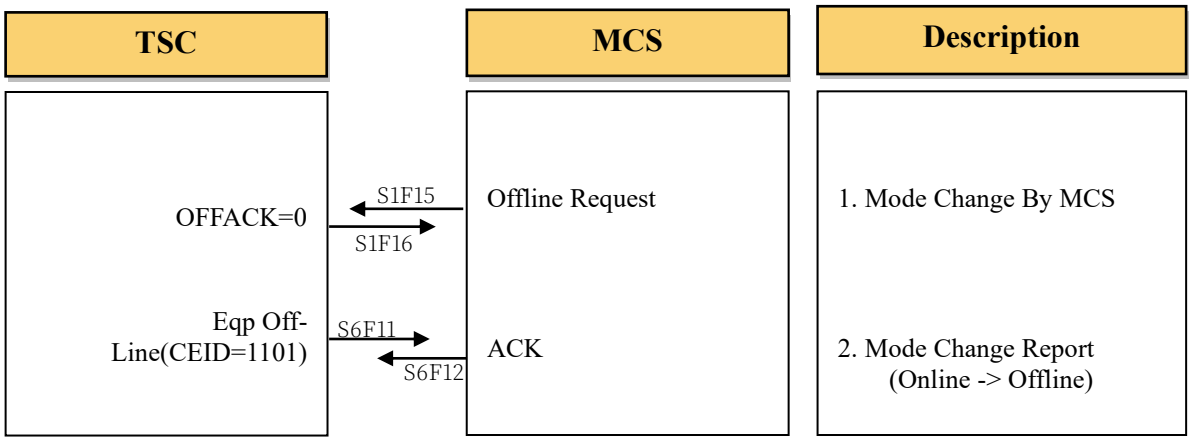
4.2.2.On-Line -> Off-Line(By TSC)

The TSC-Initiated Offline Scenario describes the process where the Transport Controller (TSC) transitions from Online Remote to Offline mode under its own control (not by the host).



4.2.3.On-Line -> Off-Line(By MCS)

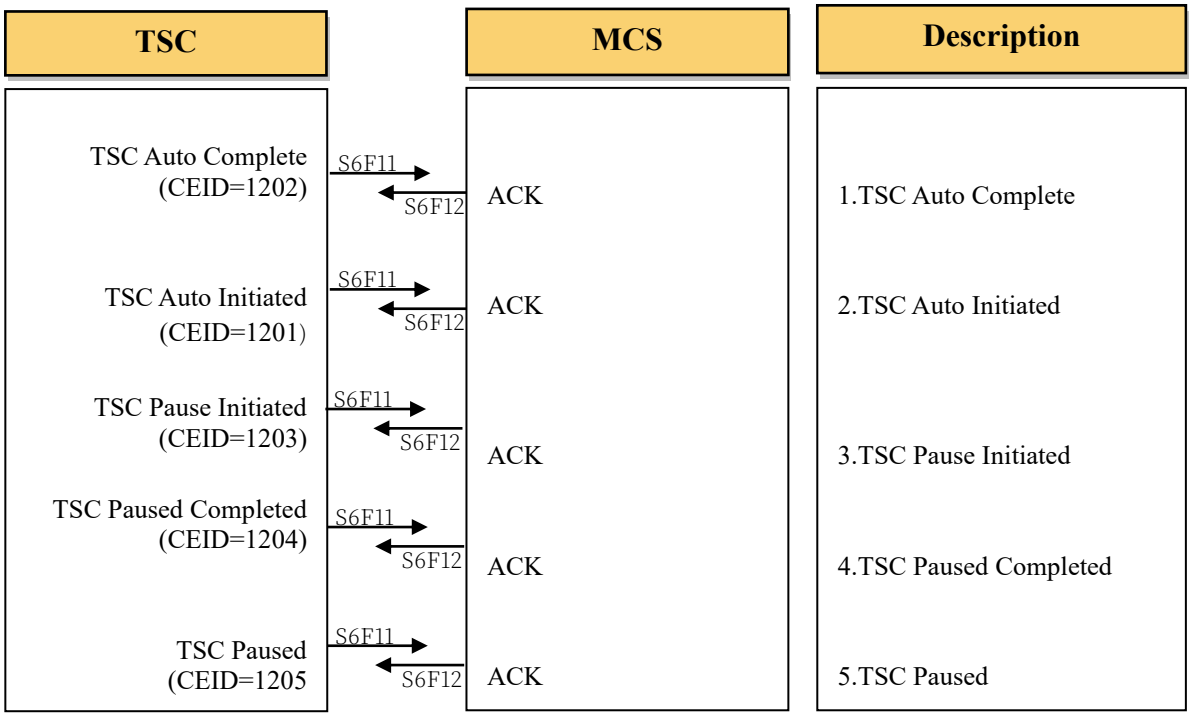
The MCS-Initiated Offline Scenario describes the process where the Material Control System (MCS) commands the Transport Controller (TSC) to transition from Online Remote to Offline mode.



4.3. TSC State Change Report

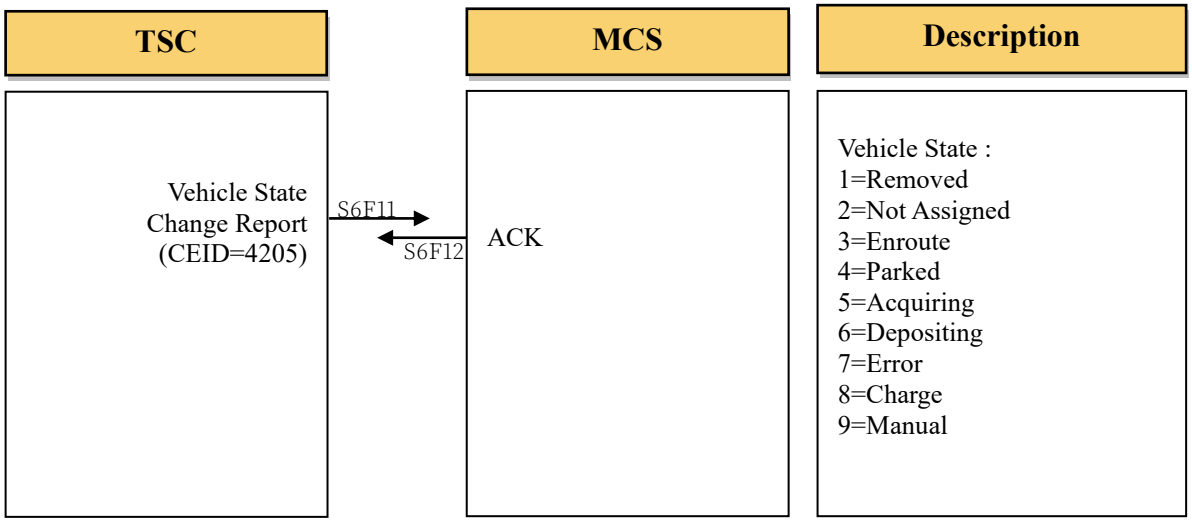
4.3.1.TSC State Change Report

The TSC (Transport System Controller) State Model defines the operational states and transitions that govern the automated material handling system. As the TSC changes its operational mode—such as entering pause mode, resuming auto mode, or completing transitions—it reports specific events to the host.



4.3.2.Vehicle State Change Report

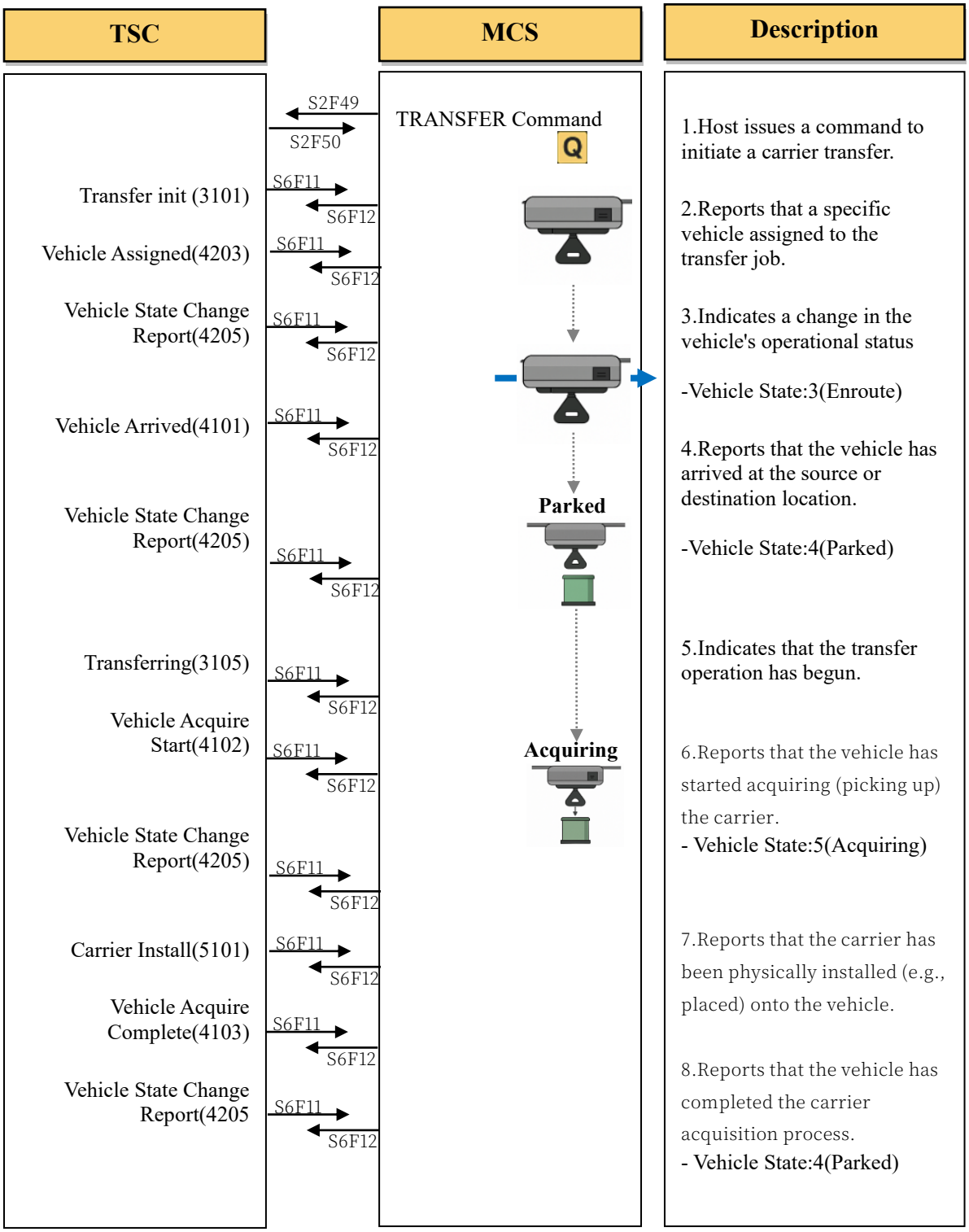
The Vehicle State Change Report (CEID=4205) is an event sent by the Transport Controller (TSC) to notify the host whenever a vehicle's operational state changes. This ensures that the host system remains synchronized with the real-time status of each vehicle in the transport system.



4.4. Transfer Operation

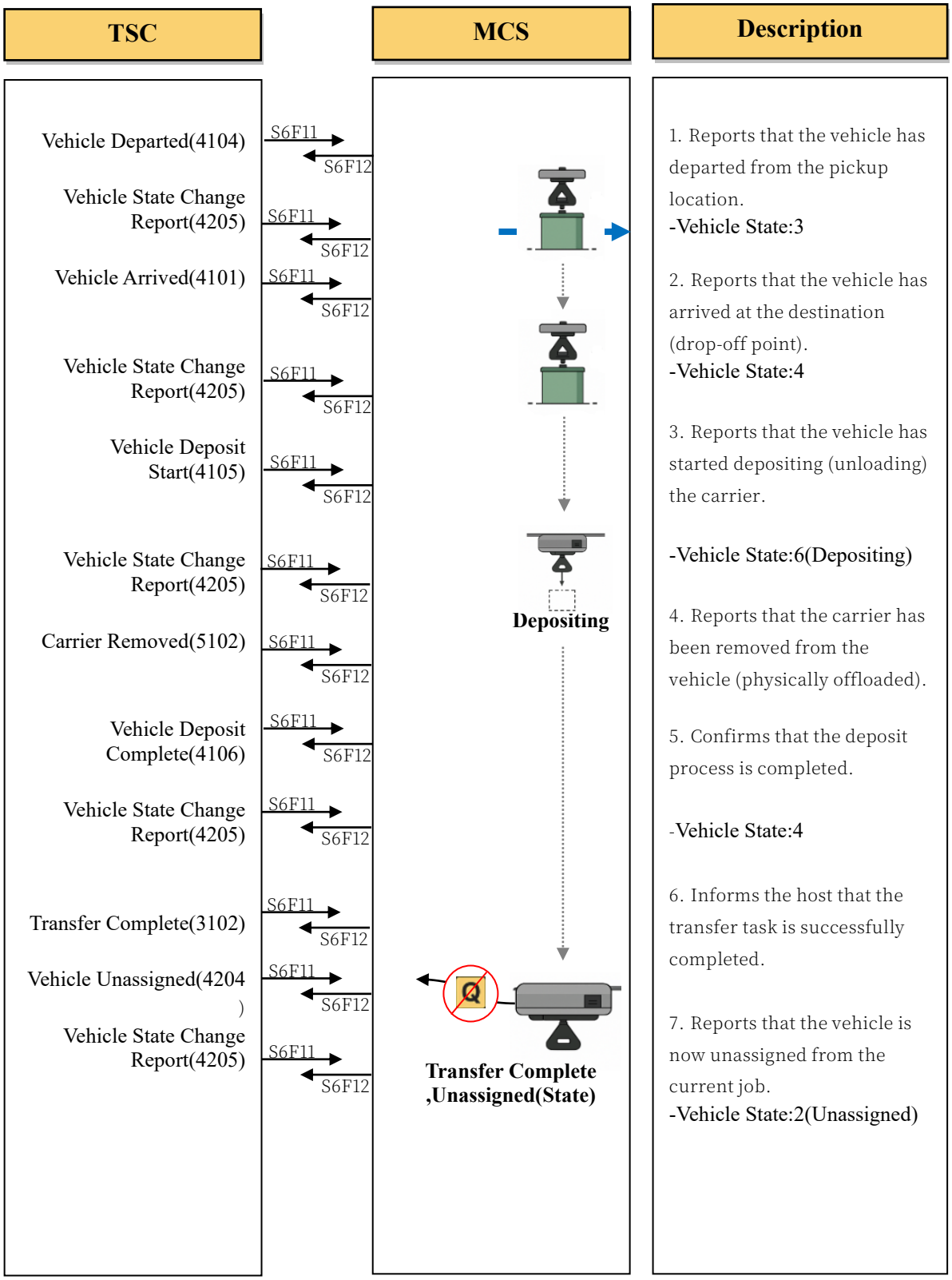
4.4.1. Normal Scenario(If the destination is not STB – 1/2)

This is an Aquiring Scenario, representing the sequence of events that occur when an automated transport vehicle (such as an OHT or AGV) is instructed to acquire (pick up) a carrier from a designated location.



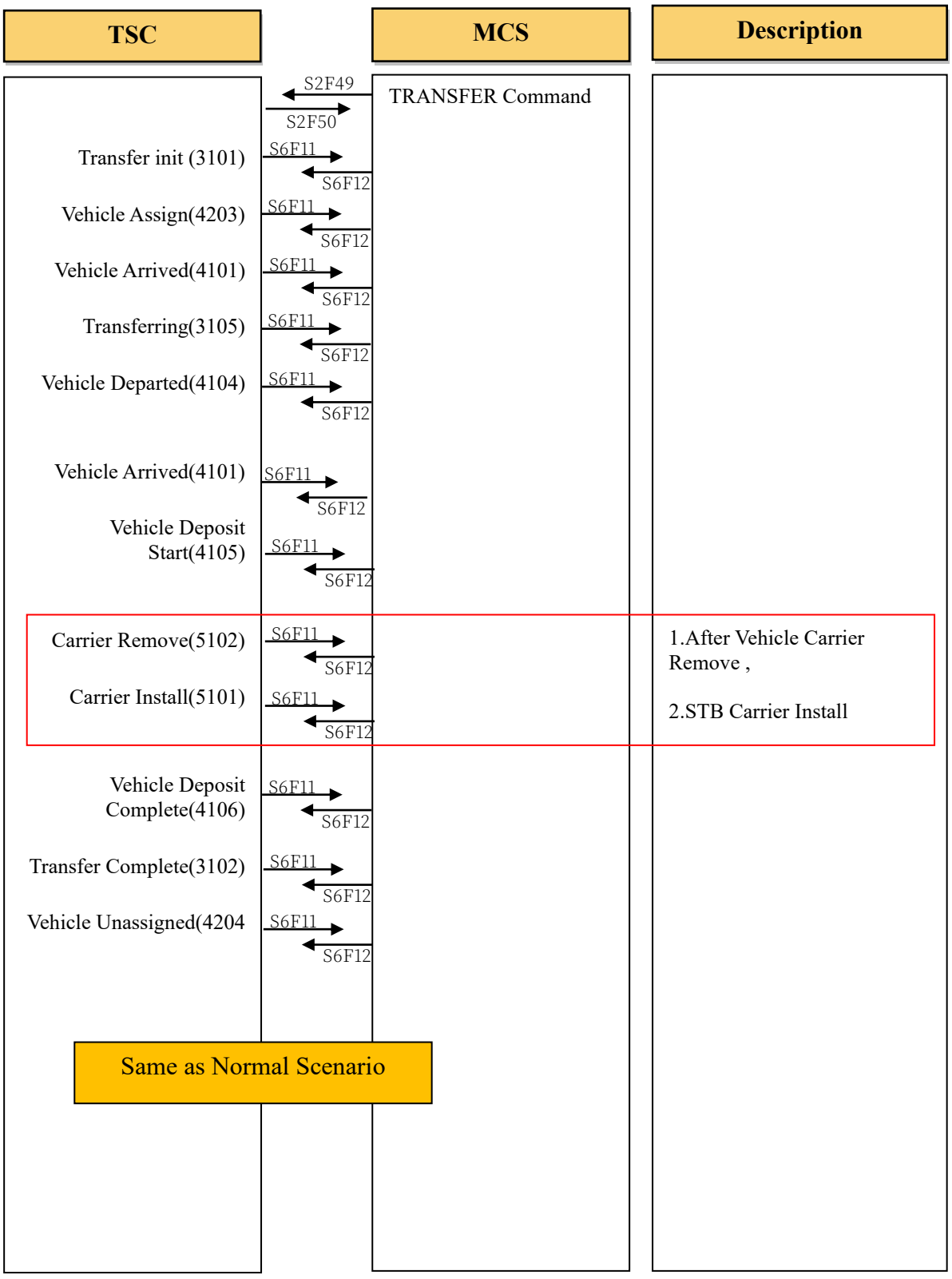
4.4.2. Normal Scenario(If the destination is not STB – 2/2)

The Depositing Scenario represents the process in which an automated vehicle (such as an OHT or AGV) delivers and unloads a carrier at the designated destination.



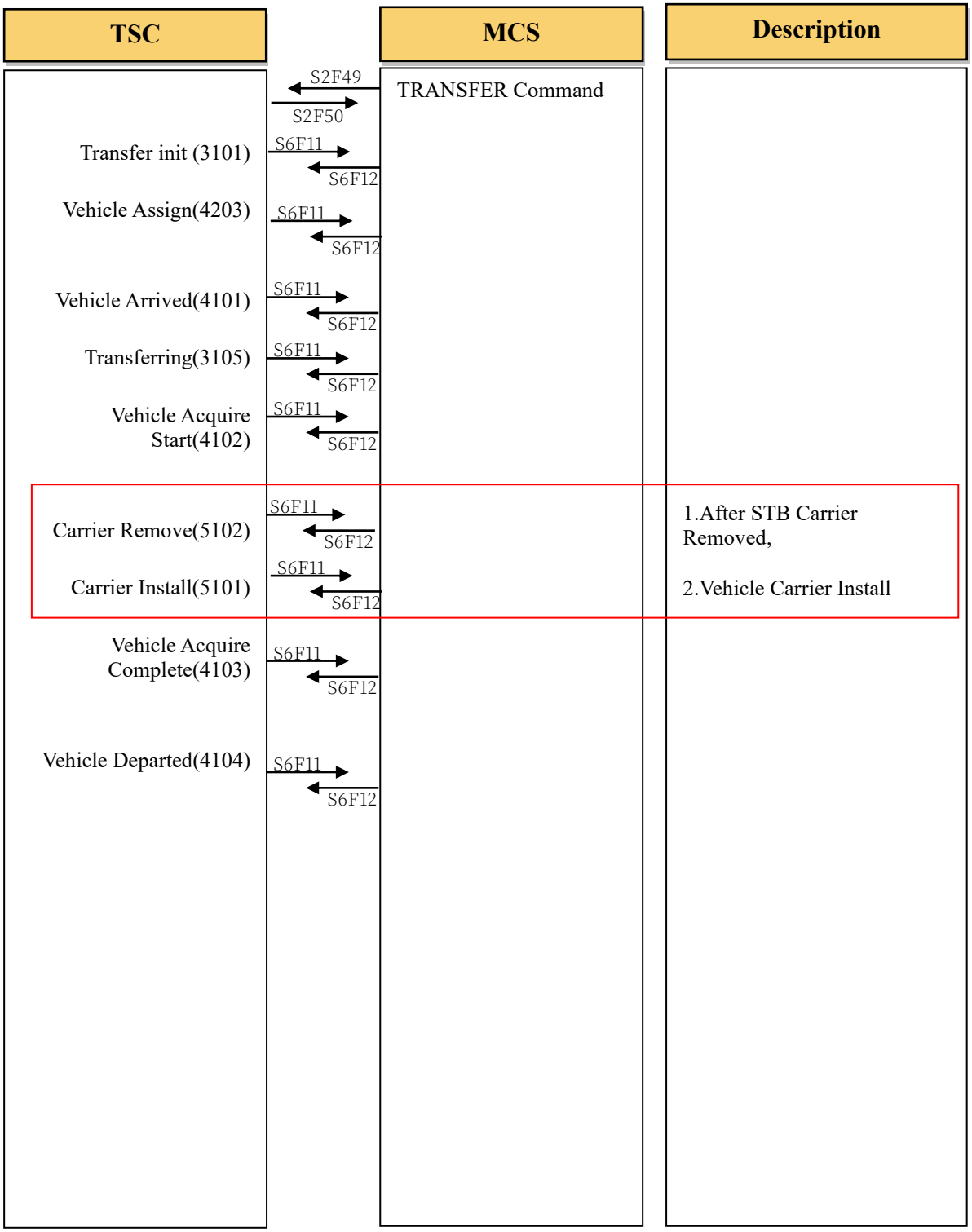
4.4.3. Normal Scenario(If the destination is STB)

This scenario describes the transfer process when the destination is a STB and highlights an important operational rule:
The vehicle must perform the Carrier Remove operation before the Carrier Install at the STB occurs.



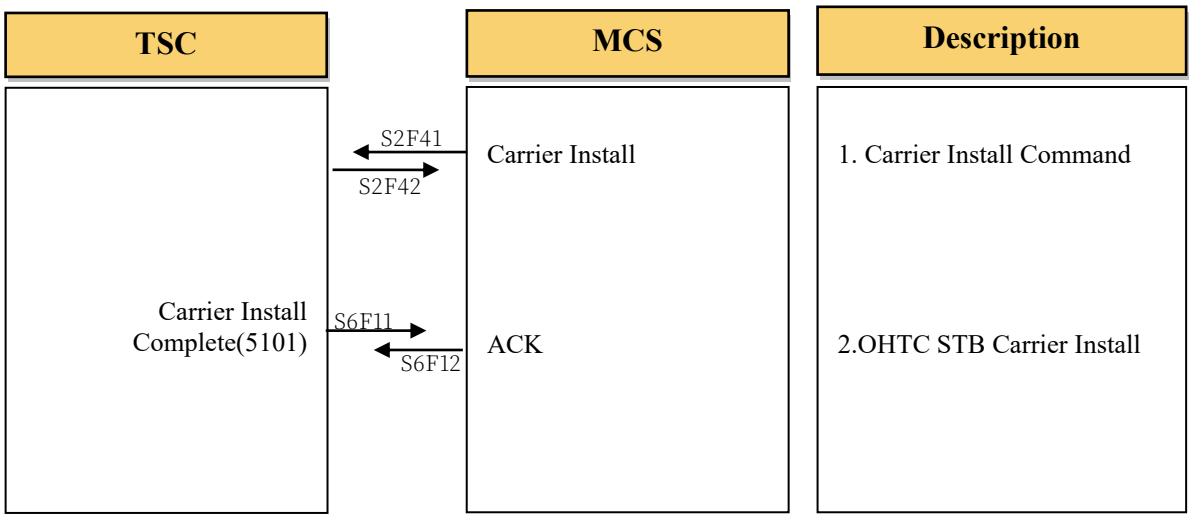
4.4.4. Normal Scenario(If the Source is STB)

This scenario outlines the process of transferring a carrier out of a STB. The key rule is that the Carrier Remove operation from the STB must occur before the vehicle performs the Carrier Install.



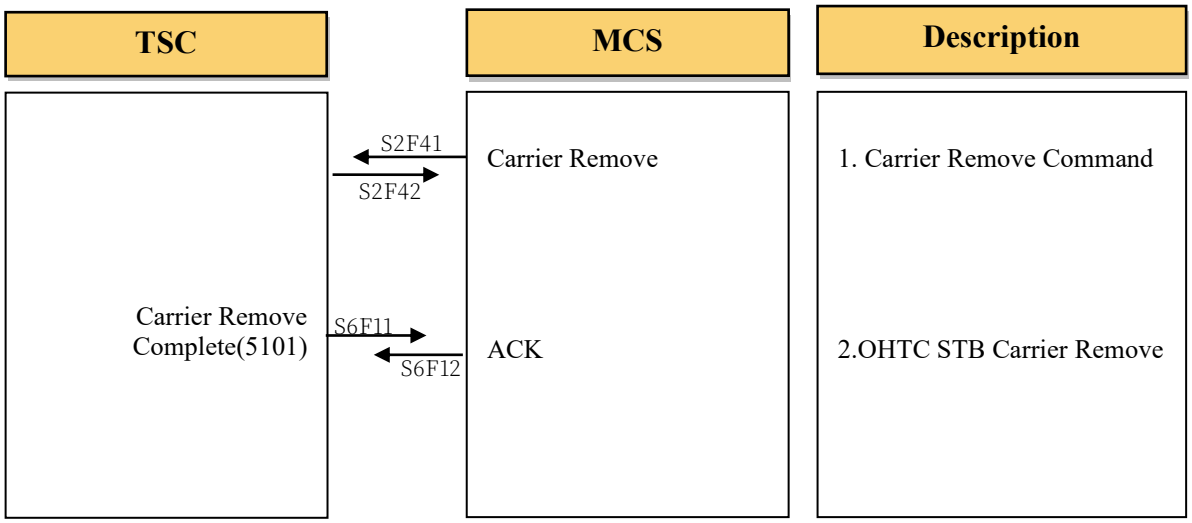
4.4.5. Install Command(Only STB)

The Install Command is a specific instruction sent from the Material Control System (MCS) to the STB to place (install) a carrier into a designated storage location within the STB.



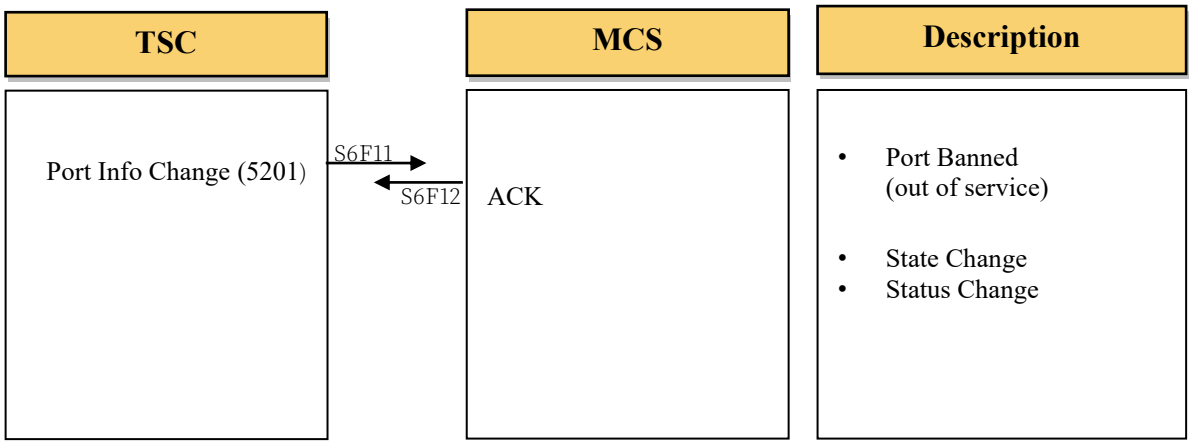
4.4.6. Remove Command(Only STB)

The Remove Command is an instruction from the Material Control System (MCS) to the STB to retrieve (remove) a carrier from a specified location inside the STB.



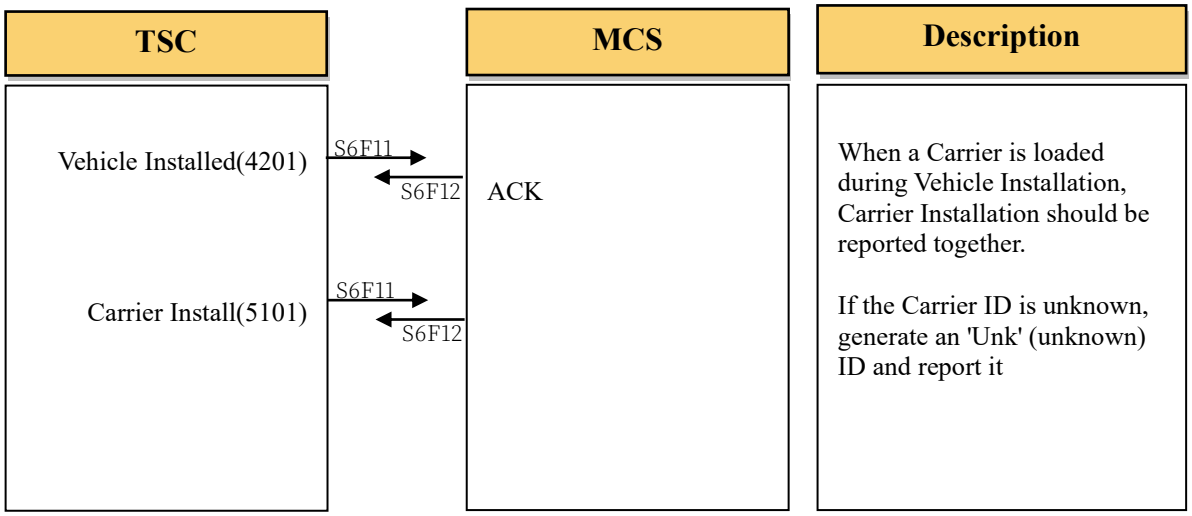
4.4.7. Port Info Change (Only STB)

The Port Info Change event occurs exclusively within the STB system when there is a change in the status or state of a port. This includes changes such as: State change, Status change



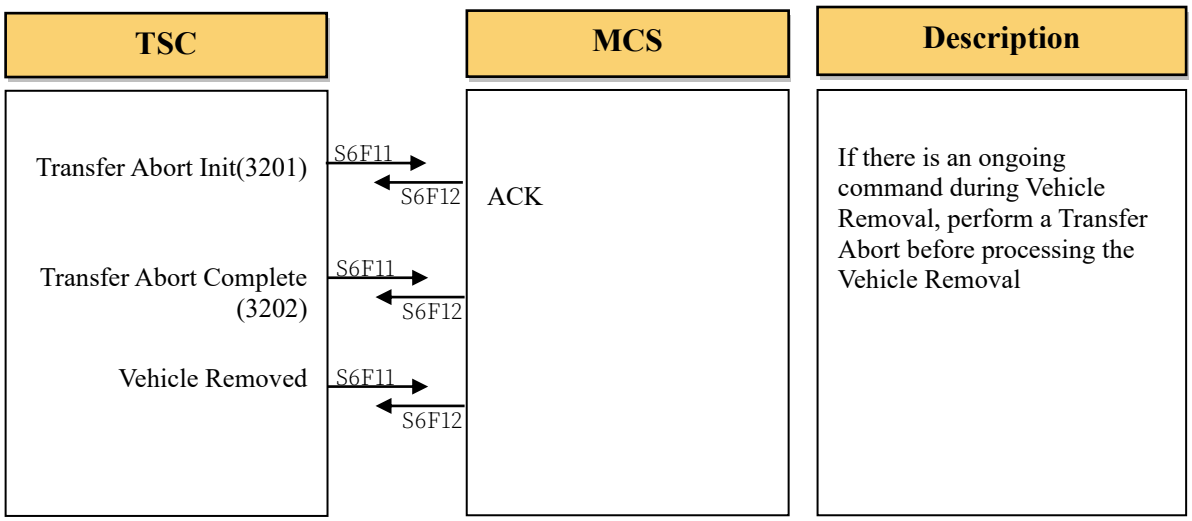
4.4.8. Vehicle Install

The Vehicle Install scenario describes the process when a vehicle is registered within the transport system.



4.4.9. Vehicle Removed

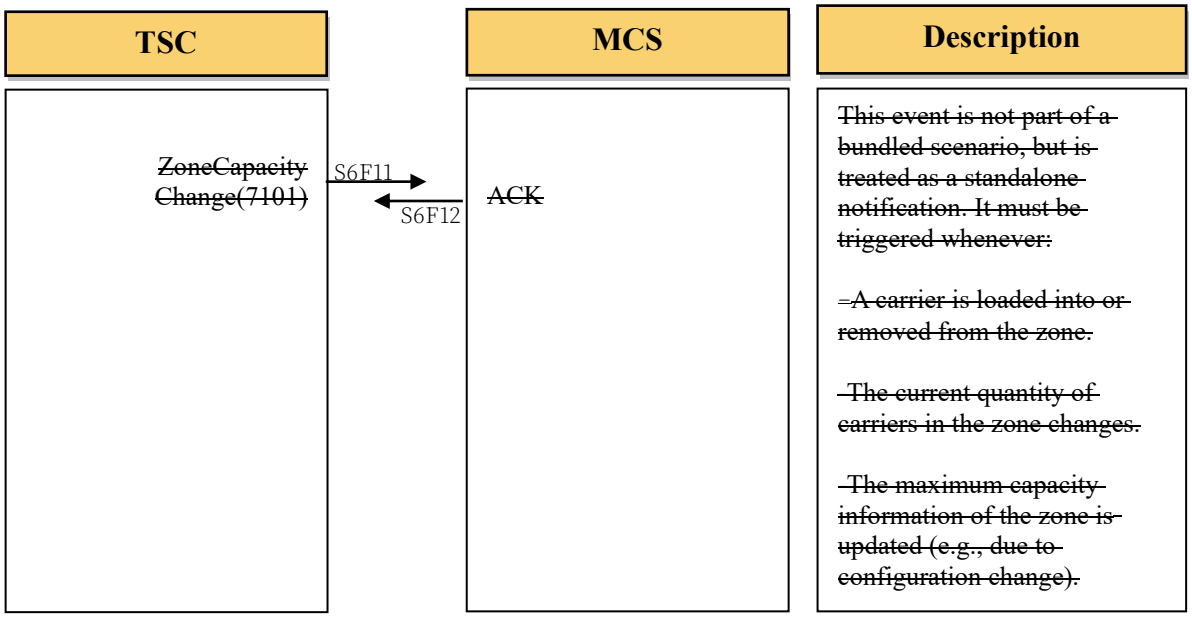
The Vehicle Remove scenario describes the process of r removing it from the system.



~~4.4.10. Zone Capacity Change~~

~~The Zone Capacity Change event occurs when there is any modification to the status or quantity.~~

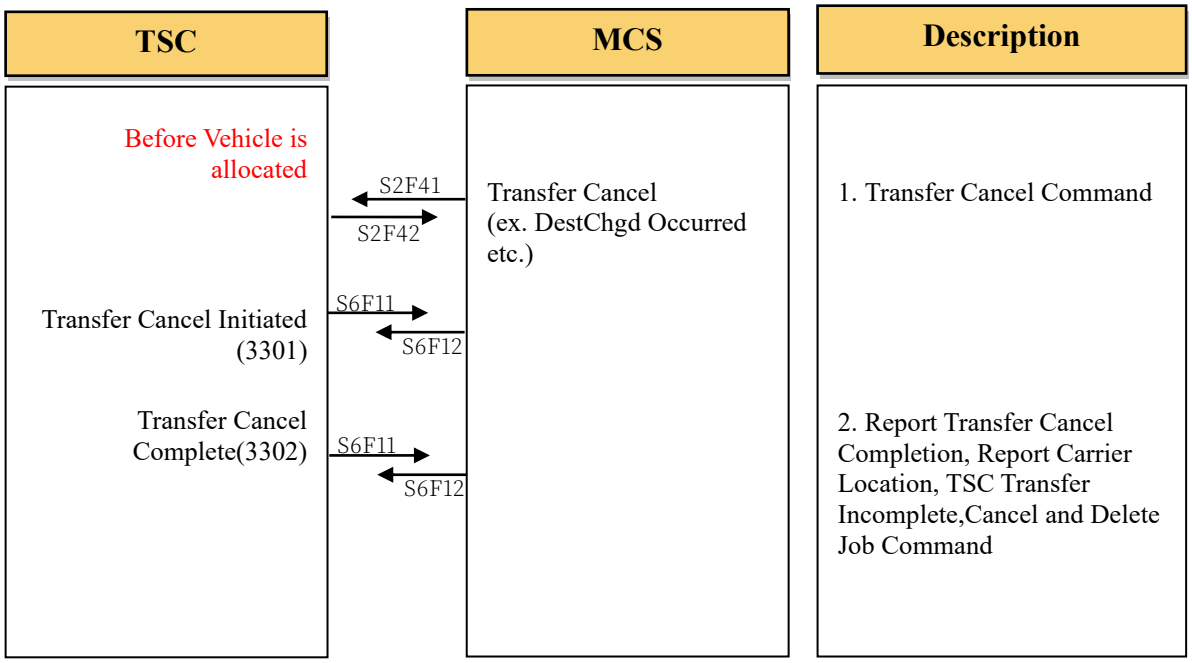
~~This ensures that the system and host always have an accurate, real-time view of zone utilization, which is crucial for managing stocker operations, transfer decisions, and capacity monitoring.~~



4.5. Abnormal Process

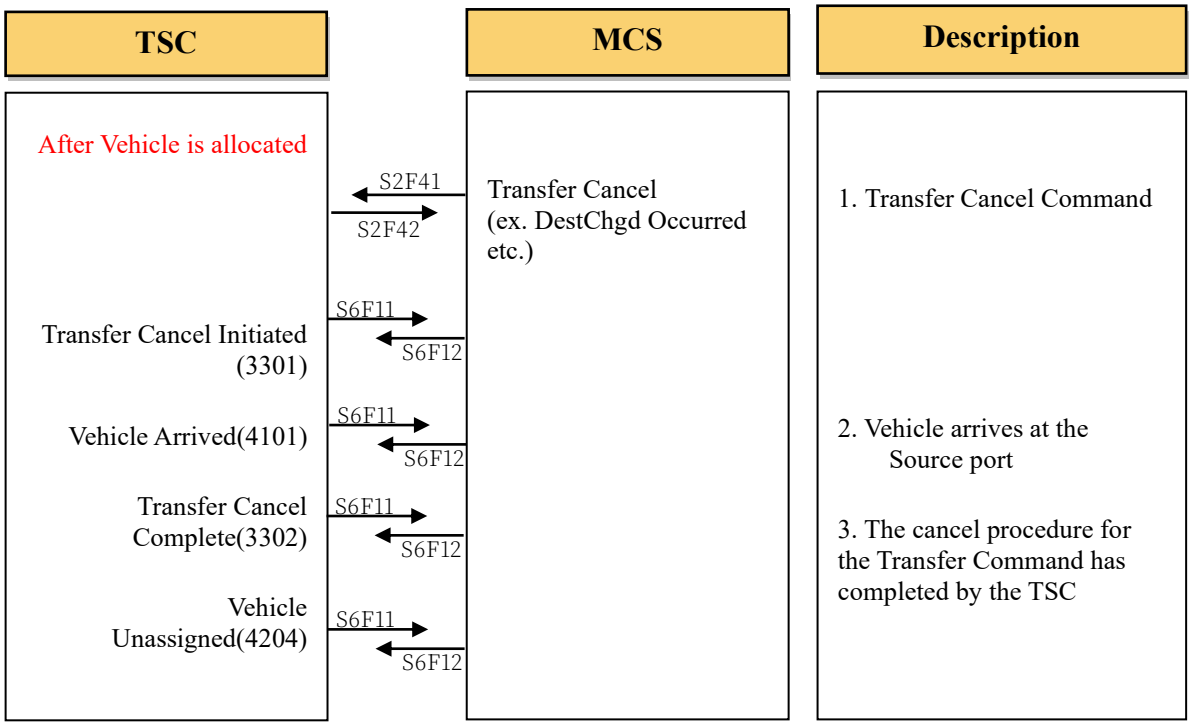
4.5.1.Cancel Command(Case1)

This scenario occurs when a transfer command is cancelled before a vehicle is assigned. Since no execution has begun, the cancellation is immediate and clean.



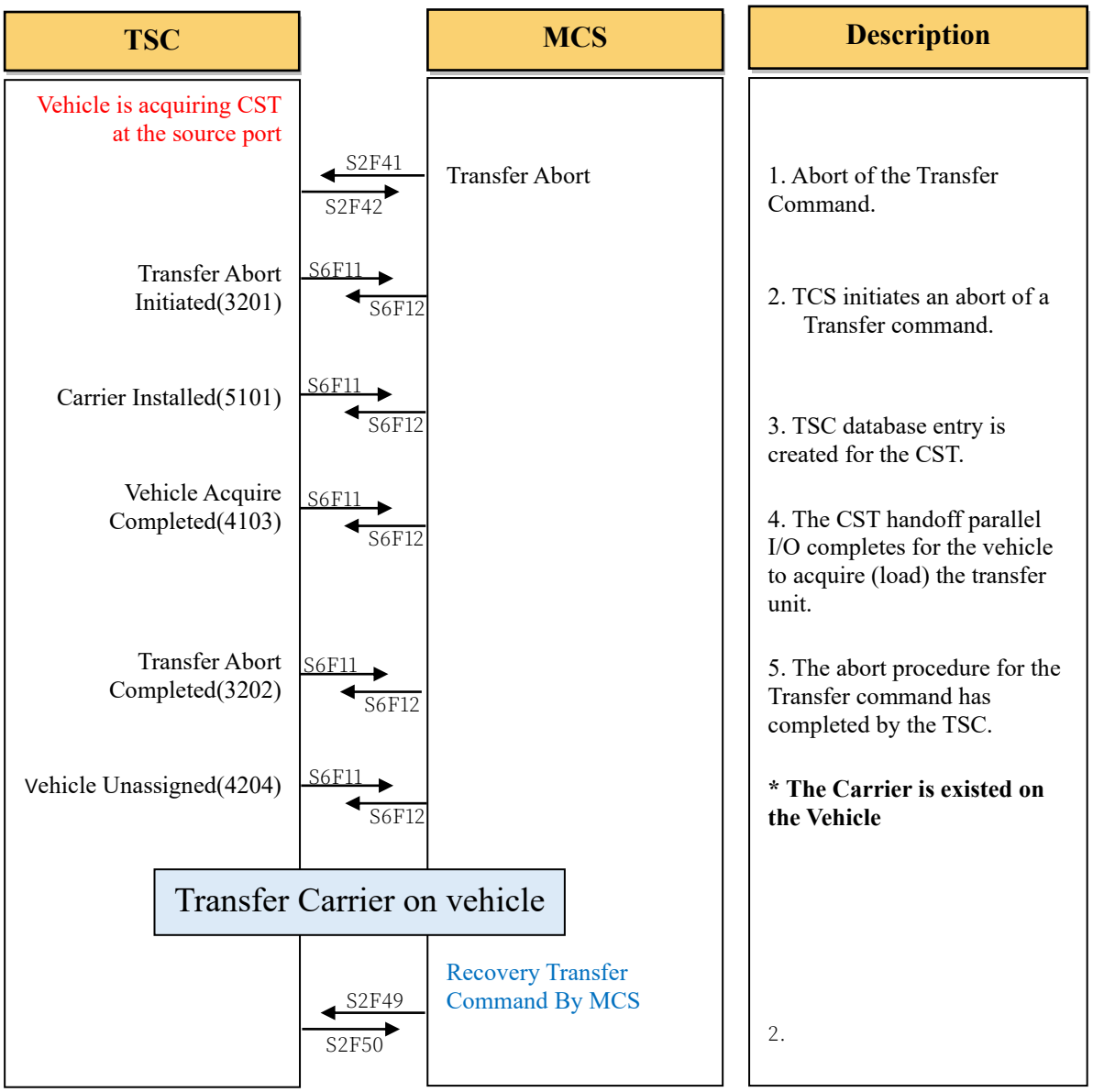
4.5.2.Cancel Command(Case2)

In this case, the vehicle has already been assigned but the command is cancelled before acquiring action (pickup) starts. The vehicle is then unassigned.



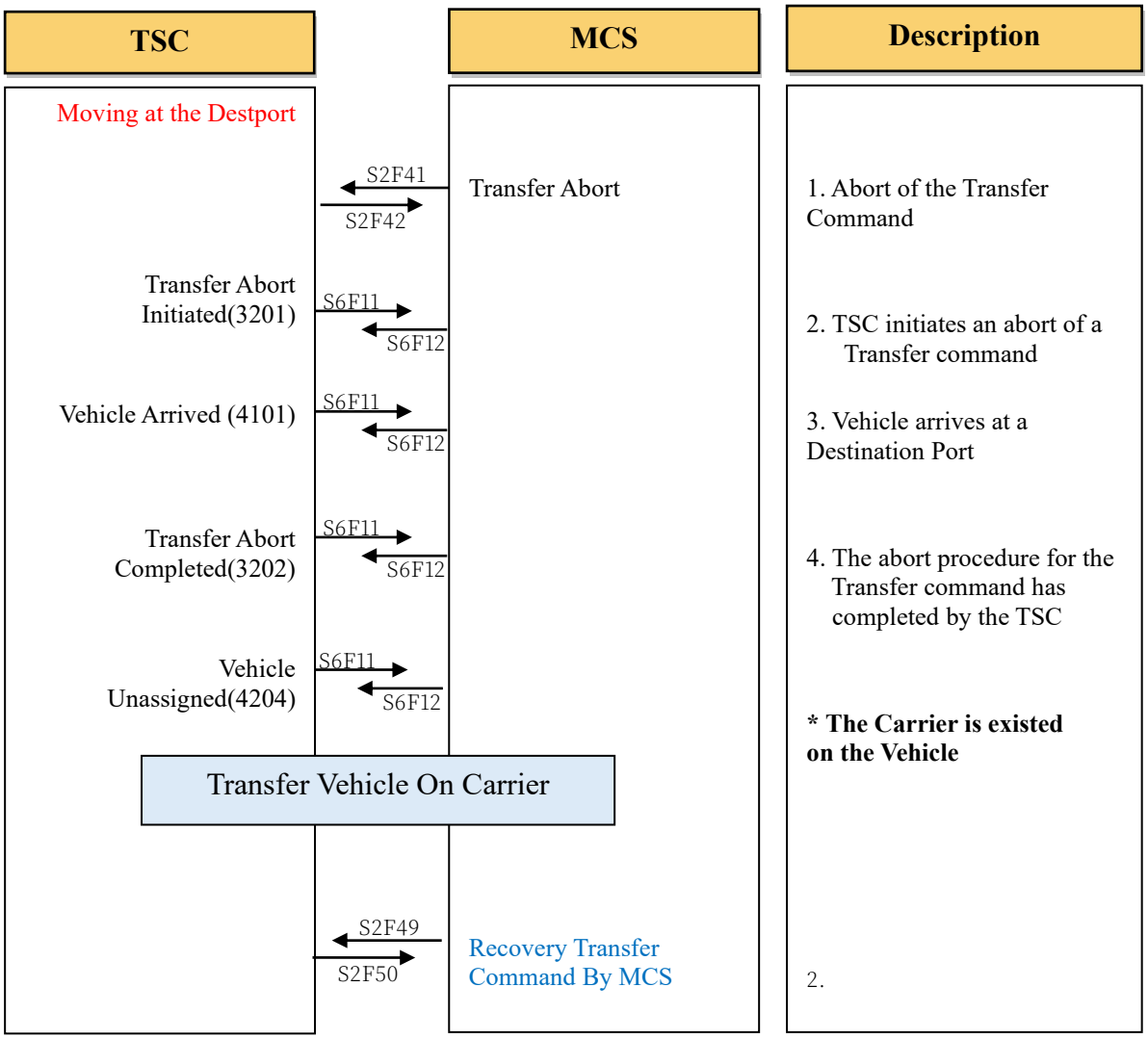
4.5.3. Abort Transfer Command (Case1) – Abort Complete

This abort scenario occurs while the vehicle is acquiring the carrier at the source port. The process is safely halted(after Acquiring process), and the transfer is considered aborted successfully. The system must reset the state and notify MCS.



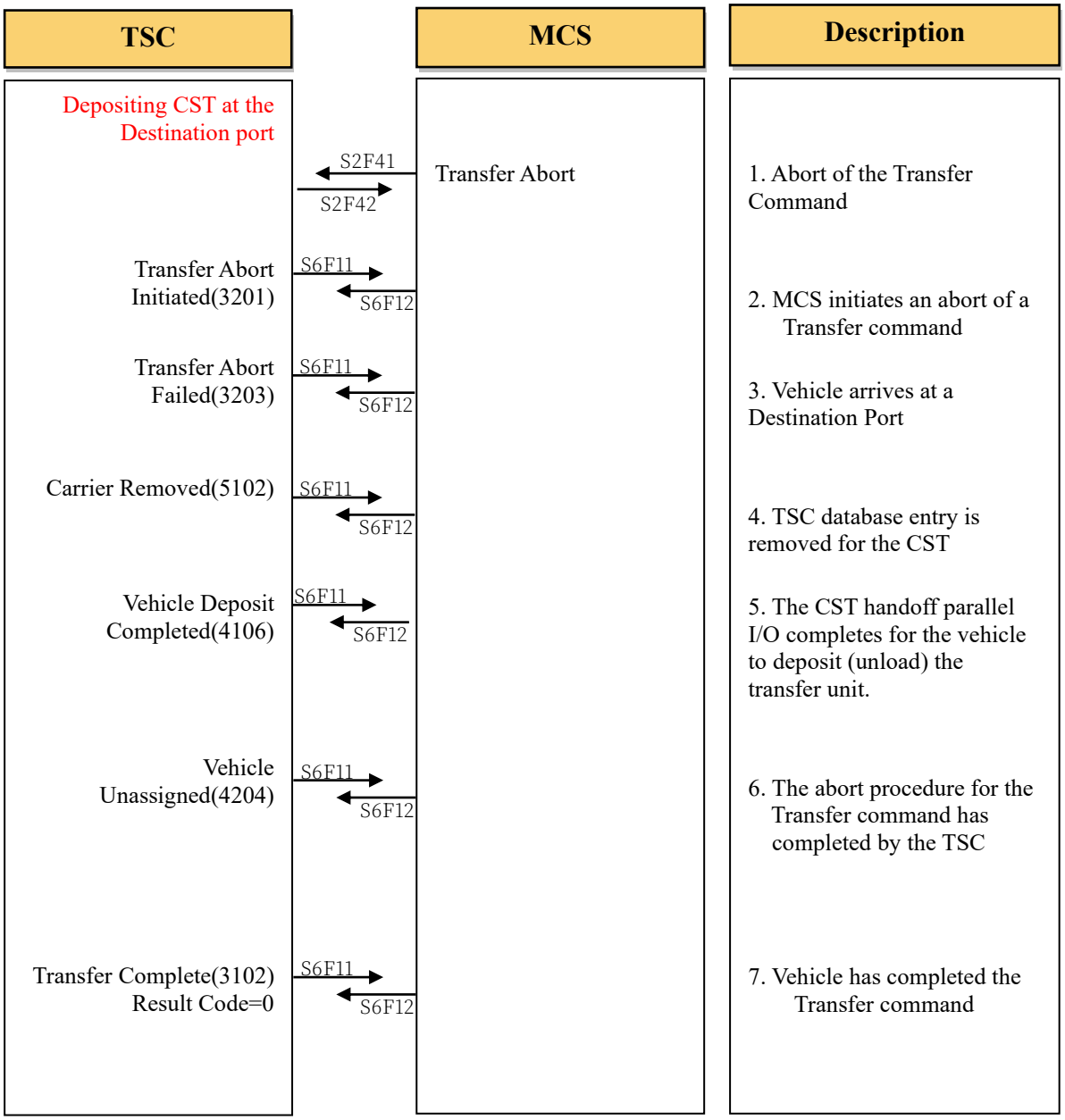
4.5.4. Abort Transfer Command (Case2) – Abort Complete

In this scenario, the vehicle is already en route to the destination port with the carrier, but an abort command is issued. The vehicle safely stops and holds the carrier, completing the abort cleanly.



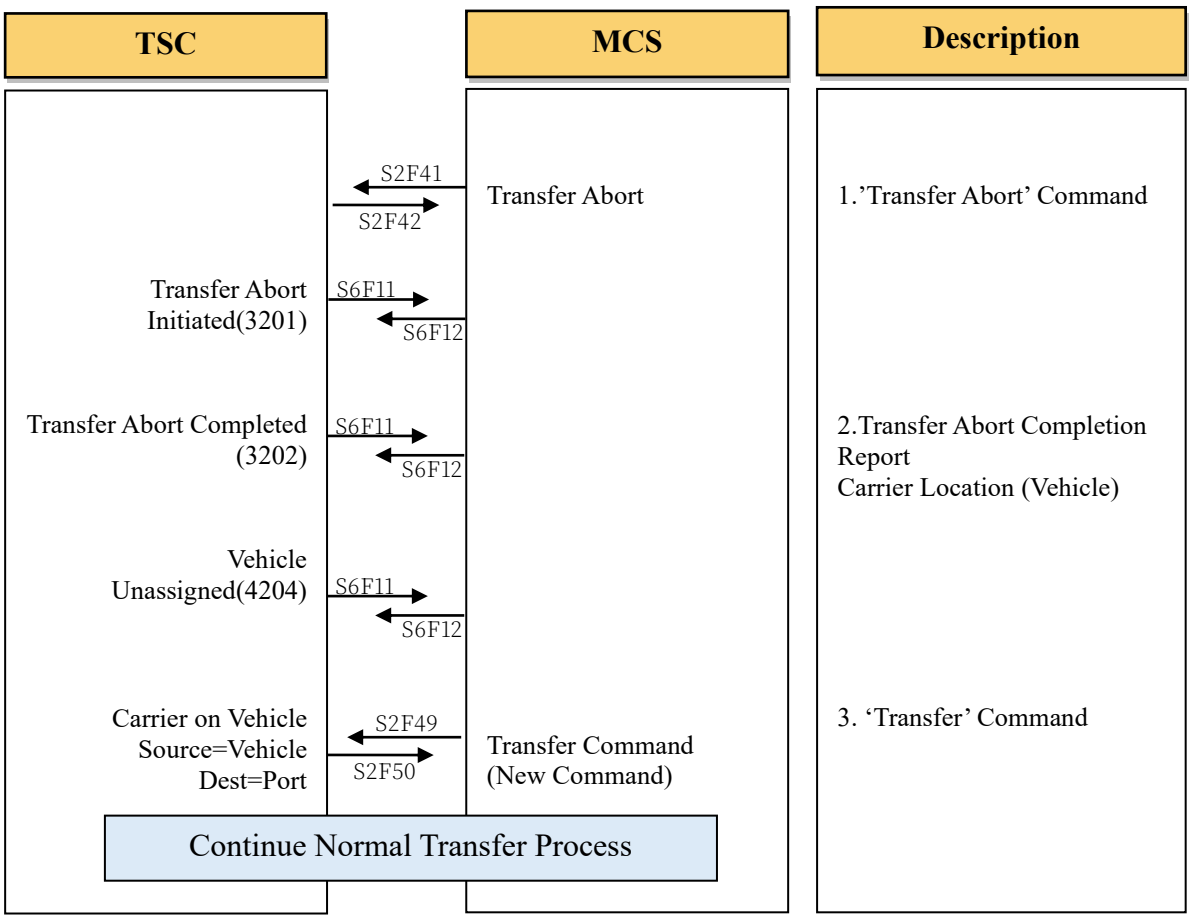
4.5.5. Abort Transfer Command (Case3) – Abort Fail

This scenario represents a failure case, where the abort command is issued during the actual depositing of the carrier. Since the deposit action is already in progress or irreversible, the abort fails, and recovery procedures may be needed.



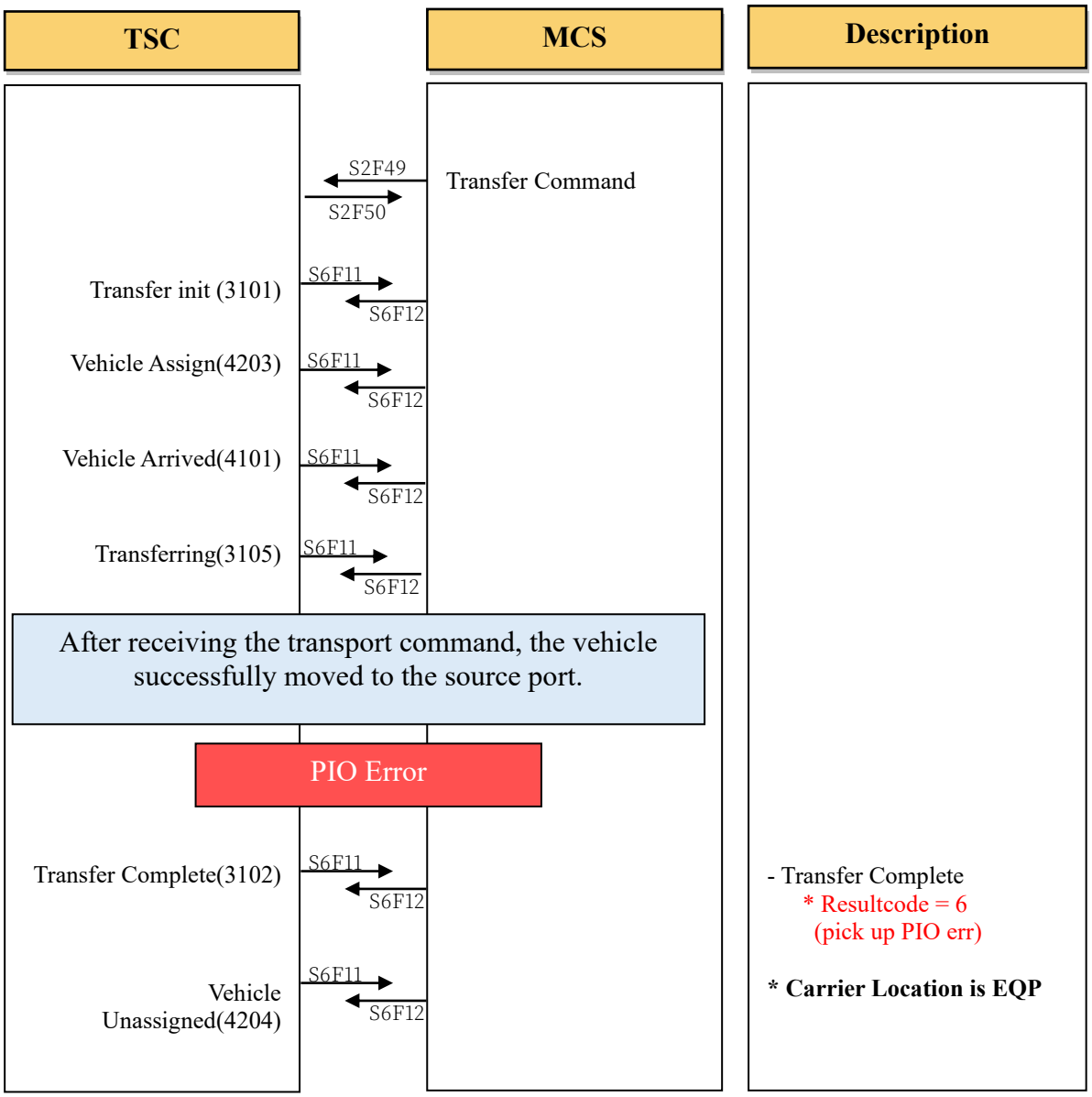
4.5.6. Override Transfer Command

This occurs after an abort transfer command has been completed. A new transfer command is issued to override the previous one, directing the vehicle to a new destination or handling the carrier differently. It's used to recover from interrupted transfers.



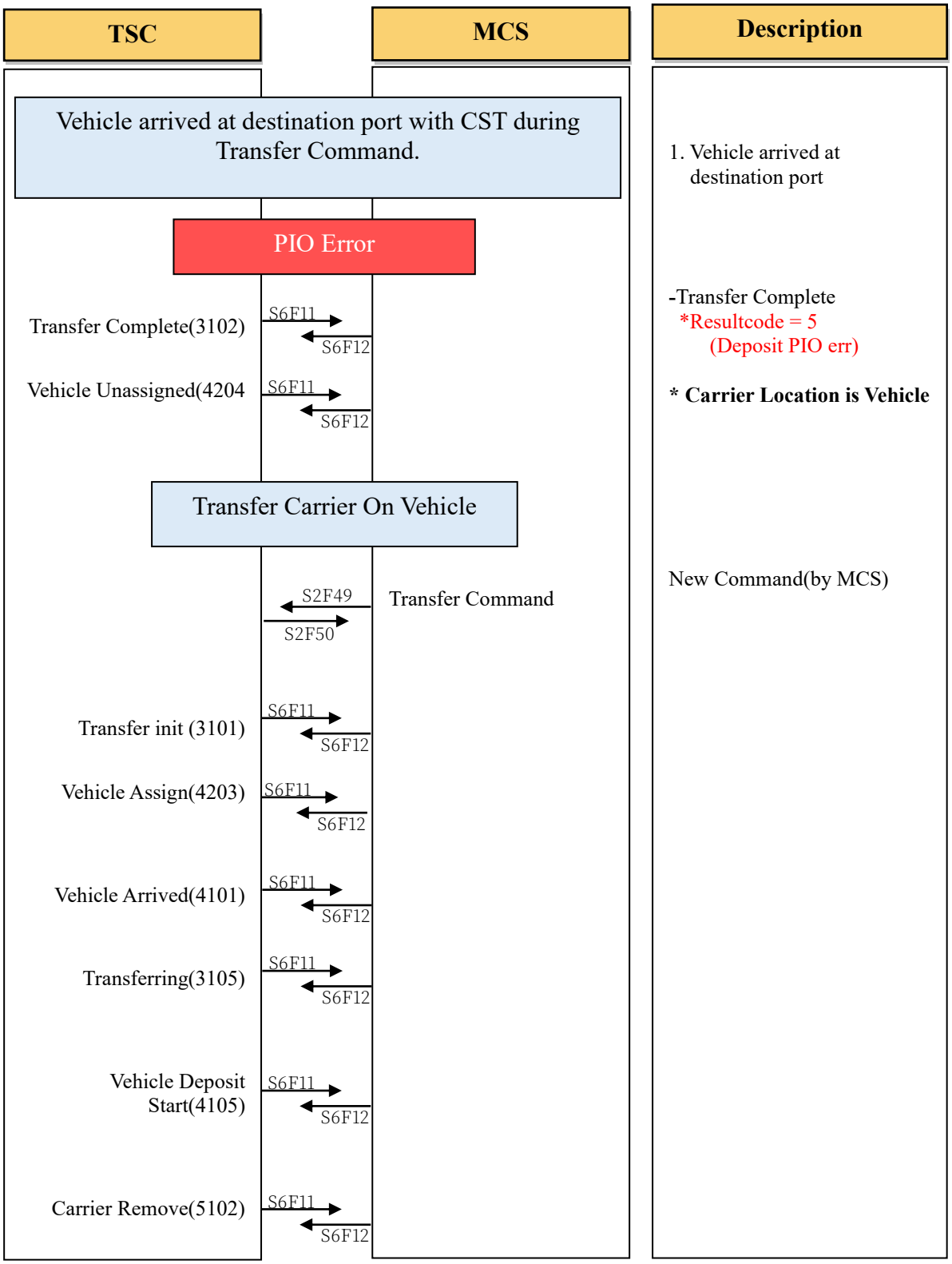
4.5.7. PickUp Case(PIO Error- Host not active)

In this case, the vehicle successfully arrives at the source port after receiving the transfer command, but encounters a PIO (Port I/O) error due to host inactivity or disconnection. The vehicle cannot acquire the carrier, triggering error handling.



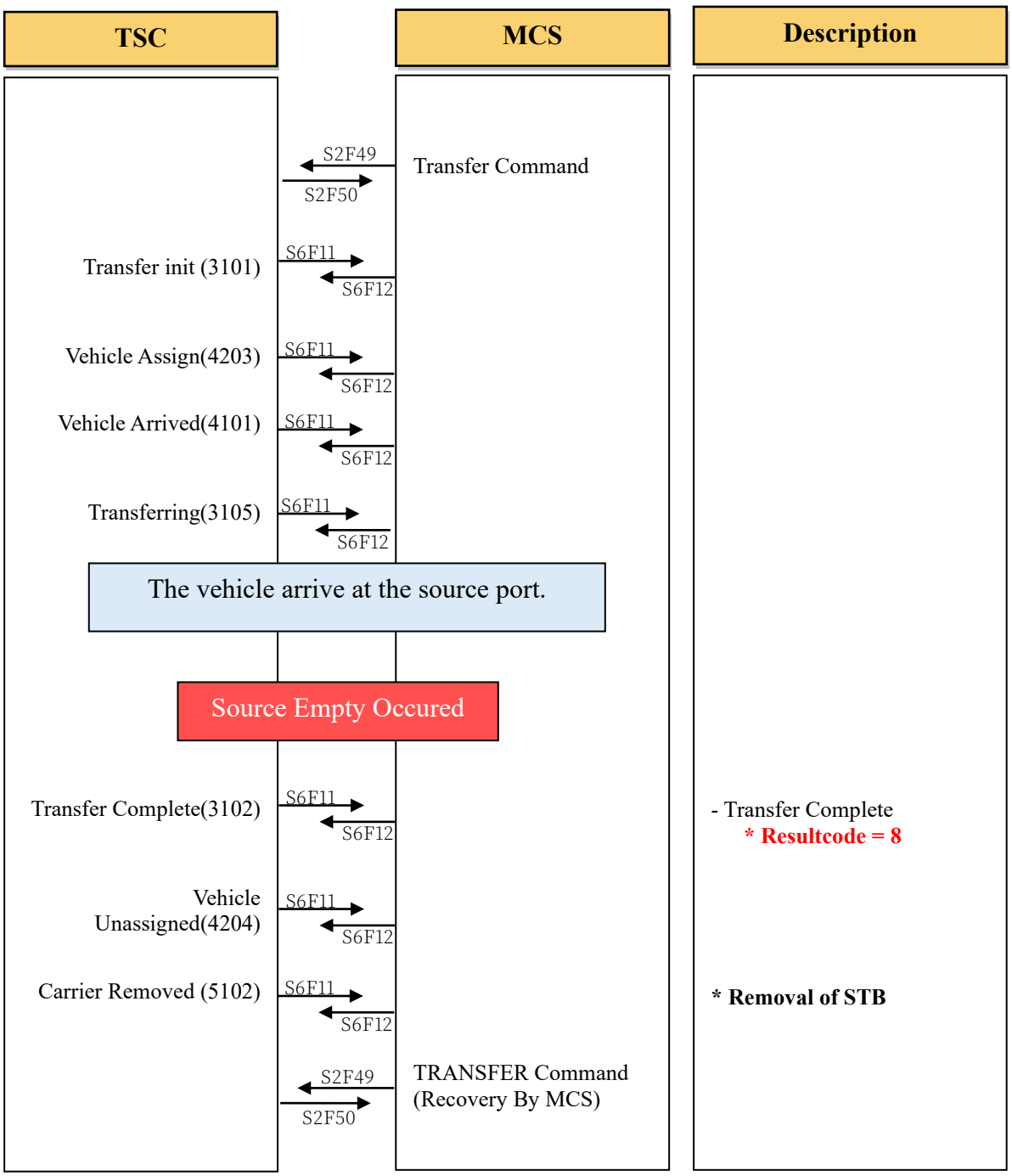
4.5.8. Deposit Case (PIO Error)

Here, the vehicle arrives at the destination port with the carrier, but encounters a PIO error (e.g., port not ready, communication lost), preventing a successful deposit. This requires exception handling or manual intervention.



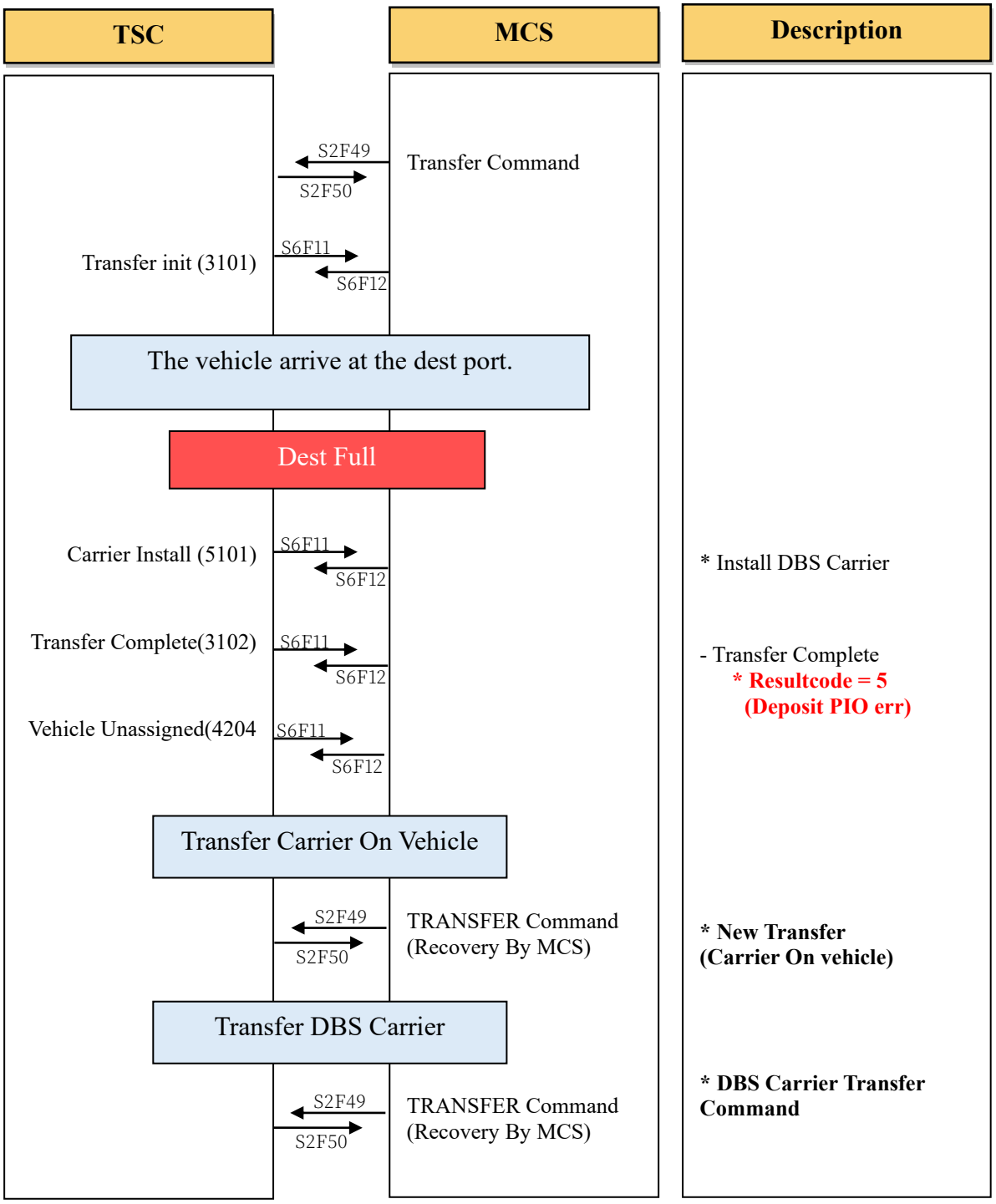
4.5.9. Source Empty – STB

This scenario occurs when the vehicle arrives at the source port in the STB as part of a transfer command, but there is no carrier present to pick up. As a result, the system cannot proceed with the acquisition process. Error handling must be triggered, and the transfer command may need to be canceled or retried based on system configuration.



4.5.10. Dest Full- STB

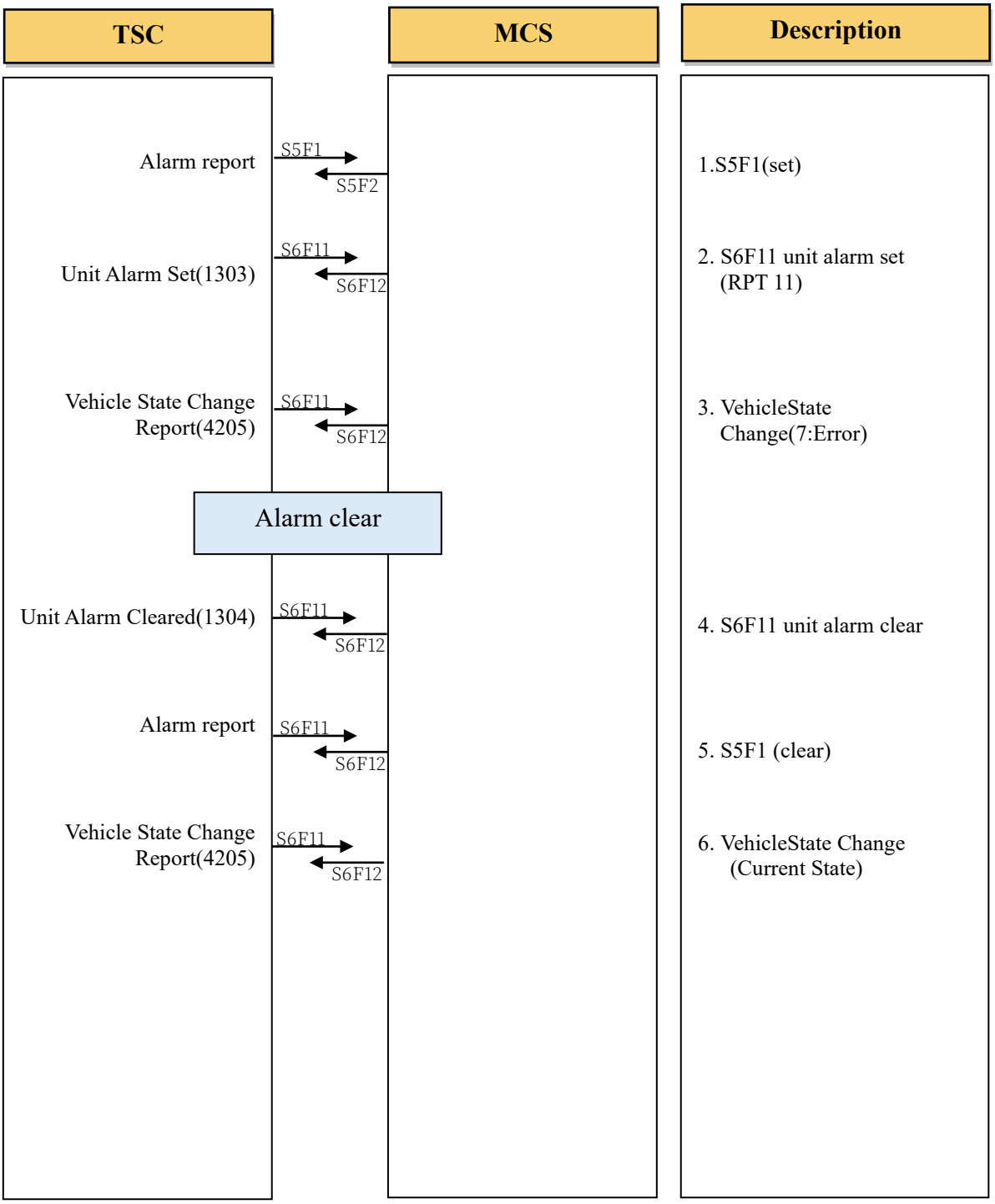
This scenario happens when the vehicle arrives at the destination port in the STB, but the port is already occupied with a carrier. As a result, the system cannot proceed with the deposit, and must trigger error handling or redirection.



4.6.Alarm

4.6.1. Alarm Set/Clear

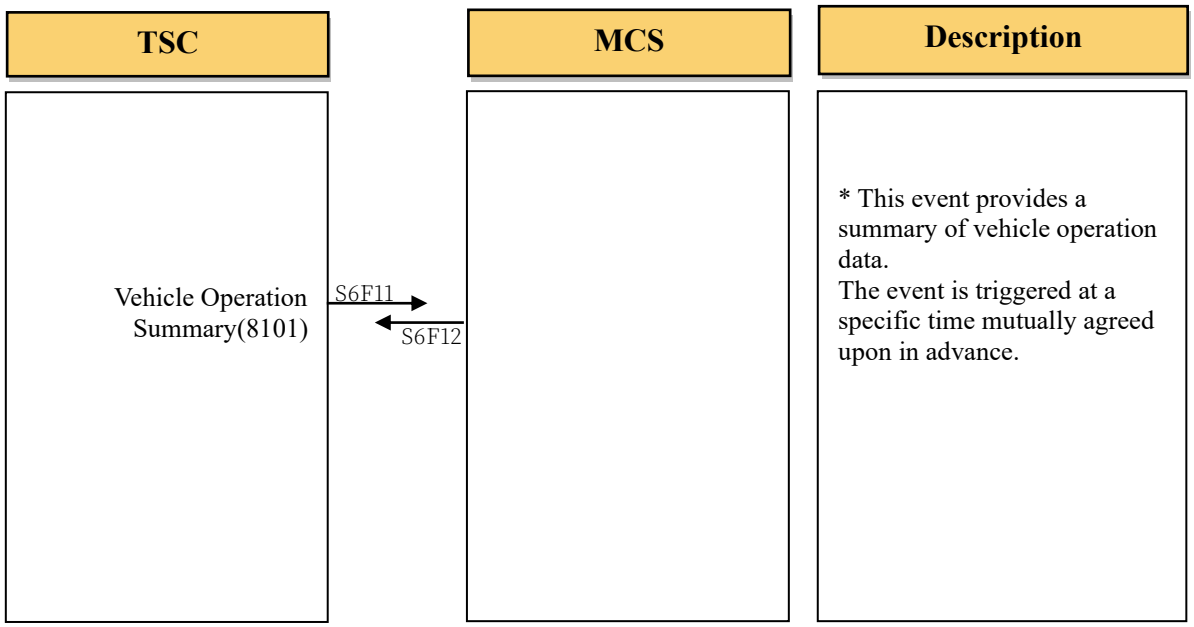
This scenario describes how the system reports alarms being activated (set) or resolved (cleared). When an equipment or process abnormality occurs, an alarm is set and a notification is sent to the host.



4.7. Operation Summary

4.7.1. Vehicle Operation Summary Event

This event provides a summary of vehicle operation data.
The event is triggered at a predefined time mutually agreed upon by both parties.

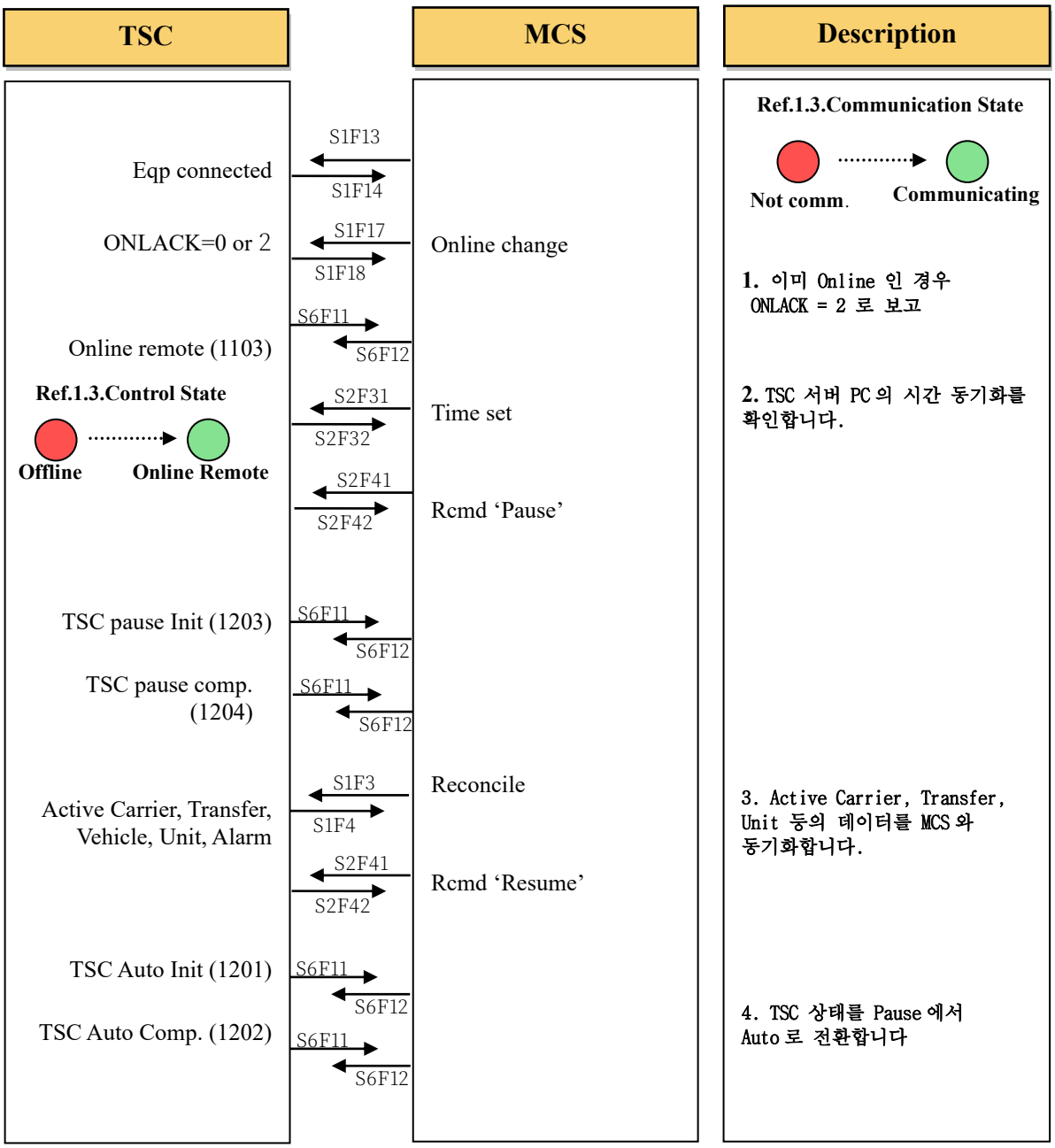


5. Scenario(한글 번역)

5.1. Initialize

5.1.1.Initialize On Connect

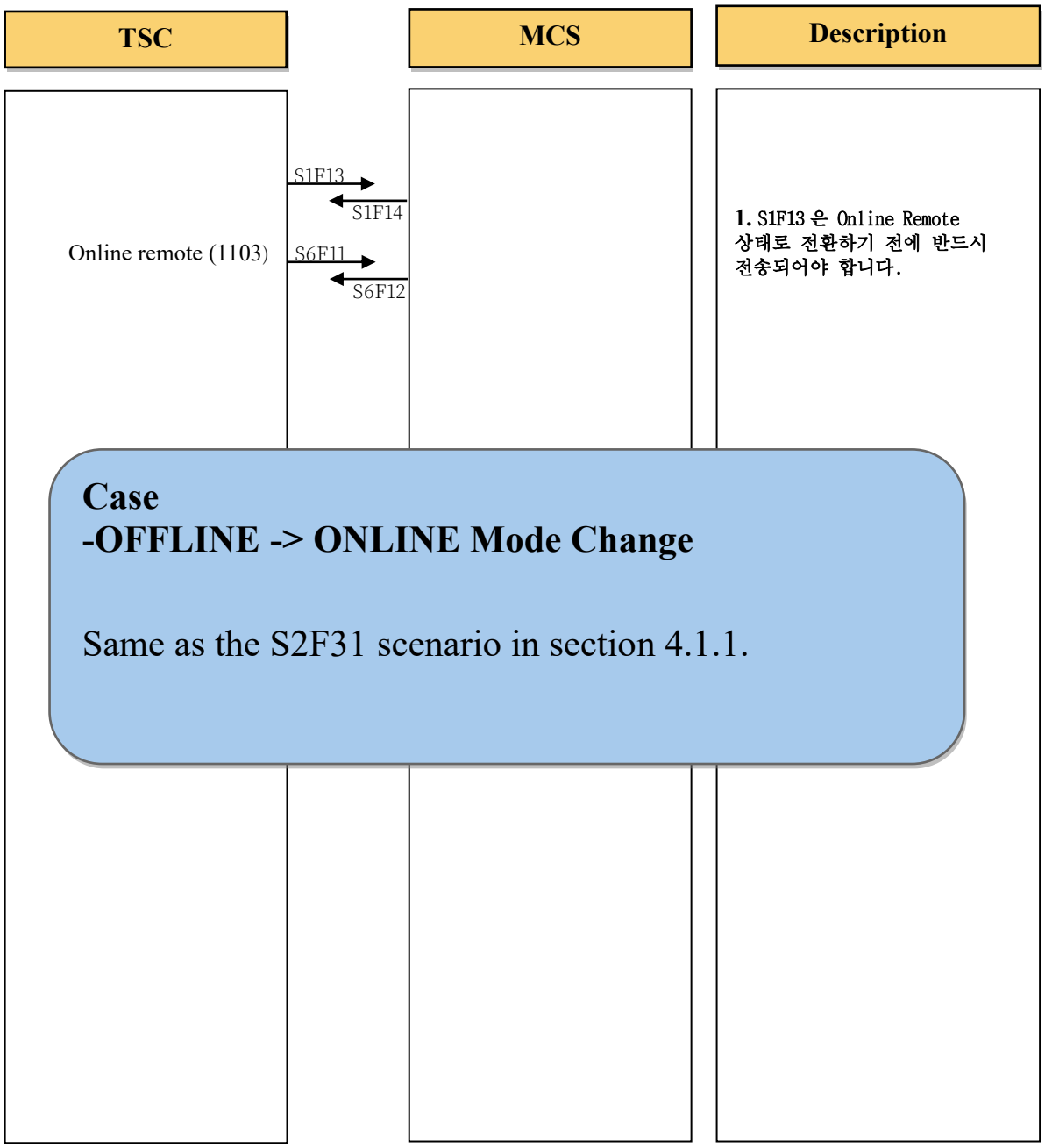
TSC 초기화 시나리오는 TSC 가 호스트와 통신을 설정하고 자동 운전 모드로 전환되는 일련의 이벤트 순서를 설명합니다.



5.2. Mode Change

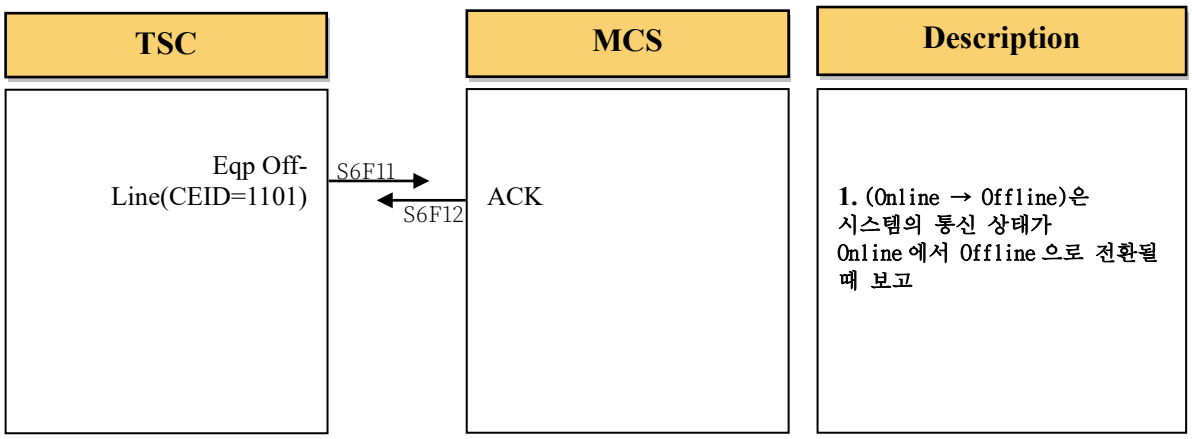
5.2.1.Initialize By TSC Offline -> Remote

운송 제어기(TSC)가 오프라인 상태에서 온라인 원격 모드로 전환하는 과정을 설명합니다.



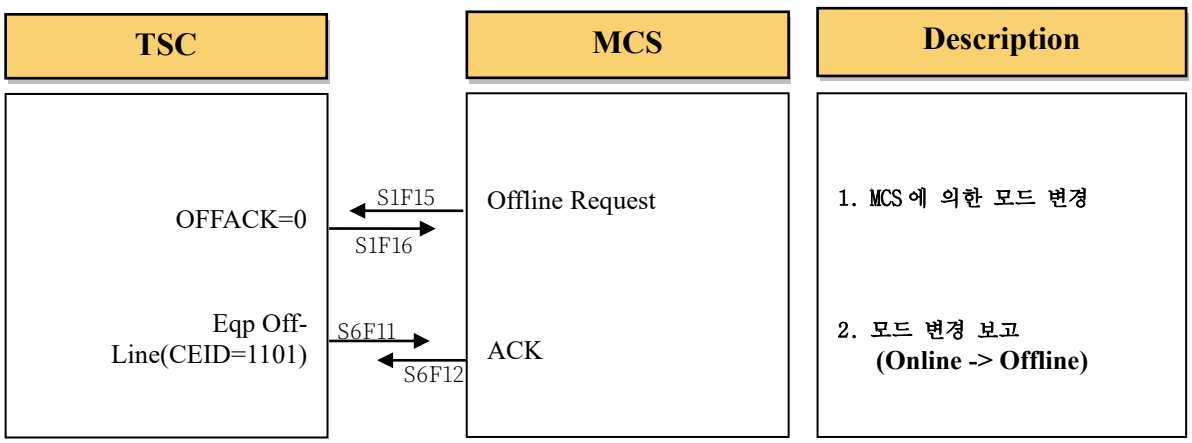
5.2.2.On-Line -> Off-Line(By TSC)

TSC 가 스스로 제어하여 온라인 Remote 에서 오프라인 모드로 전환하는 과정입니다.



5.2.3.On-Line -> Off-Line(By MCS)

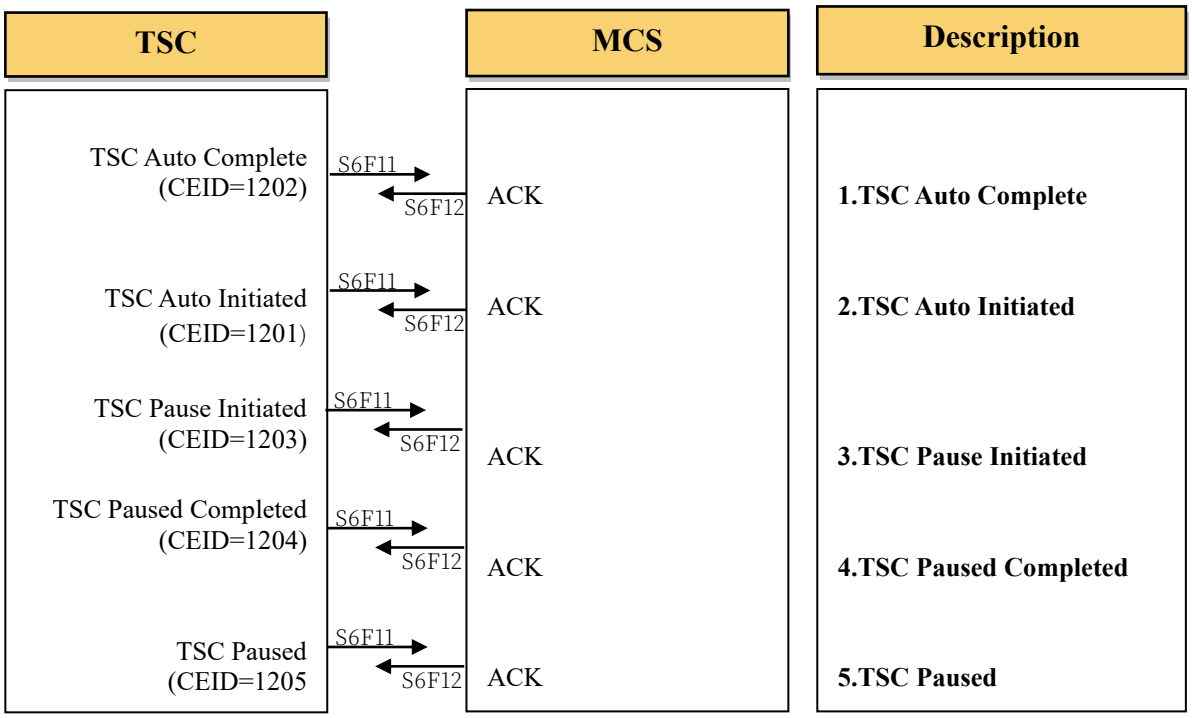
물류 제어 시스템(MCS)이 TSC 에게 온라인 Remote 에서 오프라인 모드로 전환을 명령하는 과정입니다.



5.3. TSC State Change Report

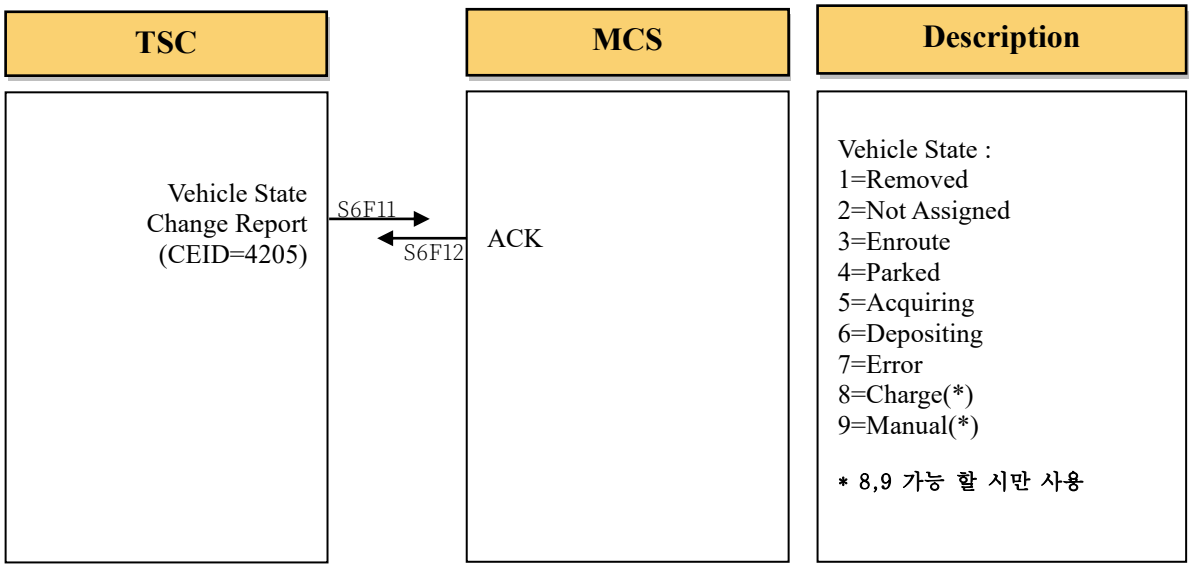
5.3.1.TSC State Change Report

자동화 물류 시스템을 관리하는 TSC 의 컨트롤러의 상태를 보고합니다.
개발 이벤트로 상태가 변경 될 때마다 발생합니다.



5.3.2.Vehicle State Change Report

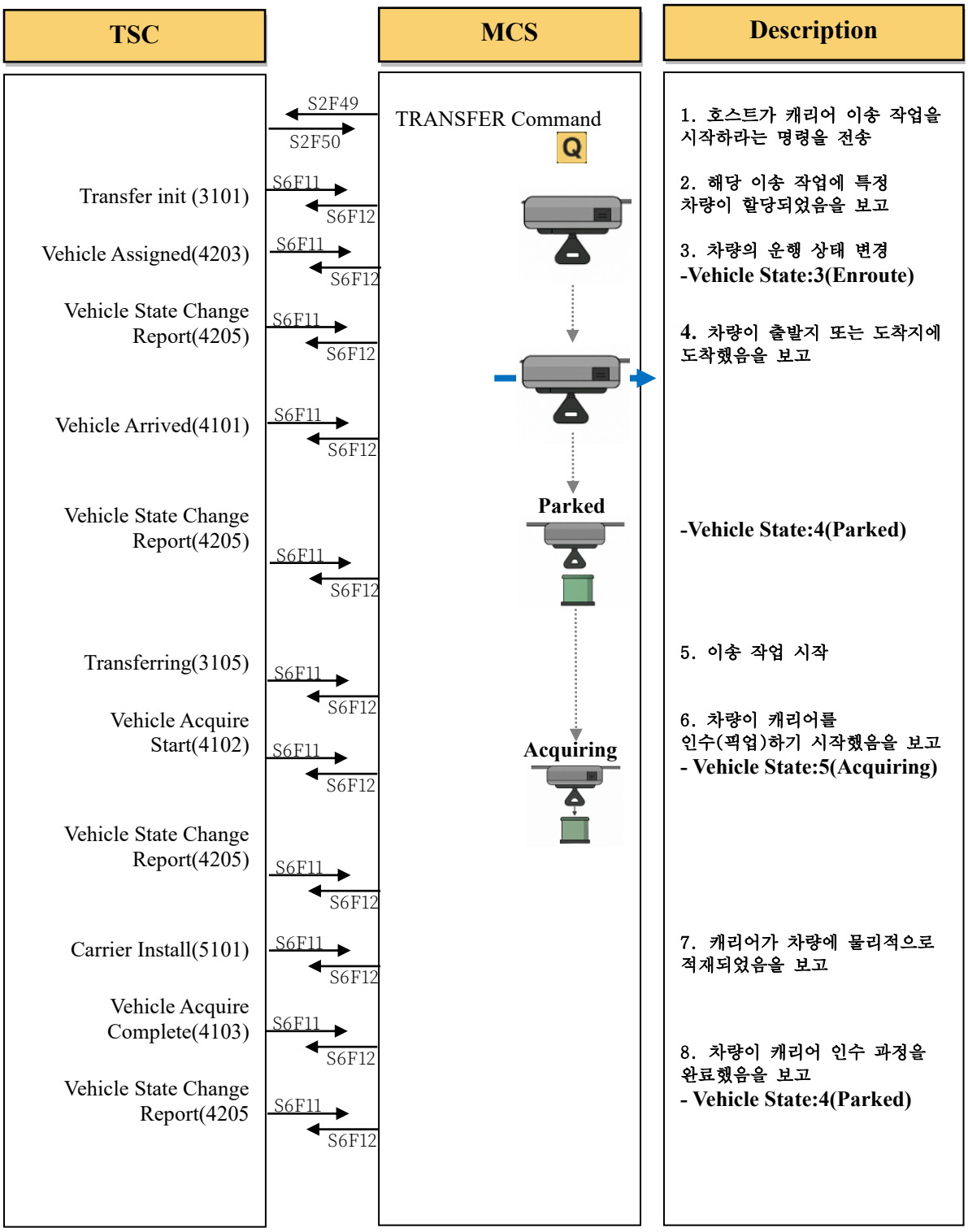
TSC 가 차량의 운전 상태 변경 시 마다 발생하는 독립 이벤트입니다.



5.4. Transfer Operation

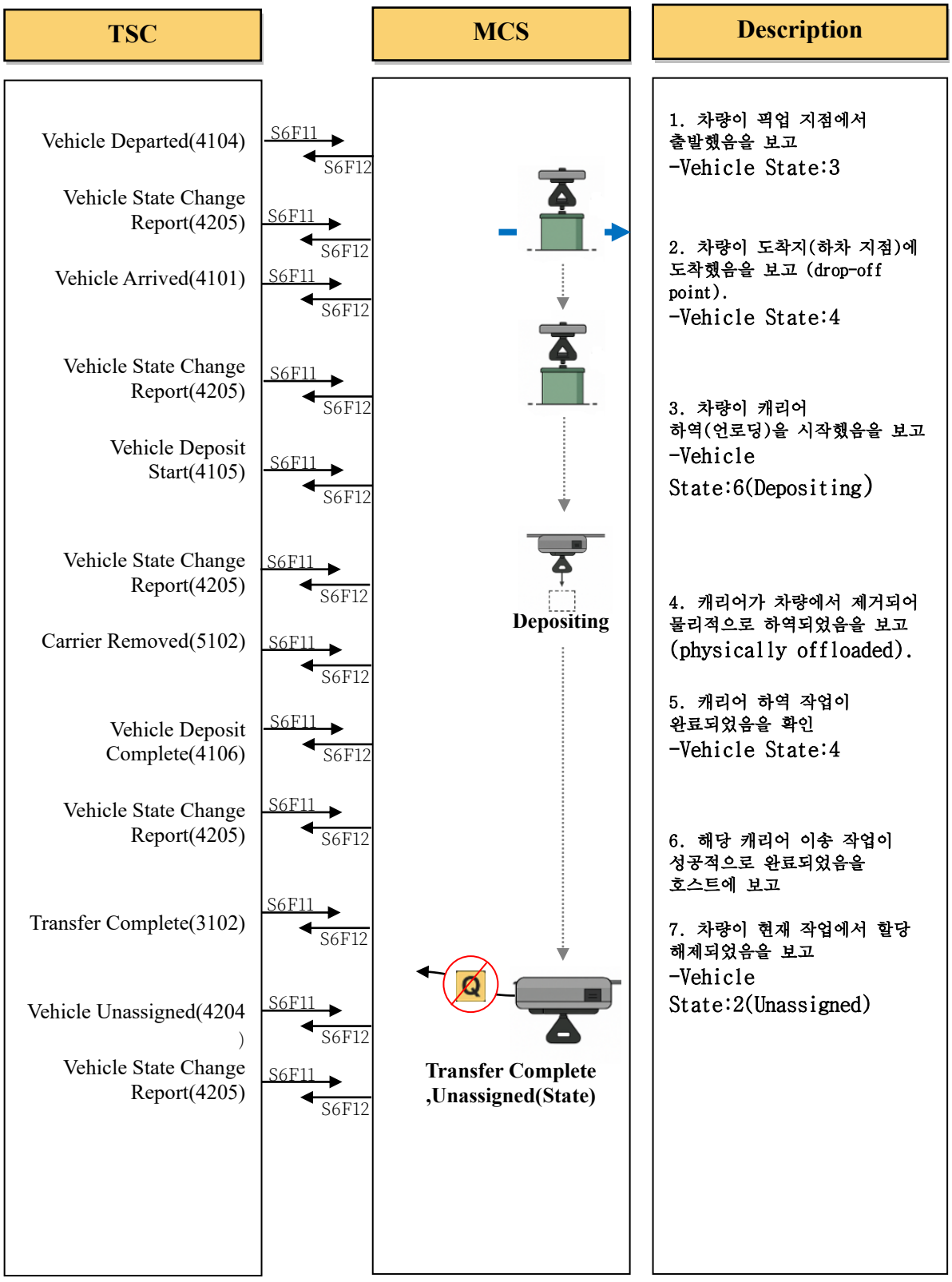
5.4.1. Normal Scenario(If the destination is not STB – 1/2)

이 시나리오는 캐리어 취득(Acquiring) 시나리오로, 자동 운송 차량(OHT)이 지정된 위치에서 캐리어를 취득하라는 명령을 받을 때 발생하는 일련의 절차를 설명합니다.



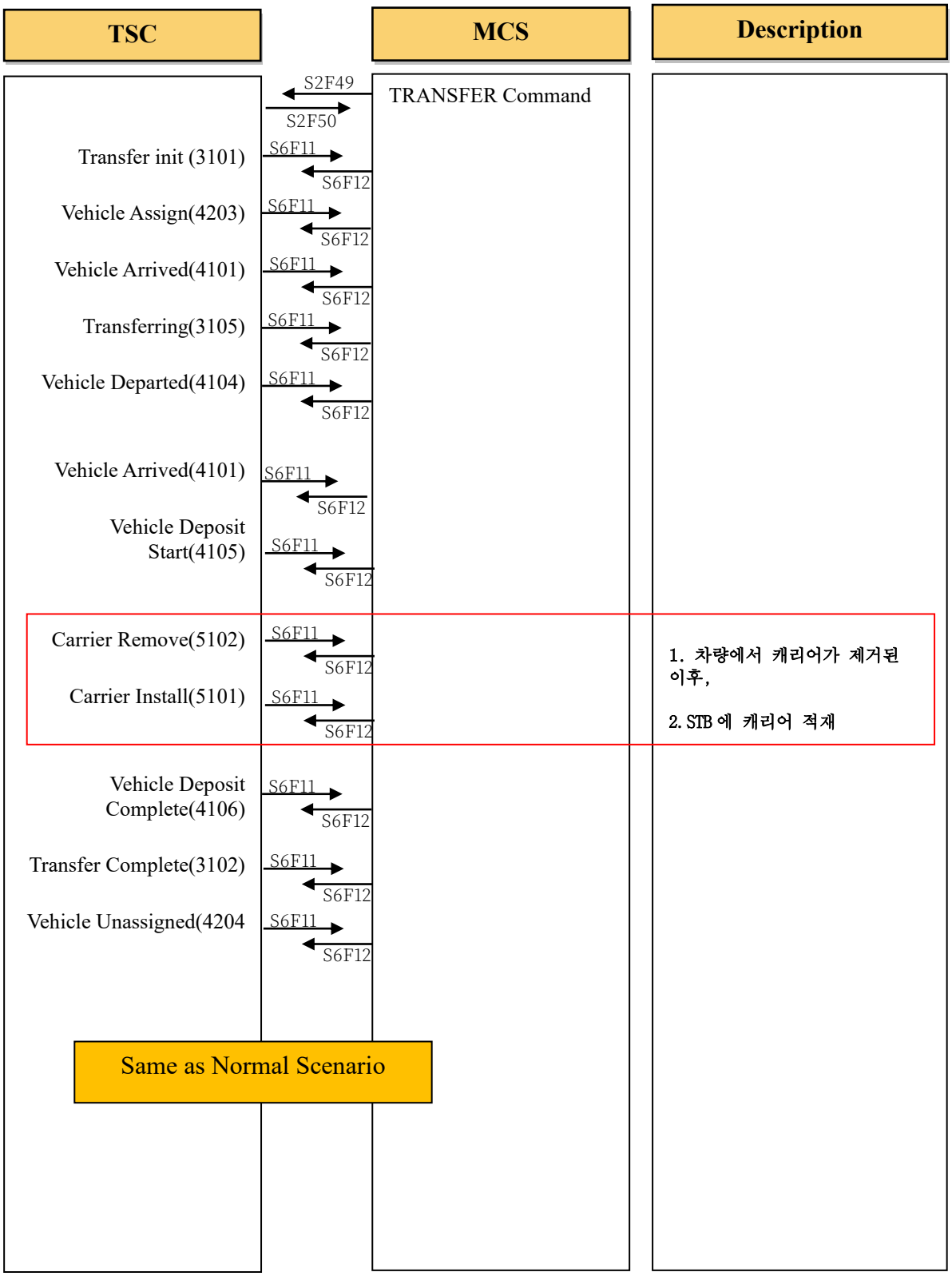
5.4.2. Normal Scenario(If the destination is not STB – 2/2)

이 시나리오는 캐리어 적재(Depositing) 시나리오로, 자동 운송 차량(OHT 등)이 지정된 목적지에 캐리어를 운반하여 하차하는 과정을 설명합니다.



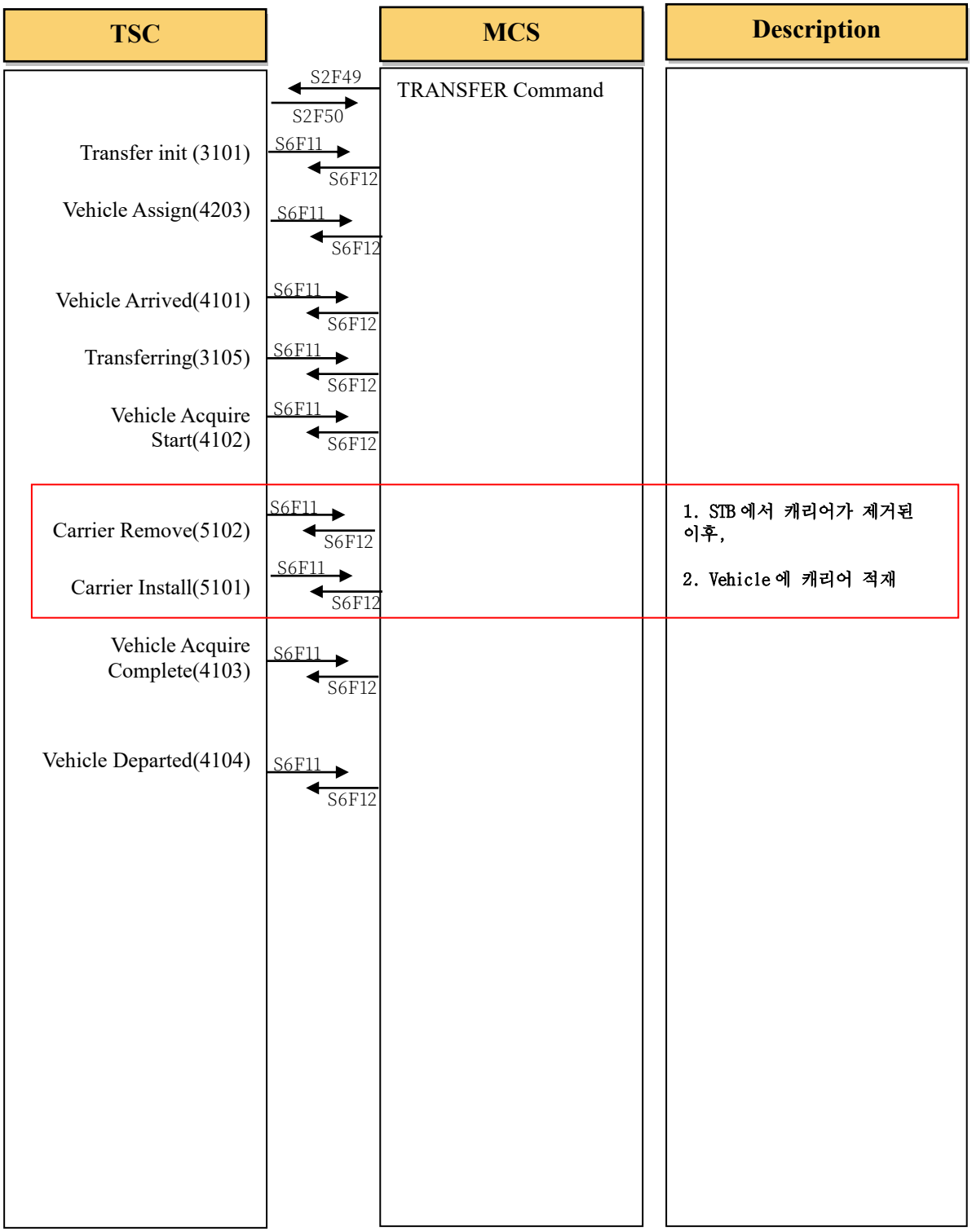
5.4.3. Normal Scenario(If the destination is STB)

이 시나리오는 목적지가 STB 인 경우의 이송 절차를 설명합니다.
STB 에서 캐리어 설치(Carrier Install)가 이루어지기 전에, 차량은 반드시 캐리어 제거(Carrier Remove) 작업을 선행해야 합니다.



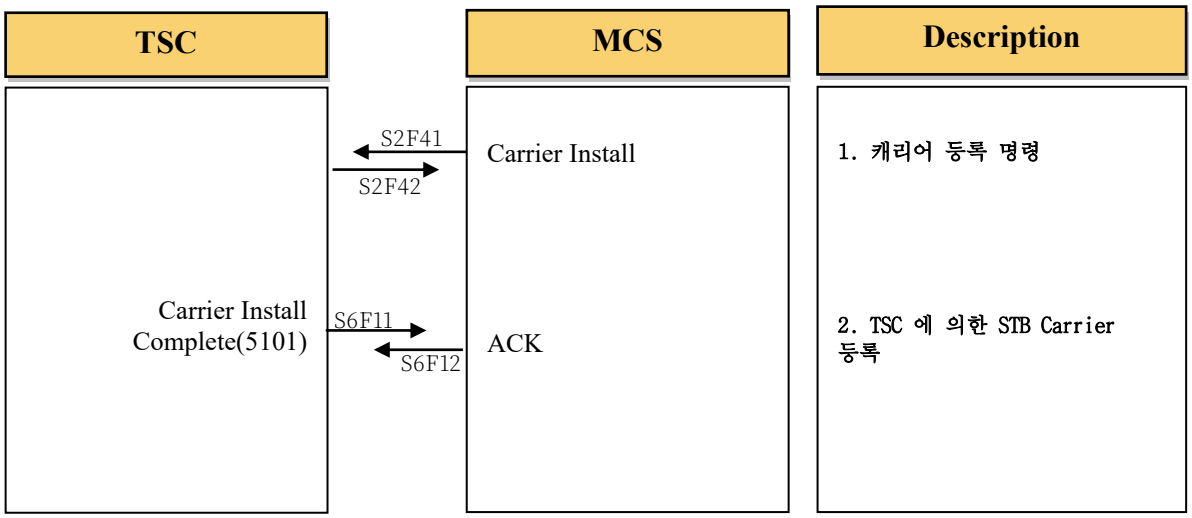
5.4.4. Normal Scenario(If the Source is STB)

이 시나리오는 STB 로부터 캐리어를 이송하는 절차를 설명 합니다.
설치(Carrier Install)를 수행하기 전에 STB 에서 캐리어 제거(Carrier Remove) 작업이 반드시 선행 되어야 합니다.



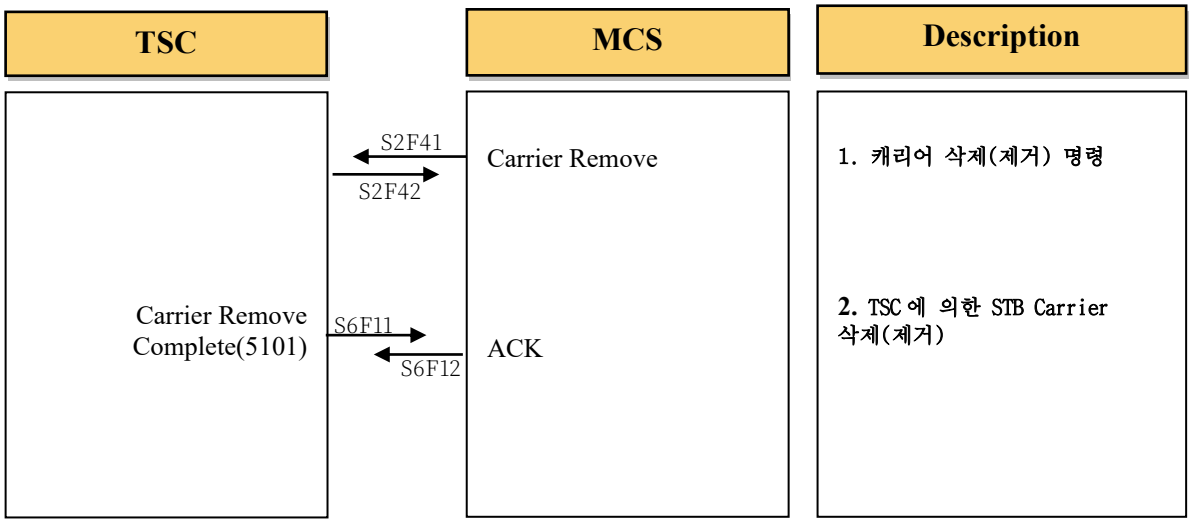
5.4.5. Install Command(Only STB)

Install Command"는 자재 제어 시스템(Material Control System, MCS)에서 STB로 전송되는 명령어로, 특정 캐리어를 STB 내 지정된 보관 위치에 저장하는 명령입니다.



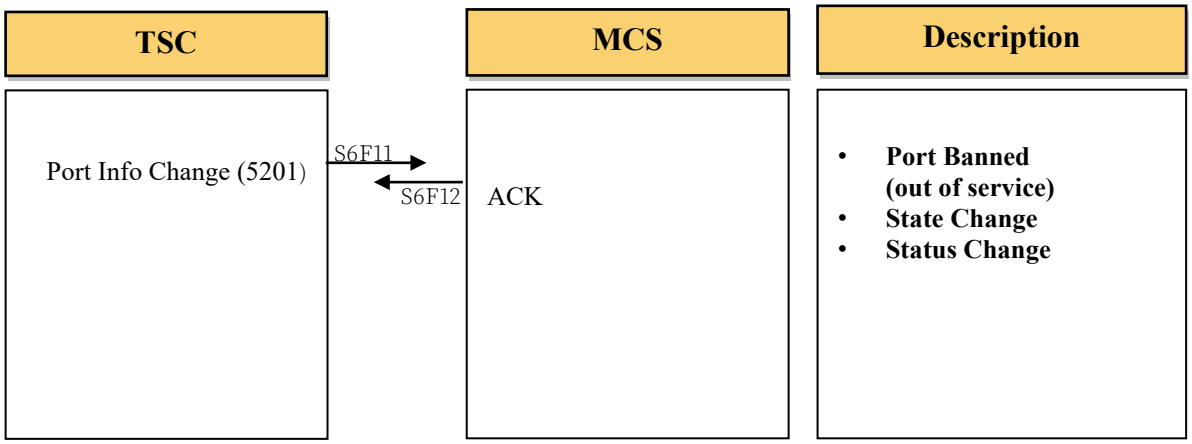
5.4.6. Remove Command(Only STB)

Remove Command"는 자재 제어 시스템(Material Control System, MCS)에서 STB로 전송되는 명령어로, STB 내의 지정된 위치로부터 캐리어를 제거하는 명령입니다.



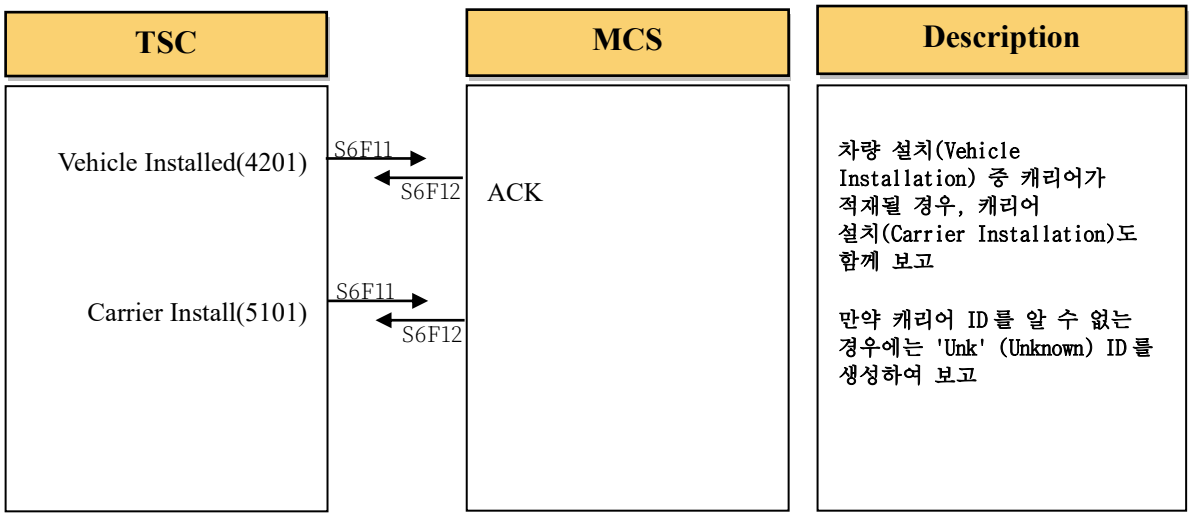
5.4.7. Port Info Change (Only STB)

Port Info Change 이벤트는 STB 시스템 내부에서만 발생하는 이벤트로, 포트의 상태(state) 또는 스테이터스(status)에 변화가 생겼을 때 발생합니다.



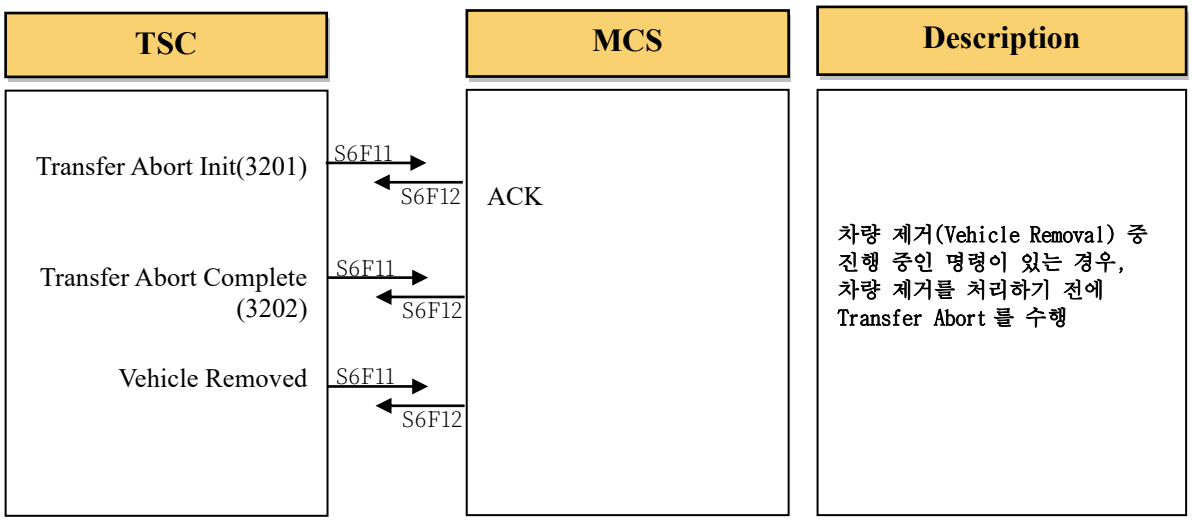
5.4.8. Vehicle Install

Vehicle Install 시나리오는 TSC 에 차량이 등록 될 때 발생합니다.



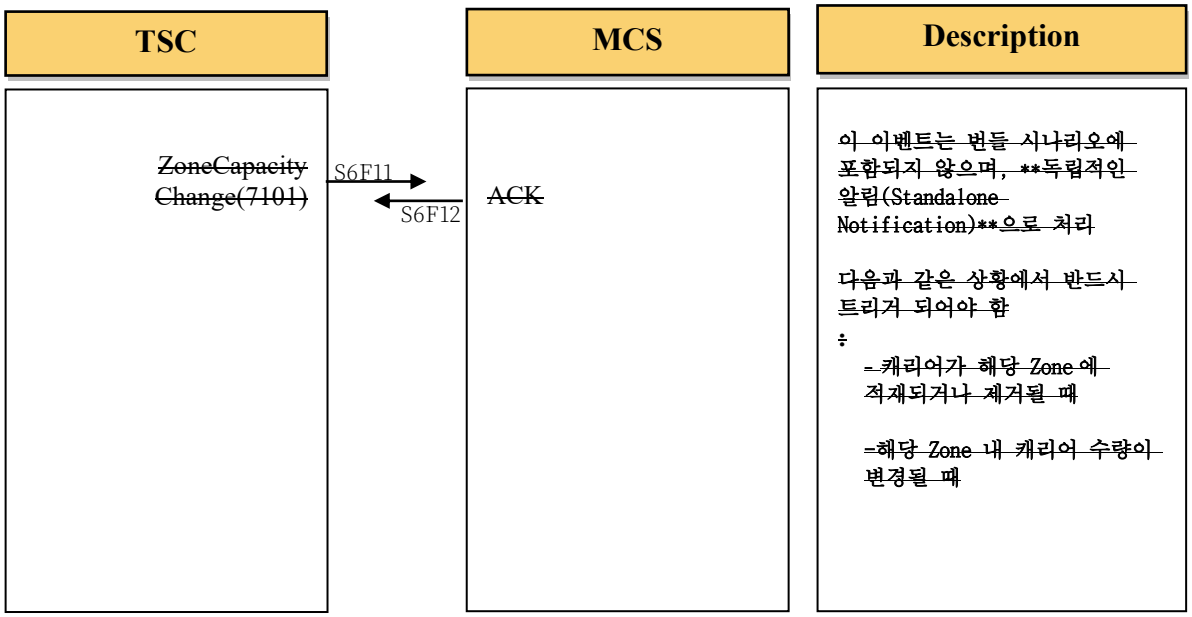
5.4.9. Vehicle Removed

Vehicle Remove 시나리오는 차량을 TSC 에 제거(사용안함) 할 때 사용합니다.



~~5.4.10. Zone Capacity Change~~

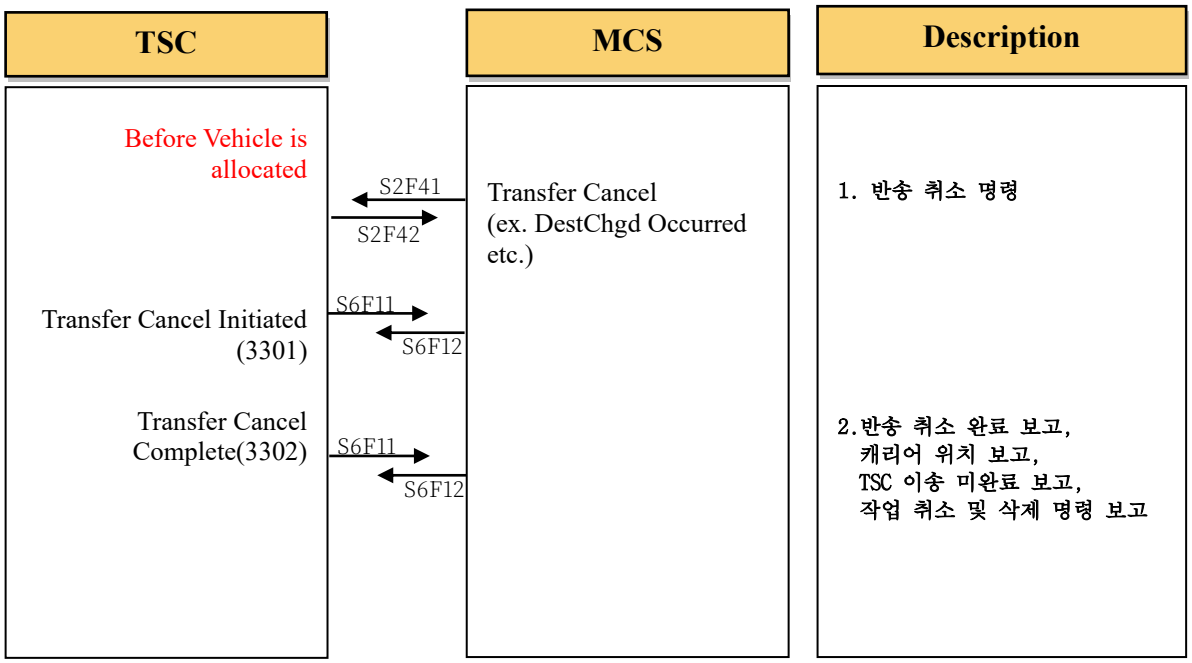
~~Zone Capacity Change 이벤트는 상태나 수량에 변경이 발생했을 때 발생~~
~~이 이벤트는 사용 현황을 실시간으로 정확하게 파악할 수 있도록 보장하며, 이는 STB 운영, 이송 판단, 용량 모니터링 등을 효과적으로 관리하는 데 매우 중요합니다.~~



5.5. Abnormal Process

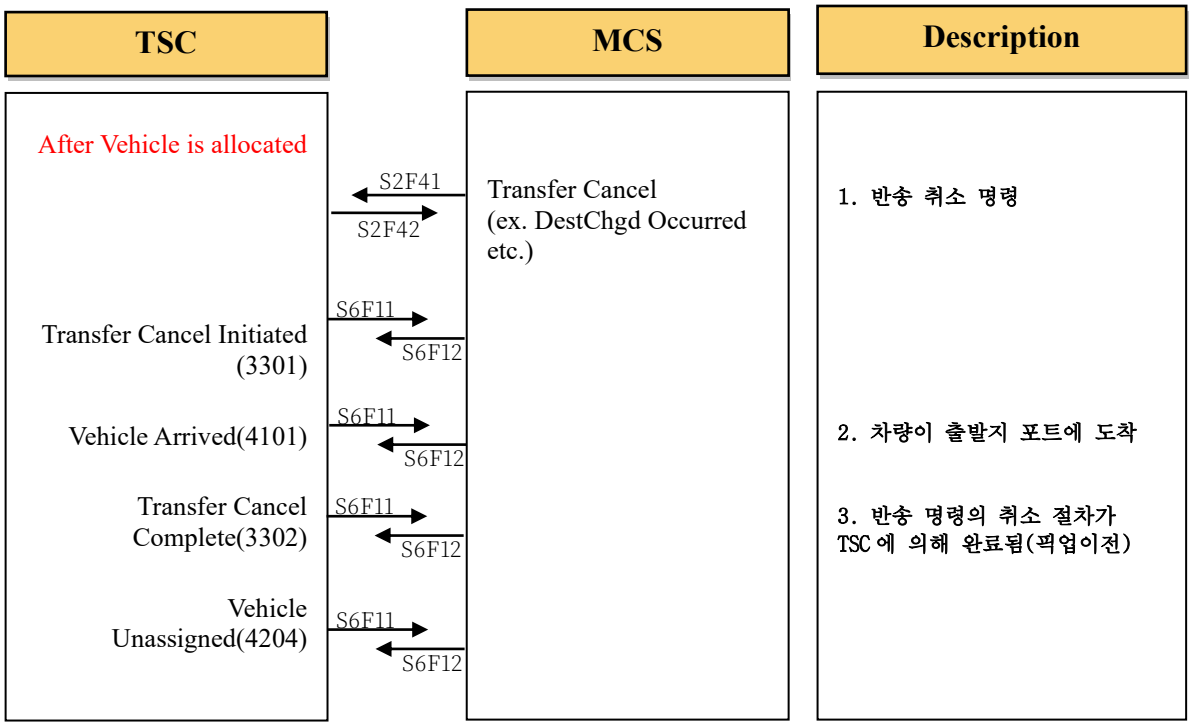
5.5.1.Cancel Command(Case1)

이 시나리오는 차량 할당 이전에 이송 명령이 취소될 때 발생합니다. 실행이 시작되지 않은 상태이므로, 취소 처리가 정상적으로 진행됩니다.



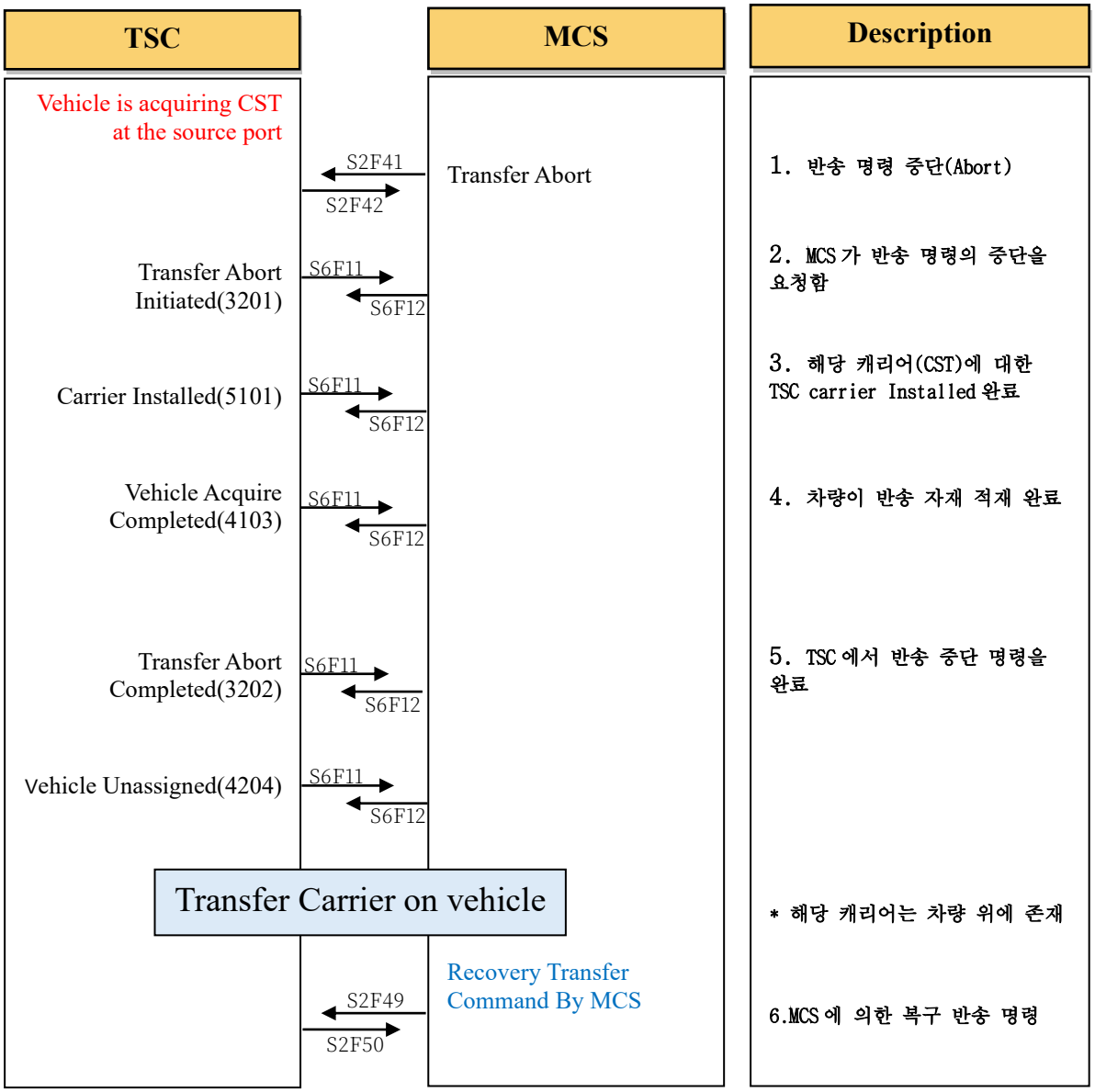
5.5.2.Cancel Command(Case2)

이미 차량에 반송 명령이 할당 된 이후에 취소 되는 상황으로 TSC 에서 허용하는 시점에 반송명령 취소(Cancel) 처리를 하면 됩니다. 할당 된 이후 이니 할당해제까지 진행 합니다.



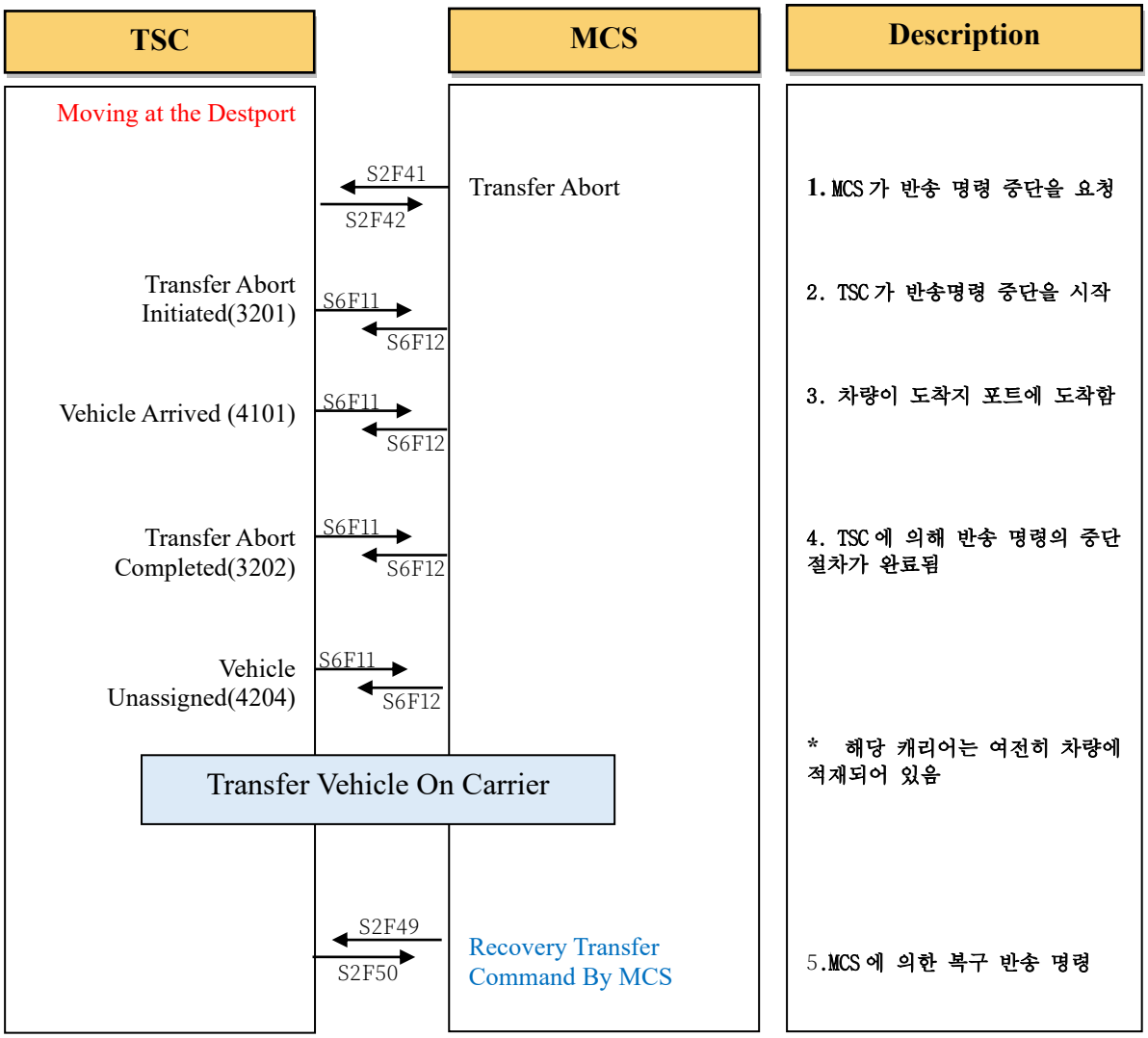
5.5.3. Abort Transfer Command (Case1) – Abort Complete

차량의 반송 진행 상태가 Transferring 이후, 하역(Deposit Start) 작업 전에 중단 명령이 하달된 경우로 차량의 상태가 행동을 진행 중이라면 Abort Initiated 이후 행동 종료 후 Abort Complete 처리하여도 무방합니다. 적재되어 있는 자재에 대해서는 MCS 에서 처리 합니다.



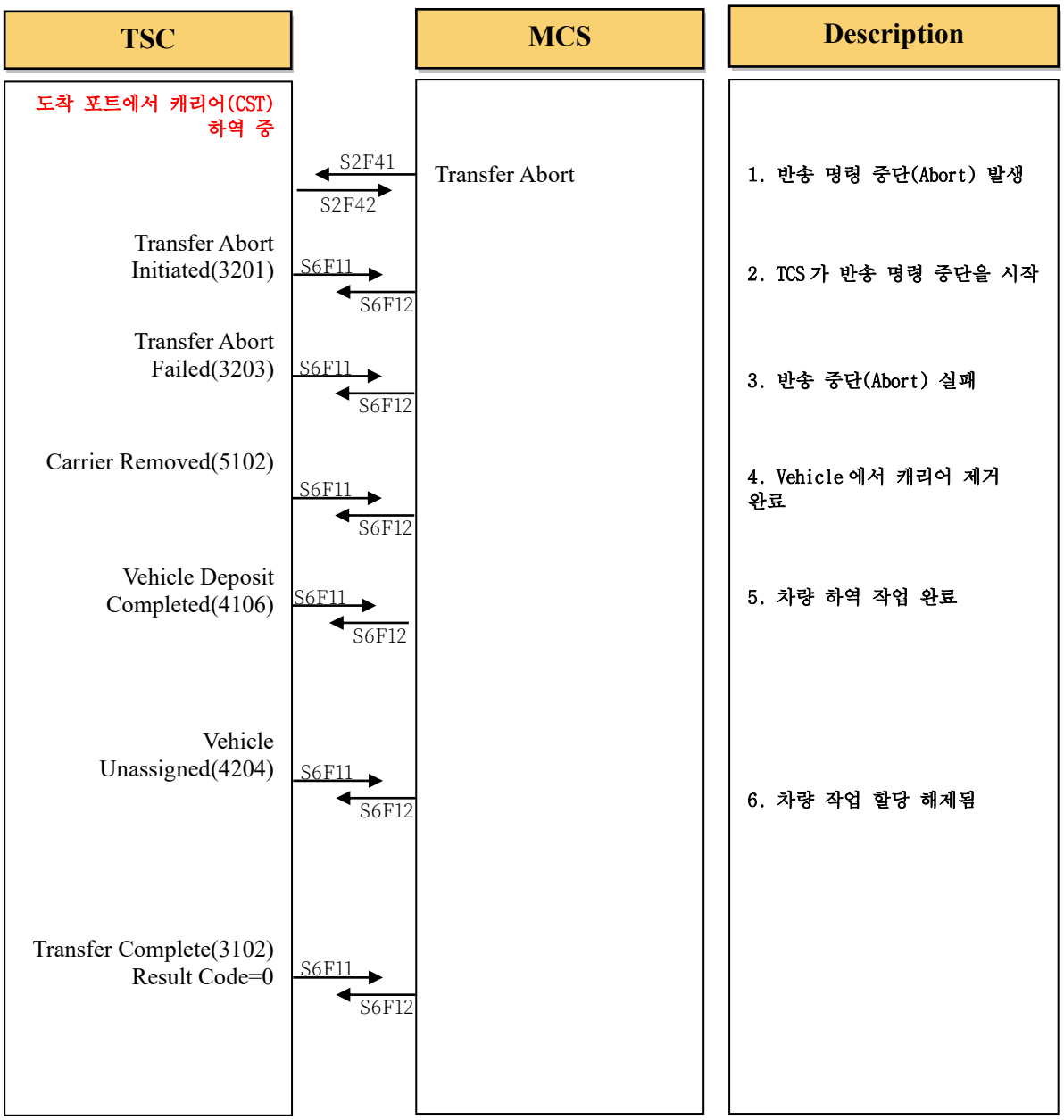
5.5.4. Abort Transfer Command (Case2) – Abort Complete

본 시나리오는 차량이 캐리어를 적재한 상태로 목적지 포트로 이동 중일 때, 중단(Abort) 명령이 발생하는 경우입니다. 차량은 안전하게 정지하며 캐리어를 보유한 상태로 대기하고, 중단 절차는 정상적으로 완료됩니다. 차량 위의 자재에 대해서는 MCS 에서 처리 합니다.



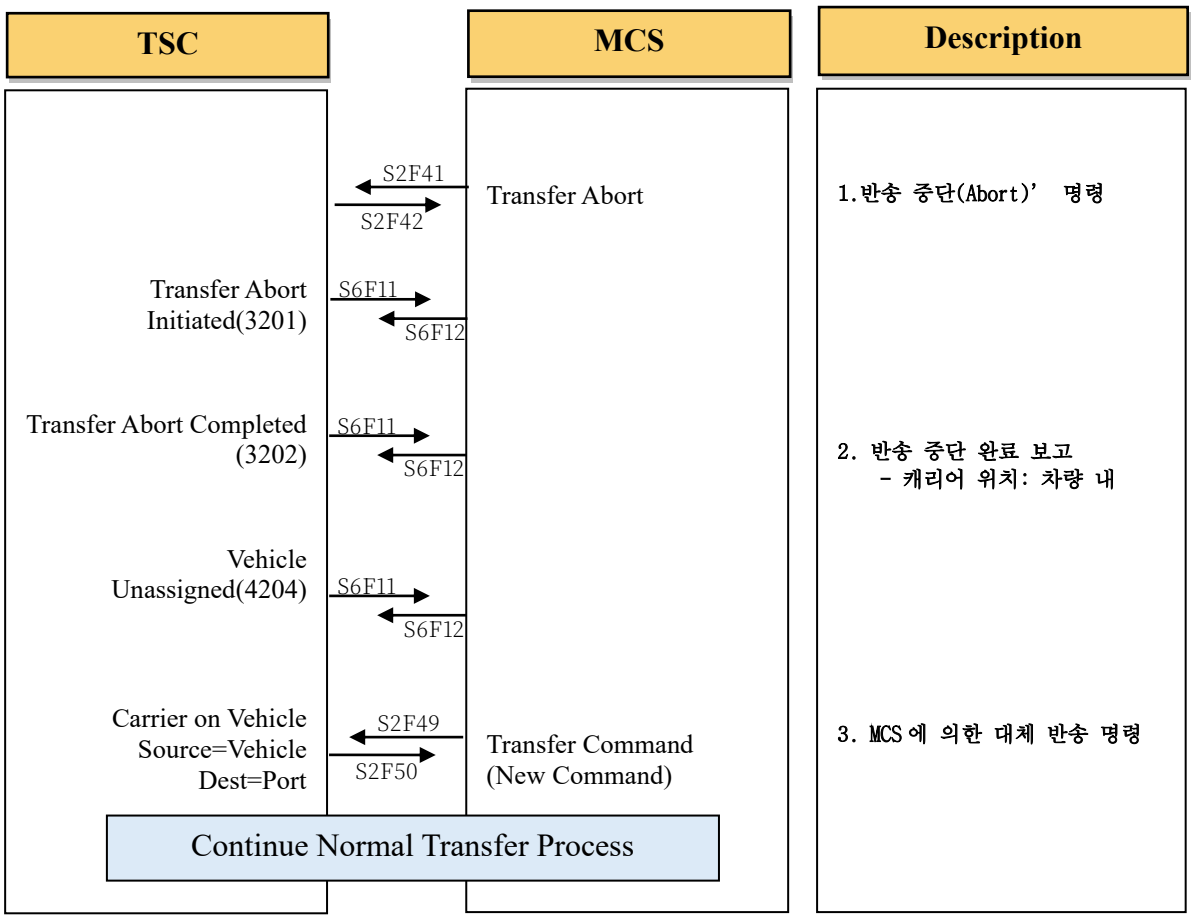
5.5.5. Abort Transfer Command (Case3) – Abort Fail

본 시나리오는 캐리어 하역(적재 해제) 작업이 진행 중일 때 중단(Abort) 명령이 발생하는 실패 사례를 나타냅니다.
이미 하역 동작이 진행 중이거나 되돌릴 수 없는 상태이기 때문에, 중단 명령은 실패하며, TSC 는 진행 중이던 작업을 마무리 합니다.



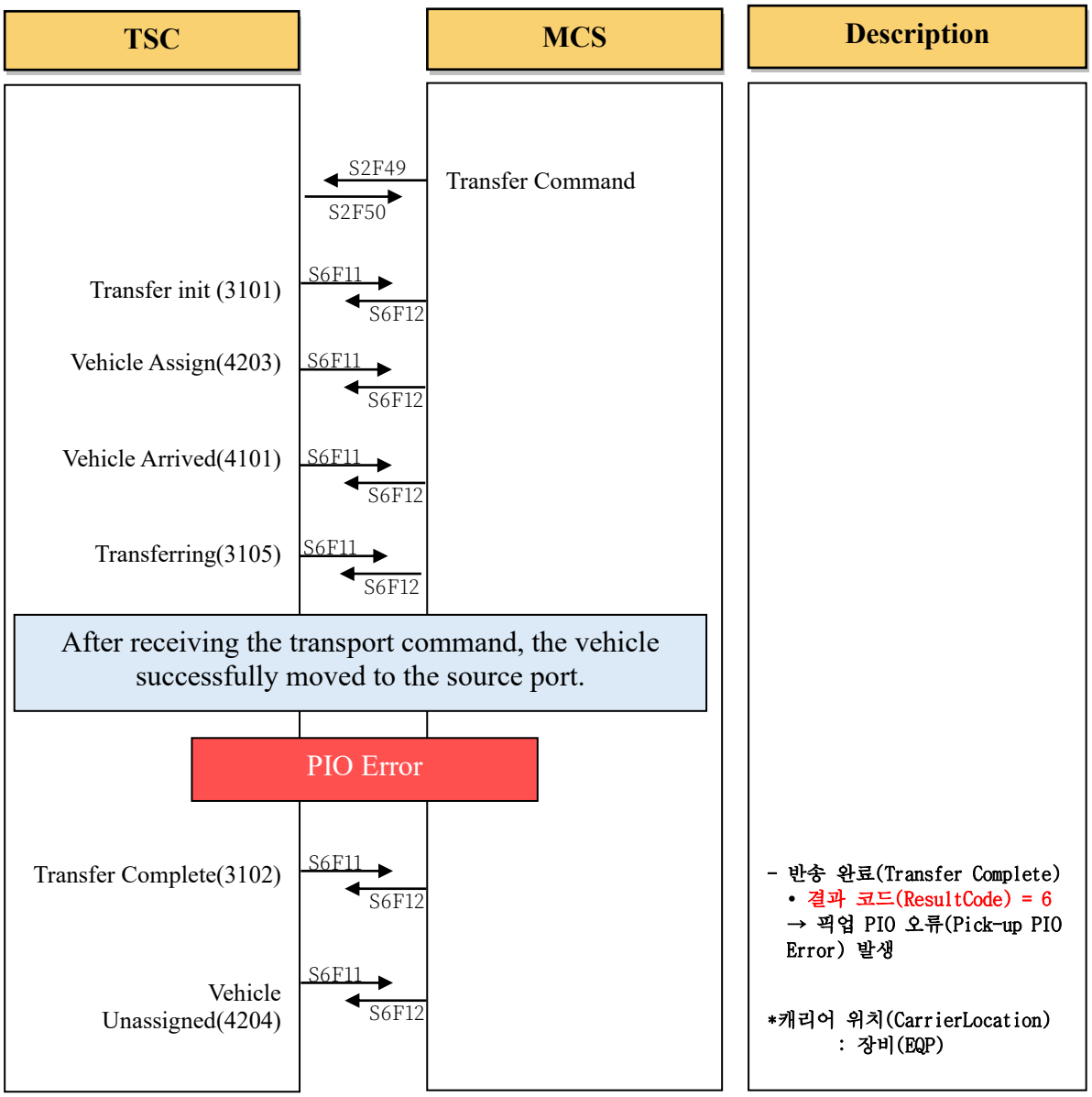
5.5.6. Override Transfer Command

본 시나리오는 반송 명령 중단(Abort)이 완료된 이후에 발생합니다. 이전 명령을 대체하기 위해 새로운 반송 명령이 발행되며, 차량을 새로운 목적지로 이동시키거나 캐리어를 다르게 처리하도록 지시합니다. 이는 중단된 반송 작업을 복구하기 위한 절차입니다.



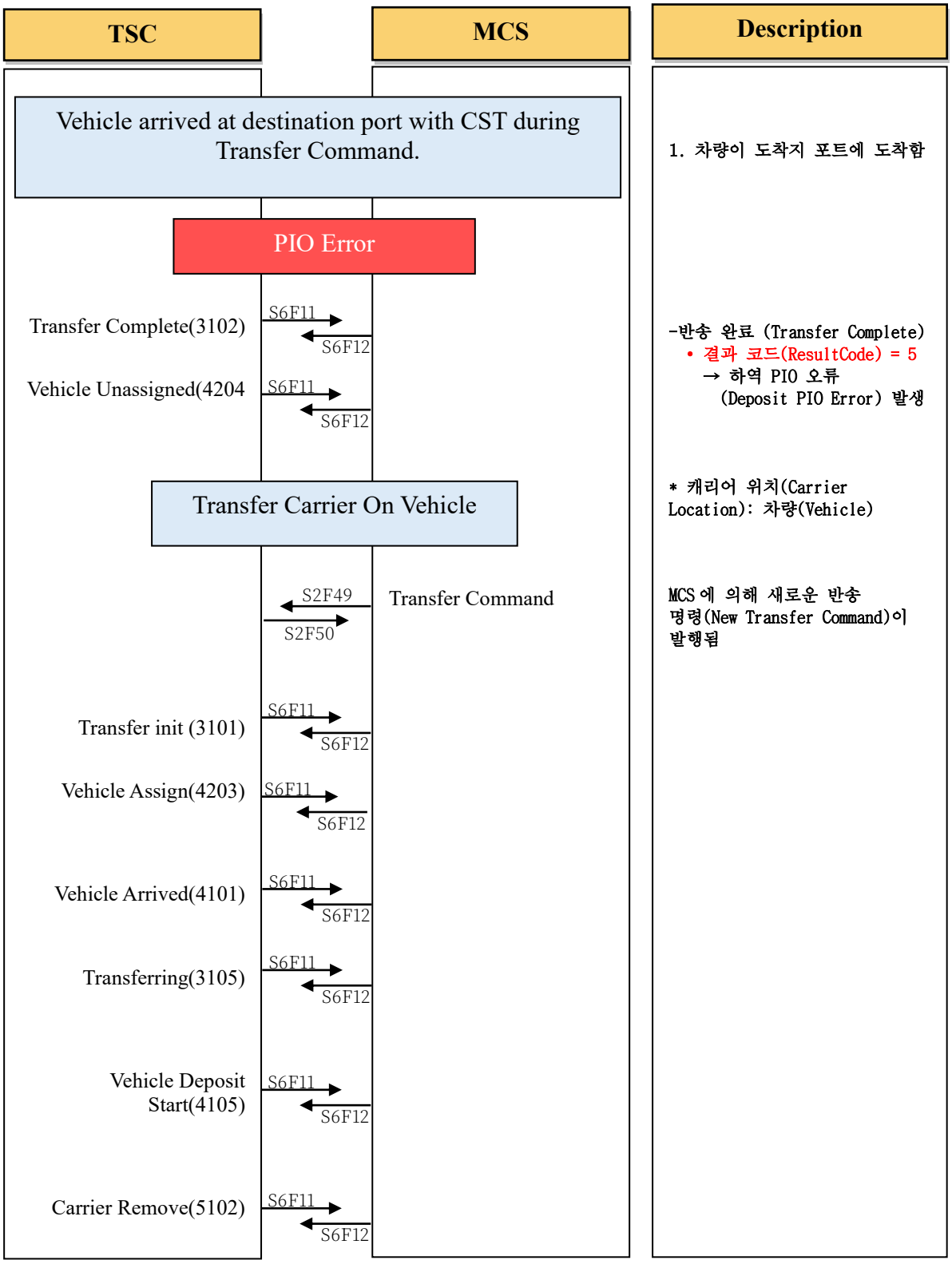
5.5.7. PickUp Case(PIO Error- Host not active)

본 경우는 차량이 반송 명령을 받고 출발지 포트에 정상적으로 도착했으나, 호스트 비활성 또는 연결 끊김으로 인해 PIO 오류가 발생하는 상황입니다. 이로 인해 차량은 캐리어를 인수할 수 없으며, 오류 처리 절차가 시작됩니다



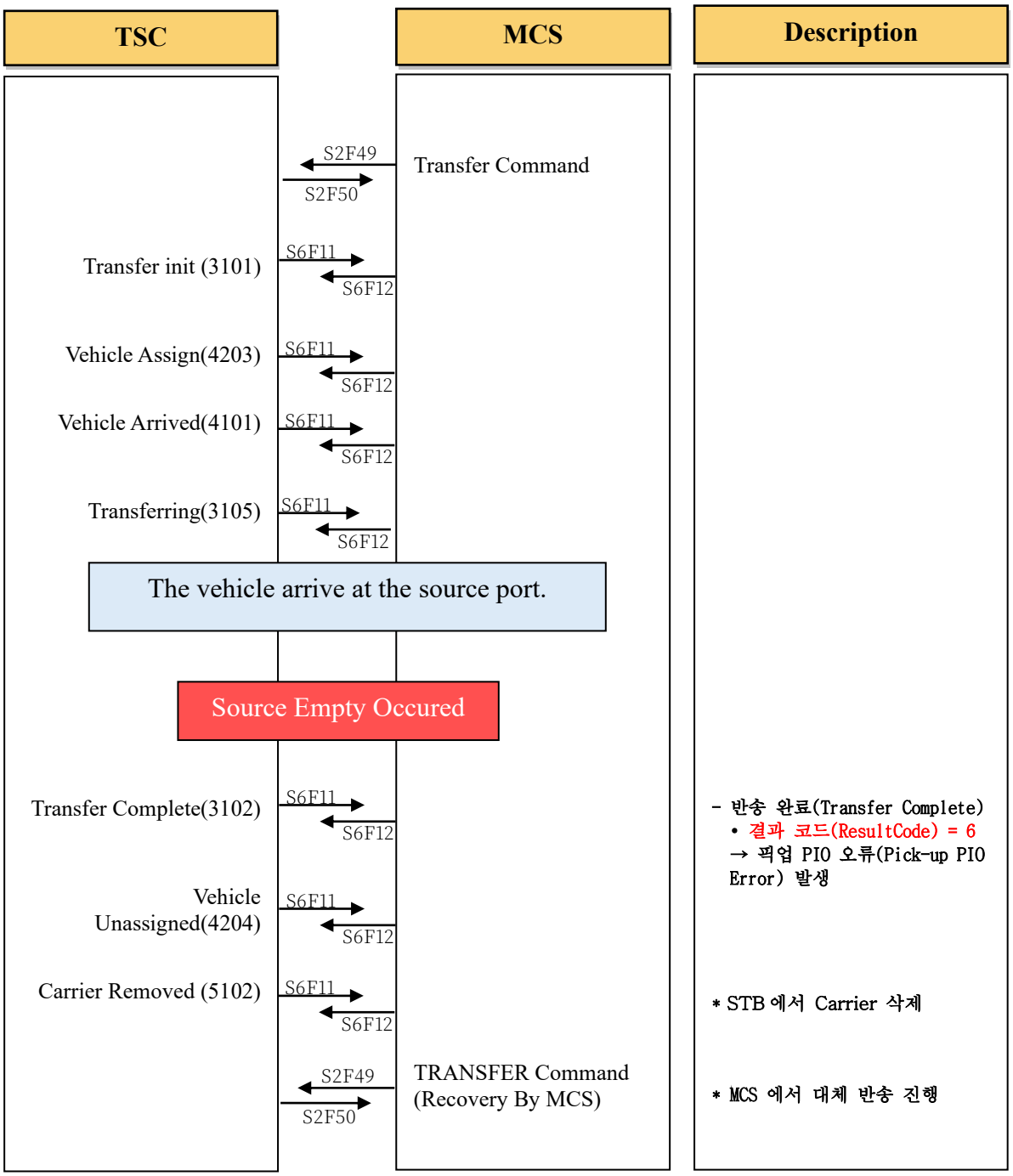
5.5.8. Deposit Case (PIO Error)

본 시나리오는 차량이 캐리어를 적재한 채 도착지 포트에 도착했으나, PIO 오류(예: 포트 미준비 상태, 통신 끊김 등)가 발생하여 정상적인 하역(Deposit)이 불가능한 경우를 나타냅니다. 이 상황은 **예외 처리 또는 수동 개입(Manual Intervention)**이 요구됩니다.



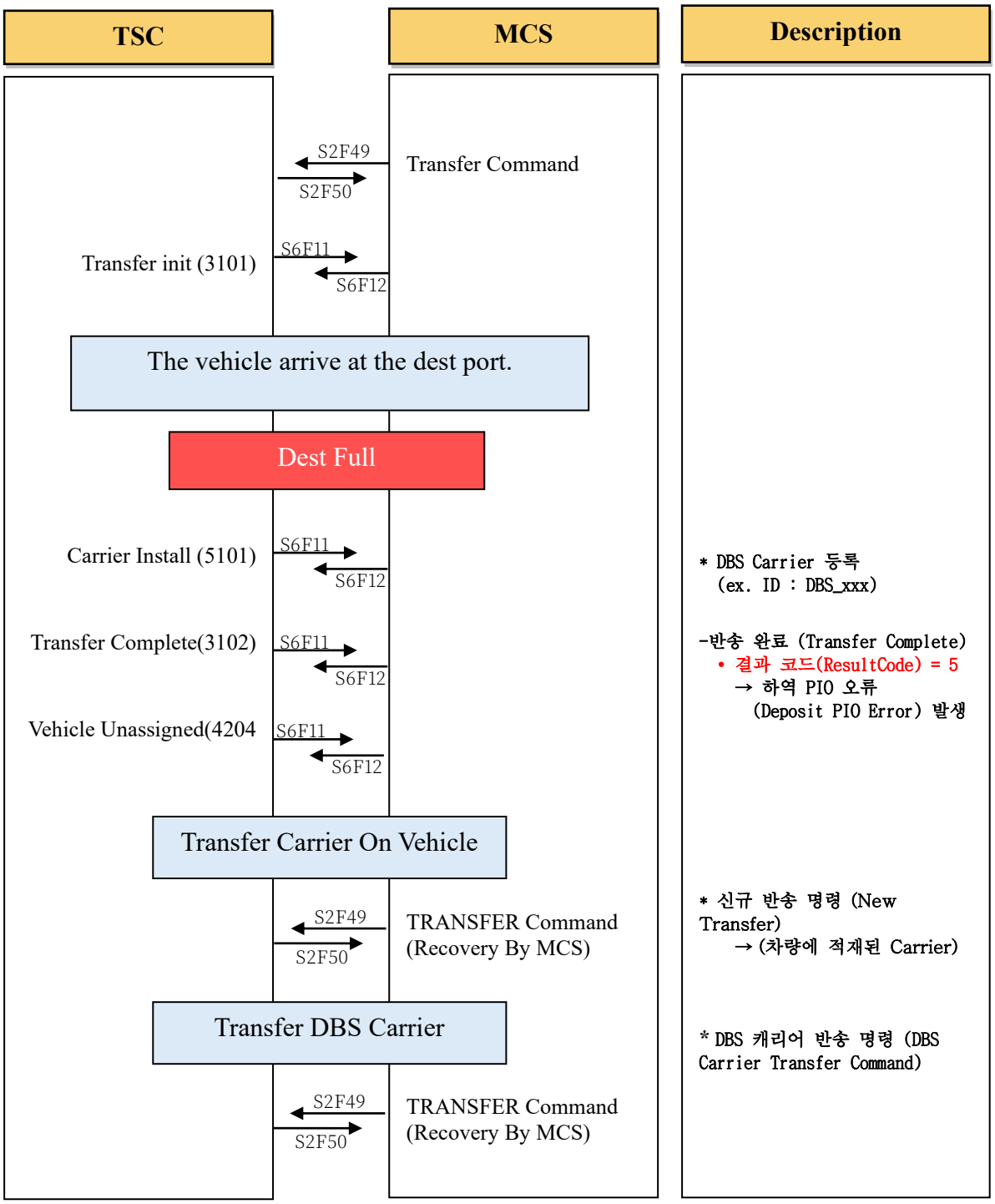
5.5.9. Source Empty – STB

이 시나리오는 반송 명령 수행 중 차량이 STB 내 출발지 포트에 도착했으나, 인수할 캐리어가 존재하지 않는 경우에 해당합니다.
이로 인해 시스템은 인수(Acquire) 절차를 진행할 수 없으며, 오류 처리 로직이 수행됩니다.



5.5.10. Dest Full- STB

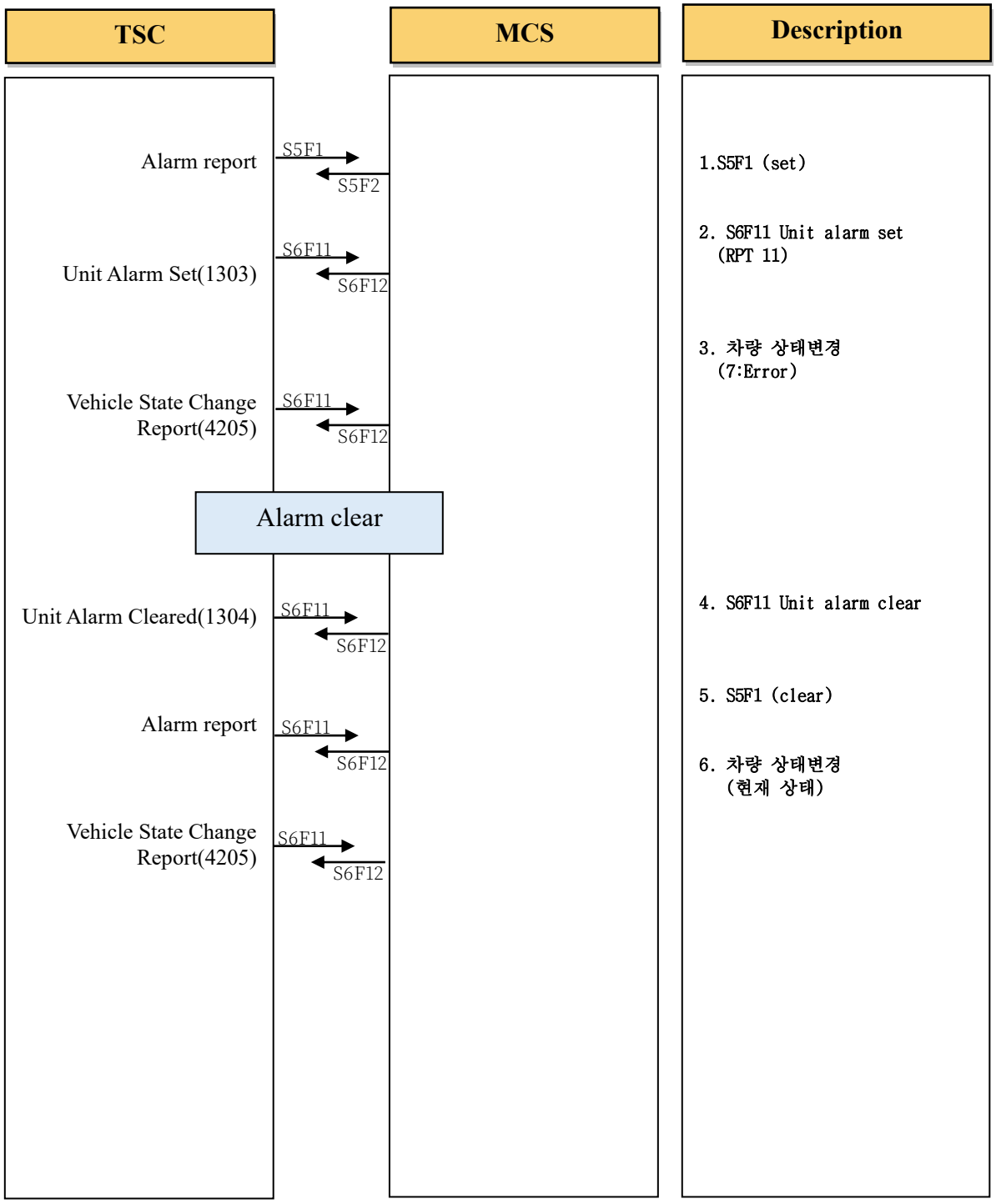
이 시나리오는 차량이 STB 내 도착 포트에 도착했으나, 해당 포트에 이미 캐리어가 적재되어 있는 경우에 해당합니다.
이로 인해 시스템은 하역(Deposit) 작업을 진행할 수 없으며, 오류 처리 또는 포트 재지정(Redirection) 등의 절차가 수행됩니다.



5.6.Alarm

5.6.1. Alarm Set/Clear

이 시나리오는 시스템이 **알람이 발생(설정, Set)되거나 해제(Cleared)**되는 상황을 보고하는 절차를 설명합니다.
설비나 공정에 이상이 발생할 경우, 시스템은 알람을 설정하고 호스트로 알람 발생 이벤트를 보고합니다.



4.7. Operation Summary

4.7.1. Vehicle Operation Summary Event

이 이벤트는 차량 운행 정보에 대한 요약 데이터를 제공합니다.
*협의된 사전 정의된 시간마다 발생하며, 포함 항목과 보고 시점은 상호 협의를 통해 조정할 수 있습니다.

