Table 8 Carrier Transfer Boundaries

Transfer Type	*Transfer Method*	*Starting Boundary*	*Ending Boundary*
LOAD	MANUAL	This starting boundary is specified by the user. Known examples of the starting boundary include but are not limited to; the presence sensor detecting a carrier, a load port door opening, input to the equipment by the operator through a switch at the load port or the equipment console.	This ending boundary is specified by the user. Known examples of the ending boundary include but are not limited to; a preset configurable time following presence and placement sensor detecting a carrier, a load port door closing, or input to the equipment by the operator through a switch at the load port or the equipment console or a service message.
	AUTO	The PIO signal "READY" is active for load. See SEMI E84.	PIO signals a transfer complete signal "COMPT". See SEMI E84.
UNLOAD	MANUAL	This starting boundary is specified by the user. Examples of the starting boundary include but are not limited to presence and placement sensor no longer detecting a carrier, a load port door opening, or input to the equipment by the operator through a switch at the load port or the equipment console or a service message.	This ending boundary is specified by the user. Examples of the ending boundary include but are not limited to a preset configurable time following presence and placement sensor no longer detecting a carrier, a load port door closing, or input to the equipment by the operator through a switch at the load port or the equipment console, or a service message.
	AUTO	The PIO signal "READY" is active for unload. See SEMI E84.	PIO signals a transfer complete signal "COMPT". See SEMI E84.

11.2 *Manual Carrier Transfer Confirmation Trigger*

11.2.1 For a manual transfer completion confirmation, the production equipment supplier must implement a software or hardware mechanism for an operator to inform the equipment that the carrier transfer is complete.

11.3 *Access Mode Initial Value*

11.3.1 Also, when equipment re-initialization occurs, the access mode(s) must be remembered, and used as the initial value when initializing. Since the access mode is remembered through re-initializations, the initial value that is used the very first time the software is ever loaded is not important. The equipment supplier is free to set this default value.

11.3.2 *Access Mode State Model Diagram*

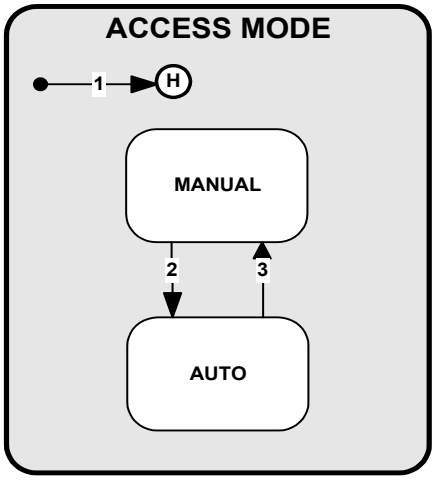


Figure 4
Access Mode State Model Diagram

11.3.3 *Access Mode State Definitions*

11.3.3.1 *ACCESS MODE* — The parent state for the MANUAL and AUTO sub-states.

11.3.3.2 *MANUAL* — A sub-state of ACCESS MODE. When the production equipment or specified load port is in this mode, only manual (non-AMHS) carrier transfers are allowed. The production equipment shall have the capability of generating an alarm if an automated (AMHS) delivery is attempted. If a ChangeAccess service with the value of MANUAL is received in this state, the equipment shall accept the service and no event is sent for this action.

11.3.3.3 *AUTO* — A sub-state of ACCESS MODE. When the production equipment or specified load ports are in this mode, only automated (AMHS) carrier transfers are allowed. The production equipment shall have the capability of generating an alarm if a manual delivery is attempted. If a ChangeAccess service with the value of AUTO is received in this state, the equipment shall accept the service and no event is sent for this action.

11.3.4 *Access Mode State Transition Table*

11.3.4.1 Table 9 defines the transitions for the Access Mode State Model.

Table 9 Access Mode State Transition Definitions

#	*Previous State*	*Trigger*	*New state*	*Actions*	*Comments*
1	(no state)	System restart.	MANUAL or AUTO (History)	The access mode returns to the mode it was previous to the system reset.	Data required to be available for this event report: PortID AccessMode
2	MANUAL	The host or operator has executed a ChangeAccess service with the value of AUTO. This trigger can happen at anytime, except during a carrier transfer.	AUTO		Manual deliveries are not allowed after this state transition. The operator may also trigger this transaction from the production equipment console. Data required to be available for this event report: PortID AccessMode
3	AUTO	The host or operator has executed a ChangeAccess service with the value of MANUAL. This trigger can happen at anytime, except during carrier transfer.	MANUAL		The operator may also trigger this transaction from the production equipment console or a manual switch at the load port. Automated transfers are not allowed after this state transition. Data required to be available for this event report: PortID AccessMode

12 Reservation State Model

12.1 The purpose of the Reservation State Model is to define the host view of future activity at a specific load port.

12.1.1 In the Reservation State Model, the ReserveAtPort and CancelReservationAtPort services enable the following items:

1. They enable the host to inform the equipment of a future carrier delivery without specifying the carrier ID and at the same time allow host based verification. (Equipment based verification is enabled via the Load Port/Carrier Association State Model, the Bind service, and the Carrier Notification service detailed in §13, ¶15.4.2 and ¶15.4.11 of SEMI E87.)
2. They enable the equipment to send a state change event to the host if the operator (either local or remote) informs the equipment of a future carrier delivery to a port without specifying the carrier ID. Thus the host

knows that the operator expects to use that port for something the host did not request for AMHS based delivery.

3. They enable internal buffer equipment to inform the host that it is physically initiating a carrier out operation (this carrier has a known or specified ID) and that no AMHS delivery should be scheduled.

4. The Bind and CancelBind services also trigger changes in the Load Port Reservation State Model. If the Load Port Reservation state model is in the NOT RESERVED state, the Bind service triggers a transition to the RESERVED state. If the Load Port Reservation is in the RESERVED State, the CancelBind service triggers a transition to NOT RESERVED.

12.1.2 For internal buffer equipment, the Reservation State Model, the ReserveAtPort service, the CancelReservationAtPort service, and all other associated functionality are necessary for fundamental compliance to this standard.

12.1.3 For fixed buffer equipment, the Reservation State Model, the ReserveAtPort service, the CancelReserveAtPort service, and all other associated functionality is a user option and not necessary for fundamental compliance.

12.1.4 For equipment implementing the reservation state model, the equipment shall provide a load port reservation state model for each load port.

12.2 *Reservation Visible Signal*

12.2.1 When a port reservation has taken place, the equipment shall display a visible signal indicating that the designated load port is in the Reserved State. Examples of visible signals for the associated load port are: Blinking LEDs, flags, color indicators, or other methods that allow easy recognition that the load port is reserved; proximity to or location on the load port is recommended. The visible signal shall remain present as long as the load port state remains RESERVED. When the state changes to NOT RESERVED the visible indicator shall cease. This capability is not required for fundamental compliance to CMS.

12.3 *Reservation State Model Diagram*

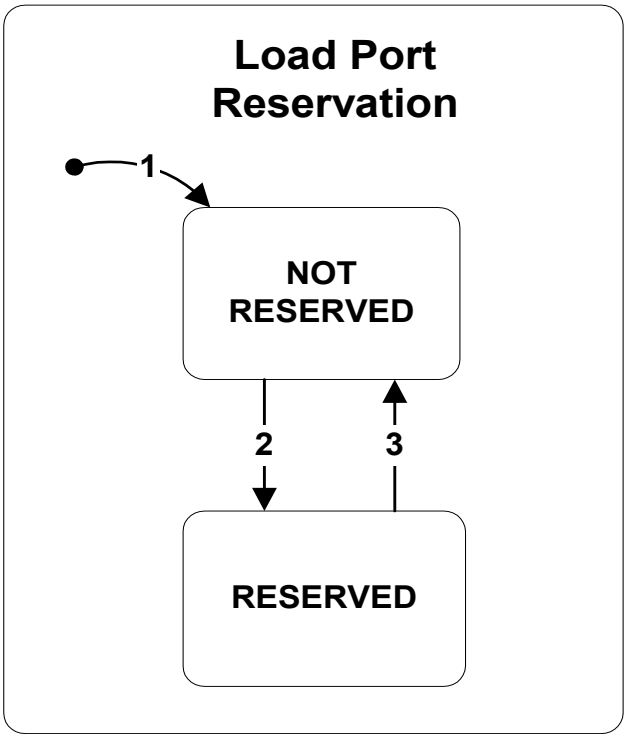


Figure 5
Reservation State Model Diagram

12.4 *Load Port Reservation State Definitions*

12.4.1 *LOAD PORT RESERVATION* — The super state of the substates NOT RESERVED and RESERVED.

12.4.2 *NOT RESERVED* — A substate of LOAD PORT RESERVATION, this state is active when there is no reservation existing at the load port.

12.4.3 *RESERVED* — A substate of LOADPORT RESERVATION, this state is active when there is a reservation for future activity at the load port. When in this state, the access mode for a load port may not be changed.

12.5 *Load Port Reservation State Transition Table*

Table 10 Load Port Reservation State Transition Table

#	*Previous State*	*Trigger*	*New State*	*Actions*	*Comments*
1	(no state)	System reset.	NOT RESERVED		No event report is required for this transition.
2	NOT RESERVED	*Service:* If reserved by service, the host or operator sends a ReserveAtPort or a Bind service to the production equipment. *CarrierOut:* This happens when the equipment physically initiates a CarrierOut operation.	RESERVED	If the user has configured the equipment to use the reservation visible signal indicator, it is activated for this load port.	Data required to be available for this event report: PortID LoadPortReservationState CarrierID may be included when a carrier out or a bind service triggers this transition.
3	RESERVED	*Service:* If a reservation is cancelled by service, the host or operator sends a CancelBind or a CancelReservationAtPort. *Carrier arrival:* A carrier arrives at the reserved port.	NOT RESERVED	If the user has configured the equipment to use the reservation visible signal, the indicator is deactivated for this load port.	Data required to be available for this event report: PortID LoadPortReservationState

12.6 *Relation of Reservation to Association*

12.6.1 The following figure indicates the relationship of Association to Reservation.

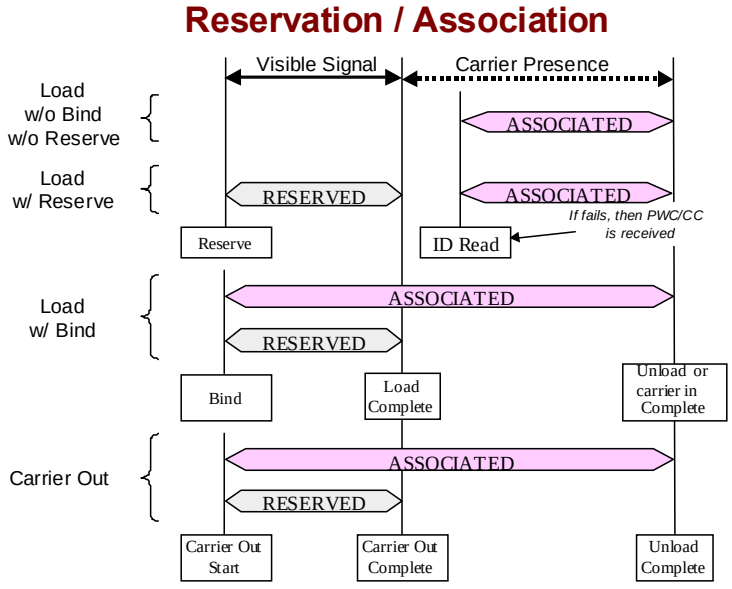


Figure 6
Relation of Reservation to Association

13 Load Port/Carrier Association State Model

13.1 The purpose of the Carrier Association State Model is to define the host view of carrier to load port association of the production equipment, as well as the host interactions with the production equipment necessary to associate a carrier to load port, and to perform equipment based carrier verification. Each load port shall maintain an independent instance of the Carrier Association State Model. Each instance of this state model must not influence the state of the same state model for a different load port.

13.1.1 This state model provides the ability to perform carrierID verification with two different methods. If the CarrierID is provided before the equipment reads the CarrierID, the CarrierID that becomes associated with the load port can be used later for equipment based carrier verification. If the association happens by CarrierID read (not by a service execution), then the production equipment shall report the CarrierID information in a data collection event.

13.2 *Load Port/Carrier Association State Model Diagram*

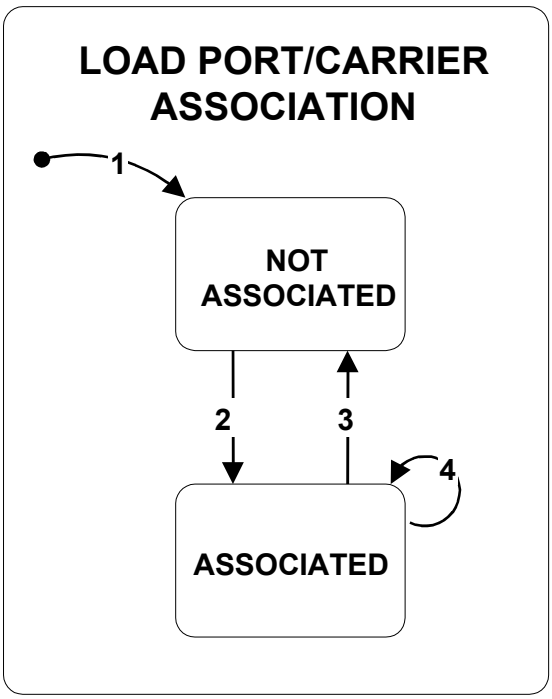


Figure 6
Load Port/Carrier Association State Model Diagram

13.2.1 *Load Port/Carrier Association State Definitions*

13.2.1.1 *LOAD PORT/CARRIER ASSOCIATION* — The parent state of the NOT ASSOCIATED and ASSOCIATED sub-states.

13.2.1.2 *NOT ASSOCIATED* — A sub-state of LOAD PORT/CARRIER ASSOCIATION. There is no carrier association present for this load port.

13.2.1.3 *ASSOCIATED* — A sub-state of LOAD PORT/CARRIER ASSOCIATION. A CarrierID has been associated with this load port. The load port is not available for a new carrier association.

13.2.2 *Load Port/Carrier Association State Transition Table*

13.2.2.1 Table 11 defines the transitions of the Load Port/Carrier Association State Model.

Table 11 Load Port/Carrier Association State Transition Definitions

#	*Previous State*	*Trigger*	*New State*	*Actions*	*Comments*
1	(no state)	System reset.	NOT ASSOCIATED		No event report is required for this transition
2	NOT ASSOCIATED	*Service Normal:* If associated by service in the noraml situation, the host sends a Bind service to the production equipment when the port is unoccupied. *Service Abnormal:* If associated with a service in an abnormal situation, the host sends a ProceedWithCarrierService to the production equipment when the load port is ocuupied. *CarrierID Read:* If associated by a CarrierID read, the production equipment creates the association at the time the CarrierID read is performed. *Known Carrier:* A carrier already known to the production equipment is being loaded onto the load port. This happens when the CarrierOut service is initiated.	ASSOCIATED		Once the CarrierID to load port association is complete, the load port is not available for association until the state returns to NOT ASSOCIATED again. Data required to be available for this event report: PortID CarrierID PortAssociationState
3	ASSOCIATED	*Service:* If cancellation of a load port association is required; then, this can be accomplished by sending a CancelBind service to the production equipment before the carrier arrives to the loadport or before a transfer sequence has started. *Carrier Unload:* An association cancellation may also be performed by removing the carrier from the load port or by the production equipment moving a carrier to an internal buffer position.	NOT ASSOCIATED		A carrier unload, may happen before or after processing occurs. The load port is available for another association once the carrier is removed. Data required to be available for this event report: PortID PortAssociationState

#	Previous State	Trigger	New State	Actions	Comments
4	ASSOCIATED	Production equipment based carrier verification fails, and the carrier assumes the ID value from the carrier that is on the load port. *Internal buffer:* A carrier is unloaded and a queued CarrierOut service starts.	ASSOCIATED	The existing carrierID that was associated by a Bind service is unassociated by the production equipment and the new carrierID is now associated to the Load Port. The production equipment shall delay further action until receiving either a CancelCarrier or a ProceedWithCarrier command from the host.	This transition only occurs when the Bind command has been used. Data required to be available for this event report: PortID CarrierID PortAssociateState

14 Verification

14.1 Verification is the operation of comparing an actual value with an expected value. Verification may be performed by either the host or the equipment, depending upon whether the host is using the Bind service or not.

14.1.1 If the host provides the expected value before the actual value is obtained by the production equipment, then the production equipment shall perform the verification.

14.1.2 If the host does not provide the expected value, using the Bind service, before the actual value is read, then the production equipment shall provide to the host, the information necessary for host based verification.

14.1.3 There are two values that are defined by Carrier Management that require verification: Carrier ID and Carrier Slot Map.

14.2 *CarrierID Verification*

14.2.1 Table 12 defines the methods for verifying the Carrier ID.

Table 12 Carrier ID Verification Methods

Verification Method Desired	*Host Actions before Load*	*Equipment Action When Carrier Is Loaded*	*Host Actions after Load*
Production Equipment Based	*Bind Service:* The host executes the Bind service to associate a load port and a CarrierID.	*Bind Service:* The production equipment reads the Carrier ID from the carrier, compares it to the CarrierID supplied with the Bind service.	
		Verification Passed: Transition 6 of the Carrier State Model occurs. The production equipment proceeds with processing.	*Verification Passed:* None.
		Verification Failed: The equipment initiates by itself a CancelBind and destroys the carrier created with the "Bind" service and instantiates a new carrier with the newly read CarrierID. The carrier shall not be opened or moved to an internal buffer in the production equipment until and unless the ProceedWithCarrier service is received from the host.	*Verification Failed:* The host uses either the CancelCarrier service to force the carrier to the unload position, or indicates to the production equipment that it may proceed with the unexpected carrier, by sending the ProceedWithCarrier service. In both cases the carrierID specified in the service is equal to the one determined by the carrierID read.

Verification Method Desired	*Host Actions before Load*	*Equipment Action When Carrier Is Loaded*	*Host Actions after Load*
	Carrier Notification Service: The host executes the CarrierNotification service to inform the equipment of the future arrival of a carrier to an unspecified port.	*Carrier Notification Service:* The production equipment reads the Carrier ID from the carrier, compares it to the CarrierID supplied with a CarrierNotification service.	
		Verification Passed: Transition 6 of the Carrier State Model occurs. The production equipment proceeds with processing.	*Verification Passed:* None.
		Verification Failed: Not Applicable; because there is no association between a load port and a carrier, equipment based verification failure is not possible. If a carrier that has not been instantiated arrives at a load port, the equipment shall consider this as host based verification.	*Verification Failed:* Not Applicable, because there is no association between a load port and a carrier, equipment based verification failed is not possible. If a carrier that has not been instantiated arrives at a load port, the equipment shall consider this as host based verification." The host will respond with either a ProceedWithCarrier or a CancelCarrier Service. (See Host Based verification method).
Host Based	None required, the host may issue a ReserveAtPort service.	The production equipment reads the CarrierID and reports it to the host in an event report. Following carrierID read the equipment initiates Transition 3 of the Carrier State Model and a carrier object with the carrierID equal to the one determined by the carrierID read is instantiated. The carrier shall not be opened or moved to an internal buffer in the production equipment until and unless the ProceedWithCarrier service is received from the host.	*Verification Passed:* The host sends a ProceedWithCarrier service indicating the verification passed.
			Verification Failed: The host uses the CancelCarrier or CancelCarrierAtPort service to force the carrier to the unload position.

14.3 *Slot Map Verification*

14.3.1 Table 13 defines the methods for verification of the Carrier Slot Map. Some user's factory operations may not require strict management of the slot map. In this case the user may use the host based verification method.

Table 13 Slot Map Verification Methods

Verification Method Desired	*Host Actions Before Verification*	*Equipment Action When Carrier is Loaded*	*Host Actions After Load*
Production Equipment Based	The host provides a Slot Map with the Bind service or the ProceedWithCarrier service.	The production equipment checks the carrier slot map and compares it to the slot map supplied by the host. Either transition 13 or 14 of the Carrier State Model occurs.	*Verification Passed:* None, the production equipment proceeds with the carrier. *Verification Failed:* If the host decides to cancel processing, the host issues the CancelCarrier service. If the host decides to continue processing, the host issues the ProceedWithCarrier service.

Verification Method Desired	*Host Actions Before Verification*	*Equipment Action When Carrier is Loaded*	*Host Actions After Load*
Host Based	None.	The production equipment checks the carrier slot map and reports it to the host in an event report. The host has the responsibility for verifying the slot map.	*Verification Passed:* The host sends a ProceedWithCarrier indicating the verification passed. *Verification Failed:* If the host decides to cancel processing, the host issues the CancelCarrier service. If the host decides to continue processing, the host issues the ProceedWithCarrier service.

14.4 This table clarifies the relation of the reservation and verification to the related services.

Table 14 Reservation and Verification Relation to Service

	Reser-vation	*CarrierID Verification*	*Carrier SlotMap Verification*	*Service Used*	*Information Provided with Service*		
					Port ID	*Carrier ID*	*Carrier SlotMap*
1	Yes	Equipment based	Equipment based	Bind	Yes	Yes	Yes
2	Yes	Equipment based	Host based	Bind	Yes	Yes	No
3	Yes	Host based	Host based	ReserveAtPort	Yes	No	No
				ProceedWithCarrier (following ID read and host verification).	No	Yes	No
4	Yes	Host based	Equipment based	ReserveAtPort	Yes	No	No
				ProceedWithCarrier to provide slotmap (following ID read and host verification).	No	Yes	Yes
5	No	Equipment based	Equipment based	CarrierNotification	No	Yes	Yes
6	No	Equipment based	Host based	CarrierNotification	No	Yes	No
7	No	Host based	Equipment based	ProceedWithCarrier to provide slotmap (following ID read and host verification).	No	Yes	Yes
8	No	Host based	Host based	ProceedWithCarrier (following ID read and host verification).	No	Yes	No

15 Carrier Release Control

15.1 For both fixed buffer and internal buffer equipment, where Carrier Read/Write technology is used, the carrier must remain at the write position where the tag may be accurately written on until the Host has completed all of its read and write operations. For this purpose, a variable that affects the equipment releasing a carrier is defined.

15.2 *Carrier Hold Trigger* — Both fixed buffer equipment and internal buffer equipment shall allow the user to select a trigger to release the carrier when reading/writing is complete. Carrier release does not mean the equipment must move the carrier from the location it currently occupies, only that it is permissible to do so.

15.2.1 *CarrierHold Trigger set to Host Release* — If the Carrier Hold trigger is set to Host Release, both fixed buffer and internal buffer equipment shall hold the carrier at the write position until the CarrierRelease service is received.

15.2.2 *CarrierHold Trigger set to Equipment Release* — If the Carrier Hold trigger is set to Equipment Release, the equipment shall release the carrier based on the Carrier Object state model transition to CARRIER COMPLETE or CARRIER STOPPED.

15.3 For fixed load port equipment in AUTO access mode, it may be desirable to leave a completed carrier clamped, locked, or at the docked position until the AMHS arrives to pick it up. This reduces the chance that an operator may remove it. For this purpose, a variable that affects UnClamp Control is provided to allow the user to select the desired behavior. When the equipment finishes with a carrier, the Carrier State transitions from ACCESSING to CARRIER COMPLETE (normal) or CARRIER STOPPED (abnormal) and the equipment sends

either the CarrierComplete event (normal) or the CarrierStopped event (abnormal). If the carrier has a door, the door shall be closed by this point.

15.4 Fixed buffer equipment shall allow the user to select a trigger to unclamp the carrier based on AMHS arrival at the equipment. If the access mode is MANUAL, the unclamp control trigger has no effect.

15.4.1 *UnclampControl trigger set to CARRIERCOMPLETE/CARRIERSTOPPED Triggered Unclamp* — The equipment automatically unclamps the carrier when the Carrier Status transitions to CARRIERCOMPLETE or CARRIERSTOPPED.

15.4.2 *UnclampControl trigger set to AMHS Triggered Unclamp* — The equipment behavior depends upon the Load Port Access State. If the Loadport Access State is AUTO, the carrier remains clamped, locked, or at the docked position (it will remain at the docked position only if that is the only position on which the carrier can be clamped) until AMHS has arrived. The AMHS arrives and begins a PIO unload sequence. The carrier must be at or moved to the pickup position and any additional clamp mechanisms must be released by the appropriate point of the sequence.

NOTE 2: It may be necessary to adjust timeouts for the AMHS to allow a few more seconds to move the carrier into the pickup position.

16 Services

16.1 The purpose of this section is to define the message services required to support CMS functionality.

16.1.1 This message service definition has four parts:

- A service description table.
- A service parameter table.
- A service parameter value table that specifies the type and range of the parameters.
- A service state mapping table that defines the states in which each service is valid.

16.2 *Service Message Description*

16.2.1 There are two types of services:

- An initial message and response between the service user and the service provider.
- A notification message from the service provider to the service user that does not require a response.

16.2.2 The “TYPE” column in the following table is used to indicate whether the service consists of a request/response message pair, “R”, or a single notification message, “N”.

Table 15 Service Message Description

Service Name	*Type*	*Description*
Bind	R	This service shall associate a CarrierID to a load port and shall cause the load port to transition to the RESERVED state.
CancelAllCarrierOut	R	This service shall cause all CarrierOut services to be removed from the queue.
CancelBind	R	This service cancels a CarrierID to load port association and shall cause the load port to transition to the NOT RESERVED state.
CancelCarrier	R	This service shall Cancel the current carrier related action, and the production equipment shall return the carrier to the unload position of the load port, or an internal buffer position, depending on the carrier’s position in the production equipment.
CancelCarrierAtPort	R	This service shall Cancel the current carrier related action, and the production equipment shall return the carrier to the unload position of the load port.
CancelCarrierNotification	R	This service shall cause the equipment to destroy a carrier object instantiated through a prior CarrierNotification.
CancelCarrierOut	R	This service shall cause a specified CarrierOut service to be removed from the queue by the production equipment.

Service Name	*Type*	*Description*
CancelReservationAtPort	R	This service shall cause the equipment to remove the reservation at the specified Port and to deactivate the visible signal.
CarrierIn	R	This service shall cause a carrier to be moved from a load port to an internal buffer location. Used in anomaly situations.
CarrierNotification	R	This service shall cause the equipment to instantiate a carrier object.
CarrierOut	R	This service shall cause a carrier to be moved from the internal buffer to a load port. This service can be queued by the production equipment.
CarrierReCreate	R	This service shall cause the carrier object (and consequently, associated state models of the object) specified by the service to be recreated. This service shall be accepted only if the load port is in the "Ready to Unload" state.
CarrierRelease	R	Release the carrier from Carrier Hold
CarrierTagReadData	R	Read data from carrier ID tag.
CarrierTagWriteData	R	Write data to the carrier ID tag.
ChangeAccess	R	This service shall change the access mode of the specified Ports at the production equipment. If the equipment is unable to change one or more of the specified port(s) to the specified Access Mode, then the equipment shall accept the command (with appropriate response acknowledgement), and shall change only the Access Mode of those Port(s) allowed by the equipment, supplying host with an indication that not all ports were successfully changed.
ChangeServiceStatus	R	This service shall change the transfer status of a specified load port at the production equipment.
ProceedWithCarrier	R	This service shall instruct the production equipment to proceed with using the specified carrier.
ReserveAtPort	R	This service shall cause the equipment to reserve the specified Port and activate a visible signal. This service is a Transfer boundary.

16.3 *Service Message Parameter Definition*

16.3.1 The following is a list of required parameters used in conjunction with service messages.

Table 16 Service Message Parameter Definition

Parameter Name	*Form*	*Description*
AccessMode	Enumerated AUTO, MANUAL.	The desired access mode of the ports specified.
AttributeData	Could be several different data types.	The data value associated with AttributeID.
AttributeID	Text 1 to 40 characters.	Identifier of the object attribute in the PropertiesList.
CarrierID	Text Conforms to ObjID as defined in SEMI E39.	Identifier of a carrier.

Parameter Name	*Form*	*Description*
CMAcknowledge	Enumerated: • Acknowledge, command has been performed • Invalid command • Cannot perform now • Invalid data or argument • Acknowledge, request will be performed with completion signaled later by an event • Rejected, invalid state	Acknowledgement of request. Some services are commanding a certain task to be performed. This task is only completed if the expected end-condition is reached or has failed. A number of services only have effect on a 'logical' level (e.g. Bind, CancelReservationAtPort). Those services in general can be acknowledged right away after having performed the task. Other services that include triggering of physical movements (e.g. CarrierOut, CancelCarrier) most likely will be interpreted as "request action to be initiated" rather than "do action". The equipment will reply in those cases the command "is going to be performed". This alleviates transaction timeouts for these services that may take a long time to perform. It is however up to the supplier to decide if this is applicable. The completion of the task initiated by the services commanding some task to be performed (either acknowledged or going to be performed) must result in either a state transition or other action that generates a collection event upon normal / abnormal completion.
CMStatus	A structure consisting of CMAcknowledge and Status.	Return information for a service.
Data	Text.	User data.
DataSeg	Protocol-specific.	Indicates specific section of data to read or write.
DataSize	Unsigned integer.	Indicates the number of bytes of data to read or write.

Parameter Name	*Form*	*Description*
ErrorCode	Enumerated: *Valid for all services listed below* Unsupported option [service] requested Command not valid for current state Insufficient parameters specified Parameters improperly specified *Bind* Load port does not exist Load port already in use Object identifier in use, Duplicate CarrierID Invalid attribute value Unknown attribute name *CancelAllCarrierOut* (none) *CancelBind* Load port does not exist Unknown object instance – Unknown CarrierID *CancelCarrier* Load port does not exist Unknown object instance – Unknown CarrierID Missing Carrier *CancelCarrierAtPort* Load port does not exist *CancelCarrierNotification* Unknown object instance – Unknown CarrierID *CancelCarrierOut* Unknown object instance – Unknown CarrierID *CancelReservationAtPort* Load port does not exist *CarrierIn* Unknown object instance – Unknown CarrierID *CarrierNotification* Object identifier in use, Duplicate CarrierID Invalid attribute value Unknown attribute name *CarrierOut* Load port does not exist Unknown object instance – Unknown CarrierID *CarrierReCreate* Unknown object instance – Unkown CarrierID Invalid attribute value Unknown attribute name Command not valid for current state *ChangeAccess* Load port does not exist *ChangeServiceStatus* Load port does not exist *ProceedWithCarrier* Load port does not exist Unknown object instance – Unknown CarrierID Invalid attribute value Unknown attribute name *ReserveAtPort* Load port does not exist Load port already in use	Contains the code for the specific error found.
ErrorText	Text	Text in support of the error code.

Parameter Name	*Form*	*Description*
PortID	Integer 1 to n.	ID number of a load port. The PortID number should be the same as the load port number.
PortList	List 1 to n items.	List of n items $PortID_1$ . . n $PortID_n$
PropertiesList	List 1 to n name/value pairs.	List of n items 1. $AttributeID_1$ $AttributeData_1$ . . n. $AttributeID_n$ $AttributeData_n$
ServiceStatus	Enumerated: IN SERVICE, or OUT OF SERVICE.	The desired transfer service status of the specified list of load ports.
Status	A list of ErrorCode/ErrorText pairs.	Reports any errors found.

16.3.2 The "Acknowledge, request will be performed with completion signaled by a later event" response to a service, may apply to services listed in the table below. If this does apply, the supplier must document the event that signals completion. Any service not included in Table 17 shall respond with "Acknowledge, command has been performed."

16.3.2.1 Events that may signal completion are listed in Table 17.

Table 17 Deferred Completion Events

Service	*Events that may signal completion*
CarrierOut	CarrierLocation Changed Event Load Port State Change Event (transition 9)
CarrierIn	CarrierLocation Change Event Load Port State Change Event (transition 8)
CancelCarrier	CarrierLocation Changed Event Load Port State Change Event (transition 9)
CancelCarrierAtPort	CarrierLocation Changed Event Load Port State Change Event (transition 9)
ChangeService	LoadPortTransferState Change Event (transition 2 and 3)
ChangeAccess	Load Port Access Mode State Change Event (transition 2 and 3)

16.4 *Service Message Definitions*

16.4.1 The following tables specify the allowable/required parameters for each service. The column marked "REQ/IND" specifies which parameters are required to be supported for CMS compliance (see ¶7.3.4.3).

16.4.2 *Bind*

16.4.2.1 The Bind service is used to associate a CarrierID with a load port. The Bind can contain a PropertiesList of carrier object attributes that are supplied by the host. A carrier object is instantiated when this service is used successfully. The Bind service will be rejected if the carrier specified has already been instantiated through the Bind or CarrierNotification service, or a carrierID read. The Bind service also triggers a transition in the Load Port Reservation state model from NOT RESERVED to RESERVED.

Table 18 Bind Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
PortID	M	—	The PortID where a carrier is expected.
CarrierID	M	—	The expected CarrierID.
PropertiesList	C	—	A list of name value pairs providing attributes for the carrier object being instantiated with the Bind service.
CMStatus	—	M	Information concerning the result of the service.

16.4.3 *CancelAllCarrierOut*

16.4.3.1 The CancelAllCarrierOut service is sent to internal buffer production equipment to cancel all CarrierOut services in queue.

Table 19 CancelAllCarrierOut Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
CMStatus	—	M	Information concerning the result of the service.

16.4.4 *CancelBind*

16.4.4.1 The CancelBind request is used to cancel the association between a port and a Carrier ID. The carrier object is destroyed when this service is used successfully. The CancelBind service also triggers a transition in the Load Port Reservation state model from RESERVED to NOT RESERVED.

Table 20 CancelBind Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
PortID	C	—	The PortID for which to cancel the load port to carrier association. Either PortID or CarrierID must be specified.
CarrierID	C	—	The CarrierID for which to cancel the load port to carrier association. Either PortID or CarrierID must be specified.
CMStatus	—	M	Information concerning the result of the service.

16.4.5 *CancelCarrier*

16.4.5.1 The CancelCarrier request is used to stop a carrier. If the carrier is at a load port, then it shall be returned to the load/unload location of the load port and made ready for unload. If the carrier is at an internal location the carrier will return to an internal buffer location. A subsequent CarrierOut request is required for the production equipment to move the carrier to the external load port. The production equipment shall reject this service if issued after substrates have been removed for processing.

Table 21 CancelCarrier Service Parameters

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
CarrierID	M	—	The carrierID to cancel.
CMStatus	—	M	Information concerning the result of the service.
PortID	C	—	The PortID where the carrier object is located. This parameter is not required if the carrier object has been previously instantiated.

16.4.6 *CancelCarrierAtPort*

16.4.6.1 CancelCarrierAtPort is used to abort any carrier at a designated port. This service can be used when the carrierID of the carrier at the designated port is unknown.

Table 22 CancelCarrierAtPort Service Parameters

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
PortID	M	—	Any carrier that exist on the load port specified shall be made ready for unloading.
CMStatus	—	M	Information concerning the result of the service.

16.4.7 *CancelCarrierNotification*

16.4.7.1 The CancelCarrierNotification is used by the host to request the equipment cancel a previous CarrierNotification service. This service shall cause the equipment to destroy the carrier object specified.

Table 23 CancelCarrierNotification Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
CarrierID	M	—	The CarrierID of the carrier object to destroy.
CMStatus	—	M	Information concerning the result of the service.

16.4.8 *CancelCarrierOut*

16.4.8.1 The CancelCarrierOut service is sent to internal buffer production equipment to cancel a queued CarrierOut.

Table 24 CancelCarrierOut Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
CarrierID	M	—	CarrierID for the CarrierOut service that is being cancelled.
CMStatus	—	M	Information concerning the result of the service.

16.4.9 *CancelReservationAtPort*

16.4.9.1 The CancelReservationAtPort service is sent by the host to cancel a reservation at the load port. The load port will enter the UNRESERVED State after receiving this service. A Port reserved by the physical initiation of a carrier out operation may not be cancelled by this service.

Table 25 CancelReservationAtPort Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
PortID	M	—	The Port ID to reserve
CMStatus	—	M	Information concerning the result of the service.

16.4.10 *CarrierIn*

16.4.10.1 The CarrierIn service is only used to request the internal buffer equipment internalize a carrier that has been moved to the load port via a previous CarrierOut service. When using host based verification, the production equipment shall move the carrier in to the internal buffer for the first time after receiving the ProceedWithCarrier request. If the CarrierIn service is received by the production equipment without previously having received a CarrierOut service for the carrier, the service will be refused.

Table 26 CarrierIn Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
CarrierID	M	—	The CarrierID for the carrier to internalize.
CMStatus	—	M	Information concerning the result of the service.

16.4.11 *CarrierNotification*

16.4.11.1 The Carrier Notification service is used by the host to inform the equipment that a Carrier with the ID specified will be arriving at the equipment. The load port is not specified; therefore no carrier to load port association takes place. A carrier object with the ObjID equal to the carrierID specified in the service is instantiated. "The CarrierNotification service will be rejected if the carrier specified has already been instantiated through the Bind or CarrierNotification service, or a carrierID read.

Table 27 CarrierNotification Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
CarrierID	M	—	The CarrierID of the carrier object to instantiate.
PropertiesList	C		The PropertiesList of the carrier to instantiate.
CMStatus	—	M	Information concerning the result of the service.

16.4.12 *CarrierOut*

16.4.12.1 The CarrierOut service is sent to internal buffer production equipment, to request that the equipment move the specified carrier to a load port, as soon as the carrier is completed. When the CarrierOut service is started, the destination load port state becomes TRANSFER BLOCKED, and the load port's association state becomes ASSOCIATED.

16.4.12.2 *CarrierOut Queuing*

16.4.12.2.1 This service request can be queued by the production equipment. The production equipment is required to support a queue of n size, where n is equal to the sum of the number of internal buffer locations and the number of internal FIMS ports. The order of the queue is FIFO for each load port. If the load port is not specified in service request, the equipment chooses which load port queue to place the CarrierOut service. The queued service does not take effect until the current substrate handling action is complete (i.e., filling, emptying of the carrier) and the load port is in the NOT ASSOCIATED state. When a CarrierOut service is queued and the production equipment load port is currently in the TRANSFER BLOCKED state, the production equipment shall keep the load port in the TRANSFER BLOCKED state. Then, after the port is cleared, the CarrierOut service shall begin.

Table 28 CarrierOut Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
CarrierID	M	—	CarrierID for the carrier to be moved out.
PortID	C	—	If omitted, the production equipment shall select an appropriate port at the time the carrier is ready to be moved.
CMStatus	—	M	Information concerning the result of the service.

16.4.13 *CarrierRelease*

16.4.13.1 CarrierRelease request is used to tell the equipment that the carrier is ready to be moved away from the read or write position. Equipment shall deny the request if PortID and CarrierID are mismatched.

Table 29 CarrierRelease Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
PortID	C	—	The ID for the location of the carrier. Either PortID or CarrierID must be used. For internal buffer equipment when the service is used at an internal location, only the carrierID is required.
CarrierID	C	—	The CarrierID of the carrier. Either LocationID or CarrierID must be used.
CMStatus	—	M	Information concerning the result of the service.

16.4.14 *CarrierReCreate*

16.4.14.1 CarrierReCreate request is used to re-create the carrier object specified by the service. This will allow a repeated introduction of the same carrier on the loadport. After the service is issued, the equipment shall treat the carrier occupying the respective loadport identically to one that was physically removed and replaced, deleting the original carrier and then re-instantiating it. If no PropertiesList is provided with the service, then the host verification scenarios for re-instantiating the carrier object shall be followed. For example, the carrier ID would be re-read (at which point Carrier State transition #3, (no state) to Waiting for Host occurs) and subsequently verified by host, followed by slot map re-read and verification by host. Alternatively, if PropertiesList is provided with this service, then the equipment shall follow the equipment based verification steps. For example, the carrier object is re-instantiated with the CarrierID (and possibly content/slot map) information provided within the CarrierReCreate Service. In this equipment based verification scenario, the equipment is responsible for verifying the contents of the carrier against the received information. If the equipment supports other SEMI standards (i.e.- SEMI E40/E90/E94), then from the perspective of those standards, when CarrierReCreate service is received, the scenario would resemble that of a carrier being removed and a new carrier placed. The service shall be accepted only if the load port is in the "Ready to Unload" state.

Table 30 CarrierReCreate Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
CarrierID	M	—	Carrier ID for the carrier object the service is to be performed upon
PropertiesList	C	—	If sent by the host, then equipment based verification scenario. If not, then host based verification scenario.
CMStatus	—	M	Information concerning the result of the service

16.4.15 *CarrierTagReadData*

16.4.15.1 CarrierTagReadData is used to request a block of data from the carrier ID tag. Equipment shall deny the request if LocationID and CarrierID are mismatched.

Table 31 CarrierTagReadData Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
LocationID	C	—	The ID for the location of the carrier. Either LocationID or CarrierID must be used.
CarrierID	C	—	The CarrierID of the carrier. Either LocationID or CarrierID must be used.
DataSeg	C	—	Indicates a specific section of data.
DataSize	C	—	Indicates the number of bytes to read.
Data	—	C	Data from the carrier ID tag. May be NULL if no data exists for the given section.
CMStatus	—	M	Information concerning the result of the service.

16.4.16 *CarrierTagWriteData*

16.4.16.1 CarrierTagWriteData is used to request that a block of data be written to the carrier ID tag. Equipment shall deny the request if LocationID and CarrierID are mismatched.

Table 32 CarrierTagWriteData Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
LocationID	C	—	The ID for the location of the carrier. Either LocationID or CarrierID must be used.
CarrierID	C	—	The CarrierID of the carrier. Either LocationID or CarrierID must be used.
DataSeg	C	—	Indicates a specific section of data.
DataSize	C	—	Indicates the number of bytes to read.
Data	M	—	Data from the carrier ID tag. May be NULL if no data exists for the given section.
CMStatus	—	M	Information concerning the result of the service.

16.4.17 *ChangeAccess*

16.4.17.1 The ChangeAccess message requests a change of access mode for the load ports specified in the PortList.

Table 33 ChangeAccess Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
AccessMode	M	—	The new desired access mode.
PortList	M	—	The list of ports to use the new access mode.
CMStatus	—	M	Information concerning the result of the service.

16.4.18 *ChangeServiceStatus*

16.4.18.1 The ChangeServiceStatus service is used to request the production equipment change a load port service state.

Table 34 ChangeServiceStatus Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
PortID	M	—	PortID to designate the new service status.
ServiceStatus	M	—	The new service state.
CMStatus	—	M	Information concerning the result of the service.

16.4.19 *ProceedWithCarrier*

16.4.19.1 The ProceedWithCarrier service is sent by the host to indicate that the carrier operations may continue. When using host based verification it is used by the host to indicate to the production equipment that the verification of Carrier ID and/or the Carrier Slot Map is correct. For successful production equipment based verification the production equipment shall not require this message before proceeding with the carrier. For failed production equipment based verification the production equipment shall require either a CancelCarrier or ProceedWithCarrier service.

16.4.19.2 Using Table 34, for the Host based CarrierID verification case, the ProceedWithCarrier service sent by the host after the first carrier ID read is referred to as ProceedWithCarrier #1, the ProceedWithCarrier service sent after slot map read is referred to as ProceedWithCarrier #2.

Table 35 ProceedWithCarrier Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
PortID	C	—	The PortID for which processing may proceed.
CarrierID	M	—	The CarrierID for which processing may proceed.
PropertiesList	C	—	A list of name value pairs providing attributes for the carrier object.
CMStatus	—	M	Information concerning the result of the service.

16.4.20 *ReserveAtPort*

16.4.20.1 The ReserveAtPort service is sent by the host to indicate future activity at the load port. This allows for reserving the port but doing host based ID verification. The load port will enter the RESERVED State after receiving this service. The equipment shall move a carrier to a reserved load port.

Table 36 ReserveAtPort Service Parameter Definitions

Parameter Name	*Req/Ind*	*Rsp/Conf*	*Description*
PortID	M	—	The Port ID to reserve
CMStatus	—	M	Information concerning the result of the service.

17 Carrier Tag Read/Write

17.1 Some technologies allow data to be stored on a carrier ID tag where it can be subsequently read and/or modified. In this case, it is the host that specifies when this data is written and read, because the equipment has no knowledge of the contents of the data. The read operations shall be performed only when the carrier is at the read position. The write operations shall be performed only when the carrier is at the write position. NOTE: The read and write positions may be the same position. The host shall be able to both read and write whenever CarrierHold switch is set to Host Release and the carrier is at the respective read or write position. Once the host has completed all of its read and write operations for that carrier, then the host sends the CarrierRelease request to the equipment. In all cases, the CarrierAccessingStatus state shall be set to either CARRIER COMPLETE or CARRIER STOPPED before the carrier may be undocked. The CarrierRelease service informs the equipment that carrier read or carrier write is complete. For internal buffer equipment the CarrierRelease service shall allow the equipment to move the carrier away from the read or write position.

Figure 7The CarrierRelease service has a different purpose from the CarrierOut service. The intent of the CarrierOut service request is to move the carrier to a loadport, while the intent of the CarrierRelease service request is to inform equipment that it may move the carrier away from the read or write position. Therefore, CarrierOut may also be used with the CarrierRelease command. If CarrierHold is Host Release, then the carrier shall be kept at the write position until an CarrierRelease service request is received, regardless of when a CarrierOut is sent. If CarrierHold is set to Equipment Release, then the CarrierRelease request has no effect.

18 Additional Events

18.1 This section identifies data collection events that are not related to State transitions for variable data items. The intent of this section is to ensure certain data is available for specific events that are not related to state transitions, not to define all the additional collection events for CMS. Also, all state transitions in CMS state models are required to have associated event reports.

18.2 *Buffer Capacity Changed Event*

18.2.1 An event shall be generated whenever Buffer Capacity changes. This applies to all internal buffers and internal buffer partitions.

18.2.2 Data required to be available for this event report:

- BufferPartitionInfo.

18.3 *Carrier Approaching Complete Event*

18.3.1 In some cases, for carrier transfer efficiency, the host needs to know carrier completion timing a little faster than actual. For example:

- If the equipment is internal buffer type, QTAT carriers need to be moved out directly from internal FIMS to a load port to shorten moving out time.
- If the equipment uses non-product carriers, such as dummy, they need to be changed before it becomes not reusable to prevent stopping the equipment operation.
- If the equipment uses non-product carriers, such as test, reject, they need to be changed before it becomes empty or full to prevent stopping the equipment operation.

18.3.2 This event shall be generated when the access by the equipment to the carrier is approaching complete. How the timing of the event is determined shall be configurable.

18.3.3 Detailed definition of the event timing depends upon the type of usage of the carrier. Some examples of event timing for different types of usage are shown below.

18.3.3.1 *PRODUCT* — When remaining time until the carrier starts moving from internal FIMS to internal buffer reaches the configurable variable time (internal buffer equipment only).

18.3.3.2 *DUMMY* — When remaining times until substrates of the carrier becomes not reusable reaches the configurable variable times.

18.3.3.3 *TEST* — When remaining substrates until the carrier becomes empty reaches the configurable variable number.

18.3.3.4 *REJECT* — When remaining slots until the carrier becomes full reaches the configurable variable number.

18.3.4 Suppliers shall document the interpretation and the configurable variable(s) in the equipment specification document.

18.3.5 Data required to be available for this event report:

- CarrierID

18.4 *Carrier Clamped Event*

18.4.1 An event shall be generated whenever a carrier is clamped. Clamped means the load port has engaged a device that would inhibit removal or movement of the carrier by any entity external to the load port. Some load ports may include more than one clamping device. This event should be generated only when the first clamping is engaged. This applies to all load ports.

18.4.2 There is no standard for when load ports clamp a carrier. Therefore the IC makers host systems and personnel will need some signal from the equipment to know if a carrier is clamped. This event provides that signal. This applies to all load ports that provide clamping. If a load ports does not clamp the carrier no event is required.

18.4.3 Data required to be available for this event report:

- Port ID,
- Carrier ID (if available), and
- Location ID.

18.5 *Carrier Closed Event*

18.5.1 If the carrier is equipped with a door, an event shall be generated when a carrier door has been closed.

18.5.2 Data required to be available for this event report:

- CarrierID,
- LocationID, and
- PortID (if valid).

18.6 *Carrier Location Change Event*

18.6.1 An event shall be generated whenever a carrier has changed location. This applies to both load ports, substrate ports, and internal buffer locations.

18.6.2 Data required to be available for this event report:

- CarrierID,
- LocationID (new destination location), and
- CarrierLocationMatrix.

18.7 *Carrier Opened Event*

18.7.1 If the carrier is equipped with a door, an event shall be generated when a carrier door has been opened.

18.7.2 Data required to be available for this event report:

- CarrierID,
- LocationID, and
- PortID (if valid).

18.8 *Carrier Unclamped Event*

18.8.1 An event shall be generated whenever a carrier is unclamped. Unclamped means that the load port has disengaged any devices that would inhibit removal or movement of the carrier by any entity external to the load port. Some load ports may include more than one clamping device. This event should be generated only when all clamping or locking devices are disengaged.

18.8.2 There is no standard for when load ports unclamp a carrier. Therefore the IC makers host systems and personnel will need some signal from the equipment to know if a carrier is unclamped. This event provides that signal. This applies to all load ports that provide clamping and unclamping. If a load ports does not clamp and unclamp the carrier no event is required.

18.8.3 Data required to be available for this event report:

- Port ID,
- Carrier ID (if available), and
- Location ID.

18.9 *CarrierID Read Fail Event*

18.9.1 An event shall be generated when the equipment attempts to read a carrierID and fails at a port in the NOT ASSOCIATED STATE.

18.9.2 Data required to be available for this event report:

- PortID

18.10 *ID Reader Available Event*

18.10.1 An event shall be generated whenever an id reader becomes available. This applies to all load ports.

18.10.2 Data required to be available for this event report:

- Port ID

18.11 *ID Reader Unavailable Event*

18.11.1 An event shall be generated whenever an id reader becomes unavailable for any reason. This applies to all load ports.

18.11.2 Data required to be available for this event report:

- Port ID

18.12 *UnknownCarrierID Event*

18.12.1 An event shall be generated when a carrier arrives at a “NOT ASSOCIATED” load port where the CarrierID reader is unavailable.

18.12.2 Data required for this event report:

- Port ID

18.12.3 Equipment shall wait for a “ProceedWithCarrier” or “CancelCarrier” service before initiating any action.

18.12.4 If a ProceedWithCarrier service is received from the host by the equipment the carrier object is instantiated via transition 4 in the Carrier State Model.

18.12.5 If a CancelCarrier service is received, the equipment uses the host provided CarrierID to instantiate the carrier object via transition 5, associates the carrier to the load port and prepares carrier for unload.

19 Variable Data

19.1 The purpose of this section is to define the list of variable data requirements for CMS equipment. Values of these variables are available to the host via collection event reports and host status queries. Some of the data items listed are valid for internal buffer production equipment only, and are marked as such.

19.2 *Variable Data Definitions*

19.2.1 The following table defines variable data that shall be provided by the production equipment. Also, for the objects defined by Carrier Management, the identifier of that object and all of the attributes of that object shall be available for inclusion in event reports associated with that object. Subscripted variables are used either as items within a list or to differentiate data representing different entities. Subscripted variables are always valid.

Table 37 Variable Data Definitions

Variable Name	*Description*	*Type*	*Access*	*Comment*
AccessMode	The access mode of the loadport.	Enumerated: MANUAL, AUTO	RO	
$AccessMode_i$	The access mode for the i^{th} load port.	Enumerated: MANUAL, AUTO	RO	
AvailPartitionCapacity	The current available buffer capacity for a logical partition inside internal buffer equipment (PartitionCapacity - # of carriers in partition).	Non-negative integer	RO	Only applicable to internal buffer production equipment.
$AvailPartitionCapacity_i$	The AvailPartitionCapacity for the i^{th} PartitionID within the internal buffer.	Non-negative integer	RO	Only applicable to internal buffer production equipment.
BufferCapacityList	The current PartitionType, AvailPartitionCapacity, and PartitionCapacity for all logical buffer partitions.	List of n groups of items 1. $BufferPartitionInfo_1$ . . n. $BufferPartitionInfo_n$	RO	Only applicable to internal buffer production equipment.
BufferPartitionInfo	The related information for a logical buffer partition.	Structure of 5 items PartitionID PartitionType AvailPartitionCapacity PartitionCapacity UnallocatedPartitionCapacity	RO	Only applicable to internal buffer production equipment.
$BufferPartitionInfo_i$	The related information for the i^{th} buffer partition.	Structure of 5 items $PartitionID_i$ $PartitionType_i$ $AvailPartitionCapacity_i$ $PartitionCapacity_i$ $UnallocatedPartitionCapacity_i$	RO	Only applicable to internal buffer production equipment.
BypassReadID	Enables or disables automatic ID acceptance when the carrier ID reader is unavailable.	Boolean.	RW	If TRUE, the ID provided with Bind is used automatically.

Variable Name	*Description*	*Type*	*Access*	*Comment*
CarrierAccessingStatus	The state of the carrier accessing status.	Enumerated: NOT ACCESSED, IN ACCESS, CARRIER COMPLETE, CARRIER STOPPED	RO	
CarrierID	The ID of the carrier.	Text	RO	
$CarrierID_i$	The CarrierID at the i^{th} locationID.	Text	RO	
CarrierIDStatus	State of the carrier ID status.	Enumerated: ID NOT READ, [ID]WAITING FOR HOST, ID VERIFICATION OK, ID VERIFICATION FAILED	RO	
CarrierLocationMatrix	A list all the carriers at/in the equipment. Both internal to the equipment, and on equipment load ports.	List of n pairs of items 1. $LocationID_1$ $CarrierID_1$ . . n. $LocationID_n$ $CarrierID_n$	RO	The $CarrierID_i$ shall be null if there is no carrier at the $locationID_i$. If a carrier is at $LocationID_i$, but the $CarrierID_i$ is not known, the value of $CarrierID_i$ shall be "UNKNOWN".
LocationID	The ID of a carrier location.	Text	RO	Carrier locations are any location at/in the production equipment where a carrier may rest.
$LocationID_i$	The LocationID of the i^{th} carrier location.	Text	RO	Carrier locations are any location at/in the production equipment where a carrier may rest.
LoadPortReservation-State	The reservation state of a Load Port.	Enumerated: NOT RESERVED, RESERVED	RO	
LoadPortReservation-$State_I$	The reservation state of the i^{th} Load Port.	Enumerated: NOT RESERVED, RESERVED	RO	
LoadPortReservation-StateList	The current reservation state of all the load ports.	A list of n items 1. $LoadPortReservationState_1$ . . n.$LoadPortReservationState_n$	RO	This can be used to resynchronize the host.
PartitionCapacity	The total PartitionCapacity for a logical internal buffer partition.	Non-negative integer	RO	Only applicable to internal buffer production equipment.
$PartitionCapacity_i$	The PartitionCapacity for the i^{th} PartitionID of the internal buffer.	Non-negative integer	RO	Only applicable to internal buffer production equipment.
PartitionID	The ID of a logical internal buffer partition.	Text	RO	Used to identify separate material types in an internal buffer.
$PartitionID_i$	The ID of the i^{th} logical partition of the internal buffer.	Text	RO	Used to identify separate material types in an internal buffer.

Variable Name	*Description*	*Type*	*Access*	*Comment*
PartitionType	The type of a logical partition within an internal buffer.	Text	RO	Only applicable to internal buffer production equipment. Some examples of logical buffer PartitionType are Product, Dummy, Substrate, and Seed.
$PartitionType_i$	The PartitionType corresponding with the i^{th} PartitionID.	Text	RO	Only applicable to internal buffer production equipment. Some examples of logical buffer PartitionType are Product, Dummy, Substrate, and Seed.
PortAssociationState	The association state of a load port.	Enumerated: ASSOCIATED, NOT ASSOCIATED	RO	
$PortAssociationState_i$	The association state of the i^{th} load port.	Enumerated: ASSOCIATED, NOT ASSOCIATED	RO	
PortAssociationState-List	The current association state for all load ports.	A list of n items 1. $PortAssociationState_1$ . . n. $PortAssociationState_n$	RO	This can be used to re-synchronize the host.
PortID	ID of a load port.	Positive integer	RO	
$PortID_i$	ID of the load port where the carrier transfer is taking place. One PortID exists for each load port.	Positive integer	RO	
PortStateInfo	The PortAssociationState combined with the PortTransferState.	List of 2 items PortAssociationState PortTransferState	RO	A combination of both port states.
$PortStateInfo_i$	The PortAssociationState combined with the PortTransferState for the i^{th} load port.	List of 2 items $PortAssociationState_i$ $PortTransferState_i$	RO	A combination of both port states.
PortStateInfoList	List of PortStateInfo for all load ports.	List of n items 1. $PortStateInfo_1$ . . n $PortStateInfo_n$	RO	A list of all the port states for all the ports.
PortTransferState	The current transfer state of a load port.	Enumerated: OUT OF SERVICE, TRANSFER BLOCKED, READY TO LOAD, READY TO UNLOAD	RO	Super states are not included, only sub states.
$PortTransferState_i$	The current transfer state of the i^{th} load port.	Enumerated: OUT OF SERVICE, TRANSFER BLOCKED, READY TO LOAD, READY TO UNLOAD	RO	Super states are not included, only sub states.
PortTransferStateList	The current Load Port Transfer State for all load ports.	A list of n items 1. $PortTransferState_1$ . . n. $PortTransferState_n$	RO	This can be used to re-synchronize the host.

Variable Name	*Description*	*Type*	*Access*	*Comment*
Reason	The reason for transition 14, SLOT MAP NOT READ to WAITING FOR HOST.	Enumerated: VERIFICATION NEEDED, VERIFICATION BY EQUIPMENT UNSUCCESSFUL, READ FAIL, IMPROPER SUBSTRATE POSITION	RO	Information to aid host in deciding appropriate action.
SlotMapStatus	State of the carrier slot map status.	Enumerated: SLOT MAP NOT READ, [SLOT]WAITING FOR HOST, SLOT MAP VERIFICATION OK, SLOT MAP VERIFICATION FAILED	RO	
UnAllocatedPartition-Capacity	The current unallocated capacity for a logical partition inside internal buffer equipment, (PartitionCapacity - # of carriers in partition - # of carriers allocated for the partition (via reception of a Bind, CarrierIn, CarrierNotification, ReserveAtPort, or ProceedWithCarrier service). Any carriers allocated for a partition will be de-allocated if the corresponding Cancel service is received (for example Bind-CancelBind, CarrierNotification – CancelCarrierNotification, ReserveAtPort – CancelReservationAtPort, ProceedWithCarrier – CancelCarrier).	Non-negative integer	RO	Only applicable to internal buffer equipment.
UnAllocatedPartition-Capacity$_i$	The UnallocatedPartitionCapacity for the i^{th} Partition ID within the internal buffer	Non-negative integer	RO	Only applicable to internal buffer equipment.

20 Alarms

20.1 This section includes specific alarms that are required to be implemented by CMS compliant equipment.

20.2 *Alarm List Table*

20.2.1 Table 38 is a listing of required alarms for both fixed buffer and internal buffer equipment. This list is only a subset of the carrier transfer alarms. There may be more carrier transfer related alarms that are not listed here.

Table 38 Alarm List

Equipment		*Danger*		*Affected*		
Configuration	*Alarm Text*	*Potential*	*Imminent*	*Operator*	*Equipment*	*Material*
Fixed & Internal Buffer Equipment	PIO Failure	X		X	X	X
	Access Mode Violation	X		X	X	X

Equipment		*Danger*		*Affected*		
Configuration	*Alarm Text*	*Potential*	*Imminent*	*Operator*	*Equipment*	*Material*
	Carrier Verification Failure	X				X
	Slot Map Read Failed	X		X	X	X
	Slot Map Verification Failed	X			X	X
	Attempt To Use Out Of Service Load Port	X			X	X
	Carrier Presence Error	X		X	X	X
	Carrier Placement Error	X		X	X	X
	Carrier Dock/UnDock Failure	X			X	X
	Carrier Open/Close Failure	X			X	X
Fixed and Internal Buffer	Duplicate CarrierID	X				X
Internal Buffer Equipment Only	Internal Buffer Carrier Move Failure	X			X	X
Fixed & Internal Buffer Equipment	Carrier Removal Error	X		X	X	X

20.3 *Duplicate CarrierID*

20.3.1 If the equipment receives a carrier with a CarrierID that is the same as that of another carrier present at the equipment, the following rules shall apply:

1. The second carrier with a CarrierID shall not be processed.
2. If processing on the first carrier with the CarrierID has not begun, it should not be processed.
3. If processing on the first carrier has begun a Duplicate Carrier ID In Process event shall be issued to notify the host.

21 Requirements for Compliance

21.1 Table 39 provides a checklist for CMS compliance.

Table 39 CMS Compliance Statement

Fundamental CMS Requirements	*CMS Section*	*Implemented*	*CMS Compliant*
Load Port Numbering	9.1	☐ Yes ☐ No	☐ Yes ☐ No
Carrier Slot Numbering	9.2	☐ Yes ☐ No	☐ Yes ☐ No
Load Port Transfer State Model	9.3–9.4.3	☐ Yes ☐ No	☐ Yes ☐ No
Carrier Object Implementation	10	☐ Yes ☐ No	☐ Yes ☐ No
Load Port Reservation State Model (internal buffer equipment)	12	☐ Yes ☐ No	☐ Yes ☐ No
Load Port/Carrier Association State Model	13	☐ Yes ☐ No	☐ Yes ☐ No
CarrierID Verification Support	14.2	☐ Yes ☐ No	☐ Yes ☐ No
Slot Map Verification Support	14.3	☐ Yes ☐ No	☐ Yes ☐ No
Services Implementation	16	☐ Yes ☐ No	☐ Yes ☐ No
Additional Events Implementation	18	☐ Yes ☐ No	☐ Yes ☐ No
Variable Data Definitions	19	☐ Yes ☐ No	☐ Yes ☐ No
Alarms Implementation	20	☐ Yes ☐ No	☐ Yes ☐ No
Additional CMS Capabilities	*CMS Section*	*Implemented*	*CMS Compliant*
Load Port Reservation State Model (fixed buffer equipment)	12	☐ Yes ☐ No	☐ Yes ☐ No
Reservation Visible Signal	12.2	☐ Yes ☐ No	☐ Yes ☐ No

RELATED INFORMATION 1
CARRIER OBJECT ID

NOTICE: This related information is not an official part of SEMI E87, but was approved for publication by full letter ballot procedures on December 15, 1999.

R1-1 Carrier Object ID

R1-1.1 The Carrier Object ID is derived as stated in the Table R1-1 Carrier ID derivation.

Table R1-1 CarrierID Derivation

	Method of Original Instantiation	*CarrierID Read*	*ID Verifi-cation*	*Following Actions*	*CarrierID =*	*Parameter Required by Service*
1	Bind	Successful	Successful and equipment based	Production equipment continues with the carrier.	CarrierID in Bind service.	*Bind:* CarrierID, PortID, and PropertiesList
2	Bind	Successful	Fails	The carrier object instantiated via the Bind message is destroyed and a new carrier object with the carrierID equal to the one determined by the carrierID is instantiated. ProceedWithCarrier service is received.	CarrierID provided by the CarrierID read.	*ProceedWith-Carrier:* CarrierID, PropertiesList
3	Bind	Successful	Fails	The carrier object instantiated via the Bind message is destroyed and a new carrier object with the carrierID equal to the one determined by the carrierID is instantiated. CancelCarrier service is received.	CarrierID provided by the CarrierID read.	*CancelCarrier*: CarrierID
4	Bind	Fails	NA	ProceedWithCarrier service is received and the carrierID matches the carrierID provided by the Bind service.	CarrierID provided by the Bind service.	*ProceedWith-Carrier*: CarrierID
5	Bind	Fails	NA	CancelCarrier service is received and the carrierID matches the carrierID provided by the Bind service.	CarrierID provided by the Bind service.	*CancelCarrier*: CarrierID
6	Carrier-Notification	Successful	Successful and equipment based	Production equipment continues with the carrier.	CarrierID in Carrier-Notification.	*Carrier-Notification:* CarrierID and PropertiesList
7	Carrier ID read	Successful	Successful and Host based	ProceedWithCarrier service is received and the carrierID matches the carrierID read by the production equipment.	CarrierID read by production equipment.	*ProceedWith-Carrier*: CarrierID and PropertiesList, PortID may be included.
8	CarrierID read	Successful	Fails and Host based	A CancelCarrier service is received and the carrierID matches the carrierID read by the production equipment.	CarrierID read by production equipment.	*CancelCarrier*: CarrierID

	Method of Original Instantiation	*CarrierID Read*	*ID Verifi-cation*	*Following Actions*	*CarrierID =*	*Parameter Required by Service*
9	The method of original instantiation is defined following the carrierID read fail and is described in column titled following actions.	Fails	NA	A ProceedWithCarrier service is received and the carrierID is provided in the service.	CarrierID provided by the Proceed-WithCarrier service.	*ProceedWith-Carrier* : CarrierID, PortID, PropertiesList
10	The method of original instantiation is defined following the carrierID read fail and is described in the column titled *Following Actions*.			A CancelCarrier service is received and the carrierID is the one provided by the CancelCarrier.	CarrierID provided by the Cancel-Carrier service.	*CancelCarrier*: CarrierID, PortID

R1-2 Scenarios

R1-2.1 The scenarios listed here are not a requirement of this standard. They are provided to aid in the understanding of the document. These scenarios are not an exhaustive set of all possible scenarios. The scenarios presented are typical or common scenarios encountered when using this standard.

R1-2.2 *Normal Roundtrip 1*

R1-2.2.1 Assumptions: Fixed buffer production equipment, FOUP, Host based verification

R1-2.2.2 Indicated states: LTS = Load Port Transfer State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status

Table R1-2 Normal Roundtrip 1

#	*Comment*	*Dir*	*Message*	*LTS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NA	(T)	(T)
1	Loading transfer starts.	H<-E	TransferBlocked	TB			
2	Loading transfer completes.						
3	CarrierID is read.	H<-E	WaitingForHost		A	WFH	SNR
4	CarrierID is verified by host, and result is OK.						
5	Host commands to proceed.	H->E	ProceedWithCarrier			IVO	
6	Carrier is docked.						
7	Slot map is read.	H<-E	WaitingForHost				WFH
8	Slot map is verified by host, and result is OK.						
9	Host commands to proceed.	H->E	ProceedWithCarrier				SVO
10	Process starts.						
11	Process completes.						
12	Carrier is undocked.	H<-E	ReadyToUnload	RTU			
13	Unloading transfer starts.	H<-E	TransferBlocked	TB			
14	Unloading transfer completes.	H<-E	ReadyToLoad	RTL	NA	(T)	(T)

R1-2.3 *Normal Roundtrip 2*

R1-2.3.1 Assumptions: Fixed buffer production equipment, FOUP, Production equipment based verification, Bind Service received

R1-2.3.2 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status

Table R1-3 Normal Roundtrip 2

#	*Comment*	*Dir*	*Message*	*LTS*	*LRS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NR	NA	(T)	(T)
1	Load port is associated with specified carrierID, and reserved for loading.	H->E	Bind		R	A	INR	SNR
2	Loading transfer starts.	H<-E	TransferBlocked	TB				
3	Loading transfer completes.				NR			
4	CarrierID is read.							
5	CarrierID is verified by production equipment, and result is OK.	H<-E	IDVerificationOK				IVO	
6	Carrier is docked.							
7	Slot map is read.							
8	Slot map is verified by production equipment, and result is OK.	H<-E	SlotMapVerificationOK					SVO
9	Process starts.							
10	Process completes.							
11	Carrier is undocked.	H<-E	ReadyToUnload	RTU				
12	Unloading transfer starts.	H<-E	TransferBlocked	TB				
13	Unloading transfer completes.	H<-E	ReadyToLoad	RTL		NA	(T)	(T)

R1-2.4 *Normal Roundtrip 3*

R1-2.4.1 Internal buffer production equipment, FOUP, Host based verification

R1-2.4.2 Indicated states: LTS = Load Port Transfer State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status, LCAS = Load Port/Carrier Association State.

Table R1-4 Normal Roundtrip 3

#	*Comment*	*Dir*	*Message*	*LTS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NA	(T)	(T)
1	Loading transfer starts.	H<-E	TransferBlocked	TB			
2	Loading transfer completes.						
3	CarrierID is read.	H<-E	WaitingForHost		A	WFH	SNR
4	CarrierID is verified by host, and result is OK.						
5	Host commands to proceed.	H->E	ProceedWithCarrier			IVO	
6	Carrier-in starts.	H<-E	BufferCapacityChange				
7	Carrier-in completes.			RTL	NA		
8	Process starts.						
9	Slot map is read at FIMS port.	H<-E	WaitingForHost				WFH
10	Slot map is verified by host, and result is OK.						
11	Host commands to proceed.	H->E	ProceedWithCarrier				SVO
12	Process completes.						
13	Carrier completes.	H<-E	CarrierComplete				
14	Host commands to carrier-out.	H->E	CarrierOut		A		
15	Carrier-out starts.	H<-E	TransferBlocked	TB			
16	Carrier-out completes.	H<-E H<-E	ReadyToUnload BufferCapacityChange	RTU			

#	Comment	Dir	Message	LTS	LCAS	CIDS	CSMS
17	Unloading transfer starts.	H<-E	TransferBlocked	TB			
18	Unloading transfer completes.	H<-E	ReadyToLoad	RTL	NA	(T)	(T)

R1-2.5 *Normal Roundtrip 4*

R1-2.5.1 Internal buffer production equipment, FOUP, Production equipment based verification, Bind service received

R1-2.5.2 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-5 Normal Roundtrip 4

#	Comment	Dir	Message	LTS	LRS	LCAS	CIDS	CSMS
0	Initial condition.			RTL	NR	NA	(T)	(T)
1	Load port is associated with specified carrierID, and reserved for loading.	H->E	Bind		R	A	INR	SNR
2	Loading transfer starts.	H<-E	TransferBlocked	TB				
3	Loading transfer completes.				NR			
4	CarrierID is read.							
5	CarrierID is verified by equipment, and result is OK.	H<-E	IDVerificationOK				IVO	
6	Carrier-in starts.	H<-E	BufferCapacityChange					
7	Carrier-in completes.			RTL		NA		
8	Process starts.							
9	Slot map is read at FIMS port.							
10	Slot map is verified by equipment, and result is OK.	H<-E	SlotMapVerificationOK					SVO
11	Process completes.							
12	Carrier completes.	H<-E	CarrierComplete					
13	Host commands to carrier-out.	H->E	CarrierOut					
14	Carrier-out starts.	H<-E	TransferBlocked	TB	R	A		
15	Carrier-out completes.	H<-E H<-E	ReadyToUnload BufferCapacityChange	RTU	NR			
16	Unloading transfer starts.	H<-E	TransferBlocked	TB				
17	Unloading transfer completes.	H<-E	ReadyToLoad	RTL		NA	(T)	(T)

R1-2.6 *Normal Roundtrip 5*

R1-2.6.1 Assumptions: Fixed buffer production equipment, FOUP, Production equipment based verification, Carrier Notification service received

R1-2.6.2 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status

Table R1-6 Normal Roundtrip 5

#	Comment	Dir	Message	LTS	LRS	LCAS	CIDS	CSMS
0	Initial condition.			RTL	NR	NA	(T)	(T)
1	Equipment is notified of future Carrier arrival.	H->E	CarrierNotification				INR	SNR
2	Loading transfer starts.	H<-E	TransferBlocked	TB				

#	Comment	Dir	Message	LTS	LRS	LCAS	CIDS	CSMS
3	Loading transfer completes.							
4	CarrierID is read.					A		
5	CarrierID is verified by production equipment, and result is OK.	H<-E	IDVerificationOK				IVO	
6	Carrier is docked.							
7	Slot map is read.							
8	Slot map is verified by production equipment, and result is OK.	H<-E	SlotMapVerificationOK					SVO
9	Process starts.							
10	Process completes.							
11	Carrier is undocked.	H<-E	ReadyToUnload	RTU				
12	Unloading transfer starts.	H<-E	TransferBlocked	TB				
13	Unloading transfer completes.	H<-E	ReadyToLoad	RTL		NA	(T)	(T)

R1-2.7 *Normal Roundtrip 6*

R1-2.7.1 Internal buffer production equipment, FOUP, Production equipment based verification, CarrierNotification service received.

R1-2.7.2 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-7 Normal Roundtrip 6

#	Comment	Dir	Message	LTS	LRS	LCAS	CIDS	CSMS
0	Initial condition.			RTL	NR	NA	(T)	(T)
1	Load port notified of future carrier arrival.	H->E	CarrierNotification				INR	SNR
2	Loading transfer starts.	H<-E	TransferBlocked	TB				
3	Loading transfer completes.							
4	CarrierID is read.					A		
5	CarrierID is verified by equipment, and result is OK.	H<-E	IDVerificationOK				IVO	
6	Carrier-in starts.	H<-E	BufferCapacityChange					
7	Carrier-in completes.			RTL		NA		
8	Process starts.							
9	Slot map is read at FIMS port.							
10	Slot map is verified by equipment, and result is OK.	H<-E	SlotMapVerificationOK					SVO
11	Process completes.							
12	Carrier completes.	H<-E	CarrierComplete					
13	Host commands to carrier-out.	H->E	CarrierOut					
14	Carrier-out starts.	H<-E	TransferBlocked	TB	R	A		
15	Carrier-out completes.	H<-E H<-E	ReadyToUnload BufferCapacityChange	RTU	NR			
16	Unloading transfer starts.	H<-E	TransferBlocked	TB				
17	Unloading transfer completes.	H<-E	ReadyToLoad	RTL		NA	(T)	(T)

R1-2.8 *Normal Roundtrip 7*

R1-2.8.1 Assumptions: Fixed buffer production equipment, FOUP, Host based verification, ReserveAtPort service received.

R1-2.8.2 Indicated states: LTS = Load Port Transfer State, LRS= Load Port Reserve State, LCAS = Load Port/Carrier State Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-8 Normal Roundtrip 7

#	*Comment*	*Dir*	*Message*	*LTS*	*LRS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NR	NA	(T)	(T)
1	Reserve a port for future activity.	H->E	ReserveAtPort		R			
2	Loading transfer starts.	H<-E	TransferBlocked	TB				
3	Loading transfer completes.				NR			
4	CarrierID is read.	H<-E	WaitingForHost			A	WFH	SNR
5	CarrierID is verified by host, and result is OK.							
6	Host commands to proceed.	H->E	ProceedWithCarrier				IVO	
7	Carrier is docked.							
8	Slot map is read.	H<-E	WaitingForHost					WFH
9	Slot map is verified by host, and result is OK.							
10	Host commands to proceed.	H->E	ProceedWithCarrier					SVO
11	Process starts.							
12	Process completes.							
13	Carrier is undocked.	H<-E	ReadyToUnload	RTU				
14	Unloading transfer starts.	H<-E	TransferBlocked	TB				
15	Unloading transfer completes.	H<-E	ReadyToLoad	RTL		NA	(T)	(T)

R1-2.9 *Normal Roundtrip 8*

R1-2.9.1 Internal buffer production equipment, FOUP, Host based verification, ReserveAtPort service received.

R1-2.9.2 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status, CPS = Carrier Processing Status.

Table R1-9 Normal Roundtrip 8

#	*Comment*	*Dir*	*Message*	*LTS*	*LRS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NR	NA	(T)	(T)
1	Reserve Port for future activity.	H->E	ReserveAtPort		R			
2	Loading transfer starts.	H<-E	TransferBlocked	TB				
3	Loading transfer completes.				NR			
4	CarrierID is read.	H<-E	WaitingForHost			A	WFH	SNR
5	CarrierID is verified by host, and result is OK.							
6	Host commands to proceed.	H->E	ProceedWithCarrier				IVO	
7	Carrier-in starts.	H<-E	BufferCapacityChange					
8	Carrier-in completes.			RTL		NA		
9	Process starts.							
10	Slot map is read at FIMS port.	H<-E	WaitingForHost					WFH

#	Comment	Dir	Message	LTS	LRS	LCAS	CIDS	CSMS
11	Slot map is verified by host, and result is OK.							
12	Host commands to proceed.	H->E	ProceedWithCarrier					SVO
13	Process completes.							
14	Carrier completes.	H<-E	CarrierComplete					
15	Host commands to carrier-out.	H->E	CarrierOut			A		
16	Carrier-out starts.	H<-E	TransferBlocked	TB	R			
17	Carrier-out completes.	H<-E H<-E	ReadyToUnload BufferCapacityChange	RTU	NR			
18	Unloading transfer starts.	H<-E	TransferBlocked	TB				
19	Unloading transfer completes.	H<-E	ReadyToLoad	RTL		NA	(T)	(T)

R1-2.10 *Abnormal CarrierID Verification 1*

R1-2.10.1 *Host based verification, CancelCarrier*

R1-2.10.2 Indicated states: LTS = Load Port Transfer State, LAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-10 Abnormal CarrierID Verification 1

#	Comment	Dir	Message	LTS	LCAS	CIDS	CSMS
0	Initial condition.			RTL	NA	(T)	(T)
1	Loading transfer starts.	H<-E	TransferBlocked	TB			
2	Loading transfer completes.						
3	CarrierID is read.	H<-E	WaitingForHost		A	WFH	SNR
4	CarrierID is verified by host, and result is Failed.						
5	Host commands to return.	H->E	CancelCarrier			IVF	
6	Carrier is made ready to unload.	H<-E	ReadyToUnload	RTU			

R1-2.11 *Abnormal CarrierID Verification 2*

R1-2.11.1 Production equipment based verification, Bind service received, CancelCarrier

R1-2.11.2 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-11 Abnormal CarrierID Verification 2

#	Comment	Dir	Message	LTS	LRS	LCAS	CIDS	CSMS
0	Initial condition.			RTL	NR	NA	(T)	(T)
1	Load port is associated with specified carrierID, and reserved for loading.	H->E	Bind		R	A	INR	SNR
2	Loading transfer starts.	H<-E	TransferBlocked	TB				
3	Loading transfer completes.				NR			
4	CarrierID is read.							
5	CarrierID is verified by production equipment, and result is Failed. The carrier object created by the Bind service is destroyed. A carrier object with the id determined by read is created.	H<-E	WaitingForHost				(T) / WFH	(T) / SNR
5	Host commands to return.	H->E	CancelCarrier				IVF	
6	Carrier is made ready to unload.	H<-E	ReadyToUnload	RTU				

R1-2.12 *Abnormal CarrierID Verification 3*

R1-2.12.1 Production equipment based verification, Bind Service received, ProceedWithCarrier

R1-2.12.2 Production equipment based verification, ProceedWithCarrier

R1-2.12.3 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-12 Abnormal CarrierID Verification 3

#	*Comment*	*Dir*	*Message*	*LTS*	*LRS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NR	NA	(T)	(T)
1	Load port is associated with specified carrierID, and reserved for loading.	H->E	Bind		R	A	INR	SNR
2	Loading transfer starts.	H<-E	TransferBlocked	TB				
3	Loading transfer completes.				NR			
4	CarrierID is read.							
5	CarrierID is verified by production equipment, and result is Failed.	H<-E	WaitingForHost				(T) / WFH	(T) / SNR
6	Host commands to proceed.	H->E	ProceedWithCarrier				IVO	
7	(Go to next step.)							

R1-2.13 *Abnormal Slot Map Verification 1*

R1-2.13.1 Fixed buffer production equipment, FOUP, Host based verification, CancelCarrier

R1-2.13.2 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State, LAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-13 Abnormal Slot Map Verification 1

#	*Comment*	*Dir*	*Message*	*LTS*	*LRS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NR	NA	(T)	(T)
1	Loading transfer starts.	H<-E	TransferBlocked	TB				
2	Loading transfer completes.							
3	CarrierID is read.	H<-E	WaitingForHost			A	WFH	SNR
4	CarrierID is verified by host, and result is OK.							
5	Host commands to proceed.	H->E	ProceedWithCarrier				IVO	
6	Carrier is docked.							
7	Slot map is read.	H<-E	WaitingForHost					WFH
8	Slot map is verified by host, and result is Failed.							
9	Host commands to return.	H->E	CancelCarrier					SVF
10	Carrier is made ready to unload.		ReadyToUnload	RTU				

R1-2.14 *Abnormal Slot Map Verification 2*

R1-2.14.1 Internal buffer production equipment, FOUP, Production equipment based verification, CancelCarrier

R1-2.14.2 Indicated states: LTS = Load Port Transfer State, LRS = Load Reservation State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-14 Abnormal Slot Map Verification 2

#	*Comment*	*Dir*	*Message*	*LTS*	*LRS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NR	NA	(T)	(T)
1	Load port is associated with specified carrierID, and reserved for loading.	H->E	Bind		R	A	INR	SNR
2	Loading transfer starts.	H<-E	TransferBlocked	TB				
3	Loading transfer completes.				NR			
4	CarrierID is read.							
5	CarrierID is verified by equipment, and result is OK.	H<-E	IDVerificationOK				IVO	
6	Carrier-in starts.	H<-E	BufferCapacityChange					
7	Carrier-in completes.			RTL		NA		
8	Process starts.							
9	Slot map is read at FIMS port.							
10	Slot map is verified by production equipment, and result is Failed.	H<-E	WaitingForHost					WFH
11	Host commands to return.	H->E	CancelCarrier					SVF
12	Carrier returns to internal buffer.							

R1-2.15 *Carrier-Out Queuing*

R1-2.15.1 *Internal Buffer Equipment*

R1-2.15.2 Initial condition: Two more carriers are within the production equipment

R1-2.15.3 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State, LCAS = Load Port/Carrier Association State

R1-15 Carrier-Out Queuing

#	*Comment*	*Dir*	*Message*	*LTS*	*LRS*	*LCAS*
0	Initial condition.			RTL	NR	NA
1	Host commands to carrier-out #1.	H->E	CarrierOut			
2	Carrier-out #1 starts.	H<-E	TransferBlocked	TB	R	A
3	Host commands to carrier-out #2 (Queued).	H->E	CarrierOut			
4	Carrier-out #1 completes.	H<-E H<-E	ReadyToUnload BufferCapacityChange	RTU	NR	
5	Unloading transfer #1 starts.	H<-E	TransferBlocked	TB		
6	Unloading transfer #1 completes.					
7	Carrier-out #2 starts.				R	
8	Carrier-out #2 completes.	H<-E H<-E	ReadyToUnload BufferCapacityChange	RTU	NR	
9	Unloading transfer #2 starts.	H<-E	TransferBlocked	TB		
10	Unloading transfer #2 completes.	H<-E	ReadyToLoad	RTL		NA

R1-2.16 *Carrier-Out Dequeuing (Cancellation)*

R1-2.16.1 *Internal Buffer Production equipment*

R1-2.16.2 Initial condition: One more carrier-out services are queued, One carrier-out service is active

R1-2.16.3 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State, LCAS = Load Port/Carrier Association State.

Table R1-16 Carrier-Out Dequeuing (Cancellation)

#	*Comment*	*Dir*	*Message*	*LTS*	*LRS*	*LCAS*
0	Initial condition.			TB	R	A
1	Host commands to cancel all carrier-out services from queue.	H->E	CancelAllCarrierOut			
2	All carrier-out services are canceled from queue.					
3	Current carrier-out service completes.	H<-E H<-E	ReadyToUnload BufferCapacityChange	RTU	NR	
4	Unloading transfer starts.	H<-E	TransferBlocked	TB		
5	Unloading transfer completes.	H<-E	ReadyToLoad	RTL		NA

R1-2.17 *Carrier Association Cancellation*

R1-2.17.1 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-17 Carrier Association Cancellation

#	*Comment*	*Dir*	*Message*	*LTS*	*LRS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NR	NA	(T)	(T)
1	Load port is associated with specified carrierID, and reserved for loading.	H->E H<-E	Bind Associated		R	A	INR	SNR
2	Host decides to cancel current carrier delivery.							
3	Host commands to cancel association.	H->E H<-E	CancelBind NotAssociated		NR	NA	(T)	(T)

R1-2.18 *Access Mode Change*

R1-2.18.1 Initial condition: Access mode = AUTO

R1-2.18.2 Indicated states: AMS = Access Mode State

Table R1-18 Access Mode Change

#	*Comment*	*Dir*	*Message*	*AMS*
0	Initial condition.			A
1	Host commands to change access mode to MANUAL.	H->E	ChangeAccess	M
2	Access mode is changed to MANUAL.	H<-E	Manual	

R1-2.19 *Load Port Service Status Change*

R1-2.19.1 Initial condition: Load port service status = IN SERVICE

R1-2.19.2 Indicated states: LTS = Load Port Transfer State

Table R1-19 Load Port Service Status Change

#	*Comment*	*Dir*	*Message*	*LTS*
0	Initial condition.			IS
1	Host commands to change service status to OUT OF SERVICE.	H->E	ChangeServiceStatus	OS
2	Service status is changed to OUT OF SERVICE.	H<-E	OutofService	

R1-2.201 *Correct Carrier Delivery to Wrong Port 1 Scenario*

R1-2.20.1 Assumptions: Fixed Load Port Equipment based verification.

R1-2.20.2 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-20 Correct Carrier Delivery to Wrong Port 1 Scenario

#	*Comment*	*Dir*	*Message*	*LTS1*	*LRS2*	*LCAS3*	*LTS2*	*LRS2*	*LCAS2*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NR	NA	RTL	NR	NA	(T)	(T)
1	Load port 1 is associated with specified carrierID, and reserved for loading.	H->E H<-E	Bind (lp1) LP1 Associated		R	A				INR	SNR
2	Transfer starts at load port 2.	H<-E	LP2 TRANSFER BLOCKED				TB				
3	Transfer Completes at load port2.	H<-E	Transfer Complete								
4	CarrierID read at load port 2 Equipment based verification indicates the carrier is at the correct equipment.	H<-E H<-E H<-E	LP1 NOT ASSOCIATED LP2 ASSOCIATED IV0		NR	NA			A	WFH	

R1-2.21 *Correct Carrier Delivery to Wrong Port 2 Scenario*

R1-2.21.1 Assumptions: Fixed Load Port Equipment based verification.

R1-21.2 Indicated states: LTS = Load Port Transfer State, LRS = Load Port Reservation State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-21 Correct Carrier Delivery to Wrong Port 2 Scenario

#	*Comment*	*Dir*	*Message*	*LTS1*	*LRS2*	*LCAS3*	*LTS2*	*LRS2*	*LCAS2*	*CIDSA*	*CSMS A*	*CIDS B*	*CSMS B*
0	Initial condition.			RTL	NR	NA	RTL	NR	NA	(T)	(T)	(T)	(T)
1	Load port 1 is associated with specified carrierID A, and reserved for loading.	H->E H<-E	Bind (CA, LP1) Lp1 Associated		R	A				INR	SNR		
2	Load port 2 is associated with specified carrierID B, and reserved for loading.	H->E H<-E	Bind (CB, LP2) Lp2 Associated					R	A			INR	SNR
2	Carrier A Transfer starts at load port 2.	H<-E	LP2 TRANSFER BLOCKED				TB						
3	Transfer Completes at load port2.	H<-E	Transfer Complete					NR					

#	Comment	Dir	Message	LTS1	LRS2	LCAS3	LTS2	LRS2	LCAS2	CIDSA	CSMS A	CIDS B	CSMS B
4	CarrierID read at load port 2, Equipment based verification indicates that a correct carrier was delivered to the wrong load port.	H<-E H<-E H<-E	LP1 NOT ASSOCI-ATED Carrier B object destroyed Alarm LP2 verification failed		NR	NA				WFH		(T)	(T)
5	Host oks processing.	H->	ProceedWith Carrier							IVO			

R1-2.22 *CarrierID Read Fail Scenario 1*

R1-2.22.1 Assumptions: Fixed buffer Equipment, Equipment based Verification, Bind service has been received.

R1-2.22.2 Indicated states: LTS = Load Port Transfer State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-22 CarrierID Read Fail Scenario 1

#	Comment	Dir	Message	LTS	LCAS	CIDS	CSMS
0	Initial condition.			RTL	A	INR	SNR
1	Carrier Arrives.	E>H	Transfer Blocked	TB	A	INR	SNR
2	ID read attempt fails.	E>H	State change to Waiting For Host	TB	A	WFH	SNR
3	Decision to continue is made.						
4	Host sends ProceedWithCarrier service.	H>E E>H	ProceedWithCarrier State change to Id Verification OK	TB	A	IVO	SNR

R1-2.23 *CarrierID Read Fail Scenario 2*

R1-2.23.1 Assumptions: Fixed buffer Equipment, Equipment based Verification, Bind service has been received.

R1-2.23.2 Indicated states: LTS = Load Port Transfer State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-23 CarrierID Read Fail Scenario 2

#	Comment	Dir	Message	LTS	LCAS	CIDS	CSMS
0	Initial condition.			RTL	A	INR	SNR
1	Carrier Arrives.	E>H	Transfer Blocked	TB			
2	ID read attempt fails.	E>H	State change to Waiting For Host	TB		WFH	
3	Decision to stop is made.						
4	Host sends CancelCarrier service.	H>E E>H	CancelCarrier State change to Id Verification Failed	TB		IVF	

R1-2.24 *CarrierID Read Fail Scenario 3*

R1-2.24.1 Assumptions: Fixed buffer Equipment, Host based Verification.

R1-2.24.2 Indicated states: LTS = Load Port Transfer State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-24 CarrierID Read Fail Scenario 3

#	*Comment*	*Dir*	*Message*	*LTS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NA	(T)	(T)
1	Carrier Arrives.	E>H	Transfer Blocked	TB			
2	ID read attempt fails.	E>H	ID read fail event				
3	Decision to continue is made.	H>E					
4	Host sends ProceedWithCarrier service.	H>E E>H E>H	ProceedWithCarrier State change to Id Verification OK State change to Load Port Associated		A	IVO	SNR

R1-2.25 *CarrierID Read Fail Scenario 4*

R1-2.25.1 Assumptions: Fixed buffer Equipment, Host based Verification.

R1-2.25.2 Indicated states: LTS = Load Port Transfer State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

Table R1-25 CarrierID Read Fail Scenario 4

#	*Comment*	*Dir*	*Message*	*LTS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NA	(T)	(T)
1	Carrier Arrives.	E>H	Transfer Blocked	TB			
2	ID read attempt fails.	E>H	ID read fail event				
3	Decision to stop is made.	H>E					
4	Host sends CancelCarrier.	H>E E>H E>H	CancelCarrier State change to Id Verification Failed State change to Load Port Associated		A	IVF	SNR

R1-2.26 *CarrierID Read Fail Scenario 5*

R1-2.26.1 Assumptions: Fixed buffer Equipment, Host based Verification.

R1-2.26.2 Indicated states: LTS = Load Port Transfer State, LCAS = Load Port/Carrier Association State, CIDS = Carrier ID Status, CSMS = Carrier Slot Map Status.

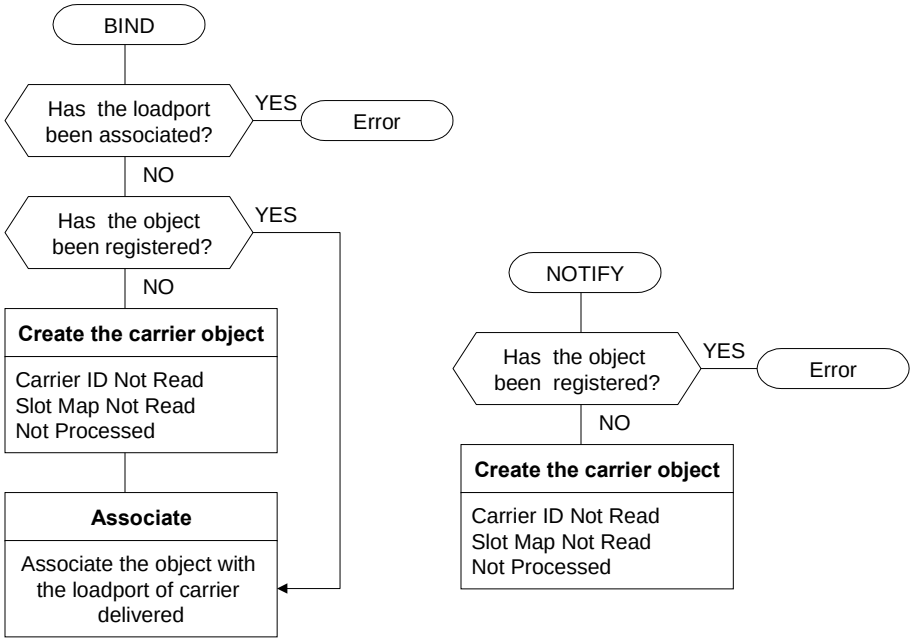
Table R1-26 CarrierID Read Fail Scenario 5

#	*Comment*	*Dir*	*Message*	*LTS*	*LCAS*	*CIDS*	*CSMS*
0	Initial condition.			RTL	NA	(T)	(T)
1	Carrier Arrives.	E>H	Transfer Blocked	TB			
2	ID read attempt fails.	E>H	ID read fail event				
3	Decision to stop is made.	H>E					
4	Host sends CancelCarrierAtPort.	H>E	CancelCarrierAtPort				

R1-3 Example Equipment Logic for Carrier Delivery

R1-3.1 To summarize the CMS carrier object behavior, following flow-charts are provided. The charts show the example of an equipment logic for the CMS definitions.

R1-3.2 *Bind and Notify*



R1-3.2.1 *Bind Service Request From the Host*

R1-3.2.1.1 Verify no object has been associated with designated loadport. If it is associated the Bind service shall be failed.

R1-3.2.1.2 Verify no object having the same ID specified in Bind service has been registered.

R1-3.2.1.2.1 If it is registered, the Bind service shall associate the object that is already registered with the designated loadport.

R1-3.2.1.2.2 If it is not registered, then create the object and associate it to the loadport. The initial states of the object are Carrier ID Not Read, Carrier Slot Map Not Read, Carrier Not Processed and Associated to the loadport.

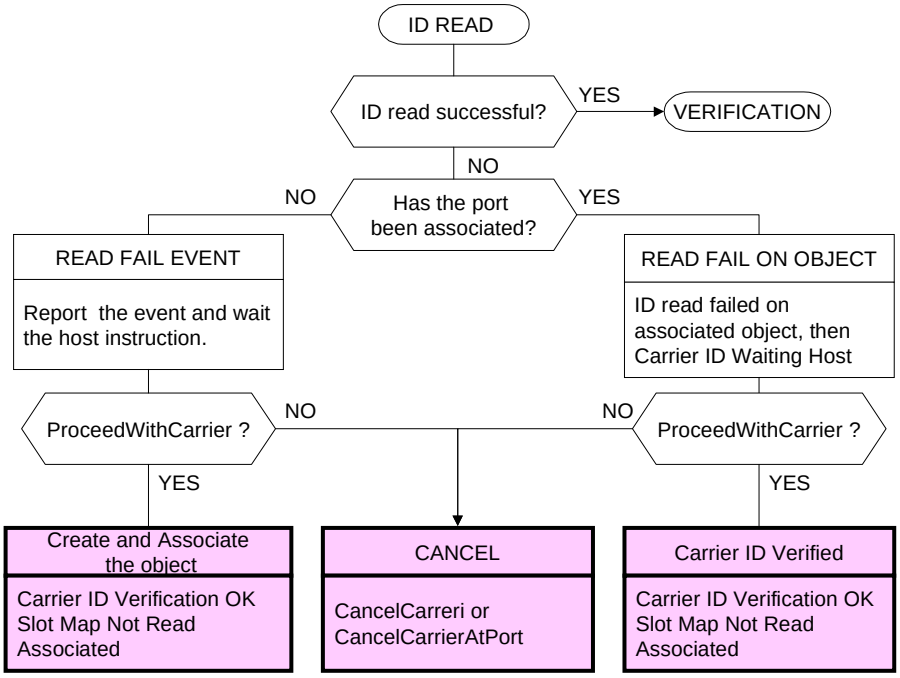
R1-3.2.2 Notify service request from the host.

R1-3.2.2.1 Verify no object having the same ID specified in Notify service has been registered.

R1-3.2.2.1.1 If it is registered, the Notify service shall be failed.

R1-3.2.2.1.2 If it is not registered, then create the carrier object. The initial states of the object are Carrier ID Not Read, Carrier Slot Map Not Read, Carrier Not Processed and Not Associated.

R1-3.3 *Carrier ID Read*



R1-3.3.1 *Carrier ID Read Event*

R1-3.3.1.1 If carrier ID has been read successfully then ID DETERMINATION (ID DET) is executed.

R1-3.3.1.2 If carrier ID has been failed to be read and the port is not associated with any object;

R1-3.3.1.2.1 Report the host the event to inform Carrier ID read fail when the loadport has no Bind.

R1-3.3.1.2.2 If the host requests ProceedWithCarrier service, then create the object and associate it with the loadport. Carrier ID state shall be changed to Carrier ID Verification OK.

R1-3.3.1.2.3 If the host requests CancelCarrierservice, then create the object and associate it with the loadport. Carrier ID state shall be changed to Carrier ID Verification Fail. Take the carrier to Ready to Unload.

R1-3.3.1.2.4 If the host requests CancelCarrierAtPort service, no objet is created. Take the carrier to Ready to Unload.

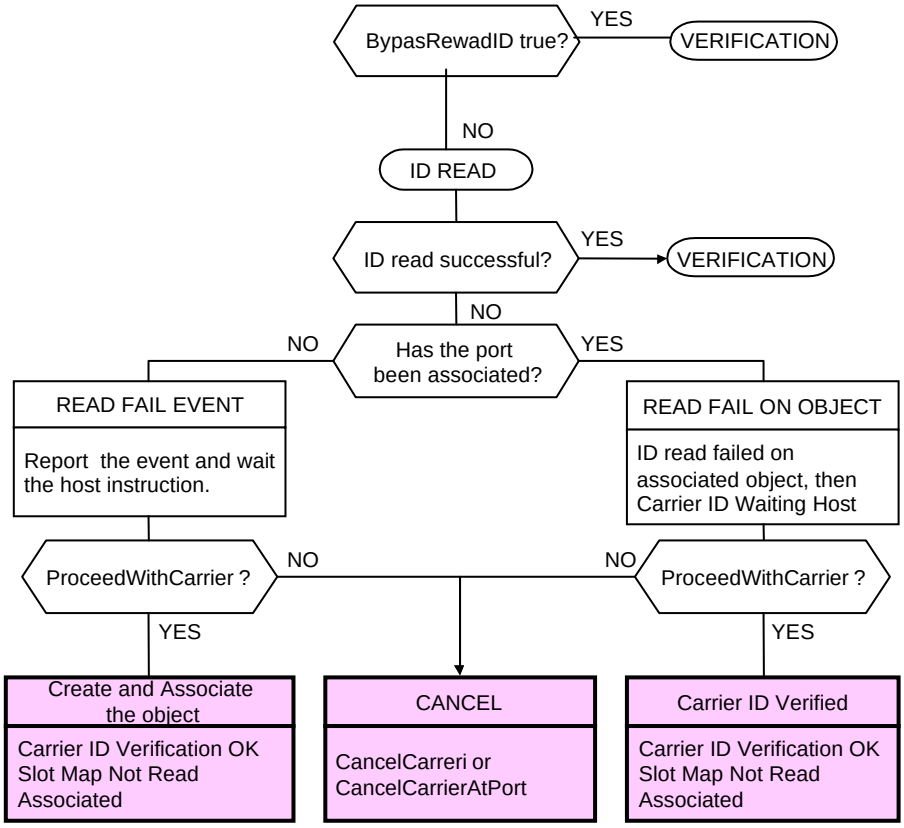
R1-3.3.1.3 If carrier ID has been failed to be read and the port is associated with any object;

R1-3.3.1.3.1 Change the Carrier ID status of the associated object to Waiting for Host. The event shall be reported to indicate carrier ID read for associated object has been failed.

R1-3.3.1.3.2 If the host requests ProceedWithCarrier service, then change the Carrie ID status of the associated object to Carrier ID Verification OK.

R1-3.3.1.3.3 If the host requests CancelCarrier service, then change the Carrie ID status of the associated object to Carrier ID Verification Fail. Take the carrier to Ready to Unload.

R1-3.4 *BypassReadID*



R1-3.4.1 *BypassReadID*

R1-3.4.1.1 If Bind has been received, then decision should be made if ID read is necessary.

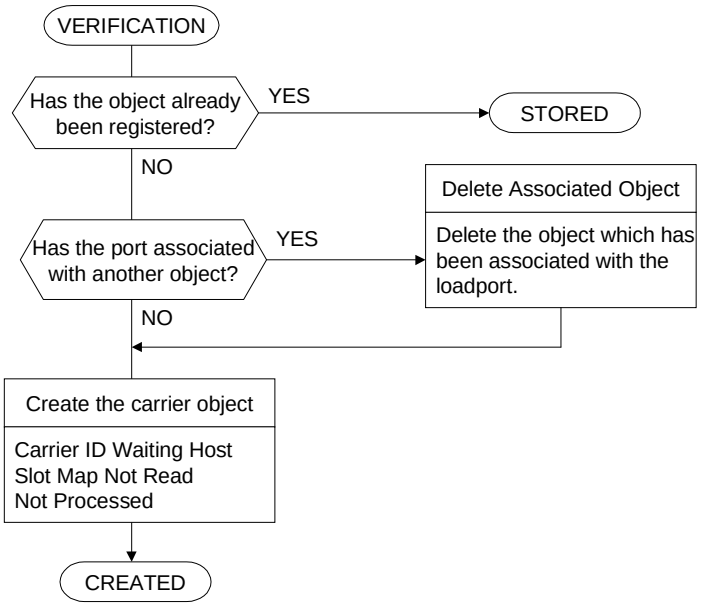
R1-3.4.1.2 If BypassReadID is equal to True.

R1-3.4.1.2.1 No ID read is required and carrier object enters ID Verification OK state.

R1-3.4.1.3 If BypassReadID is equal to False.

R1-3.4.1.3.1 ID Read is required.

R1-3.5 *Carrier Object Verification*



R1-3.5.1 If the object having the ID read from the carrier has been registered, then STORED object logic shall be executed.

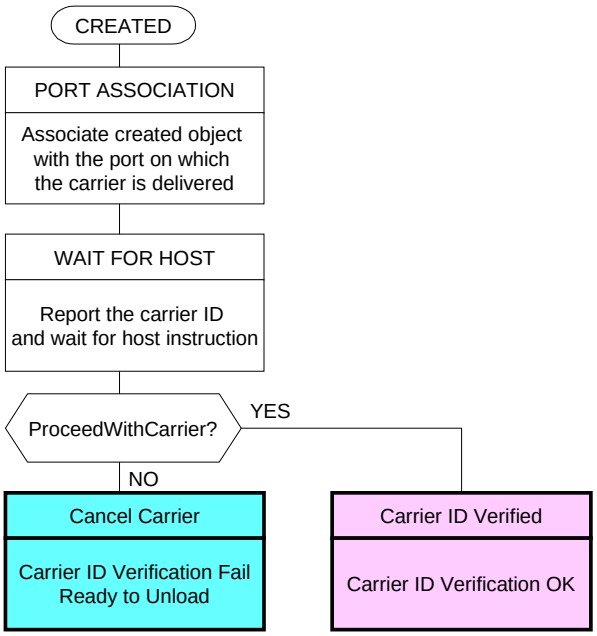
R1-3.5.2 If no object having the ID read from the carrier has been registered;

R1-3.5.2.1 Create the object.

R1-3.5.2.2 If an object has been associated with the loadport on which the carrier is delivered, the event means the carrier delivered is not expected by the associated object. That is Carrier ID verification fail. Then, delete the asoociated object.

R1-3.5.2.3 CREATED logic shall be executed.

R1-3.6 *CREATED*



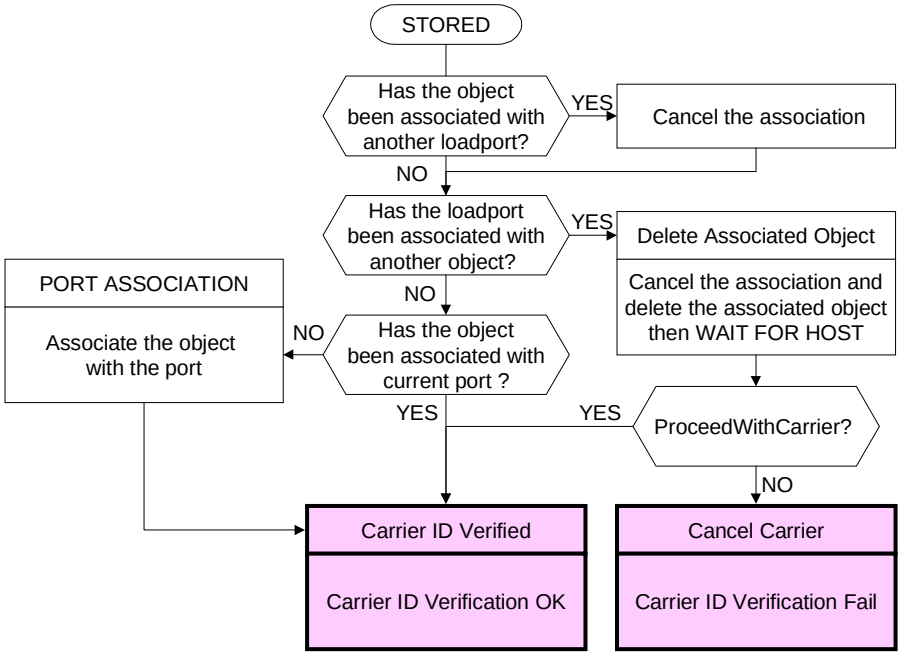
R1-3.6.1 Associate the object just created with the loadport on which the carrier is delivered.

R1-3.6.2 Report the carrier ID and wait for host instruction.

R1-3.6.3 If the host requests ProceedWithCarrier service, change the Carrier ID Status to Carrier ID Verification OK.

R1-3.6.4 If the host requests CancelCarrier service, change the Carrier ID Status to Carrier ID Verification Fail. The carrier shall be taken to Ready to Unload.

R1-3.7 *STORED*



R1-3.7.1 If the object has been already associated with the loadport other than the carrier is delivered;

R1-3.7.1.1 This is the case for misloading to a wrong loadport.

R1-3.7.1.2 Cancel the association.

R1-3.7.2 And If the loadport on which the carrier has been delivered is associated to another object, then delete the object associated with the port on which the carrier is delivered.

R1-3.7.2.1 This is the case for equipment base ID VERIFICATION FAIL.

R1-3.7.2.2 Associate the object with the loadport on which the carrier has been delivered.

R1-3.7.2.3 Then enter WAITING FOR HOST.

R1-3.7.2.4 If ProceedWithCarrier is given, then the carrier is verified.

R1-3.7.2.5 If CancelCarrier is given, then the carrier verification is failed.

R1-3.7.3 If the object has been associated with the loadport on which the carrier is delivered, the carrier is verified. Change the Carrier ID status to Carrier ID Verified.

R1-3.7.4 If no object has been associated with the loadport on which the carrier is delivered, associate the object with the loadport. This is the case for associating object created by Notify.

SEMI E87.1-0702
PROVISIONAL SPECIFICATION FOR SECS-II PROTOCOL FOR CARRIER MANAGEMENT (CMS)

This provisional specification was technically approved by the Global Information and Control Committee and is the direct responsibility of the North American Information and Control Committee. Current edition approved by the North American Regional Standards Committee on April 30 2002. Initially available at www.semi.org June 2002; to be published July 2002. Originally published February 2000; previously published March 2002.

1 Purpose

1.1 This document maps the services and data of SEMI E87 to SECS-II streams and functions, and data definitions.

2 Scope

2.1 This is a provisional specification covering equipment supporting automated access to load ports from the host point-of-view. The provisional status is required because of the immaturity of implementations of integrated equipment with AMHS, and additional specifications may yet be defined. Also, further exception handling and error recovery scenarios need to be defined.

2.2 This document applies to all implementations of SEMI E87 that use the SECS-II message protocol (SEMI E5). Compliance to this standard requires compliance to both SEMI E87 and SEMI E5.

2.3 This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

3 Limitations

3.1 This specification applies to semiconductor equipment with SEMI E15.1 compliant load ports. It may also be applied to other manufacturing equipment that supports automated carrier transfer and or contains an internal buffer.

3.2 This is a provisional specification. The following areas must be completed before the provisional status is removed:

1) Any additional services, or changes to existing services, in Carrier Management must be mapped to SECS-II messages.

4 Referenced Standards

4.1 *SEMI Standards*

SEMI E5 — SEMI Equipment Communications Standard 2 Message Content (SECS-II)

SEMI 15.1 — Provisional Specification for 300 mm Tool Load Port

SEMI E39.1 — SECS-II Protocol for Object Services Standard (OSS)

SEMI E87 — Specification for Carrier Management (CMS)

NOTE 1: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Services Mapping

5.1 This section shows the specific SECS-II streams and functions that shall be used for SECS-II implementation of the services defined in SEMI E87, as well as the parameter mapping for data attached to services.

5.2 *Services Message Mapping*

5.2.1 Table 1 defines the relationships between SEMI E87 services and SECS-II messages.

Table 1 Services Message Mapping Table

Service Name	*Stream, Function*	*SECS-II Message Name*
Bind	S3,F17/18	Carrier Action Request/Acknowledge
CancelBind	S3,F17/18	Carrier Action Request/Acknowledge
CancelAllCarrierOut	S3,F19/20	Cancel All Carrier Out Request/Acknowledge
CancelCarrier	S3,F17/18	Carrier Action Request/Acknowledge
CancelCarrierAtPort	S3,F17/18	Carrier Action Request/Acknowledge
CancelCarrierNotification	S3,F17/18	Carrier Action Request/Acknowledge
CancelCarrierOut	S3,F17/18	Carrier Action Request/Acknowledge
CancelReservationAtPort	S3,F25/26	Port Action Request/Acknowledge
CarrierIn	S3,F17/18	Carrier Action Request/Acknowledge
CarrierNotification	S3,F17/18	Carrier Action Request/Acknowledge
CarrierOut	S3,F17/18	Carrier Action Request/Acknowledge
CarrierReCreate	S3,F17/18	CarrierReCreate Rquest/Acknowledge
CarrierRelease	S3,F17/18	Carrier Action Request/Acknowledge
CarrierTagReadData	S3,F29/30	Carrier Tag Read Data Request/Acknowledge
CarrierTagWriteData	S3,F31/32	Carrier Tag Write Data Request/Acknowledge
ChangeAccess	S3,F27/28	ChangeAccess
ChangeServiceStatus	S3,F25/26	Port Action Request/Acknowledge
ProceedWithCarrier	S3,F17/18	Carrier Action Request/Acknowledge
ReserveAtPort	S3,F25/26	Port Action Request/Acknowledge

5.3 *Services Parameter Mapping*

5.3.1 Table 2 maps the SEMI E87 service parameters to SECS-II Data Items.

NOTE 2: Use of parameters not specified for a given message in SEMI E87 is prohibited. SECS-II data items not used for a given message shall be sent as zero-length items.

Table 2 Service Parameters to SECS-II Data Items Mapping

Parameter Name	*Range*	*SECS-II Data Item*
AccessMode	Enumerated: MANUAL, AUTO	PORTACCESS
AttributeData	Any	CATTRDATA
AttributeID	Text format restrictions per SEMI E39.1, Section 6.	CATTRID
CarrierID	1 to 80 characters	CARRIERID
CMAcknowledge	Enumerated	CAACK
CMStatus	Structure	L,2 1. <CAACK> 2. Status
Data	ASCII (20)	DATA
DataLength	Integer (Un or Sn)	DATALENGTH
DataSeg	ASCII (20)	DATASEG
ErrorCode	Enumerated	ERRCODE
ErrorText	1 to 80 characters	ERRTEXT
LocationID	ASCII (20)	LOCID
PropertiesList	Non-identifier properties	L,n 1. L,2 1. <$CATTRID_1$> 2. <$CATTRDATA_1$>

Parameter Name	*Range*	*SECS-II Data Item*
		. . n. L,2 1.< CATTRID $_n$> 2. <CATTRDATA $_n$>
PortID	U1 (1–255)	PTN
ServiceStatus	Enumerated: IN SERVICE, OUT OF SERVICE	U1 0 = OUT OF SERVICE 1 = IN SERVICE
Status	n errors	L,n 1. L,2 1. <ERRCODE$_1$> 2. < ERRTEXT $_1$> . . n. 1.< ERRCODE $_n$> 2. <ERRTEXT $_n$>

5.4 *SECS-II Data Items Without Corresponding SEMI E87 Parameters*

5.4.1 Table 3 contains the SECS-II data items that do not correspond to SEMI E87's service parameter.

Table 3 Additional Data Item Requirements Table

Function	*SECS-II Data Item*
Used by S3,F17 to differentiate between Bind, CancelCarrierOut, CancelCarrierAtPort, CancelBind, CarrierIn, ProceedWithCarrier, CancelCarrierNotification CarrierNotification services, and CarrierReCreate.	CARRIERACTION
Used to satisfy SECS-II conventions for linking a multi-block inquiry with a subsequent multi-block message. Neither required nor specified by CMS.	DATAID
Used to inform receiver of total message length size for SECS-II multi-block conventions. May also be used to indicate the length of a section of data being transmitted to or from a carrier tag.	DATALENGTH
Used to satisfy SECS-II multi-block requirements. Neither required nor specified by SEMI E87.	GRANT
Used by S3,F25 to differentiate between port related, CancelReservationAtPort, and ReserveAtPort services.	PORTACTION
Used by S3F27 to specify desired Port Access Mode.	ACCESSMODE

6 Variable Data Item Mapping

6.1 This section shows the specific SECS-II data classes, and formats needed for SECS-II implementations of SEMI E87 variable data items.

Table 4 Variable Data Item Mapping Table

Variable Name	*Class*	*Format*
AccessMode	DVVAL	51 (U1) Enumerated: 0 = MANUAL 1 = AUTO
AccessMode$_i$	SV	51 (U1) Enumerated: 0 = MANUAL 1 = AUTO
AvailPartitionCapacity	DVVAL	51
AvailPartitionCapacity$_i$	SV	51
BufferCapacityList	SV	L,n 1. <BufferPartitionInfo$_1$> . . n. <BufferPartitionInfo$_n$>
BufferPartitionInfo	DVVAL	L,4 1. <PartitionID> 2. <PartitionType> 3. <AvailPartitionCapacity> 4. <PartitionCapacity>
BufferPartitionInfo$_i$	SV	L,4 1. <PartitionID$_i$> 2. <PartitionType$_i$> 3. <AvailPartitionCapacity$_i$> 4. <PartitionCapacity$_i$>
CarrierAccessingStatus	DVVAL	51 (U1) Enumerated as: 0 = NOT ACCESSED 1 = IN ACCESS 2 = CARRIER COMPLETE 3 = CARRIER STOPPED
CarrierID	DVVAL	A[1-80] (Conforms to restrictions of ObjID as specified in SEMI E39.1, Section 6.)
CarrierID$_i$	SV	A[1-80] (Conforms to restrictions of ObjID as specified in SEMI E39.1, Section 6.)
CarrierIDStatus	DVVAL	51 (U1) Enumerated as: 0 = ID NOT READ 1 = [ID] WAITING FOR HOST 2 = ID VERIFICATION OK 3 = ID VERIFICATION FAILED