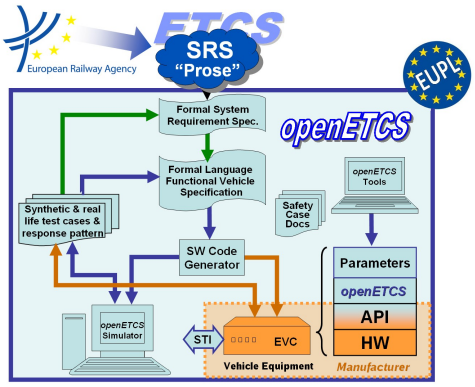
openSource

Level Management Function

Scade Model description



Funded by:

Generated documentation from the Scade model of Level Management Function.

Summary:

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1. Project Architecture

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- OutputToRBC

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3 Levels Project

1. Root Elements

1. ManageLevels Operator

Declared as **`public node`**

1. Comments and Information

ManageLevels Comments:
This function is in charge to compute at each cycle, the Level to apply according data receivec from trackside, driver and train position.
“5.10 Level Transitions”
“5.10.1 General requirements”
“5.10.1.1 Every level transition border to levels 2, 3, or NTC shall be announced to the
ERTMS/ETCS on-board equipment via balise group or via the RBC.”
This is an input of the node “Data_from_track_to_Level” provided at each cycle.
“5.10.1.2 A level transition announcement to the ERTMS/ETCS on-board equipment shall
consist of an order to execute the level transition at a further location corresponding to
the border.”
See definition of the type “T_Level_Transition”.
“5.10.1.3 When the ERTMS/ETCS on-board equipment receives a level transition announcement, and if this announcement will result in a change of the on-board level,
it shall immediately inform the driver about the announced level transition.”
Computation of the output “announced_level”.
“5.10.1.4 At the level transition border a balise group shall be placed with an immediate level
transition order or a conditional level transition order.”
Trackside requirement.
“5.10.1.7 As soon as the announcement of the level transition has been received, some data
(mainly movement authority and track description data) from the transmission media of
the new level shall be accepted, but shall not be used until the level transition is effective.”
Output “announced_level” produced, then selection of data is out of the scope of this function.
“5.10.1.8 When the onboard has performed the level transition, further data (mainly movement

authority and track description data) received from the transmission media of the level
being left shall be rejected."
Output "announced_level" produced, then selection of data is out of the scope of this function.
"5.10.2.5 When the onboard has selected the level it will switch to, it shall carry out the level
transition as if it has received a level transition order to this level only i.e. it shall ignore
the requirements related to transitions to the other levels."
Core of this function and computation of output "announced_level".
"5.10.2.6 The ERTMS/ETCS on-board equipment shall inform the driver about the selected level
transition only."
Computation of the output "announced_level".
"5.10.2.8 The ERTMS/ETCS on-board equipment shall store the table of priority of trackside
supported ERTMS/ETCS levels."
Storage and memorisation is out of the scope of this function.
"5.10.3.14.4 In the same way as for a level transition order, the ERTMS/ETCS on-board equipment
shall store the table of ERTMS/ETCS levels supported by trackside."
Storage and memorisation is out of the scope of this function.
Requirement of §5.10 out of the scope of this function (trackside or other functions) :

5.10.2.1, 5.10.2.2, 5.10.2.3
5.10.3.1.2, 5.10.3.1.3, 5.10.3.1.4, 5.10.3.1.6
5.10.3.2.2, 5.10.3.2.4, 5.10.3.2.6,
5.10.3.3.1,
5.10.3.3.2,
5.10.3.4.2, 5.10.3.5.1, 5.10.3.5.2, 5.10.3.6.15.10.3.6.4, 5.10.3.7.2
5.10.3.7.4, 5.10.3.7.6, 5.10.3.8.2, 5.10.3.9.1, 5.10.3.10.1
5.10.3.12.2, 5.10.3.13.3

2. Interface

Table 1: Inputs of ManageLevels

Name	Type	Comments and Information
trainStandstill	bool	
driverLevelTransition	Level_And_Mode_Types_Pkg::T_LevelTransition	

levelAck	bool	
trainPosition	TrainPosition_Types_Pck::trainPosition_T	
ERTMScapabilities	Level_And_Mode_Types_Pkg::T_ERTMS_capabilities	
DataFromTrackToLevel	Level_And_Mode_Types_Pkg::T_Data_From_Track_To_Level	
MemorizedLevelIn	M_LEVEL	

Table 2: Outputs of ManageLevels

Name	Type	Comments and Information
nextLevel	M_LEVEL	
TripTrainRequested	bool	
needsAckFromDriver	bool	
announcedLevelTransition	Level_And_Mode_Types_Pkg::T_LevelTransition	
serviceBrakeRequested	bool	
connectionToRBCRequested	bool	
positionReportNeeded	bool	
levelIsNew	bool	**Comments:** The requested transition was not successfull, e.g., because of missing confirmation by the driver.
isAvailableForUse	bool	

3. Locals

Table 3: Locals of ManageLevels

Name	Type	Comments and Information
Loc_IsNewLevel	bool	
Loc_NextLevel	M_LEVEL	

4. Operator Hierarchy

diagram : diagram_ManageLevels_1

5. Graphical and Textual Diagrams

1. View of diagram_ManageLevels_1 (ManageLevels)

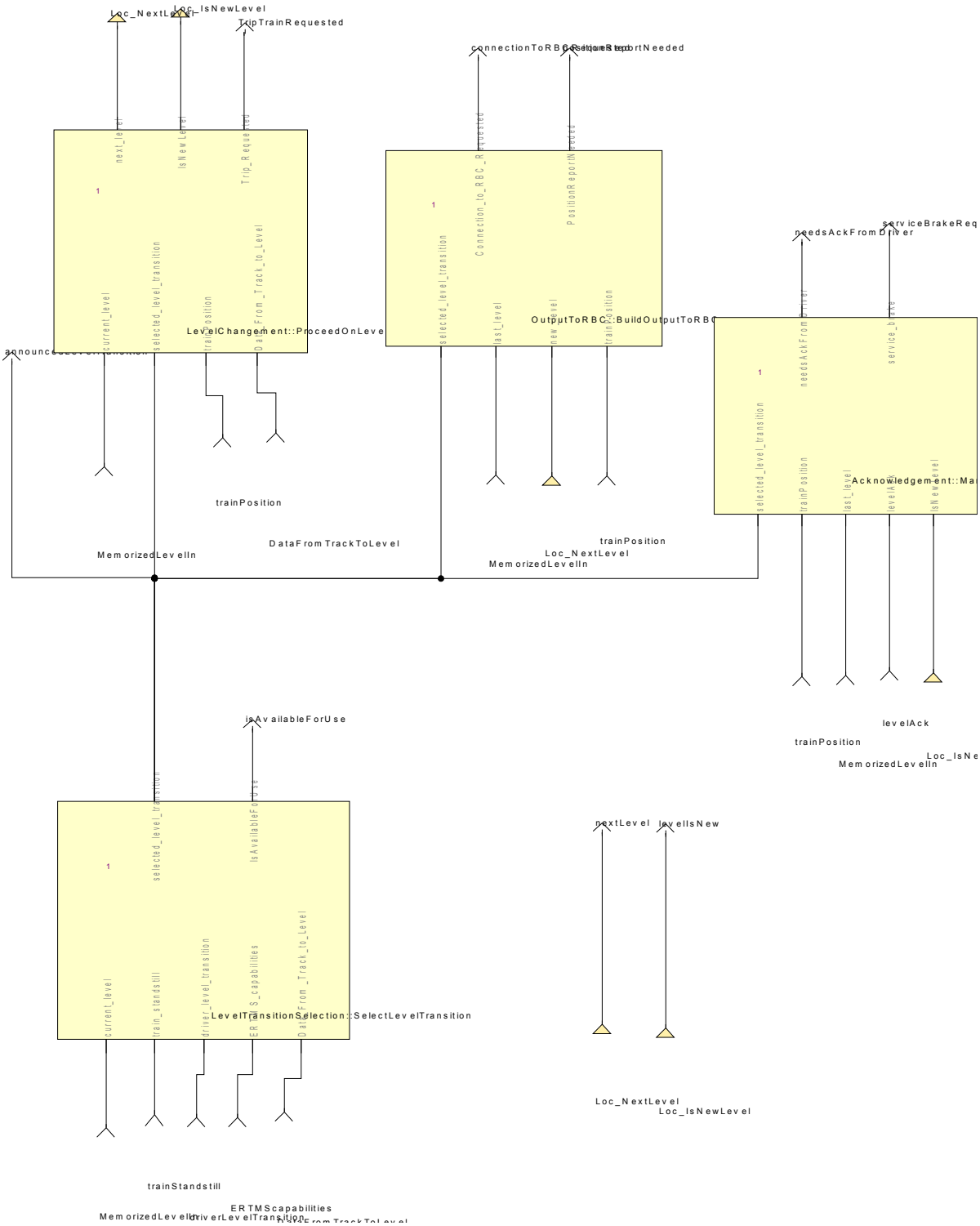


Figure 1: View of diagram_ManageLevels_1 (ManageLevels)

2. Acknowledgement Package

1. IsAckNeeded Operator

Declared as `public function`

1. Comments and Information

IsAckNeeded Comments:

5.10.4.4 For the following transitions marked as "YES", the level transition announcement shall
define the location from where an acknowledgement is required:

Coming from	Acknowledgement when entering				
	L 0	L 1	L 2	L 3	L NTC
L 0	-	No	No	No	Yes
L 1	Yes	-	No	No	Yes
L 2	Yes	No	-	No	Yes
L 3	Yes	No	No	-	Yes
L NTC	Yes	Yes	Yes	Yes	Yes

2. Interface

Table 4: Inputs of IsAckNeeded

Name	Type	Comments and Information
selected_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
last_level	M_LEVEL	

Table 5: Outputs of IsAckNeeded

Name	Type	Comments and Information
isAckNeeded	bool	

3. Locals

Table 6: Locals of IsAckNeeded

Name	Type	Comments and Information
Loc_new_level	M_LEVEL	

4. Operator Hierarchy

diagram : diagram_IsAckNeeded_1

5. Graphical and Textual Diagrams

1. View of diagram_IsAckNeeded_1 (IsAckNeeded)

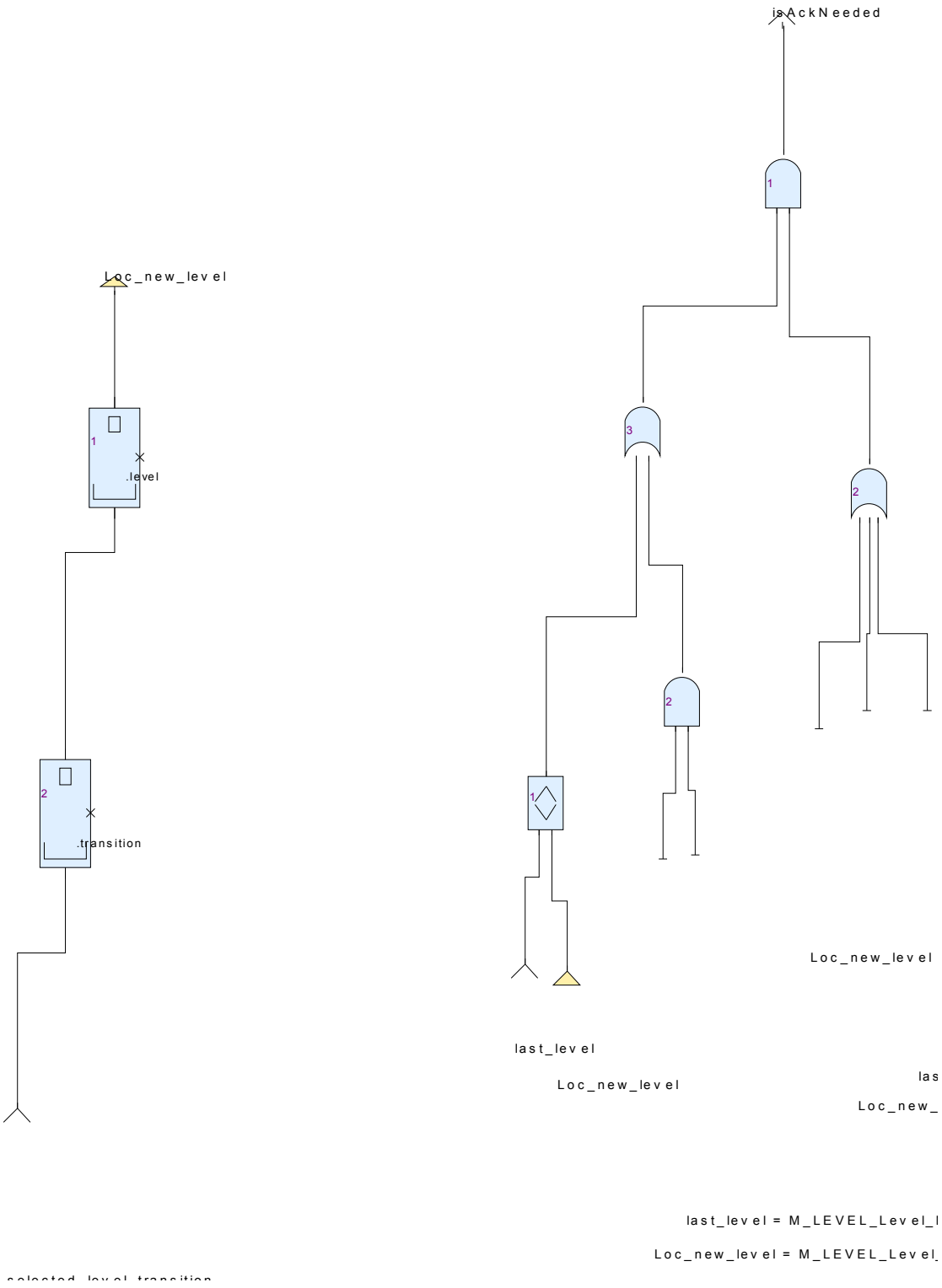


Figure 2: View of diagram_IsAckNeeded_1 (IsAckNeeded)

2. ManageAck Operator

Declared as `public node`

1. Comments and Information

ManageAck Comments:
5.10.4 Acknowledgement of the level transition
5.10.4.1.1 Exception: An ERTMS/ETCS on-board equipment in NL mode shall not require an
acknowledgement from the driver.

2. Interface

Table 7: Inputs of ManageAck

Name	Type	Comments and Information
selected_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
trainPosition	TrainPosition_Types_Pck::trainPosition_T	
last_level	M_LEVEL	
levelAck	bool	
IsNewLevel	bool	

Table 8: Outputs of ManageAck

Name	Type	Comments and Information
needsAckFromDriver	bool	
service_brake	bool	

3. Operator Hierarchy

diagram : diagram_ManageAck_1

4. Graphical and Textual Diagrams

1. View of diagram_ManageAck_1 (ManageAck)

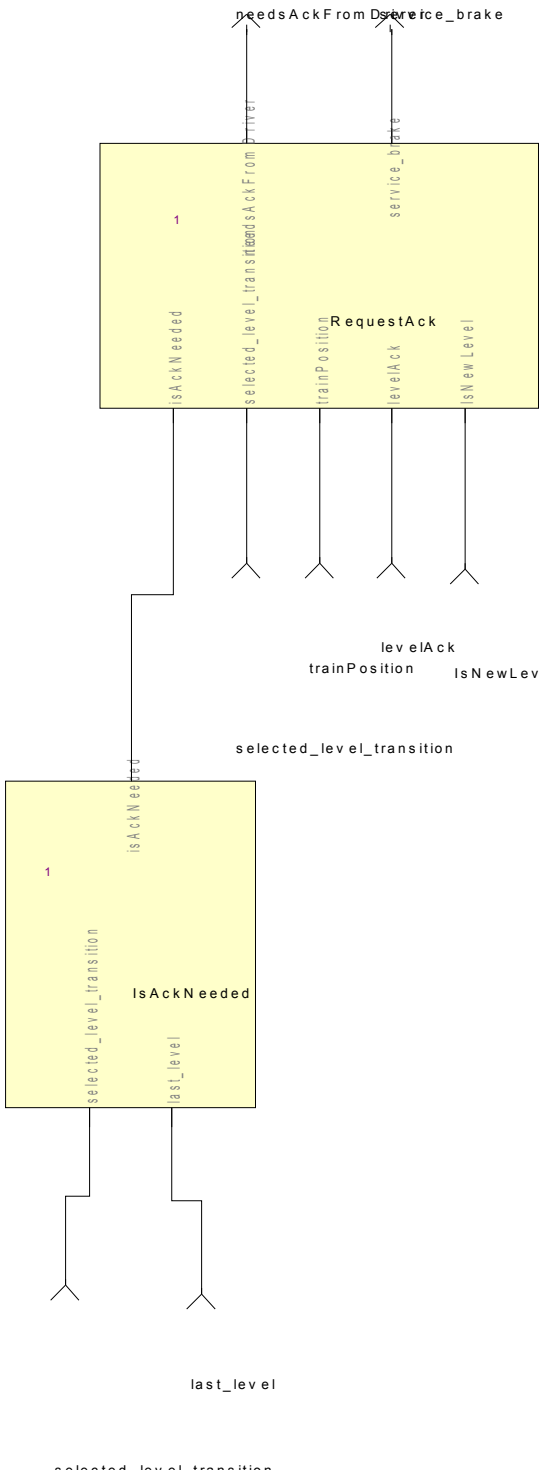


Figure 3: View of diagram_ManageAck_1 (ManageAck)

3. Position_In_Ack_Area Operator

Declared as `public function`

1. Interface

Table 9: Inputs of Position_In_Ack_Area

Name	Type	Comments and Information
Position	Obu_BasicTypes_Pkg::Location_T	
D_Area	Obu_BasicTypes_Pkg::Location_T	
L_Ack_Area	Obu_BasicTypes_Pkg::Location_T	

Table 10: Outputs of Position_In_Ack_Area

Name	Type	Comments and Information
Position_In_Ack_Area	bool	

2. Operator Hierarchy

diagram : diagram_Position_In_Ack_Area_1

3. Graphical and Textual Diagrams

1. View of diagram_Position_In_Ack_Area_1 (Position_In_Ack_Area)

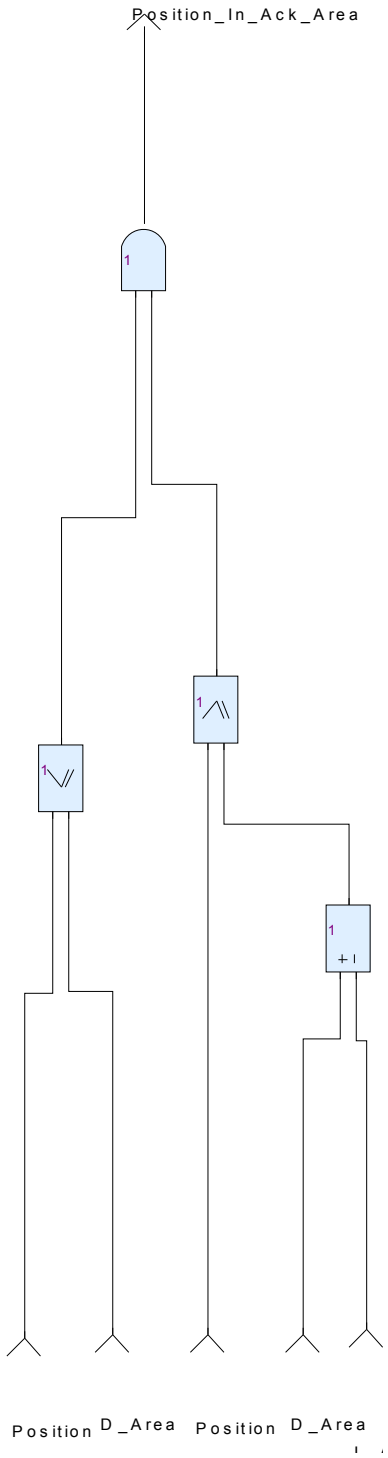


Figure 4: View of diagram_Position_In_Ack_Area_1 (Position_In_Ack_Area)

4. RequestAck Operator

Declared as `public node`

1. Comments and Information

RequestAck Comments:
5.10.4.1 If defined so for the level transition (see table below), the driver shall be requested to
acknowledge the transition
a) when the max safe front end of the train has passed a trackside defined location in
rear of the level transition border
b) upon receipt of the order to switch to the new level immediately
5.10.4.2 If the driver has not yet acknowledged within the driver acknowledgement time (refer to
Appendix A3.1) after the level transition, a service brake command shall be initiated.
5.10.4.3 The driver shall then acknowledge the level transition in order to release the service
brake command.

2. Interface

Table 11: Inputs of RequestAck

Name	Type	Comments and Information
isAckNeeded	bool	
selected_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
trainPosition	TrainPosition_Types_Pck::trainPosition_T	
levelAck	bool	
IsNewLevel	bool	

Table 12: Outputs of RequestAck

Name	Type	Comments and Information
needsAckFromDriver	bool	
service_brake	bool	

3. Locals

Table 13: Locals of RequestAck

Name	Type	Comments and Information
Loc_AckLength	Obu_BasicTypes_Pkg::Location_T	
Loc_Immediate	bool	

Loc_isSet	bool	
Loc_MaxSafeFrontEnd	Obu_BasicTypes_Pkg::Location_T	
Loc_Position	M_POSITION	
Loc_PositionInAckArea	bool	

4. Operator Hierarchy

diagram : diagram_RequestAck_1

state-machine : SM1

state : AckReceived

state : LaunchRequest

state : Waiting

5. Graphical and Textual Diagrams

1. View of diagram_RequestAck_1 (RequestAck)

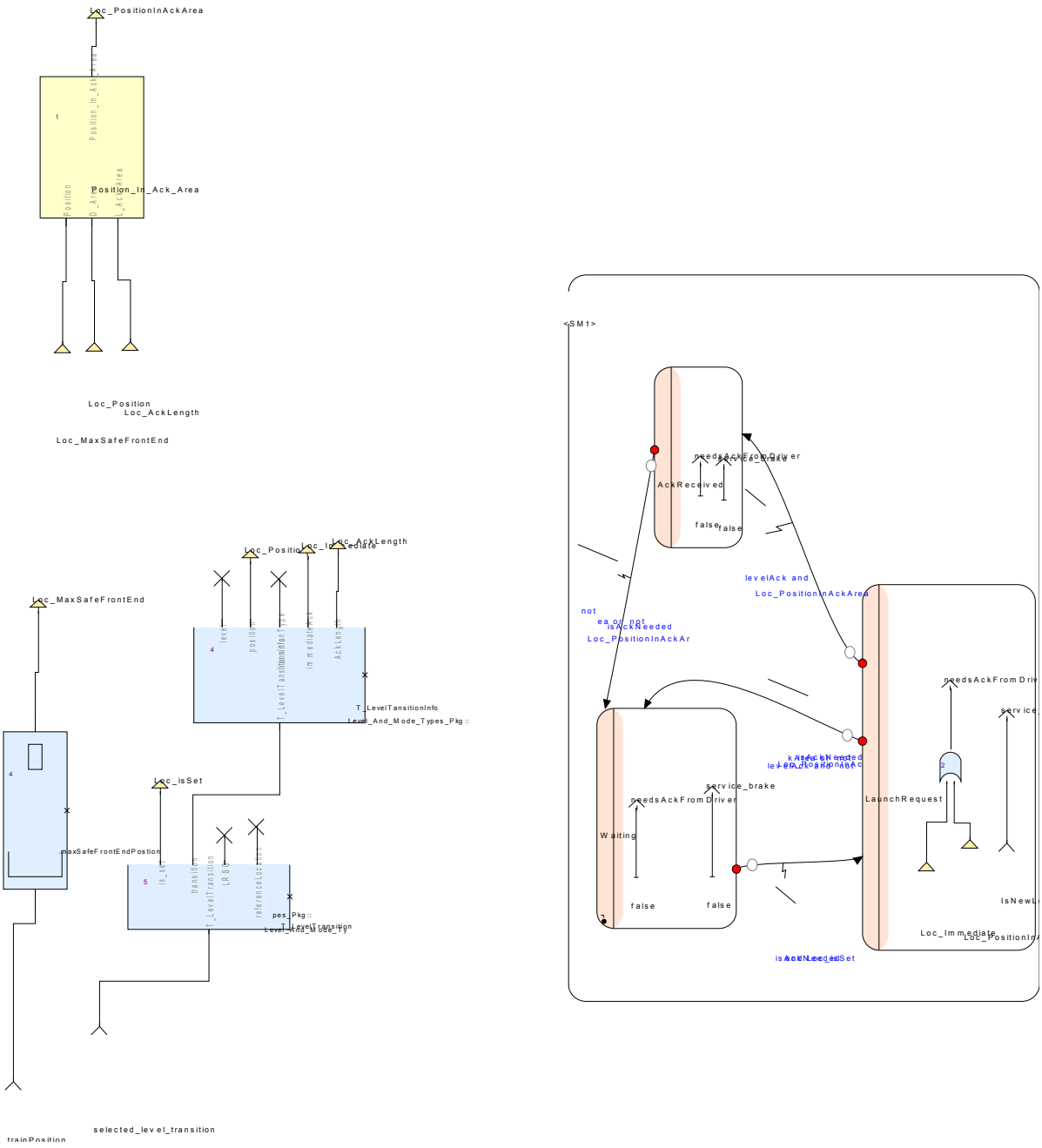


Figure 5: View of diagram_RequestAck_1 (RequestAck)

Table 14: State Machines of diagram_RequestAck_1

State Machine	Comments and Information
SM1	

Table 15: States of diagram_RequestAck_1

State	Comments and Information

SM1:AckReceived	
SM1:LaunchRequest	
SM1:Waiting	

Table 16: Transitions of diagram_RequestAck_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: SM1:AckReceived **Target:** SM1:Waiting	1	**Condition:** not Loc_PositionInAckArea or not isAckNeeded	
Source: SM1:LaunchRequest **Target:** SM1:Waiting	1	**Condition:** levelAck and not Loc_PositionInAckArea or not isAckNeeded	
Source: SM1:LaunchRequest **Target:** SM1:AckReceived	2	**Condition:** levelAck and Loc_PositionInAckArea	
Source: SM1:Waiting **Target:** SM1:LaunchRequest	1	**Condition:** isAckNeeded and Loc_isSet	

3. LevelChangement Package

1. ComputeNewLevel Operator

Declared as `public function`

1. Comments and Information

ComputeNewLevel Comments:

5.10.1.5 If the message from the border balise group is not received, the level transition shall
still be executed when the estimated front end passes the location given in the announcement.

2. Interface

Table 17: Inputs of ComputeNewLevel

Name	Type	Comments and Information
current_level	M_LEVEL	
selected_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
trainPosition	TrainPosition_Types_Pck::trainPosition_T	

Table 18: Outputs of ComputeNewLevel

Name	Type	Comments and Information
next_level	M_LEVEL	

IsNewLevel	bool	

3. Locals

Table 19: Locals of ComputeNewLevel

Name	Type	Comments and Information
Loc_is_set	bool	
Loc_Level	M_LEVEL	
Loc_Position	M_POSITION	
Loc_Type	Level_And_Mode_Types_Pkg::T_TransitionType	

4. Operator Hierarchy

diagram : diagram_ComputeNewLevel_1

5. Graphical and Textual Diagrams

1. View of diagram_ComputeNewLevel_1 (ComputeNewLevel)

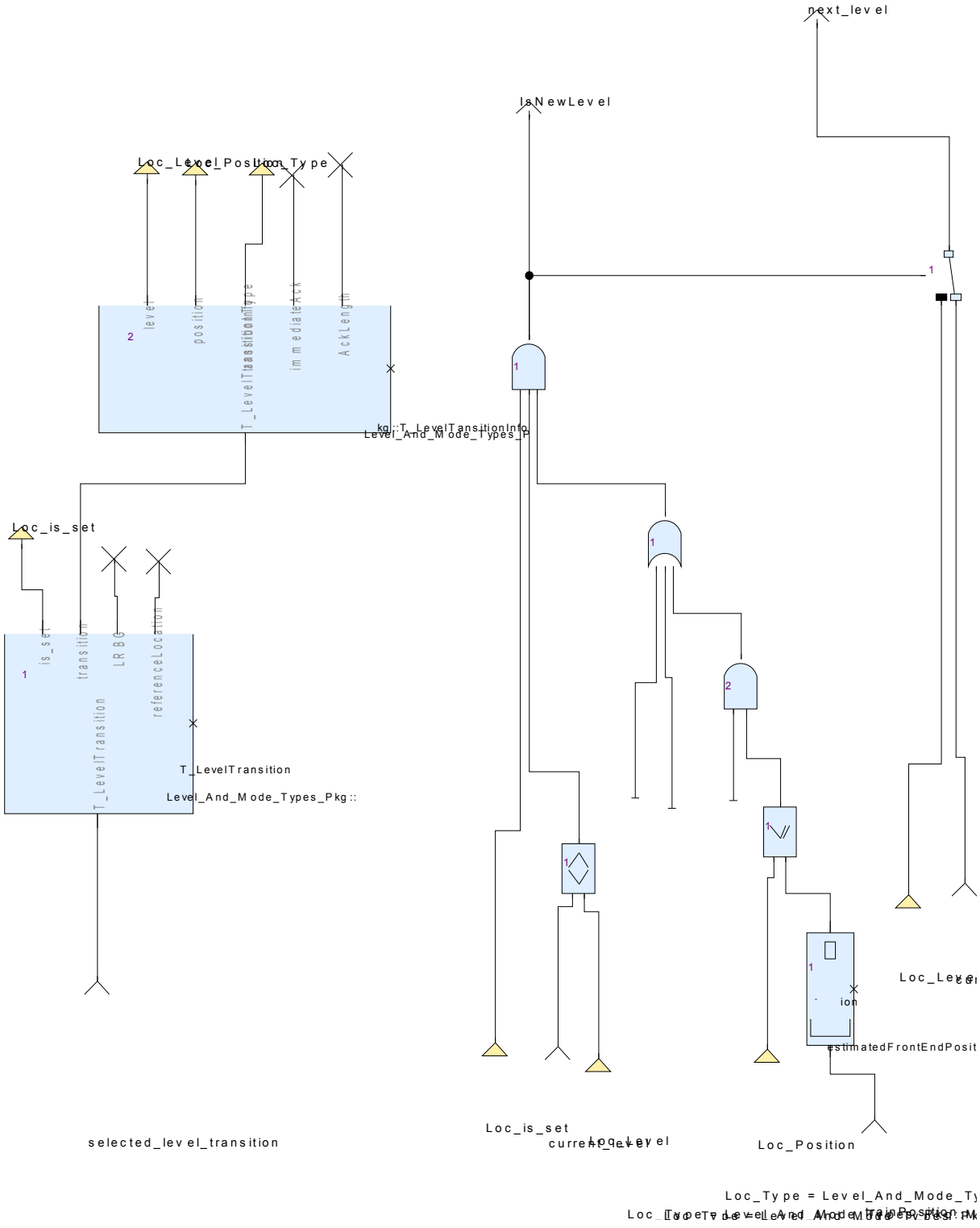


Figure 6: View of diagram_ComputeNewLevel_1 (ComputeNewLevel)

2. ProceedOnLevelChange Operator

Declared as `public function`

1. Comments and Information

2. Interface

Table 20: Inputs of ProceedOnLevelChange

Name	Type	Comments and Information
current_level	M_LEVEL	
selected_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
trainPosition	TrainPosition_Types_Pck::trainPosition_T	
Data_From_Track_to_Level	Level_And_Mode_Types_Pkg::T_Data_From_Track_To_Level	

Table 21: Outputs of ProceedOnLevelChange

Name	Type	Comments and Information
next_level	M_LEVEL	
IsNewLevel	bool	
Trip_Requested	bool	

3. Operator Hierarchy

diagram : diagram_ProceedOnLevelChange_1

4. Graphical and Textual Diagrams

1. View of diagram_ProceedOnLevelChange_1 (ProceedOnLevelChange)

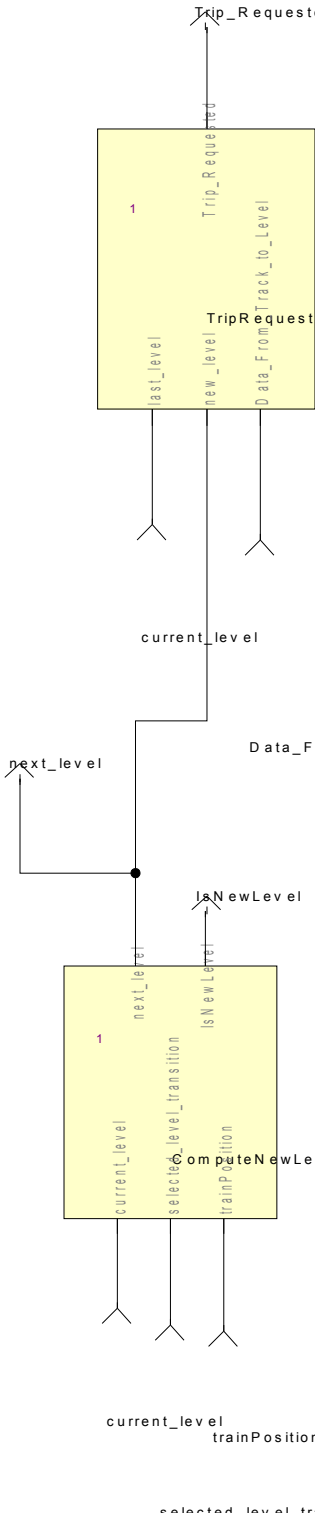


Figure 7: View of diagram_ProceedOnLevelChange_1 (ProceedOnLevelChange)

3. TripRequests Operator

Declared as `public function`

1. Comments and Information

TripRequests Comments:
5.10.3.2 Transition from Level 0 (Unfitted) to Level 2/3 area
5.10.3.2.3 A level 2/3 MA and track description information shall be received from the RBC before
the level transition border. If not, the train shall be tripped at passage of the border, i.e.
after switching to level 2 or 3, movement is not allowed without a movement authority
(refer to SRS chapter 4, transitions between modes).
5.10.3.4 Transition from Level 0 (Unfitted) to Level 1 area
5.10.3.4.1 A level 1 MA and track description information shall be received before or at the level
transition border. If not, when the level transition is performed, the train shall be tripped, i.e. after switching to level 1, movement is not allowed without a movement
authority (refer to SRS chapter 4, transitions between modes).
5.10.3.7 Transition from Level NTC to Level 2/3 area
5.10.3.7.3 A level 2/3 MA and track description information shall be received from the RBC before
the level transition border. If not, the train shall be tripped at passage of the border, i.e.
after switching to level 2 or 3, movement is not allowed without a movement authority
(refer to SRS chapter 4, transitions between modes).
5.10.3.8 Transition from Level NTC to Level 1 area
5.10.3.8.1 A level 1 MA and track description information shall be received before or at the level
transition border. If not, when the level transition is performed, the train shall be tripped, i.e. after switching to level 1, movement is not allowed without a movement
authority (refer to SRS chapter 4, transitions between modes).

2. Interface

Table 22: Inputs of TripRequests

Name	Type	Comments and Information
last_level	M_LEVEL	
new_level	M_LEVEL	

Data_From_Track_to_Level	Level_And_Mode_Types_Pkg::T_Data_From_Track_To_Level	

Table 23: Outputs of TripRequests

Name	Type	Comments and Information
Trip_Requested	bool	

3. Locals

Table 24: Locals of TripRequests

Name	Type	Comments and Information
Loc_L1_MA_track	bool	
Loc_L2L3_MA_track	bool	

4. Operator Hierarchy

diagram : diagram_TripRequests_1
activate if : IfBlock1
branch : then
activate if : IfBlock2
branch : then
branch : else
branch : then
branch : else
branch : else

5. Graphical and Textual Diagrams

1. View of diagram_TripRequests_1 (TripRequests)

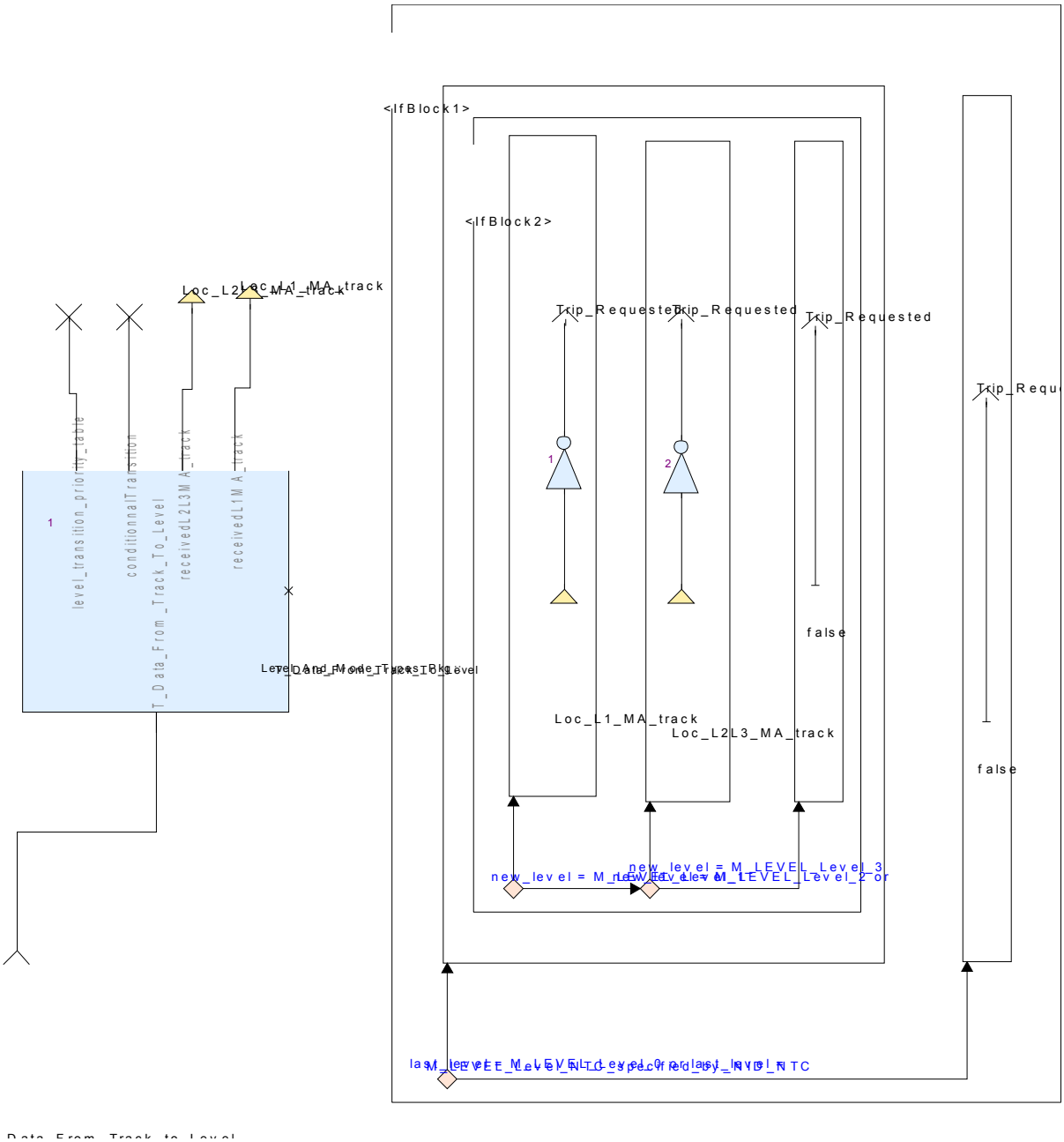


Figure 8: View of diagram_TripRequests_1 (TripRequests)

Table 25: Conditional Blocks of diagram_TripRequests_1

Conditional Block	Comments and Information
IfBlock1	
IfBlock1:then:IfBlock2	

Table 26: Actions of diagram_TripRequests_1

Conditional Block Action	Comments and Information
IfBlock1:then	
IfBlock1:then:IfBlock2:then	

IfBlock1:then:IfBlock2:else:then	
IfBlock1:then:IfBlock2:else:else	
IfBlock1:else	

4. LevelTransitionSelection Package

1. IsInPriorityTable Operator

Declared as `public function`

1. Comments and Information

IsInPriorityTable Comments:
"5.10.3.14.1 When the ERTMS/ETCS on-board equipment accepts a conditional level transition
order the onboard shall check whether the current level is contained in the priority list
of the conditional level transition order."
Core of the function

2. Interface

Table 27: Inputs of IsInPriorityTable

Name	Type	Comments and Information
In_same_level_and_set	bool	
level	M_LEVEL	
level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	

Table 28: Outputs of IsInPriorityTable

Name	Type	Comments and Information
same_level_and_set	bool	

3. Operator Hierarchy

diagram : diagram_IsInPriorityTable_1

4. Graphical and Textual Diagrams

1. View of diagram_IsInPriorityTable_1 (IsInPriorityTable)

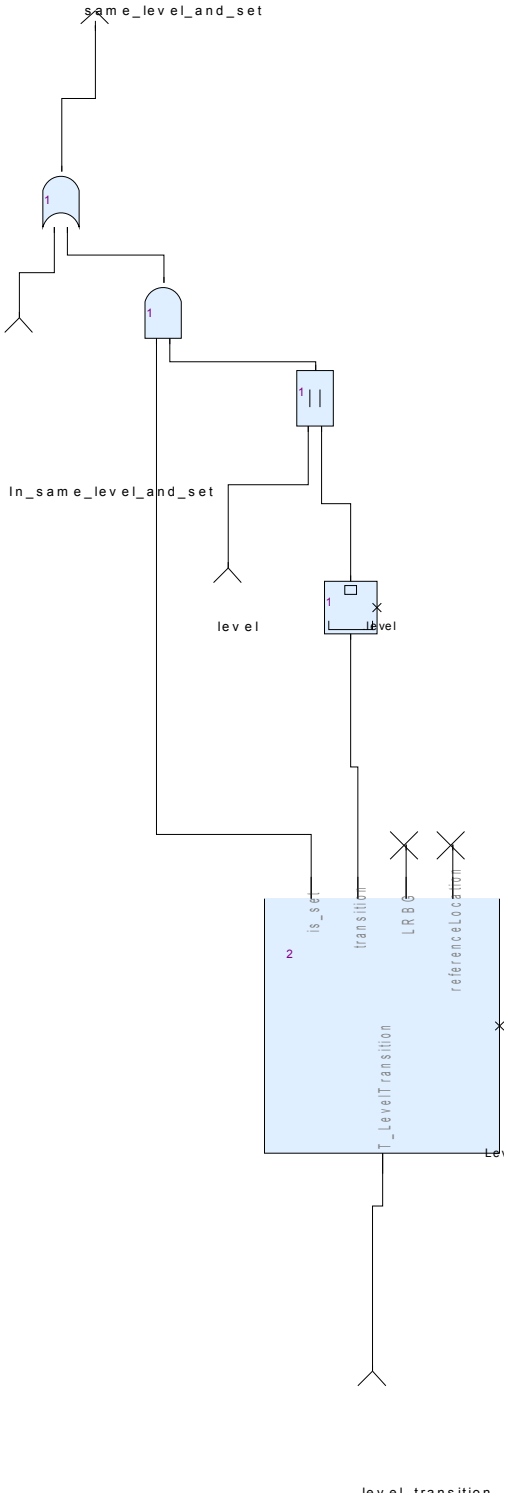


Figure 9: View of diagram_IsInPriorityTable_1 (IsInPriorityTable)

2. IsSelectedTransition Operator

Declared as `public function`

1. Comments and Information

IsSelectedTransition Comments:
"5.10.2.4.1 The on-board equipment shall consider an ERTMS/ETCS level as "Available for use"
as follows:
a) Level 2 or 3: the level is configured on-board and at least one Mobile Terminal is
available on-board, i.e. the ETCS onboard has detected at least one Mobile Terminal in working condition, independently whether it is registered to a network or
not.
b) Level NTC: the concerned National System is available on-board (if an STM is used, refer to SUBSET-035 for further details).
c) Level 0 or 1: always."
To compute stop condition.

2. Interface

Table 29: Inputs of IsSelectedTransition

Name	Type	Comments and Information
last_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
ERTMS_capabilities	Level_And_Mode_Types_Pkg::T_ERTMS_capabilities	

Table 30: Outputs of IsSelectedTransition

Name	Type	Properties		Comments and Information
available_transition_not_selected	bool			
selected_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	default	Level_And_Mode_Types_Pkg::M_Default_Transition	

3. Locals

Table 31: Locals of IsSelectedTransition

Name	Type	Comments and Information

capability_Level0	bool	
capability_Level1	bool	
capability_Level2	bool	
capability_Level3	bool	
capability_NTC	bool	
Loc_is_valid	bool	

4. Operator Hierarchy

diagram : diagram_IsSelectedTransition_1
activate if : SelectHigherPriority
branch : then
branch : else

5. Graphical and Textual Diagrams

1. View of diagram_IsSelectedTransition_1 (IsSelectedTransition)

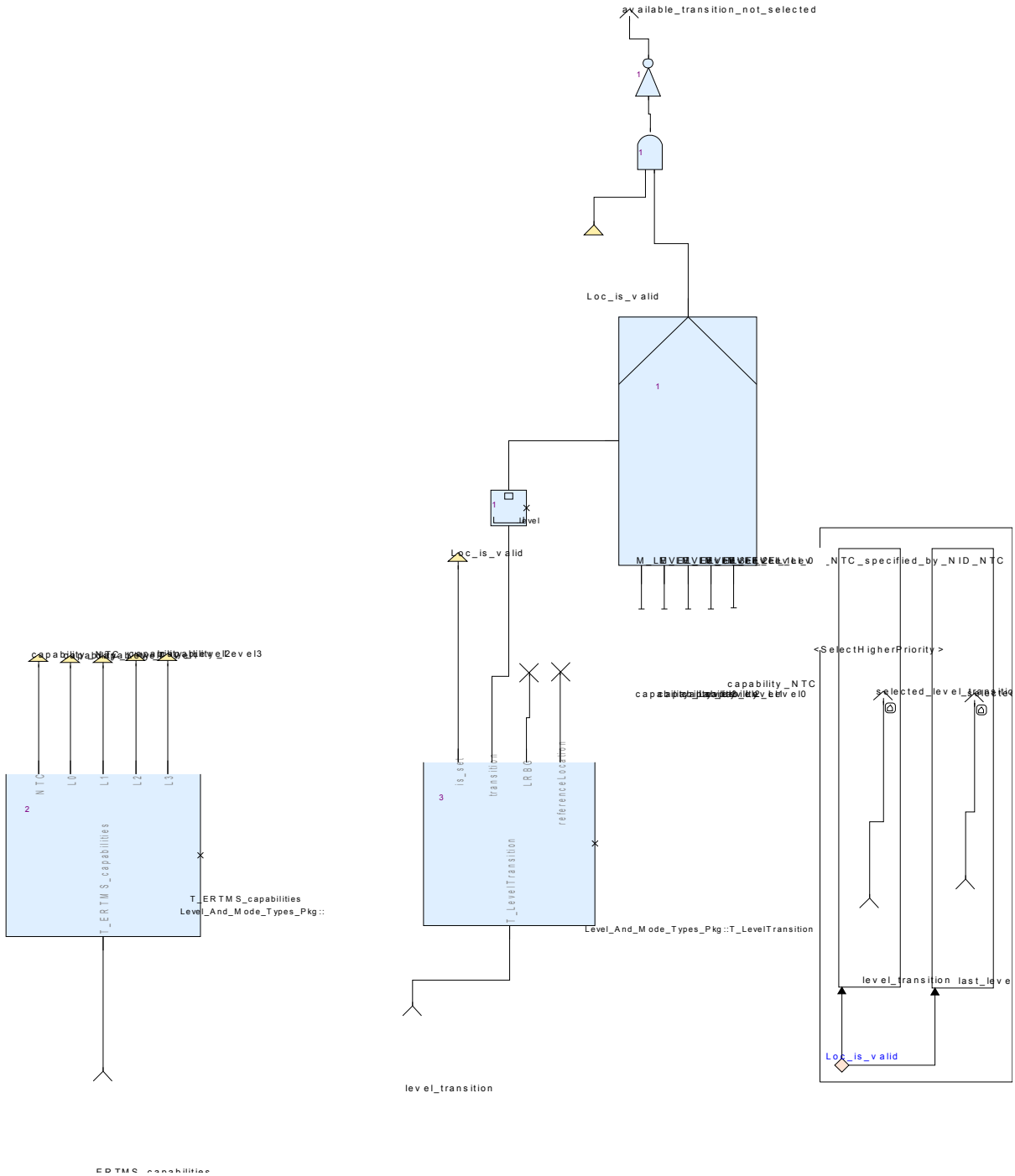


Figure 10: View of diagram_IsSelectedTransition_1 (IsSelectedTransition)

Table 32: Conditional Blocks of diagram_IsSelectedTransition_1

Conditional Block	Comments and Information

SelectHigherPriority	

Table 33: Actions of diagram_IsSelectedTransition_1

Conditional Block Action	Comments and Information
SelectHigherPriority:then	
SelectHigherPriority:else	

3. SelectConditionnalTransition Operator

Declared as `public function`

1. Comments and Information

SelectConditionnalTransition Comments:
"5.10.3.14.2 If the current level is contained in the priority list of the conditional level transition order,
the onboard shall not change the level."
If branch.
"5.10.3.14.3 If the current level is not contained in the priority list of the conditional level transition
order, the onboard shall evaluate the conditional level transition order in the same way
as an immediate level transition order (see section 5.10.2)."
Else branch.

2. Interface

Table 34: Inputs of SelectConditionnalTransition

Name	Type	Comments and Information
current_level	M_LEVEL	
conditional_transition	Level_And_Mode_Types_Pkg::T_LevelTransition_PriorityTable	
ERTMS_capabilities	Level_And_Mode_Types_Pkg::T_ERTMS_capabilities	
last_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
last_available_for_use	bool	

Table 35: Outputs of SelectConditionnalTransition

Name	Type	Comments and Information
Available_for_use	bool	
output_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	

3. Locals

Table 36: Locals of SelectConditionnalTransition

Name	Type	Comments and Information
Loc_contain_current_level	bool	

4. Operator Hierarchy

diagram : diagram_SelectConditionnalTransition_1
activate if : IfBlock1
branch : then
branch : else

5. Graphical and Textual Diagrams

1. View of diagram_SelectConditionnalTransition_1 (SelectConditionnalTransition)

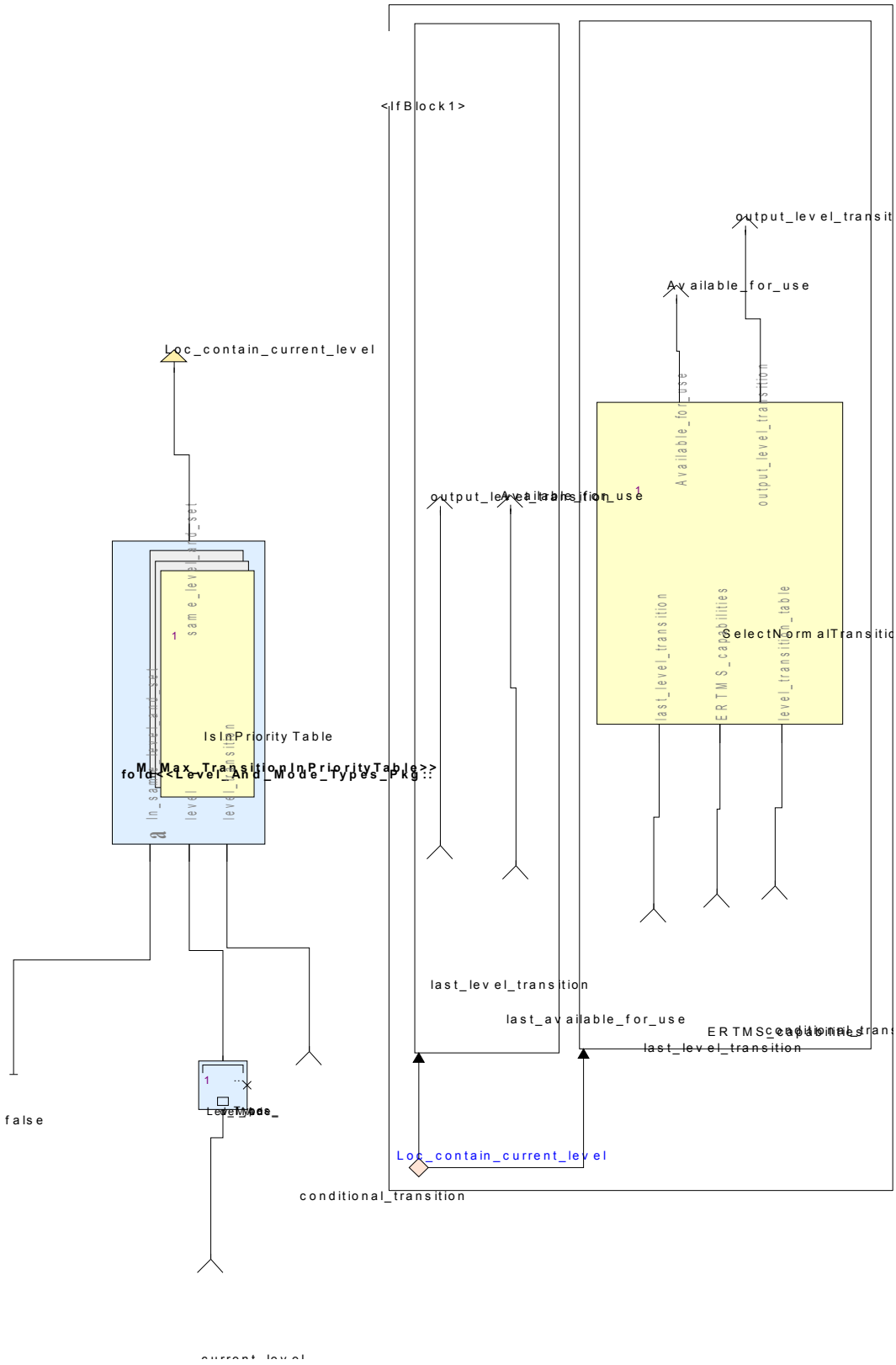


Figure 11: View of diagram_SelectConditionnalTransition_1 (SelectConditionnalTransition)

Table 37: Conditional Blocks of diagram_SelectConditionnalTransition_1

Conditional Block	Comments and Information
IfBlock1	

Table 38: Actions of diagram_SelectConditionnalTransition_1

Conditional Block Action	Comments and Information
IfBlock1:then	
IfBlock1:else	

4. SelectDriverCondition Operator

Declared as `public function`

1. Comments and Information

SelectDriverCondition Comments:
"5.10.3.15 Transition initiated by driver
5.10.3.15.1 In addition to the level transitions ordered by trackside, it is also possible, at standstill,
for the driver to change the ERTMS/ETCS level (refer to section 3.18.4.2).
"

If the train is at standstill
and if a driver transition is received
with a level different from the current level
the received transition from the driver is selected, otherwise the last one is kept.
There are no check of capabilities in this case, if the request is not correct TRIP mode shall be triggered latter (see condition to Trip Mode)

2. Interface

Table 39: Inputs of SelectDriverCondition

Name	Type	Comments and Information
current_level	M_LEVEL	
train_standstill	bool	
driver_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
last_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	

Table 40: Outputs of SelectDriverCondition

Name	Type	Comments and Information
driver_output_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	

3. Locals

Table 41: Locals of SelectDriverCondition

Name	Type	Comments and Information
Driver_Transition_Level	M_LEVEL	
Driver_Transition_Set	bool	

4. Operator Hierarchy

diagram : diagram_SelectDriverCondition_1

5. Graphical and Textual Diagrams

1. View of diagram_SelectDriverCondition_1 (SelectDriverCondition)

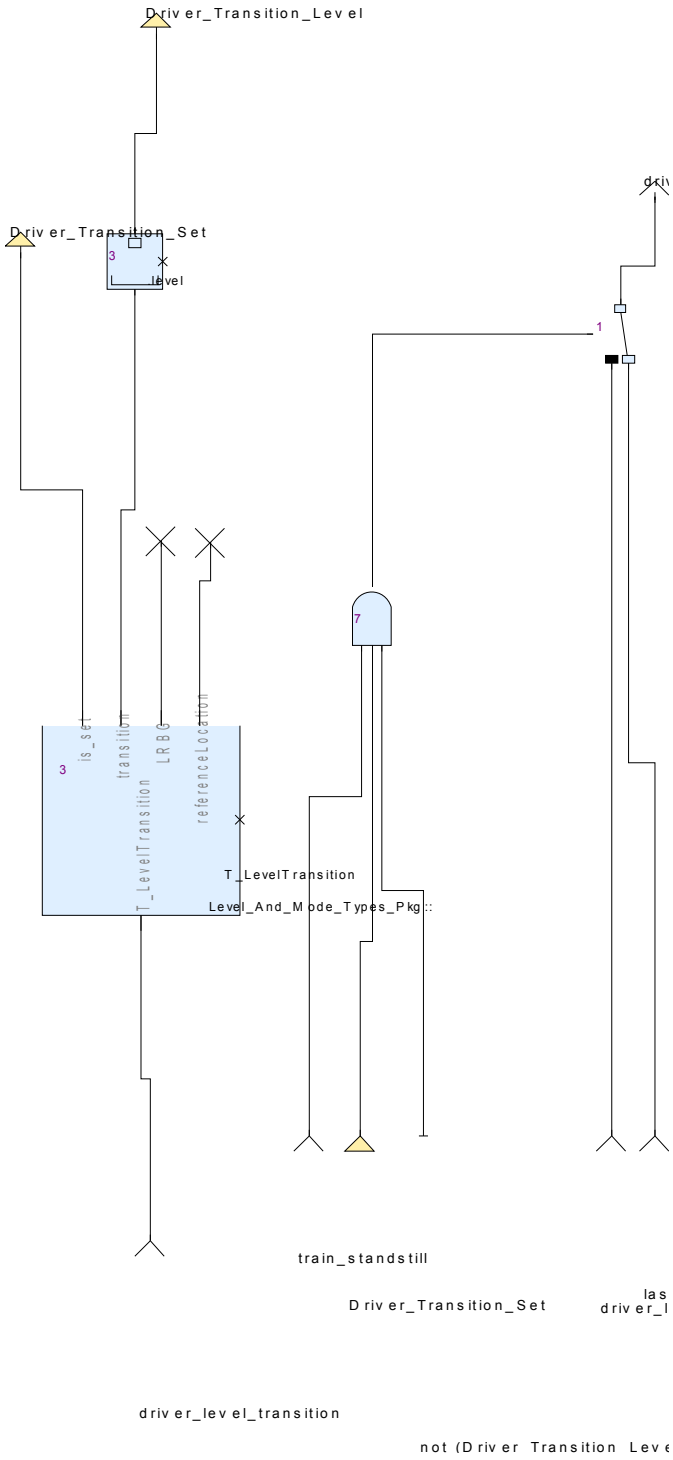


Figure 12: View of diagram_SelectDriverCondition_1 (SelectDriverCondition)

5. SelectLevelTransition Operator

Declared as `public node`

1. Comments and Information

SelectLevelTransition Comments:
Operator in charge of the selection of the last received level transition.
"5.10.1.6 The on-board equipment shall manage only one level transition order at a time.
Therefore a new level transition order shall replace a previously received order, i.e. if a
new order to switch to a different level or to the same level but at a different location is
received, before the action from the first order has been performed, only the last order
shall be executed."
Selection of one transition.
"5.10.1.6.1 In Shunting and Passive Shunting modes only one set of Level Transition Information
shall be stored at a time. Therefore a set of Level Transition Information received shall
replace any Level Transition Information already stored on-board."
No specific implementation.

2. Interface

Table 42: Inputs of SelectLevelTransition

Name	Type	Comments and Information
current_level	M_LEVEL	
train_standstill	bool	
driver_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
ERTMS_capabilities	Level_And_Mode_Types_Pkg::T_ERTMS_capabilities	
Data_From_Track_to_Level	Level_And_Mode_Types_Pkg::T_Data_From_Track_To_Level	

Table 43: Outputs of SelectLevelTransition

Name	Type	Properties		Comments and Information
selected_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	default	Level_And_Mode_Types_Pkg::M_Default_Transition	

		last	Level_And_Mode_Types_Pkg::M_Default_Transition	
IsAvailableForUse	bool	default	false	
		last	false	

3. Locals

Table 44: Locals of SelectLevelTransition

Name	Type	Comments and Information
last_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
Loc_conditionnal	Level_And_Mode_Types_Pkg::T_LevelTransition	
Loc_Conditionnal_Available	bool	
Loc_conditionnal_set	bool	
Loc_conditionnal_transition_table	Level_And_Mode_Types_Pkg::T_LevelTransition_PriorityTable	
Loc_driver	Level_And_Mode_Types_Pkg::T_LevelTransition	
Loc_driver_set	bool	
Loc_Normal	Level_And_Mode_Types_Pkg::T_LevelTransition	
Loc_Normal_Available	bool	
Loc_normal_set	bool	
Loc_normal_transition_table	Level_And_Mode_Types_Pkg::T_LevelTransition_PriorityTable	

4. Operator Hierarchy

diagram : diagram_SelectLevelTransition_1
activate if : IfBlock1
branch : then
branch : else
branch : then
branch : else
branch : then
branch : else

5. Graphical and Textual Diagrams

1. View of diagram_SelectLevelTransition_1 (SelectLevelTransition)

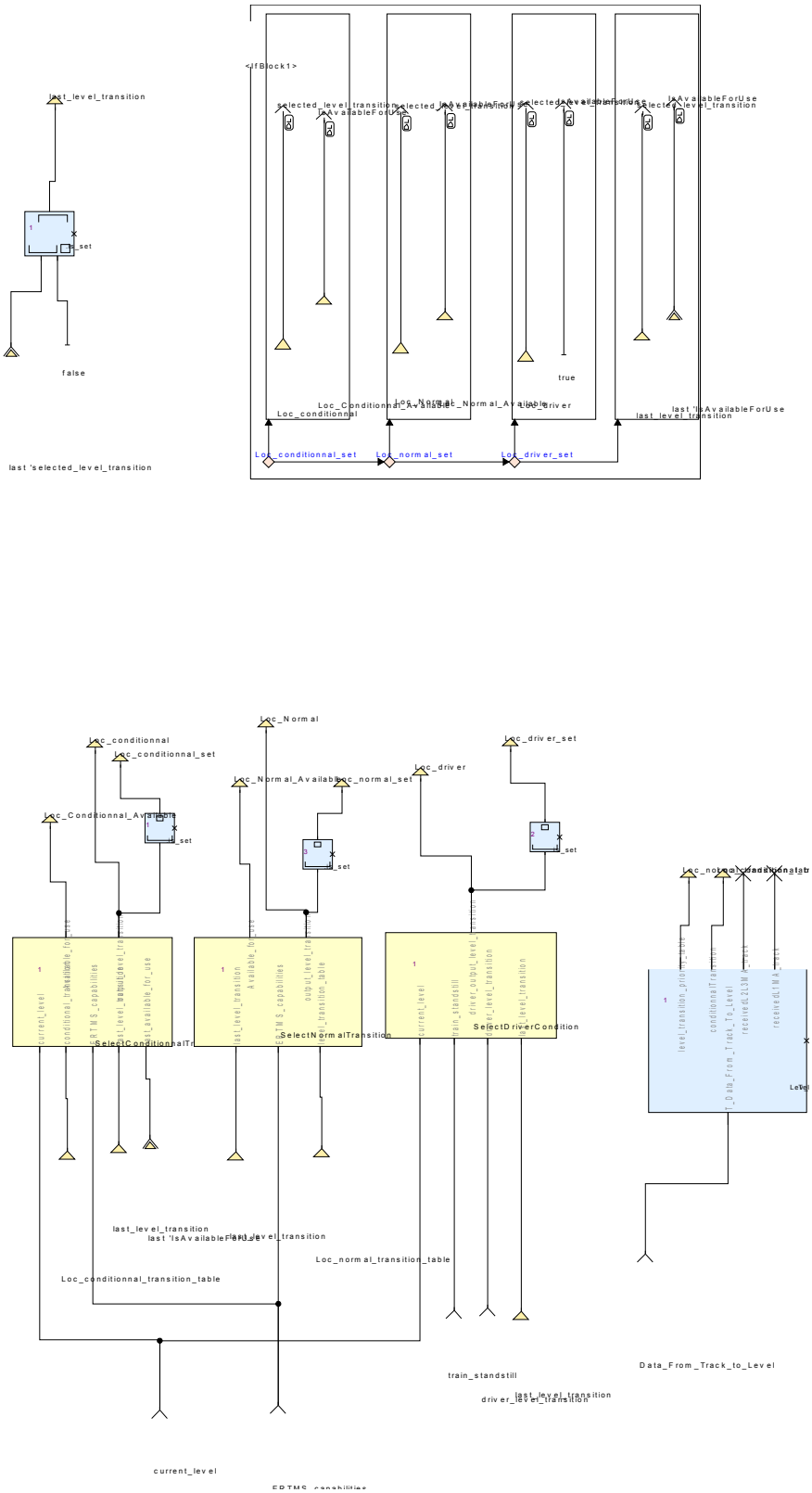


Figure 13: View of diagram_SelectLevelTransition_1 (SelectLevelTransition)

Table 45: Conditional Blocks of diagram_SelectLevelTransition_1

Conditional Block	Comments and Information
IfBlock1	

Table 46: Actions of diagram_SelectLevelTransition_1

Conditional Block Action	Comments and Information
IfBlock1:then	
IfBlock1:else:then	
IfBlock1:else:else:then	
IfBlock1:else:else:else	

6. SelectNormalTransition Operator

Declared as `public function`

1. Comments and Information

SelectNormalTransition Comments:
"5.10.2.4 When receiving the information about all ERTMS/ETCS levels that are supported by
trackside, the ERTMS/ETCS on-board equipment shall select from the table the level
with the highest priority, which is available for use by the onboard equipment."
Loop on the table of transition until one available for use is found.
"5.10.2.4.1 The on-board equipment shall consider an ERTMS/ETCS level as "Available for use"
as follows:
a) Level 2 or 3: the level is configured on-board and at least one Mobile Terminal is
available on-board, i.e. the ETCS onboard has detected at least one Mobile Terminal in working condition, independently whether it is registered to a network or
not.
b) Level NTC: the concerned National System is available on-board (if an STM is used, refer to SUBSET-035 for further details).
c) Level 0 or 1: always."
To compute the stop condition of the loop.
"5.10.2.7 If none of the ordered level(s) is available for use by the ERTMS/ETCS on-board
equipment, it shall nevertheless make the transition, to the ordered level with the
lowest priority."
Lowest priority transition selected until one available for use is found.

2. Interface

Table 47: Inputs of SelectNormalTransition

Name	Type	Comments and Information
last_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
ERTMS_capabilities	Level_And_Mode_Types_Pkg::T_ERTMS_capabilities	
level_transition_table	Level_And_Mode_Types_Pkg::T_LevelTransition_PriorityTable	

Table 48: Outputs of SelectNormalTransition

Name	Type	Comments and Information
Available_for_use	bool	
output_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	

3. Locals

Table 49: Locals of SelectNormalTransition

Name	Type	Comments and Information
Loc_index	int	

4. Operator Hierarchy

diagram : diagram_SelectNormalTransition_1

5. Graphical and Textual Diagrams

1. View of diagram_SelectNormalTransition_1 (SelectNormalTransition)

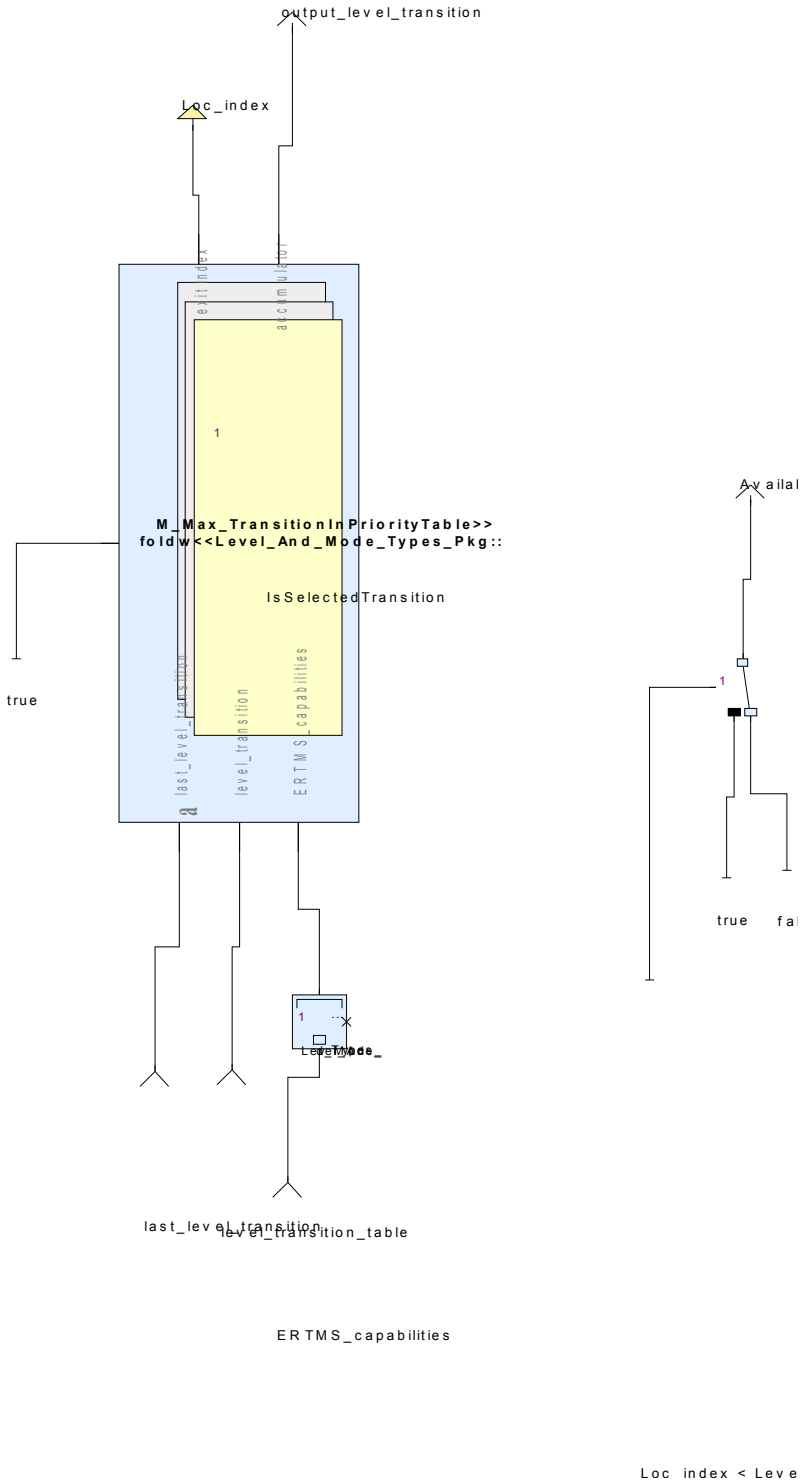


Figure 14: View of diagram_SelectNormalTransition_1 (SelectNormalTransition)

5. OutputToRBC Package

1. BuildOutputToRBC Operator

Declared as `public node`

1. Interface

Table 50: Inputs of BuildOutputToRBC

Name	Type	Comments and Information
selected_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
last_level	M_LEVEL	
new_level	M_LEVEL	
trainPosition	TrainPosition_Types_Pck::trainPosition_T	

Table 51: Outputs of BuildOutputToRBC

Name	Type	Comments and Information
Connection_to_RBC_Requested	bool	
PositionReportNeeded	bool	

2. Operator Hierarchy

diagram : diagram_BuildOutputToRBC_1

3. Graphical and Textual Diagrams

1. View of diagram_BuildOutputToRBC_1 (BuildOutputToRBC)

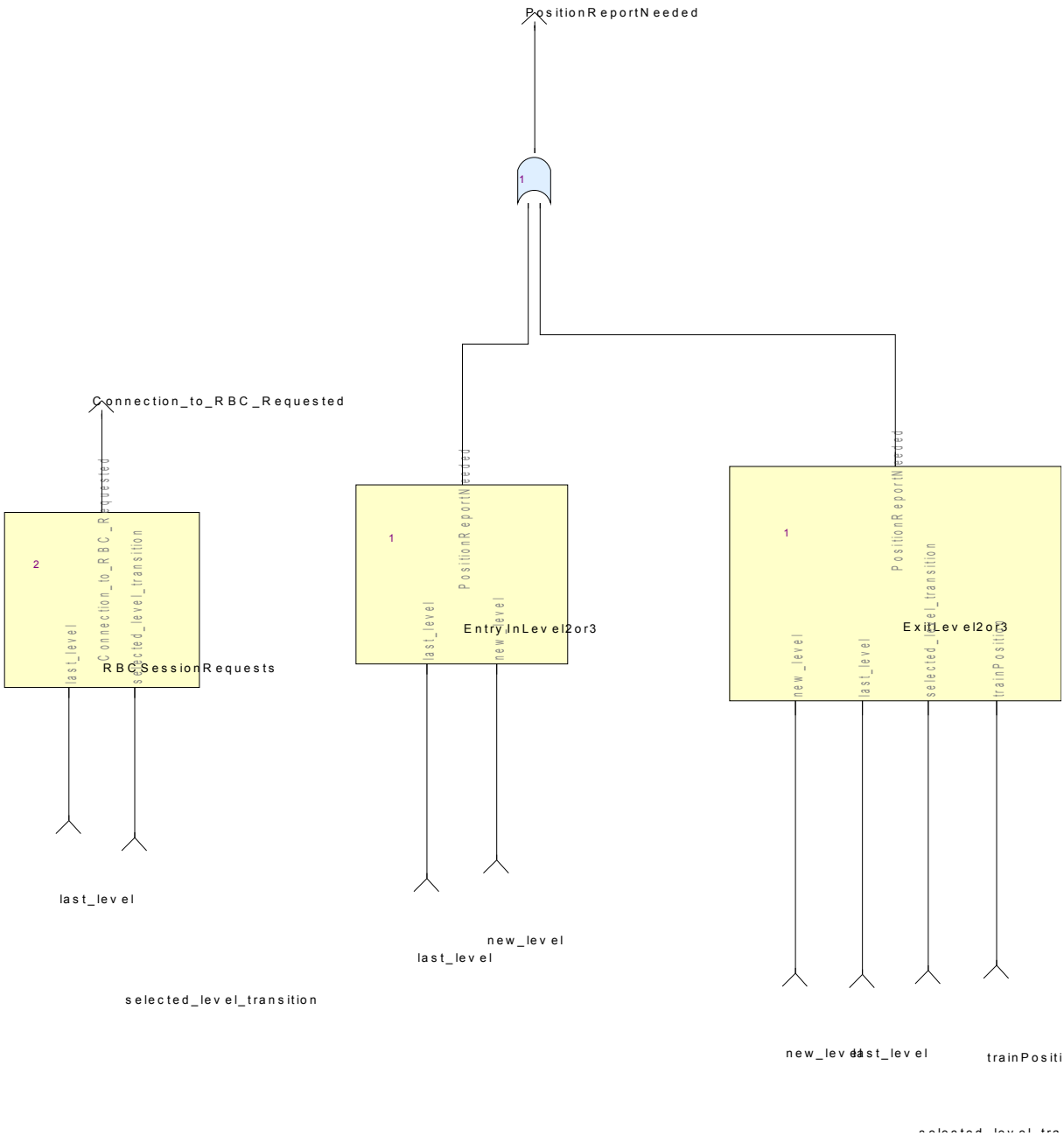


Figure 15: View of diagram_BuildOutputToRBC_1 (BuildOutputToRBC)

2. EntryInLevel2or3 Operator

Declared as `public function`

1. Comments and Information

EntryInLevel2or3 Comments:
5.10.3.1 Transition from Level 1 to Level 2/3 area
5.10.3.1.5 When the ERTMS/ETCS on-board equipment has switched to the new level, it shall
report the new on-board level, including a position report.
5.10.3.2 Transition from Level 0 (Unfitted) to Level 2/3 area
5.10.3.2.5 When the ERTMS/ETCS on-board equipment has switched to the new level, it shall
report the new on-board level, including a position report.
5.10.3.7 Transition from Level NTC to Level 2/3 area
5.10.3.7.5 When the level transition location is passed with the estimated front end a position
report shall be sent to the RBC. In case the ERTMS/ETCS on-board equipment is interfaced to the National System through an STM, please refer to SUBSET-035 for
the STM state transition order.
The switch of level occured when the estimated front-end pass the border.

2. Interface

Table 52: Inputs of EntryInLevel2or3

Name	Type	Comments and Information
last_level	M_LEVEL	
new_level	M_LEVEL	

Table 53: Outputs of EntryInLevel2or3

Name	Type	Comments and Information
PositionReportNeeded	bool	

3. Operator Hierarchy

diagram : diagram_EntryInLevel2or3_1

4. Graphical and Textual Diagrams

1. View of diagram_EntryInLevel2or3_1 (EntryInLevel2or3)

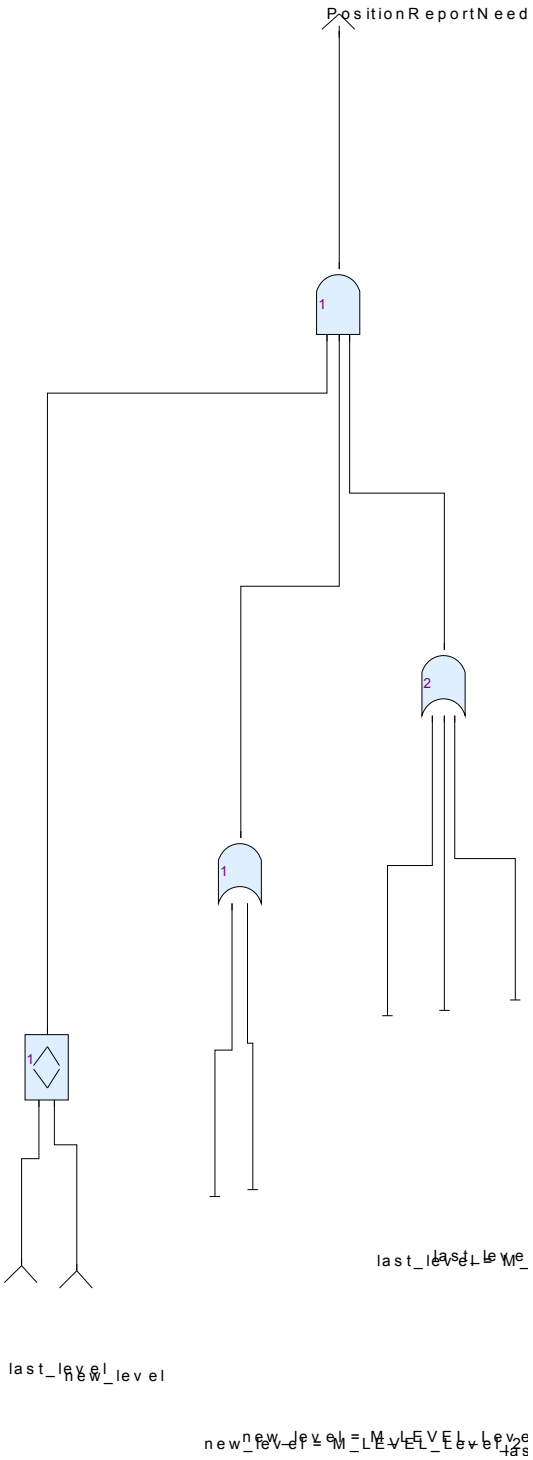


Figure 16: View of diagram_EntryInLevel2or3_1 (EntryInLevel2or3)

3. ExitLevel2or3 Operator

Declared as **`public node`**

1. Comments and Information

ExitLevel2or3 Comments:

5.10.3.3 Transition from Level 2/3 to Level 1 area
5.10.3.3.3 When the train has passed the level transition border with its min safe rear end, i.e.
when the whole train has left the level 2/3 area, the onboard equipment of the leading
engine shall send a position report to the RBC.
5.10.3.3.4 After receiving this exit position report, the RBC can order the train to terminate the
session (leading and non-leading engines).
5.10.3.6 Transition from Level 2/3 to Level 0 (Unfitted) area
5.10.3.6.2 When the train has passed the level transition border with its min safe rear end, i.e.
when the whole train has left the level 2/3 area, the onboard equipment of the leading
engine shall send a position report to the RBC.
5.10.3.6.3 After receiving this exit position report, the RBC can order the train to terminate the
session (leading and non-leading engines).
5.10.3.10 Transition from Level 2/3 to Level NTC area
5.10.3.10.3 When the train has passed the level transition border with its min safe rear end, i.e.
when the whole train has left the level 2/3 area, the onboard equipment of the leading
engine shall send a position report to the RBC.
5.10.3.10.4 After receiving this exit position report, the RBC can order the train to terminate the
session (leading and non-leading engines).
5.10.3.15 Transition initiated by driver
5.10.3.15.3 If the driver changes the level from 2 or 3 to any other, the ERTMS/ETCS on-board
equipment shall report the new level to the RBC if a communication session is established. When receiving the level change report, the RBC shall order the communication session to be terminated.

2. Interface

Table 54: Inputs of ExitLevel2or3

Name	Type	Comments and Information
new_level	M_LEVEL	
last_level	M_LEVEL	
selected_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	
trainPosition	TrainPosition_Types_Pck::trainPosition_T	

Table 55: Outputs of ExitLevel2or3

Name	Type	Properties		Comments and Information
PositionReportNeeded	bool	default	false	

3. Locals

Table 56: Locals of ExitLevel2or3

Name	Type	Properties		Comments and Information
Loc_MinSafeRearEnd	Obu_BasicTypes_Pkg::Location_T			
Loc_Position	M_POSITION	default	0	
		last	0	
Loc_PositionReportToPlan	bool			

4. Operator Hierarchy

diagram : diagram_ExitLevel2or3_1

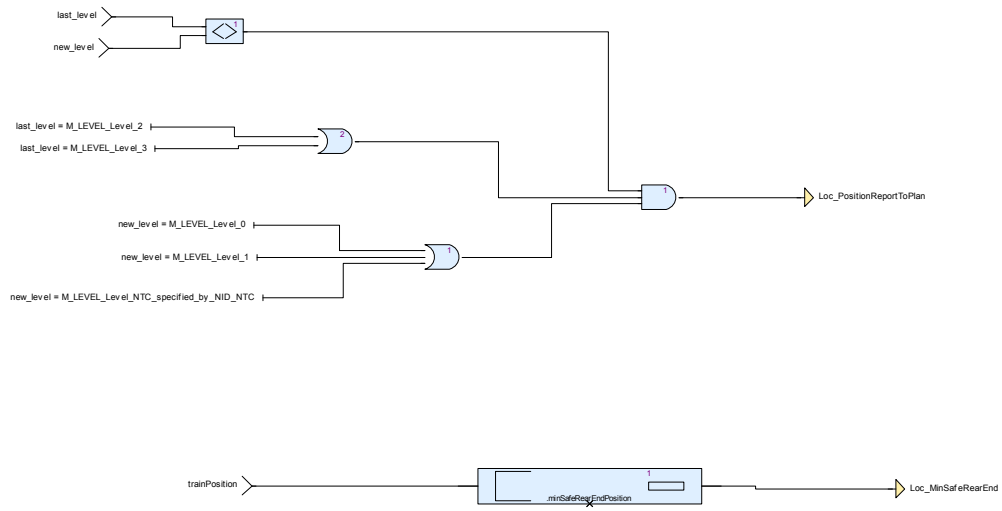
state-machine : SM1

state : BeforeChange

state : State2

5. Graphical and Textual Diagrams

1. View of diagram_ExitLevel2or3_1 (ExitLevel2or3)



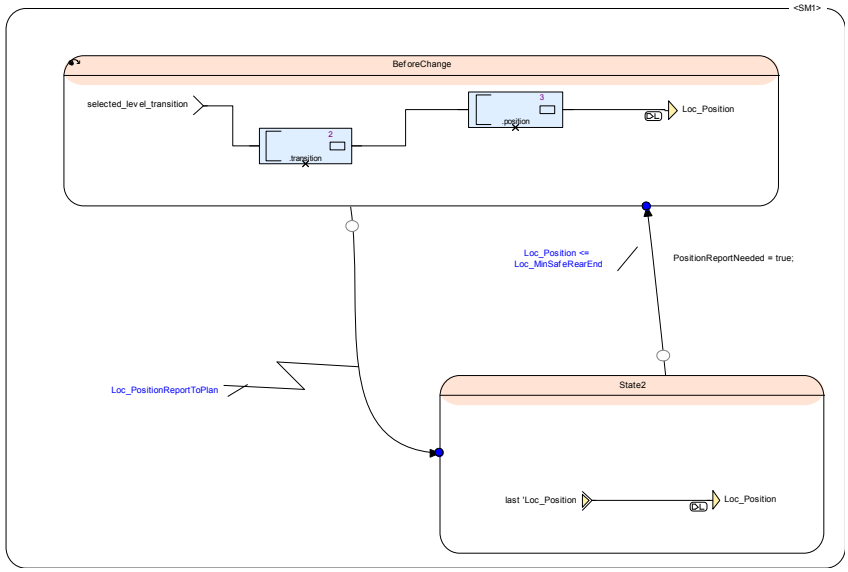


Figure 17: View of diagram_ExitLevel2or3_1 (ExitLevel2or3)

Table 57: State Machines of diagram_ExitLevel2or3_1

State Machine	Comments and Information
SM1	

Table 58: States of diagram_ExitLevel2or3_1

State	Comments and Information
SM1:BeforeChange	
SM1:State2	

Table 59: Transitions of diagram_ExitLevel2or3_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: SM1:BeforeChange **Target:** SM1:State2	1	**Condition:** Loc_PositionReportToPlan **Actions:**	
Source: SM1:State2 **Target:** SM1:BeforeChange	1	**Condition:** Loc_Position <= Loc_MinSafeRearEnd **Actions:** PositionReportNeeded = true;	

4. RBCSessionRequests Operator

Declared as `public function`

1. Comments and Information

RBCSessionRequests Comments:

"5.10.3.1 Transition from Level 1 to Level 2/3 area
5.10.3.1.1 An order to connect to the RBC with a given id and telephone number shall be given
via balise group in rear of the border location.
5.10.3.2
Transition from Level 0 (Unfitted) to Level 2/3 area
5.10.3.2.1 An order to connect to the RBC with a given id and telephone number shall be given
via balise group in rear of the border location.
5.10.3.7
Transition from Level NTC to Level 2/3 area
5.10.3.7.1 An order to connect to the RBC with a given id and telephone number shall be given
via balise group in rear of the border location."
From Level 0, 1 or NTC to level 2 or 3 a RBC session as soon a new selected transition is received.

2. Interface

Table 60: Inputs of RBCSessionRequests

Name	Type	Comments and Information
last_level	M_LEVEL	
selected_level_transition	Level_And_Mode_Types_Pkg::T_LevelTransition	

Table 61: Outputs of RBCSessionRequests

Name	Type	Comments and Information
Connection_to_RBC_Requested	bool	

3. Locals

Table 62: Locals of RBCSessionRequests

Name	Type	Comments and Information
Loc_new_level	M_LEVEL	

4. Operator Hierarchy

diagram : diagram_RBCSessionRequests_1

5. Graphical and Textual Diagrams

1. View of diagram_RBCSessionRequests_1 (RBCSessionRequests)

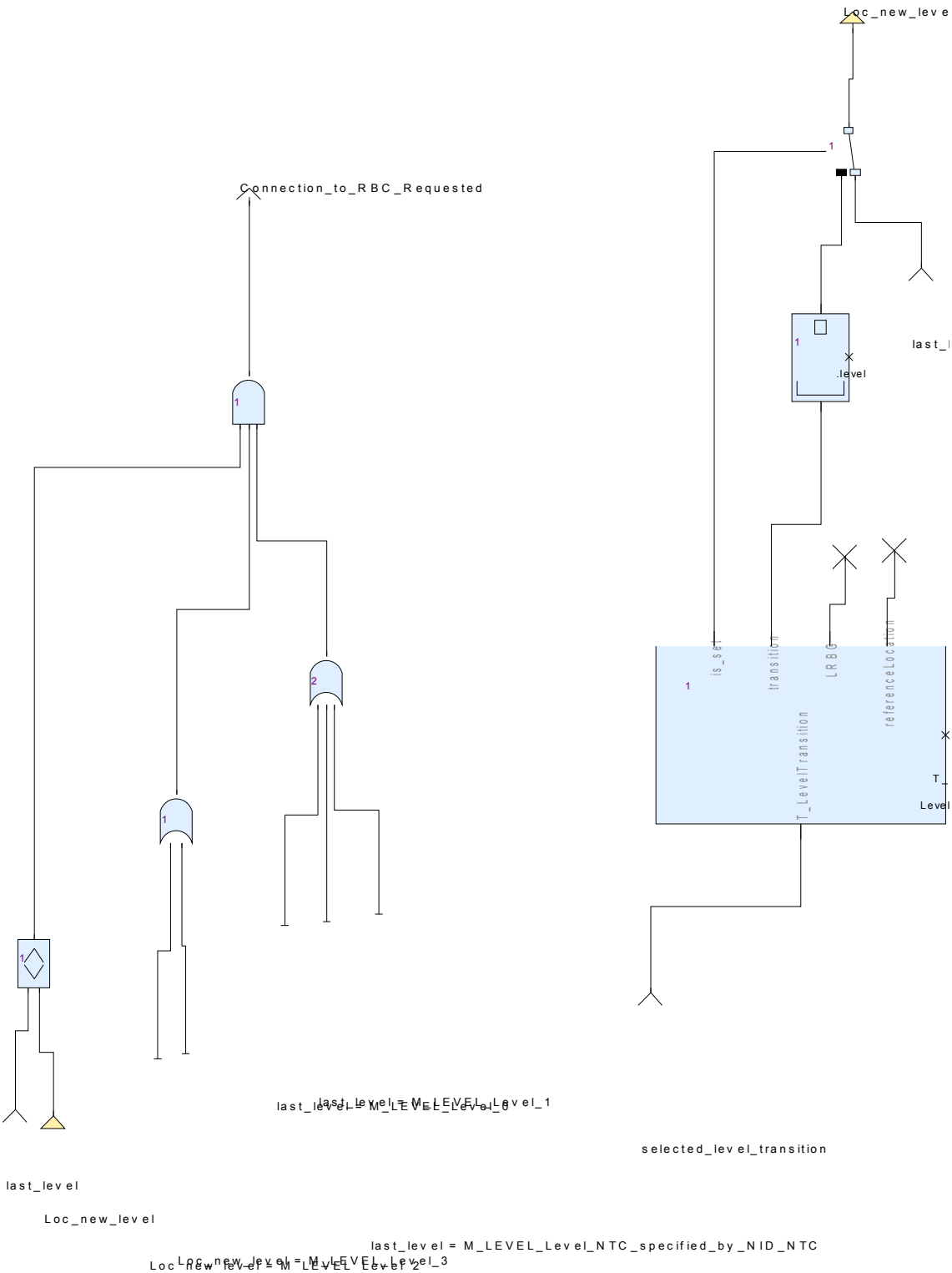


Figure 18: View of diagram_RBCSessionRequests_1 (RBCSessionRequests)

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