

# **openETCS: WP3-Initial-Architecture**

## *Balise Channel Reception and Train Positioning*

### **Summary:**

ETCS OBU Kernel Function Implementation

The train moves on a track equipped with balises and determines its position

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**Reference:** UNISIG Subset 026, 3.3.0

**Index:** Version No 00.02.00

**Date:** 2014-09-04

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**Distribution List:** WP3@openetcs.org; wp4@openetcs.org

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# 1. General Project Description

Minimum OBU Kernel Function Implementation:

The train moves on a track equipped with balises and determines its position

Implemented functions:

- Receive and manage balise information
- Determine train position
- ETCS language data types

References:

- <https://github.com/openETCS/SRS-Analysis/issues/9>
- <https://github.com/openETCS/SRS-Analysis/issues/36>
- <https://github.com/openETCS/SRS-Analysis/issues>
- <https://github.com/openETCS/modeling/blob/master/openETCS%20ArchitectureAndDesign/FirstIteration/openETCSArchitectureAndDesignSpecification.pdf>
- <https://github.com/openETCS/validation/issues/227>
- [https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/MLRI\\_Integration](https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/MLRI_Integration)

This document reflects the current implementation status.

---

- Name: MLRI\_Integration.etp
- Description: SUBSET-026, ISSUE : 3.3.0
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- Gist URL: ---
- Cryptography: No
- Author(s): Uwe Steinke

The use of this software is limited to non-vital applications.

It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.

THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.

## 2. Software Architecture

### 2.1. Project Architecture

This section displays the package hierarchy of projects.

Project MLRI\_Integration  
MLRI\_Integration\_Pkg

Project Library BasicLocationFunctions  
BasicLocationFunctions\_Pkg

Project Library BG\_Types  
BG\_Types\_Pkg

Project Library BuildBGMessage  
BuildBGMessage\_Pkg  
BaliseSupport

Project Library CalculateTrainPosition  
CalculateTrainPosition\_Pkg  
BG\_relocation\_Pkg  
BG\_utilities\_Pkg  
gp\_functions\_Pkg  
Pos\_Pkg

Project Library CheckBGConsistency  
CheckBGConsistency\_Pkg

Project Library ManageBaliseInformation\_Integration  
ManageBaliseInformation\_Integration\_Pkg

Project Library Obu\_BasicTypes  
Obu\_BasicTypes\_Pkg

Project Library ProvidePositionReport  
ProvidePositionReport\_Pkg

Project Library ReceiveEuroBaliseFromAPI  
btmSupportPkg  
ReceiveEuroBaliseFromAPI\_Pkg

Project Library SelectUsableInfo  
SelectUsableInfo\_Pkg

Project Library TrainPosition\_Integration  
TrainPosition\_Integration\_Pkg

Project Library TrainPosition\_Types  
TrainPosition\_Types\_Pck

Project Library ValidateDataDirection  
ValidateDataDirection\_Pkg

## 2.2. Call Graph

This Call Graph displays the dependency tree of model operators.

1. MLRI\_Integration\_Pkg::LocationRelatedInformation
  - 1.1. ManageBaliseInformation\_Integration\_Pkg::ManageBaliseInformation
  - 1.2. TrainPosition\_Integration\_Pkg::ManageTrainPosition

## 3. MLRI\_Integration Project

### 3.1. MLRI\_Integration\_Pkg Package

#### 3.1.1. LocationRelatedInformation Operator

Declared as **public node**

##### 3.1.1.1. Comments and Information

###### LocationRelatedInformation Comments:

- Integrates all subfunctions of the Block "ManageLocationRelatedInformation"

##### 3.1.1.2. Interface

**Table 1: Inputs of LocationRelatedInformation**

Name	Type	Comments and Information
currentOdometry	Obu_BasicTypes_Pkg::odometry_T	<b>Comments:</b> The current odometry values
LRBG	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> The LRBG used for RBC communication.
prevLRBG	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> A previously used LRBG used in RBC communication.
reset	bool	<b>Comments:</b> Resets all to an initials state and deletes all stored BGs.
systemTime	ProvidePositionReport_Pkg::SystemTime_T	
errorMsg	ProvidePositionReport_Pkg::ErrorMessage_T	
posRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	
trackInfo	ProvidePositionReport_Pkg::TrackInfo_T	
trainProps	TrainPosition_Types_Pkg::trainProperties_T	
rcbComm	ProvidePositionReport_Pkg::RBC_Communication_T	
linkingInfoUsed	ProvidePositionReport_Pkg::LinkingInfoUsedOnBoard	
API_balise	API_Telegram_T	
TrainInfo_	BG_Types_Pkg::TrainToTrackStatus_T	
currentMode	M_MODE	
Train_Data	TrainData	
announced_BGs	BG_Types_Pkg::LinkedBGs_T	

Name	Type	Comments and Information
directionLRBG	ProvidePositionReport_Pkg::BG_Orientation_T	
prvDirTrain	Q_DIRTRAIN	

**Table 2: Outputs of LocationRelatedInformation**

Name	Type	Comments and Information
posRep	ProvidePositionReport_Pkg::PositionReport_T	
trainPosition	TrainPosition_Types_Pkg::trainPosition_T	
trainPosInfo	TrainPosition_Types_Pkg::trainPositionInfo_T	<b>Comments:</b> The resulting train position with reference to the LRBG
trainPosErrors	TrainPosition_Types_Pkg::positionErrors_T	<b>Comments:</b> Errors and inconsistencies detected by the calculation.
BGs	TrainPosition_Types_Pkg::positionedBGs_T	<b>Comments:</b> The collection of currently known BGs.
ApplyServiceBrake	bool	
BadBaliseMessageToDMI	CheckBGConsistency_Pkg::String_T	
q_linkingReaction	Q_LINKREACTION	

### 3.1.1.3. Locals

**Table 3: Locals of LocationRelatedInformation**

Name	Type	Properties		Comments and Information
BGs_loc	TrainPosition_Types_Pkg::positionedBGs_T	last	CalculateTrainPosition_Pkg::cNoPositionedBGs	

### 3.1.1.4. Operator Hierarchy

diagram : diagram\_LocationRelatedInformation\_1

3.1.1.5. Graphical and Textual Diagrams

3.1.1.5.1. View of diagram\_LocationRelatedInformation\_1  
(LocationRelatedInformation)

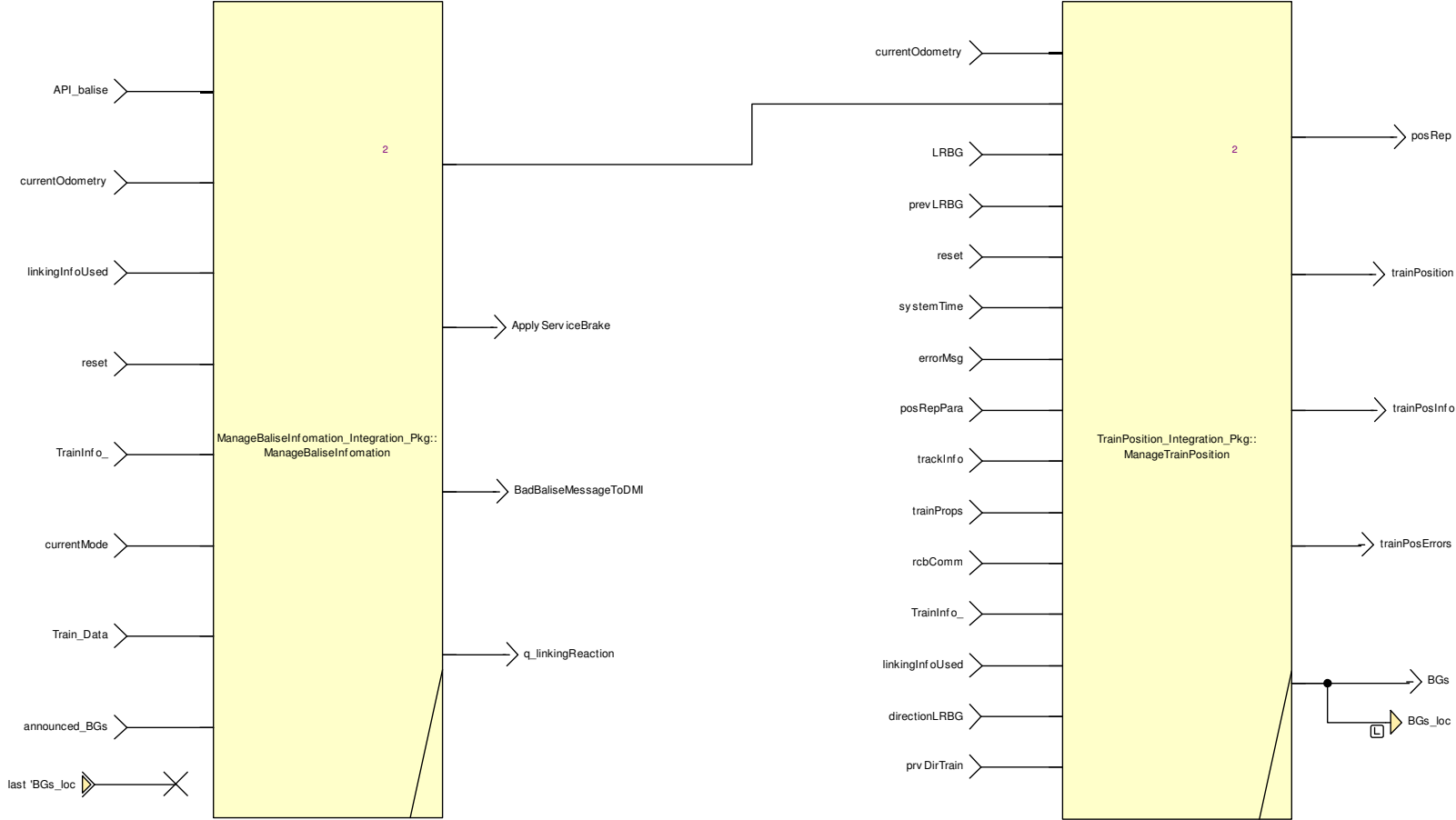


Figure 1: View of diagram\_LocationRelatedInformation\_1 (LocationRelatedInformation)



## 4. Project Library: BG\_Types

### 4.1. BG\_Types\_Pkg Package

#### 4.1.1. Types

**Table 4: Public Types of BG\_Types\_Pkg**

Name	Definition	Comments and Information
AdditionalInformation_T	{linkingPackets : BG_Types_Pkg::LinkedBGs_T}	<b>Comments:</b> Packets received from balises
BG_Header_T	{q_updown : Q_UPDOWN, m_version : M_VERSION, q_media : Q_MEDIA, n_total : N_TOTAL, m_mcount : M_MCOUNT, nid_c : NID_C, nid_bg : NID_BG, q_link : Q_LINK}	<b>Comments:</b> Common header of the balise group datagram
BG_Message_T	{present : bool, Telegrams : BG_Types_Pkg::TelegramArray_T, numberBalises : int, centerOfBalisePosition : BG_Types_Pkg::centerOfBalisePosition_T, BGOrientation : Q_DIRTRAIN}	<b>present Comments:</b> indicates whether the bg-message present is. <b>Telegrams Comments:</b> headers of all received telegrams filled up from the start of the array <b>numberBalises Comments:</b> additional packets received with the balises <b>centerOfBalisePosition Comments:</b> position of the balise group <b>BGOrientation Comments:</b> Orientation of the balise group
centerOfBalisePosition_T	{valid : bool, centerOfBalisePosition : Obu_BasicTypes_Pkg::OdometryLocations_T, BG_centerDetectionInaccuracies : Obu_BasicTypes_Pkg::LocWithInAccuracy_T, timestamp : Obu_BasicTypes_Pkg::T_internal_Type}	<b>Comments:</b> Gives the information for location and accuracy of measurements <b>valid Comments:</b> Indicates the element has valid data. <b>centerOfBalisePosition Comments:</b> Location <b>BG_centerDetectionInaccuracies Comments:</b> Location inaccuracies caused by the balise group center detection <b>timestamp Comments:</b> timestamp when measurement was taken
levelTransitionOrder_T	{valid : bool, q_dir : Q_DIR, q_scale : Q_SCALE, d_leveltr : D_LEVELTR, m_leveltr : M_LEVELTR, nid_ntc : NID_NTC, l_ackleveltr : L_ACKLEVELTR}	
levelTransitionOrderBG_Msg_T	{valid : bool, BG_Header : BG_Types_Pkg::BG_Header_T, orders : BG_Types_Pkg::levelTransitionOrders_T}	

Name	Definition	Comments and Information
levelTransitionOrderCmd_T	{valid : bool, distanceSinceLTORef : Obu_BasicTypes_Pkg::L_internal_Type, nextLTO : BG_Types_Pkg::levelTransitionOrder_T}	<b>distanceSinceLTORef</b> <b>Comments:</b> Estimated distance since refBG of LTO passed
levelTransitionOrders_T	BG_Types_Pkg::levelTransitionOrder_T ^cMaxNoOfLevelTransitionOrders	

Name	Definition	Comments and Information
LinkedBG_T	<pre>{valid : bool, nid_LRBG : NID_LRBG, nid_packet : NID_PACKET, q_dir : Q_DIR, l_packet : L_PACKET, q_scale : Q_SCALE, d_link : D_LINK, q_newcountry : Q_NEWCOUNTRY, nid_c : NID_C, nid_bg : NID_BG, q_linkorientation : Q_LINKORIENTATION, q_linkreaction : Q_LINKREACTION, q_locacc : Q_LOCACC}</pre>	<p><b>Comments:</b> 7.4.2.2: Single, but complete, element from LinkingPacket_Type</p> <p><b>valid Comments:</b> This element has valid data</p> <p><b>nid_LRBG Comments:</b> 8.4.4.6.1: ID of the reference LRBG (refers to radio message)</p> <p><b>nid_packet Comments:</b> Packet identifier: probably not needed here: Packet 5 = constant</p> <p><b>q_dir Comments:</b> Validity direction of transmitted data with reference to directionality of the balise group sending the information or to directionality of the LRBG</p> <p><b>l_packet Comments:</b> 7.3.3.2 Number of bits in the packet.</p> <p><b>q_scale Comments:</b> 7.5.1.129: Qualifier for the distance scale: 10 cm, 1 m, 10 m</p> <p><b>d_link Comments:</b> 7.5.1.10: Incremental linking distance to next linked balise group</p> <p><b>q_newcountry Comments:</b> 7.5.1.121: New Country Qualifier</p> <p><b>nid_c Comments:</b> 7.5.1.86: Identity number of the country or region</p> <p><b>nid_bg Comments:</b> 7.5.1.85: Identity number of the balise group Identity number of a balise group or loop within the country or region defined by NID_C</p> <p><b>q_linkorientation Comments:</b> 7.5.1.116: Qualifier for the direction of the linked balise group: Indicates whether the linked balise group will be overpassed by the train in nominal or reverse direction.</p> <p><b>q_linkreaction Comments:</b> 7.5.1.117: Qualifier for the reaction to be performed if a linking or a balise group message consistency problem occurs with the balise group linked to</p> <p><b>q_locacc Comments:</b> 7.5.1.115: defines the absolute value of the accuracy of the Balise location (max +/- 63 m)</p>

Name	Definition	Comments and Information
LinkedBGs_T	BG_Types_Pkg::LinkedBG_T ^cMaxNoOfLinkedBGs	<b>Comments:</b> Array of linked balise groups. This array replaces the linking packet (TrackToTrain::Linking )
passedBG_T	{valid : bool, timestamp : Obu_BasicTypes_Pkg::T_internal_Type, odometristamp : Obu_BasicTypes_Pkg::OdometryLocations_T, BG_centerDetectionInaccuracies : Obu_BasicTypes_Pkg::LocWithInAcc_T, BG_Header : BG_Types_Pkg::BG_Header_T, linkedBGs : BG_Types_Pkg::LinkedBGs_T, noCoordinateSystemHasBeenAssigned : bool, trainOrientationToBG : Q_DIRLRBG, trainRunningDirectionToBG : Q_DIRTRAIN, passingSpeed : Obu_BasicTypes_Pkg::Speed_T}	<b>Comments:</b> Information received from a BG passed <b>odometristamp Comments:</b> Odometry values when the balise group was passed <b>BG_centerDetectionInaccuracies Comments:</b> Location inaccuracies caused by the balise group center detection <b>BG_Header Comments:</b> Common header of the balise group datagram <b>linkedBGs Comments:</b> The linked balise groups announced from this BG. <b>noCoordinateSystemHasBeenAssigned Comments:</b> 3.4.2, 3.6.3.1.4: Every balise group has its own co-ordinate system <b>trainOrientationToBG Comments:</b> 3.6.1.3: Orientation of the train in relation to the direction of the BG <b>trainRunningDirectionToBG Comments:</b> 3.6.1.3: Direction of train movement in relation to the BG orientation <b>passingSpeed Comments:</b> Train speed while passing the BG; its sign characterizes the passing direction based on odometry information
RBCOrientationReport_T	{assignment_of_coordinate_system : Radio_TrackToTrain::Assignment_of_coordinate_system}	<b>Comments:</b> !! Check: Usecase
RBCReport_T	{train_position_report : Radio_TrainToTrack::Train_Position_Report}	<b>Comments:</b> !! Check: Usecase

Name	Definition	Comments and Information
Telegram_T	<pre>{valid : bool, checkResult : bool, telegramheader : BG_Types_Pkg::TelegramHeader_T, packets : BG_Types_Pkg::AdditionalInformation_T}</pre>	<p><b>Comments:</b>  8.4.2: Structure of a telegram in the balise group channel.</p> <p><b>valid Comments:</b>  The element has valid data</p> <p><b>checkResult Comments:</b>  Result generated by the API on the success of the decoding of the telegram.</p> <p>True: teegram decoded without errors</p> <p>False errors recognised when decoding the telegram.</p> <p>The decoding routine performs checks on bit level on all relevant parameters.</p> <p><b>telegramheader Comments:</b>  Information received from the balise</p> <p><b>packets Comments:</b>  Packets received via the balises</p>
TelegramArray_T	BG_Types_Pkg::Telegram_T ^cMaxNoBalises	<p><b>Comments:</b>  Array of Telegrams making a Balise Group (for check)</p>

Name	Definition	Comments and Information
TelegramHeader_T	{q_updown : Q_UPDOWN, m_version : M_VERSION, q_media : Q_MEDIA, n_pig : N_PIG, n_total : N_TOTAL, m_dup : M_DUP, m_mcount : M_MCOUNT, nid_c : NID_C, nid_bg : NID_BG, q_link : Q_LINK}	<p><b>Comments:</b> 8.4.2.1: The Balise Telegram Header This structure is not "packed" to bit boundaries</p> <p><b>q_updown Comments:</b> 7.5.1.142: Balise telegram transmission direction</p> <p><b>m_version Comments:</b> 7.5.1.79: Version of ETCS system</p> <p><b>q_media Comments:</b> 7.5.1.119: Qualifier to indicate the type of media, i.e., 0 Balise 1 Loop</p> <p><b>n_pig Comments:</b> 7.5.1.81: Defines the relative position in a balise group</p> <p><b>n_total Comments:</b> 7.5.1.82: Total number of balise(s) in the group, i.e., 0 --&gt; 1 balise in the group 7 --&gt; 8 balises in the group</p> <p><b>m_dup Comments:</b> 7.5.1.63: Duplicate balise, Flags to tell whether the balise is a duplicate of one of the adjacent balises.</p> <p><b>m_mcount Comments:</b> 7.5.1.71: Message counter, The purpose of this counter is to make it possible for the ERTMS/ETCS on-board to detect which balise group message the telegram belongs to.</p> <p><b>nid_c Comments:</b> 7.5.1.86: Identity number of the country or region</p> <p><b>nid_bg Comments:</b> 7.5.1.85: Identity number of the balise group Identity number of a balise group or loop within the country or region defined by NID_C</p> <p><b>q_link Comments:</b> 7.5.1.114: Link Qualifier This qualifier is used to mark a balise group as linked or unlinked.</p>
TrainToTrackStatus_T	{m_mode : M_MODE, m_level : M_LEVEL, m_leveltr : M_LEVELTR, nid_ntc : NID_NTC, q_length : Q_LENGTH}	<p><b>Comments:</b> structure capturing modi, leves and train integrity</p>

#### 4.1.2. Constants

**Table 5: Public Constants of BG\_Types\_Pkg**

Name	Type	Value	Comments and Information
------	------	-------	--------------------------

Name	Type	Value	Comments and Information
cAddInfo	BG_Types_Pkg::AdditionalInformation_T	<pre>{linkingPackets : [{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation :</pre>	<p><b>Comments:</b> empty structure for additional information</p>



Name	Type	Value	Comments and Information
cEmpty_BaliseTlg	BG_Types_Pkg::Telegram_T openETCS WP3_InitialArchitecture NIDesign Description	{valid : false, checkResult : false, telegramheader : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 st, n_total : N_TOTAL_1_balise_ in_the_group, m_dup : M_DUP_No_duplicat es, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, packets : {linkingPackets : [{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation :	<b>Comments:</b> empty telegram

Name	Type	Value	Comments and Information
		<pre>{present : false, Telegrams : [{valid : false, checkResult : false, telegramheader : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 st, n_total : N_TOTAL_1_balise_ in_the_group, m_dup : M_DUP_No_duplicat es, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, packets : {linkingPackets : [{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0,</pre>	

Name	Type	Value	Comments and Information
cEmptyHeader	BG_Types_Pkg::TelegramHeader_T	{q_updown : Q_UPDOWN_Down_link_telegram, m_version : M_VERSION_Previous_versions_according_to_e_g_EEIG_SRS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1st, n_total : N_TOTAL_1_balise_in_the_group, m_dup : M_DUP_No_duplicates, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}	<b>Comments:</b> empty telegram header

Name	Type	Value	Comments and Information
		<pre>[{valid : false, checkResult : false, telegramheader : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 st, n_total : N_TOTAL_1_balise_ in_the_group, m_dup : M_DUP_No_duplicat es, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}}, packets : {linkingPackets : [{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation :</pre>	

Name	Type	Value	Comments and Information
		{valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_total : N_TOTAL_1_balise_ in_the_group, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, linkedBGs : [{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, }	

Name	Type	Value	Comments and Information
cemptyPosition	BG_Types_Pkg::centerOfBalisePosition_T	{valid : false, centerOfBalisePosition : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetectionInaccuracies : {nominal : 0, d_min : 0, d_max : 0}, timestamp : 0}	<b>Comments:</b> empty Balise Position
cInitOrientation	Q_DIRTRAIN	Q_DIRTRAIN_Unknown	<b>Comments:</b> Default Orientation
cInvalidIndex	int	-1	
cMaxDistanceBalisesInGroup	Obu_BasicTypes_Pkg::OdometryLocations_T	{o_nominal : 1200, o_min : 1200, o_max : 1200}	<b>Comments:</b> Maximum distance between balises within a group: Subset 40 section 4.1.1.2
cMaxListBGs	int	20	
cMaxNoBalises	int	8	<b>Comments:</b> Max. number of balises in a balise group
cMaxNoOfLevelTransitionOrders	int	4	<b>Comments:</b> Max. number = 31
cMaxNoOfLinkedBGs	int	4	<b>Comments:</b> Max. number of linked balise groups announced by a BG (arbitrary value); Must be 33, but set to 4 to ease debugging !!!
cNID_BG_unknown	NID_BG	16383	<b>Comments:</b> type NID_BG = int /* MinVal = 0, MaxVal = 16382 */ -- 16383 = Identity_is_unknown_(only_to_be_used_for_Linking_information)
cNID_LRBG_14Bits_Multiplier	int	16384	<b>Comments:</b> 16384: Serves to calculate NID_LRBG = 16384 * NID_C + NID_BG
cNID_LRBG_unknown	NID_LRBG	16777215	<b>Comments:</b> type NID_LRBG = int -- 16777215 = Unknown

## 5. Project Library: OBU\_BasicTypes

### 5.1. OBU\_BasicTypes\_Pkg Package

#### 5.1.1. Comments and Information

##### OBU\_BasicTypes\_Pkg Comments:

- Standardized basic type definitions to be used within all internal OBU functions

#### 5.1.2. Types

**Table 6: Public Types of OBU\_BasicTypes\_Pkg**

Name	Definition	Comments and Information
A_internal_Type	int	<b>Comments:</b> Standardized acceleration type for all internal calculations: in 0.01 m/s <sup>2</sup>
G_internal_Type	int	<b>Comments:</b> Standardized gradient type for all internal gradient calculations: in per 0.1 mill
L_internal_Type	int	<b>Comments:</b> Standardized length type for all internal length, distance and location calculations: in cm
Location_T	OBU_BasicTypes_Pkg::L_internal_Type	<b>Comments:</b> Generic for all length, distance and location calculation: in cm
LocWithInAcc_T	{nominal : OBU_BasicTypes_Pkg::L_internal_Type, d_min : OBU_BasicTypes_Pkg::L_internal_Type, d_max : OBU_BasicTypes_Pkg::L_internal_Type}	<b>Comments:</b> Location with +/- tolerance <b>nominal Comments:</b> Nominal location <b>d_min Comments:</b> Min Location = nominal + d_min (typically < 0) <b>d_max Comments:</b> Max Location = nominal + d_max
odometry_T	{valid : bool, timestamp : OBU_BasicTypes_Pkg::T_internal_Type, odo : OBU_BasicTypes_Pkg::OdometryLocations_T, speed : OBU_BasicTypes_Pkg::Speed_T}	<b>Comments:</b> Odometry values with time stamp <b>odo Comments:</b> Odometry values
OdometryLocations_T	{o_nominal : OBU_BasicTypes_Pkg::L_internal_Type, o_min : OBU_BasicTypes_Pkg::L_internal_Type, o_max : OBU_BasicTypes_Pkg::L_internal_Type}	<b>Comments:</b> Location information provided by odometry <b>o_nominal Comments:</b> Nominal odometry value <b>o_min Comments:</b> Min. distance = o_min2 - o_min1 <b>o_max Comments:</b> Max distance = o_max2 - o_max1
Speed_T	OBU_BasicTypes_Pkg::V_internal_Type	<b>Comments:</b> General speed type: in km/h.

Name	Definition	Comments and Information
T_internal_Type	int	<b>Comments:</b> Standardized system time type used for all internal time calculations: in ms
V_internal_Type	int	<b>Comments:</b> Standardized speed type used for all internal speed calculations: in km/h

### 5.1.3. Constants

**Table 7: Public Constants of Obu\_BasicTypes\_Pkg**

Name	Type	Value	Comments and Information
cLocWithInAcc_0	Obu_BasicTypes_Pkg::LocWithInAcc_T	{nominal : 0, d_min : 0, d_max : 0}	
cOdometryInitialValue	Obu_BasicTypes_Pkg::OdometryLocations_T	{o_nominal : 0, o_min : 0, o_max : 0}	<b>Comments:</b> Initial odometry values



## 6. Project Library: ManageBaliseInfomation\_Integration

### 6.1. ManageBaliseInfomation\_Integration\_Pkg Package

#### 6.1.1. ManageBaliseInfomation Operator

Declared as **public node**

##### 6.1.1.1. Interface

**Table 8: Inputs of ManageBaliseInfomation**

Name	Type	Comments and Information
API_balise	API_Telegram_T	
ActualOdometry	Obu_BasicTypes_Pkg::odometry_T	
linkingInUse	bool	
reset	bool	
TrainInfo_	BG_Types_Pkg::TrainToTrackStatus_T	
currentMode	M_MODE	
Train_Data	TrainData	
announced_BGs	BG_Types_Pkg::LinkedBGs_T	

**Table 9: Outputs of ManageBaliseInfomation**

Name	Type	Comments and Information
BG_Message	BG_Types_Pkg::passedBG_T	
ApplyServiceBrake	bool	
BadBaliseMessageToDMI	CheckBGConsistency_Pkg::String_T	
q_linkingReaction	Q_LINKREACTION	

##### 6.1.1.2. Operator Hierarchy

diagram : diagram\_ManageBaliseInfomation\_1

### 6.1.1.3. Graphical and Textual Diagrams

#### 6.1.1.3.1. View of diagram\_ManageBaliseInfomation\_1 (ManageBaliseInfomation)

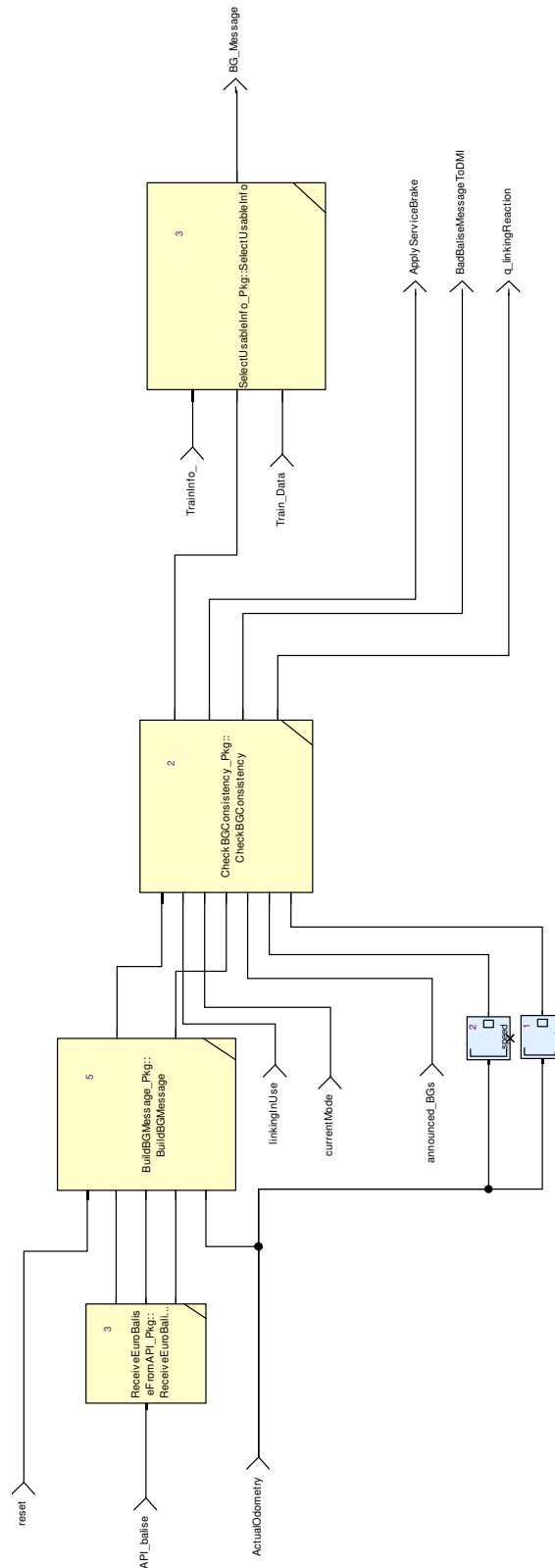


Figure 2: View of diagram\_ManageBaliseInfomation\_1 (ManageBaliseInfomation)

## **7. Project Library: BuildBGMessage**

### **7.1. BuildBGMessage\_Pkg Package**

#### **7.1.1. Open Packages**

- BuildBGMessage\_Pkg::BaliseSupport

## 7.1.2. Types

**Table 10: Public Types of BuildBGMessage\_Pkg**

Name	Definition	Comments and Information
BGCollector_T	<pre>{badBaliseFlag : bool, BGMessageSent : bool, C_ID : NID_C, BG_ID : NID_BG, balisePosition : BG_Types_Pkg::centerOfBalisePositio n_T, positionFirstContact : BG_Types_Pkg::centerOfBalisePositio n_T, collectedTelegrams : int, totalTelegrams : int}</pre>	<p><b>Comments:</b> This data structure is used internally to collect balise telegrams</p> <p><b>badBaliseFlag Comments:</b> indicates an transmission error on the btm interface between track and train.</p> <p><b>BGMessageSent Comments:</b> If true balise message has been sent already.</p> <p><b>C_ID Comments:</b> 7.5.1.86: Identity number of the country or region Code used to identify the country or region in which the balise group, the RBC or the RIU is situated. These need not necessarily follow administrative or political boundaries.</p> <p><b>BG_ID Comments:</b> 7.5.1.85: Identity number of the balise group. Identity number of a balise group or loop within the country or region defined by NID_C.</p> <p><b>balisePosition Comments:</b> Information where the coordinate system of the bg is anchored. The position is given with pig = 1st or pig = 2nd and balises are duplicates The information will be used for calculating the position of the bg-coordinate system.</p> <p><b>positionFirstContact Comments:</b> Information where the first information of the balise group has been received. - can be related to a read error (bad balise) - is the information related to the first telegram involved, irregardless of the pig-identifier</p> <p><b>collectedTelegrams Comments:</b> Gives the number of telegrams collected in the bg-message</p> <p><b>totalTelegrams Comments:</b> Counter for the different telegrams collected for the balise group</p>

Name	Definition	Comments and Information
TelegramStore_T	{valid : bool, telegram : BG_Types_Pkg::Telegram_T, position : BG_Types_Pkg::centerOfBalisePosition_T}	<b>Comments:</b> The telegram store. In this data structure telegrams are stored if they have to be kept for the next cycle. <b>valid Comments:</b> data is valid (i.e., stored by purpose) <b>position Comments:</b> Information on where the balise was positioned

### 7.1.3. Constants

Table 11: Public Constants of BuildBGMessage\_Pkg

Name	Type	Value	Comments and Information
cCollectorInit	BuildBGMessage_Pkg::BGCollector_T	{badBaliseFlag : false, BGMessageSent : false, C_ID : 0, BG_ID : 16383, balisePosition : {valid : false, centerOfBalisePosition : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetectionInaccuracies : {nominal : 0, d_min : 0, d_max : 0}, timestamp : 0}, positionFirstContact : {valid : false, centerOfBalisePosition : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetectionInaccuracies : {nominal : 0, d_min : 0, d_max : 0}, timestamp : 0}, collectedTelegrams : 0, totalTelegrams : 0}	<b>Comments:</b> Init value for the data structureBG CollectorInit_T

Name	Type	Value	Comments and Information
		<pre>{valid : false, telegram : {valid : false, checkResult : false, telegramheader : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 st, n_total : N_TOTAL_1_balise_ in_the_group, m_dup : M_DUP_No_duplicat es, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, packets : {linkingPackets : [{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0,</pre>	

#### 7.1.4. addTelegram Operator

Declared as **public function**

##### 7.1.4.1. Comments and Information

###### **addTelegram Comments:**

- This function adds the received telegram to the balise group data.
- Precondition: all relevant checks are done beforehand.

##### 7.1.4.2. Interface

**Table 12: Inputs of addTelegram**

Name	Type	Comments and Information
newTelegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> The telegram to be added to the bg message. The telegram is checked prior to adding it to the group.
inCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> The actual collector block.
inoldTelegramArray	BG_Types_Pkg::TelegramArray_T	<b>Comments:</b> Input: The actual telegram header array.
doUpdate	bool	<b>Comments:</b> bool: only if true the telegram needs changing.
inPosition	BG_Types_Pkg::centerOfBalisePosition_T	<b>Comments:</b> the actual position information

**Table 13: Outputs of addTelegram**

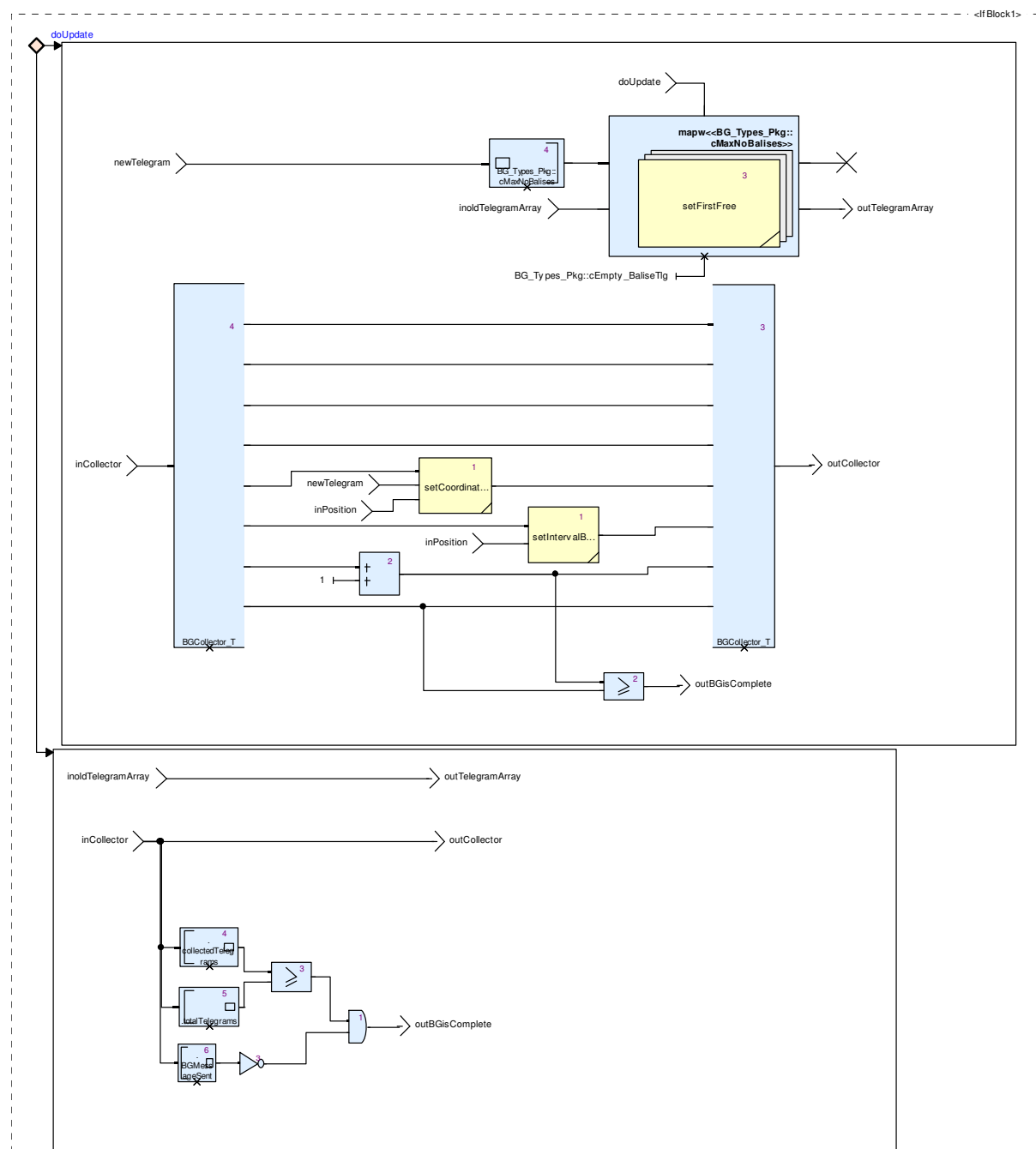
Name	Type	Comments and Information
outCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> updated collector
outTelegramArray	BG_Types_Pkg::TelegramArray_T	<b>Comments:</b> updated telegram array.
outBGisComplete	bool	<b>Comments:</b> out: indicates: the bg is completed, i.e., all telegrams have been collected.

##### 7.1.4.3. Operator Hierarchy

diagram : diagram\_addTelegram\_1  
    *activate if* : IfBlock1  
        branch : then  
        branch : else

#### 7.1.4.4. Graphical and Textual Diagrams

#### 7.1.4.4.1. View of diagram\_addTelegram\_1 (addTelegram)



**Figure 3: View of diagram\_addTelegram\_1 (addTelegram)**

**Table 14: Conditional Blocks of diagram\_addTelegram\_1**

Conditional Block	Comments and Information
IfBlock1	

**Table 15: Actions of diagram\_addTelegram\_1**

Conditional Block Action	Comments and Information
IfBlock1:then	



Conditional Block Action	Comments and Information
IfBlock1:else	

## 7.1.5. BuildBGMessage Operator

Declared as **public node**

### 7.1.5.1. Comments and Information

#### BuildBGMessage Comments:

- Main function of this block: build the balise message.
- Refers to 3.4.1, 3.4.2 and other sections.
- According to the specification, the balise group is defined to be complete, based on the following rules:
  - The last balise of the balise group has been received.
  - In build bg message, this is recognised based on number of balises announced in the first received balise.
- [3.16.2.1.3] A balise within a balise group shall be regarded as missed if
  - a) No balise is found within the maximum distance between balises from the previous balise in the group.
  - or
  - b) A following balise within the group has been passed.
- This is indicated by passing a balise with a different balise group identity (bg\_id + c\_id)
- Special Case for "bad balise" situation:
  - in the case of a read error (e.g., CRC check failure) on the balise interface a bad balise information is fed into the balise channel.
  - If the bad balise has been recognised while a balises of a balise group are being collected the telegram will be missing in the balise group message (number of expected balises < number received balises).
  - If the bad balise has been recognised outside a balise group location interval, the bad balise will be indicated to the check bg block (CRC Failure).
  - In this scenario, the output bg-message is "not present" and the output CRC\_Failure = true.
  - In practice, this means: setting the CRC\_Failure output will wait until the train has moved out of the interval.
- The function makes use of data which is maintained over lifetime of a balise.:
  - - store collector represents the working data like ids, numbers and position data
  - - store BG Header collects the telegrams of a balise group
  - - store BG Add Info collects the packets coming with the telegrams of a balise group
  - - store Additional Telegram keeps data of an telegram if it could not be processed immediately after receiving the telegram
- All stores are to be reset when the obu is reset.

## 7.1.5.2. Interface

**Table 16: Inputs of BuildBGMessage**

Name	Type	Comments and Information
reset	bool	<b>Comments:</b> Input: Request a reset of the data in the function. If reset=true no other input is valid.
inTelegramPresent	bool	<b>Comments:</b> Indicates the input inDecodedTelegram is "present", i.e., the input has been updated in this cycle. Only if the telegram is present the position information (incenterOfBalise) is to be used.
inDecodedTelegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> Input: Balise Telegram. The parameter is only to be used if the inTelegramPresent parameter is set to true. The data in the telegram may be "valid=true" (telegram has been received without faults) or "valid=false". This indicates an error in transmission.
incenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	<b>Comments:</b> Input: Balise Telegram. The parameter is only to be used if the inTelegramPresent parameter is set to true. The parameter passes the position of the balise evaluated by the btm.
inActualOdometry	Obu_BasicTypes_Pkg::odometry_T	<b>Comments:</b> Actual Information from the Odometry.

Table 17: Outputs of BuildBGMessage

Name	Type	Properties		Comments and Information
outBGMessage	BG_Types_Pkg::BG_Message_T			<p><b>Comments:</b> Output: the balise group message. The element present (bool) indicates whether the information in the telegram is updated. The message passes all telegrams received, the number of balises received with a valid content and the position, where the balise group coordinate system is positioned. The direction parameter is not known at this step. It will be determined later in the flow. The numberBalises element indicates the number of different valid telegrams received for the group. It may differ from the expected number, e.g., after transmission errors. In this context different means each telegram is valid and has a unique nid_pig (position in group) parameter. All telegrams in the group have to have the same nid_bg parameter.</p>
outCRCFailure	bool	default	false	<p><b>Comments:</b> Output: bool, indicates a CRC-Failure has been detected when reading the balises. This parameter is set to true, if the erroneous telegram could not be allocated to a balise group. In all other situations, the balise group message contains all relevant information. A potential error of telegrams in the message is visible with the number of balises counted in the message.</p>

### 7.1.5.3. Locals

**Table 18: Locals of BuildBGMessage**

Name	Type	Properties		Comments and Information
BGisChangedEarly	bool	default	false	<b>Comments:</b> Bool: indicates a balise group has changed before all expected telegrams have been received.
BGisComplete	bool			<b>Comments:</b> Bool: indicates the BG-Message is complete
needTelegramStore	bool	default	false	<b>Comments:</b> This flag is used for showing if the data in the telegram store is stil to be used.
positionToUse	BG_Types_Pkg::centerOfBalisePosition_T	default	BG_Types_Pkg::cemptyPosition	<b>Comments:</b> Temporary store fot the telegram position information. Information is determined by the manageAdditionalTelegram function.
storeAdditionalTelegra	BuildBGMessage_Pkg::	default	cemptyStore	<b>Comments:</b>

Name	Type	Properties		Comments and Information
m	TelegramStore_T	last	emptyStore	<p>This memory is used to store an additional telegram.</p> <p>The store is needed when:</p> <ul style="list-style-type: none"> <li>- the end of the previous BG is indicated by a new bg</li> </ul> <p>In this situation, first the new telegram is stored but not immediately processed. In the same cycle the BG-Message of the now complete balise group is processed. This implies, there might be a balise telegram left over from the previous run o the procedure which needs to be taken care of before being able to handle the next one. Practically, this means:</p> <ul style="list-style-type: none"> <li>- if no (or new odometry info) is present: first empty the store.</li> <li>- if a new telegram is received, swap the telegrams in the store and proceed with the elder telegram.</li> </ul>
storeBGTelegramArray	BG_Types_Pkg::TelegramArray_T	last	BG_Types_Pkg::emptyHeaderArray	<p><b>Comments:</b></p> <p>This variable is used to collect the telegrams of the balise group. The store has to be initialised when a reset command has been requested.</p>
storeCollector	BuildBGMessage_Pkg::BGCollector_T	last	cCollectorInit	<p><b>Comments:</b></p> <p>Keeps the control data for the collection procedure. The variable is to be reset when a reset command has been indicate with the input reset set to true.</p>
storeIsChanged	bool	default	false	<p><b>Comments:</b></p> <p>Bool, Indicates the stores for the collector and for the telegram array have to be updated.</p>

Name	Type	Properties		Comments and Information
telegramPresent	bool			<b>Comments:</b> Temporary store fot the telegram presence information. Information is determined by the manageAdditionalTelegram function.
telegramToUse	BG_Types_Pkg::Telegram_T	default	BG_Types_Pkg::cEmpty_BaliseTlg	<b>Comments:</b> Temporary store for the telegram information. Information is determined by the manageAdditionalTelegram function.
tempBGTelegramArray	BG_Types_Pkg::TelegramArray_T	default	BG_Types_Pkg::cemptyHeaderArray	<b>Comments:</b> Temporary variable for keeping the telegram array. The variable results from problems in scade to link information between different if then else branches.
tempCollectorStore	BuildBGMessage_Pkg::BGCollector_T	default	cCollectorInit	<b>Comments:</b> Temporary variable for keeping the collector information.. The variable results from problems in scade to link information between different if then else branches.

#### 7.1.5.4. Operator Hierarchy

diagram : diagram\_BuildBGMessage\_1

```

    activate if : IfBlock1
      branch : then
      branch : else
        activate if : IfBlock3
          branch : then
          branch : else
        activate if : IfBlock2
          branch : then
          branch : else
            activate if : IfBlock3
              branch : then
              branch : else
            activate if : IfBlock4
              branch : then
              branch : else

```

## 7.1.5.5. Graphical and Textual Diagrams

### 7.1.5.5.1. View of diagram\_BuildBGMessage\_1 (BuildBGMessage)

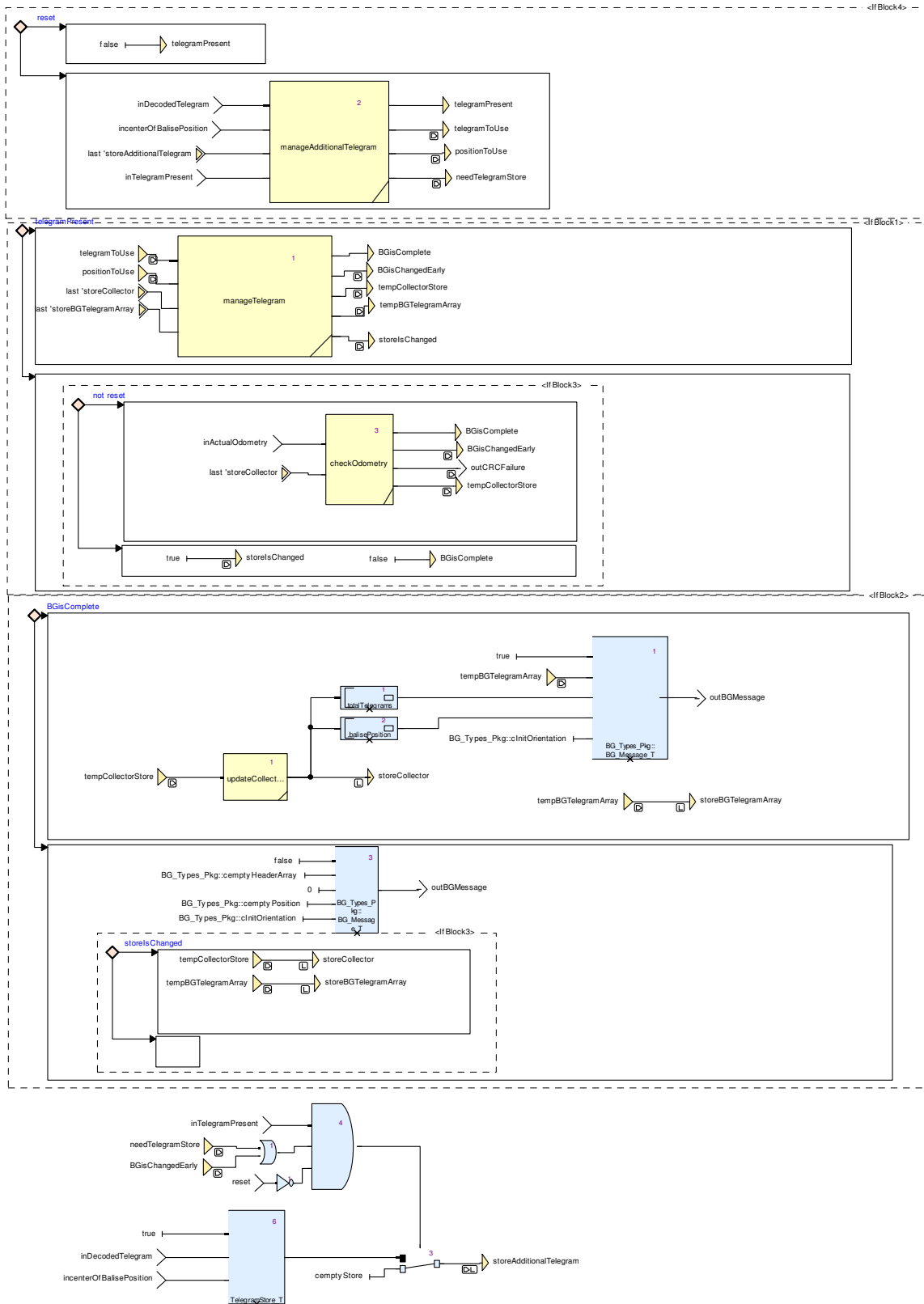


Figure 4: View of diagram\_BuildBGMessage\_1 (BuildBGMessage)

**Table 19: Conditional Blocks of diagram\_BuildBGMessage\_1**

Conditional Block	Comments and Information
IfBlock1	
IfBlock1:else:IfBlock3	
IfBlock2	
IfBlock2:else:IfBlock3	
IfBlock4	

**Table 20: Actions of diagram\_BuildBGMessage\_1**

Conditional Block Action	Comments and Information
IfBlock1:then	
IfBlock1:else	
IfBlock1:else:IfBlock3:then	
IfBlock1:else:IfBlock3:else	
IfBlock2:then	
IfBlock2:else	
IfBlock2:else:IfBlock3:then	
IfBlock2:else:IfBlock3:else	
IfBlock4:then	
IfBlock4:else	

## 7.1.6. checkInit Operator

Declared as **public function**

### 7.1.6.1. Comments and Information

#### **checkInit Comments:**

- This block checks on valid data in the collector. If data has init values collector is set to information from new balise.

### 7.1.6.2. Interface

**Table 21: Inputs of checkInit**

Name	Type	Comments and Information
newTelegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> Input: the actual telegram which is being processed.
inCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> Input: the actual collector

**Table 22: Outputs of checkInit**

Name	Type	Properties	Comments and Information
outCollector	BuildBGMessage_Pkg::BGCollector_T	default cCollectorInit	<b>Comments:</b> out: updated collector



#### 7.1.6.3. Locals

**Table 23: Locals of checkInit**

Name	Type	Comments and Information
isDefined	bool	<b>Comments:</b> bool: the collector is already in use for a balise group.

#### 7.1.6.4. Operator Hierarchy

diagram : diagram\_checkInit\_1  
    *activate if* : IfBlock1  
        branch : then  
        branch : else

## 7.1.6.5. Graphical and Textual Diagrams

### 7.1.6.5.1. View of diagram\_checkInit\_1 (checkInit)

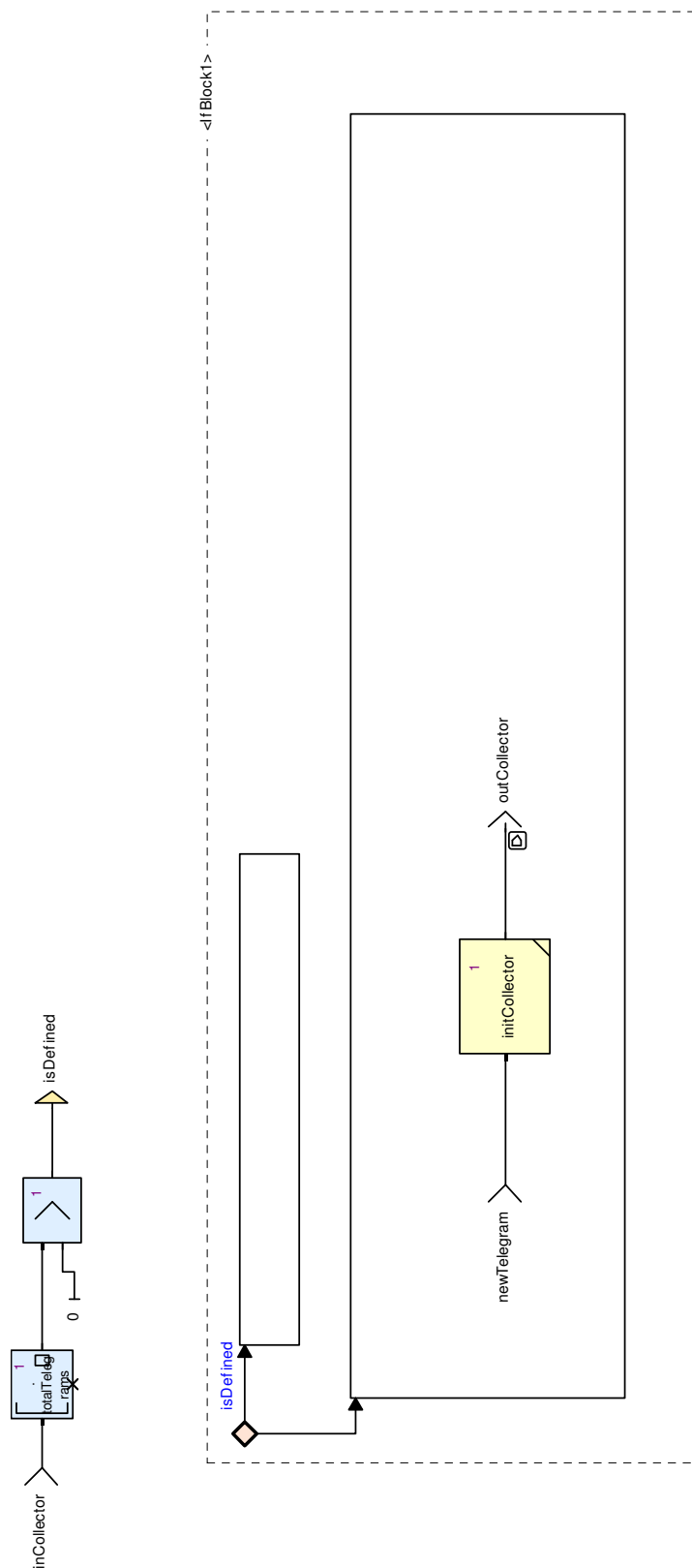


Figure 5: View of diagram\_checkInit\_1 (checkInit)

**Table 24: Conditional Blocks of diagram\_checkInit\_1**

Conditional Block	Comments and Information
IfBlock1	

**Table 25: Actions of diagram\_checkInit\_1**

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

### 7.1.7. checkOdometry Operator

Declared as **public function**

#### 7.1.7.1. Comments and Information

**checkOdometry Comments:**

- The operator checks whether the absolute distance between two odometry values is less than cMaxDistance.
- The check is needed to determine whether the antenna of the train is still in the allowed range for collecting balises in a balise group.
- The check is requested in section 3.16.2 . Details are defined in subset 40 section 4.1.1.2.

#### 7.1.7.2. Interface

**Table 26: Inputs of checkOdometry**

Name	Type	Comments and Information
actualOdometry	Obu_BasicTypes_Pkg::odometry_T	<b>Comments:</b> Input: the actual Odometry of the train. The odometry is taken for comparing the actual value with the known position of the balise group.
inCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> input: the actual collector

**Table 27: Outputs of checkOdometry**

Name	Type	Comments and Information
outMessageComplete	bool	<b>Comments:</b> Out: The bg-message is being completed. true indicates the odometry data imply the train has left the location of the balise group.
outBGIsChangedEarly	bool	<b>Comments:</b> out: the odometry indicates the train has left the range of the balise group and the bg telegrams are not fully received.
outsingleBadBalise	bool	<b>Comments:</b> out: the odometry indicates the train has left the range of the balise group and the bg telegrams are not fully received.
outCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> output: updated collector

#### 7.1.7.3. Locals

**Table 28: Locals of checkOdometry**

Name	Type	Comments and Information
isValid	bool	<b>Comments:</b> bool: both input parameters are valid.

#### 7.1.7.4. Operator Hierarchy

diagram : diagram\_checkOdometry\_1

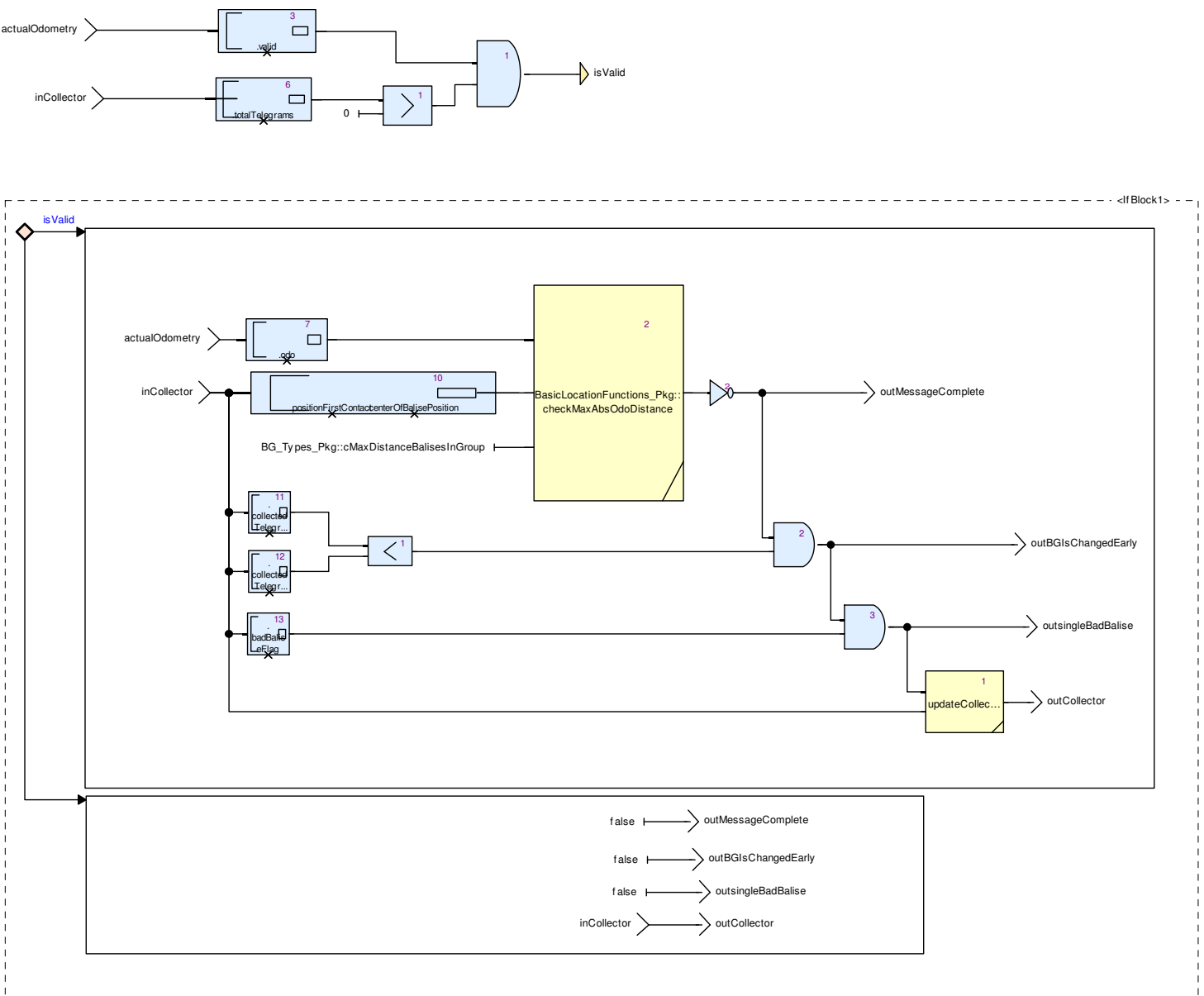
*activate if* : IfBlock1

        branch : then

        branch : else

#### 7.1.7.5. Graphical and Textual Diagrams

#### 7.1.7.5.1. View of diagram\_checkOdometry\_1 (checkOdometry)



**Table 30: Actions of diagram\_checkOdometry\_1**

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

## 7.1.8. checkTelegram Operator

Declared as **public function**

### 7.1.8.1. Comments and Information

#### checkTelegram Comments:

- Procedure checks for consistency of the input data (valid) and looks for the telegram in the balise group.
- If the switch of an balise group is detected which already has been sent as a balise group message the stores are being initialised prior to use.

### 7.1.8.2. Interface

**Table 31: Inputs of checkTelegram**

Name	Type	Comments and Information
newTelegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> The telegram to be checked
inTelegramArray	BG_Types_Pkg::TelegramArray_T	<b>Comments:</b> the already collected telegrams of the balise group.
BGCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> input: the actual collector information

**Table 32: Outputs of checkTelegram**

Name	Type	Comments and Information
outCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> the updated collector information
outTelegramArray	BG_Types_Pkg::TelegramArray_T	<b>Comments:</b> output: the updated array of telegrams
outTelegramNotInGroup	bool	<b>Comments:</b> out: bool the telegram is valid, but it does not belong to the actually collected group.
outBGchangedEarly	bool	<b>Comments:</b> out: the bg in the telegram indicates the train has left the range of the balise group and the bg telegrams are not fully received.

### 7.1.8.3. Locals

**Table 33: Locals of checkTelegram**

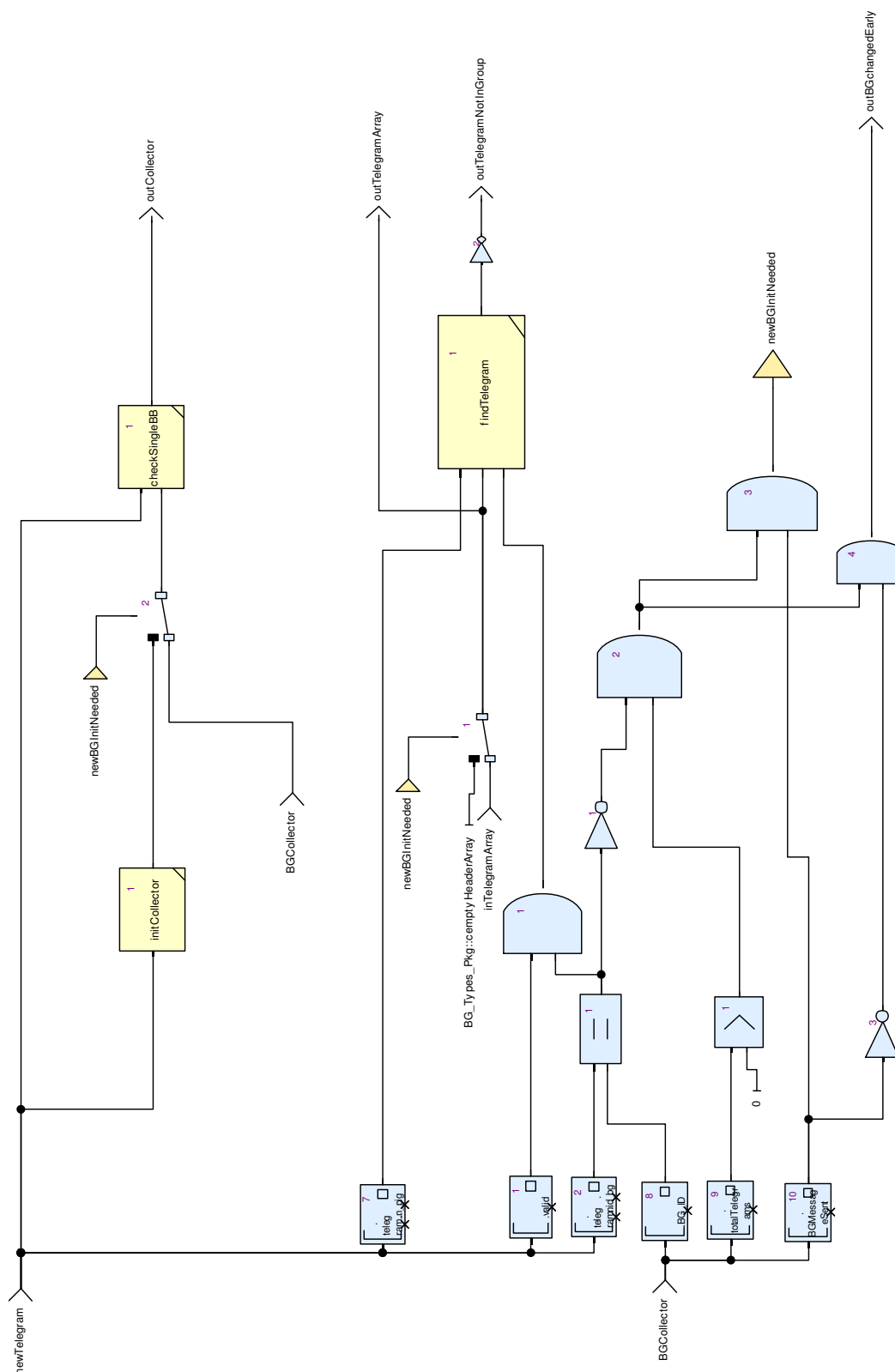
Name	Type	Comments and Information
newBGInitNeeded	bool	<b>Comments:</b> bool: the collector store needs initialisation with the balise groups data.

7.1.8.4. Operator Hierarchy

diagram : diagram\_checkTelegram\_1

#### 7.1.8.5. Graphical and Textual Diagrams

7.1.8.5.1. View of diagram\_checkTelegram\_1 (checkTelegram)



**Figure 7: View of diagram\_checkTelegram\_1 (checkTelegram)**

**diagram\_checkTelegram\_1 Comments:**



- Provides control data for the balise group collection.

### 7.1.9. manageAdditionalTelegram Operator

Declared as **public function**

#### 7.1.9.1. Comments and Information

##### **manageAdditionalTelegram Comments:**

- When a balise of another balise group has been received before sending of the balise message the additional telegram has to be kept on hold.
- First the balise group will be completed.
- In the next call of the message, the additional telegram will be tasken from the hold before processing another balise telegram.

#### 7.1.9.2. Interface

**Table 34: Inputs of manageAdditionalTelegram**

Name	Type	Comments and Information
inDecodedTelegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> Input: the newly received telegram.
incenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	<b>Comments:</b> Input: the position data corresponding to the telegram.
inTelegramStore	BuildBGMessage_Pkg::TelegramStore_T	<b>Comments:</b> Input: the telegram store with the information from the previous run
inputTelegramPresent	bool	<b>Comments:</b> input: presence indicator related to the freshly received telegram.

**Table 35: Outputs of manageAdditionalTelegram**

Name	Type	Comments and Information
outputPresent	bool	<b>Comments:</b> output: new presence indicator. The telegram is present if either a telegram is kept in the store or if the new telegram is present.
outDecodedTelegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> output: new telegram. The telegram is either taken from the store (first choice) or from the new telegram.
outcenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	<b>Comments:</b> Output: the telegram position information.
outNeedStore	bool	<b>Comments:</b> Out: bool, indicates the store is still needed after the procedure is executed.

#### 7.1.9.3. Locals

**Table 36: Locals of manageAdditionalTelegram**

Name	Type	Comments and Information
storeValid	bool	<b>Comments:</b> bool: the telegramStore is valid

#### 7.1.9.4. Operator Hierarchy

diagram : diagram\_manageAdditionalTelegram\_1

#### 7.1.9.5. Graphical and Textual Diagrams

7.1.9.5.1. View of diagram\_manageAdditionalTelegram\_1  
(manageAdditionalTelegram)

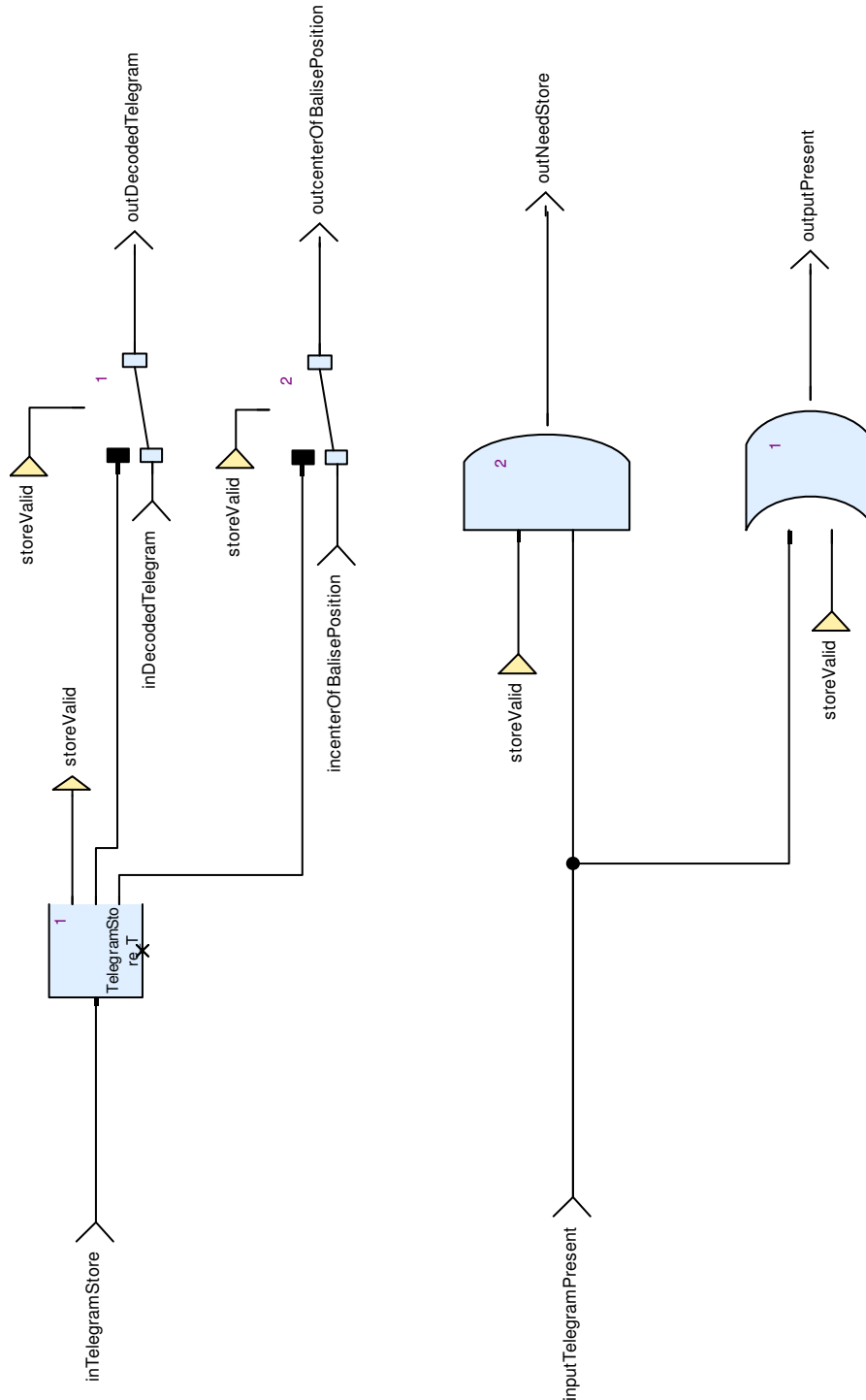


Figure 8: View of diagram\_manageAdditionalTelegram\_1 (manageAdditionalTelegram)

## 7.1.10. manageTelegram Operator

Declared as **public function**

### 7.1.10.1. Comments and Information

#### **manageTelegram Comments:**

- A valid telegram has been received. This block performs necessary checks and causes updates of the stores.

### 7.1.10.2. Interface

**Table 37: Inputs of manageTelegram**

Name	Type	Comments and Information
newTelegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> Input: the actual telegram to be managed
incenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	<b>Comments:</b> Input: the position information to the actual telegram to be managed
inCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> Input: the actual collector information
inoldTelegramArray	BG_Types_Pkg::TelegramArray_T	<b>Comments:</b> Input: the actual balise group array with the collected telegrams.

**Table 38: Outputs of manageTelegram**

Name	Type	Comments and Information
outBGisComplete	bool	<b>Comments:</b> out: indicates: the bg is completed, i.e., all telegrams have been collected.
outBGisChangedEarly	bool	<b>Comments:</b> out: the bg in the telegram indicates the train has left the range of the balise group and the bg telegrams are not fully received.
outCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> out: updated collector
outTelegramArray	BG_Types_Pkg::TelegramArray_T	<b>Comments:</b> out: updated bg-array.
outStoresChanged	bool	<b>Comments:</b> out: the stores are changed and need updating.

### 7.1.10.3. Operator Hierarchy

diagram : diagram\_manageTelegram\_1

#### 7.1.10.4. Graphical and Textual Diagrams

##### 7.1.10.4.1. View of diagram\_manageTelegram\_1 (manageTelegram)

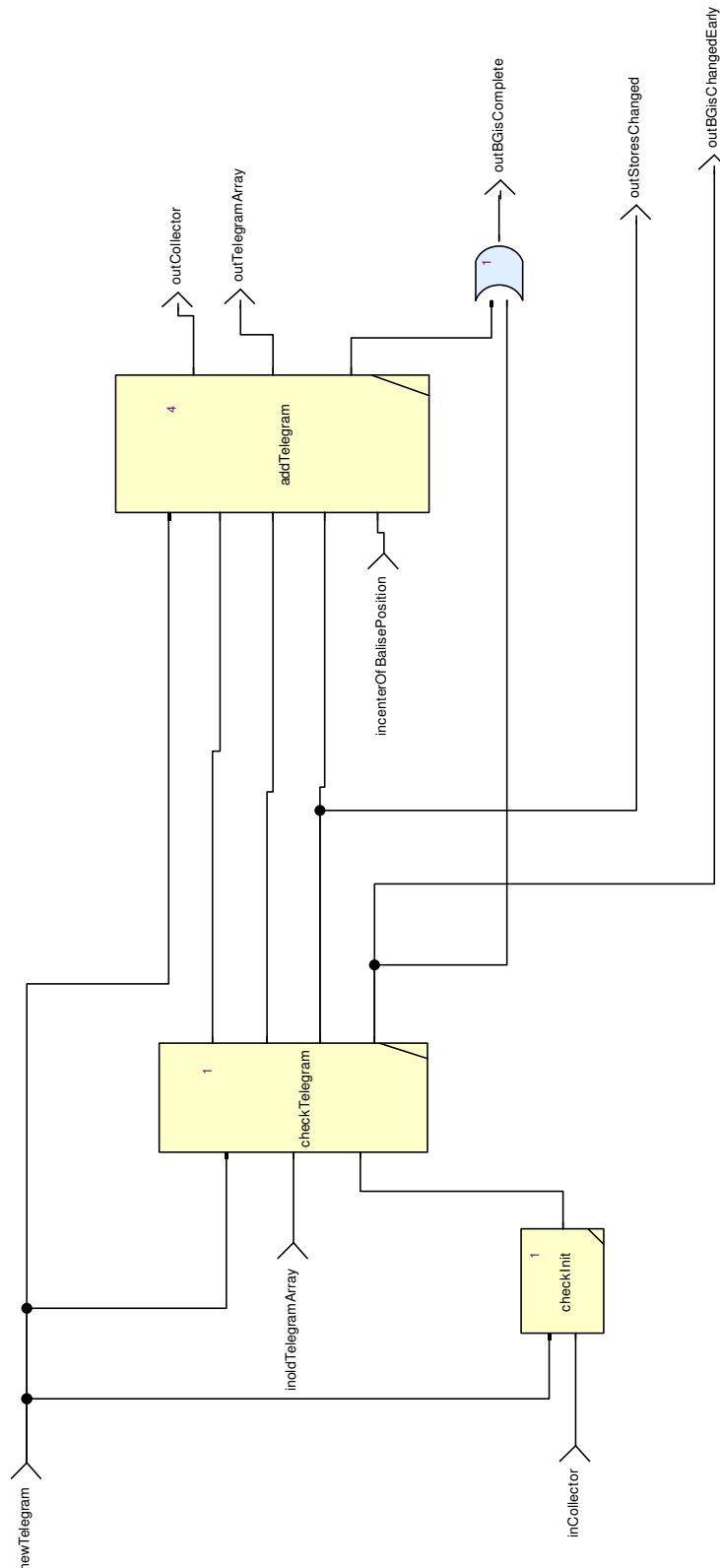


Figure 9: View of diagram\_manageTelegram\_1 (manageTelegram)

### 7.1.11. setCoordinateSystemPosition Operator

Declared as **public function**

#### 7.1.11.1. Comments and Information

##### **setCoordinateSystemPosition Comments:**

- This function is responsible for setting the position of the balise coordinate system.
- In general the position is determined with the position of the 1st balise in the group (3.4.2.2).
- In the exceptional case of a duplicated balise the position can be taken from the

#### 7.1.11.2. Interface

**Table 39: Inputs of setCoordinateSystemPosition**

Name	Type	Comments and Information
inOldPosition	BG_Types_Pkg::centerOfBalisePosition_T	<b>Comments:</b> input: position known
newTelegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> input actual telegram
incenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	<b>Comments:</b> input: position information of the actual telegram

**Table 40: Outputs of setCoordinateSystemPosition**

Name	Type	Comments and Information
outUpdateBGPosition	BG_Types_Pkg::centerOfBalisePosition_T	<b>Comments:</b> out<. updated position information for the balise group

#### 7.1.11.3. Operator Hierarchy

diagram : diagram\_setCoordinateSystemPosition\_1



## 7.1.12. setIntervallBGPosition Operator

Declared as **public function**

### 7.1.12.1. Comments and Information

#### setIntervallBGPosition Comments:

- This function is responsible for setting the position of the first balise of the balise group.

### 7.1.12.2. Interface

**Table 41: Inputs of setIntervallBGPosition**

Name	Type	Comments and Information
inOldPosition	BG_Types_Pkg::centerOfBalisePosition_T	<b>Comments:</b> input: position known
incenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	<b>Comments:</b> input: position information of the actual telegram

**Table 42: Outputs of setIntervallBGPosition**

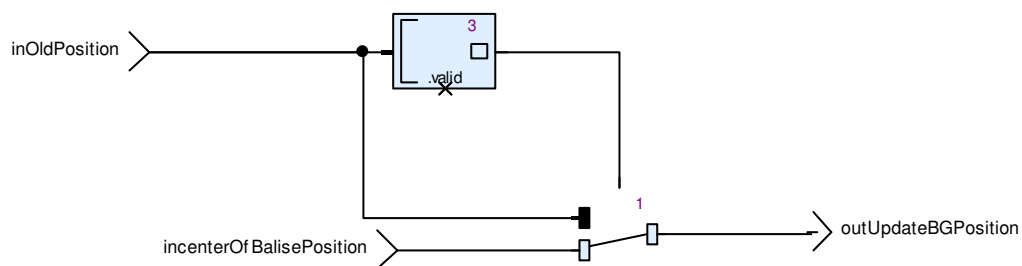
Name	Type	Comments and Information
outUpdateBGPosition	BG_Types_Pkg::centerOfBalisePosition_T	<b>Comments:</b> out<. updated position information for the balise group

### 7.1.12.3. Operator Hierarchy

diagram : diagram\_setIntervallBGPosition\_1

### 7.1.12.4. Graphical and Textual Diagrams

#### 7.1.12.4.1. View of diagram\_setIntervallBGPosition\_1 (setIntervallBGPosition)



**Figure 11: View of diagram\_setIntervallBGPosition\_1 (setIntervallBGPosition)**

## 7.2. BuildBGMessage\_Pkg::BaliseSupport Package

### 7.2.1. checkSingleBB Operator

Declared as **public function**

### 7.2.1.1. Comments and Information

#### checkSingleBB Comments:

- This function checks whether the condition for a single bad balise has to be set resp. reset.
- Set condition:
  - either no bg known and bg message sent
  - and badbalise received
- Reset Condition:
  - singlebb set and
  - valid telegram received

#### 7.2.1.2. Interface

**Table 43: Inputs of checkSingleBB**

Name	Type	Comments and Information
inTelegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> input: actual telegram. Only the valid flag is needed to calculate the badBalise flag.
inCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> input: the actual collector

**Table 44: Outputs of checkSingleBB**

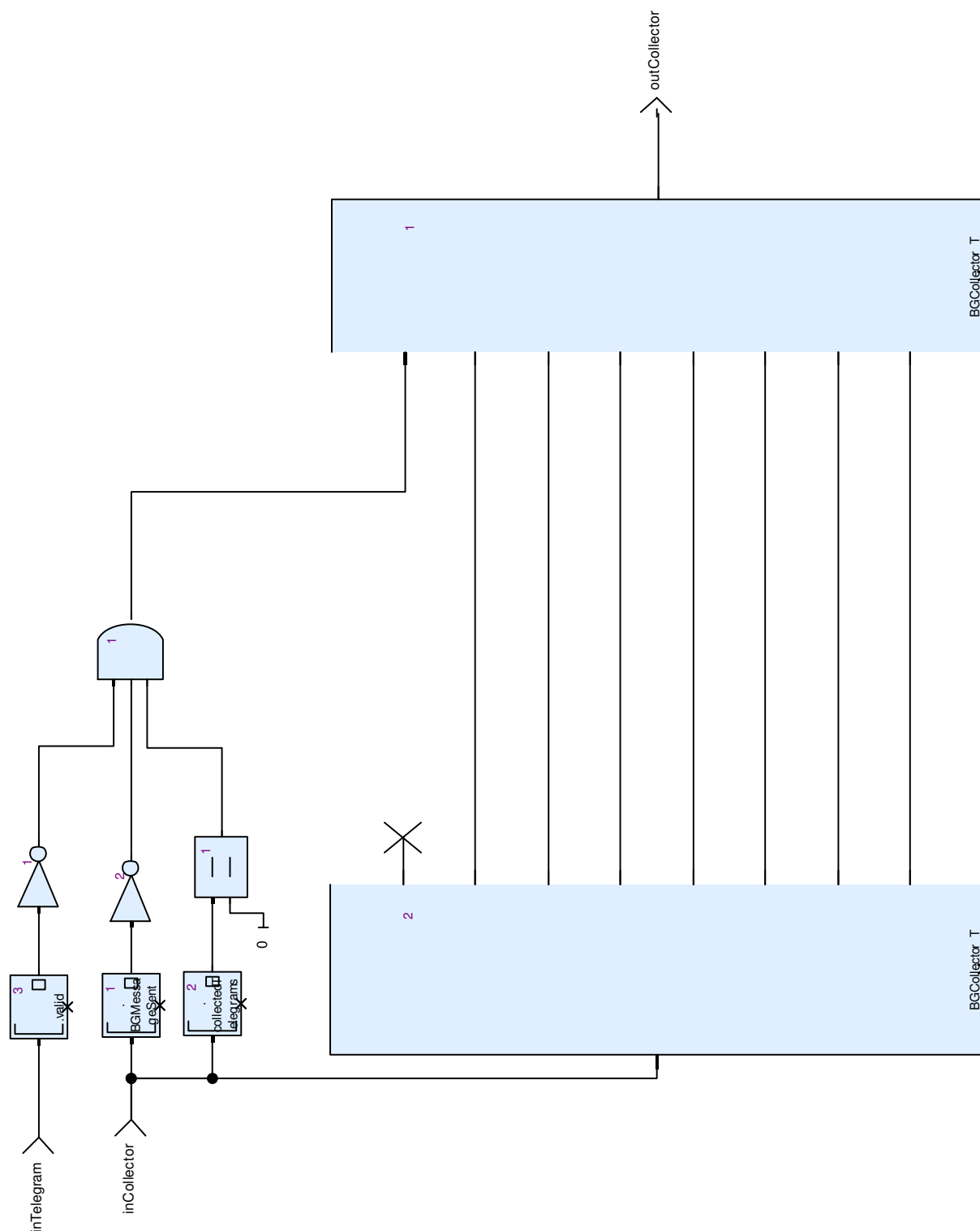
Name	Type	Comments and Information
outCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> output: updated collector

#### 7.2.1.3. Operator Hierarchy

diagram : diagram\_checkSingleBB\_1



#### 7.2.1.4.1. View of diagram\_checkSingleBB\_1 (checkSingleBB)



**Figure 12: View of diagram\_checkSingleBB\_1 (checkSingleBB)**

Declared as `public function`

#### 7.2.2.1. Comments and Information

##### convNTotal Comments:

- Supporting Function: Converts N\_Total (enumerative type) into integer according to the meaning of the values.

#### 7.2.2.2. Interface

**Table 45: Inputs of convNTotal**

Name	Type	Comments and Information
inNTotal	N_TOTAL	<b>Comments:</b> Input: NTotal as enumartion (ETCS Language)

**Table 46: Outputs of convNTotal**

Name	Type	Comments and Information
outTotal	int	<b>Comments:</b> Output: nTotal as integer. The mapping is according to the meanin, e.g., #pragma kgc enum_val 0 #end N_TOTAL_1_balise_in_the_group = 1 An undefined / unexpected value is mapped to 0.

#### 7.2.2.3. Operator Hierarchy

diagram : diagram\_convNTotal\_1

```

activate if : IfBlock1
  branch : then
  branch : else
    branch : then
    branch : else
      branch : then
      branch : else
        branch : then
        branch : else
          branch : then
          branch : else
            branch : then
            branch : else
              branch : then
              branch : else
                branch : then
                branch : else

```

## 7.2.2.4. Graphical and Textual Diagrams

### 7.2.2.4.1. View of diagram\_convNTotal\_1 (convNTotal)

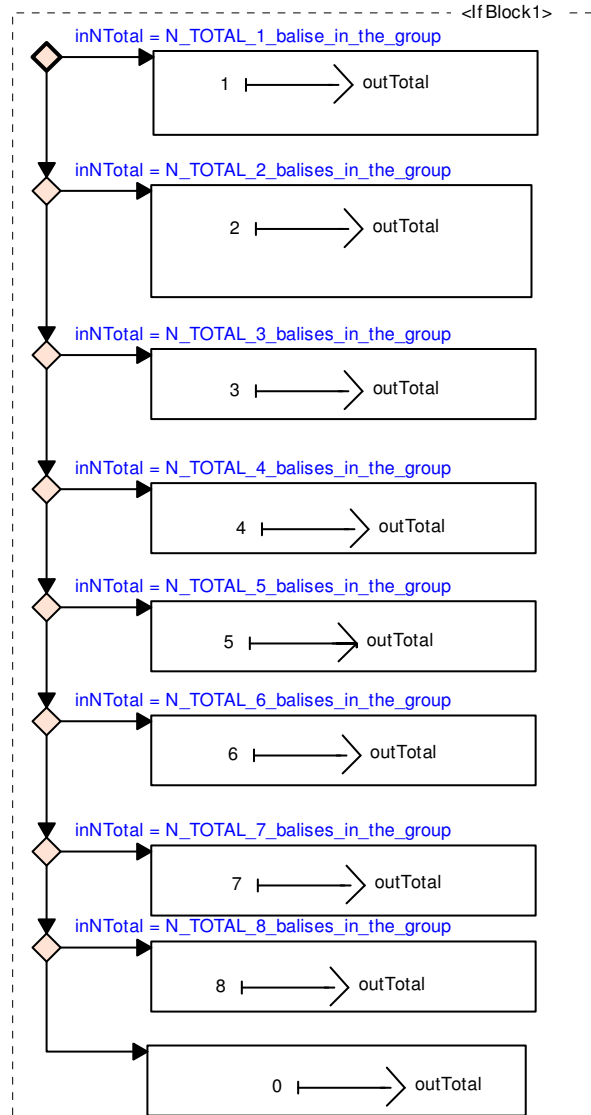


Figure 13: View of diagram\_convNTotal\_1 (convNTotal)

Table 47: Conditional Blocks of diagram\_convNTotal\_1

Conditional Block	Comments and Information
IfBlock1	

Table 48: Actions of diagram\_convNTotal\_1

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

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

### 7.2.3. findTelegram Operator

Declared as **public function**

#### 7.2.3.1. Comments and Information

##### findTelegram Comments:

- Supportive Function: searches for a telegram in the header array.
- The search is stopped with result true when a telegram could be identified in the array which has the same pig and is valid.

#### 7.2.3.2. Interface

**Table 49: Inputs of findTelegram**

Name	Type	Comments and Information
which_pig	N_PIG	<b>Comments:</b> Input: position in Group (ETCS language)
HeaderArray	BG_Types_Pkg::Telegr amArray_T	<b>Comments:</b> Input: the actual balise group array. Each telegram in this array is to be checked for the pig. Search is done if at least one element in the array is valid.
doSearch	bool	<b>Comments:</b> Input: the search may be skipped with this parameter. Option for e.g., a not-valid telegram.

**Table 50: Outputs of findTelegram**

Name	Type	Properties		Comments and Information
telegramAlreadyInGroup	bool	default	false	<b>Comments:</b> Output: Result of the Search. The value is set to false, if the array was empty, or if the search was actually skipped by means of the doSearch input parameter.

#### 7.2.3.3. Locals

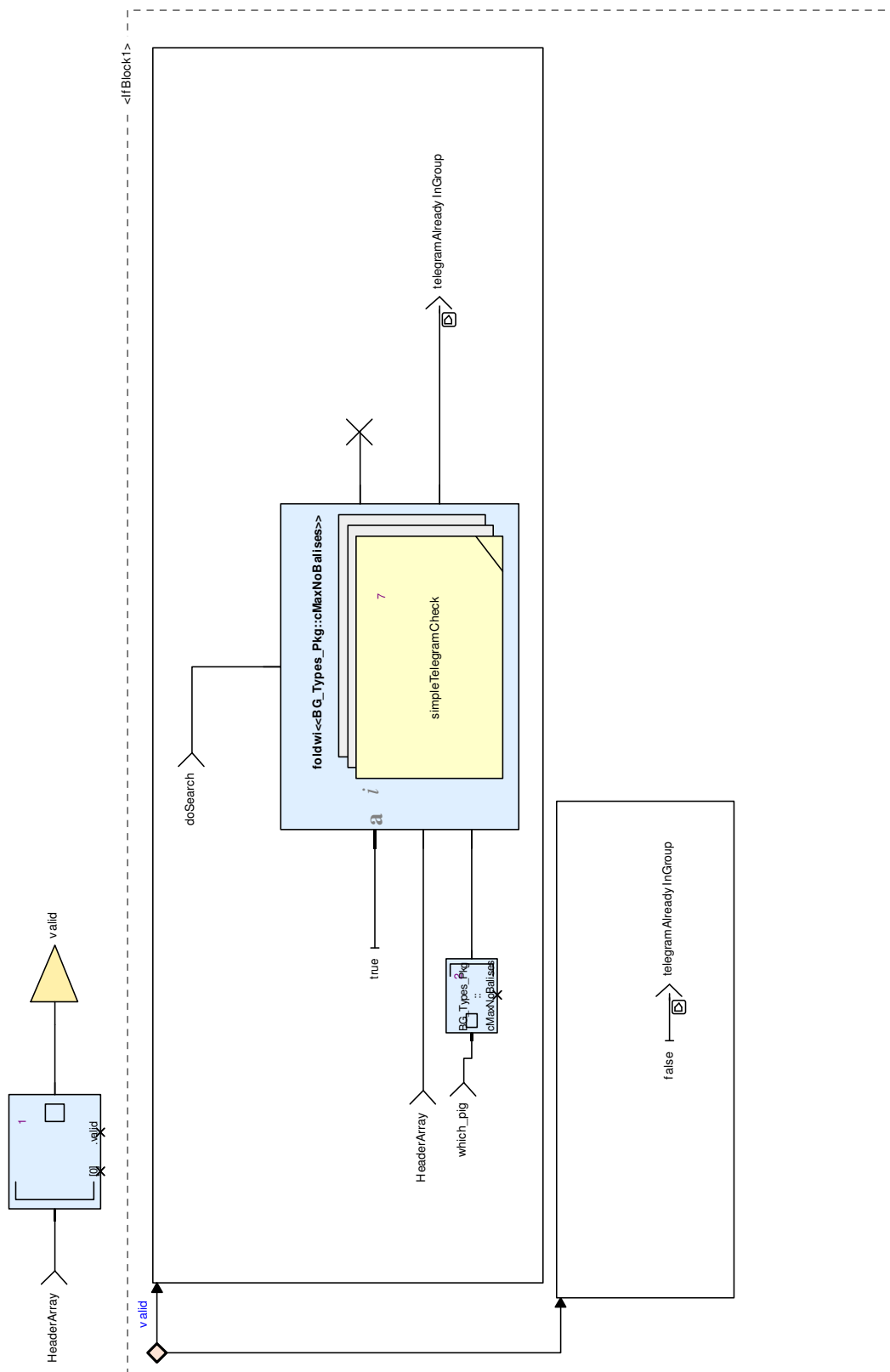
**Table 51: Locals of findTelegram**

Name	Type	Comments and Information
valid	bool	<b>Comments:</b> bool: the parameter is true if the first element of the input array is valid.

#### 7.2.3.4. Operator Hierarchy

diagram : diagram\_findTelegram\_1  
    *activate if* : IfBlock1  
        branch : then  
        branch : else

#### 7.2.3.5.1. View of diagram\_findTelegram\_1 (findTelegram)



**Figure 14: View of diagram\_findTelegram\_1 (findTelegram)**

**Table 52: Conditional Blocks of diagram\_findTelegram\_1**

Conditional Block	Comments and Information
IfBlock1	

**Table 53: Actions of diagram\_findTelegram\_1**

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

## 7.2.4. initCollector Operator

Declared as **public function**

### 7.2.4.1. Interface

**Table 54: Inputs of initCollector**

Name	Type	Comments and Information
newTelegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> Input: the actual telegram which is being processed.

**Table 55: Outputs of initCollector**

Name	Type	Comments and Information
outCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> out: updated collector

### 7.2.4.2. Operator Hierarchy

diagram : diagram\_initCollector\_1

### 7.2.4.3. Graphical and Textual Diagrams

#### 7.2.4.3.1. View of diagram\_initCollector\_1 (initCollector)

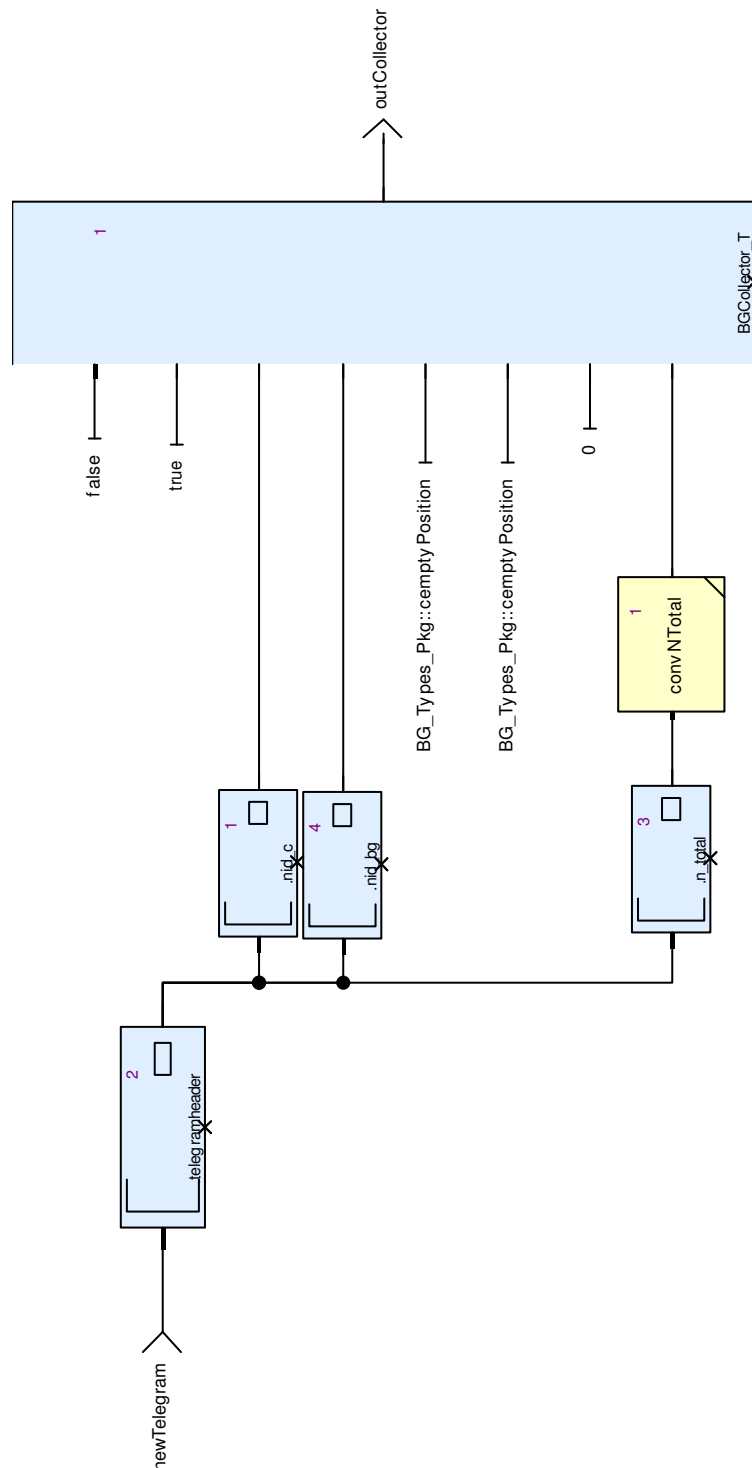


Figure 15: View of diagram\_initCollector\_1 (initCollector)

### 7.2.5. mergeAddInfo Operator

Declared as **public function**



#### 7.2.5.1. Comments and Information

##### **mergeAddInfo Comments:**

- This function combines packets received in the telegrams of a balise group.
- The function is limited to the packets used in the respective scope of the model:
  - - linking packet (5).
  -
- The behaviour is according to the subset 26, section
  - - 8.4.2 (rules for balise telegrams) and
  - - 8.4.1 (multiplicity of packets in a balise group message).
- We interpret the term "message" in this context as a balise message consisting of several telegrams. This implies in general, only single packets are to be expected for the whole balise group message (respecting documented exeptions).

#### 7.2.5.2. Interface

**Table 56: Inputs of mergeAddInfo**

Name	Type	Comments and Information
newAddInfo	BG_Types_Pkg::AdditionalInformation_T	
oldAddInfo	BG_Types_Pkg::AdditionalInformation_T	

**Table 57: Outputs of mergeAddInfo**

Name	Type	Comments and Information
mergedAddInfo	BG_Types_Pkg::AdditionalInformation_T	

#### 7.2.5.3. Operator Hierarchy

diagram : diagram\_mergeAddInfo\_1

#### 7.2.5.4. Graphical and Textual Diagrams

##### 7.2.5.4.1. View of diagram\_mergeAddInfo\_1 (mergeAddInfo)

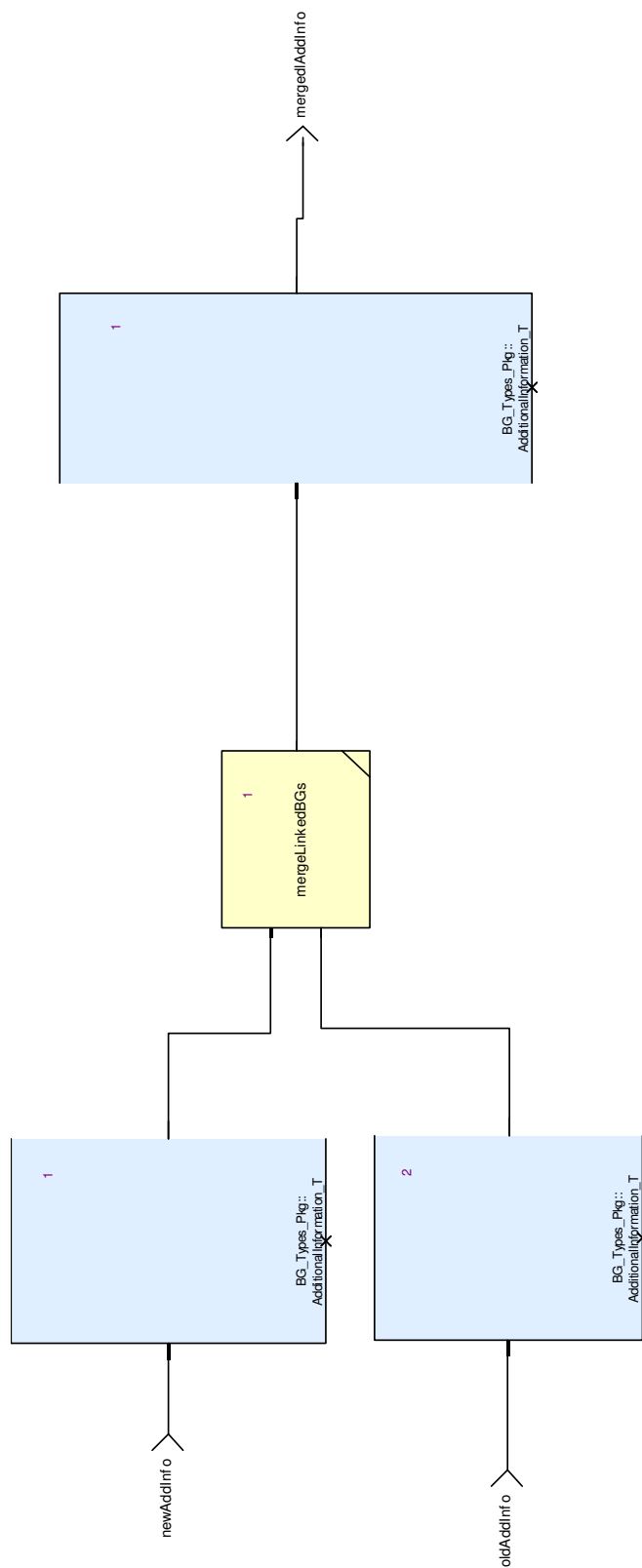


Figure 16: View of diagram\_mergeAddInfo\_1 (mergeAddInfo)

## 7.2.6. mergeLinkedBGs Operator

Declared as **public function**

### 7.2.6.1. Comments and Information

#### **mergeLinkedBGs Comments:**

- This information is made up of the linking packet (5) of the btm
- The linking is a list of variable size.
- According to my understanding of the standard the package only appears once in a message and is not allowed to be split across telegrams.
- Therefore, no special procedure for copying is needed.
- (only replace whole list if already received entry is not valid).

### 7.2.6.2. Interface

**Table 58: Inputs of mergeLinkedBGs**

Name	Type	Comments and Information
newLinkedBGs	BG_Types_Pkg::LinkedBGs_T	
oldLinkedBGs	BG_Types_Pkg::LinkedBGs_T	

**Table 59: Outputs of mergeLinkedBGs**

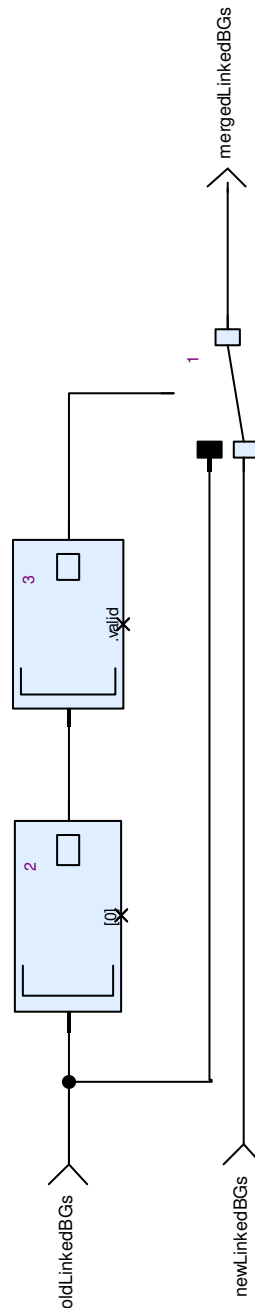
Name	Type	Comments and Information
mergedLinkedBGs	BG_Types_Pkg::LinkedBGs_T	

### 7.2.6.3. Operator Hierarchy

diagram : diagram\_mergeLinkedBGs\_1

#### 7.2.6.4. Graphical and Textual Diagrams

##### 7.2.6.4.1. View of diagram\_mergeLinkedBGs\_1 (mergeLinkedBGs)



**Figure 17: View of diagram\_mergeLinkedBGs\_1 (mergeLinkedBGs)**

#### 7.2.7. setFirstFree Operator

Declared as **public function**

##### 7.2.7.1. Comments and Information

###### **setFirstFree Comments:**

- adds the telegram in the next available slot. Used as a parameter in the mapw function of routine addTelegram.

### 7.2.7.2. Interface

**Table 60: Inputs of setFirstFree**

Name	Type	Comments and Information
newTelegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> Input: new telegram to be added
inTelegramArray	BG_Types_Pkg::Telegram_T	<b>Comments:</b> Array of already collected telegrams of the Balisegrouzp. The routine searches this array.

**Table 61: Outputs of setFirstFree**

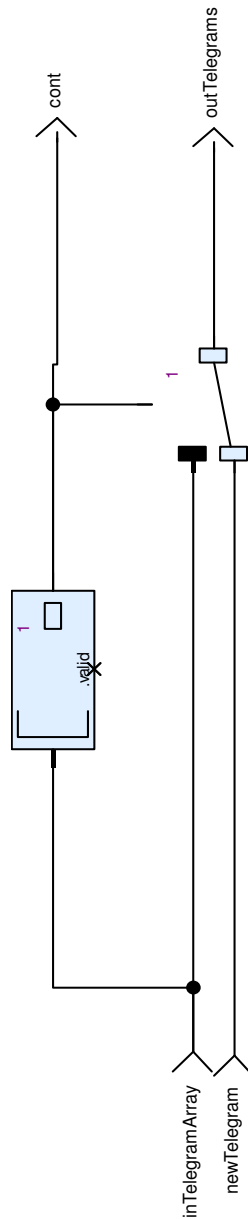
Name	Type	Comments and Information
cont	bool	<b>Comments:</b> output: search result
outTelegrams	BG_Types_Pkg::Telegram_T	<b>Comments:</b> output: updated array of telegrams.

### 7.2.7.3. Operator Hierarchy

diagram : diagram\_setFirstFree\_1

#### 7.2.7.4. Graphical and Textual Diagrams

##### 7.2.7.4.1. View of diagram\_setFirstFree\_1 (setFirstFree)



**Figure 18: View of diagram\_setFirstFree\_1 (setFirstFree)**

#### 7.2.8. simpleTelegramCheck Operator

Declared as **public function**

##### 7.2.8.1. Comments and Information

###### **simpleTelegramCheck Comments:**

- Used in find telegram (parameter of the foldwi operator).
- Checks pig and valid flag

#### 7.2.8.2. Interface

**Table 62: Inputs of simpleTelegramCheck**

Name	Type	Comments and Information
iteratorIndex	int	<b>Comments:</b> Input: needed by Scade for generating the loop.
accu	bool	<b>Comments:</b> Input: needed by Scade for generating the loop.
telegram	BG_Types_Pkg::Telegram_T	<b>Comments:</b> Input: telegram from the BG array
which_pig	N_PIG	<b>Comments:</b> Input: identifies the position in group of the balise telegram.

**Table 63: Outputs of simpleTelegramCheck**

Name	Type	Comments and Information
cont	bool	<b>Comments:</b> Output: needed by Scade for generating the loop.
telegramAlreadyInGroup	bool	<b>Comments:</b> Output: Result of the check.

#### 7.2.8.3. Operator Hierarchy

diagram : diagram\_simpleTelegramCheck\_1

#### 7.2.8.4. Graphical and Textual Diagrams

##### 7.2.8.4.1. View of diagram\_simpleTelegramCheck\_1 (simpleTelegramCheck)

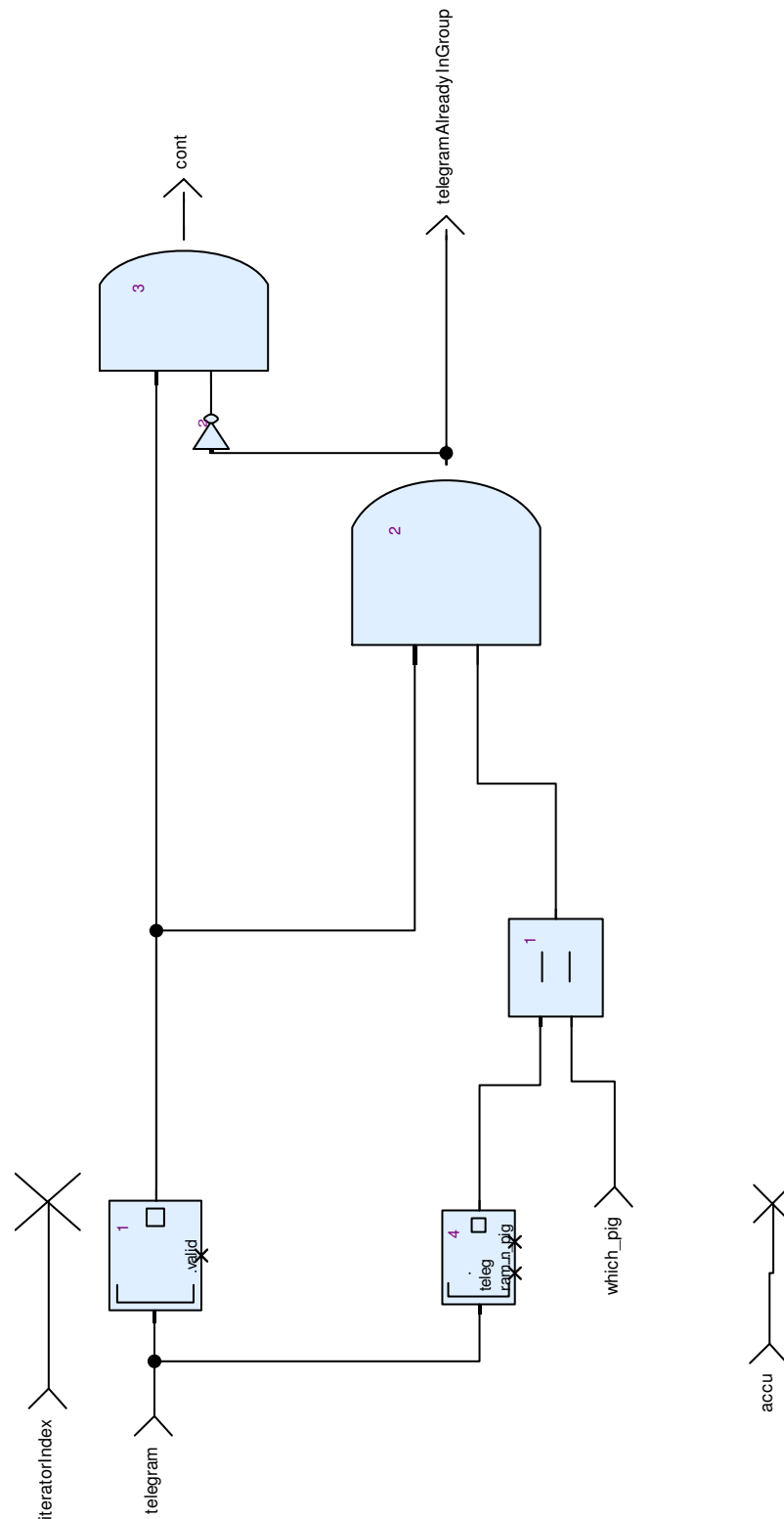


Figure 19: View of diagram\_simpleTelegramCheck\_1 (simpleTelegramCheck)

#### 7.2.9. updateCollectorSendMessage Operator Declared as **public function**



#### 7.2.9.1. Comments and Information

##### **updateCollectorSendMessage Comments:**

- Copy Function for the Collector. The SendMessage flag is set to true.

#### 7.2.9.2. Interface

**Table 64: Inputs of updateCollectorSendMessage**

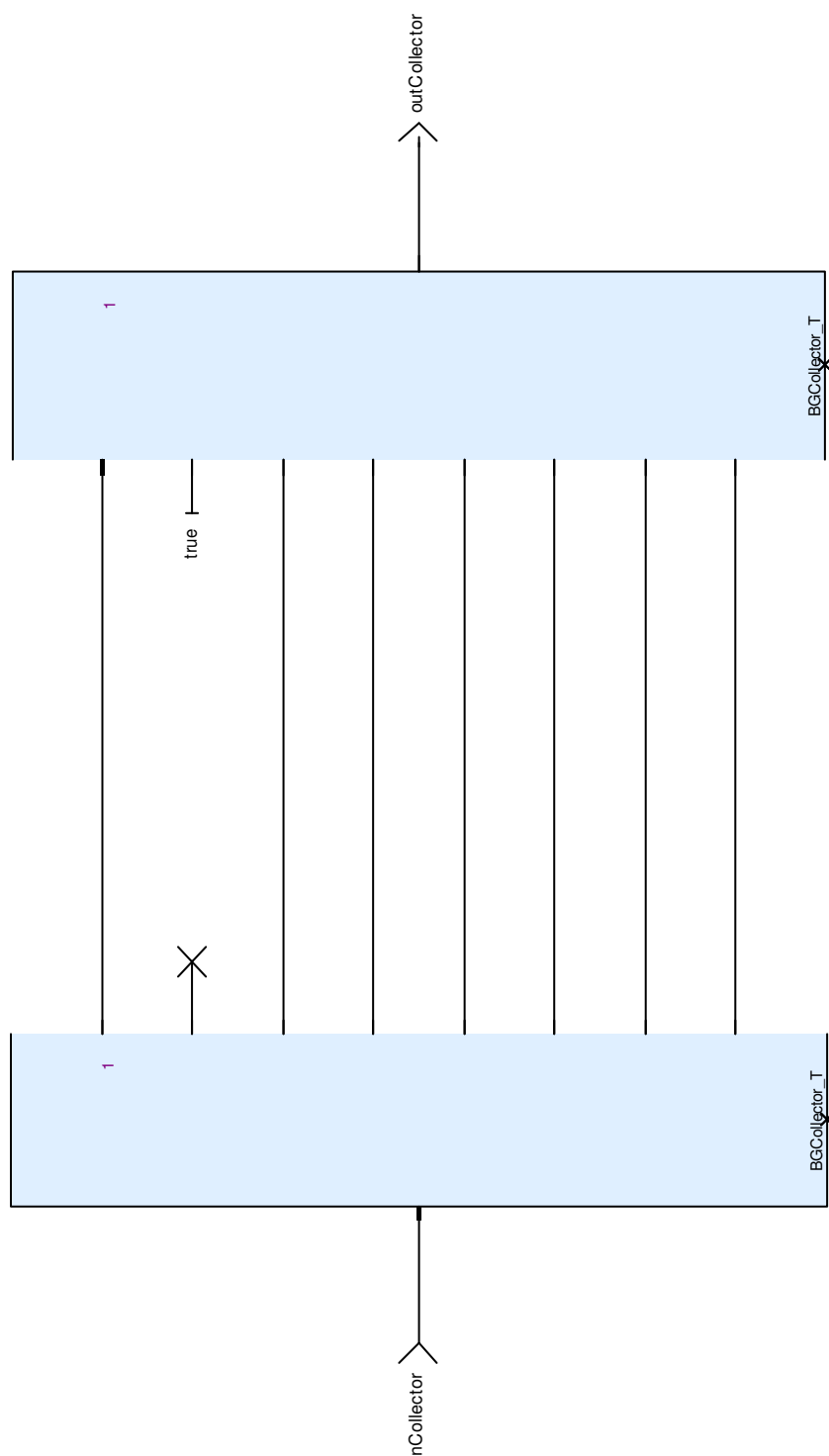
Name	Type	Comments and Information
inCollector	BuildBGMessage_Pkg:: BGCollector_T	<b>Comments:</b> input: the actual collector

**Table 65: Outputs of updateCollectorSendMessage**

Name	Type	Comments and Information
outCollector	BuildBGMessage_Pkg:: BGCollector_T	<b>Comments:</b> output: updated collector

#### 7.2.9.3. Operator Hierarchy

diagram : diagram\_updateCollectorSendMessage\_1



### 7.2.10.1. Comments and Information

#### **updateCollectorSingleBB Comments:**

- copy function for the collector.
- The bad balises flag is set to false iff the output bad balise is set to true.

### 7.2.10.2. Interface

**Table 66: Inputs of updateCollectorSingleBB**

Name	Type	Comments and Information
inSingleBadBalise	bool	<b>Comments:</b> out: the odometry indicates the train has left the range of the balise group and the bg telegrams are not fully received.
inCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> input: the actual collector

**Table 67: Outputs of updateCollectorSingleBB**

Name	Type	Comments and Information
outCollector	BuildBGMessage_Pkg::BGCollector_T	<b>Comments:</b> output: updated collector

### 7.2.10.3. Operator Hierarchy

diagram : diagram\_updateCollectorSingleBB\_1

#### 7.2.10.4. Graphical and Textual Diagrams

##### 7.2.10.4.1. View of diagram\_updateCollectorSingleBB\_1 (updateCollectorSingleBB)

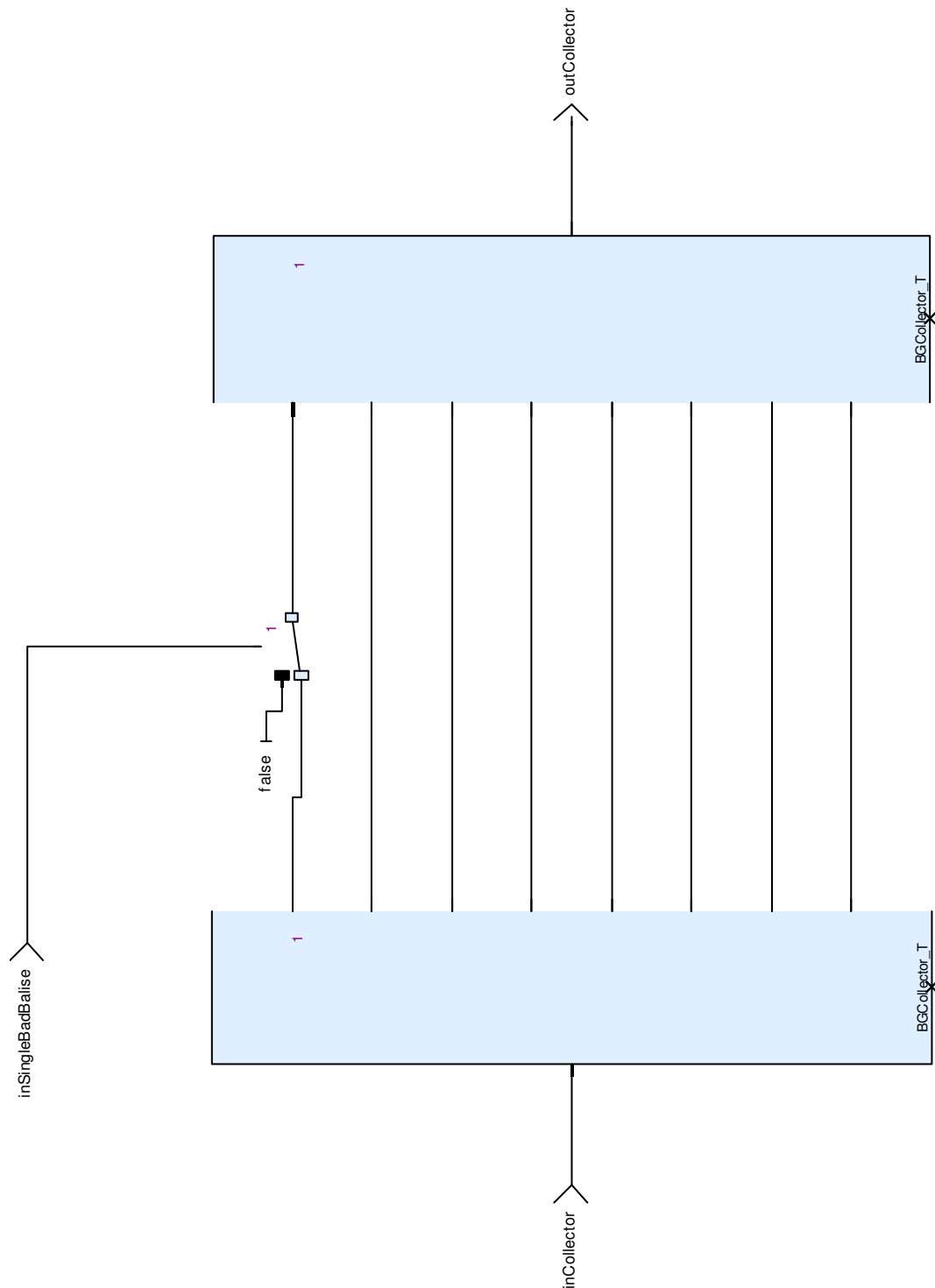


Figure 21: View of diagram\_updateCollectorSingleBB\_1 (updateCollectorSingleBB)

## 8. Project Library: TrainPosition\_Types

### 8.1. TrainPosition\_Types\_Pck Package

#### 8.1.1. Comments and Information

##### TrainPosition\_Types\_Pck Comments:

- This library provides the data type definitions used in train position calculations

Table 68: TrainPosition\_Types\_Pck Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-06-03
	Version	00.03.00
	to_c	True
Remark_1	Description	Description : Determines the index of BG in BGs - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> ) - Gist URL: --- - Cryptography: No - Author(s): Uwe Steinke  The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.
	to_c	True

## 8.1.2. Types

**Table 69: Public Types of TrainPosition\_Types\_Pck**

Name	Definition	Comments and Information
infoFromLinking_T	{valid : bool, nid_bg_fromLinkingBG : NID_BG, nid_c_fromLinkingBG : NID_C, expectedLocation : Obu_BasicTypes_Pkg::LocWithInAcc_T, d_link : Obu_BasicTypes_Pkg::LocWithInAcc_T, linkingInfo : BG_Types_Pkg::LinkedBG_T}	<b>Comments:</b> Describes a linked BG as announced from the linking BG. Mainly, this information is taken from the linking packet. <b>nid_bg_fromLinkingBG</b> <b>Comments:</b> ID of the BG, where the linking information originates from <b>expectedLocation</b> <b>Comments:</b> Location, where the BG is expected to be found, calculated from announced linking distance. <b>d_link</b> <b>Comments:</b> Linking distance with inaccuracies, converted from Q_SCALE, D_LINK, Q_LOCACC of the linking packet. <b>linkingInfo</b> <b>Comments:</b> Linking info as announced from the linking BG, where this BG.
linkedBGs_asPositionedBGs_T	TrainPosition_Types_Pck::positionedBG_T ^BG_Types_Pkg::cMaxNoOfLinkedBGs	<b>Comments:</b> Array of linked balises groups in the format of positioned BGs
positionedBG_T	{valid : bool, nid_c : NID_C, nid_bg : NID_BG, q_link : Q_LINK, location : Obu_BasicTypes_Pkg::LocWithInAcc_T, seqNoOnTrack : int, infoFromLinking : TrainPosition_Types_Pck::infoFromLinking_T, infoFromPassing : BG_Types_Pkg::passedBG_T}	<b>location</b> <b>Comments:</b> The best known location calculated from linking and from passing information <b>seqNoOnTrack</b> <b>Comments:</b> Sequence number: specifies the order of the BG passed or expected to be passed <b>infoFromLinking</b> <b>Comments:</b> If linked, this is the BG info as announced from a linked BG. Most of the data is taken from the linking information. <b>infoFromPassing</b> <b>Comments:</b> If the balise group was passed, this is the relevant information received from the BG.
positionedBGs_T	TrainPosition_Types_Pck::positionedBG_T ^cMaxNoOfStoredBGs	<b>Comments:</b> All balise groups stored for train position calculation

Name	Definition	Comments and Information
positionErrors_T	{outOfMemSpace : bool, passedBG_notFoundWhereExpected : bool, positionCalculation_inconsistent : bool}	<b>outOfMemSpace Comments:</b> Memory overrun: a passed or announced BG could not be stored <b>passedBG_notFoundWhereEx pected Comments:</b> The currently passed linked BG location does not match the expected location <b>positionCalculation_inconsist ent Comments:</b> A consistency problem arised during position calculation

Name	Definition	Comments and Information
trainPosition_T	<pre> {valid : bool, timestamp : Obu_BasicTypes_Pkg::T_internal_Type, trainPositionIsUnknown : bool, noCoordinateSystemHasBeenAssigned : bool, trainPosition : Obu_BasicTypes_Pkg::LocWithInAcc_T, estimatedFrontEndPosition : Obu_BasicTypes_Pkg::Location_T, minSafeFrontEndPosition : Obu_BasicTypes_Pkg::Location_T, maxSafeFrontEndPosition : Obu_BasicTypes_Pkg::Location_T, nid_LRBG : NID_BG, nid_PrVLRB : NID_PRVLRBG, nominalOrReverseToLRBG : Q_DLRBG, trainOrientationToLRBG : Q_DIRLRBG, trainRunningDirectionToLRBG : Q_DIRTRAIN, speed : Obu_BasicTypes_Pkg::Speed_T} </pre>	<p><b>Comments:</b> 3.6.1.3 <b>trainPositionIsUnknown</b> <b>Comments:</b> 3.6.3.1.3.1 <b>noCoordinateSystemHasBeenAssigned</b> <b>Comments:</b> 3.4.2, 3.6.3.1.4: Every balise group has its own co-ordinate system <b>trainPosition</b> <b>Comments:</b> The calculated train position with inaccuracies. <b>estimatedFrontEndPosition</b> <b>Comments:</b> 3.6.4.4 a): Absolute train front end position since system start <b>minSafeFrontEndPosition</b> <b>Comments:</b> 3.6.4.4 c) :Minimum safe front end position <b>maxSafeFrontEndPosition</b> <b>Comments:</b> 3.6.4.4.b) :Maximum safe front end position <b>nid_LRBG</b> <b>Comments:</b> Identity of last relevant balise group <b>nid_PrVLRB</b> <b>Comments:</b> Identity of previous LRBG (7.4.3.2, 7.5.1.94), for position report based on 2 balise groups <b>nominalOrReverseToLRBG</b> <b>Comments:</b> 7.5.1.106: Q_DLRBG: Qualifier telling on which side of the LRBG the estimated front end is <b>trainOrientationToLRBG</b> <b>Comments:</b> 3.6.1.3: Orientation of the train in relation to the direction of the LRBG <b>trainRunningDirectionToLRBG</b> <b>Comments:</b> 3.6.1.3: Direction of train movement in relation to the LRBG orientation <b>speed</b> <b>Comments:</b> Actual train speed</p>



Name	Definition	Comments and Information
trainPositionInfo_T	{valid : bool, timestamp : Obu_BasicTypes_Pkg::T_internal_Type, trainPosition : Obu_BasicTypes_Pkg::LocWithInAcc_T, trainPositionDerivedFromLastLinkedBG : Obu_BasicTypes_Pkg::LocWithInAcc_T, trainPositionDerivedFromLastUnlinkedBG : Obu_BasicTypes_Pkg::LocWithInAcc_T, lastPassedLinkedBG : TrainPosition_Types_Pck::positionedBG_T, lastPassedUnlinkedBG : TrainPosition_Types_Pck::positionedBG_T, speed : Obu_BasicTypes_Pkg::Speed_T}	<b>trainPosition Comments:</b> The best known train position <b>trainPositionDerivedFromLastLinkedBG Comments:</b> The train position measured by odometry behind the position of the last passed linked BG <b>trainPositionDerivedFromLastUnlinkedBG Comments:</b> The train position measured by odometry behind the position of the last passed unlinked BG <b>lastPassedLinkedBG Comments:</b> The last passed linked BG <b>lastPassedUnlinkedBG Comments:</b> The last passed unlinked BG <b>speed Comments:</b> Actual train speed
trainProperties_T	{nid_engine : NID_ENGINE, nid_operational : NID_OPERATIONAL, l_train : L_TRAIN, d_baliseAntenna_2_frontend : Obu_BasicTypes_Pkg::LocWithInAcc_T, d_frontend_2_rearend : Obu_BasicTypes_Pkg::LocWithInAcc_T, locationAccuracy_NationalValue : Q_NVLOCACC, locationAccuracy_DefaultValue : Obu_BasicTypes_Pkg::LocWithInAcc_T, centerDetectionAcc_DefaultValue : Obu_BasicTypes_Pkg::LocWithInAcc_T}	<b>Comments:</b> Static train properties necessary for train position calculation. <b>nid_engine Comments:</b> 7.5.1.88, Onboard ETCS identity. <b>nid_operational Comments:</b> 7.5.1.92, Train Running Number <b>l_train Comments:</b> 7.5.1.56, train length <b>d_baliseAntenna_2_frontend Comments:</b> Distance from the trains balise antenna to the trains front end. <b>d_frontend_2_rearend Comments:</b> Distance from the trains front end to rear end <b>locationAccuracy_NationalValue Comments:</b> 3.6.4.3.2 <b>locationAccuracy_DefaultValue Comments:</b> 3.6.4.3.2 <b>centerDetectionAcc_DefaultValue Comments:</b> Will be applied, if centerDetectionInaccuracy from BTM is not available, especially for announced and not yet passed BGs

### 8.1.3. Constants

Table 70: Public Constants of TrainPosition\_Types\_Pck

Name	Type	Value	Comments and Information
cMaxNoOfStoredBGs	int	2 * BG_Types_Pkg::cMaxNoOfLinkedBGs	<b>Comments:</b> Max. number of balise groups stored for position calculation

Name	Type	Value	Comments and Information
cQ_SCALE_10_cm_resolution	Obu_BasicTypes_Pkg::Location_T	10	<b>Comments:</b> 7.5.1.129: Resolution of Q_SCALE::10cm: = 10 cm (Location_Type in cm)
cQ_SCALE_10_m_resolution	Obu_BasicTypes_Pkg::Location_T	1000	<b>Comments:</b> 7.5.1.129: Resolution of Q_SCALE::10 m: = 1000 cm (Location_Type in cm)
cQ_SCALE_1_m_resolution	Obu_BasicTypes_Pkg::Location_T	100	<b>Comments:</b> 7.5.1.129: Resolution of Q_SCALE::1 m: = 100 cm (Location_Type in cm)
cQLOCACC_resolution	Obu_BasicTypes_Pkg::Location_T	100	<b>Comments:</b> 7.5.1.115: Resolution of Q_LOCACC is in m = 100 cm (Location_Type in cm)

## 9. Project Library: BasicLocationFunctions

### 9.1. BasicLocationFunctions\_Pkg Package

#### 9.1.1. Comments and Information

##### BasicLocationFunctions\_Pkg Comments:

- This component provides basic position calculation functions as specified in [https://github.com/openETCS/SRS-Analysis/blob/master/System%20Analysis/WorkingRepository/Group4/SUBSET\\_26\\_3-6/DetermineTrainLocationProcedures.docx](https://github.com/openETCS/SRS-Analysis/blob/master/System%20Analysis/WorkingRepository/Group4/SUBSET_26_3-6/DetermineTrainLocationProcedures.docx) while taking inaccuracies into account.
- ---
- Basic calculation functions for position determination of train and track elements
  - - Name: BasicLocationFunctions.etp
  - - Description: Basic calculation functions for position determination of train and track elements
  - - Copyright Siemens AG, 2014
  - - Licensed under the EUPL V.1.1 ( <http://joinup.ec.europa.eu/software/page/eupl/licence-eupl> )
  - - Gist URL: ---
  - - Cryptography: No
  - - Author(s): Uwe Steinke
- The use of this software is limited to non-vital applications.
- It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.
- THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.

Table 71: BasicLocationFunctions\_Pkg Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True

Note Name	Attribute	Value
Remark_1	Description	<p>Basic calculation functions for position determination of train and track elements</p> <ul style="list-style-type: none"> <li>- Name: BasicLocationFunctions.etp</li> <li>- Description: Basic calculation functions for position determination of train and track elements</li> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.</p> <p>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

## 9.1.2. add\_2\_Distances Operator

Declared as **public function**

### 9.1.2.1. Comments and Information

#### **add\_2\_Distances Comments:**

- Calculates the sum of 2 distances  $\text{dist}_2 + \text{dist}_1$

**Table 72: add\_2\_Distances Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True

Note Name	Attribute	Value
Remark_1	Description	<p>Calculates the sum of 2 distances</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications.  It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.  THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 9.1.2.2. Interface

**Table 73: Inputs of add\_2\_Distances**

Name	Type	Comments and Information
dist_2	Obu_BasicTypes_Pkg::LocWithInAcc_T	
dist_1	Obu_BasicTypes_Pkg::LocWithInAcc_T	

**Table 74: Outputs of add\_2\_Distances**

Name	Type	Comments and Information
distance	Obu_BasicTypes_Pkg::LocWithInAcc_T	

#### 9.1.2.3. Operator Hierarchy

diagram : diagram\_add\_2\_Distances\_1

#### 9.1.2.4. Graphical and Textual Diagrams

##### 9.1.2.4.1. View of diagram\_add\_2\_Distances\_1 (add\_2\_Distances)

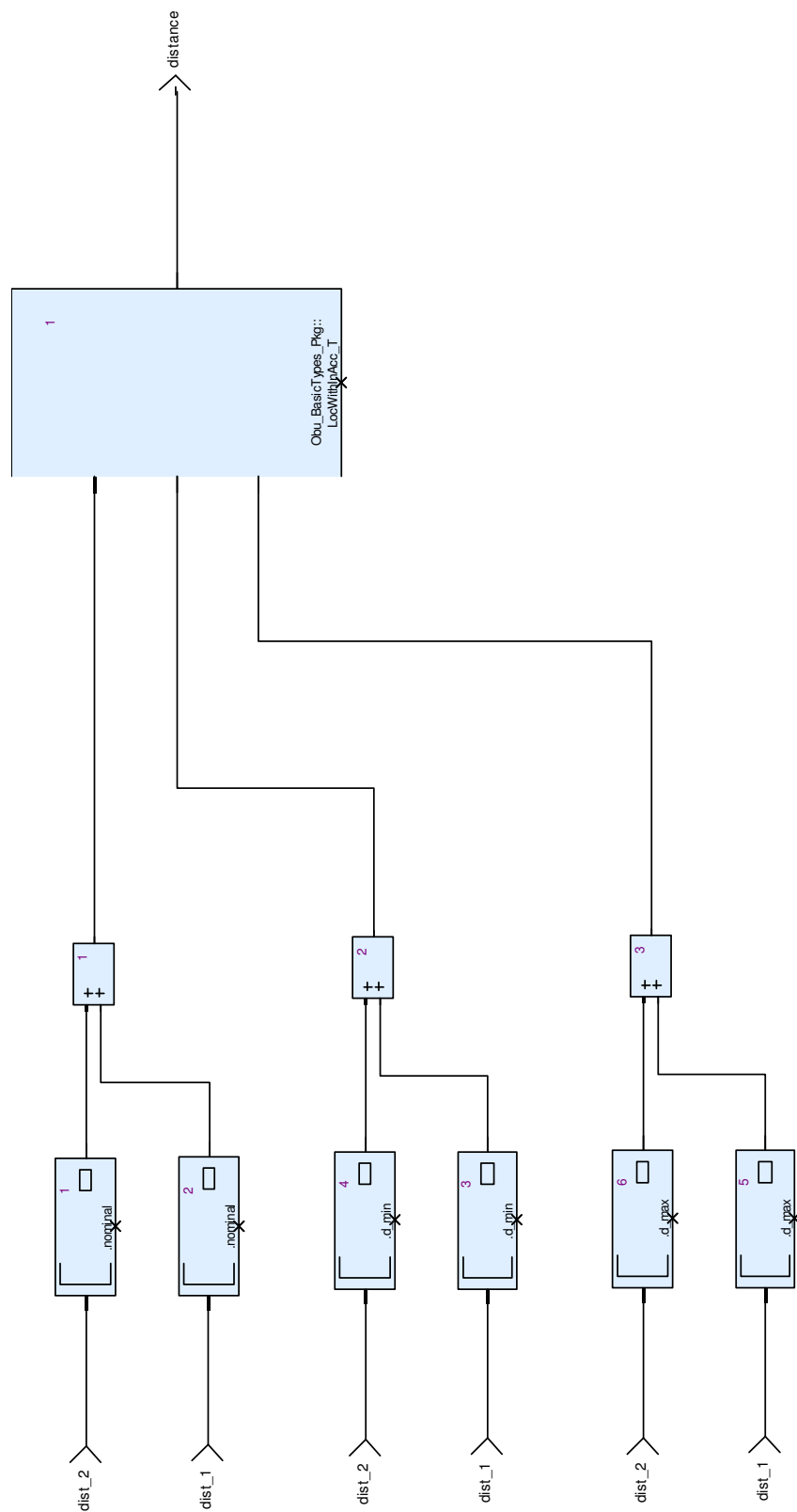


Figure 22: View of diagram\_add\_2\_Distances\_1 (add\_2\_Distances)

### 9.1.3. add\_odo\_2\_Location Operator

Declared as **public function**

#### 9.1.3.1. Comments and Information

##### **add\_odo\_2\_Location Comments:**

- Calculates the target location after a reference location measured by the odometry:
- $location = refLocation + (odoValue - refOdoValue)$ .
- Applicable, if a reference location is given and a travel distance behind it is measured with the odometry.

**Table 75: add\_odo\_2\_Location Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the target location after a reference location measured by the odometry</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications.  It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.  THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 9.1.3.2. Interface

**Table 76: Inputs of add\_odo\_2\_Location**

Name	Type	Comments and Information
refLocation	Obu_BasicTypes_Pkg::LocWithInAcc_T	<b>Comments:</b> The reference location
refOdoValue	Obu_BasicTypes_Pkg::OdometryLocations_T	<b>Comments:</b> The odometry value at refLocation
odoValue	Obu_BasicTypes_Pkg::OdometryLocations_T	<b>Comments:</b> The odometry value at the target location "location"

**Table 77: Outputs of add\_odo\_2\_Location**

Name	Type	Comments and Information
location	Obu_BasicTypes_Pkg:: LocWithInAcc_T	<b>Comments:</b> The target location

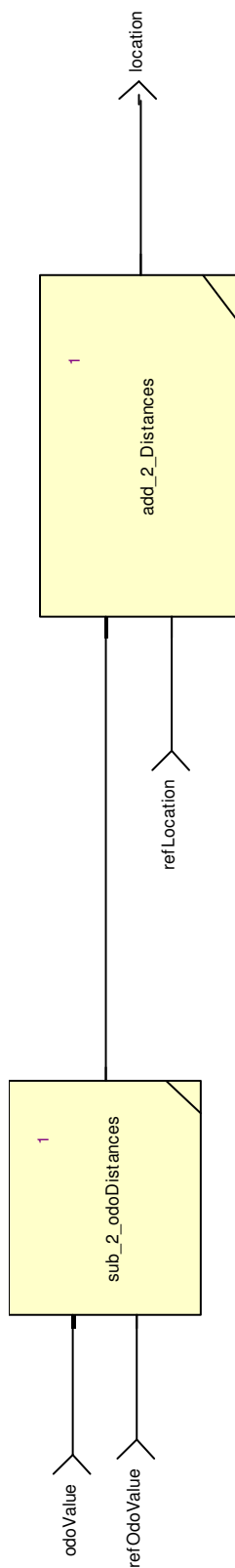
#### 9.1.3.3. Operator Hierarchy

diagram : diagram\_add\_odo\_2\_Location\_1



#### 9.1.3.4. Graphical and Textual Diagrams

##### 9.1.3.4.1. View of diagram\_add\_odo\_2\_Location\_1 (add\_odo\_2\_Location)



**Figure 23: View of diagram\_add\_odo\_2\_Location\_1 (add\_odo\_2\_Location)**

#### 9.1.4. addDistances Operator

Declared as **public function**

##### 9.1.4.1. Comments and Information

###### **addDistances Comments:**

- Calculates the sum of an array of distances

**Table 78: addDistances Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the sum of an array of distances</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications.  It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.  THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

##### 9.1.4.2. Interface

**Table 79: Inputs of addDistances**

Name	Type	Comments and Information
distances	Obu_BasicTypes_Pkg:: LocWithInAcc_T ^noOfSummands	

**Table 80: Outputs of addDistances**

Name	Type	Comments and Information
sum	Obu_BasicTypes_Pkg:: LocWithInAcc_T	

**Table 81: Size Parameters of addDistances**

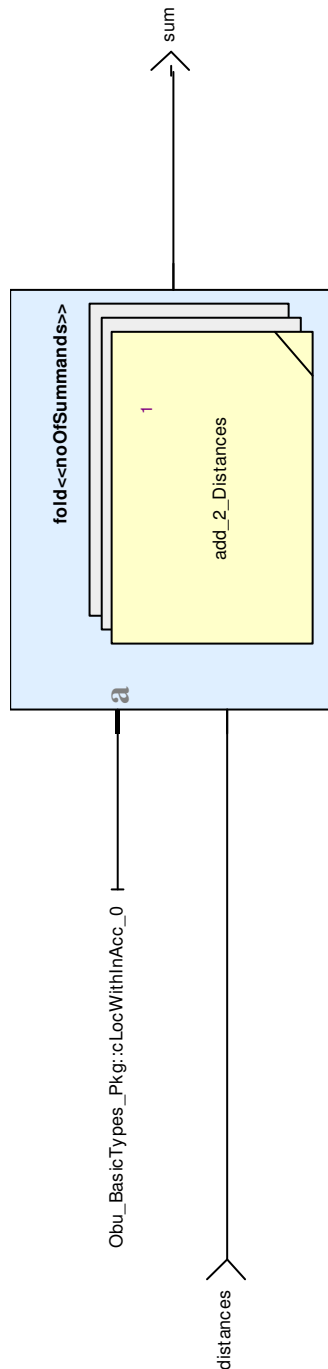
Name	Comments and Information
noOfSummands	<b>Comments:</b> Number of summands

9.1.4.3. Operator Hierarchy

diagram : diagram\_sumOfDistances\_1

#### 9.1.4.4. Graphical and Textual Diagrams

##### 9.1.4.4.1. View of diagram\_sumOfDistances\_1 (addDistances)



**Figure 24: View of diagram\_sumOfDistances\_1 (addDistances)**

#### 9.1.5. addDistancesBetwLinkedElements Operator

Declared as **public function**

##### 9.1.5.1. Comments and Information

###### **addDistancesBetwLinkedElements Comments:**

- Calculates the distance between linked elements like linked balise groups by adding their distances,
- Linked elements like balises are – as specified in Subset 026-3.6 – thought to be positioned on an absolutely correct nominal position with a known min/max accuracy around the nominal position.
- The distances of elements not needed in the calculation must be set to 0.

**Table 82: addDistancesBetwLinkedElements Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the distance between linked elements</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 9.1.5.2. Interface

**Table 83: Inputs of addDistancesBetwLinkedElements**

Name	Type	Comments and Information
distances	Obu_BasicTypes_Pkg::LocWithInAcc_T ^noOfLinkedElements	

**Table 84: Outputs of addDistancesBetwLinkedElements**

Name	Type	Comments and Information
sumOfDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T	

**Table 85: Size Parameters of addDistancesBetwLinkedElements**

Name	Comments and Information
noOfLinkedElements	

9.1.5.3. Operator Hierarchy

diagram : diagram\_distanceBetweenLinkedElements\_1



## 9.1.6. addDistancesBetwLinkedElements\_itr Operator

Declared as **private function**

### 9.1.6.1. Comments and Information

#### addDistancesBetwLinkedElements\_itr Comments:

- distanceBetweenLinkedElements\_itr is the iterated function for the distance calculation between linked elements.
- The nominal distances are added.
- d\_min and d\_max are taken from the summand, if it is  $\neq 0$  and from the previous sum\_in, if  $= 0$ .
- This assures that the inaccuracies from the last element in the iteration  $\neq 0$  are forward even if not all iterations are filled with valid data.

**Table 86: addDistancesBetwLinkedElements\_itr Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>iterated function for the distance calculation between linked elements</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

### 9.1.6.2. Interface

**Table 87: Inputs of addDistancesBetwLinkedElements\_itr**

Name	Type	Comments and Information
sum_in	Obu_BasicTypes_Pkg::LocWithInAcc_T	
summand_in	Obu_BasicTypes_Pkg::LocWithInAcc_T	



**Table 88: Outputs of addDistancesBetwLinkedElements\_itr**

Name	Type	Comments and Information
sum_out	Obu_BasicTypes_Pkg:: LocWithInAcc_T	

#### 9.1.6.3. Operator Hierarchy

diagram : diagram\_addDistancesBetwLinkedElements\_itr\_1

#### 9.1.6.4. Graphical and Textual Diagrams

##### 9.1.6.4.1. View of diagram\_addDistancesBetwLinkedElements\_itr\_1 (addDistancesBetwLinkedElements\_itr)

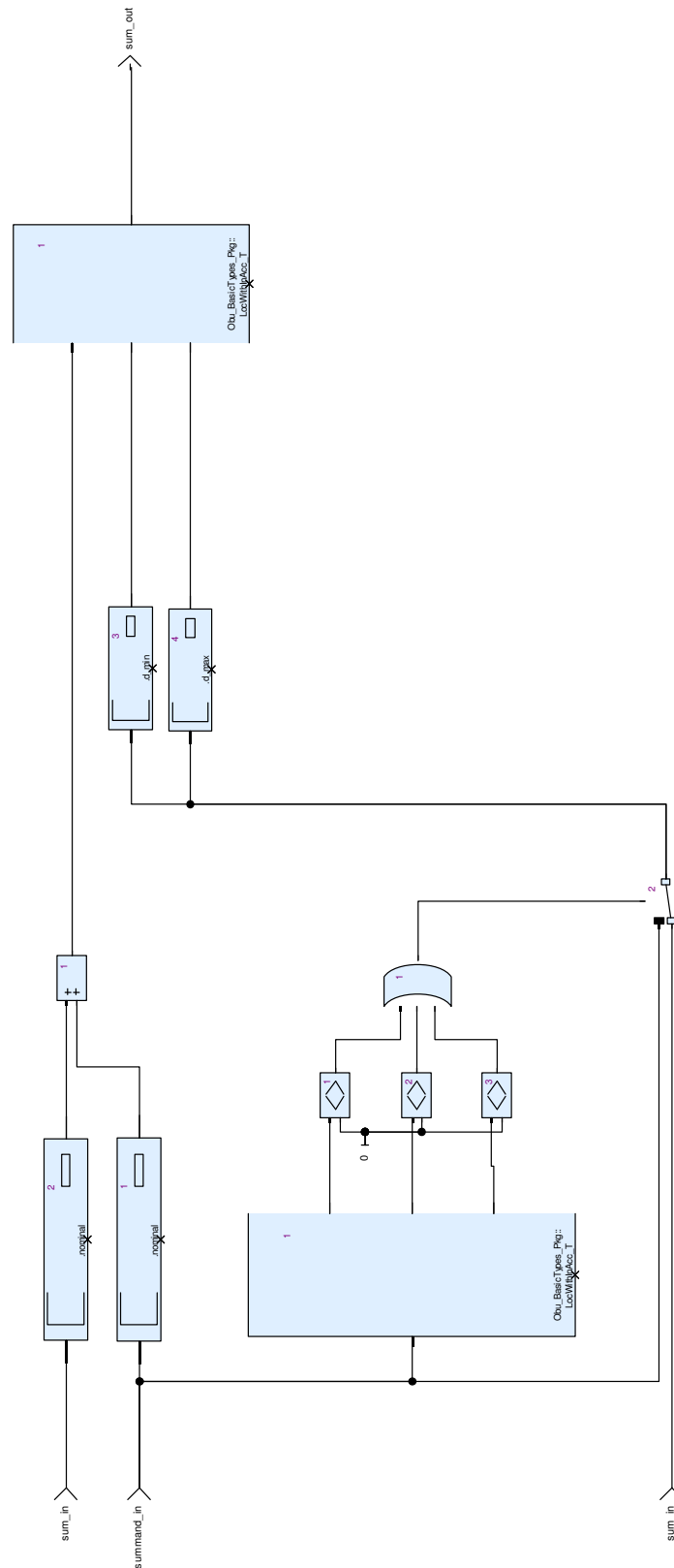


Figure 26: View of diagram\_addDistancesBetwLinkedElements\_itr\_1  
(addDistancesBetwLinkedElements\_itr)

### 9.1.7. checkMaxAbsOdoDistance Operator

Declared as **public function**

#### 9.1.7.1. Comments and Information

##### **checkMaxAbsOdoDistance Comments:**

- Determines, if the distance between odometry positions `odo_2` and `odo_1` is less than or equal `maxDelta`.
- Please consider the applicable rules for odometry value calculations!

#### 9.1.7.2. Interface

**Table 89: Inputs of checkMaxAbsOdoDistance**

Name	Type	Comments and Information
<code>odo_2</code>	<code>Obu_BasicTypes_Pkg::OdometryLocations_T</code>	
<code>odo_1</code>	<code>Obu_BasicTypes_Pkg::OdometryLocations_T</code>	
<code>maxDelta</code>	<code>Obu_BasicTypes_Pkg::OdometryLocations_T</code>	

**Table 90: Outputs of checkMaxAbsOdoDistance**

Name	Type	Comments and Information
<code>isLessThanOrEqual</code>	<code>bool</code>	

#### 9.1.7.3. Operator Hierarchy

diagram : `diagram_checkMaxAbsOdoDistance_1`

#### 9.1.7.4. Graphical and Textual Diagrams

##### 9.1.7.4.1. View of diagram\_checkMaxAbsOdoDistance\_1 (checkMaxAbsOdoDistance)

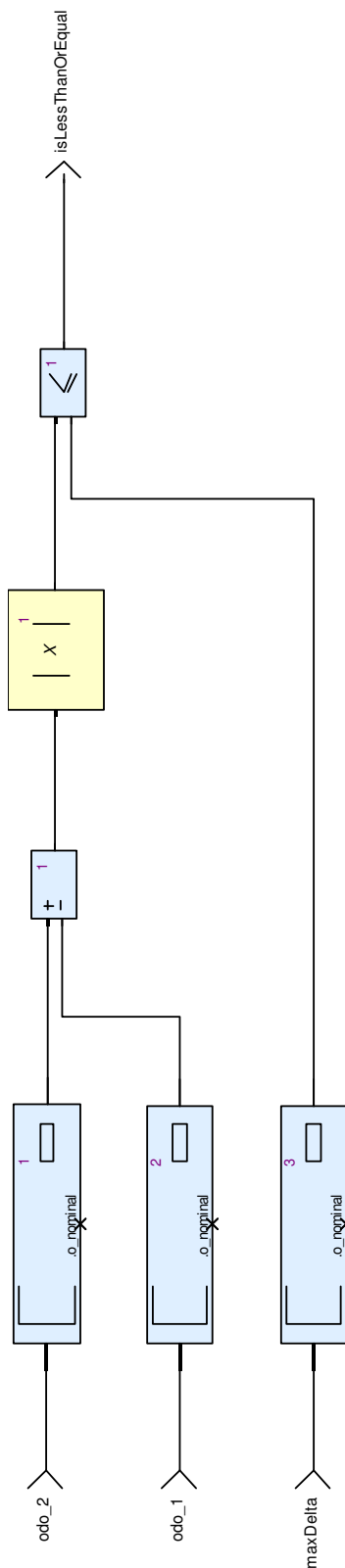


Figure 27: View of diagram\_checkMaxAbsOdoDistance\_1 (checkMaxAbsOdoDistance)

## 9.1.8. dTrain2Trackelem\_unlinkedBG Operator

Declared as **public function**

### 9.1.8.1. Comments and Information

#### dTrain2Trackelem\_unlinkedBG Comments:

- Calculates the distance from the actual train position to a track element, that is linked with a previously passed unlinked BG.
- Remark:
- There is no need to determine the distance via a second calculation with reference to the following linked balise group.
- Instead, the input loc\_unlinkedBG should be fed via the odoLoc\_2\_refLocations function, based on two different reference calculations.

**Table 91: dTrain2Trackelem\_unlinkedBG Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Distance from the actual train position to a track element</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

### 9.1.8.2. Interface

**Table 92: Inputs of dTrain2Trackelem\_unlinkedBG**

Name	Type	Comments and Information
dLink_unlinkedBG2Trackelem	Obu_BasicTypes_Pkg::LocWithInAcc_T	<p><b>Comments:</b></p> <p>Linking distance from a previously passed unlinked balise group to the track element</p>

Name	Type	Comments and Information
loc_unlinkedBG	Obu_BasicTypes_Pkg::LocWithInAcc_T	<b>Comments:</b> Location of a previously passed unlinked balise group
odo_unlinkedBG	Obu_BasicTypes_Pkg::OdometryLocations_T	<b>Comments:</b> Odometry value at the previously passed unlinked balise group
actOdo_train	Obu_BasicTypes_Pkg::OdometryLocations_T	<b>Comments:</b> Odometry value at the actual train position

**Table 93: Outputs of dTrain2Trackelem\_unlinkedBG**

Name	Type	Comments and Information
dTrain2Trackelem	Obu_BasicTypes_Pkg::LocWithInAcc_T	<b>Comments:</b> Distance from the actual train position to the track element in front

### 9.1.8.3. Operator Hierarchy

diagram : diagram\_dTrain2Trackelem\_unlinkedBG\_1

#### 9.1.8.4. Graphical and Textual Diagrams

##### 9.1.8.4.1. View of diagram\_dTrain2Trackelem\_unlinkedBG\_1 (dTrain2Trackelem\_unlinkedBG)

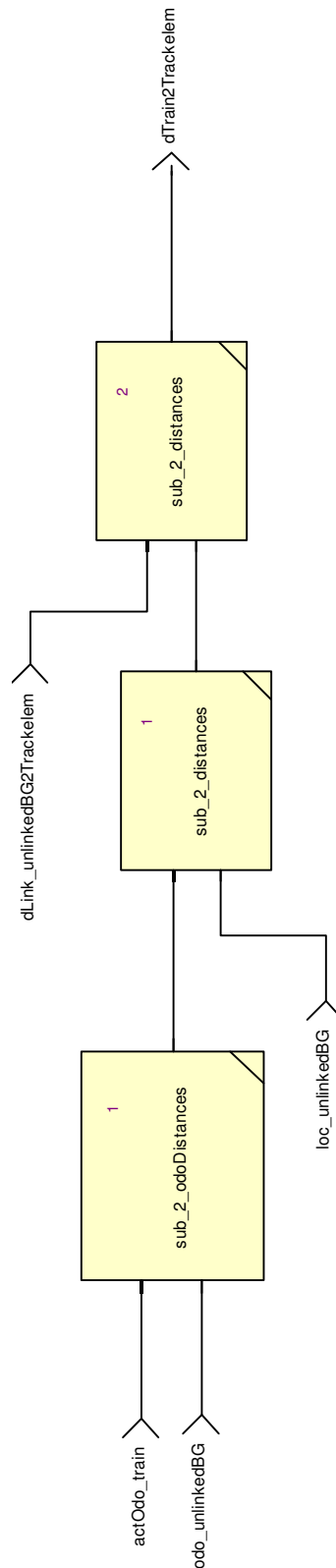


Figure 28: View of diagram\_dTrain2Trackelem\_unlinkedBG\_1 (dTrain2Trackelem\_unlinkedBG)

### 9.1.9. odoLoc\_2\_refLocations Operator

Declared as **public function**

#### 9.1.9.1. Comments and Information

##### odoLoc\_2\_refLocations Comments:

- Determines the location of an element, measured by odometry, with reference to 2 different known reference locations.
- The location of the element can, but must not be necessarily between the two reference locations.
- If the locations, calculated internally from refLoc2 and refLoc1 don't overlap, the resulting location will be selected from refLoc1 alone.
- This function can be used to calculate the location of an unlinked balise group between 2 linked balise groups.

**Table 94: odoLoc\_2\_refLocations Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Determines the location of an element, measured by odometry, with reference to 2 different known reference locations</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 9.1.9.2. Interface

**Table 95: Inputs of odoLoc\_2\_refLocations**

Name	Type	Comments and Information
refLoc_2	Obu_BasicTypes_Pkg::LocWithInAcc_T	<b>Comments:</b> Reference location 2
refLoc_1	Obu_BasicTypes_Pkg::LocWithInAcc_T	<b>Comments:</b> Reference location 1



Name	Type	Comments and Information
refOdo_2	Obu_BasicTypes_Pkg:: OdometryLocations_T	<b>Comments:</b> Odometry value at reference location 2
refOdo_1	Obu_BasicTypes_Pkg:: OdometryLocations_T	<b>Comments:</b> Odometry value at reference location 1
odo	Obu_BasicTypes_Pkg:: OdometryLocations_T	<b>Comments:</b> Odometry value at the location to be determined

**Table 96: Outputs of odoLoc\_2\_refLocations**

Name	Type	Comments and Information
location	Obu_BasicTypes_Pkg:: LocWithInAcc_T	<b>Comments:</b> The resulting location to be determined

### 9.1.9.3. Operator Hierarchy

diagram : diagram\_odoLoc\_2\_refLocations\_1

#### 9.1.9.4. Graphical and Textual Diagrams

##### 9.1.9.4.1. View of diagram\_odoLoc\_2\_refLocations\_1 (odoLoc\_2\_refLocations)

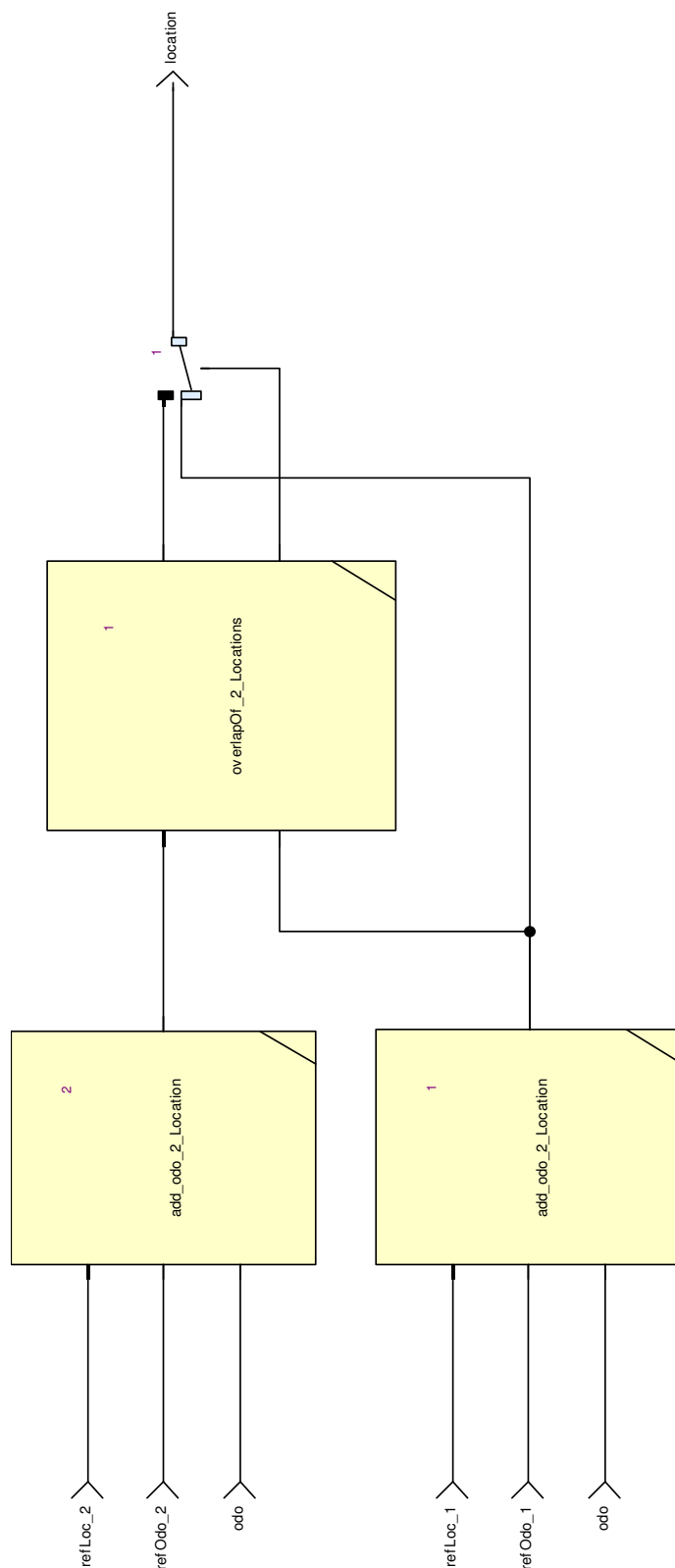


Figure 29: View of diagram\_odoLoc\_2\_refLocations\_1 (odoLoc\_2\_refLocations)

### 9.1.10. overlapOf\_2\_Locations Operator

Declared as **public function**

#### 9.1.10.1. Comments and Information

##### overlapOf\_2\_Locations Comments:

- Determines the overlapping section of 2 locations, i. e. a more precise location ("best of") than each of the 2 input locations.
- The nominal value of the resulting location is set to the middle of the overlapping section.
- The overlap output is set to true, if an overlapping part exists.
- The overlapping section is seen as the mostAccurateValueOf both locations.

**Table 97: overlapOf\_2\_Locations Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Determines the overlapping section of 2 locations</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications.  It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.  THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 9.1.10.2. Interface

**Table 98: Inputs of overlapOf\_2\_Locations**

Name	Type	Comments and Information
loc_2	Obu_BasicTypes_Pkg::LocWithInAcc_T	
loc_1	Obu_BasicTypes_Pkg::LocWithInAcc_T	

**Table 99: Outputs of overlapOf\_2\_Locations**

Name	Type	Comments and Information
loc	Obu_BasicTypes_Pkg:: LocWithInAcc_T	
overlap	bool	

#### 9.1.10.3. Operator Hierarchy

diagram : diagram\_overlapOf\_2\_Locations\_1

#### 9.1.10.4. Graphical and Textual Diagrams

##### 9.1.10.4.1. View of diagram\_overlapOf\_2\_Locations\_1 (overlapOf\_2\_Locations)

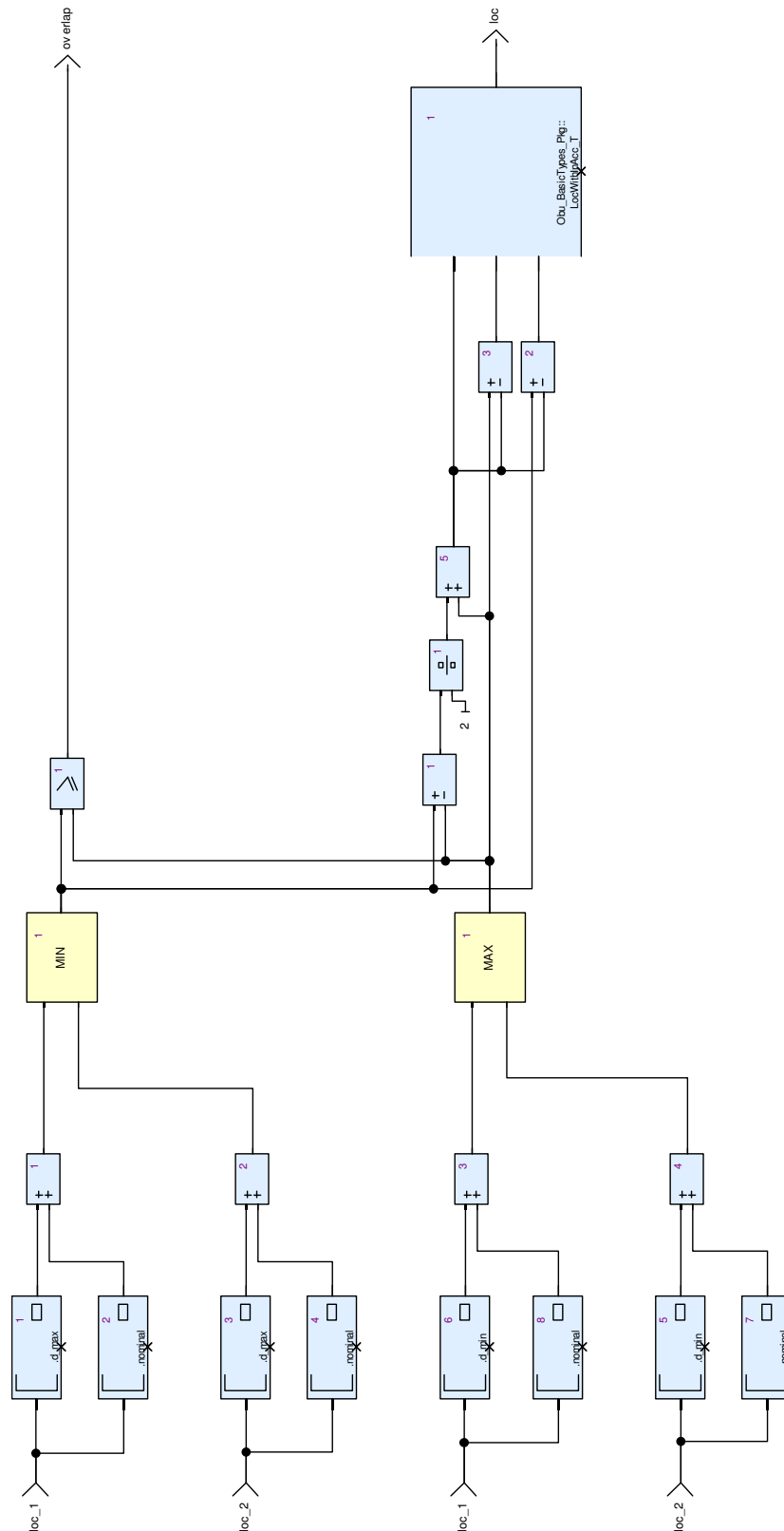


Figure 30: View of diagram\_overlapOf\_2\_Locations\_1 (overlapOf\_2\_Locations)

### 9.1.11. scaledDLINK\_2\_dlink Operator

Declared as **public function**

#### 9.1.11.1. Comments and Information

##### **scaledDLINK\_2\_dlink Comments:**

- Converts the linking distance variables into the uniform distance type.

**Table 100: scaledDLINK\_2\_dlink Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Converts the linking distance variables into the uniform distance type</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications.  It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.  THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 9.1.11.2. Interface

**Table 101: Inputs of scaledDLINK\_2\_dlink**

Name	Type	Comments and Information
q_scale	Q_SCALE	
d_link	D_LINK	
q_locacc	Q_LOCACC	

**Table 102: Outputs of scaledDLINK\_2\_dlink**

Name	Type	Comments and Information
distance	Obu_BasicTypes_Pkg::LocWithInAcc_T	

#### 9.1.11.3. Operator Hierarchy

diagram : diagram\_scaledDLINK\_2\_dlink\_1

#### 9.1.11.4. Graphical and Textual Diagrams

##### 9.1.11.4.1. View of diagram\_scaledDLINK\_2\_dlink\_1 (scaledDLINK\_2\_dlink)

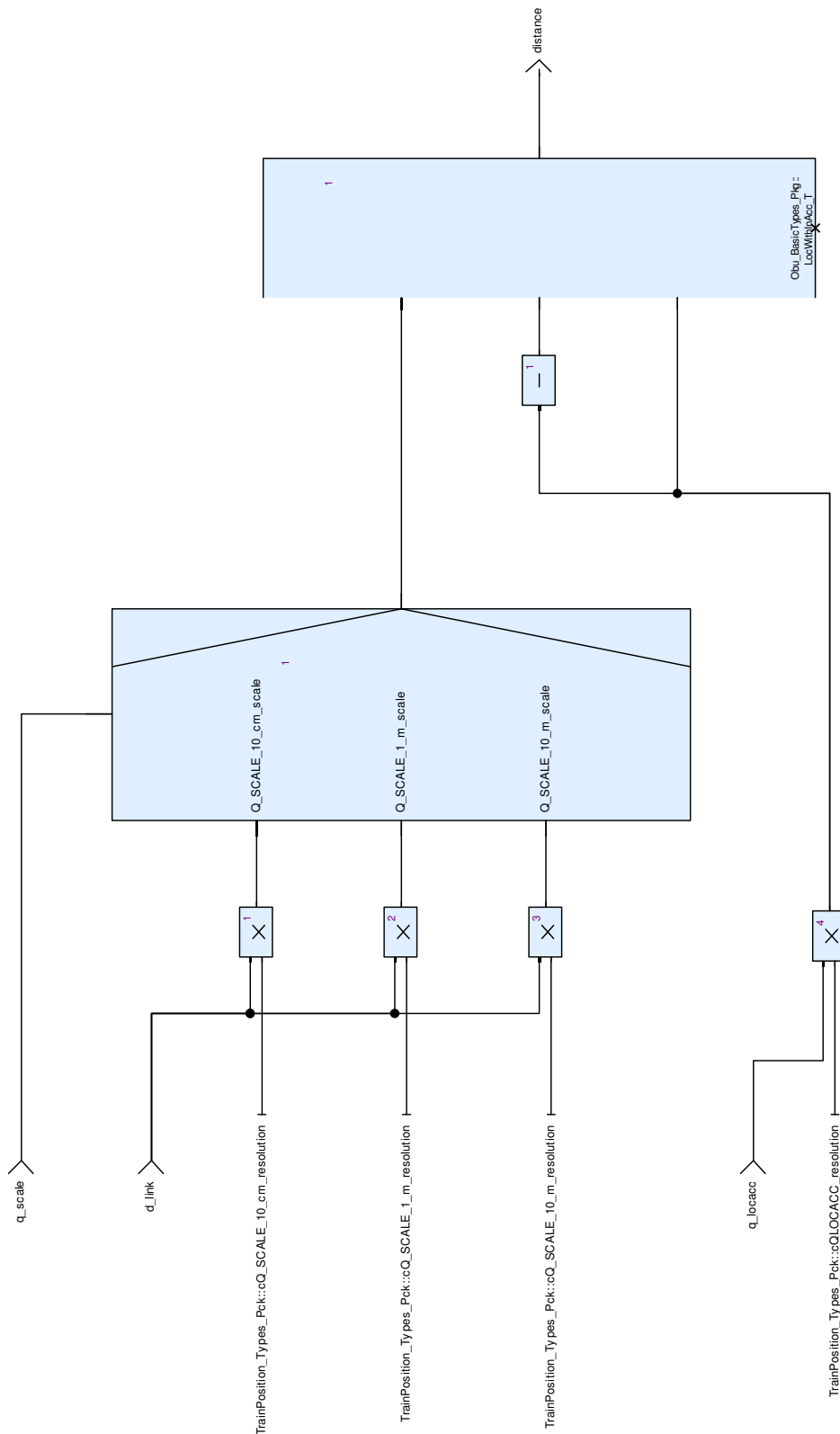


Figure 31: View of diagram\_scaledDLINK\_2\_dlink\_1 (scaledDLINK\_2\_dlink)



### 9.1.12. sub\_2\_distances Operator

Declared as **public function**

#### 9.1.12.1. Comments and Information

##### sub\_2\_distances Comments:

- Calculates the distance loc\_2 - loc\_1 between two locations

**Table 103: sub\_2\_distances Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the distance loc_2 - loc_1 between two locations</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 9.1.12.2. Interface

**Table 104: Inputs of sub\_2\_distances**

Name	Type	Comments and Information
loc_2	Obu_BasicTypes_Pkg::LocWithInAcc_T	
loc_1	Obu_BasicTypes_Pkg::LocWithInAcc_T	

**Table 105: Outputs of sub\_2\_distances**

Name	Type	Comments and Information
distance	Obu_BasicTypes_Pkg::LocWithInAcc_T	

### 9.1.12.3. Operator Hierarchy

diagram : diagram\_sub\_2\_distances\_1

#### 9.1.12.4. Graphical and Textual Diagrams

##### 9.1.12.4.1. View of diagram\_sub\_2\_distances\_1 (sub\_2\_distances)

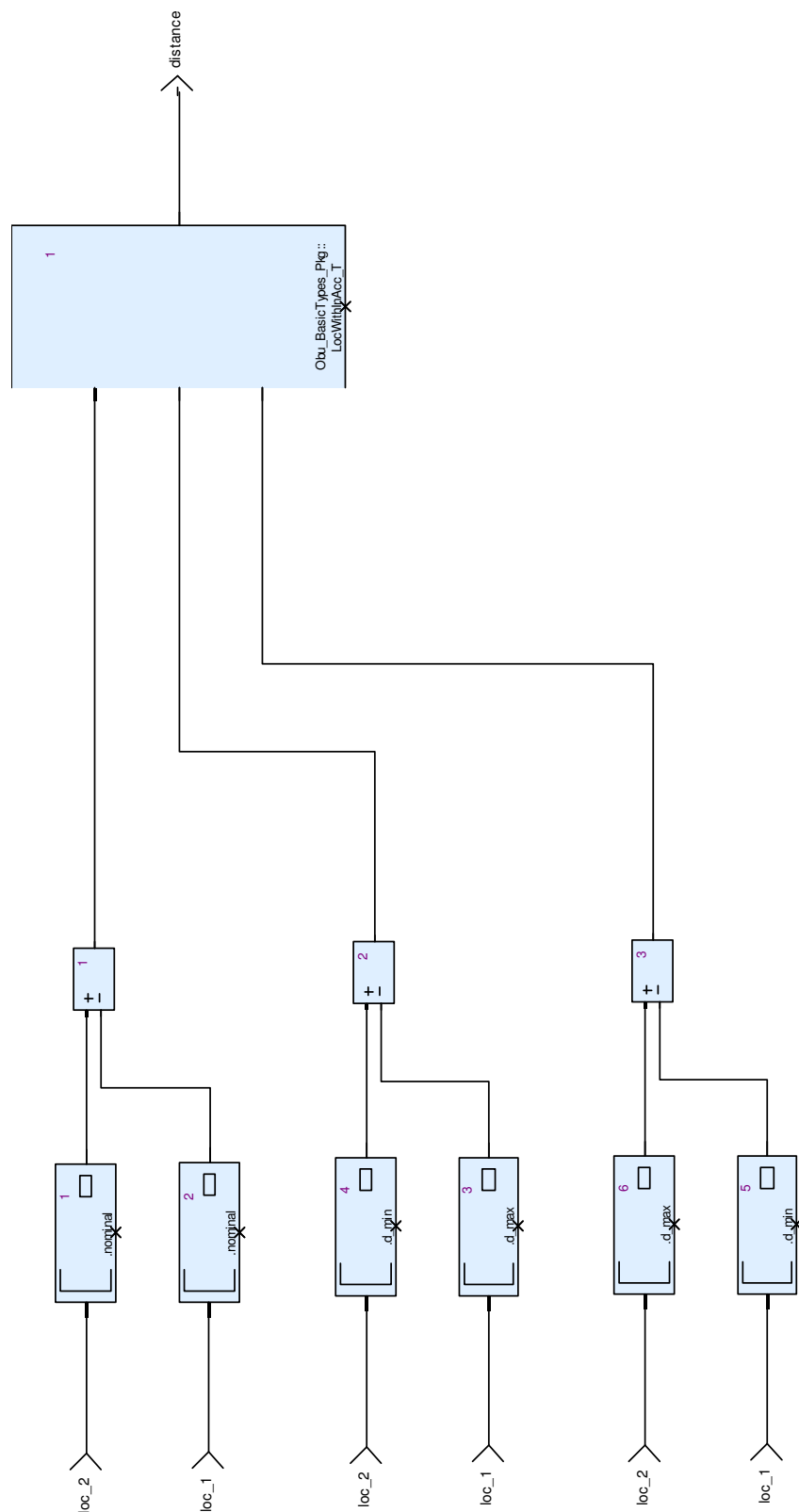


Figure 32: View of diagram\_sub\_2\_distances\_1 (sub\_2\_distances)

### 9.1.13. sub\_2\_odoDistances Operator

Declared as **public function**

#### 9.1.13.1. Comments and Information

##### sub\_2\_odoDistances Comments:

- Calculates the distance o2 - o1 based on odometry data

**Table 106: sub\_2\_odoDistances Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the distance o2 - o1 based on odometry data</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 9.1.13.2. Interface

**Table 107: Inputs of sub\_2\_odoDistances**

Name	Type	Comments and Information
odo_2	Obu_BasicTypes_Pkg::OdometryLocations_T	
odo_1	Obu_BasicTypes_Pkg::OdometryLocations_T	

**Table 108: Outputs of sub\_2\_odoDistances**

Name	Type	Comments and Information
distance	Obu_BasicTypes_Pkg::LocWithInAcc_T	

### 9.1.13.3. Operator Hierarchy

diagram : diagram\_sub\_2\_odoDistances\_1

#### 9.1.13.4. Graphical and Textual Diagrams

##### 9.1.13.4.1. View of diagram\_sub\_2\_odoDistances\_1 (sub\_2\_odoDistances)

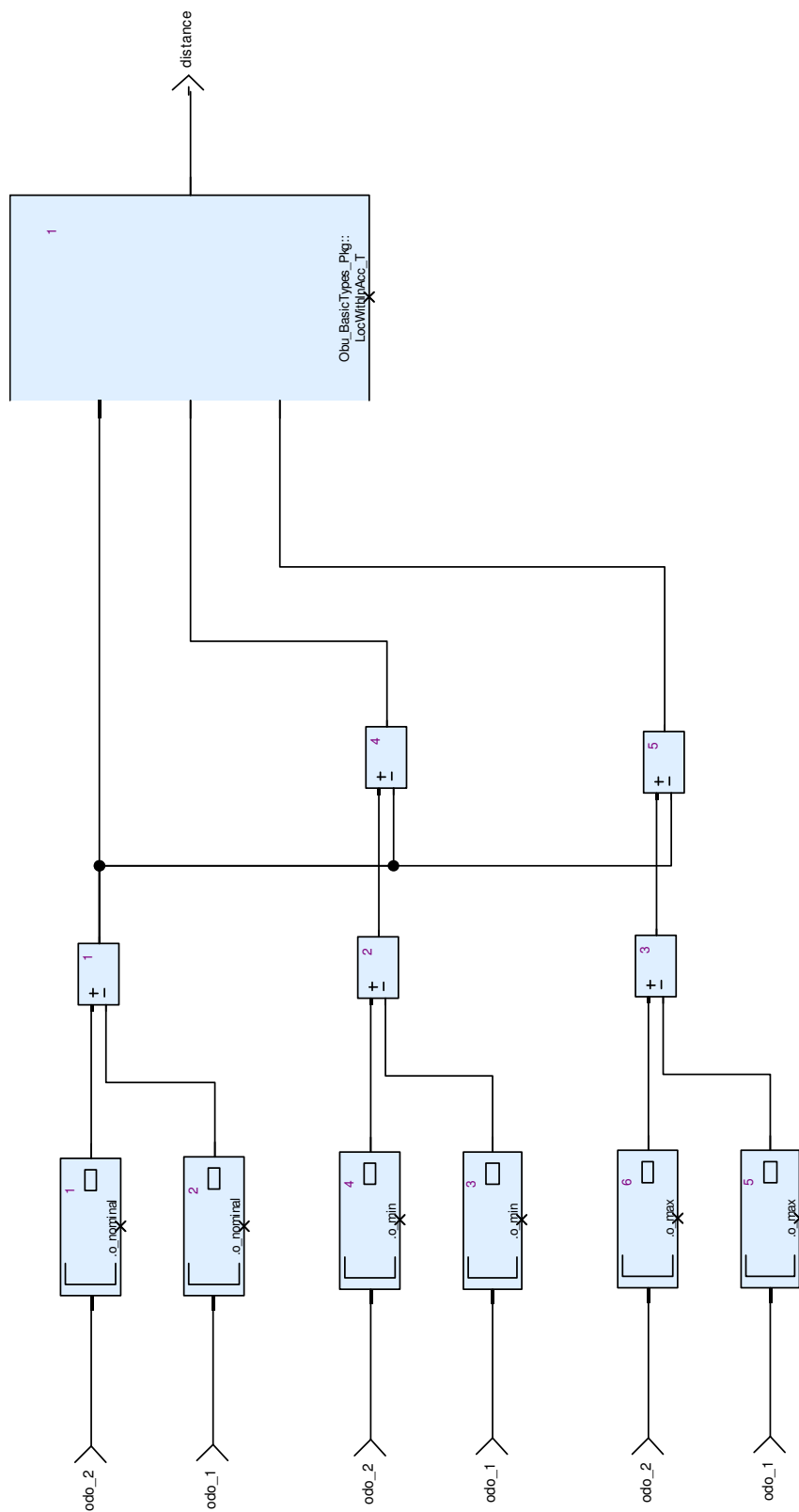


Figure 33: View of diagram\_sub\_2\_odoDistances\_1 (sub\_2\_odoDistances)



Name	Type	Value	Comments and Information
NoLinkedBG	BG_Types_Pkg::LinkedBG_T	{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}	



Name	Type	Value	Comments and Information
		{valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Loop, n_total : N_TOTAL_1_balise_ in_the_group, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, linkedBGs : [{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, }	

Name	Type	Value	Comments and Information
NoReactionByNotFound	BG_Types_Pkg::LinkedBG_T	{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_No_Reaction, q_locacc : 0}	
theTelegramFitsWithAll	int	255	
theTelegramNeverFitsAnyMessage	int	254	

### 10.1.3. BuildBGheader Operator

Declared as **public function**

#### 10.1.3.1. Comments and Information

##### BuildBGheader Comments:

- Auxiliary function for Build PassedBG

#### 10.1.3.2. Interface

**Table 111: Inputs of BuildBGheader**

Name	Type	Comments and Information
telegram_header_in	BG_Types_Pkg::TelegramHeader_T	

**Table 112: Outputs of BuildBGheader**

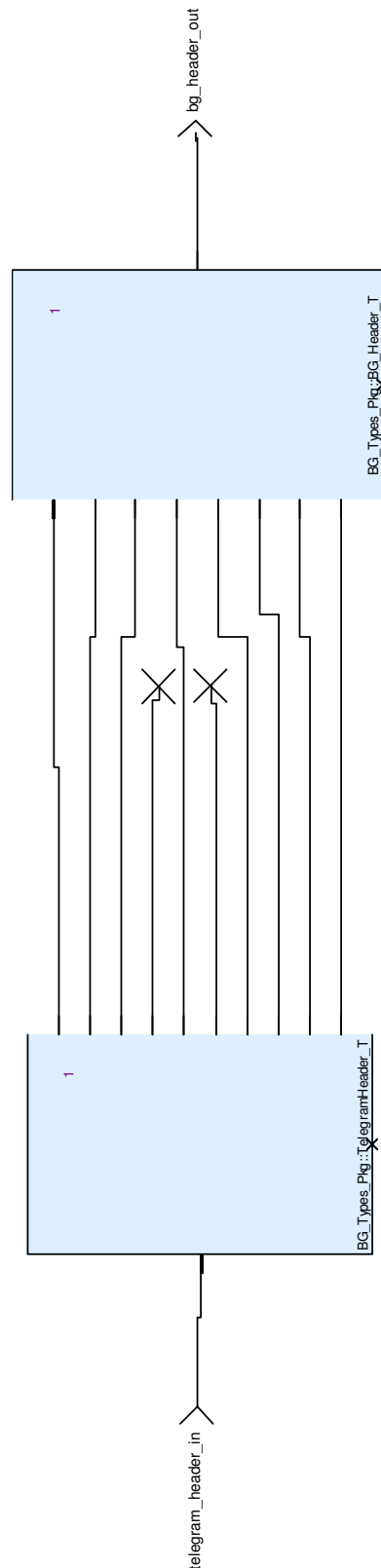
Name	Type	Comments and Information
bg_header_out	BG_Types_Pkg::BG_Header_T	

#### 10.1.3.3. Operator Hierarchy

diagram : diagram\_BuildBGheader\_1

#### 10.1.3.4. Graphical and Textual Diagrams

##### 10.1.3.4.1. View of diagram\_BuildBGheader\_1 (BuildBGheader)



**Figure 34: View of diagram\_BuildBGheader\_1 (BuildBGheader)**

**diagram\_BuildBGheader\_1 Comments:**

- need to be implemented

#### 10.1.4. BuildPassedBG Operator

Declared as **public function**

##### 10.1.4.1. Comments and Information

###### **BuildPassedBG Comments:**

- Filter the bg\_telegrams and build the bg\_message

##### 10.1.4.2. Interface

**Table 113: Inputs of BuildPassedBG**

Name	Type	Comments and Information
passingSpeed	Obu_BasicTypes_Pkg::V_internal_Type	
timestamp_in	Obu_BasicTypes_Pkg::T_internal_Type	
telegram_in	BG_Types_Pkg::Telegram_T	
BG_Message_in	BG_Types_Pkg::BG_Message_T	

**Table 114: Outputs of BuildPassedBG**

Name	Type	Comments and Information
passedBG_out	BG_Types_Pkg::passedBG_T	

##### 10.1.4.3. Operator Hierarchy

diagram : diagram\_BuildPassedBG\_1



### 10.1.5. CheckBGConsistency Operator

Declared as **public node**

#### 10.1.5.1. Interface

**Table 115: Inputs of CheckBGConsistency**

Name	Type	Comments and Information
BG_Message_in	BG_Types_Pkg::BG_Message_T	
linkingInUse	bool	
currentMode	M_MODE	
CRC_Check	bool	
announced_BGs	BG_Types_Pkg::LinkedBGs_T	
passingSpeed	Obu_BasicTypes_Pkg::V_internal_Type	
timestamp_in	Obu_BasicTypes_Pkg::T_internal_Type	

**Table 116: Outputs of CheckBGConsistency**

Name	Type	Properties	Comments and Information
passedBG_out	BG_Types_Pkg::passedBG_T	last	NoPassedBG
ApplyServiceBrake	bool	last	false
BadBaliseMessageToDMI	CheckBGConsistency_Pkg::String_T	last	NoErrorToDMI
q_linkingReaction	Q_LINKREACTION	last	Q_LINKREACTION_No_Reaction

#### 10.1.5.2. Locals

**Table 117: Locals of CheckBGConsistency**

Name	Type	Comments and Information
isLinked	bool	
mode_check	bool	
telegram_header	BG_Types_Pkg::Telegram_T	

#### 10.1.5.3. Operator Hierarchy

diagram : diagram\_CheckBGConsistency\_1

*activate if* : IfBlock1

        branch : then

        branch : else

            branch : then

            branch : else

## 10.1.5.4. Graphical and Textual Diagrams

### 10.1.5.4.1. View of diagram\_CheckBGConsistency\_1 (CheckBGConsistency)

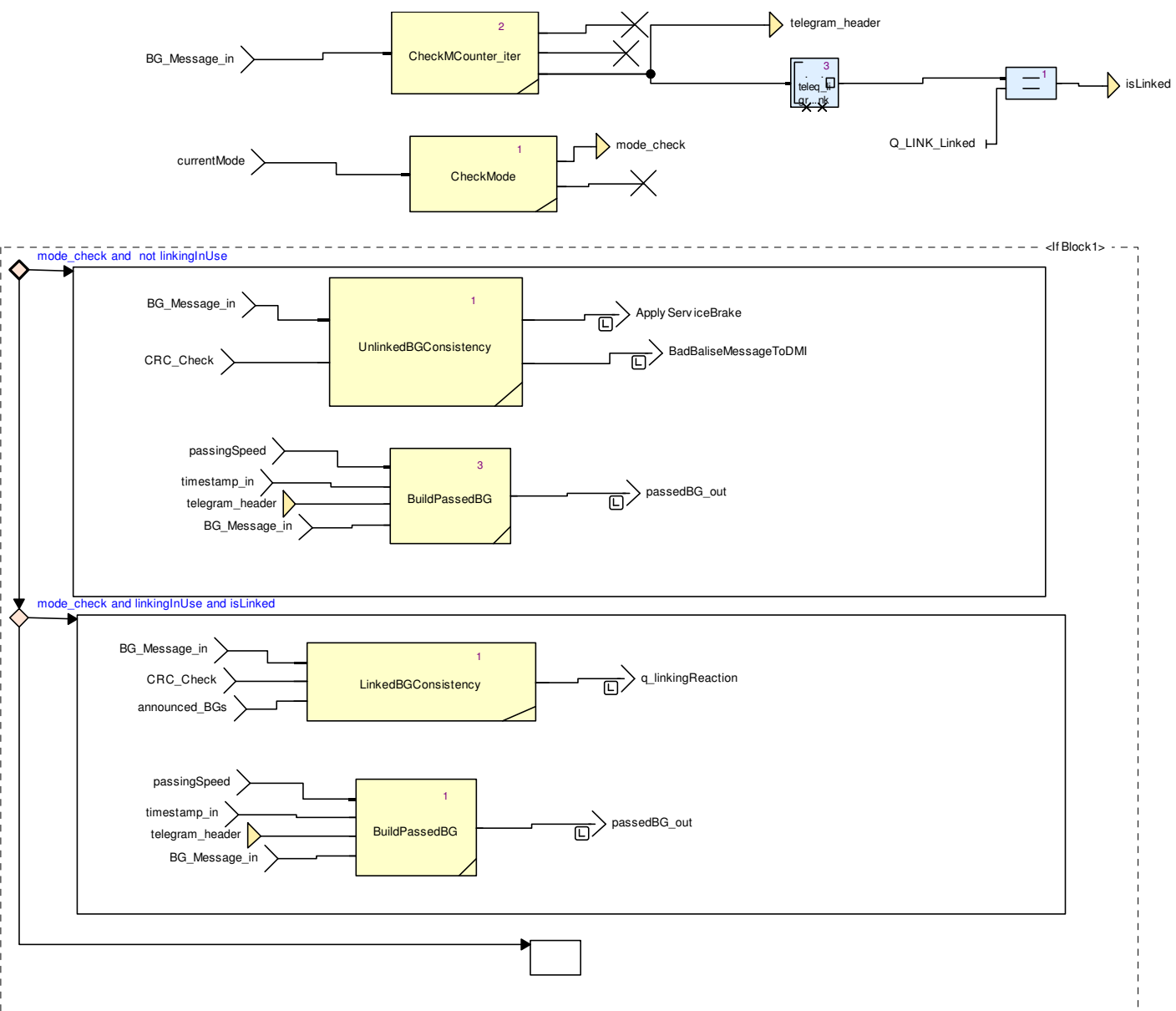


Figure 36: View of diagram\_CheckBGConsistency\_1 (CheckBGConsistency)

Table 118: Conditional Blocks of diagram\_CheckBGConsistency\_1

Conditional Block	Comments and Information
IfBlock1	

**Table 119: Actions of diagram\_CheckBGConsistency\_1**

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

### 10.1.6. CheckCompleteness Operator

Declared as **public function**

#### 10.1.6.1. Comments and Information

**CheckCompleteness Comments:**

- -the possible duplicates are :
- (Balise1, Balise2) (Balise3, Balise4) (Balise5, Balise6) (Balise7, Balise8)

#### 10.1.6.2. Interface

**Table 120: Inputs of CheckCompleteness**

Name	Type	Comments and Information
acc_in	BG_Types_Pkg::Telegram_T	
reverseBG	bool	
telegramHeaderFlag_in	BG_Types_Pkg::Telegram_T	

**Table 121: Outputs of CheckCompleteness**

Name	Type	Comments and Information
go_on	bool	
acc_out	BG_Types_Pkg::Telegram_T	

#### 10.1.6.3. Locals

**Table 122: Locals of CheckCompleteness**

Name	Type	Comments and Information
diff	int	
diff1	bool	
diff2	bool	
diff3	bool	
m_dup_Acc	M_DUP	
m_dup_input	M_DUP	
validcheck	bool	



#### 10.1.6.4. Operator Hierarchy

diagram : diagram\_CheckCompleteness\_1

*activate if* : IfBlock1

        branch : then

        branch : else

            branch : then

            branch : else

                branch : then

                branch : else

## 10.1.6.5. Graphical and Textual Diagrams

### 10.1.6.5.1. View of diagram\_CheckCompleteness\_1 (CheckCompleteness)

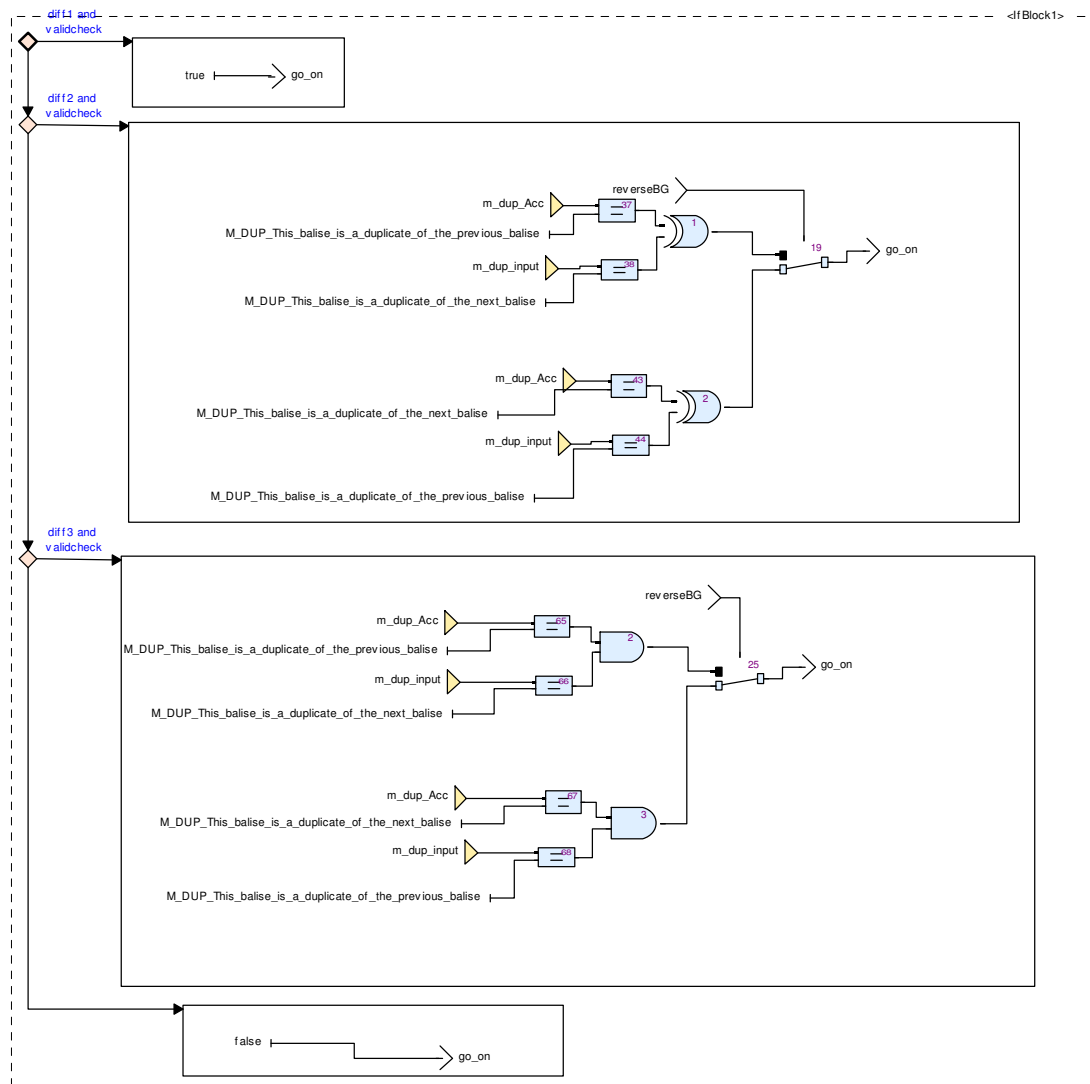
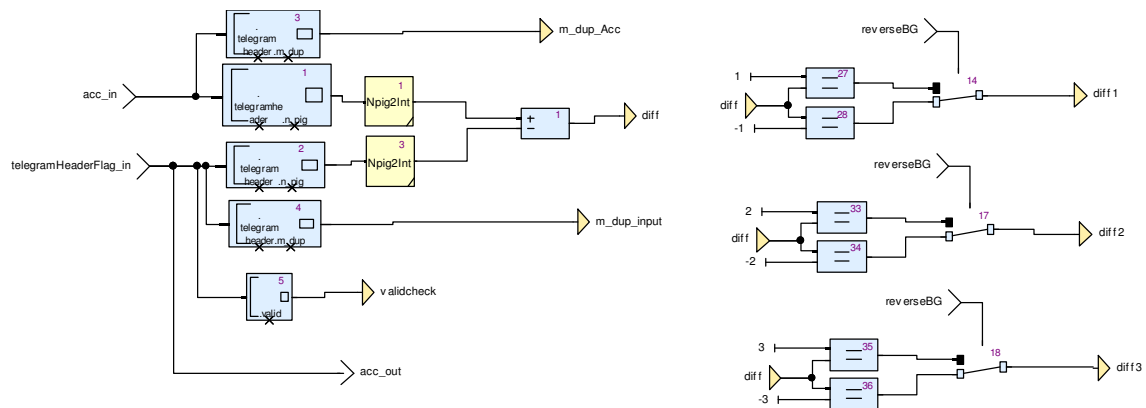


Figure 37: View of diagram\_CheckCompleteness\_1 (CheckCompleteness)

**Table 123: Conditional Blocks of diagram\_CheckCompleteness\_1**

Conditional Block	Comments and Information
IfBlock1	

**Table 124: Actions of diagram\_CheckCompleteness\_1**

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

### 10.1.7. CheckCompleteness\_iter Operator

Declared as **public function**

#### 10.1.7.1. Comments and Information

**CheckCompleteness\_iter Comments:**

- here is not checked if m\_dup==11 (spare value)

#### 10.1.7.2. Interface

**Table 125: Inputs of CheckCompleteness\_iter**

Name	Type	Comments and Information
bg_message_in	BG_Types_Pkg::BG_Message_T	

**Table 126: Outputs of CheckCompleteness\_iter**

Name	Type	Comments and Information
isComplete	bool	

#### 10.1.7.3. Locals

**Table 127: Locals of CheckCompleteness\_iter**

Name	Type	Comments and Information
directionOfBG	CheckBGConsistency_Pkg::bg_direction_T	
isValid	bool	

#### 10.1.7.4. Operator Hierarchy

diagram : diagram\_CheckCompleteness\_iter\_1

*activate if* : IfBlock1

        branch : then

        branch : else

            branch : then

            branch : else

branch : then  
branch : else

#### 10.1.7.5. Graphical and Textual Diagrams

##### 10.1.7.5.1. View of diagram\_CheckCompleteness\_iter\_1 (CheckCompleteness\_iter)

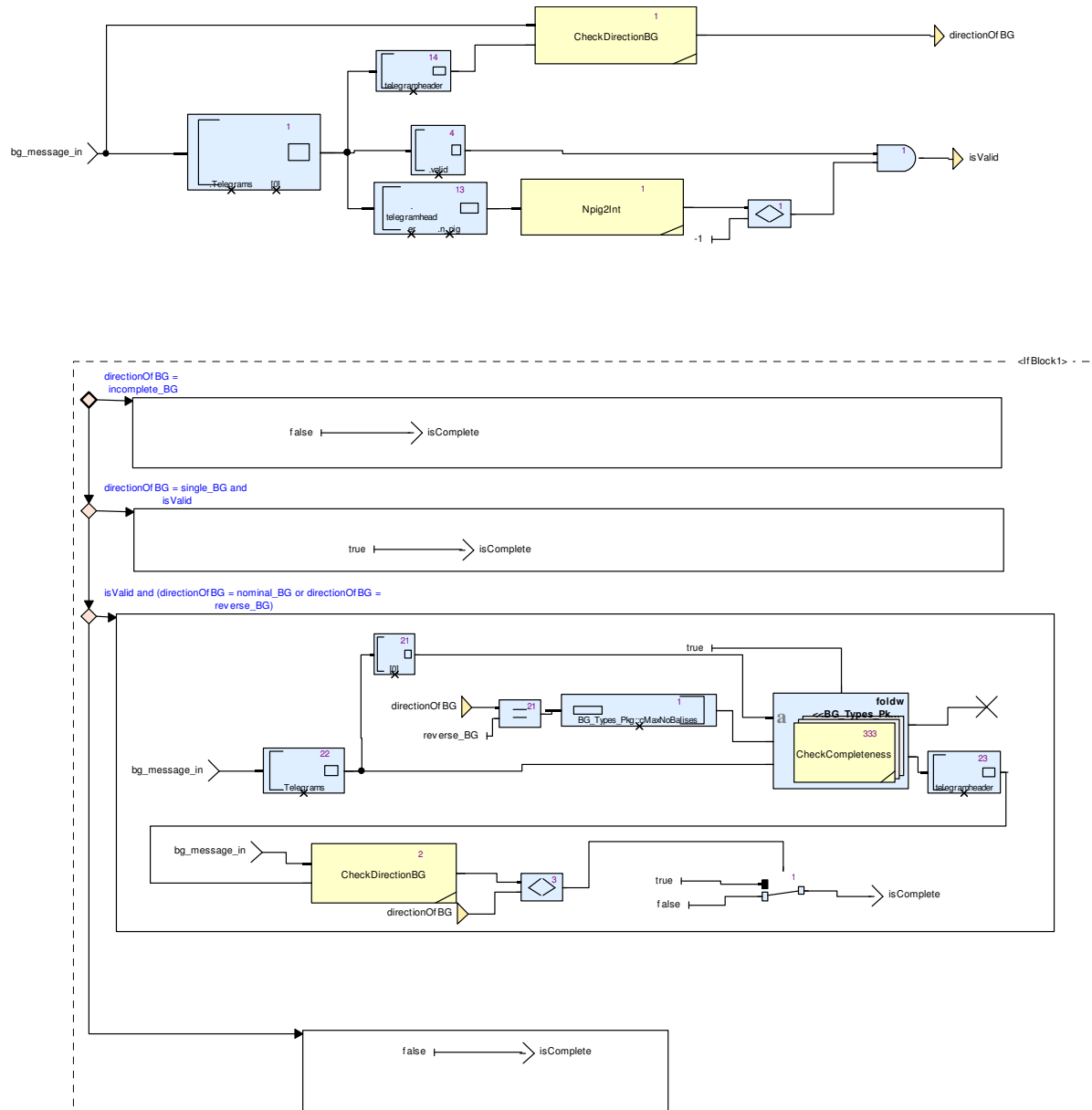


Figure 38: View of diagram\_CheckCompleteness\_iter\_1 (CheckCompleteness\_iter)

#### diagram\_CheckCompleteness\_iter\_1 Comments:

- here is not checked if m\_dup==11

Table 128: Conditional Blocks of diagram\_CheckCompleteness\_iter\_1

Conditional Block	Comments and Information
IfBlock1	

**Table 129: Actions of diagram\_CheckCompleteness\_iter\_1**

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

#### 10.1.8. CheckDirectionBG Operator

Declared as **public function**

##### 10.1.8.1. Comments and Information

**CheckDirectionBG Comments:**

- -nominal
- -reverse
- -single
- or not complet

##### 10.1.8.2. Interface

**Table 130: Inputs of CheckDirectionBG**

Name	Type	Comments and Information
bg_messag_in	BG_Types_Pkg::BG_Message_T	
telegramHeader	BG_Types_Pkg::TelegramHeader_T	

**Table 131: Outputs of CheckDirectionBG**

Name	Type	Comments and Information
directionOfBG	CheckBGConsistency_Pkg::bg_direction_T	

##### 10.1.8.3. Locals

**Table 132: Locals of CheckDirectionBG**

Name	Type	Comments and Information
first_m_dup	bool	
first_n_pig	N_PIG	
first_n_total	N_TOTAL	
numberOfRecivedBalises	int	

##### 10.1.8.4. Operator Hierarchy

diagram : diagram\_CheckDirectionBG\_1

*activate if* : IfBlock1  
        branch : then  
        branch : else

```
branch : then
branch : else
  branch : then
  branch : else
    branch : then
    branch : else
      branch : then
      branch : else
        branch : then
        branch : else
          branch : then
          branch : else
            branch : then
            branch : else
```

**Figure 39: View of diagram\_CheckDirectionBG\_1 (CheckDirectionBG)**

**Table 133: Conditional Blocks of diagram\_CheckDirectionBG\_1**

Conditional Block	Comments and Information
IfBlock1	

**Table 134: Actions of diagram\_CheckDirectionBG\_1**

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

### 10.1.9. CheckDup Operator

Declared as **public function**

#### 10.1.9.1. Comments and Information

##### **CheckDup Comments:**

- -the possible duplicates are :
- (Balise1, Balise2) (Balise3, Balise4) (Balise5, Balise6) (Balise7, Balise8)

#### 10.1.9.2. Interface

**Table 135: Inputs of CheckDup**

Name	Type	Comments and Information
telegramheader_input	BG_Types_Pkg::Telegr amHeader_T	

**Table 136: Outputs of CheckDup**

Name	Type	Comments and Information
is_dup	bool	
is_valid	bool	



### 10.1.9.3. Locals

**Table 137: Locals of CheckDup**

Name	Type	Comments and Information
case_1	bool	
case_2	bool	
case_3	bool	
m_dup	M_DUP	
n_pig	N_PIG	

### 10.1.9.4. Operator Hierarchy

diagram : diagram\_CheckDup\_1

*activate if* : IfBlock1

        branch : then

        branch : else

            branch : then

            branch : else

                branch : then

                branch : else

## 10.1.9.5. Graphical and Textual Diagrams

### 10.1.9.5.1. View of diagram\_CheckDup\_1 (CheckDup)

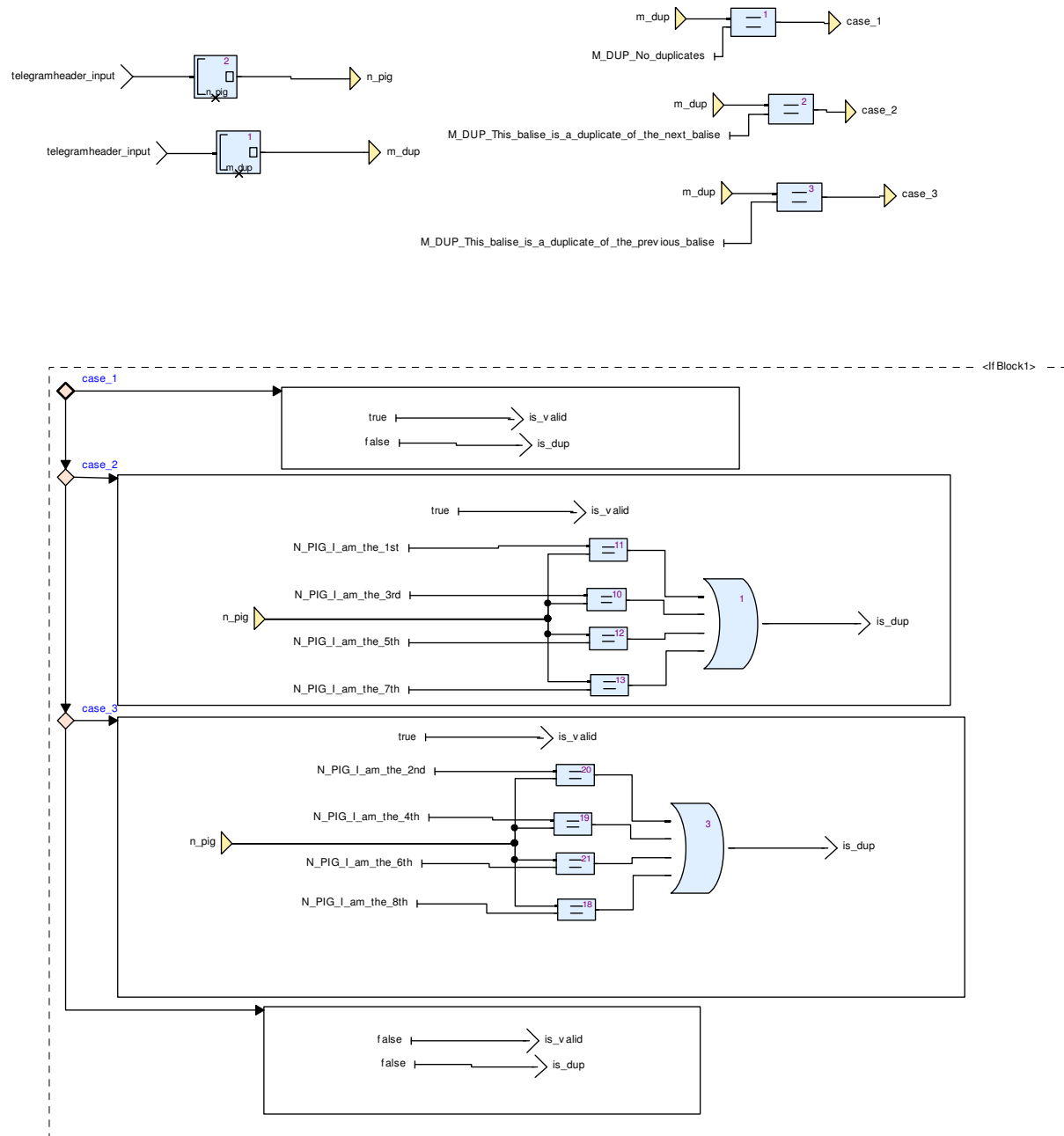


Figure 40: View of diagram\_CheckDup\_1 (CheckDup)

Table 138: Conditional Blocks of diagram\_CheckDup\_1

Conditional Block	Comments and Information
IfBlock1	

Table 139: Actions of diagram\_CheckDup\_1

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

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

## 10.1.10. CheckLinkingConsistency Operator

Declared as **public function**

### 10.1.10.1. Interface

**Table 140: Inputs of CheckLinkingConsistency**

Name	Type	Comments and Information
currentMode	M_MODE	
linkedBGs_list	BG_Types_Pkg::LinkedBGs_T	

**Table 141: Outputs of CheckLinkingConsistency**

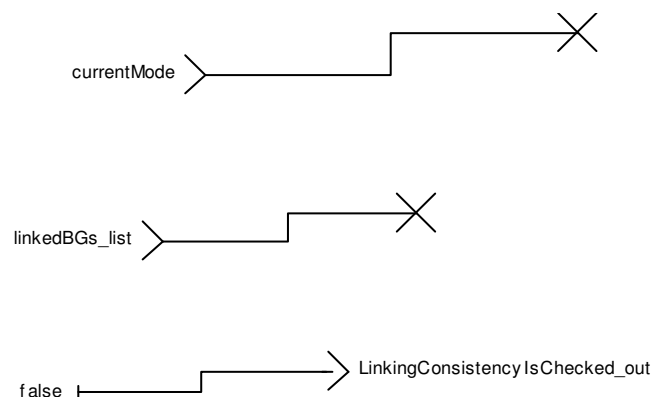
Name	Type	Comments and Information
LinkingConsistencyIsChecked_out	bool	

### 10.1.10.2. Operator Hierarchy

diagram : diagram\_CheckLinkingConsistency\_1

### 10.1.10.3. Graphical and Textual Diagrams

#### 10.1.10.3.1. View of diagram\_CheckLinkingConsistency\_1 (CheckLinkingConsistency)



**Figure 41: View of diagram\_CheckLinkingConsistency\_1 (CheckLinkingConsistency)**

## 10.1.11. CheckMCounter Operator

Declared as **public function**

### 10.1.11.1. Comments and Information

#### CheckMCounter Comments:

- 3.16.2.4.4 d)
- comparison two m\_mcount values with each other and with 255 and 254

- if different q\_link occurs -> BG will be marked as unlinked.

#### 10.1.11.2. Interface

**Table 142: Inputs of CheckMCounter**

Name	Type	Comments and Information
acc	BG_Types_Pkg::Telegram_T	
telegramHeaderFlag_in	BG_Types_Pkg::Telegram_T	

**Table 143: Outputs of CheckMCounter**

Name	Type	Comments and Information
go_on	bool	
ACC_out	BG_Types_Pkg::Telegram_T	

#### 10.1.11.3. Operator Hierarchy

diagram : diagram\_CheckMCounter\_1

#### 10.1.11.4. Graphical and Textual Diagrams

##### 10.1.11.4.1. View of diagram\_CheckMCounter\_1 (CheckMCounter)

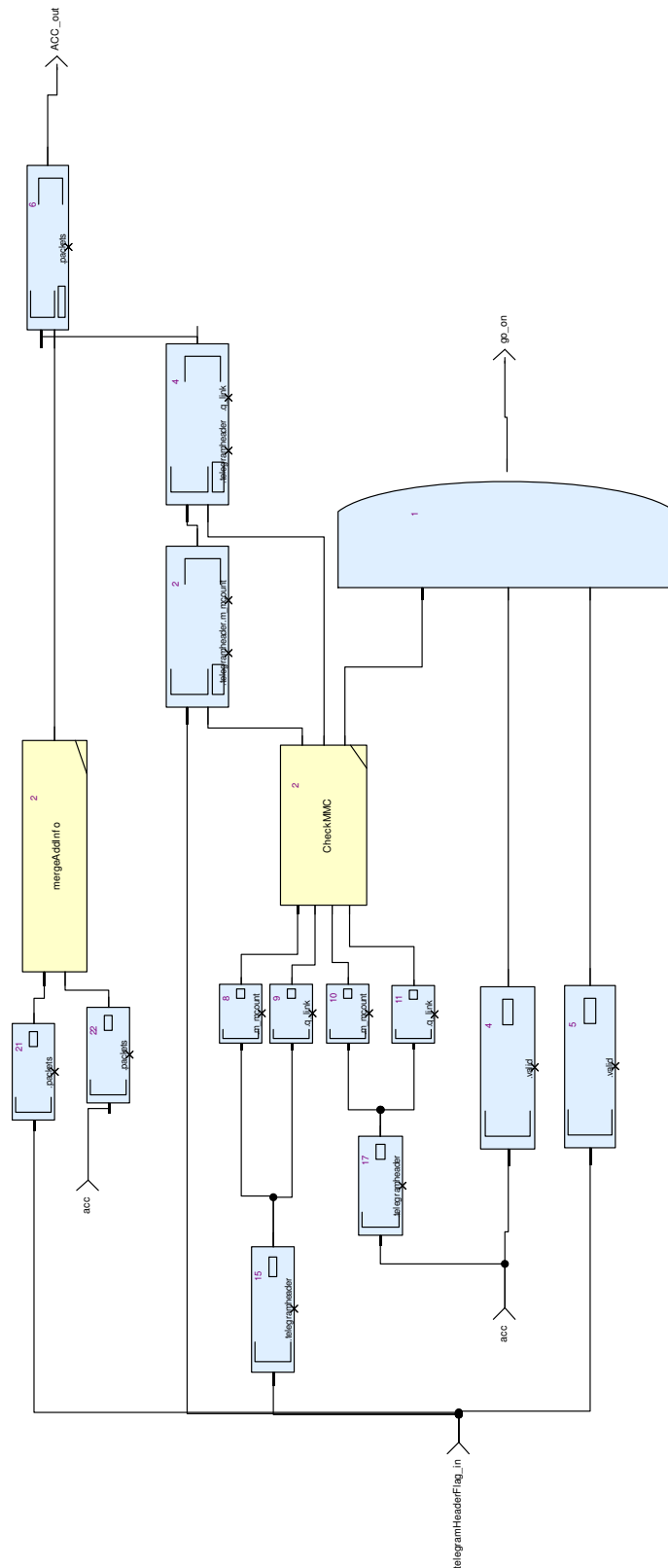


Figure 42: View of diagram\_CheckMCounter\_1 (CheckMCounter)

### 10.1.12. CheckMCounter\_iter Operator

Declared as **public function**

#### 10.1.12.1. Comments and Information

##### **CheckMCounter\_iter Comments:**

- 3.16.2.4.4 d)
- comparison two m\_mcount values with each other and with 255 and 254
- if different q\_link occurs -> BG will be marked as unlinked.

#### 10.1.12.2. Interface

**Table 144: Inputs of CheckMCounter\_iter**

Name	Type	Comments and Information
bg_message_in	BG_Types_Pkg::BG_Message_T	

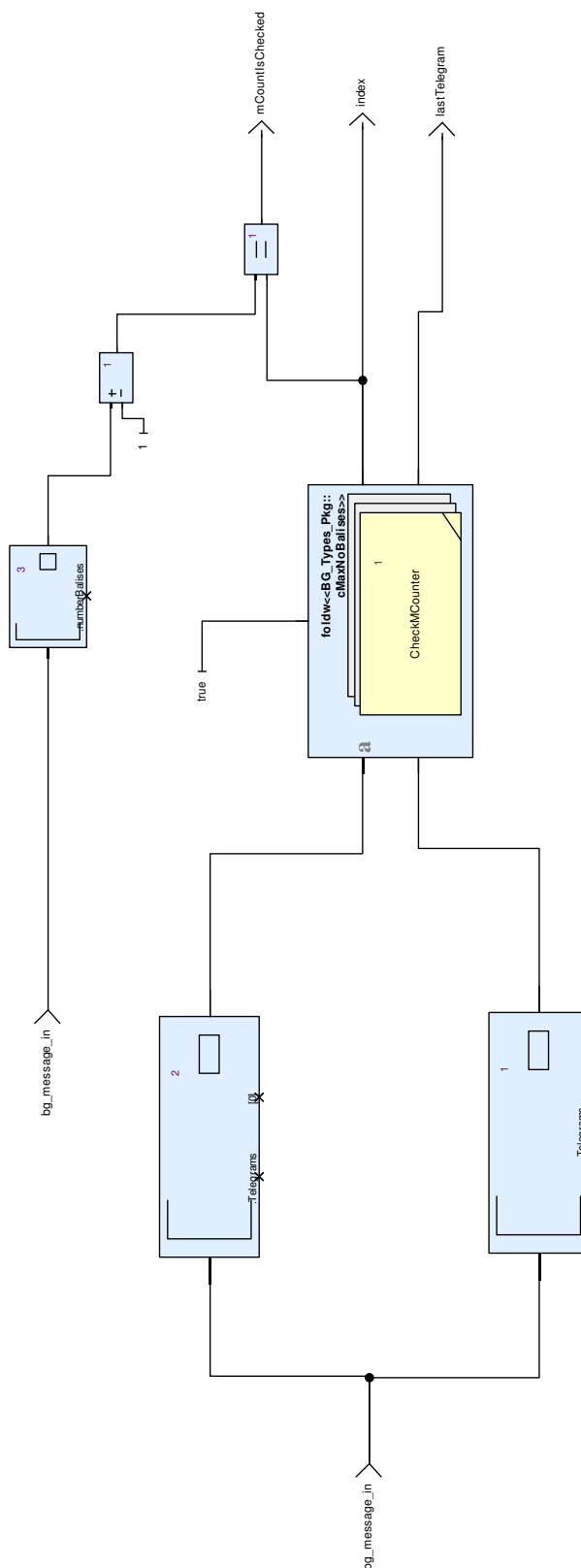
**Table 145: Outputs of CheckMCounter\_iter**

Name	Type	Comments and Information
mCountIsChecked	bool	
index	int	
lastTelegram	BG_Types_Pkg::Telegram_T	

#### 10.1.12.3. Operator Hierarchy

diagram : diagram\_CheckMCounter\_iter\_1

#### 10.1.12.4.1. View of diagram\_CheckMCounter\_iter\_1 (CheckMCounter\_iter)



**Figure 43: View of diagram\_CheckMCounter\_iter\_1 (CheckMCounter\_iter)**

### 10.1.13. CheckMMC Operator

Declared as **public function**

#### 10.1.13.1. Comments and Information

##### **CheckMMC Comments:**

- Auxiliary function for check m\_mcounter

#### 10.1.13.2. Interface

**Table 146: Inputs of CheckMMC**

Name	Type	Comments and Information
mcount1	int	
qLink1	Q_LINK	
mcount2	int	
qLink2	Q_LINK	

**Table 147: Outputs of CheckMMC**

Name	Type	Comments and Information
newMCount	int	
newQLink	Q_LINK	
valid	bool	

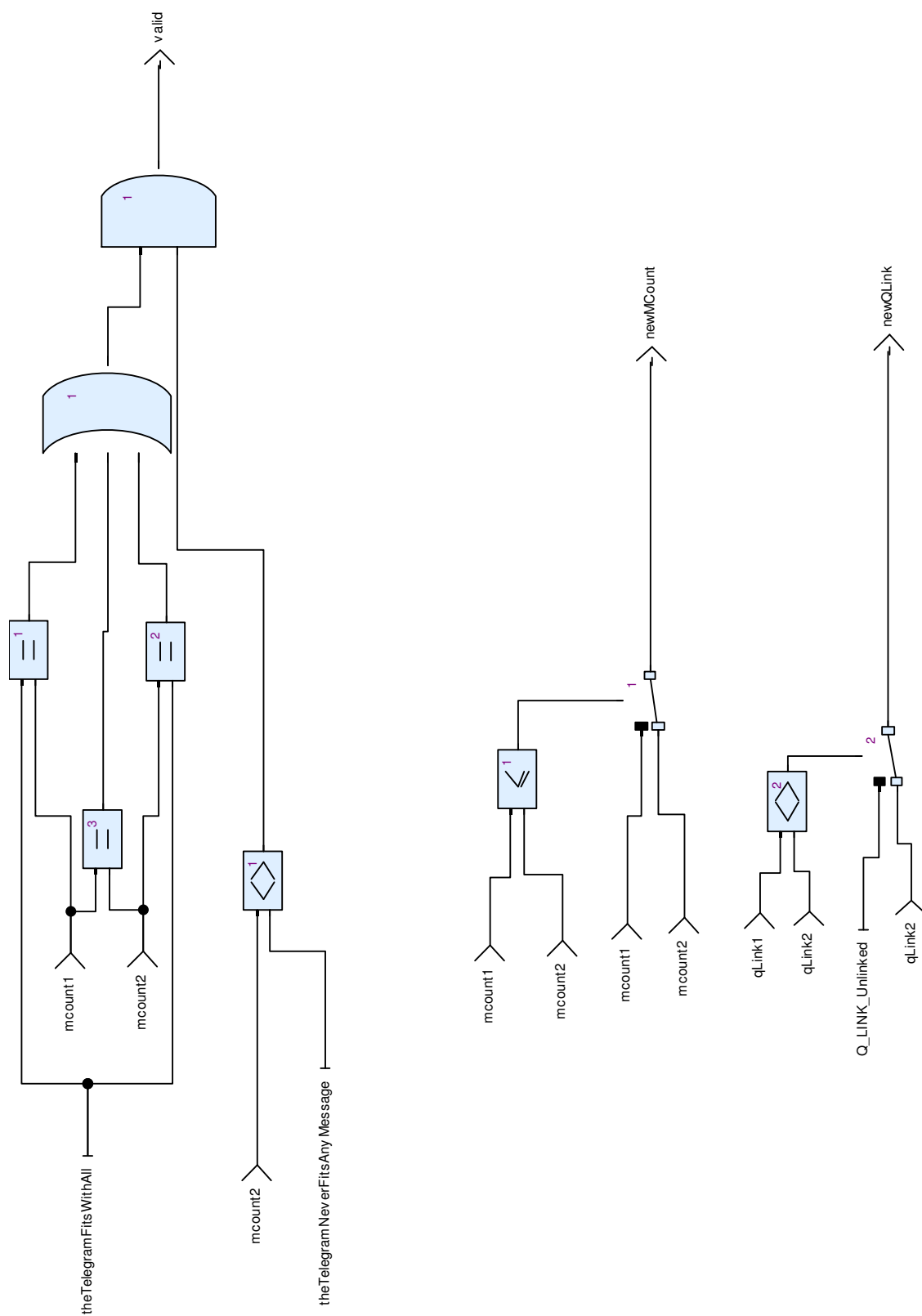
#### 10.1.13.3. Operator Hierarchy

diagram : diagram\_CheckMMC\_1



#### 10.1.13.4. Graphical and Textual Diagrams

10.1.13.4.1. View of diagram\_CheckMMC\_1 (CheckMMC)



**Figure 44: View of diagram\_CheckMMC\_1 (CheckMMC)**

#### 10.1.14. CheckMode Operator

Declared as **public function**

##### 10.1.14.1. Comments and Information

###### **CheckMode Comments:**

- subset 26: 4.5.2
- when should be BG-Consistency active.

##### 10.1.14.2. Interface

**Table 148: Inputs of CheckMode**

Name	Type	Comments and Information
currentMode	M_MODE	

**Table 149: Outputs of CheckMode**

Name	Type	Comments and Information
BGConsistansyIsActive_out	bool	
LinkingConsistencyIsActive_out	bool	

##### 10.1.14.3. Operator Hierarchy

diagram : diagram\_CheckMode\_1

## 10.1.14.4. Graphical and Textual Diagrams

### 10.1.14.4.1. View of diagram\_CheckMode\_1 (CheckMode)

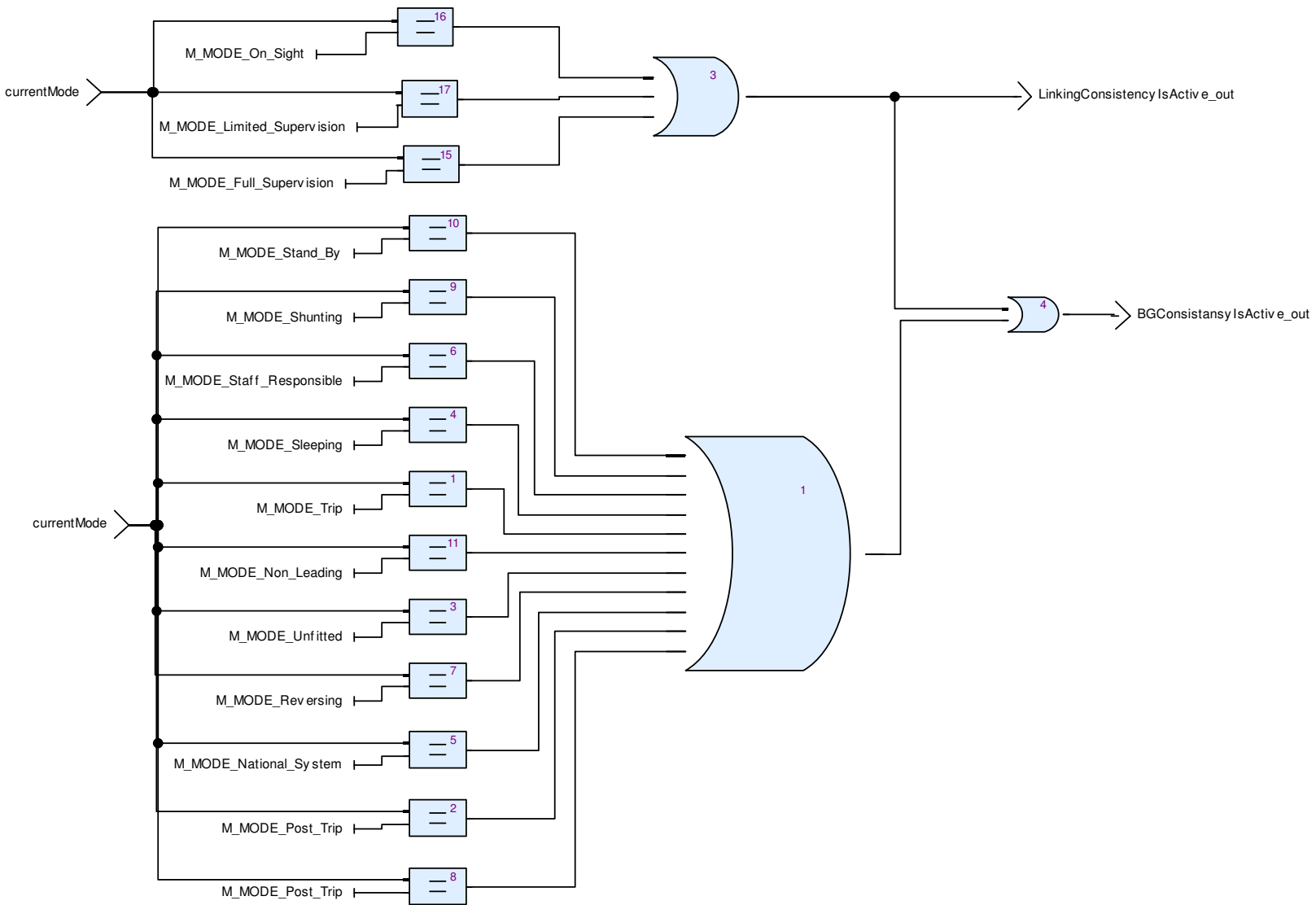


Figure 45: View of diagram\_CheckMode\_1 (CheckMode)

### 10.1.15. IsBG\_announced Operator

Declared as **public function**

#### 10.1.15.1. Comments and Information

##### **IsBG\_announced Comments:**

- check if the received BG is in the announced BG list

#### 10.1.15.2. Interface

**Table 150: Inputs of IsBG\_announced**

Name	Type	Comments and Information
receivedBG_header	BG_Types_Pkg::BG_Header_T	
announcedBG	BG_Types_Pkg::LinkedBG_T	

**Table 151: Outputs of IsBG\_announced**

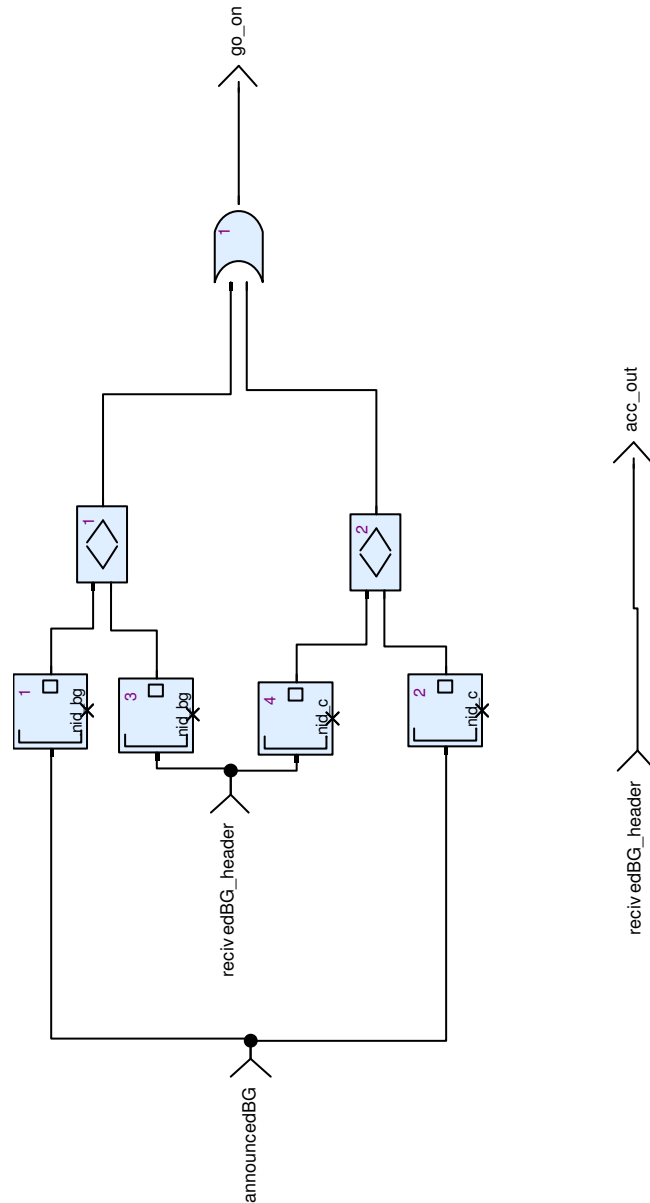
Name	Type	Comments and Information
go_on	bool	
acc_out	BG_Types_Pkg::BG_Header_T	

#### 10.1.15.3. Operator Hierarchy

diagram : diagram\_IsBG\_announced\_1

#### 10.1.15.4. Graphical and Textual Diagrams

##### 10.1.15.4.1. View of diagram\_IsBG\_announced\_1 (IsBG\_announced)



**Figure 46: View of diagram\_IsBG\_announced\_1 (IsBG\_announced)**

#### 10.1.16. isBG\_announced\_iter Operator

Declared as **public function**

##### 10.1.16.1. Comments and Information

**isBG\_announced\_iter Comments:**

- check if the recived BG is in the annoned BG list

### 10.1.16.2. Interface

**Table 152: Inputs of isBG\_announced\_iter**

Name	Type	Comments and Information
announced_BGs	BG_Types_Pkg::Linked BGs_T	
BG_header	BG_Types_Pkg::BG_He ader_T	

**Table 153: Outputs of isBG\_announced\_iter**

Name	Type	Comments and Information
index	int	
isAnnounced	bool	

### 10.1.16.3. Operator Hierarchy

diagram : diagram\_isBG\_announced\_iter\_1

#### 10.1.16.4. Graphical and Textual Diagrams

##### 10.1.16.4.1. View of diagram\_isBG\_announced\_iter\_1 (isBG\_announced\_iter)

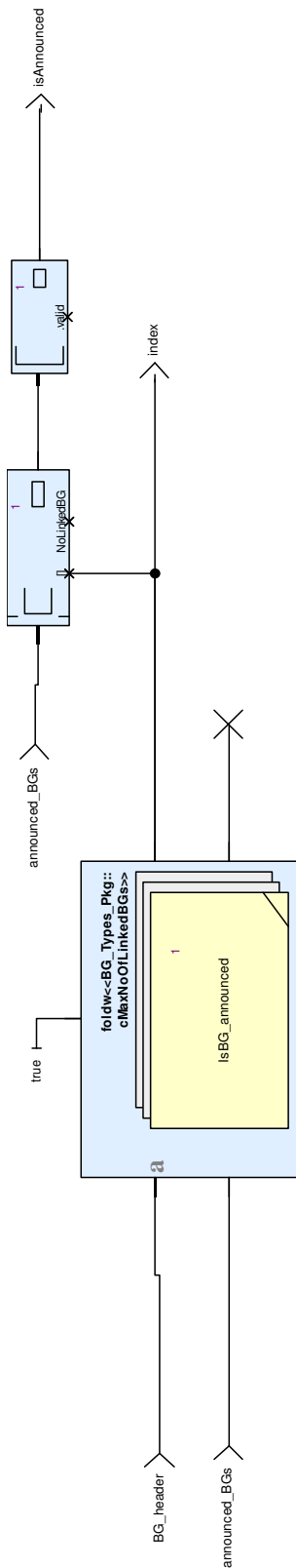


Figure 47: View of diagram\_isBG\_announced\_iter\_1 (isBG\_announced\_iter)

### 10.1.17. LinkedBGConsistency Operator

Declared as **public function**

#### 10.1.17.1. Comments and Information

##### **LinkedBGConsistency Comments:**

- Balise group message consistency subset 26: 3.16.2.4

#### 10.1.17.2. Interface

**Table 154: Inputs of LinkedBGConsistency**

Name	Type	Comments and Information
bg_message_in	BG_Types_Pkg::BG_Message_T	
CRC_Check	bool	
announced_BGs	BG_Types_Pkg::LinkedBGs_T	

**Table 155: Outputs of LinkedBGConsistency**

Name	Type	Comments and Information
q_linkingReaction	Q_LINKREACTION	

#### 10.1.17.3. Locals

**Table 156: Locals of LinkedBGConsistency**

Name	Type	Comments and Information
isAnnounced	bool	
IsConsistent	bool	
linkingReaction	Q_LINKREACTION	

#### 10.1.17.4. Operator Hierarchy

diagram : diagram\_LinkedBGConsistency\_1

*activate if* : IfBlock1

        branch : then

        branch : else



## 10.1.17.5. Graphical and Textual Diagrams

### 10.1.17.5.1. View of diagram\_LinkedBGConsistency\_1 (LinkedBGConsistency)

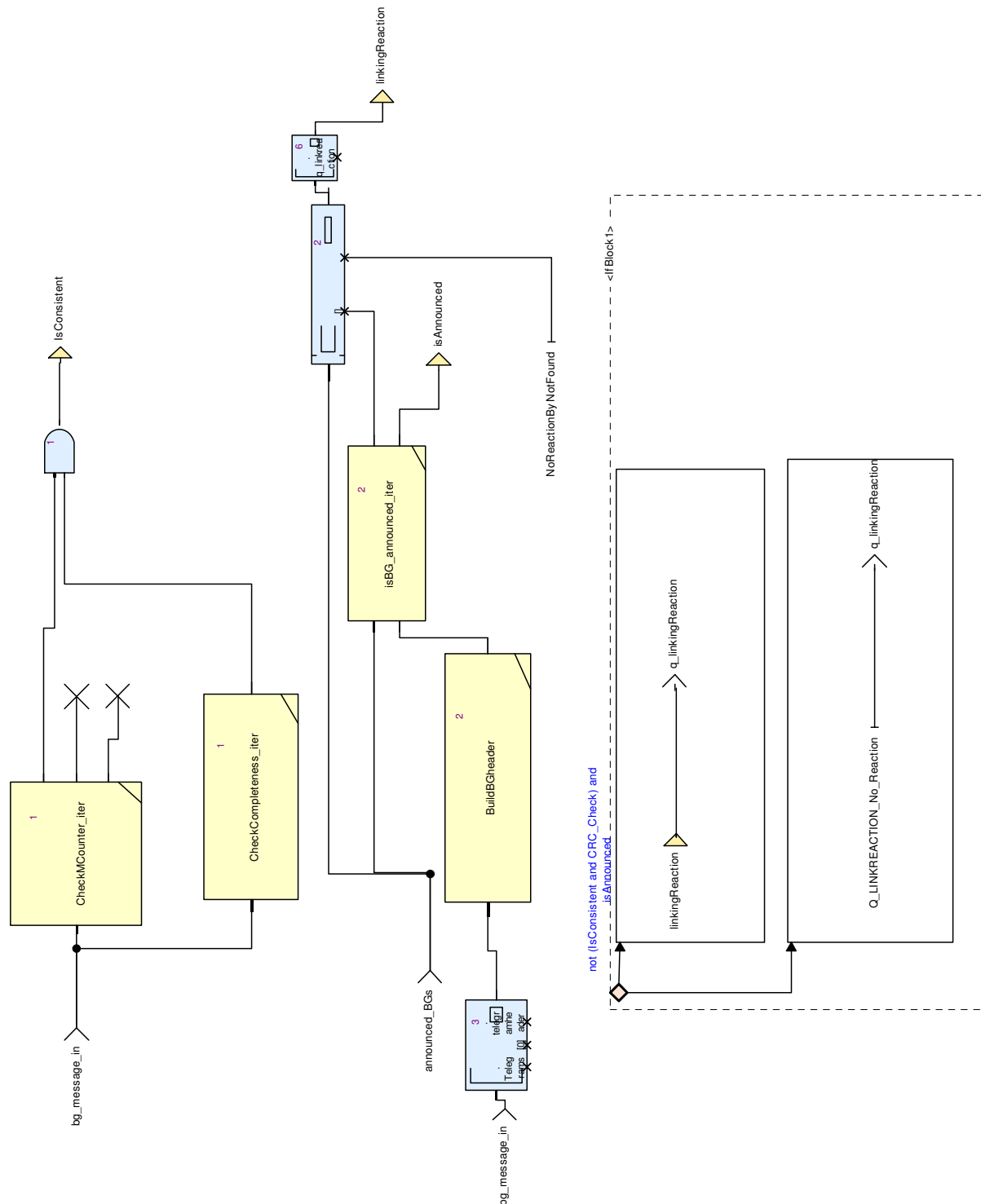


Figure 48: View of diagram\_LinkedBGConsistency\_1 (LinkedBGConsistency)

Table 157: Conditional Blocks of diagram\_LinkedBGConsistency\_1

Conditional Block	Comments and Information
IfBlock1	

**Table 158: Actions of diagram\_LinkedBGConsistency\_1**

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

#### 10.1.18. mergeAddInfo Operator

Declared as **public function**

##### 10.1.18.1. Comments and Information

**mergeAddInfo Comments:**

- This function combines packets received in the telegrams of a balise group.
- The function is limited to the packets used in the respective scope of the model:
  - - linking packet (5).
  -
- The behaviour is according to the subset 26, section
  - - 8.4.2 (rules for balise telegrams) and
  - - 8.4.1 (multiplicity of packets in a balise group message).
- We interpret the term "message" in this context as a balise message consisting of several telegrams. This implies in general, only single packets are to be expected for the whole balise group message (respecting documented exeptions).

##### 10.1.18.2. Interface

**Table 159: Inputs of mergeAddInfo**

Name	Type	Comments and Information
newAddInfo	BG_Types_Pkg::Additi onalInformation_T	
oldAddInfo	BG_Types_Pkg::Additi onalInformation_T	

**Table 160: Outputs of mergeAddInfo**

Name	Type	Comments and Information
mergedlAddInfo	BG_Types_Pkg::Additi onalInformation_T	

##### 10.1.18.3. Operator Hierarchy

diagram : diagram\_mergeAddInfo\_1

#### 10.1.18.4. Graphical and Textual Diagrams

##### 10.1.18.4.1. View of diagram\_mergeAddInfo\_1 (mergeAddInfo)

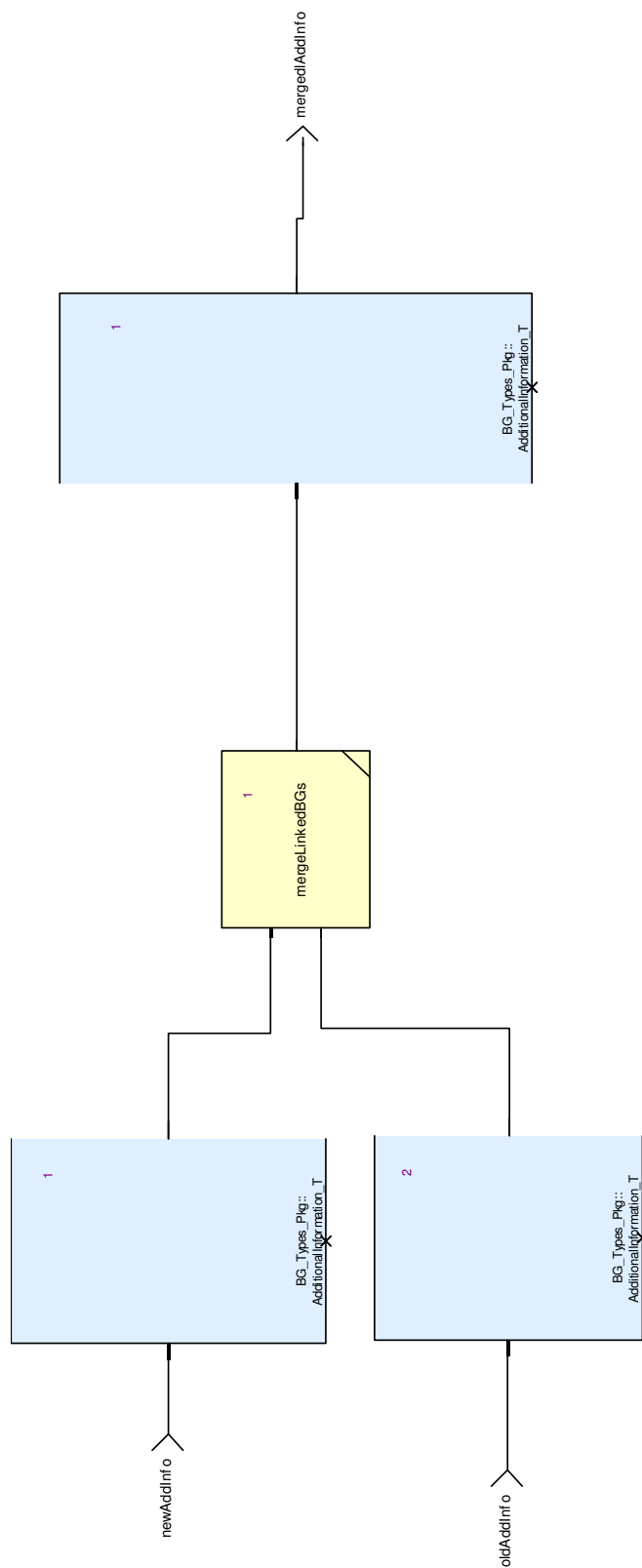


Figure 49: View of diagram\_mergeAddInfo\_1 (mergeAddInfo)

### 10.1.19. mergeLinkedBGs Operator

Declared as **public function**

#### 10.1.19.1. Comments and Information

##### **mergeLinkedBGs Comments:**

- This information is made up of the linking packet (5) of the btm
- The linking is a list of variable size.
- According to my understanding of the standard the package only appears once in a message and is not allowed to be split across telegrams.
- Therefore, no special procedure for copying is needed.
- (only replace whole list if already received entry is not valid).

#### 10.1.19.2. Interface

**Table 161: Inputs of mergeLinkedBGs**

Name	Type	Comments and Information
newLinkedBGs	BG_Types_Pkg::LinkedBGs_T	
oldLinkedBGs	BG_Types_Pkg::LinkedBGs_T	

**Table 162: Outputs of mergeLinkedBGs**

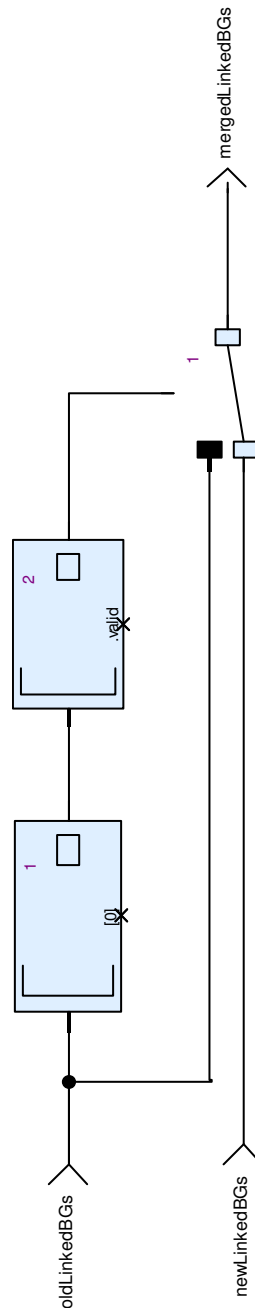
Name	Type	Comments and Information
mergedLinkedBGs	BG_Types_Pkg::LinkedBGs_T	

#### 10.1.19.3. Operator Hierarchy

diagram : diagram\_mergeLinkedBGs\_1

#### 10.1.19.4. Graphical and Textual Diagrams

##### 10.1.19.4.1. View of diagram\_mergeLinkedBGs\_1 (mergeLinkedBGs)



**Figure 50: View of diagram\_mergeLinkedBGs\_1 (mergeLinkedBGs)**

#### 10.1.20. Npig2Int Operator

Declared as **public function**

##### 10.1.20.1. Comments and Information

###### **Npig2Int Comments:**

- convert n\_pig to intager

#### 10.1.20.2. Interface

**Table 163: Inputs of Npig2Int**

Name	Type	Comments and Information
n_pig	N_PIG	

**Table 164: Outputs of Npig2Int**

Name	Type	Comments and Information
n_pig2int	int	

#### 10.1.20.3. Operator Hierarchy

diagram : diagram\_Npig2Int\_1

*activate if* : IfBlock1

        branch : then

        branch : else

            branch : then

            branch : else

                branch : then

                branch : else

                    branch : then

                    branch : else

                        branch : then

                        branch : else

                            branch : then

                            branch : else

                                branch : then

                                branch : else

                                    branch : then

                                    branch : else

#### 10.1.20.4. Graphical and Textual Diagrams

##### 10.1.20.4.1. View of diagram\_Npig2Int\_1 (Npig2Int)

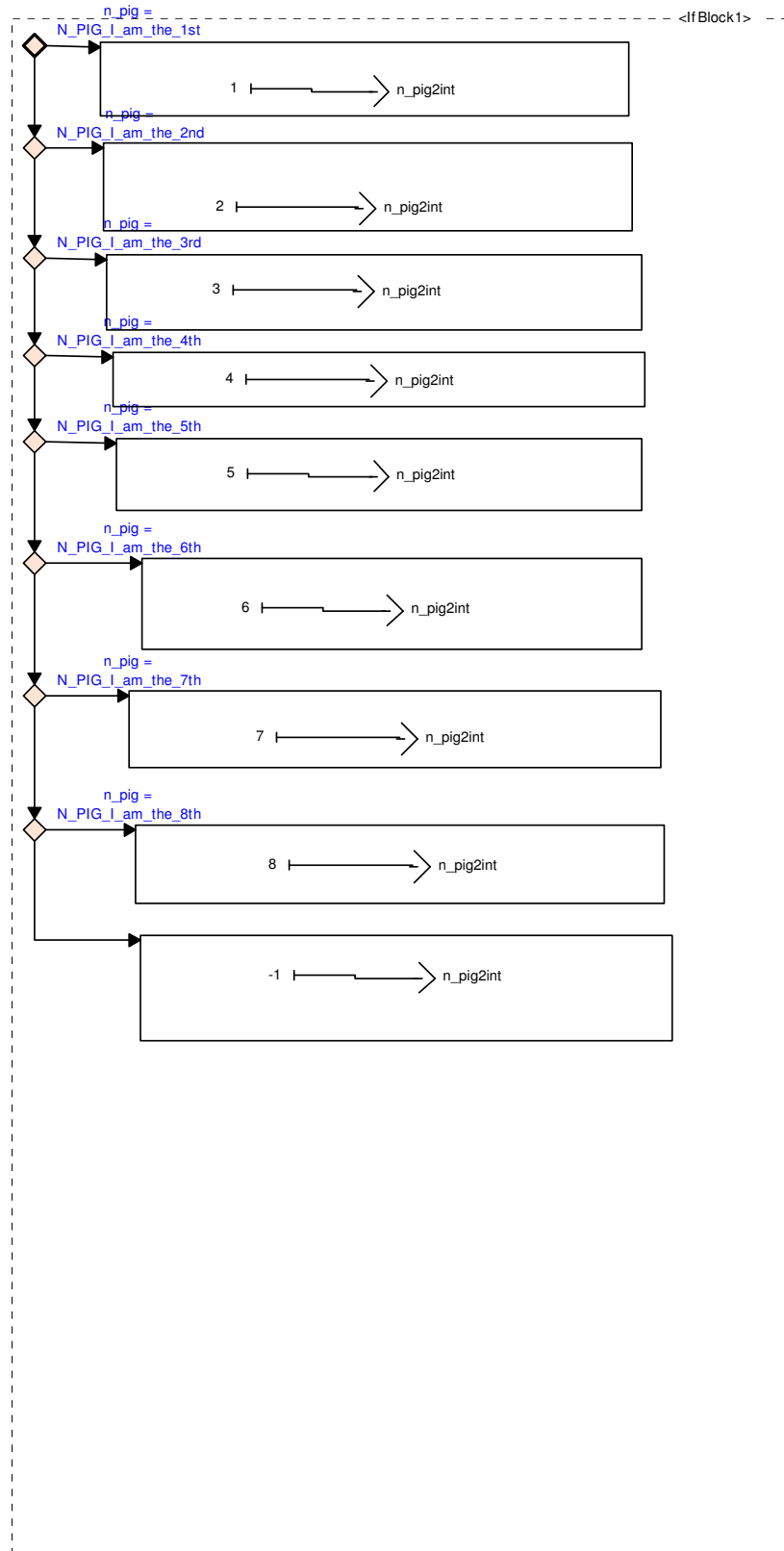


Figure 51: View of diagram\_Npig2Int\_1 (Npig2Int)

**Table 165: Conditional Blocks of diagram\_Npig2Int\_1**

Conditional Block	Comments and Information
IfBlock1	

**Table 166: Actions of diagram\_Npig2Int\_1**

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

### 10.1.21. UnlinkedBGConsistency Operator

Declared as **public function**

#### 10.1.21.1. Comments and Information

**UnlinkedBGConsistency Comments:**

- unlinked Balise group message consistency subset 26: 3.16.2.5

#### 10.1.21.2. Interface

**Table 167: Inputs of UnlinkedBGConsistency**

Name	Type	Comments and Information
bg_message_in	BG_Types_Pkg::BG_Message_T	
CRC_Check	bool	

**Table 168: Outputs of UnlinkedBGConsistency**

Name	Type	Comments and Information
ApplyServiceBrake	bool	
BadBaliseMessageToDMI	CheckBGConsistency_Pkg::String_T	

#### 10.1.21.3. Locals

**Table 169: Locals of UnlinkedBGConsistency**

Name	Type	Comments and Information
IsConsistent	bool	



#### 10.1.21.4. Operator Hierarchy

diagram : diagram\_UnlinkedBGConsistency\_1

*activate if* : IfBlock1

branch : then

branch : else

## 10.1.21.5. Graphical and Textual Diagrams

### 10.1.21.5.1. View of diagram\_UnlinkedBGConsistency\_1 (UnlinkedBGConsistency)

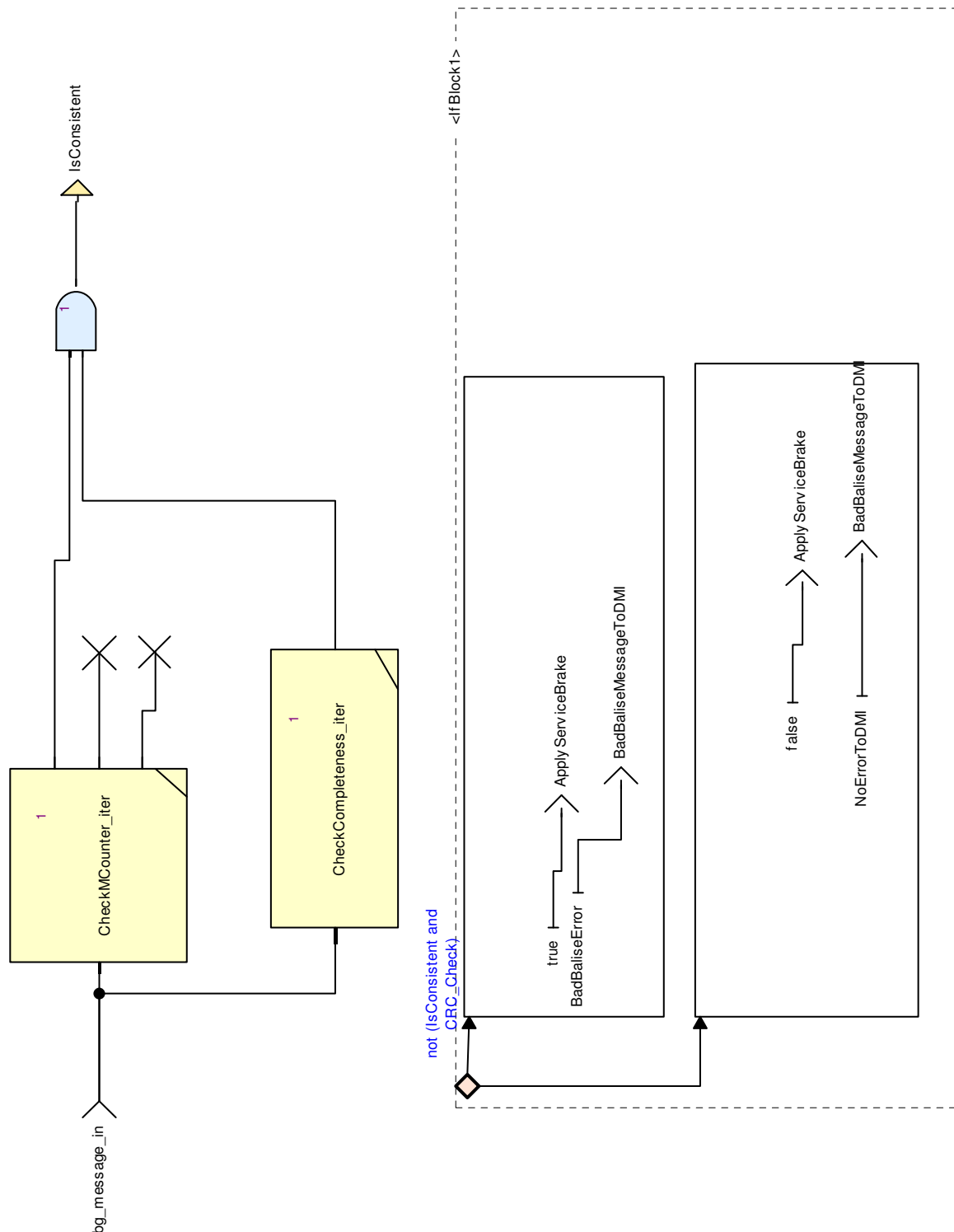


Figure 52: View of diagram\_UnlinkedBGConsistency\_1 (UnlinkedBGConsistency)

Table 170: Conditional Blocks of diagram\_UnlinkedBGConsistency\_1

Conditional Block	Comments and Information
IfBlock1	

**Table 171: Actions of diagram\_UnlinkedBGConsistency\_1**

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

## 11. Project Library: ReceiveEuroBaliseFromAPI

### 11.1. Root Elements

#### 11.1.1. Types

**Table 172: Public Types of ReceiveEuroBaliseFromAPI**

Name	Definition	Comments and Information
API_addInfo_T	{listLinking : BG_Types_Pkg::LinkedBGs_T}	<b>Comments:</b> packet information received via telegram <b>listLinking Comments:</b> Linking information received via packet 5. Information is of variable length.
API_Telegram_T	{present : bool, checkResult : bool, api_bad_balise_received : bool, api_header : BG_Types_Pkg::TelegramHeader_T, api_packets : API_addInfo_T, centerOfBalisePosition : BG_Types_Pkg::centerOfBalisePosition_T}	<b>Comments:</b> Telegram as received via the API. This type has to be defined in the openETCS API <b>present Comments:</b> Indicates the presence of new and valid information at the start of the routine <b>checkResult Comments:</b> reports the result of the decoding procedure. true: successfully decoded false: errors during decoding. Typically, this is the result of the check of the parameters of the telegram. <b>api_bad_balise_received Comments:</b> indicates, whether a bad balise has been received. In this scenario, data are not valid. <b>api_header Comments:</b> Telegram_Header <b>api_packets Comments:</b> Packets received with this balise <b>centerOfBalisePosition Comments:</b> actual odometry of where the telegram has been received

## 11.1.2. Constants

**Table 173: Public Constants of ReceiveEuroBaliseFromAPI**

Name	Type	Value	Comments and Information
bad_balise_init	BG_Types_Pkg::TelegramHeader_T	{q_updown : Q_UPDOWN_Down_link_telegram, m_version : M_VERSION_Previous_versions_according_to_e_g_EEIG_SRS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1st, n_total : N_TOTAL_1_balise_in_the_group, m_dup : M_DUP_No_duplicates, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}	<b>Comments:</b> Init for the bad balise telegram

Name	Type	Value	Comments and Information
cEmptyTelegramPackets	BG_Types_Pkg::AdditionalInformation_T	<pre>{linkingPackets : [ {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation :</pre>	<p><b>Comments:</b> Init for the optional packets in an balise telegram. Optional Packets are provided in the additionalInformation structure.</p>

Name	Type	Value	Comments and Information
cInitEmptyLRBGs	BG_Types_Pkg::LinkedBGs_T	[{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country__or__ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country__or__ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country__or__ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection,	<b>Comments:</b> Init for empty list of Linking Information.
	openETCS WP3_InitialArchitecture_DesignDescription	nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO	

Name	Type	Value	Comments and Information
cInitEmptyPosition	BG_Types_Pkg::centerOfBalisePosition_T	{valid : false, centerOfBalisePosition : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetectionInaccuracies : {nominal : 0, d_min : 0, d_max : 0}, timestamp : 0}	<b>Comments:</b> Init for empty position information

## 11.2. btmSupportPkg Package

### 11.2.1. transferPackets Operator

Declared as **public function**

#### 11.2.1.1. Comments and Information

##### transferPackets Comments:

- Transfers of packets of the telegram received via the API interface into a telegram to be used for handling balises of balise groups. The format is defined to fit to the BTM interface defined in section .8.4.2 of the SRS.
- However, it is assumed the decoding of telegrams is task of the API. This implies:
  - - no fields of the telegram on bit-boundary
  - - variant size information is mapped to arrays wherever visible.
  - In the scope of the first iteration only packet 5 is relevant (linking).
  - Other packets are not considered.

#### 11.2.1.2. Interface

**Table 174: Inputs of transferPackets**

Name	Type	Comments and Information
api_packets	API_addInfo_T	

**Table 175: Outputs of transferPackets**

Name	Type	Comments and Information
out_AddInfo	BG_Types_Pkg::AdditionalInformation_T	

#### 11.2.1.3. Operator Hierarchy

diagram : diagram\_transferPackets\_1



#### 11.2.1.4. Graphical and Textual Diagrams

##### 11.2.1.4.1. View of diagram\_transferPackets\_1 (transferPackets)

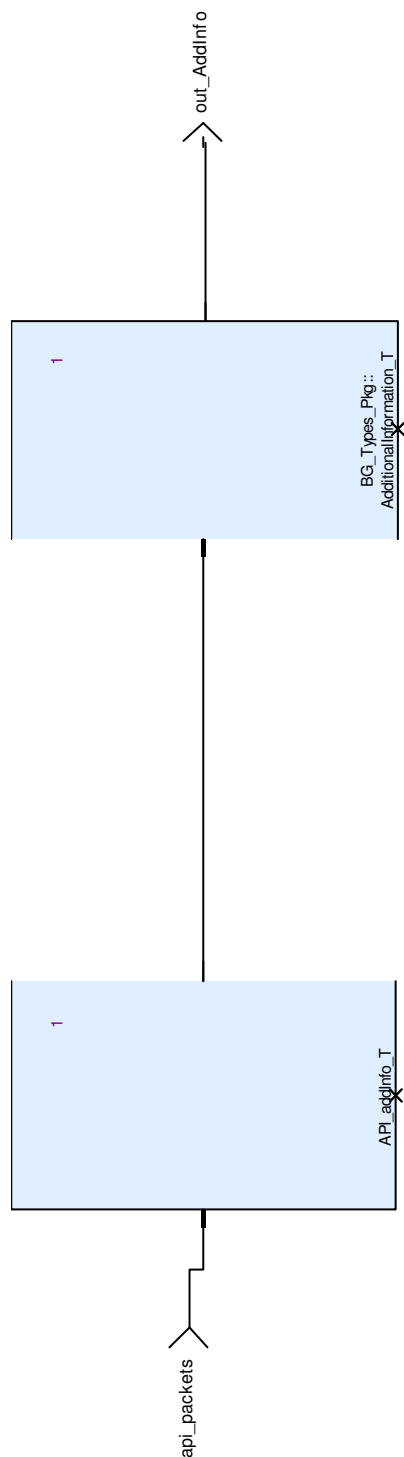


Figure 53: View of diagram\_transferPackets\_1 (transferPackets)

#### 11.2.2. transferTelegram Operator

Declared as **public function**

#### 11.2.2.1. Comments and Information

##### **transferTelegram Comments:**

- Transfers a telegram received via the API interface into a telegram to be used for handling balises of balise groups. The format is defined to fit to the BTM interface defined in section .8.4.2 of the SRS.
- However, it is assumed the decoding of telegrams is task of the API. This implies:
  - - no fields of the telegram on bit-boundary
  - - variant size information is mapped to arrays wherever visible.

#### 11.2.2.2. Interface

**Table 176: Inputs of transferTelegram**

Name	Type	Comments and Information
API_balise	API_Telegram_T	

**Table 177: Outputs of transferTelegram**

Name	Type	Comments and Information
outDecodedTelegram	BG_Types_Pkg::Telegram_T	
outCenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	

#### 11.2.2.3. Operator Hierarchy

diagram : diagram\_transferTelegram\_1

#### 11.2.2.4. Graphical and Textual Diagrams

##### 11.2.2.4.1. View of diagram\_transferTelegram\_1 (transferTelegram)

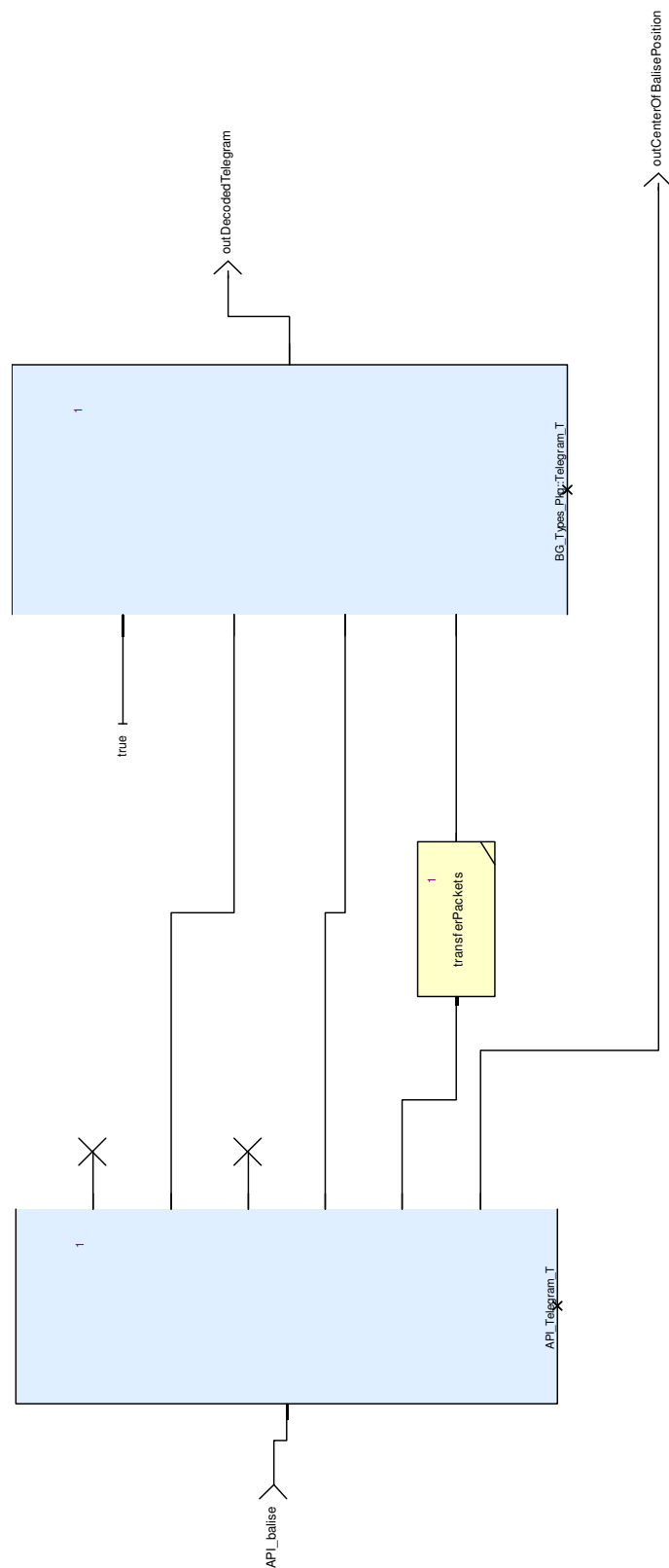


Figure 54: View of diagram\_transferTelegram\_1 (transferTelegram)

diagram\_transferTelegram\_1 Comments:

- Transfer of the telegram from api to openETCS model structure.

### 11.3. ReceiveEuroBaliseFromAPI\_Pkg Package

#### 11.3.1. ReceiveEuroBaliseFromAPI Operator

Declared as **public function**

##### 11.3.1.1. Comments and Information

###### **ReceiveEuroBaliseFromAPI Comments:**

- This module defines the interface to the API.
- Assumption is we do not perform a decoding in scade. we get proper decoded telegrams from the API.
- Preferred Interface : (Header + Flag + odometry ) + addInf

##### 11.3.1.2. Interface

**Table 178: Inputs of ReceiveEuroBaliseFromAPI**

Name	Type	Comments and Information
API_balise	API_Telegram_T	<b>Comments:</b> Input: The balise information received via the API. It is assumed there is at most one telegram passed with this interface. The present flag indicates the input whether the input is available for processing.

**Table 179: Outputs of ReceiveEuroBaliseFromAPI**

Name	Type	Properties	Comments and Information
outTelegramPresent	bool		<b>Comments:</b> Presence indicatio for the output

Name	Type	Properties		Comments and Information
outDecodedTelegram	BG_Types_Pkg::Telegram_T	default	BG_Types_Pkg::cEmpty_BaliseTlg	<b>Comments:</b> Decoded Telegram passed to the balise group message. The present flag indicates output is available. The valid flag being part of the telegram has at this interface an additional meaning: - present = false -> ignore telegram, no input - present = true and valid = true: a proper telegram has been received via btm. - present = true and valid = false: BTM has indicated reception of an invalid telegram (e.g., CRC failure).
outcenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	default	cInitEmptyPosition	<b>Comments:</b> Position reported by the antenna where the telegram has been received.

#### 11.3.1.3. Locals

**Table 180: Locals of ReceiveEuroBaliseFromAPI**

Name	Type	Comments and Information
bad_balise	bool	
is_present	bool	

#### 11.3.1.4. Operator Hierarchy

diagram : diagram\_ReceiveEuroBaliseFromAPI\_1  
*activate if* : is\_present\_blk  
branch : then  
*activate if* : has\_fresh\_data\_blk  
branch : then  
branch : else  
branch : else

### 11.3.1.5. Graphical and Textual Diagrams

#### 11.3.1.5.1. View of diagram\_ReceiveEuroBaliseFromAPI\_1 (ReceiveEuroBaliseFromAPI)

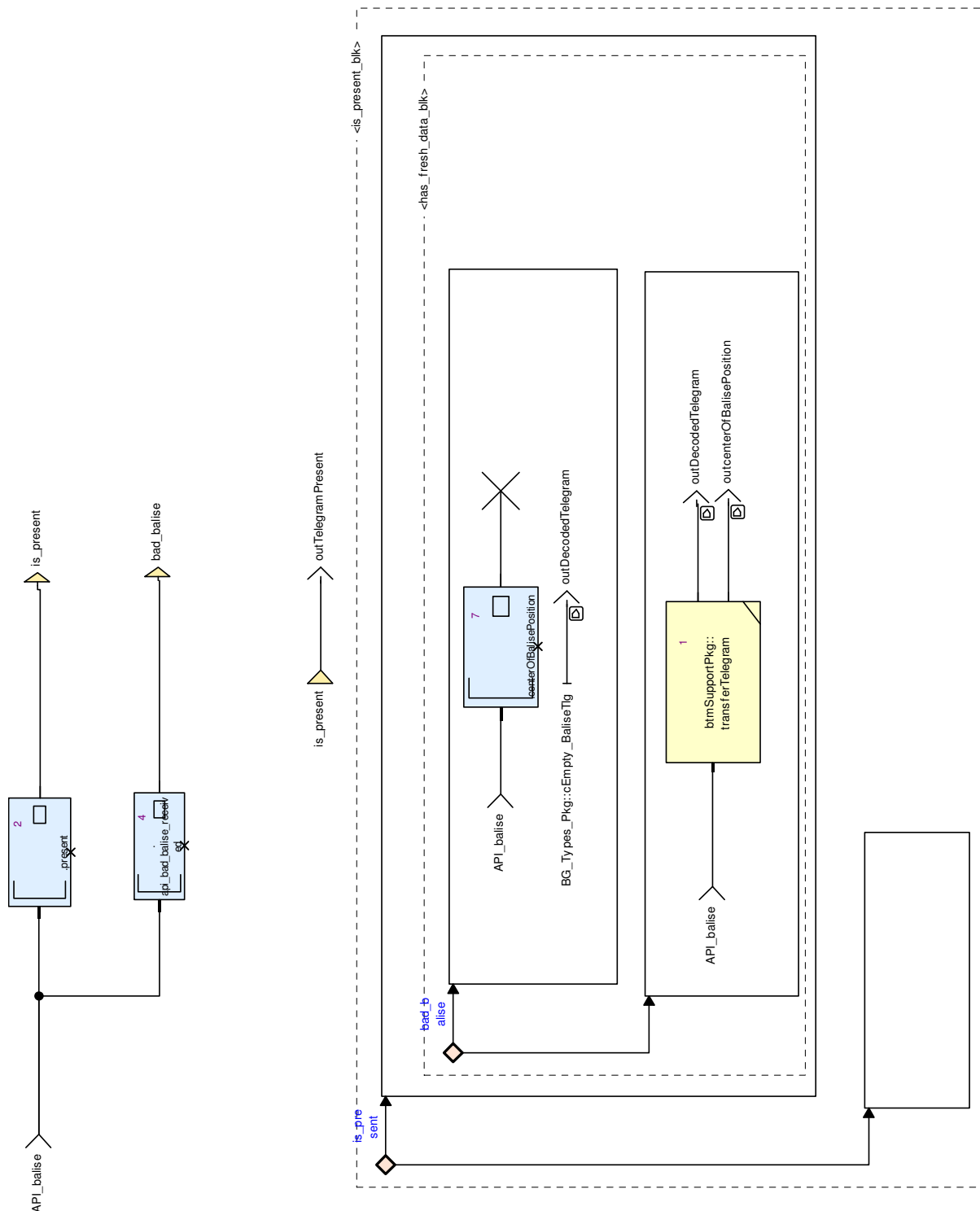


Figure 55: View of diagram\_ReceiveEuroBaliseFromAPI\_1 (ReceiveEuroBaliseFromAPI)

Table 181: Conditional Blocks of diagram\_ReceiveEuroBaliseFromAPI\_1

Conditional Block	Comments and Information
is_present_blk	

Conditional Block	Comments and Information
is_present_blk:then:has_fresh_data_blk	

**Table 182: Actions of diagram\_ReceiveEuroBaliseFromAPI\_1**

Conditional Block Action	Comments and Information
is_present_blk:then	
is_present_blk:then:has_fresh_data_blk:then	
is_present_blk:then:has_fresh_data_blk:else	
is_present_blk:else	

## 12. Project Library: SelectUsableInfo

### 12.1. Root Elements

#### 12.1.1. Types

**Table 183: Public Types of SelectUsableInfo**

Name	Definition	Comments and Information
IND_REJ	enum {IND_REJ_Not_Relevant, IND_REJ_Accepted, IND_REJ_Rejected}	
TrainData	{valid : bool, RecExit : bool, ActiveCab : bool}	<b>RecExit Comments:</b> 1 for following the reception of the information "Recognition of Exit from TR mode" with a more recent time stamp <b>ActiveCab Comments:</b> 1 for "cab is active"



## 12.1.2. Constants

**Table 184: Public Constants of SelectUsableInfo**

Name	Type	Value	Comments and Information
------	------	-------	--------------------------

Name	Type	Value	Comments and Information
		<pre>{valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previous_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_total : N_TOTAL_1_balise_ in_the_group, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, linkedBGs : [{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0,</pre>	

## 12.2. SelectUsableInfo\_Pkg Package

### 12.2.1. FirstFilter Operator

Declared as **public function**

#### 12.2.1.1. Comments and Information

##### **FirstFilter Comments:**

- 4.8.3 Filter for accepting information depending on the level
- In the first iteration of work only linking information is processed and the level is fixed to ETCS level 1.
- Thus, the information will always be accepted.

#### 12.2.1.2. Interface

**Table 185: Inputs of FirstFilter**

Name	Type	Comments and Information
TrainInfo_	BG_Types_Pkg::TrainT oTrackStatus_T	
passedBG	BG_Types_Pkg::passe dBG_T	

**Table 186: Outputs of FirstFilter**

Name	Type	Comments and Information
Indicator_Reject	IND_REJ	

#### 12.2.1.3. Operator Hierarchy

diagram : diagram\_FirstFilter\_1

#### 12.2.1.4. Graphical and Textual Diagrams

##### 12.2.1.4.1. View of diagram\_FirstFilter\_1 (FirstFilter)

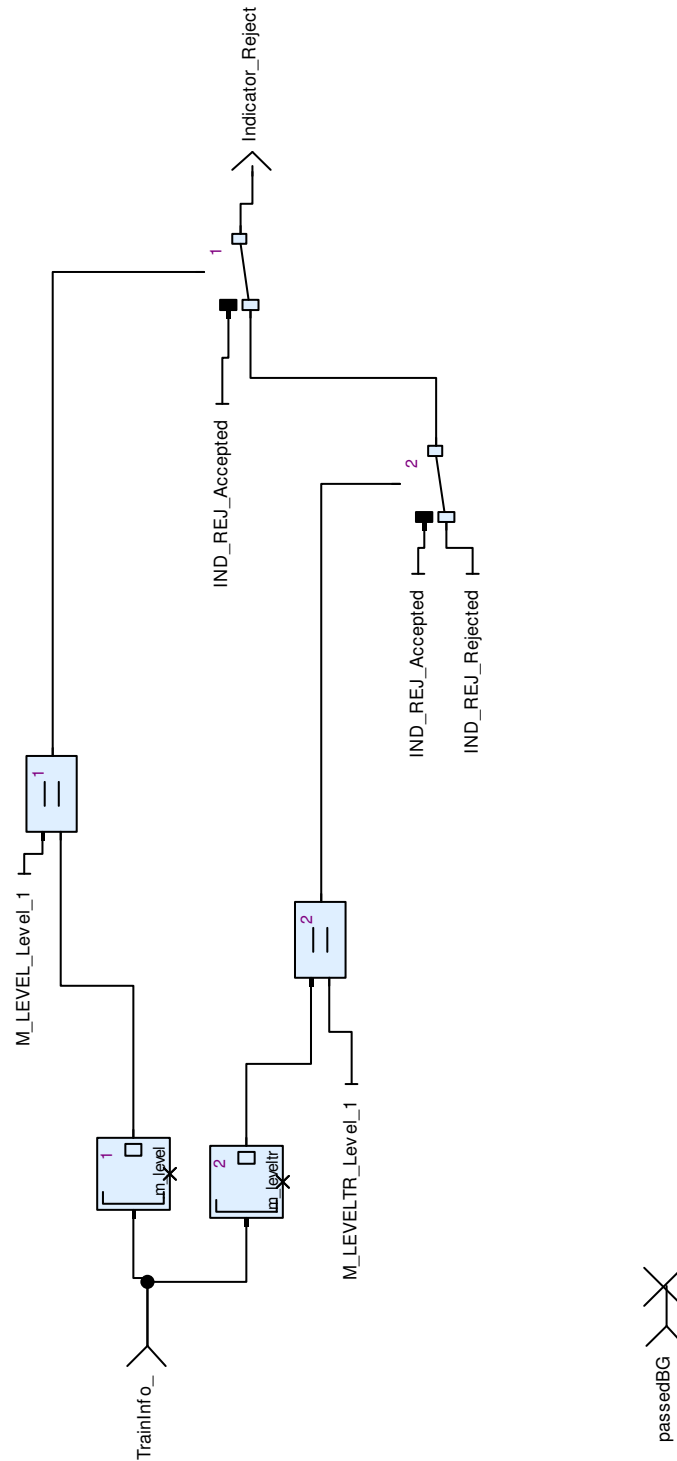


Figure 56: View of diagram\_FirstFilter\_1 (FirstFilter)

#### 12.2.2. SecondFilter Operator

Declared as **public function**

#### 12.2.2.1. Comments and Information

##### SecondFilter Comments:

- This filter is not relevant for the first iteration since radio messages are not part of the model.

#### 12.2.2.2. Interface

**Table 187: Inputs of SecondFilter**

Name	Type	Comments and Information
TrainInfo_	BG_Types_Pkg::TrainToTrackStatus_T	
passedBG	BG_Types_Pkg::passedBG_T	
in_Indicator_Reject	IND_REJ	

**Table 188: Outputs of SecondFilter**

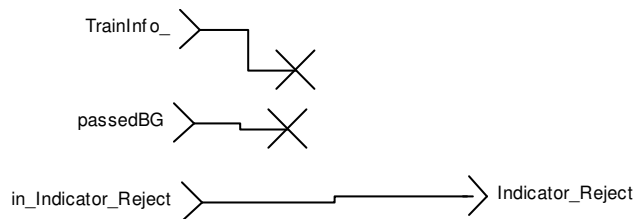
Name	Type	Comments and Information
Indicator_Reject	IND_REJ	

#### 12.2.2.3. Operator Hierarchy

diagram : diagram\_SecondFilter\_1

#### 12.2.2.4. Graphical and Textual Diagrams

##### 12.2.2.4.1. View of diagram\_SecondFilter\_1 (SecondFilter)



**Figure 57: View of diagram\_SecondFilter\_1 (SecondFilter)**

#### 12.2.3. SelectUsableInfo Operator

Declared as **public function**

##### 12.2.3.1. Comments and Information

##### SelectUsableInfo Comments:

- 4.8 acceptance of received information
- In the first iteration of work only linking packages are relevant.
- Moreover, RBC messages are not part of the model, modes are not processed, and the level is limited to ETCS level 1.
- Thus, the second and third filters functionality is not needed in the first iteration.

### 12.2.3.2. Interface

**Table 189: Inputs of SelectUsableInfo**

Name	Type	Comments and Information
TrainInfo_	BG_Types_Pkg::TrainToTrackStatus_T	
passedBG	BG_Types_Pkg::passedBG_T	
Train_Data	TrainData	

**Table 190: Outputs of SelectUsableInfo**

Name	Type	Properties	Comments and Information
out_passedBG	BG_Types_Pkg::passedBG_T	default invalidPassedBG	

### 12.2.3.3. Locals

**Table 191: Locals of SelectUsableInfo**

Name	Type	Comments and Information
Indicator_RE	IND_REJ	

### 12.2.3.4. Operator Hierarchy

diagram : diagram\_SelectUsableInfo\_1

*activate if* : IfBlock1  
        branch : then  
        branch : else

### 12.2.3.5. Graphical and Textual Diagrams

#### 12.2.3.5.1. View of diagram\_SelectUsableInfo\_1 (SelectUsableInfo)

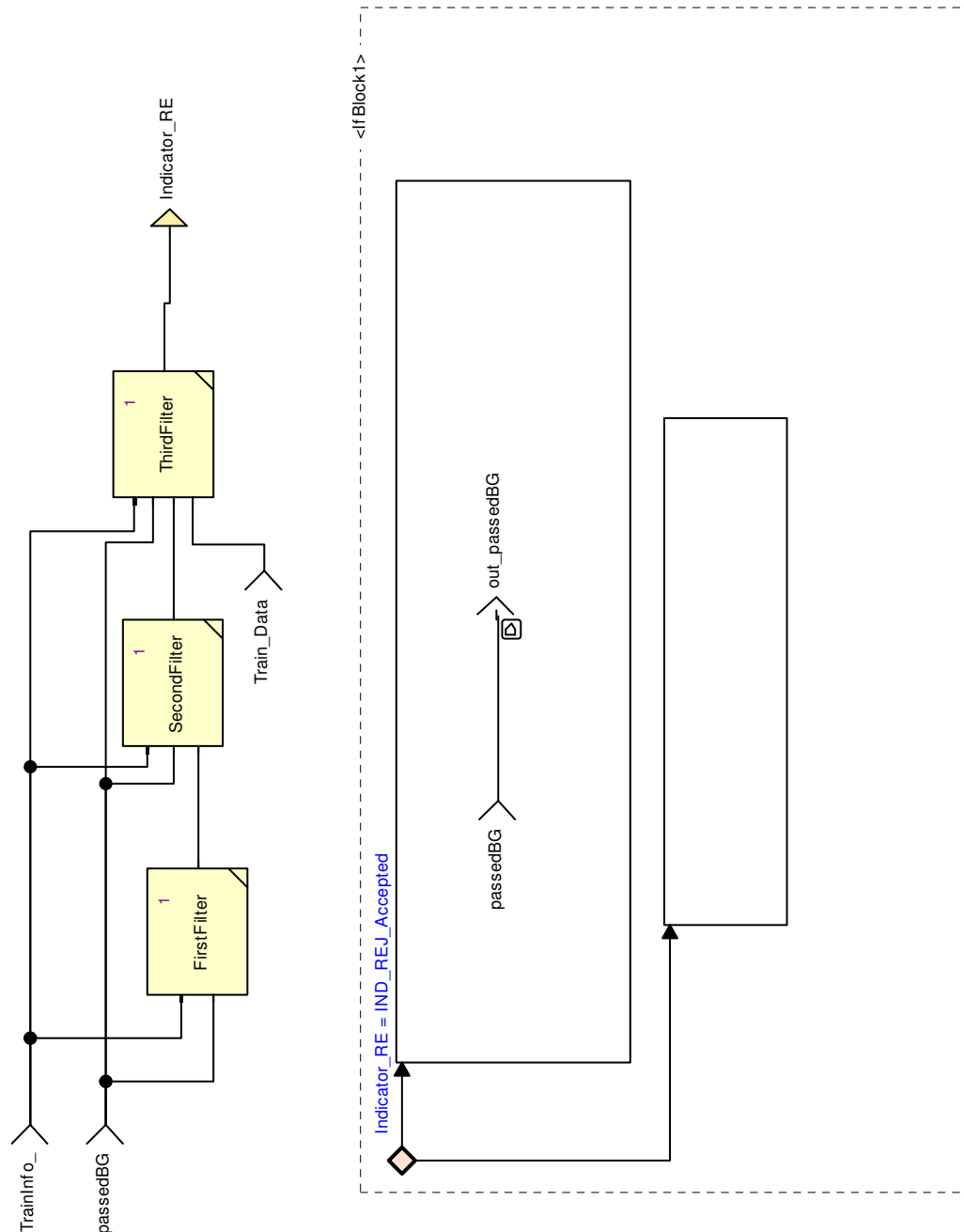


Figure 58: View of diagram\_SelectUsableInfo\_1 (SelectUsableInfo)

Table 192: Conditional Blocks of diagram\_SelectUsableInfo\_1

Conditional Block	Comments and Information
IfBlock1	

Table 193: Actions of diagram\_SelectUsableInfo\_1

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

## 12.2.4. ThirdFilter Operator

Declared as **public function**

### 12.2.4.1. Comments and Information

#### **ThirdFilter Comments:**

- 4.8.4 Filter for accepting information depending on the modes
- Filter is not relevant currently since modes are not processed in the first iteration of work.

### 12.2.4.2. Interface

**Table 194: Inputs of ThirdFilter**

Name	Type	Comments and Information
TrainInfo_	BG_Types_Pkg::TrainT oTrackStatus_T	
passedBG	BG_Types_Pkg::passe dBG_T	
in_Indicator_Reject	IND_REJ	
Train_Data	TrainData	

**Table 195: Outputs of ThirdFilter**

Name	Type	Comments and Information
Indicator_Reject	IND_REJ	

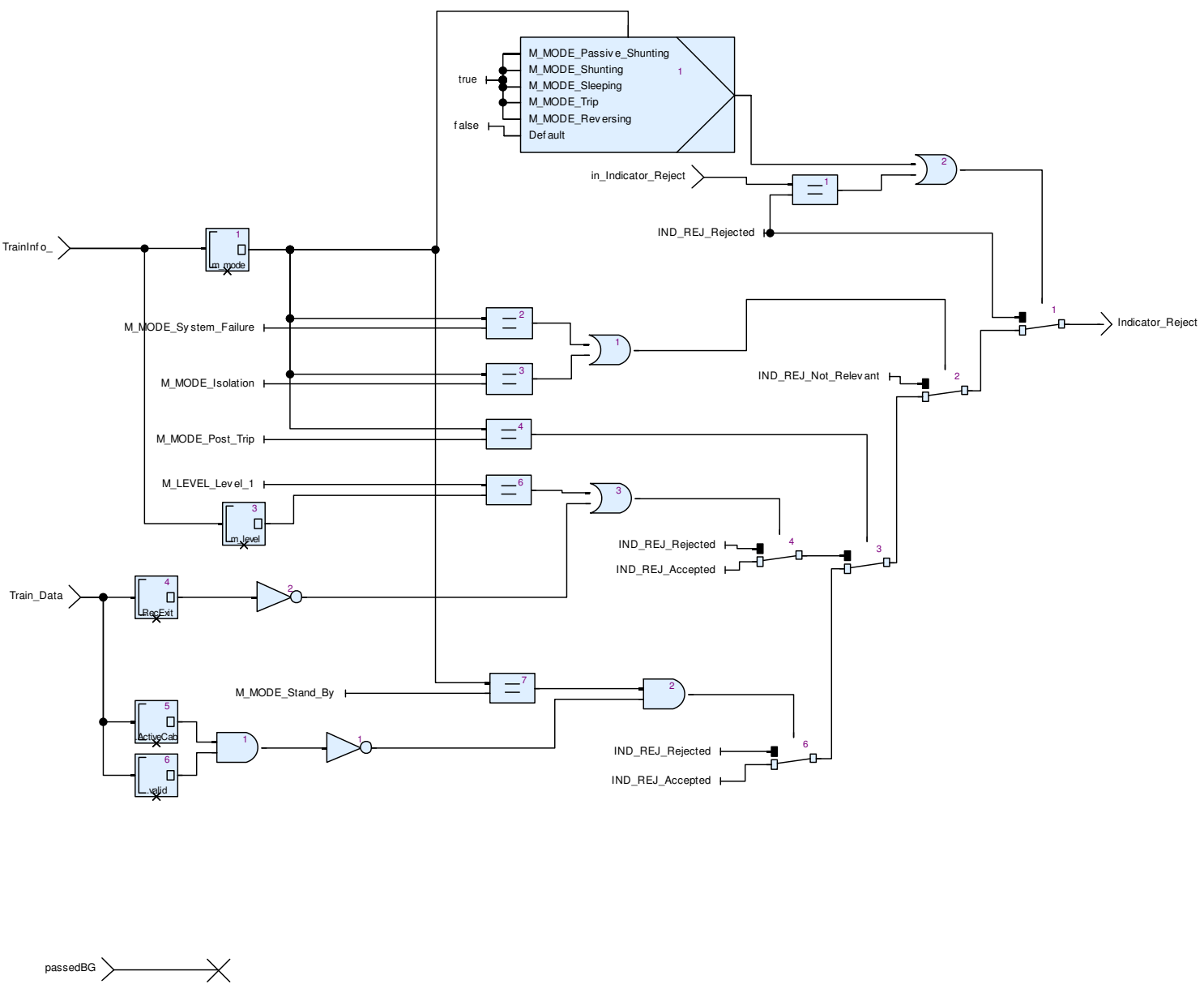
### 12.2.4.3. Operator Hierarchy

diagram : diagram\_ThirdFilter\_1



#### 12.2.4.4. Graphical and Textual Diagrams

#### 12.2.4.4.1. View of diagram\_ThirdFilter\_1 (ThirdFilter)



**Figure 59: View of diagram\_ThirdFilter\_1 (ThirdFilter)**

## 13. Project Library: TrainPosition\_Integration

### 13.1. TrainPosition\_Integration\_Pkg Package

#### 13.1.1. ManageTrainPosition Operator

Declared as **public node**

##### 13.1.1.1. Interface

**Table 196: Inputs of ManageTrainPosition**

Name	Type	Comments and Information
currentOdometry	Obu_BasicTypes_Pkg::odometry_T	<b>Comments:</b> The current odometry values
passedBG	BG_Types_Pkg::passedBG_T	<b>Comments:</b> Input event reporting a balise group during its passage, if there is one.
LRBG	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> The LRBG used for RBC communication.
prevLRBG	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> A previously used LRBG used in RBC communication.
reset	bool	<b>Comments:</b> Resets all to an initials state and deletes all stored BGs.
systemTime	ProvidePositionReport_Pkg::SystemTime_T	
errorMsg	ProvidePositionReport_Pkg::ErrorMessage_T	
posRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	
trackInfo	ProvidePositionReport_Pkg::TrackInfo_T	
trainProps	TrainPosition_Types_Pkg::trainProperties_T	
rcbComm	ProvidePositionReport_Pkg::RBC_Communication_T	
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	
linkingInfoUsed	ProvidePositionReport_Pkg::LinkingInfoUsedOnBoard	
directionLRBG	ProvidePositionReport_Pkg::BG_Orientation_T	
prvDirTrain	Q_DIRTRAIN	

**Table 197: Outputs of ManageTrainPosition**

Name	Type	Comments and Information
posRep	ProvidePositionReport_Pkg::PositionReport_T	
trainPosition	TrainPosition_Types_Pkg::trainPosition_T	

Name	Type	Comments and Information
trainPosInfo	TrainPosition_Types_Pkg::trainPositionInfo_T	<b>Comments:</b> The resulting train position with reference to the LRBG
trainPosErrors	TrainPosition_Types_Pkg::positionErrors_T	<b>Comments:</b> Errors and inconsistencies detected by the calculation.
BGs	TrainPosition_Types_Pkg::positionedBGs_T	<b>Comments:</b> The collection of currently known BGs.

#### 13.1.1.2. Locals

**Table 198: Locals of ManageTrainPosition**

Name	Type	Properties	Comments and Information
trainPosition_loc	TrainPosition_Types_Pkg::trainPosition_T	last CalculateTrainPosition_Pkg::cTrainPosition_0	

#### 13.1.1.3. Operator Hierarchy

diagram : diagram\_ManageTrainPosition\_1

13.1.1.4. Graphical and Textual Diagrams

13.1.1.4.1. View of diagram\_ManageTrainPosition\_1 (ManageTrainPosition)

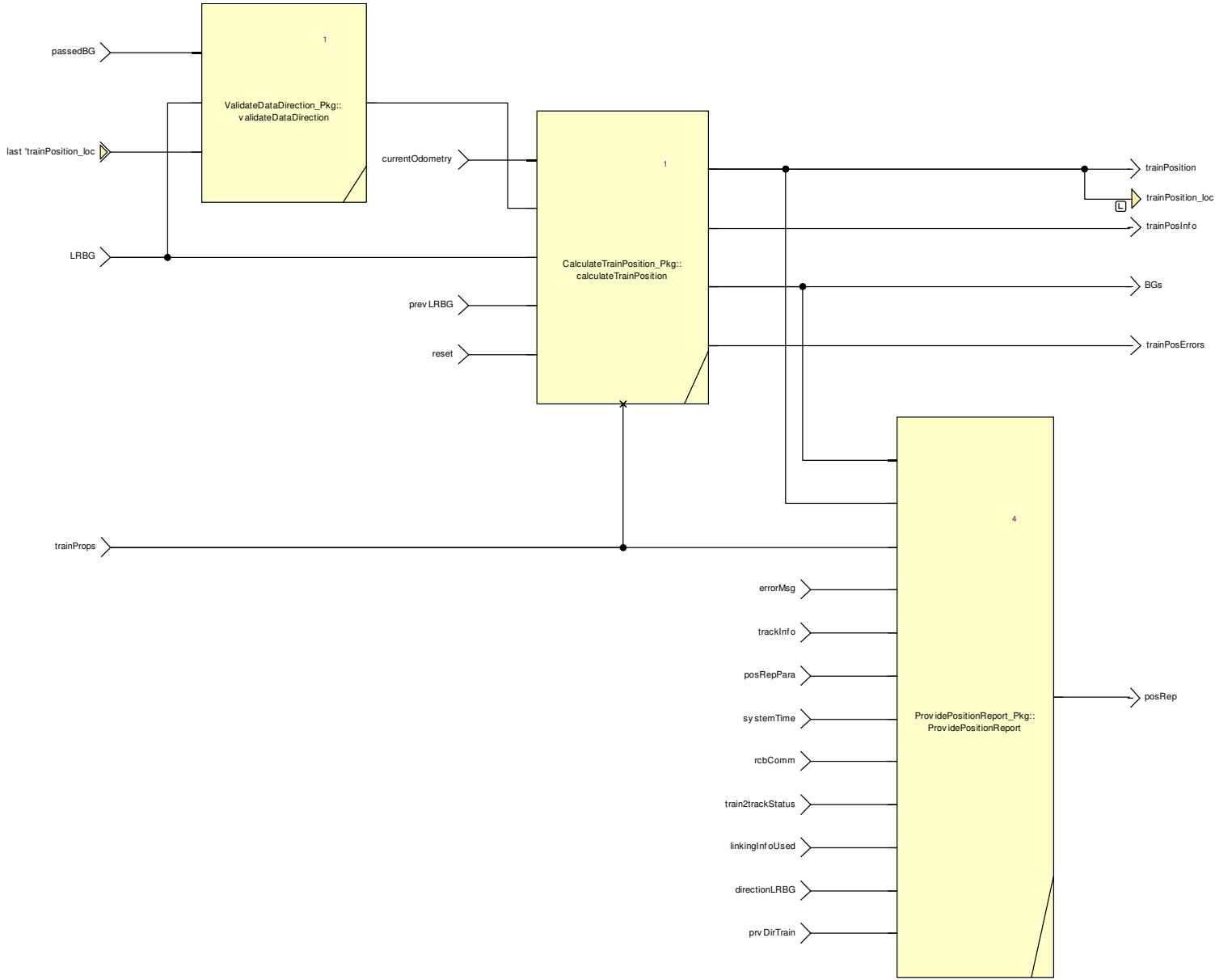


Figure 60: View of diagram\_ManageTrainPosition\_1 (ManageTrainPosition)

## 14. Project Library: CalculateTrainPosition

### 14.1. CalculateTrainPosition\_Pkg Package

#### 14.1.1. Comments and Information

##### CalculateTrainPosition\_Pkg Comments:

- Incorporates the functions to calculate the balise group locations and the actual train position.

Table 199: CalculateTrainPosition\_Pkg Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-09-01
	Version	00.09.0
	to_c	True
Remark_1	Description	<p>CalculateTrainPosition</p> <ul style="list-style-type: none"><li>- Description: Calculates the actual train position based on passed balise groups</li><li>- Copyright Siemens AG, 2014</li><li>- Licensed under the EUPL V.1.1 (<a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li><li>- Gist URL: ---</li><li>- Cryptography: No</li><li>- Author(s): Uwe Steinke</li></ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.1.2. Types

Table 200: Public Types of CalculateTrainPosition\_Pkg

Name	Definition	Comments and Information
positionedBGs_w_overrun_T	{BGs : TrainPosition_Types_Pck::positionedBGs_T, overrun : bool}	

### 14.1.3. Constants

**Table 201: Public Constants of CalculateTrainPosition\_Pkg**

Name	Type	Value	Comments and Information
cNoInfoFromLinking	TrainPosition_Types_Pck::infoFromLinking_T	{valid : false, nid_bg_fromLinkingBG : 0, nid_c_fromLinkingBG : 0, expectedLocation : {nominal : 0, d_min : 0, d_max : 0}, d_link : {nominal : 0, d_min : 0, d_max : 0}, linkingInfo : {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}}	
cNoOfAtLeast_8_LRBGs	int	3	<b>Comments:</b> Covers 3.6.2.2 c): ??? The on-board equipment shall be able to accept information referring to one of at least eight LRBGONB last reported to the RBC.
cNoOfAtLeast_x_unlinkedBGs	int	2	<b>Comments:</b> Covers ????: Min no of unlinked BGs to be memorized

Name	Type	Value	Comments and Information
		<pre> {valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previous_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_total : N_TOTAL_1_balise_ in_the_group, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, linkedBGs : [{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, </pre>	

Name	Type	Value	Comments and Information
		<pre> {valid : false, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked, location : {nominal : 0, d_min : 0, d_max : 0}, seqNoOnTrack : 0, infoFromLinking : {valid : false, nid_bg_fromLinking BG : 0, nid_c_fromLinkingB G : 0, expectedLocation : {nominal : 0, d_min : 0, d_max : 0}, d_link : {nominal : 0, d_min : 0, d_max : 0}, linkingInfo : {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}}, infoFromPassing : {valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, </pre>	



Name	Type	Value	Comments and Information
		<pre>[{valid : false, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked, location : {nominal : 0, d_min : 0, d_max : 0}, seqNoOnTrack : 0, infoFromLinking : {valid : false, nid_bg_fromLinking BG : 0, nid_c_fromLinkingB G : 0, expectedLocation : {nominal : 0, d_min : 0, d_max : 0}, d_link : {nominal : 0, d_min : 0, d_max : 0}, linkingInfo : {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}}, infoFromPassing : {valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi ng_to_EU_Railway_R S_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise,</pre>	

Name	Type	Value	Comments and Information
cNoPositionErrors	TrainPosition_Types _Pck::positionErrors _T	{outOfMemSpace : false, passedBG_notFound WhereExpected : false, positionCalculation_ inconsistent : false}	
cNoValidIndex	int	-1	<b>Comments:</b> An invalid index.
cTrainPosition_0	TrainPosition_Types _Pck::trainPosition_ T	{valid : false, timestamp : 0, trainPositionIsUnkn own : false, noCoordinateSyste mHasBeenAssigned : false, trainPosition : {nominal : 0, d_min : 0, d_max : 0}, estimatedFrontEndP osition : 0, minSafeFrontEndPo sition : 0, maxSafeFrontEndPo sition : 0, nid_LRBG : 0, nid_PrivLRB : 0, nominalOrReverseT oLRBG : Q_DLRBG_Reverse, trainOrientationToL RBG : Q_DIRLRBG_Revers e, trainRunningDirecti onToLRBG : Q_DIRTRAIN_Rever se, speed : 0}	

#### 14.1.4. calculateBGLocations Operator

Declared as **private node**

##### 14.1.4.1. Comments and Information

###### calculateBGLocations Comments:

- Calculation of the locations of passed and announced BGs

**Table 202: calculateBGLocations Annotations**

Note Name	Attribute	Value
GdC_1	Author	Author : Uwe Steinke
	DateC	Created : 2014-15-22
	DateM	Modified : 2014-06-03
	Version	No 00.03.00
	to_c	True

Note Name	Attribute	Value
Remark_1	Description	<p>The main function calculating the actual train position.</p> <ul style="list-style-type: none"> <li>- Description: Calculates the actual train position based on passed balise groups</li> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.1.4.2. Interface

**Table 203: Inputs of calculateBGLocations**

Name	Type	Properties	Comments and Information
passedBG	BG_Types_Pkg::passedBG_T		<b>Comments:</b> Input event reporting a balise group during its passage, if there is one.
lastBGs	TrainPosition_Types_Pkg::positionedBGs_T		<b>Comments:</b> The last collection of currently known BGs.
reset	bool		<b>Comments:</b> Resets all to an initials state and deletes all stored BGs.
trainProperties	TrainPosition_Types_Pkg::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 204: Outputs of calculateBGLocations**

Name	Type	Comments and Information
BGs	TrainPosition_Types_Pkg::positionedBGs_T	<b>Comments:</b> The collection of currently known BGs.
errors	TrainPosition_Types_Pkg::positionErrors_T	

#### 14.1.4.3. Locals

**Table 205: Locals of calculateBGLocations**

Name	Type	Comments and Information
outOfMemSpace	bool	
passedBG_notFoundWhereExpected	bool	

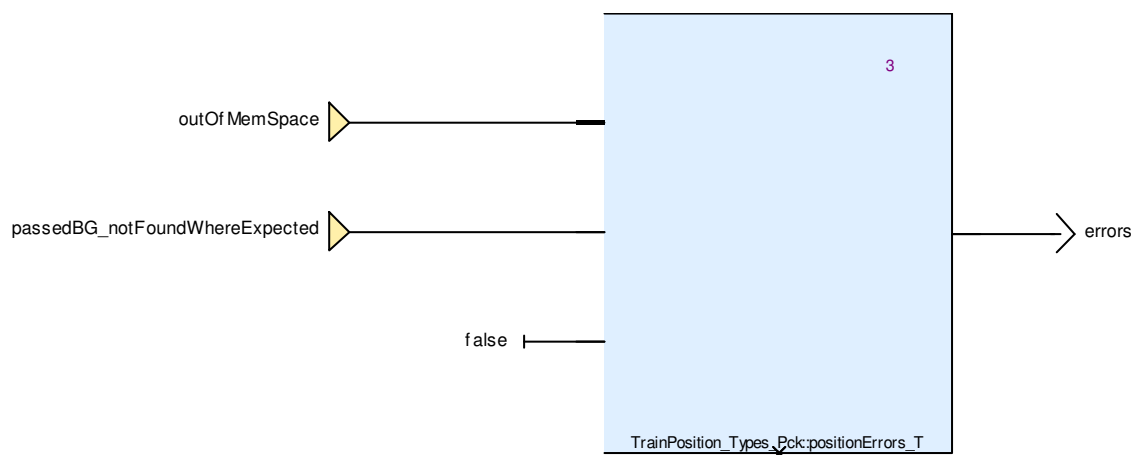
#### 14.1.4.4. Operator Hierarchy

diagram : diagram\_errorReporting

diagram : diagram\_passing\_a\_BG

#### 14.1.4.5. Graphical and Textual Diagrams

##### 14.1.4.5.1. View of diagram\_errorReporting (calculateBGLocations)



**Figure 61: View of diagram\_errorReporting (calculateBGLocations)**



#### 14.1.5.1. Comments and Information

##### calculateTrainPosition Comments:

- The main function calculating the locations of balise groups and the actual train position.

**Table 206: calculateTrainPosition Annotations**

Note Name	Attribute	Value
GdC_1	Author	Author : Uwe Steinke
	DateC	Created : 2014-15-22
	DateM	Modified : 2014-06-03
	Version	No 00.03.00
	to_c	True
Remark_1	Description	<p>The main function calculating the actual train position.</p> <ul style="list-style-type: none"> <li>- Description: Calculates the actual train position based on passed balise groups</li> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.1.5.2. Interface

**Table 207: Inputs of calculateTrainPosition**

Name	Type	Properties	Comments and Information
currentOdometry	Obu_BasicTypes_Pkg::odometry_T		<b>Comments:</b> The current odometry values
passedBG	BG_Types_Pkg::passedBG_T		<b>Comments:</b> Input event reporting a balise group during its passage, if there is one.
LRBG	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The LRBG used for RBC communication.
prevLRBG	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> A previously used LRBG used in RBC communication.

Name	Type	Properties	Comments and Information
reset	bool		<b>Comments:</b> Resets all to an initials state and deletes all stored BGs.
trainProperties	TrainPosition_Types_Pc k::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 208: Outputs of calculateTrainPosition**

Name	Type	Comments and Information
trainPosition	TrainPosition_Types_Pc k::trainPosition_T	<b>Comments:</b> The resulting train position with reference to the LRBG
trainPositionInfo	TrainPosition_Types_Pc k::trainPositionInfo_T	<b>Comments:</b> The resulting train position with reference to the known list of balise groups.
BGs	TrainPosition_Types_Pc k::positionedBGs_T	<b>Comments:</b> The collection of currently known BGs.
errors	TrainPosition_Types_Pc k::positionErrors_T	<b>Comments:</b> Errors and inconsistencies detected by the calculation.

#### 14.1.5.3. Locals

**Table 209: Locals of calculateTrainPosition**

Name	Type	Properties	Comments and Information
BGs_loc	TrainPosition_Types_Pc k::positionedBGs_T	last cNoPositioned BGs	

#### 14.1.5.4. Operator Hierarchy

diagram : diagram\_calculateTrainPosition

#### 14.1.5.5. Graphical and Textual Diagrams

##### 14.1.5.5.1. View of diagram\_calculateTrainPosition (calculateTrainPosition)

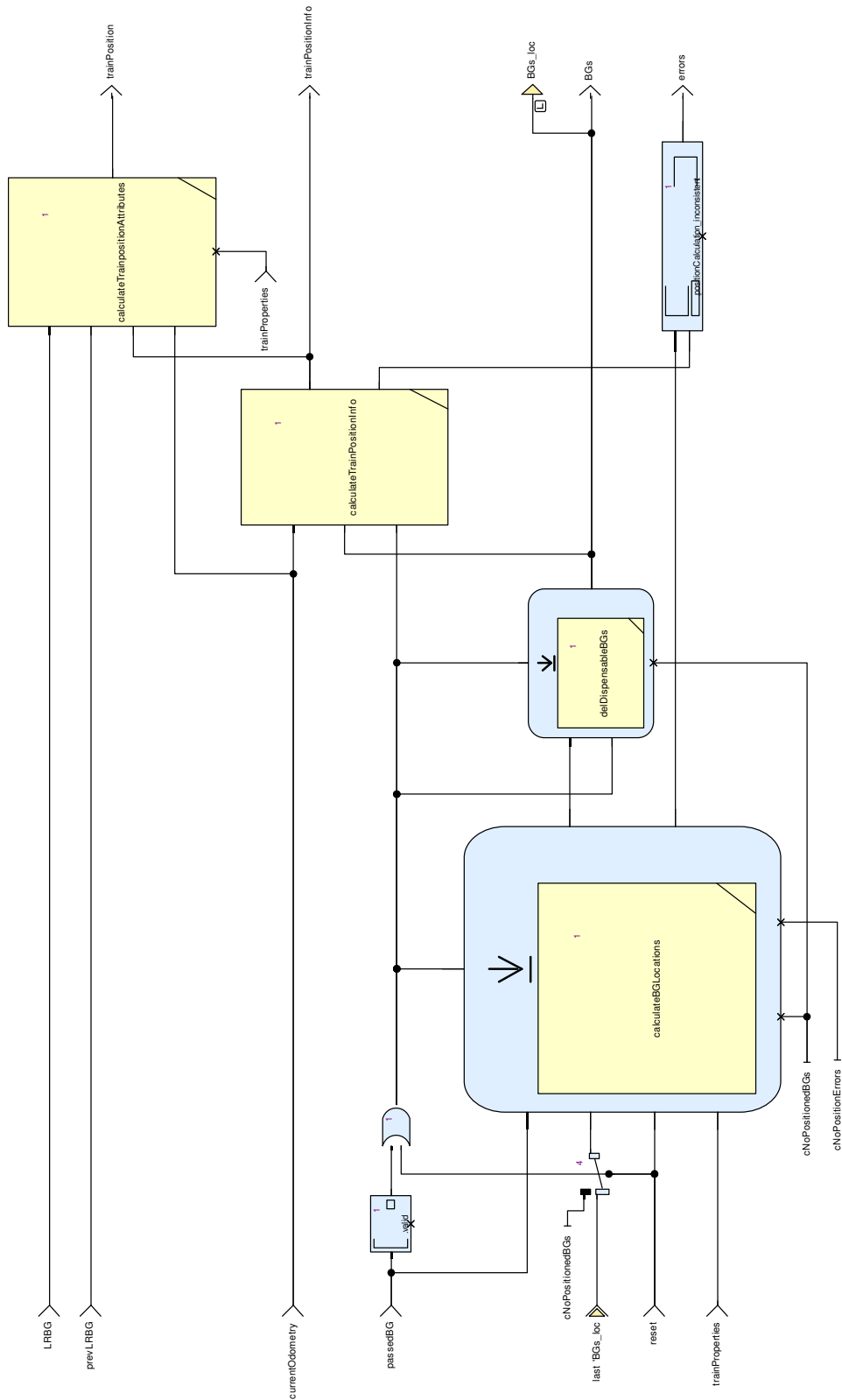


Figure 63: View of diagram\_calculateTrainPosition (calculateTrainPosition)



#### 14.1.6. calculateTrainpositionAttributes Operator

Declared as **private node**

##### 14.1.6.1. Comments and Information

###### calculateTrainpositionAttributes Comments:

- Figures out the attributes of the current train position with reference to a given LRBG.

**Table 210: calculateTrainpositionAttributes Annotations**

Note Name	Attribute	Value
GdC_1	Author	Author : Uwe Steinke
	DateC	Created : 2014-15-22
	DateM	Modified : 2014-06-03
	Version	No 00.03.00
	to_c	True
Remark_1	Description	<p>The main function calculating the actual train position.</p> <ul style="list-style-type: none"> <li>- Description: Calculates the actual train position based on passed balise groups</li> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

##### 14.1.6.2. Interface

**Table 211: Inputs of calculateTrainpositionAttributes**

Name	Type	Properties	Comments and Information
LRBG	TrainPosition_Types_Pc k::positionedBG_T		<b>Comments:</b> The LRBG used for RBC communication.
prevLRBG	TrainPosition_Types_Pc k::positionedBG_T		<b>Comments:</b> A previously used LRBG used in RBC communication.

Name	Type	Properties	Comments and Information
trainPositionInfo	TrainPosition_Types_Pck::trainPositionInfo_T		<b>Comments:</b> The resulting train position with reference to the known list of balise groups.
currentOdometry	Obu_BasicTypes_Pkg::odometry_T		<b>Comments:</b> The current odometry values
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 212: Outputs of calculateTrainpositionAttributes**

Name	Type	Comments and Information
trainPosition	TrainPosition_Types_Pck::trainPosition_T	<b>Comments:</b> The resulting train position with reference to the LRBG

#### 14.1.6.3. Operator Hierarchy

diagram : diagram\_calculateTrainpositionAttributes

**Figure 64: View of diagram\_calculateTrainpositionAttributes (calculateTrainpositionAttributes)**

#### 14.1.7.1. Comments and Information

##### **calculateTrainPositionInfo Comments:**

- Provides the train position information.

#### 14.1.7.2. Interface

**Table 213: Inputs of calculateTrainPositionInfo**

Name	Type	Comments and Information
currentOdometry	Obu_BasicTypes_Pkg::odometry_T	<b>Comments:</b> The current odometry values
BGs	TrainPosition_Types_Pkg::positionedBGs_T	
recalculateBGs	bool	<b>Comments:</b> Triggers the recalculation of the last linked and unlinked BGs.

**Table 214: Outputs of calculateTrainPositionInfo**

Name	Type	Comments and Information
trainPositionInfo	TrainPosition_Types_Pkg::trainPositionInfo_T	<b>Comments:</b> The resulting train position with reference to the known list of balise groups.
positionCalculationNotConsistent	bool	

#### 14.1.7.3. Operator Hierarchy

diagram : diagram\_calculateTrainPositionInfo\_1

14.1.7.4. Graphical and Textual Diagrams

14.1.7.4.1. View of diagram\_calculateTrainPositionInfo\_1 (calculateTrainPositionInfo)

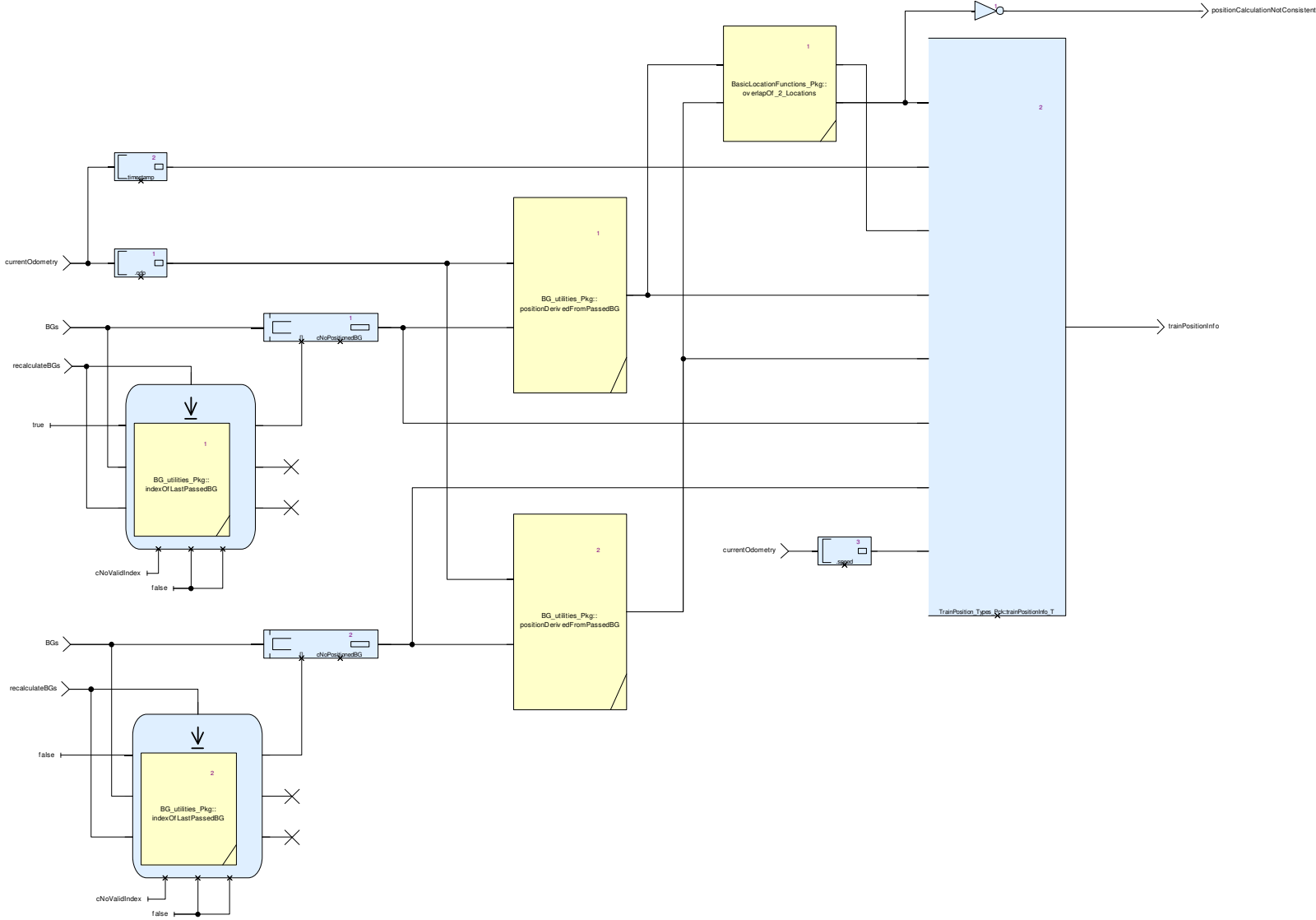


Figure 65: View of diagram\_calculateTrainPositionInfo\_1 (calculateTrainPositionInfo)

#### 14.1.8. delDispensableBGs Operator

Declared as **private function**

##### 14.1.8.1. Comments and Information

###### delDispensableBGs Comments:

- Deletes dispensable BGs.
- As dispensable are seen
- - if at least on passed linked BGs exist: all BGs prior to the last cNoOfAtLeast\_8\_LRBGs linked BGs (covers 3.6.2.2 c) ).
- - if no passed linked BGs exist: all BGs prior to the last cNoOfAtLeast\_2\_unlinkedBGs unlinked BGs.

##### 14.1.8.2. Interface

**Table 215: Inputs of delDispensableBGs**

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T	<b>Comments:</b> The collection of BGs as known before passedBG was passed.
delete	bool	

**Table 216: Outputs of delDispensableBGs**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	<b>Comments:</b> The collection of BGs as known when passedBG was passed.

##### 14.1.8.3. Locals

**Table 217: Locals of delDispensableBGs**

Name	Type	Comments and Information
passedLinkedBGsCount	int	
passedUnlinkedBGsCount	int	

##### 14.1.8.4. Operator Hierarchy

diagram : diagram\_delDispensableBGs\_1  
    *activate if* : IfBlock1  
        branch : then  
        branch : else

#### 14.1.8.5. Graphical and Textual Diagrams

##### 14.1.8.5.1. View of diagram\_delDispensableBGs\_1 (delDispensableBGs)

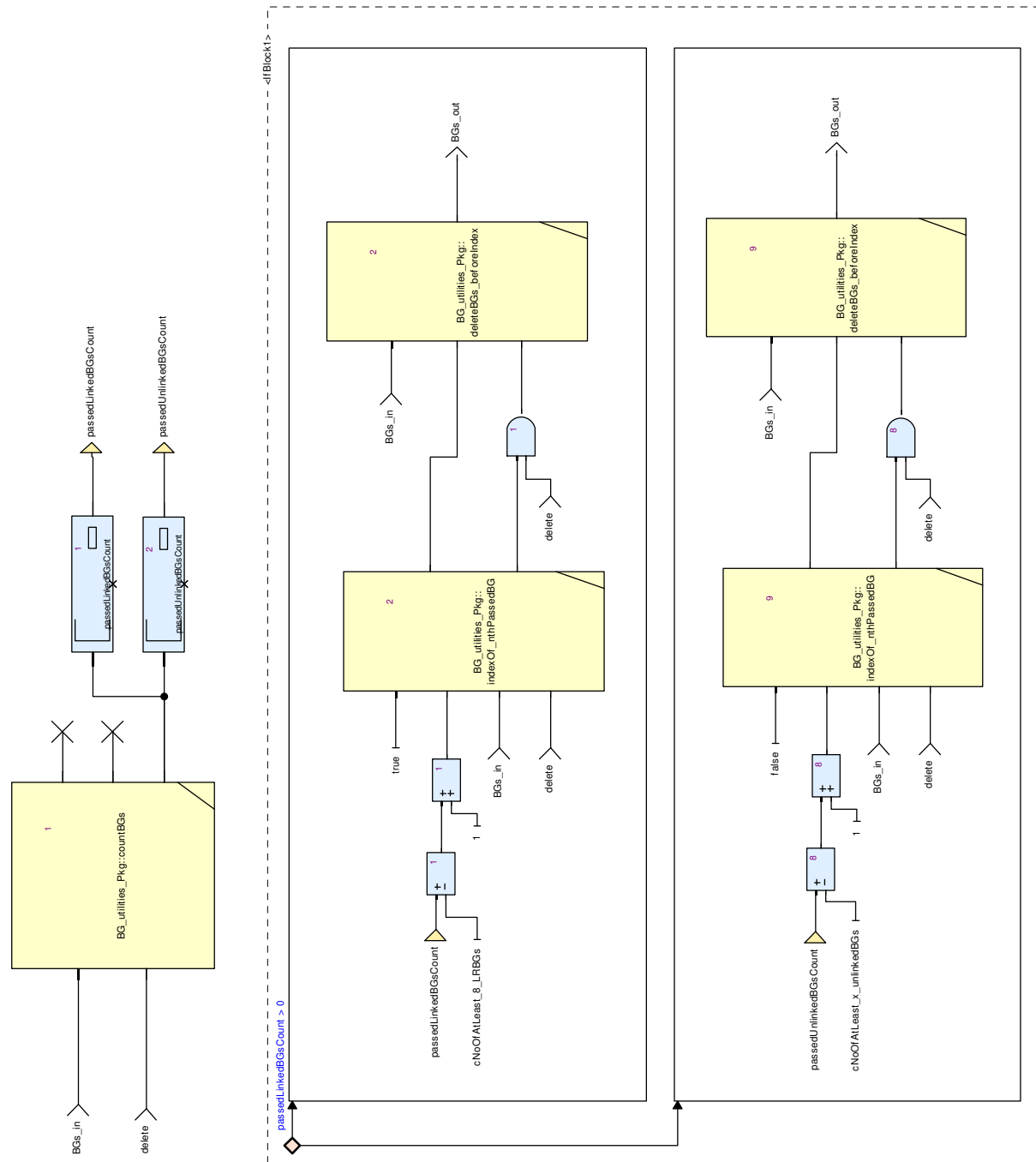


Figure 66: View of diagram\_delDispensableBGs\_1 (delDispensableBGs)

Table 218: Conditional Blocks of diagram\_delDispensableBGs\_1

Conditional Block	Comments and Information
IfBlock1	

Table 219: Actions of diagram\_delDispensableBGs\_1

Conditional Block Action	Comments and Information
IfBlock1:then	

Conditional Block Action	Comments and Information
IfBlock1:else	

#### 14.1.9. genPassedBG\_SeqNo Operator

Declared as **private node**

##### 14.1.9.1. Comments and Information

###### genPassedBG\_SeqNo Comments:

- Generates a sequence number for every passed BG. The sequence no is intended to be an order criterion for the BGs on the track.
- If a BG was already passed before, it's sequence no is preserved.

##### 14.1.9.2. Interface

**Table 220: Inputs of genPassedBG\_SeqNo**

Name	Type	Comments and Information
passedBG	BG_Types_Pkg::passedBG_T	<b>Comments:</b> Input event reporting a balise group during its passage, if there is one.
BGs	TrainPosition_Types_Pkg::positionedBGs_T	
reset	bool	<b>Comments:</b> Resets all to an initial state and deletes all stored BGs.

**Table 221: Outputs of genPassedBG\_SeqNo**

Name	Type	Comments and Information
seqNo	int	

##### 14.1.9.3. Locals

**Table 222: Locals of genPassedBG\_SeqNo**

Name	Type	Comments and Information
incrPassedBGSeqNo	bool	
keepPassedBGSeqNo	bool	

##### 14.1.9.4. Operator Hierarchy

diagram : diagram\_genPassedBG\_SeqNo\_1



#### 14.1.9.5. Graphical and Textual Diagrams

##### 14.1.9.5.1. View of diagram\_genPassedBG\_SeqNo\_1 (genPassedBG\_SeqNo)

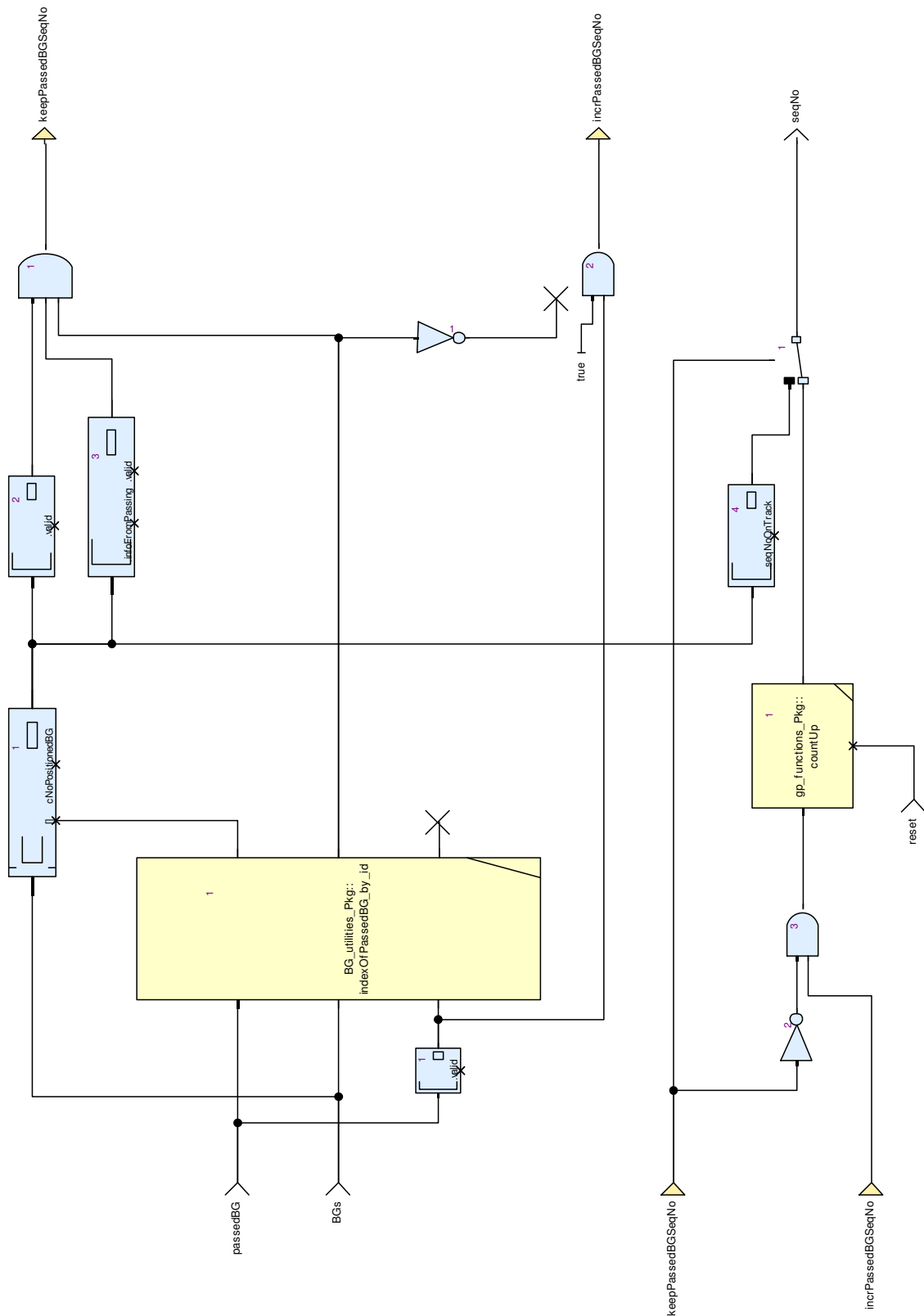


Figure 67: View of diagram\_genPassedBG\_SeqNo\_1 (genPassedBG\_SeqNo)

#### 14.1.10. memPassedBG Operator

Declared as **private node**

##### 14.1.10.1. Comments and Information

###### memPassedBG Comments:

- Memorizes the passed linked and unlinked BG

**Table 223: memPassedBG Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Memorizes the passed linked and unlinked BG</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

##### 14.1.10.2. Interface

**Table 224: Inputs of memPassedBG**

Name	Type	Comments and Information
passedBG	TrainPosition_Types_Pc k::positionedBG_T	
prevPassedLinkedBG	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The previously passed linked BG as a reference location for improvement of an unlinked BG location.
reset	bool	

**Table 225: Outputs of memPassedBG**

Name	Type	Comments and Information
passedLinkedBG	TrainPosition_Types_Pc k::positionedBG_T	

Name	Type	Comments and Information
passedUnlinkedBG	TrainPosition_Types_Pc k::positionedBG_T	

#### 14.1.10.3. Locals

**Table 226: Locals of memPassedBG**

Name	Type	Properties		Comments and Information
passedUnlinkedBG_loc	TrainPosition_Types_Pc k::positionedBG_T	last	cNoPositioned BG	

#### 14.1.10.4. Operator Hierarchy

diagram : diagram\_memPassedBG\_1

## 14.1.10.5. Graphical and Textual Diagrams

### 14.1.10.5.1. View of diagram\_memPassedBG\_1 (memPassedBG)

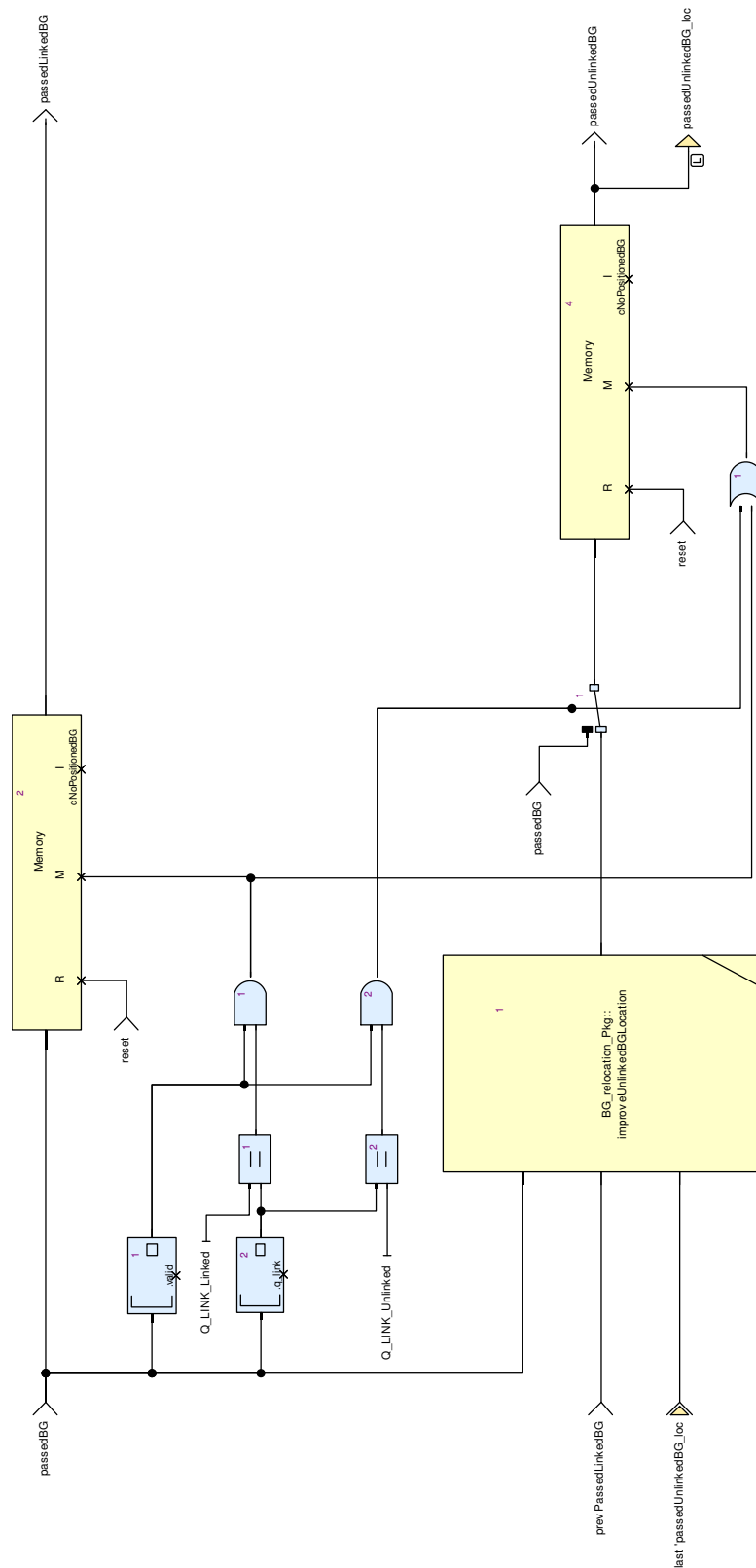


Figure 68: View of diagram\_memPassedBG\_1 (memPassedBG)

#### 14.1.11. passedBG\_2\_positionedBG Operator

Declared as **private function**

##### 14.1.11.1. Comments and Information

###### passedBG\_2\_positionedBG Comments:

- Converts a passed balise group information to a positioned balise group information and calculates the location of the passed BG.

**Table 227: passedBG\_2\_positionedBG Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Converts a passed balise group to a positioned balise group information</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

##### 14.1.11.2. Interface

**Table 228: Inputs of passedBG\_2\_positionedBG**

Name	Type	Properties	Comments and Information
passedBG	BG_Types_Pkg::passedBG_T		<b>Comments:</b> The balise group as actually passed.
passedBG_asAnnounced	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> If the passed balise group was previously announced, this is the passed BG as known before passing. If the passed balise group was not announced, this input has to be set invalid.

Name	Type	Properties	Comments and Information
previouslyPassedLinkedBG	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The previously passed linked BG, if there is one. Serves a reference point for location calculation.
passedBGSeqNo	int		<b>Comments:</b> Sequence no of the just passed BG
trainProperties	TrainPosition_Types_Pkg::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 229: Outputs of passedBG\_2\_positionedBG**

Name	Type	Properties		Comments and Information
passedPositionedBG	TrainPosition_Types_Pkg::positionedBG_T			<b>Comments:</b> The passed and positioned balise group. If the BG was announced by linking information previously, the linking and the passing information are merged together. If the BG was not announced before, only the passing information is evaluated.
notFoundWhereAnnounced	bool	default	false	<b>Comments:</b> Indicates that the location of the passed BG does not fit into the range, where it was expected by the linking information.
linkedBGs	TrainPosition_Types_Pkg::linkedBGs_asPositionedBGs_T			<b>Comments:</b> The balise groups linked with the passed BG.

#### 14.1.11.3. Locals

**Table 230: Locals of passedBG\_2\_positionedBG**

Name	Type	Comments and Information
BG_wasAnnounced	bool	<b>Comments:</b> Indicates, that the BG was previously announced with linking information and the signature is consistent.
location	Obu_BasicTypes_Pkg::LocWithInAcc_T	
passedPositionedBG_location	TrainPosition_Types_Pkg::positionedBG_T	

#### 14.1.11.4. Operator Hierarchy

diagram : diagram\_calculateDistance

*activate if* : ifAnnouncedOrABGWasPreviouslyPassed

        branch : then

        branch : else

            branch : then

            branch : else

                branch : then

                branch : else

diagram : diagram\_checkAnnouncedInfo

diagram : diagram\_passedBG\_2\_positionedBG

diagram : diagram\_positionLinkedBGs

14.1.11.5. Graphical and Textual Diagrams

14.1.11.5.1. View of diagram\_calculatedDistance (passedBG\_2\_positionedBG)

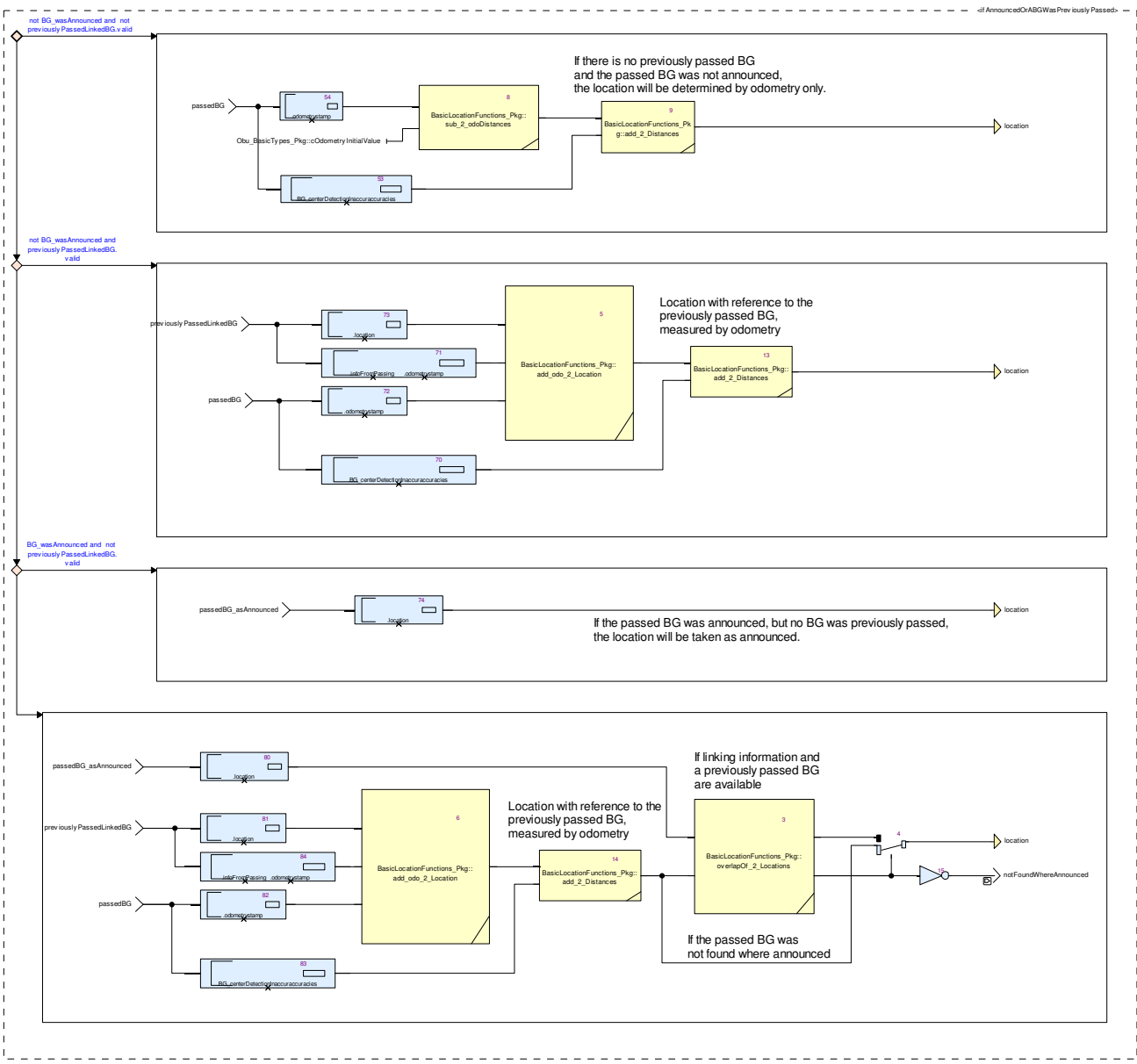


Figure 69: View of diagram\_calculatedDistance (passedBG\_2\_positionedBG)

diagram\_calculatedDistance Comments:

- Calculates the location of the passed balise group, dependant on if it was announced by linking or not and if another BG was previously passed or not.

Table 231: Conditional Blocks of diagram\_calculatedDistance

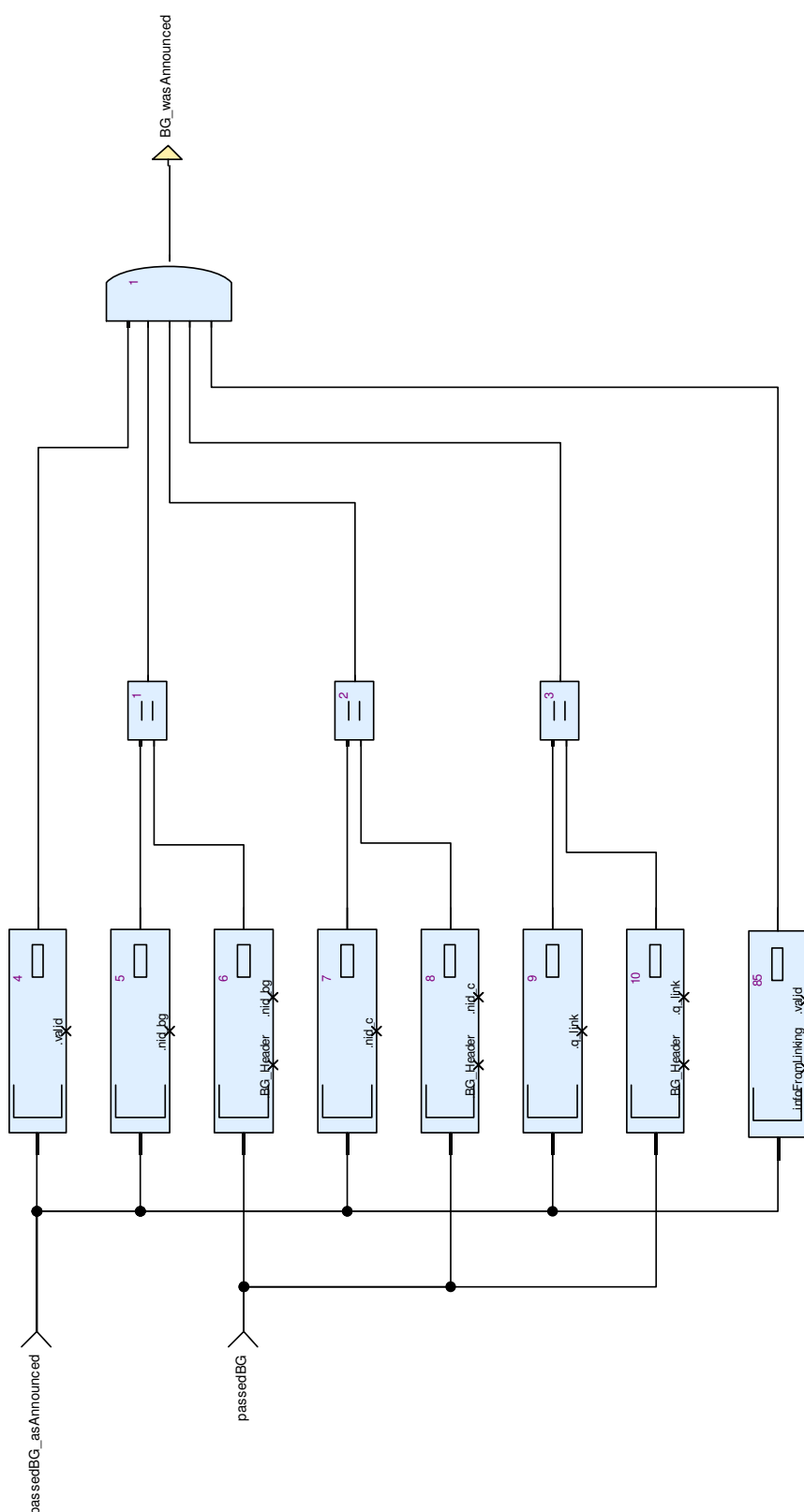
Conditional Block	Comments and Information
ifAnnouncedOrABGWasPreviouslyPassed	



**Table 232: Actions of diagram\_calculateDistance**

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

#### 14.1.11.5.2. View of diagram\_checkAnnouncedInfo (passedBG\_2\_positionedBG)



**Figure 70: View of diagram\_checkAnnouncedInfo (passedBG\_2\_positionedBG)**

**diagram\_checkAnnouncedInfo** Comments:

- Checks if the passed BG was announced with linking information.

14.1.11.5.3. View of diagram\_passedBG\_2\_positionedBG (passedBG\_2\_positionedBG)

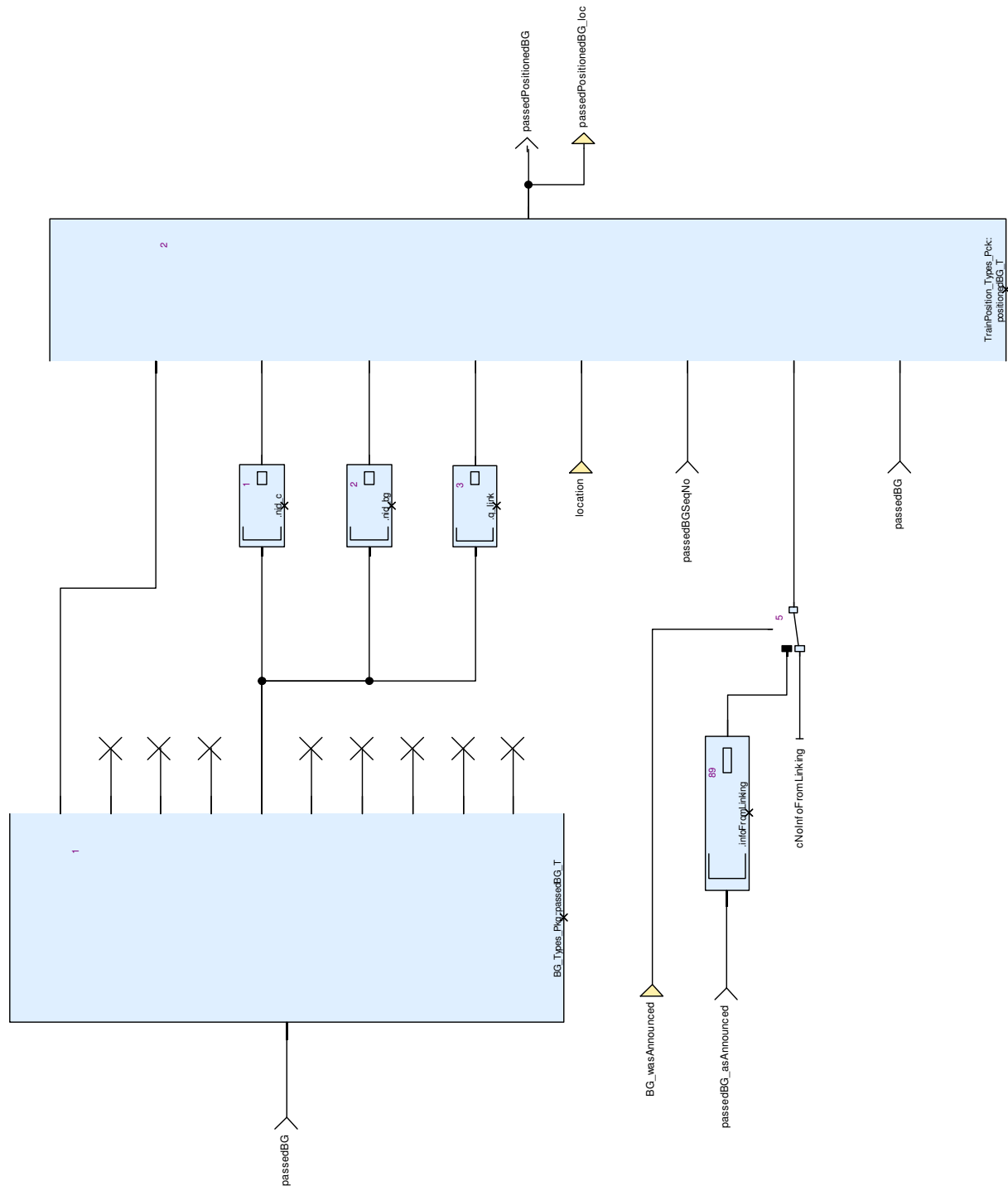


Figure 71: View of diagram\_passedBG\_2\_positionedBG (passedBG\_2\_positionedBG)

#### 14.1.11.5.4. View of diagram\_positionLinkedBGs (passedBG\_2\_positionedBG)

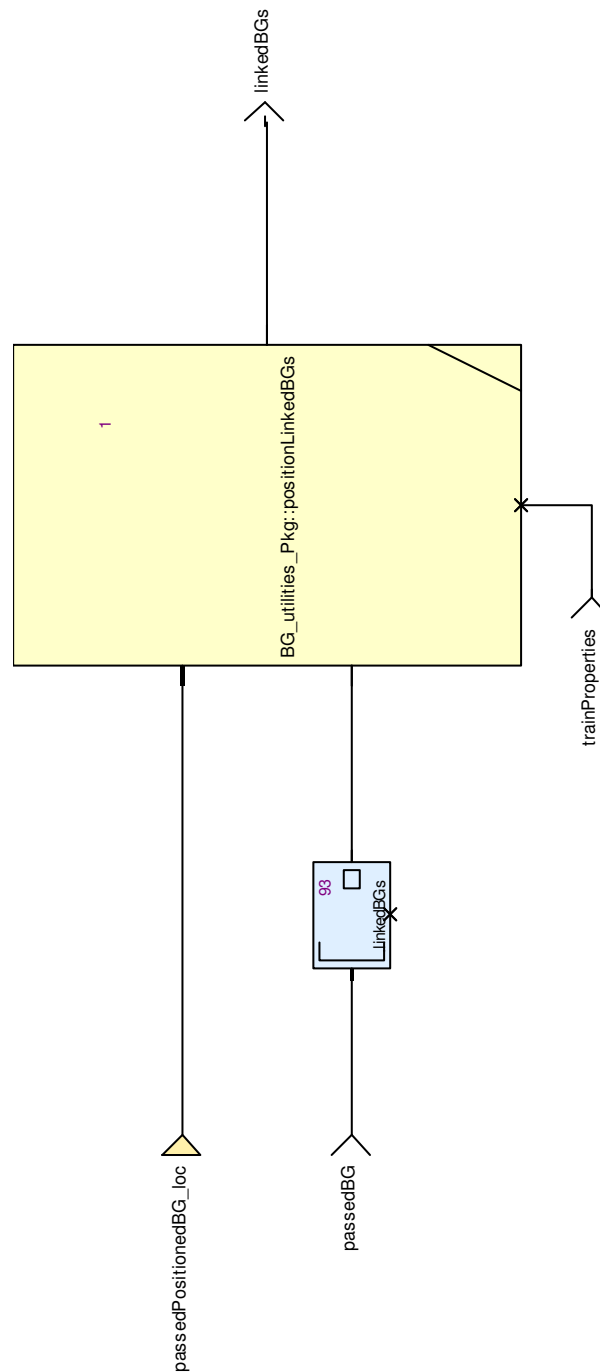


Figure 72: View of diagram\_positionLinkedBGs (passedBG\_2\_positionedBG)

#### 14.1.12. passing\_a\_BG Operator

Declared as **private function**

##### 14.1.12.1. Comments and Information

###### passing\_a\_BG Comments:

- Provides the location calculations while passing a BG

**Table 233: passing\_a\_BG Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Provides the location calculations while passing a BG</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.1.12.2. Interface

**Table 234: Inputs of passing\_a\_BG**

Name	Type	Properties	Comments and Information
passedBG	BG_Types_Pkg::passedBG_T		
previouslyPassedLinkedBG	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The previously passed linked BG, if there is one. Serves a reference point for location calculation.
BGs_in	TrainPosition_Types_Pkg::positionedBGs_T		<b>Comments:</b> The collection of BGs as known before passedBG was passed.
passedBGSeqNo	int		<b>Comments:</b> Sequence no of the just passed BG
trainProperties	TrainPosition_Types_Pkg::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 235: Outputs of passing\_a\_BG**

Name	Type	Comments and Information
passedPositionedBG	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The passed and positioned balise group. If the BG was announced by linking information previously, the linking and the passing information are merged together. If the BG was not announced before, only the passing information is evaluated.
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	<b>Comments:</b> The collection of BGs as known when passedBG was passed.
overrun	bool	<b>Comments:</b> Indicates, that not all of the elements of BGs_2 could be merged into BGs_out, due to not enough space in BGs_out.
notFoundWhereAnnounced	bool	<b>Comments:</b> Indicates that the location of the passed BG does not fit into the range, where it was expected by the linking information.

#### 14.1.12.3. Operator Hierarchy

diagram : diagram\_passing\_a\_BG\_1

14.1.12.4. Graphical and Textual Diagrams

14.1.12.4.1. View of diagram\_passing\_a\_BG\_1 (passing\_a\_BG)

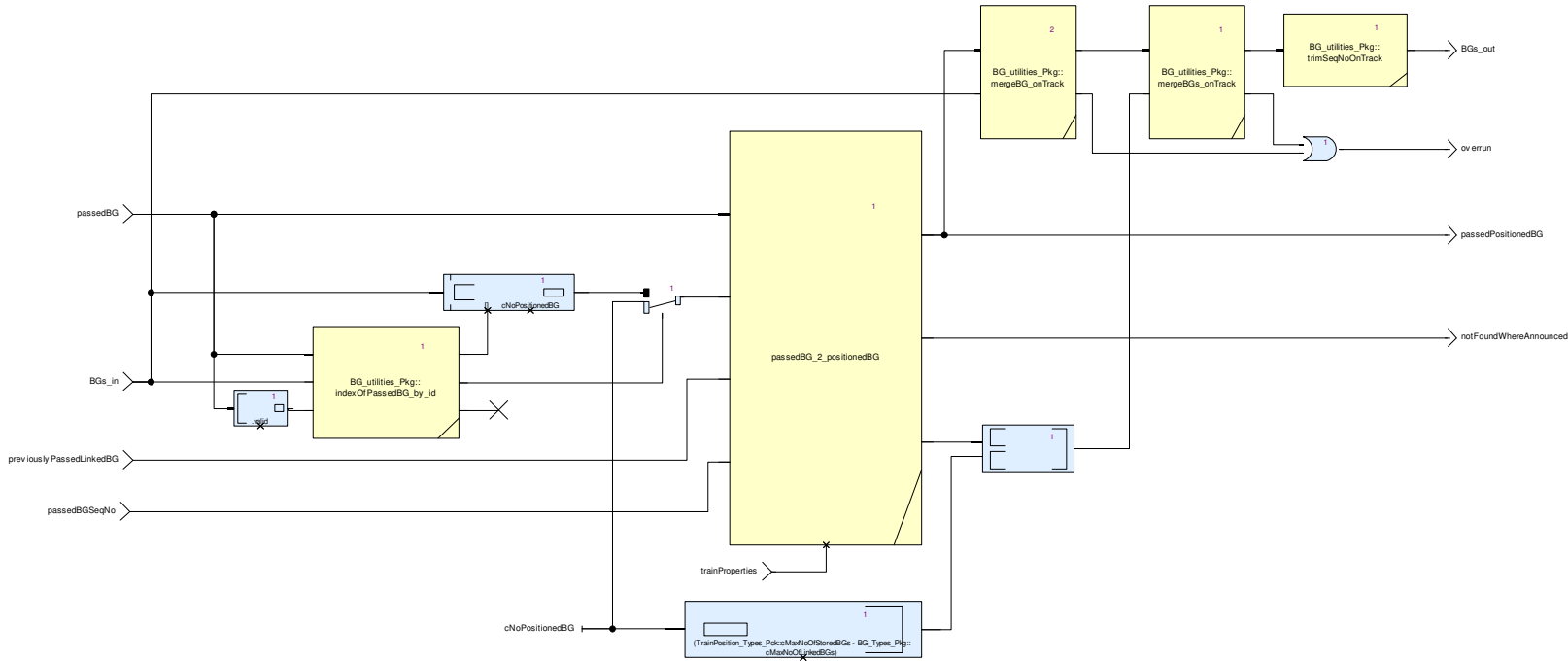


Figure 73: View of diagram\_passing\_a\_BG\_1 (passing\_a\_BG)

### 14.1.13. prevPassedLinkedBG Operator

Declared as **private function**

#### 14.1.13.1. Comments and Information

##### prevPassedLinkedBG Comments:

- Memorizes the previously passed BG when a new BG is passed and the IDs are different

**Table 236: prevPassedLinkedBG Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Memorizes the previously passed BG when a new BG is passed and the IDs are different.</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.1.13.2. Interface

**Table 237: Inputs of prevPassedLinkedBG**

Name	Type	Comments and Information
passedBG	BG_Types_Pkg::passedBG_T	<b>Comments:</b> The currently passed BG
last_BGs	TrainPosition_Types_Pkg::positionedBGs_T	<b>Comments:</b> The current collection of BGs before the passed BG was found.

**Table 238: Outputs of prevPassedLinkedBG**

Name	Type	Comments and Information
previouslyPassedBG	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> The previously passed linked BG



#### 14.1.13.3. Operator Hierarchy

diagram : diagram\_prevPassedLinkedBG\_1



## 14.2. CalculateTrainPosition\_Pkg::BG\_relocation\_Pkg Package

### 14.2.1. Types

**Table 239: Public Types of BG\_relocation\_Pkg**

Name	Definition	Comments and Information
BGs_forImprovement_T	{prevLinkedBG : TrainPosition_Types_Pck::positionedB G_T, unlinkedBG : TrainPosition_Types_Pck::positionedB G_T, indexOfUnlinkedBG : int}	<b>Comments:</b> Serves to map and fold through the BGs <b>prevLinkedBG Comments:</b> The previous linked BG in the map and fold chain <b>unlinkedBG Comments:</b> The previous unlinked BG in the map and fold chain <b>indexOfUnlinkedBG Comments:</b> Enables the location recalculation for all BGs subsequent to refBG
linkedBG_index_T	{previousLinkedBG_idx : int, currentIndex : int, subsequentLinkedBG_idx : int}	<b>previousLinkedBG_idx Comments:</b> Index of the BG before <b>currentIndex Comments:</b> The current index <b>subsequentLinkedBG_idx Comments:</b> Index of the BG behind
linkedBGs_indices_T	CalculateTrainPosition_Pkg::BG_reloc ation_Pkg::linkedBG_index_T ^TrainPosition_Types_Pck::cMaxNoOf StoredBGs	
refBGs_T	{refBG : TrainPosition_Types_Pck::positionedB G_T, prevLinkedBG : TrainPosition_Types_Pck::positionedB G_T, prevUnlinkedBG : TrainPosition_Types_Pck::positionedB G_T, recalculate : bool, sumOfBestDistances : Obu_BasicTypes_Pkg::LocWithInAcc_ T}	<b>Comments:</b> Serves to map and fold through the BGs <b>refBG Comments:</b> The reference BG for the location recalculation. <b>prevLinkedBG Comments:</b> The previous linked BG in the map and fold chain; the linked BG, where sumOfPrevLinkingDistances refer to. <b>prevUnlinkedBG Comments:</b> The previous unlinked BG in the map and fold chain <b>recalculate Comments:</b> Enables the location recalculation for all BGs subsequent to refBG <b>sumOfBestDistances Comments:</b> The sum of the linking distances and odometry (for linking holes) from the chain of previous linked BGs since refBG.

## 14.2.2. Constants

**Table 240: Public Constants of BG\_relocation\_Pkg**

Name	Type	Value	Comments and Information
cNoLinkedBG_index	CalculateTrainPosition_Pkg::BG_relocation_Pkg::linkedBG_index_T	{previousLinkedBG_idx : gp_functions_Pkg::noValidIndex, currentIndex : (-1), subsequentLinkedBG_idx : gp_functions_Pkg::noValidIndex}	

Name	Type	Value	Comments and Information
		<pre>{refBG : {valid : false, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked, location : {nominal : 0, d_min : 0, d_max : 0}, seqNoOnTrack : 0, infoFromLinking : {valid : false, nid_bg_fromLinking BG : 0, nid_c_fromLinkingB G : 0, expectedLocation : {nominal : 0, d_min : 0, d_max : 0}, d_link : {nominal : 0, d_min : 0, d_max : 0}, linkingInfo : {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}}, infoFromPassing : {valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi ng_to_EU_Railway_R S_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise,</pre>	

### 14.2.3. calculateLocalBGInaccuracies Operator

Declared as **private function**

#### 14.2.3.1. Comments and Information

##### **calculateLocalBGInaccuracies Comments:**

- Calculates the inaccuracies of a BG caused by local effects:
- - centerDetectionInaccuracy
- - linking inaccuracy
- - Q\_NVLOCACC (National Value)
- - Default value

#### 14.2.3.2. Interface

**Table 241: Inputs of calculateLocalBGInaccuracies**

Name	Type	Properties	Comments and Information
BG_in	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The BG that's location has to be recalculated
trainProperties	TrainPosition_Types_Pkg::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 242: Outputs of calculateLocalBGInaccuracies**

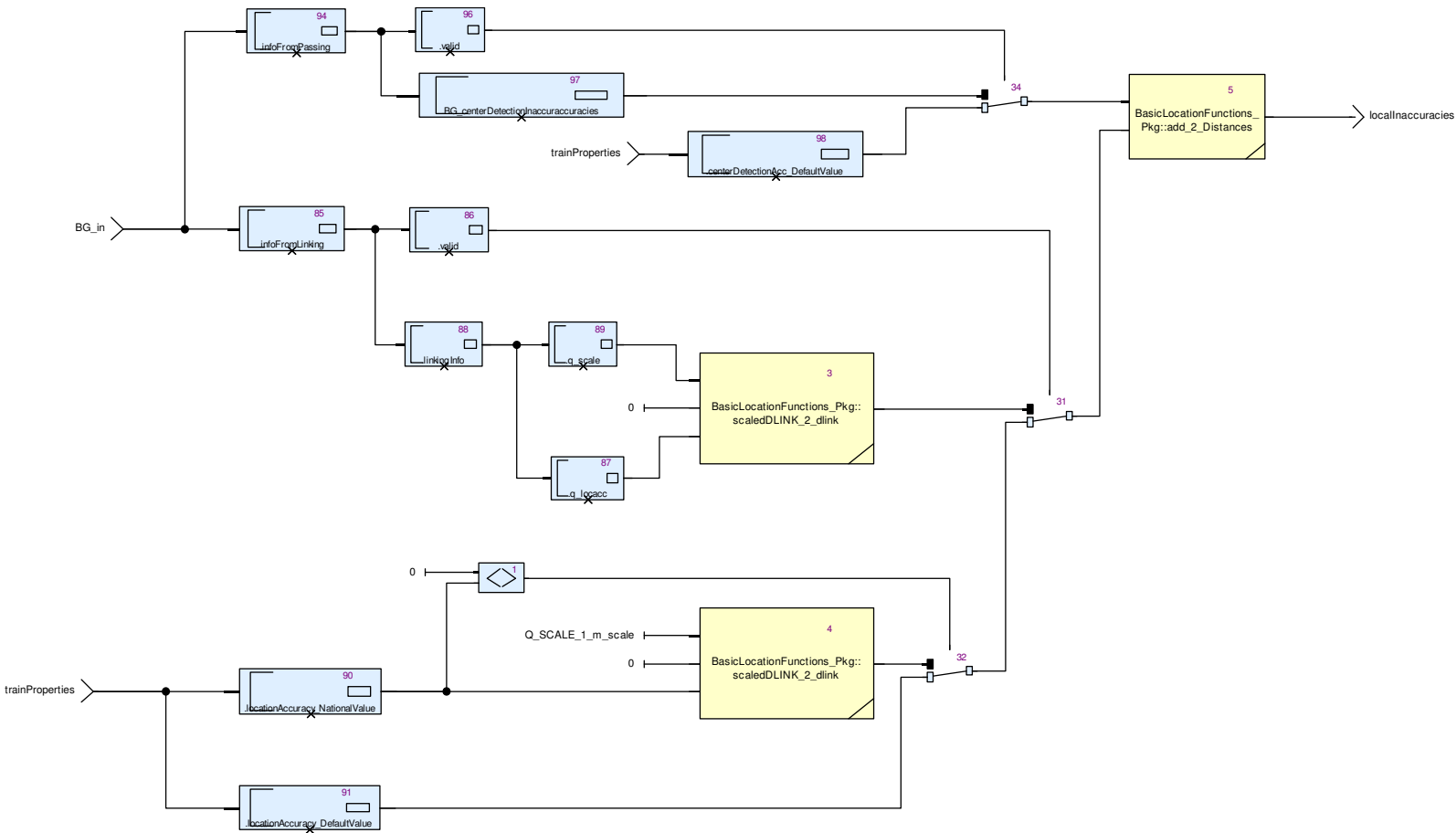
Name	Type	Comments and Information
localInaccuracies	Obu_BasicTypes_Pkg::LocWithInAcc_T	

#### 14.2.3.3. Operator Hierarchy

diagram : diagram\_calculateLocalBGInaccuracies\_1

14.2.3.4. Graphical and Textual Diagrams

14.2.3.4.1. View of diagram\_calculateLocalBGInaccuracies\_1  
(calculateLocalBGInaccuracies)



**Figure 75: View of diagram\_calculateLocalBGInaccuracies\_1 (calculateLocalBGInaccuracies)**

#### 14.2.4. findLinkedBG\_bckwd\_itr Operator

Declared as **private function**

##### 14.2.4.1. Comments and Information

###### **findLinkedBG\_bckwd\_itr Comments:**

- Function for iterating through all BGs in backward direction.
- If BG\_in is a linked BG, index\_out.subsequentLinkedIndex is set to the current index.
- If not, index\_out.subsequentLinkedIndex is taken from the previous iteration.
- index\_out.currentIndex is taken from index\_in without change.
- index\_out.previousLinkedIndex is taken unchanged from index\_in.

##### 14.2.4.2. Interface

**Table 243: Inputs of findLinkedBG\_bckwd\_itr**

Name	Type	Comments and Information
index_acc_in	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::linkedBG_index_T	
index_in	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::linkedBG_index_T	
BG_in	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The unlinked BG that's location shall be improved

**Table 244: Outputs of findLinkedBG\_bckwd\_itr**

Name	Type	Comments and Information
index_acc_out	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::linkedBG_index_T	
index_out	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::linkedBG_index_T	

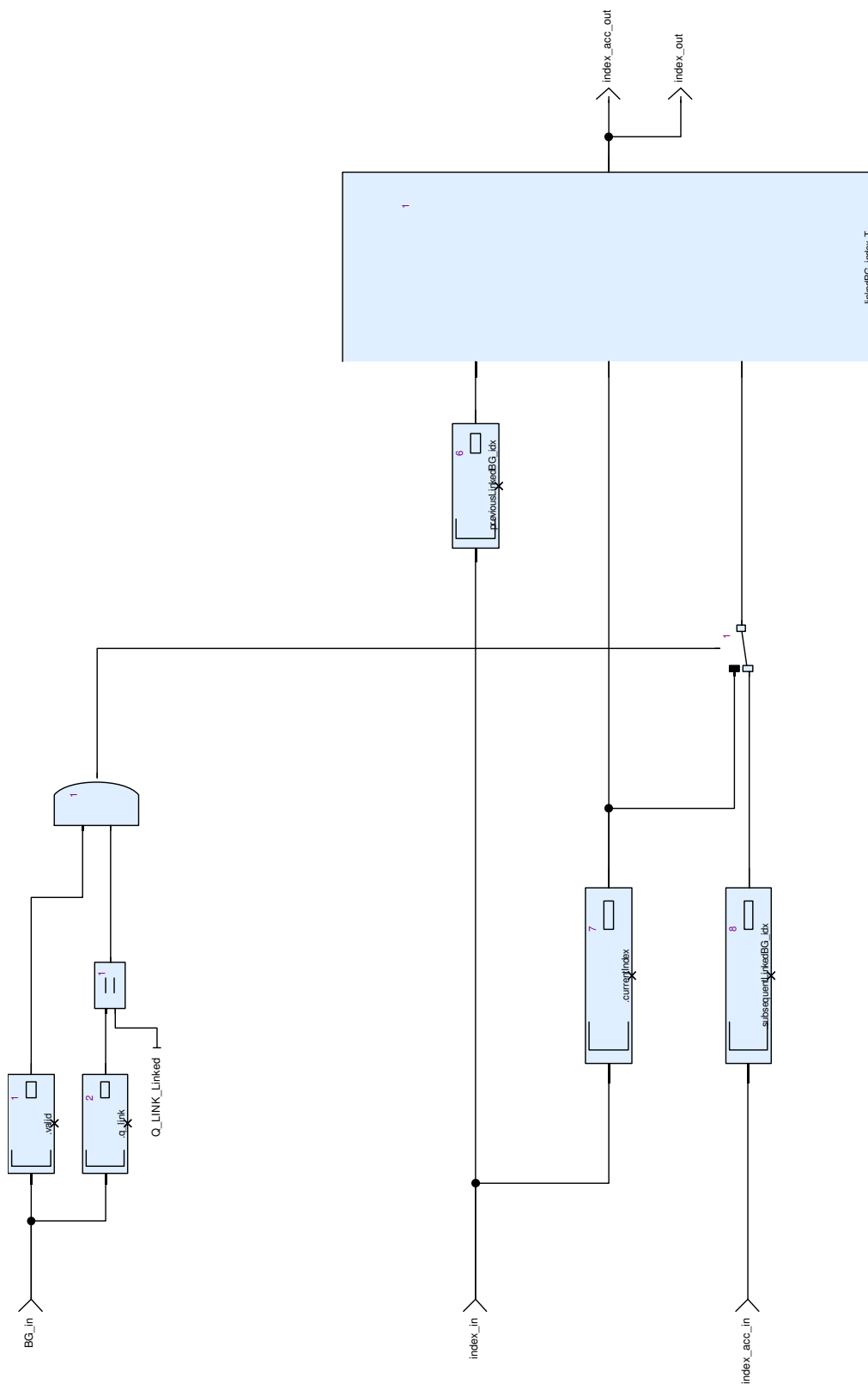
##### 14.2.4.3. Operator Hierarchy

diagram : diagram\_findLinkedBG\_bckwd\_itr\_1



#### 14.2.4.4. Graphical and Textual Diagrams

##### 14.2.4.4.1. View of diagram\_findLinkedBG\_bckwd\_itr\_1 (findLinkedBG\_bckwd\_itr)



**Figure 76: View of diagram\_findLinkedBG\_bckwd\_itr\_1 (findLinkedBG\_bckwd\_itr)**

#### 14.2.5. findLinkedBG\_fwd\_itr Operator

Declared as **private function**

##### 14.2.5.1. Comments and Information

###### findLinkedBG\_fwd\_itr Comments:

- Function for iterating through all BGs in forward direction.
- If BG\_in is a linked BG, index\_out.previousLinked\_BG\_idx is set to the current index.
- If not, index\_out.previousLinked\_BG\_idx is taken from the previous iteration.
- index\_out.currentIndex is generated by incrementing the index from the previous iteration.
- index\_out.subsequentLinkedIndex taken unchanged from index\_in.

##### 14.2.5.2. Interface

**Table 245: Inputs of findLinkedBG\_fwd\_itr**

Name	Type	Comments and Information
index_in	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::linkedBG_index_T	<b>Comments:</b> Indices for the iteration
BG_in	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The BG to be searched for.

**Table 246: Outputs of findLinkedBG\_fwd\_itr**

Name	Type	Comments and Information
index_acc	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::linkedBG_index_T	<b>Comments:</b> The results to be transferred to the next iteration.
index_out	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::linkedBG_index_T	<b>Comments:</b> The resulting indices

##### 14.2.5.3. Operator Hierarchy

diagram : diagram\_findLinkedBG\_fwd\_itr\_1



#### 14.2.6. findLinkedBGs Operator

Declared as **private function**

##### 14.2.6.1. Comments and Information

###### **findLinkedBGs Comments:**

- Iterates through BGs\_in forward and backward direction and looks for linked BGs.
- The result is an array of indices, where each cell related to an unlinked BG provides the indices of the linked BG before and behind the unlinked BG.

##### 14.2.6.2. Interface

**Table 247: Inputs of findLinkedBGs**

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pkg::positionedBGs_T	<b>Comments:</b> The BGs to be analyzed.

**Table 248: Outputs of findLinkedBGs**

Name	Type	Comments and Information
BGs_indices	CalculateTrainPosition_Pkg::BG_relocation_Pkg::linkedBGs_indices_T	<b>Comments:</b> The resulting array of indices.

##### 14.2.6.3. Operator Hierarchy

diagram : diagram\_findLinkedBGs\_1

#### 14.2.6.4. Graphical and Textual Diagrams

##### 14.2.6.4.1. View of diagram\_findLinkedBGs\_1 (findLinkedBGs)

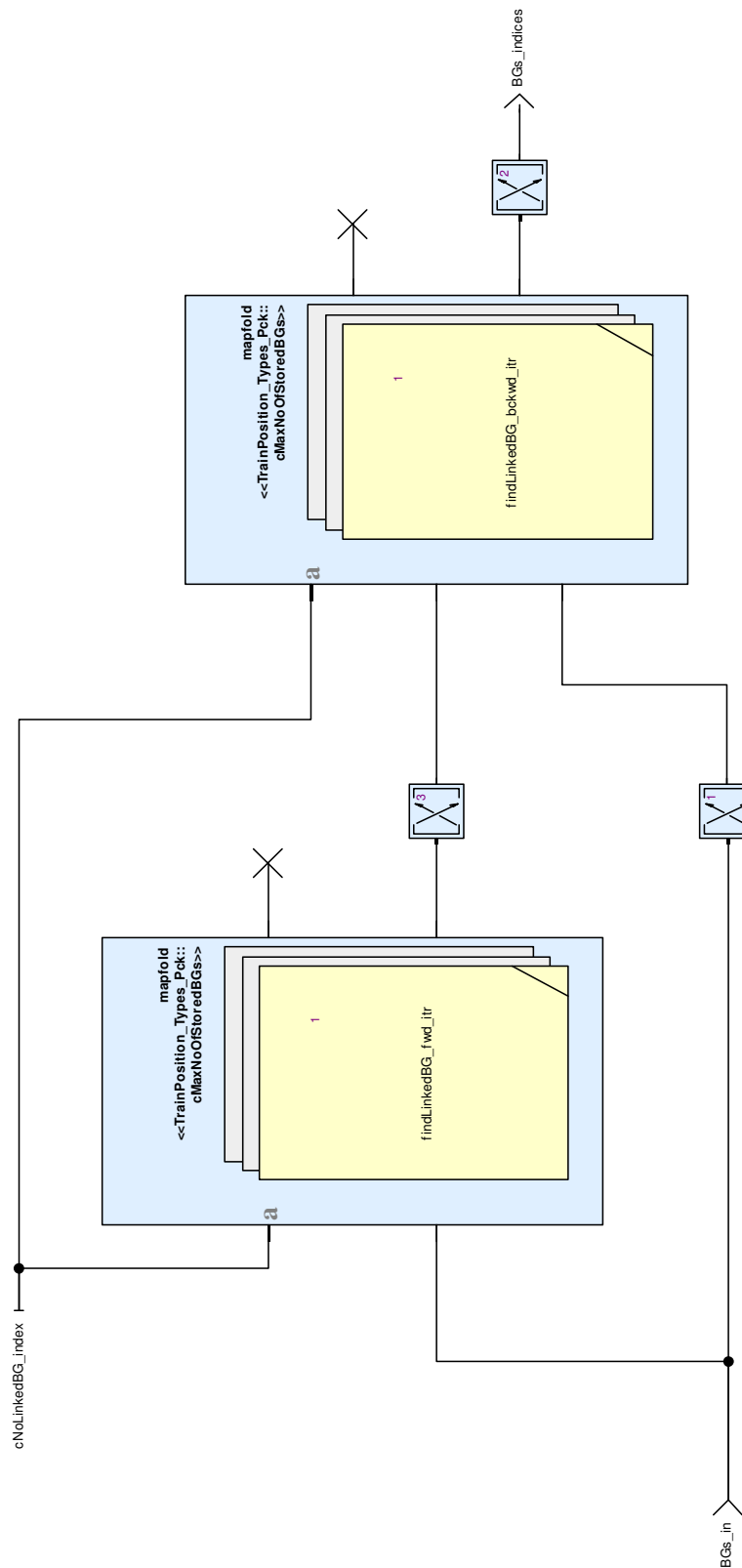


Figure 78: View of diagram\_findLinkedBGs\_1 (findLinkedBGs)

## 14.2.7. improve\_BG\_locations Operator

Declared as **public function**

### 14.2.7.1. Interface

**Table 249: Inputs of improve\_BG\_locations**

Name	Type	Properties	Comments and Information
referenceBG	TrainPosition_Types_Pc k::positionedBG_T		<b>Comments:</b> Recalculates the locations of all BGs with reference to referenceBG. Reduces the inaccuracy of referenceBG to a minimum, while the inaccuracies of all BGs in front and behind are growing in both directions.
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T		
trainProperties	TrainPosition_Types_Pc k::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 250: Outputs of improve\_BG\_locations**

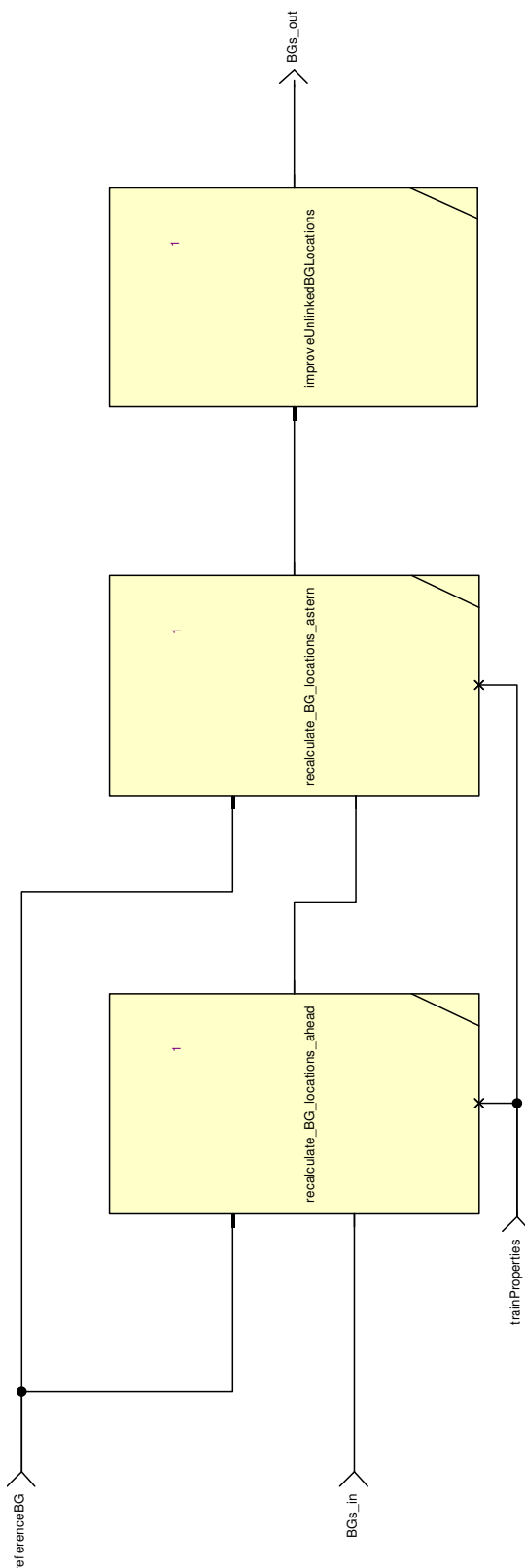
Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	

### 14.2.7.2. Operator Hierarchy

diagram : diagram\_recalculate\_refBG\_location

### 14.2.7.3. Graphical and Textual Diagrams

#### 14.2.7.3.1. View of diagram\_recalculate\_refBG\_location (improve\_BG\_locations)



**Figure 79: View of diagram\_recalculate\_refBG\_location (improve\_BG\_locations)**

#### 14.2.8. improveUnlinkedBGLocation Operator

Declared as **public function**

##### 14.2.8.1. Comments and Information

###### **improveUnlinkedBGLocation Comments:**

- Tries to improve the location of an unlinked BG with reference to two different passed linked BGs.
- If the improvement fails, the location of the unlinked BG will be left unchanged.

##### 14.2.8.2. Interface

**Table 251: Inputs of improveUnlinkedBGLocation**

Name	Type	Comments and Information
passedLinkedBG_2	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The second passed linked BG as the second reference location.
passedLinkedBG_1	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The first passed linked BG as the first reference location.
unlinkedBG_in	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The unlinked BG that's location shall be improved

**Table 252: Outputs of improveUnlinkedBGLocation**

Name	Type	Comments and Information
unlinkedBG_out	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The unlinked BG that's location might have been improved

##### 14.2.8.3. Operator Hierarchy

diagram : diagram\_improveUnlinkedBGLocation\_1



#### 14.2.8.4. Graphical and Textual Diagrams

##### 14.2.8.4.1. View of diagram\_improveUnlinkedBGLocation\_1 (improveUnlinkedBGLocation)

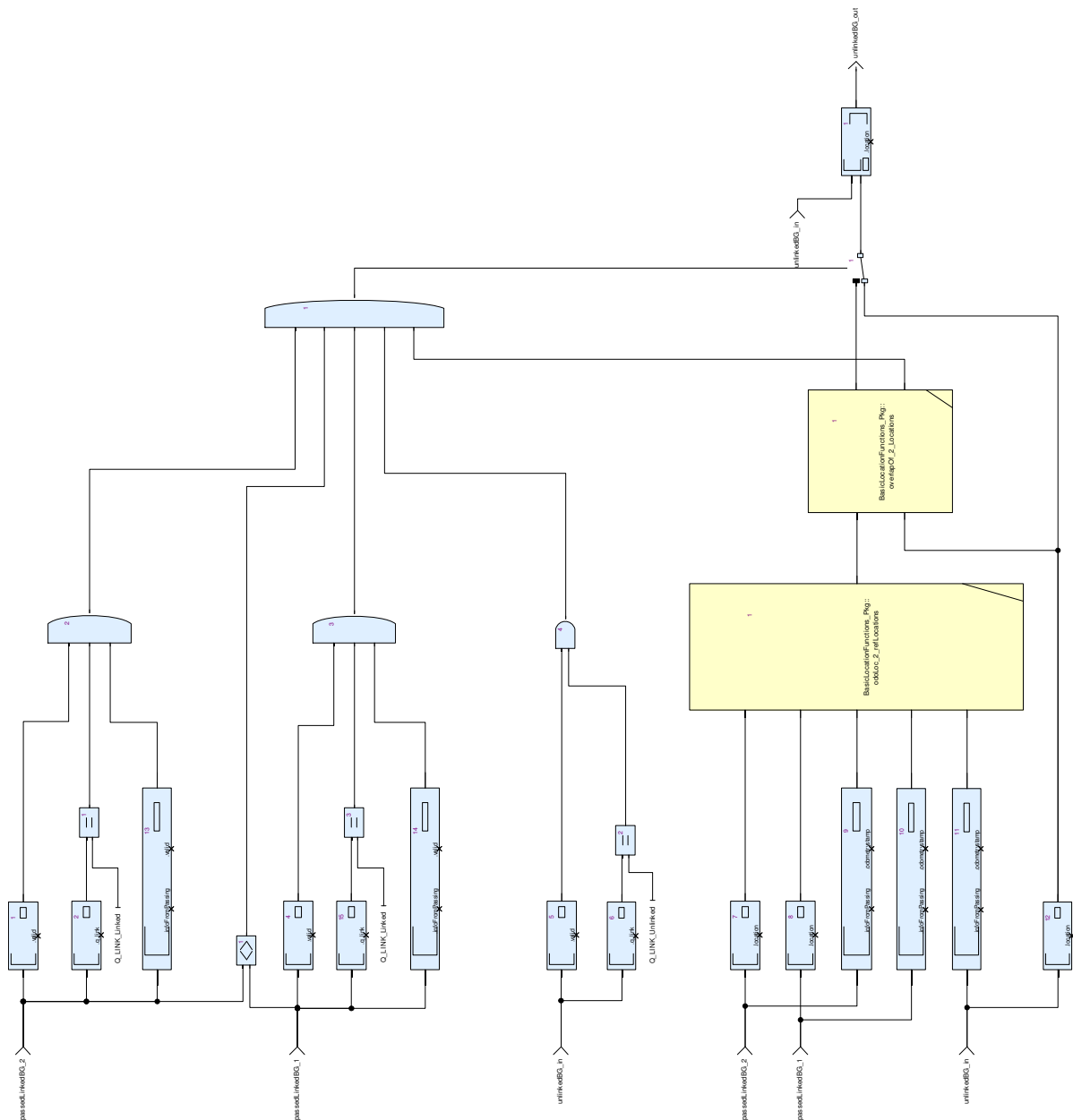


Figure 80: View of diagram\_improveUnlinkedBGLocation\_1 (improveUnlinkedBGLocation)

#### 14.2.9. improveUnlinkedBGLocations Operator

Declared as **private function**

##### 14.2.9.1. Interface

Table 253: Inputs of improveUnlinkedBGLocations

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	

**Table 254: Outputs of improveUnlinkedBGLocations**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	

#### 14.2.9.2. Operator Hierarchy

diagram : diagram\_improveUnlinkedBGLocations\_1

### 14.2.9.3. Graphical and Textual Diagrams

#### 14.2.9.3.1. View of diagram\_improveUnlinkedBGLocations\_1 (improveUnlinkedBGLocations)

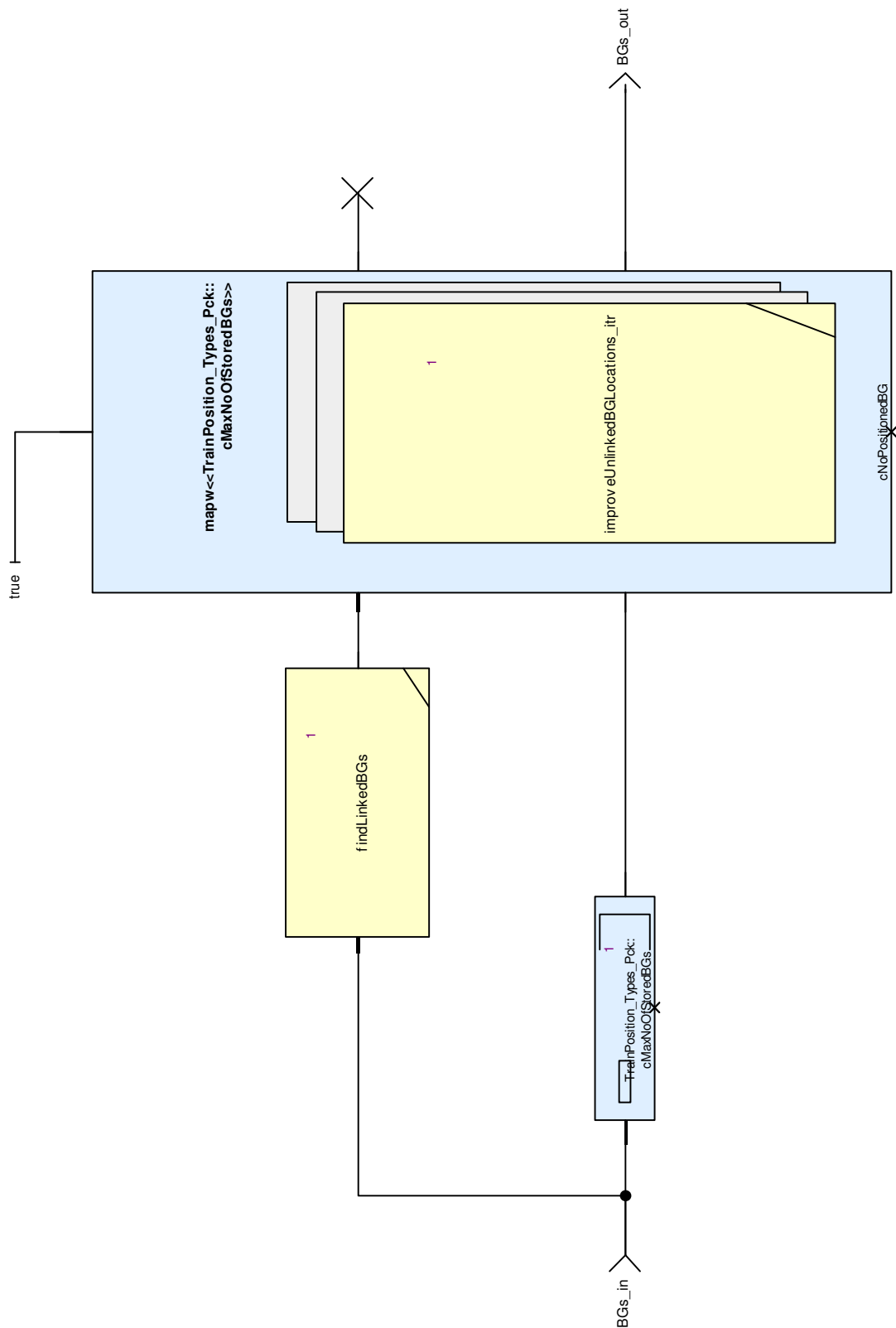


Figure 81: View of diagram\_improveUnlinkedBGLocations\_1 (improveUnlinkedBGLocations)

## 14.2.10. improveUnlinkedBGLocations\_itr Operator

Declared as **private function**

### 14.2.10.1. Interface

**Table 255: Inputs of improveUnlinkedBGLocations\_itr**

Name	Type	Comments and Information
BG_index_in	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::linkedBG_index_T	<b>Comments:</b> Indices for the iteration
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T	

**Table 256: Outputs of improveUnlinkedBGLocations\_itr**

Name	Type	Comments and Information
cont	bool	
BG_out	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The BG to be searched for.

### 14.2.10.2. Operator Hierarchy

diagram : diagram\_improveUnlinkedBGLocations\_itr\_1

### 14.2.10.3. Graphical and Textual Diagrams

#### 14.2.10.3.1. View of diagram\_improveUnlinkedBGLocations\_itr\_1 (improveUnlinkedBGLocations\_itr)

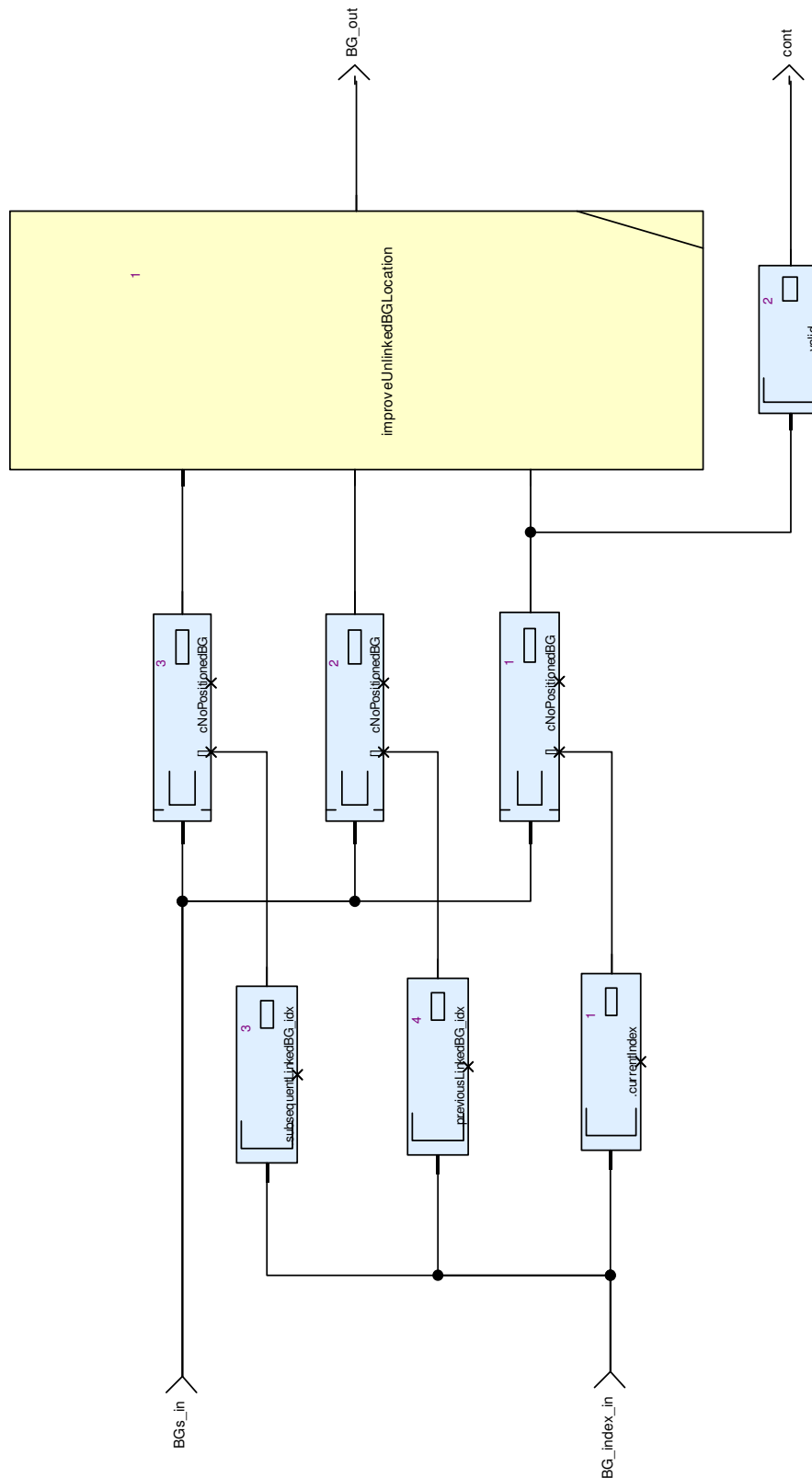


Figure 82: View of diagram\_improveUnlinkedBGLocations\_itr\_1 (improveUnlinkedBGLocations\_itr)

#### 14.2.11. recalculate\_BG\_location\_ahead Operator

Declared as **private function**

##### 14.2.11.1. Comments and Information

###### recalculate\_BG\_location\_ahead Comments:

- Recalculates the location of a BG based on the location of a previous BG.
- If prevBG and BG\_in are linked BGs, the linking information will be evaluated for location calculation.
- If prevBG is not a linked BG, the BG location will be calculated from odometry only.
- if prevBG is not valid, the location will remain unchanged.
- Preconditions:
  - - prevBG must have a location assigned.
  - - BG\_in and prevBG should have linking and passing information, if appropriate.

##### 14.2.11.2. Interface

**Table 257: Inputs of recalculate\_BG\_location\_ahead**

Name	Type	Properties	Comments and Information
BG_in	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The BG that's location has to be recalculated
prevLinkedBG	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The previous linked BG.
refBG	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The referende BG.
sumOfBestDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T		<b>Comments:</b> The distances with between refBG and prevLinkedBG.
trainProperties	TrainPosition_Types_Pkg::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 258: Outputs of recalculate\_BG\_location\_ahead**

Name	Type	Comments and Information
BG_out	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> The BG that's location has been recalculated.

##### 14.2.11.3. Operator Hierarchy

diagram : diagram\_recalculate\_BG\_location

#### 14.2.11.4. Graphical and Textual Diagrams

#### 14.2.11.4.1. View of diagram\_recalculate\_BG\_location (recalculate\_BG\_location\_ahead)

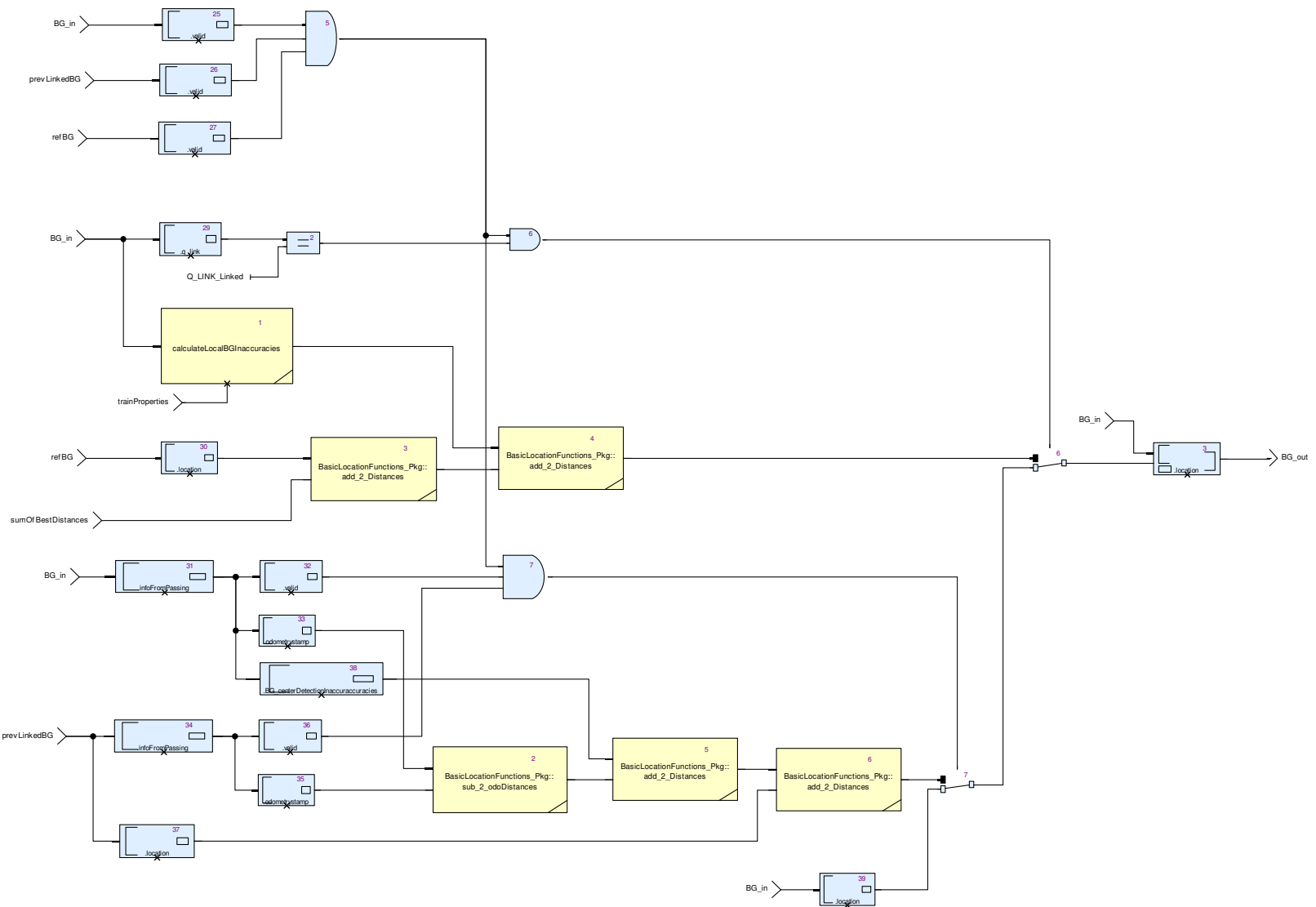


Figure 83: View of diagram\_recalculate\_BG\_location (recalculate\_BG\_location\_ahead)

## 14.2.12. recalculate\_BG\_location\_astern Operator

Declared as **private function**

### 14.2.12.1. Comments and Information

#### recalculate\_BG\_location\_astern Comments:

- Recalculates the location of a BG based on the location of a BG ahead (prevBG).
- if BG\_in is a linked BG, it's location is given by the sumOfBestDistances plus it's local mounting inaccuracies.
- if BG\_in is unlinked, it's location is calculated from the location of the previous linked BG and the distance measured by odometry.
- Otherwise, the BG\_in location is left unchanged.
- Preconditions:
  - - prevLinkedBG must have a location assigned.
  - - BG\_in and prevLinkedfBG should have linking and passing information, if appropriate.

### 14.2.12.2. Interface

**Table 259: Inputs of recalculate\_BG\_location\_astern**

Name	Type	Properties	Comments and Information
BG_in	TrainPosition_Types_Pck::positionedBG_T		<b>Comments:</b> The BG that's location has to be recalculated
prevLinkedBG	TrainPosition_Types_Pck::positionedBG_T		<b>Comments:</b> The previous linked BG.
refBG	TrainPosition_Types_Pck::positionedBG_T		<b>Comments:</b> The referende BG.
sumOfBestDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T		<b>Comments:</b> The distances with between refBG and prevLinkedBG.
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 260: Outputs of recalculate\_BG\_location\_astern**

Name	Type	Comments and Information
BG_out	TrainPosition_Types_Pck::positionedBG_T	<b>Comments:</b> The BG that's location has been recalculated.

### 14.2.12.3. Operator Hierarchy

diagram : diagram\_recalculate\_BG\_location



#### 14.2.12.4. Graphical and Textual Diagrams

#### 14.2.12.4.1. View of diagram recalculat\_BG\_location (recalculat\_BG\_location\_astern)

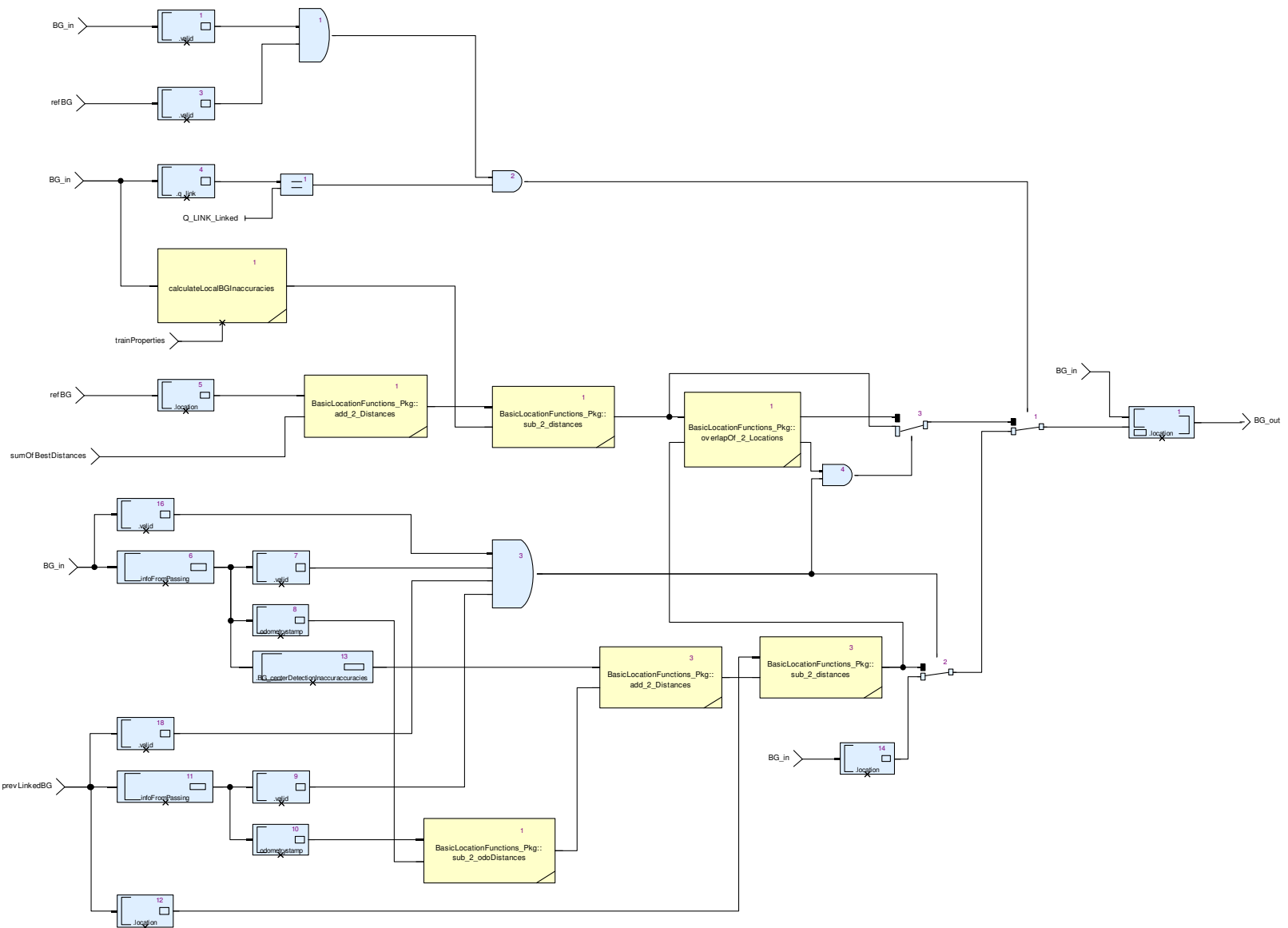


Figure 84: View of diagram\_recalculate\_BG\_location (recalculate\_BG\_location\_astern)

### 14.2.13. recalculate\_BG\_locations\_ahead Operator

Declared as **private function**

#### 14.2.13.1. Comments and Information

##### recalculate\_BG\_locations\_ahead Comments:

- Recalculates the BG locations in forward direction, starting from referenceBG to all BGs ahead.
- The location accuracy of referenceBG in BGs is minimized while leaving its nominal location unchanged.
- The locations of all BGs ahead of referenceBG are adjusted relatively to referenceBG.
- The locations of all BGs astern of referenceBG are left unchanged.
- BGs\_in should have locations assigned and arranged in increasing order of locations.

#### 14.2.13.2. Interface

**Table 261: Inputs of recalculate\_BG\_locations\_ahead**

Name	Type	Properties	Comments and Information
referenceBG	TrainPosition_Types_Pck::positionedBG_T		<b>Comments:</b> Recalculates the locations of all BGs with reference to referenceBG, beginning with the referenceBG and all BGs afterwards. Reduces the inaccuracy of referenceBG to a minimum, while the inaccuracies of all BGs before and after are growing in both directions.
BGs_in	TrainPosition_Types_Pck::positionedBGs_T		
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 262: Outputs of recalculate\_BG\_locations\_ahead**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

#### 14.2.13.3. Operator Hierarchy

diagram : diagram\_recalculate\_BG\_locations\_ahead\_1



#### 14.2.14. recalculate\_BG\_locations\_ahead\_itr Operator

Declared as **private function**

##### 14.2.14.1. Comments and Information

###### recalculate\_BG\_locations\_ahead\_itr Comments:

- Iterated function for recalculating the locations of all BGs in forward direction, starting from refBGs\_in.refBG with all BGs ahead.
- The location accuracy of refBGs\_in.refBG is minimized while leaving its nominal location unchanged.
- The location of a BG\_in ahead of refBGs\_in.refBG is adjusted relatively to refBGs\_in.
- The locations of a BG\_in astern of refBGs\_in.refBG is left unchanged.
- See diagram descriptions for more details.

##### 14.2.14.2. Interface

**Table 263: Inputs of recalculate\_BG\_locations\_ahead\_itr**

Name	Type	Properties	Comments and Information
refBGs_in	CalculateTrainPosition_Pkg::BG_relocation_Pkg::refBGs_T		
BG_in	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The BG that's location has to be recalculated
trainProperties	TrainPosition_Types_Pkg::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 264: Outputs of recalculate\_BG\_locations\_ahead\_itr**

Name	Type	Comments and Information
refBGs_out	CalculateTrainPosition_Pkg::BG_relocation_Pkg::refBGs_T	
BG_out	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> The BG that's location has been recalculated.

##### 14.2.14.3. Locals

**Table 265: Locals of recalculate\_BG\_locations\_ahead\_itr**

Name	Type	Comments and Information
BG_loc_inacc	Obu_BasicTypes_Pkg::LocWithInAcc_T	
BGin_is_refBG	bool	
d_prevLinkedBG_refBG	Obu_BasicTypes_Pkg::LocWithInAcc_T	<b>Comments:</b> Distance from the previous linked BG to the refBG, if refBG is an unlinked BG.
prevLinkedBG	TrainPosition_Types_Pkg::positionedBG_T	
prevUnlinkedBG	TrainPosition_Types_Pkg::positionedBG_T	

Name	Type	Comments and Information
recalculateSubsequentBGs	bool	
refBG	TrainPosition_Types_Pkg::positionedBG_T	
refLocation	Obu_BasicTypes_Pkg::LocWithInAcc_T	<b>Comments:</b> The recalculated location of the reference BG.
relocatedBG	TrainPosition_Types_Pkg::positionedBG_T	
sumOfBestDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T	<b>Comments:</b> Accumulates the distances with between refBG and a linked BG_in.

#### 14.2.14.4. Operator Hierarchy

diagram : diagram\_assembleResults

diagram : diagram\_assign\_refBG

diagram : diagram\_calculate\_BGin\_inaccuracies

diagram : diagram\_determinePreviousLinkedBG

diagram : diagram\_determinePreviousUnlinkedBG

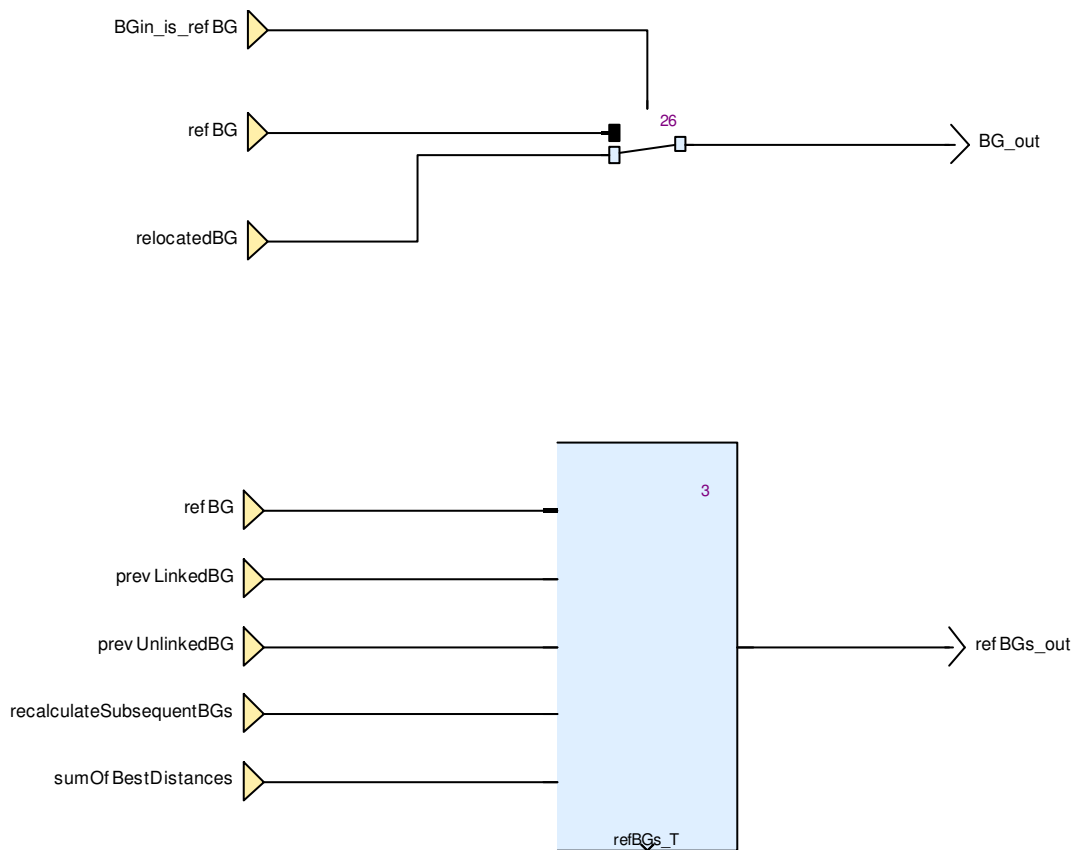
diagram : diagram\_recalculate\_BG\_location

diagram : diagram\_recalculate\_refBG\_location

diagram : diagram\_sumOfPrevBestDistances

#### 14.2.14.5. Graphical and Textual Diagrams

##### 14.2.14.5.1. View of diagram\_assembleResults (recalculate\_BG\_locations\_ahead\_itr)

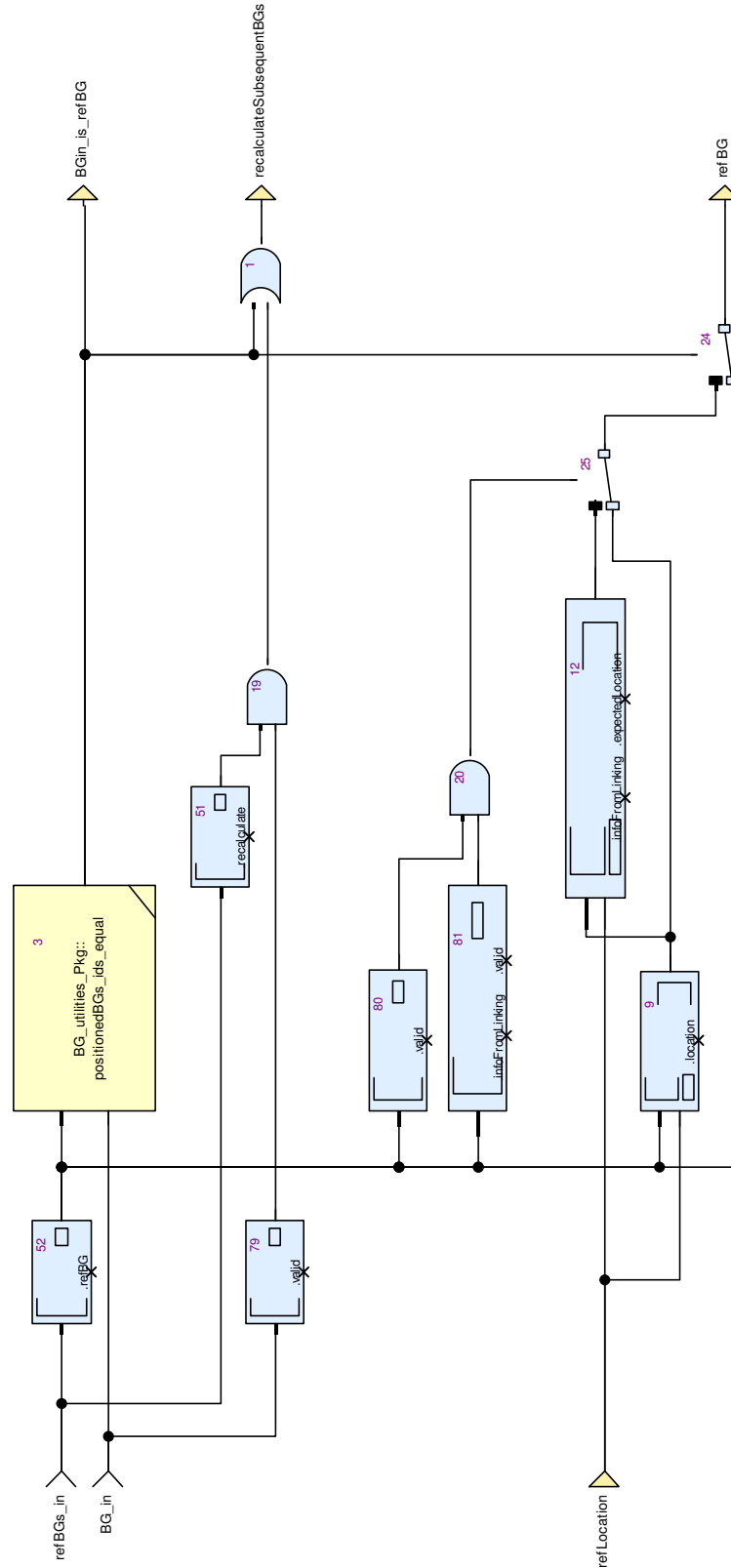


**Figure 86: View of diagram\_assembleResults (recalculate\_BG\_locations\_ahead\_itr)**

**diagram\_assembleResults Comments:**

- Assembles the outputs.

14.2.14.5.2. View of diagram\_assign\_refBG (recalculate\_BG\_locations\_ahead\_itr)

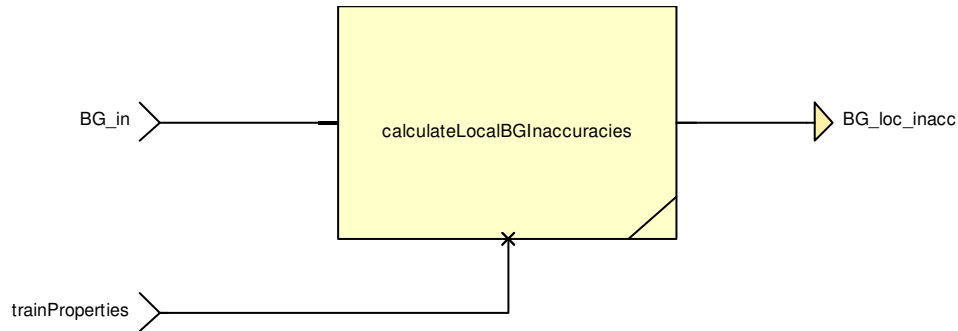


**Figure 87: View of diagram\_assign\_refBG (recalculate\_BG\_locations\_await\_itr)**

**diagram\_assign\_refBG Comments:**

- Determines if BG\_in is the reference BG.
- If yes, the location of the reference BG has to be recalculated.
- For all subsequent BGs in the iteration, the locations have to be recalculated.
- For all BGs in the iteration before the reference BGs, the locations are kept unchanged.

14.2.14.5.3. View of diagram\_calculate\_BGin\_inaccuracies  
(recalculate\_BG\_locations\_ahead\_itr)

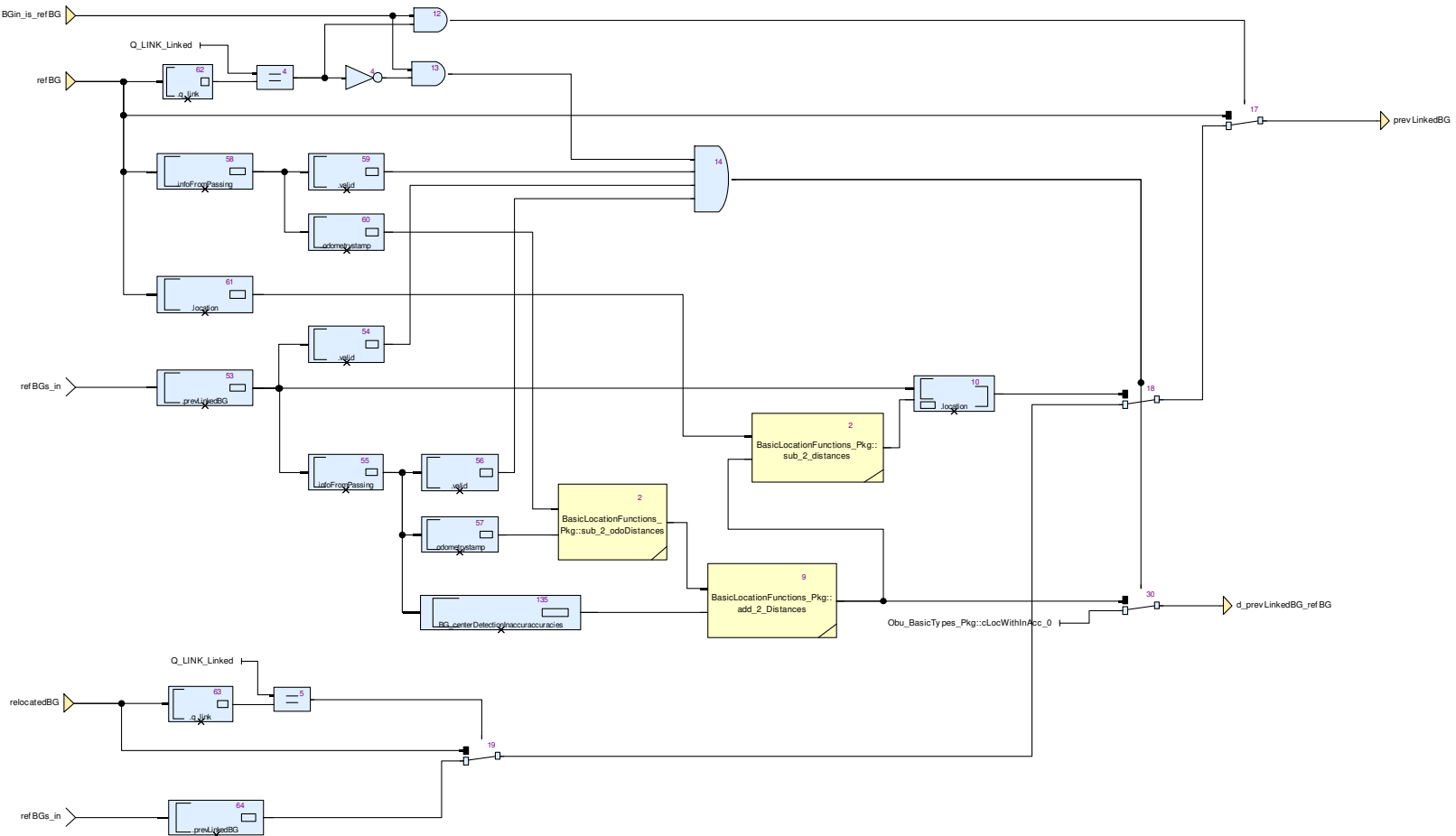


**Figure 88: View of diagram\_calculate\_BGin\_inaccuracies (recalculate\_BG\_locations\_ahead\_itr)**

**diagram\_calculate\_BGin\_inaccuracies Comments:**

- Calculates the local inaccuracies of BG\_in, i. e. the inaccuracies caused
- - by linking Q\_LOCACC or
- - by the national value Q\_NVLOCACC or
- - by the default location inaccuracy
- and the centerDetectionInaccuracies.

# 14.2.14.5.4. View of diagram\_determinePreviousLinkedBG (recalculate\_BG\_locations\_ahead\_itr)



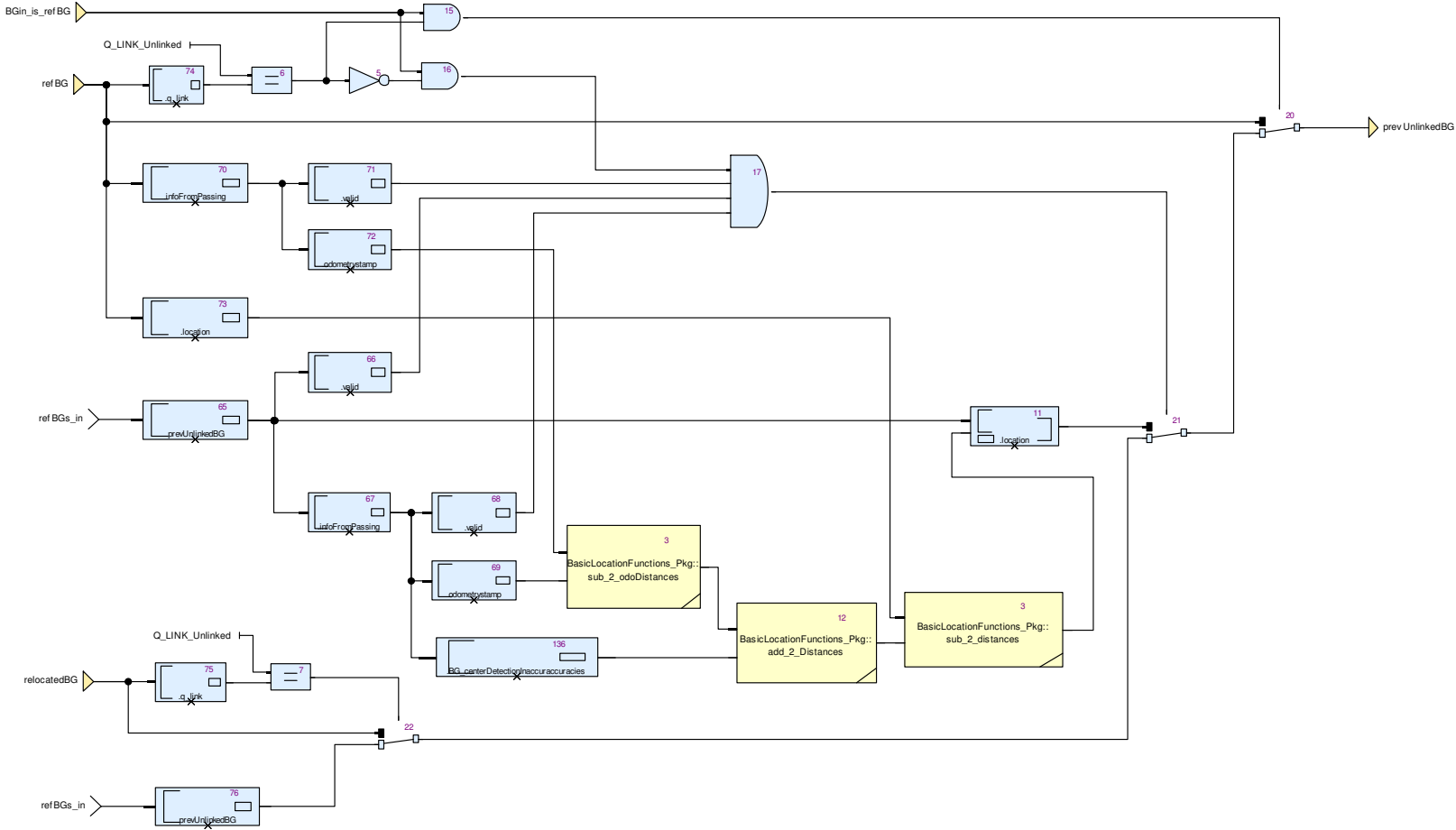
**Figure 89: View of diagram\_determinePreviousLinkedBG (recalculate\_BG\_locations\_ahead\_itr)**  
**diagram\_determinePreviousLinkedBG Comments:**

- Determines the previous linked BG.



- If BG\_in is the reference BG and the reference BG is a linked BG, prevLinkedBG is set to refBG.
- If BG\_in is the reference BG and is an unlinked BG, the location of prevLinkedBG is recalculated from refBG based upon odometry values.
- This is possible, because refBG must have been passed, and therefore prevLinkedBG too.
- If BG\_in is not the reference BG and is a linked BG, prevLinkedBG is set to BG\_in.
- If BG\_in is not the reference BG and is an unlinked BG, prevLinkedBG is taken from refBGs\_in.prevLinkedBG.

14.2.14.5.5. View of diagram\_determinePreviousUnlinkedBG  
(recalculate\_BG\_locations\_ahead\_itr)



**Figure 90:** View of diagram\_determinePreviousUnlinkedBG (recalculate\_BG\_locations\_ahead\_itr)  
diagram\_determinePreviousUnlinkedBG Comments:

- Determines the previous unlinked BG.
- If BG\_in is the reference BG and the reference BG is an unlinked BG, prevUnlinkedBG is set to refBG.
- If BG\_in is the reference BG and a linked BG with or without linking information, the location of prevUnlinkedBG is recalculated from refBG based upon odometry values.
- This is possible, because refBG must have been passed, and therefore prevUnlinkedBG too.
- If BG\_in is not the reference BG and is an unlinked BG, prevLinkedBG is set to the relocated BG\_in.
- If BG\_in is not the reference BG and is not an unlinked BG, prevLinkedBG is taken from refBGs\_in.prevUnlinkedBG.

14.2.14.5.6. View of diagram\_recalculate\_BG\_location  
(recalculate\_BG\_locations\_ahead\_itr)

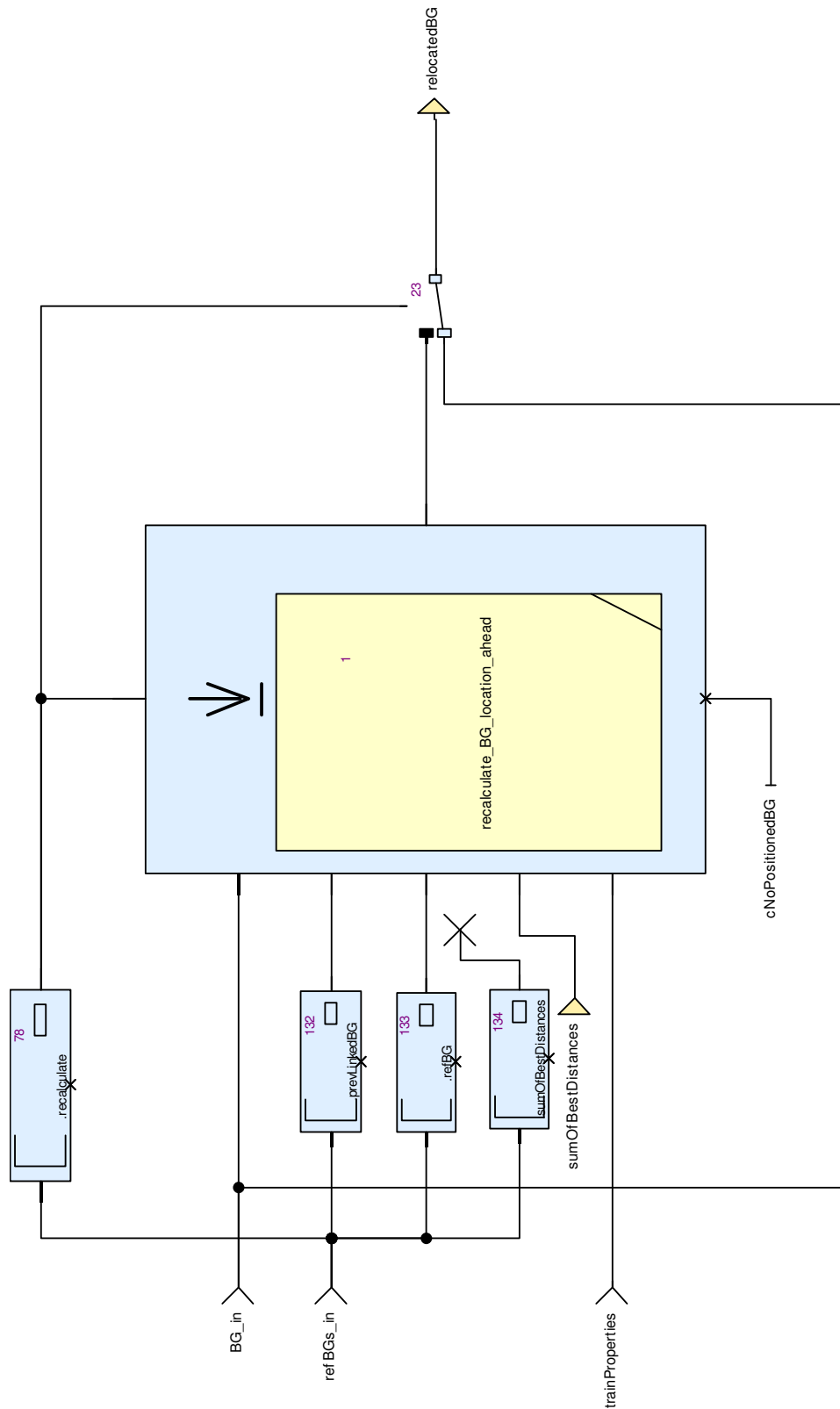
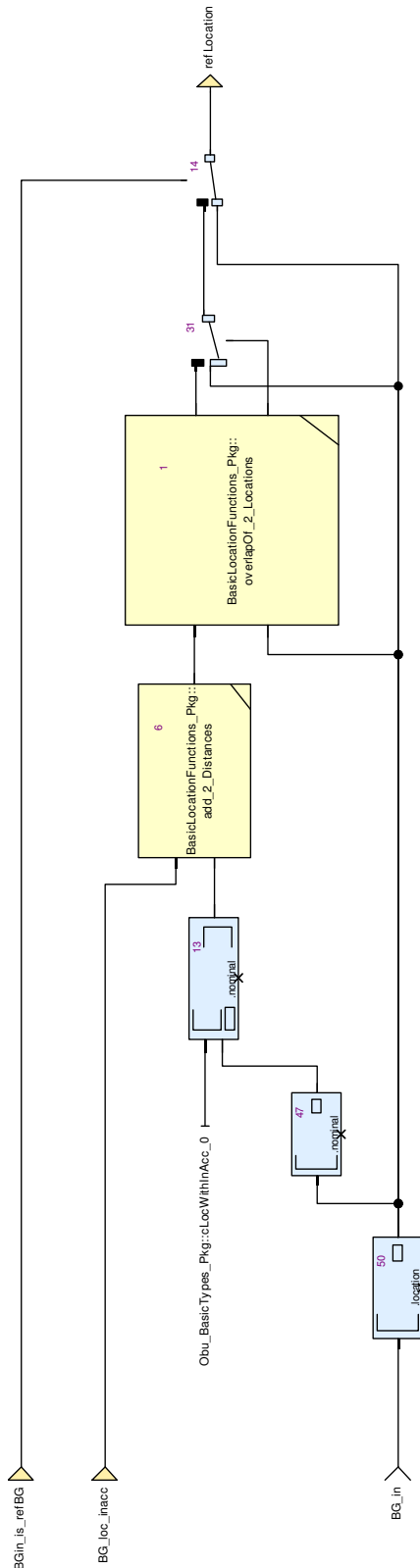


Figure 91: View of diagram\_recalculate\_BG\_location (recalculate\_BG\_locations\_ahead\_itr)

14.2.14.5.7. View of diagram\_recalculate\_refBG\_location  
(recalculate\_BG\_locations\_ahead\_itr)



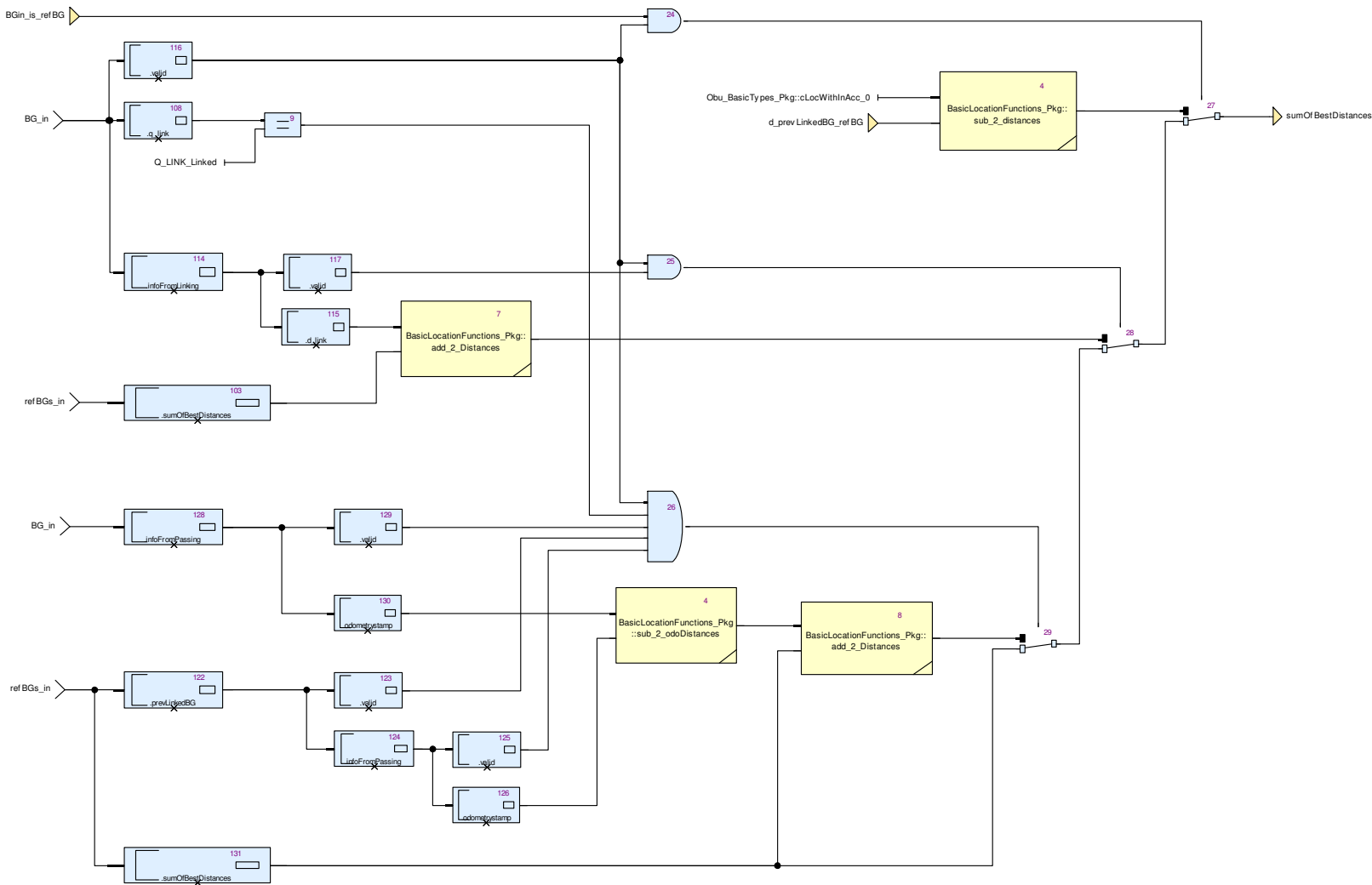
**Figure 92: View of diagram\_recalculate\_refBG\_location (recalculate\_BG\_locations\_ahead\_itr)**

**diagram\_recalculate\_refBG\_location Comments:**

- Recalculate the location of the reference BG.

- The location of the reference BG will be the origin, from where all other locations have to be recalculated.
- If the refBG is
  - - a linked BG with linking information available or
  - - an unlinked BG or
  - - a linked BG without linking information
- its nominal location is kept unchanged with only the local inaccuracies applied.

14.2.14.5.8. View of diagram\_sumOfPrevBestDistances  
(recalculate\_BG\_locations\_ahead\_itr)



**Figure 93:** View of diagram\_sumOfPrevBestDistances (recalculate\_BG\_locations\_ahead\_itr)  
**diagram\_sumOfPrevBestDistances Comments:**

- Accumulates the sum of linking distances and - in case of linking holes - odometry distances.
- The sum is reset to 0, if BGIN is the refBG and a linked BG.
- If BGIN is the refBG and an unlinked BG, sumOfBestDistances is set to the negative distance of the previous linked BG to refBG.
- This assures, that sumOfBestDistances will be calculated correctly for all BGs ahead of refBG.

#### 14.2.15. recalculate\_BG\_locations\_astern Operator

Declared as **private function**

##### 14.2.15.1. Comments and Information

###### recalculate\_BG\_locations\_astern Comments:

- Recalculates the BG locations in backward direction, starting from referenceBG to all previous BGs.
- The location of referenceBG in BGs stays unchanged.
- The locations of all BGs before referenceBG are adjusted relatively to referenceBG.
- The locations of all BGs ahead of referenceBG are left unchanged.
- BGs\_in should have locations assigned and arranged in increasing order of locations.

##### 14.2.15.2. Interface

**Table 266: Inputs of recalculate\_BG\_locations\_astern**

Name	Type	Properties	Comments and Information
referenceBG	TrainPosition_Types_Pc k::positionedBG_T		<b>Comments:</b> Recalculates the locations of all BGs with reference to referenceBG, beginning with the BG before the referenceBG and then all BGs backwards.
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T		
trainProperties	TrainPosition_Types_Pc k::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 267: Outputs of recalculate\_BG\_locations\_astern**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	

##### 14.2.15.3. Operator Hierarchy

diagram : diagram\_recalculate\_BG\_locations\_astern\_1



#### 14.2.15.4. Graphical and Textual Diagrams

##### 14.2.15.4.1. View of diagram\_recalculate\_BG\_locations\_astern\_1 (recalculate\_BG\_locations\_astern)

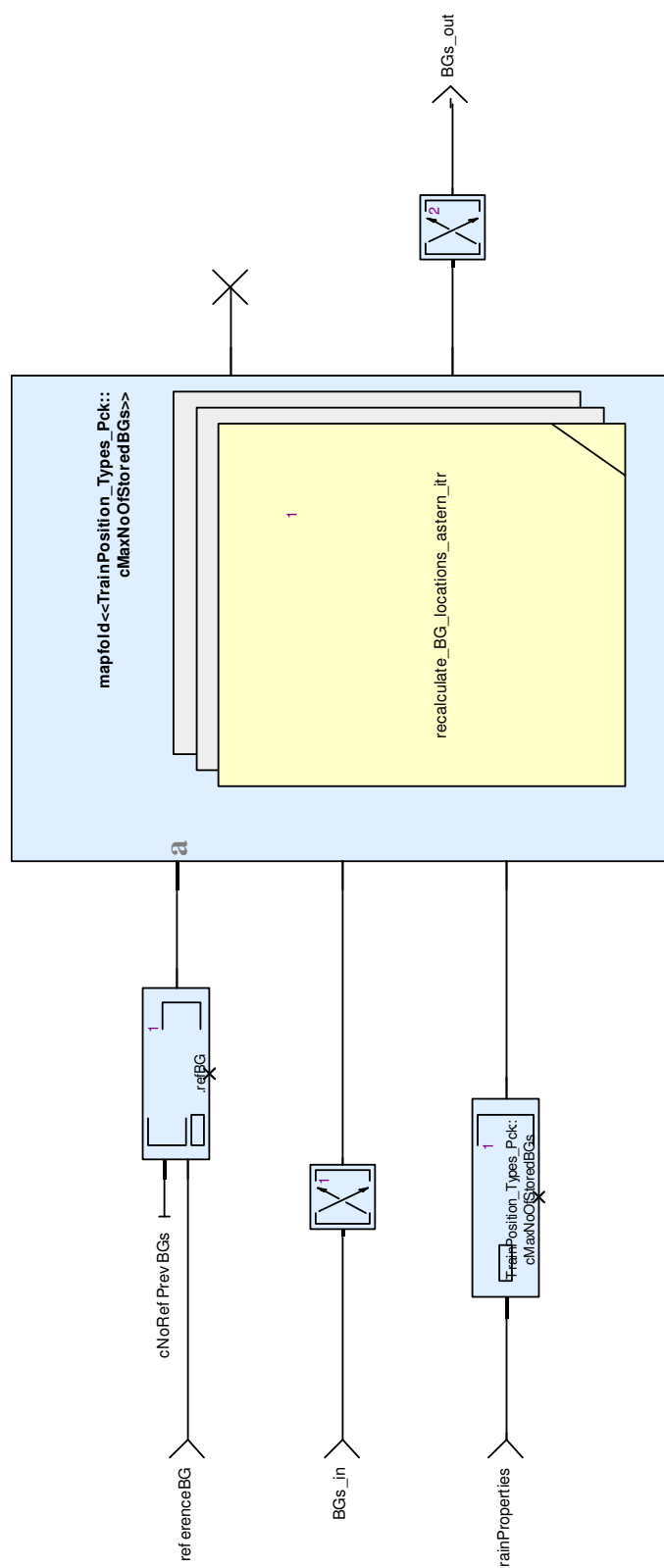


Figure 94: View of diagram\_recalculate\_BG\_locations\_astern\_1 (recalculate\_BG\_locations\_astern)

## 14.2.16. recalculate\_BG\_locations\_astern\_itr Operator

Declared as **private function**

### 14.2.16.1. Comments and Information

#### recalculate\_BG\_locations\_astern\_itr Comments:

- Iterated function for recalculating the locations of all BGs in backward direction, starting from refBGs\_in.refBG with all BGs astern.
- The location of refBGs\_in.refBG is left unchanged.
- The location of a BG\_in astern of refBGs\_in.refBG is adjusted relatively to refBGs\_in.
- The location of a BG\_in ahead of refBGs\_in.refBG is left unchanged.
- This function is for iterating through the BGs from tail to head, i. e. in backwards direction.
- Therefore, refBGs\_in.prevLinkedBG and refBGs\_in.prevUnlinkedBG refer to BGs previously in the iteration, i. e. ahead of BG\_in.
- See diagram description for more details.

### 14.2.16.2. Interface

**Table 268: Inputs of recalculate\_BG\_locations\_astern\_itr**

Name	Type	Properties	Comments and Information
refBGs_in	CalculateTrainPosition_Pkg::BG_relocation_Pkg::refBGs_T		<b>Comments:</b> Note: prevUnlinkedBG and prevLinkedBG are previous for the backward iteration.
BG_in	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The BG that's location has to be recalculated
trainProperties	TrainPosition_Types_Pkg::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 269: Outputs of recalculate\_BG\_locations\_astern\_itr**

Name	Type	Comments and Information
refBGs_out	CalculateTrainPosition_Pkg::BG_relocation_Pkg::refBGs_T	
BG_out	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> The BG that's location has been recalculated.

### 14.2.16.3. Locals

**Table 270: Locals of recalculate\_BG\_locations\_astern\_itr**

Name	Type	Comments and Information
BGin_is_refBG	bool	
prevLinkedBG	TrainPosition_Types_Pkg::positionedBG_T	
prevUnlinkedBG	TrainPosition_Types_Pkg::positionedBG_T	

Name	Type	Comments and Information
recalculateSubsequentBGs	bool	
refBG	TrainPosition_Types_Pkg::positionedBG_T	
relocatedBG	TrainPosition_Types_Pkg::positionedBG_T	
sumOfBestDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T	<b>Comments:</b> Accumulates the distances with between refBG and a linked BG_in.

#### 14.2.16.4. Operator Hierarchy

diagram : diagram\_assembleResults

diagram : diagram\_assign\_refBG

diagram : diagram\_determinePreviousLinkedBG

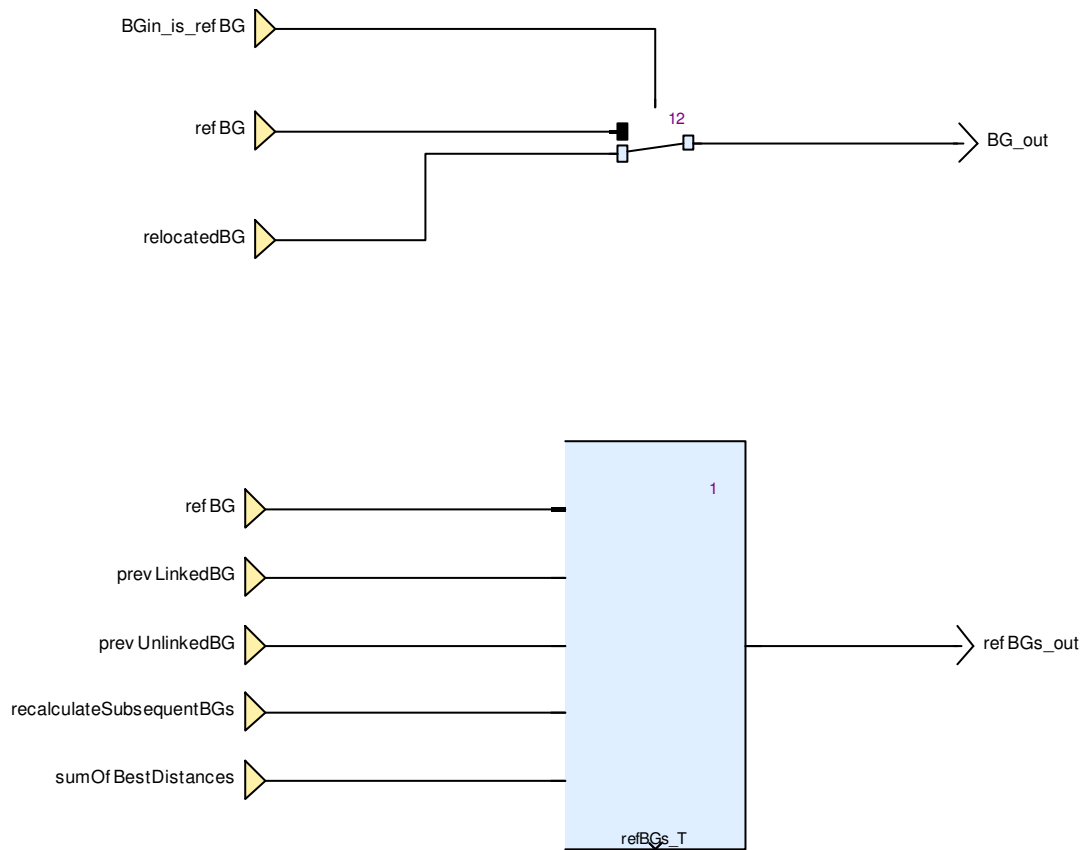
diagram : diagram\_determinePreviousUnlinkedBG

diagram : diagram\_recalculate\_BG\_location

diagram : diagram\_sumOfPrevBestDistances

#### 14.2.16.5. Graphical and Textual Diagrams

##### 14.2.16.5.1. View of diagram\_assembleResults (recalculate\_BG\_locations\_astern\_itr)

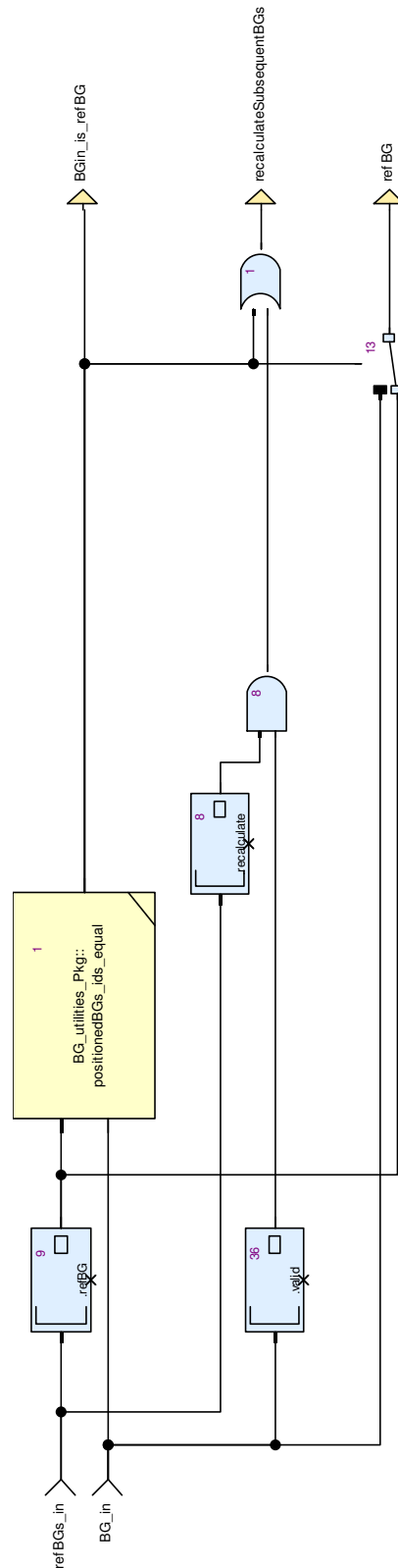


**Figure 95: View of diagram\_assembleResults (recalculate\_BG\_locations\_astern\_itr)**

#### **diagram\_assembleResults Comments:**

- Assembles the outputs.

14.2.16.5.2. View of diagram\_assign\_refBG (recalculate\_BG\_locations\_astern\_itr)



**Figure 96: View of diagram\_assign\_refBG (recalculate\_BG\_locations\_astern\_itr)**

**diagram\_assign\_refBG Comments:**

- Determines if BG\_in is the reference BG.

- If yes, the location of the reference BG has to be taken from BG\_in instead of refBGs\_in, since the location of the reference BG was recalculated in the previous "recalculate\_BG\_locations\_ahead" function.
- For all subsequent BGs in the iteration, the locations have to be recalculated.
- For all BGs in the iteration before the reference BGs, the locations are kept unchanged.

14.2.16.5.3. View of diagram\_determinePreviousLinkedBG  
(recalculate\_BG\_locations\_astern\_itr)

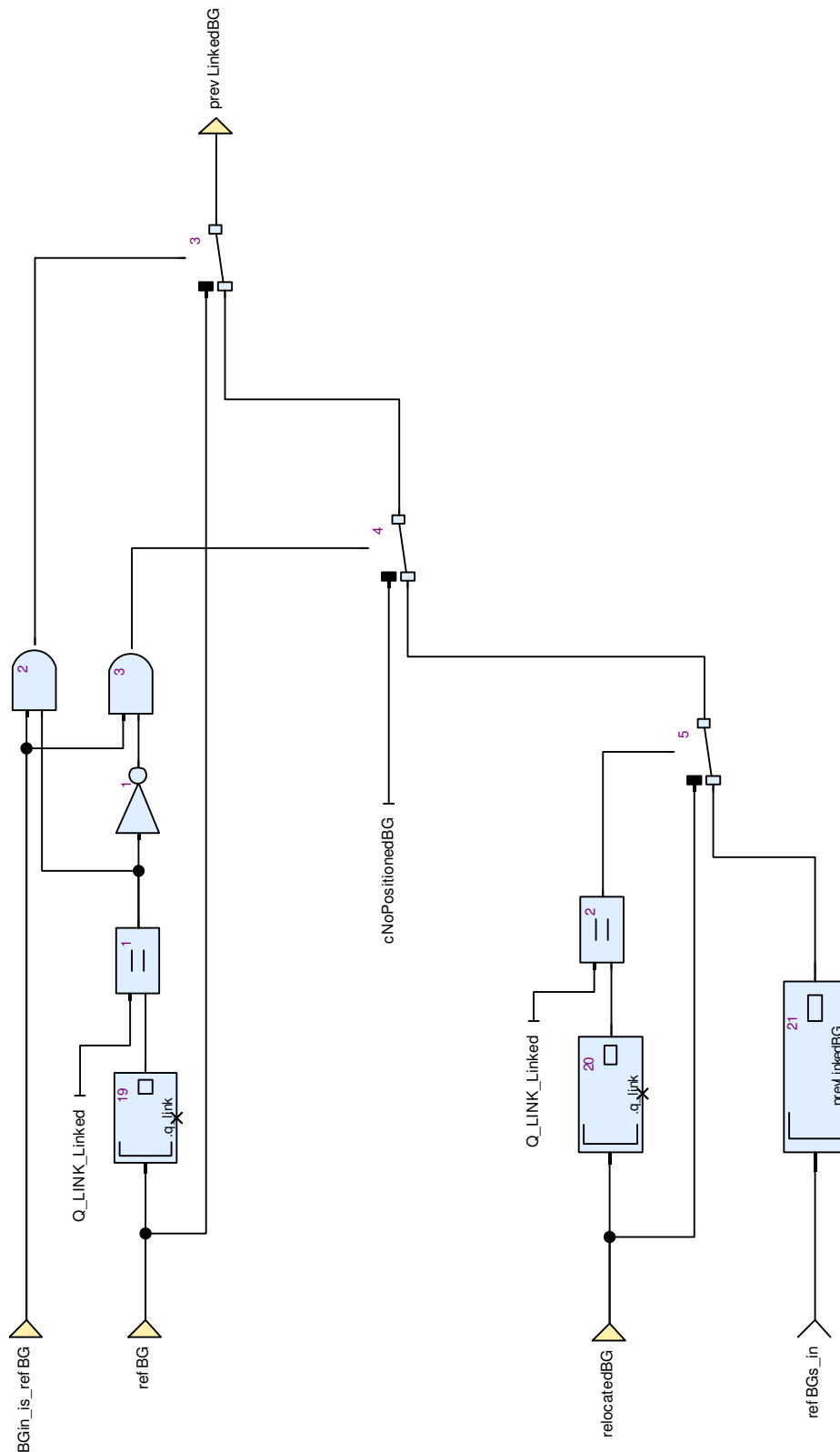


Figure 97: View of diagram\_determinePreviousLinkedBG (recalculate\_BG\_locations\_astern\_itr)

diagram\_determinePreviousLinkedBG Comments:

- Determines the previous linked BG.

- If BG\_in is the reference BG and the reference BG is a linked BG, prevLinkedBG is set to refBG.
- If BG\_in is the reference BG and is an unlinked BG, prevLinkedBG is set to no BG (cNoPositionedBG).
- If BG\_in is not the reference BG and is a linked BG, prevLinkedBG is set to the relocated BG\_in.
- If BG\_in is not the reference BG and is an unlinked BG, prevLinkedBG is taken from refBGs\_in.prevLinkedBG.





- If BG\_in is the reference BG and a linked BG with or without linking information, prevUnlinkedBG is set to no BG (cNoPositionedBG).
- If BG\_in is not the reference BG and is an unlinked BG, prevLinkedBG is set to the relocated BG\_in.
- If BG\_in is not the reference BG and is not an unlinked BG, prevUnlinkedBG is taken from refBGs\_in.prevUnlinkedBG.

14.2.16.5.5. View of diagram\_recalculate\_BG\_location  
(recalculate\_BG\_locations\_astern\_itr)

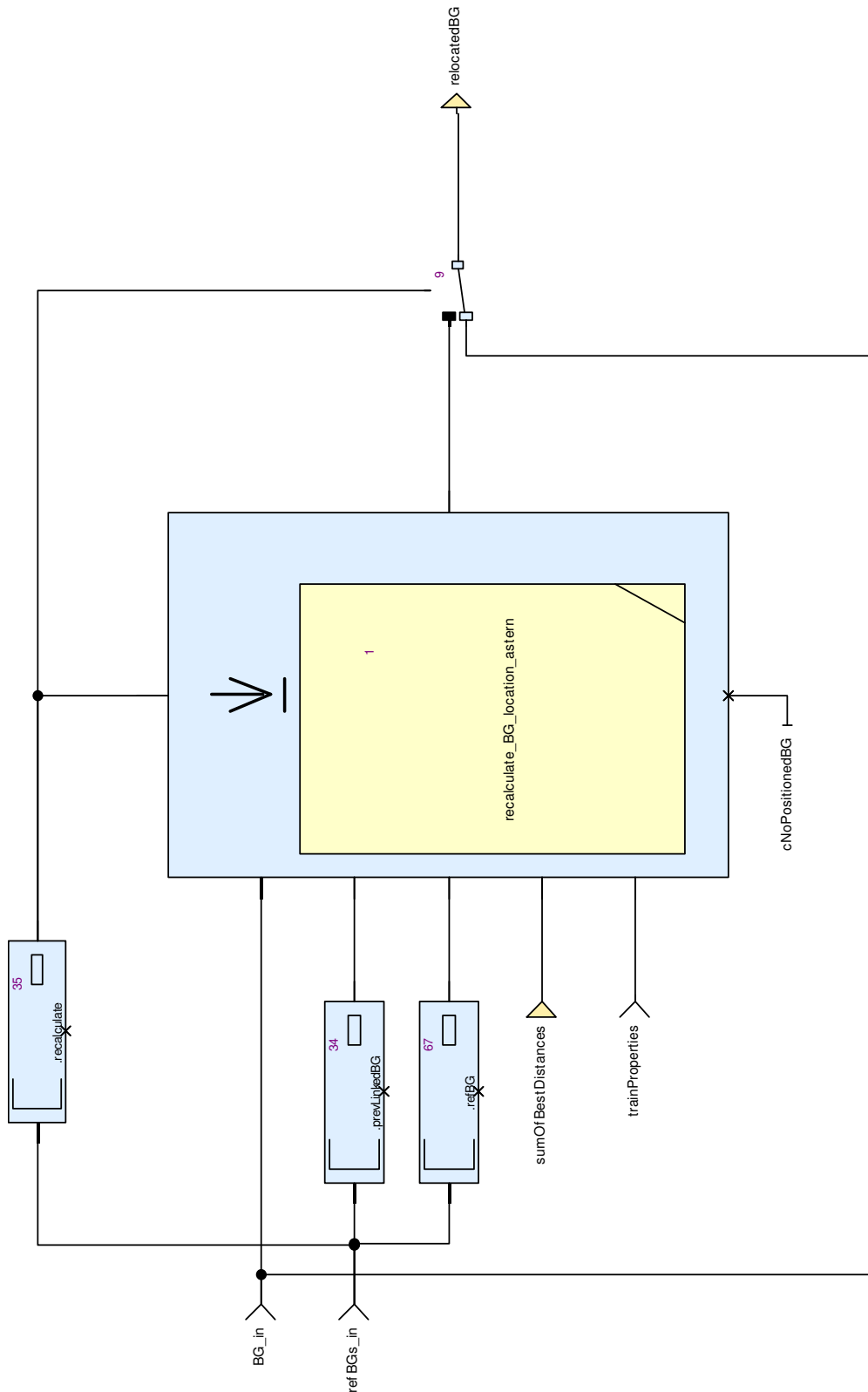


Figure 99: View of diagram\_recalculate\_BG\_location (recalculate\_BG\_locations\_astern\_itr)

diagram\_recalculate\_BG\_location Comments:

- Recalculates the location of BG\_in.

14.2.16.5.6. View of diagram\_sumOfPrevBestDistances  
(recalculate\_BG\_locations\_astern\_itr)

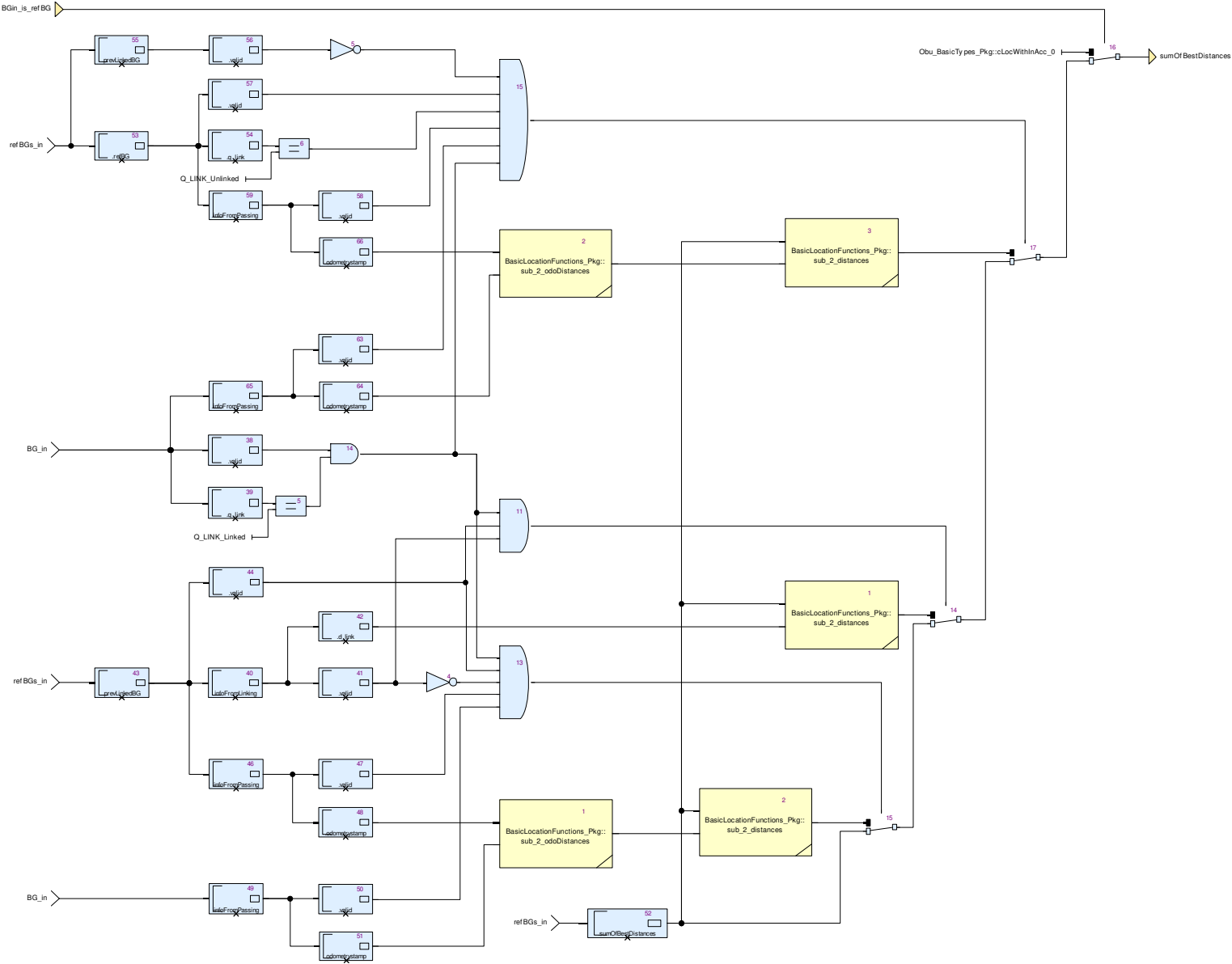


Figure 100: View of diagram\_sumOfPrevBestDistances (recalculate\_BG\_locations\_astern\_itr)

diagram\_sumOfPrevBestDistances Comments:

- Accumulates the sum of linking distances and - in case of linking holes - odometry distances.
- The sum is reset to 0, if BGin is the refBG and a linked BG.

## 14.3. CalculateTrainPosition\_Pkg::BG\_utilities\_Pkg Package

### 14.3.1. Types

**Table 271: Public Types of BG\_utilities\_Pkg**

Name	Definition	Comments and Information
BG_counters_T	{unlinkedBGsCount : int, linkedBGsCount : int, totalBGsCount : int, passedUnlinkedBGsCount : int, passedLinkedBGsCount : int, passedTotalBGsCount : int}	<b>Comments:</b> Serves to count the BGs
BG_find_T	{index : int, noOfFoundBGs : int, BGFound : bool}	<b>Comments:</b> Serves to search through the BGs

### 14.3.2. Constants

**Table 272: Public Constants of BG\_utilities\_Pkg**

Name	Type	Value	Comments and Information
cBG_find_0	CalculateTrainPosition_Pkg::BG_utilities_Pkg::BG_find_T	{index : cNoValidIndex, noOfFoundBGs : 0, BGFound : false}	
cBGCounters_0	CalculateTrainPosition_Pkg::BG_utilities_Pkg::BG_counters_T	{unlinkedBGsCount : 0, linkedBGsCount : 0, totalBGsCount : 0, passedUnlinkedBGsCount : 0, passedLinkedBGsCount : 0, passedTotalBGsCount : 0}	

Name	Type	Value	Comments and Information
		{valid : false, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked, location : {nominal : 0, d_min : 0, d_max : 0}, seqNoOnTrack : 0, infoFromLinking : {valid : false, nid_bg_fromLinkingBG : 0, nid_c_fromLinkingBG : 0, expectedLocation : {nominal : 0, d_min : 0, d_max : 0}, d_link : {nominal : 0, d_min : 0, d_max : 0}, linkingInfo : {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}}, infoFromPassing : {valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetectionInaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Downlink_telegram, m_version : M_VERSION_Previous_versions_according_to_RS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise,	

### 14.3.3. countBGs Operator

Declared as **public function**

#### 14.3.3.1. Comments and Information

##### **countBGs Comments:**

- Determines the linked, unlinked and total number of BGs in BG\_in.

#### 14.3.3.2. Interface

**Table 273: Inputs of countBGs**

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pkg::positionedBGs_T	
enable	bool	

**Table 274: Outputs of countBGs**

Name	Type	Comments and Information
empty	bool	<b>Comments:</b> No BG in BGs_in.
full	bool	<b>Comments:</b> BGs_in filled completely with BGs.
counters	CalculateTrainPosition_Pkg::BG_utilities_Pkg::BG_counters_T	

#### 14.3.3.3. Operator Hierarchy

diagram : diagram\_countBGs\_1

#### 14.3.3.4. Graphical and Textual Diagrams

##### 14.3.3.4.1. View of diagram\_countBGs\_1 (countBGs)

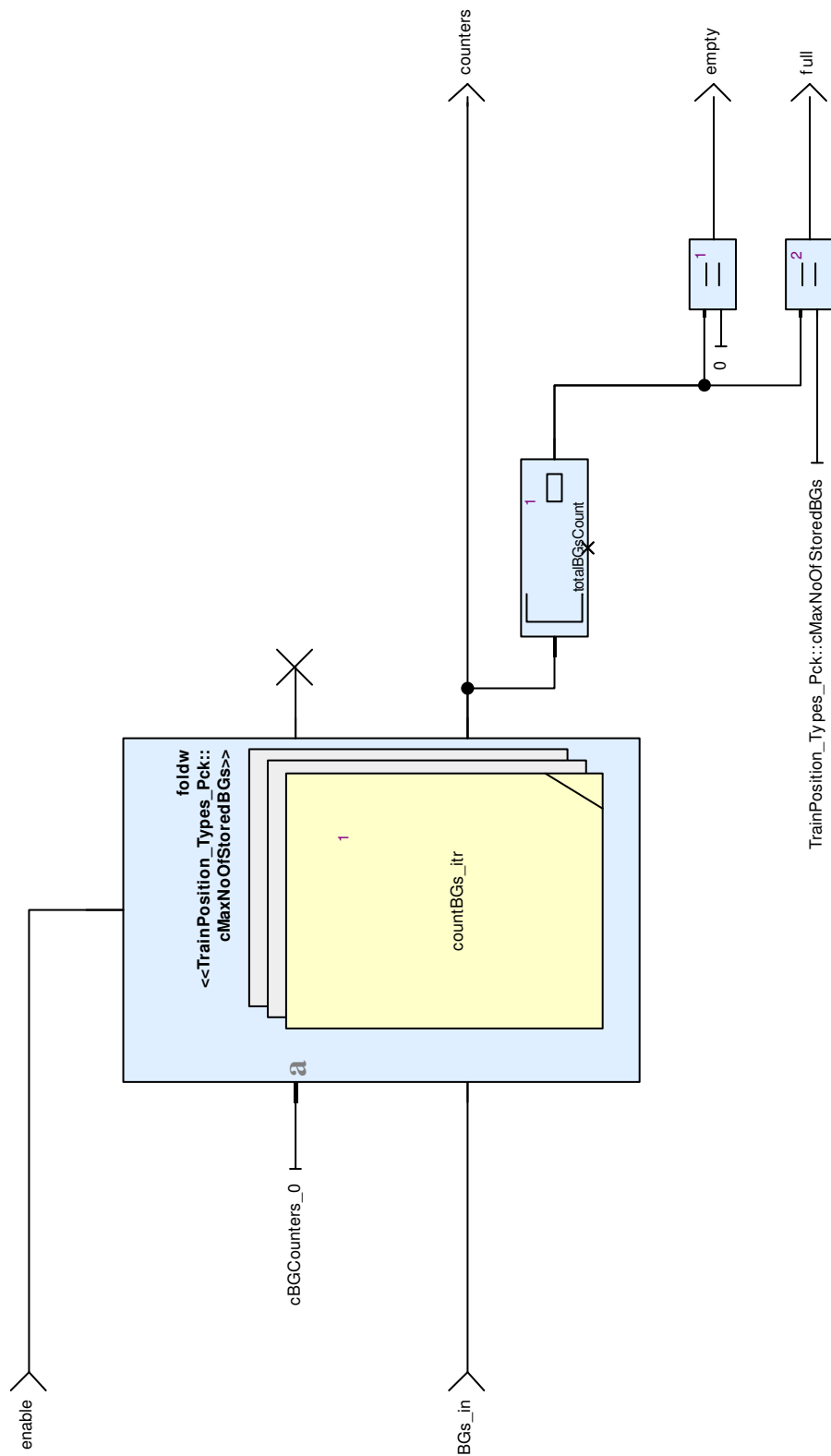


Figure 101: View of diagram\_countBGs\_1 (countBGs)

#### 14.3.4. countBGs\_itr Operator

Declared as **private function**

##### 14.3.4.1. Comments and Information

###### **countBGs\_itr Comments:**

- Iterated function for countBGs

##### 14.3.4.2. Interface

**Table 275: Inputs of countBGs\_itr**

Name	Type	Comments and Information
counters_in	CalculateTrainPosition_ Pkg::BG_utilities_Pkg:: BG_counters_T	
BG_in	TrainPosition_Types_Pc k::positionedBG_T	

**Table 276: Outputs of countBGs\_itr**

Name	Type	Comments and Information
cont	bool	
counters_out	CalculateTrainPosition_ Pkg::BG_utilities_Pkg:: BG_counters_T	

##### 14.3.4.3. Operator Hierarchy

diagram : diagram\_countBGs\_itr\_1



#### 14.3.4.4. Graphical and Textual Diagrams

##### 14.3.4.4.1. View of diagram\_countBGs\_itr\_1 (countBGs\_itr)

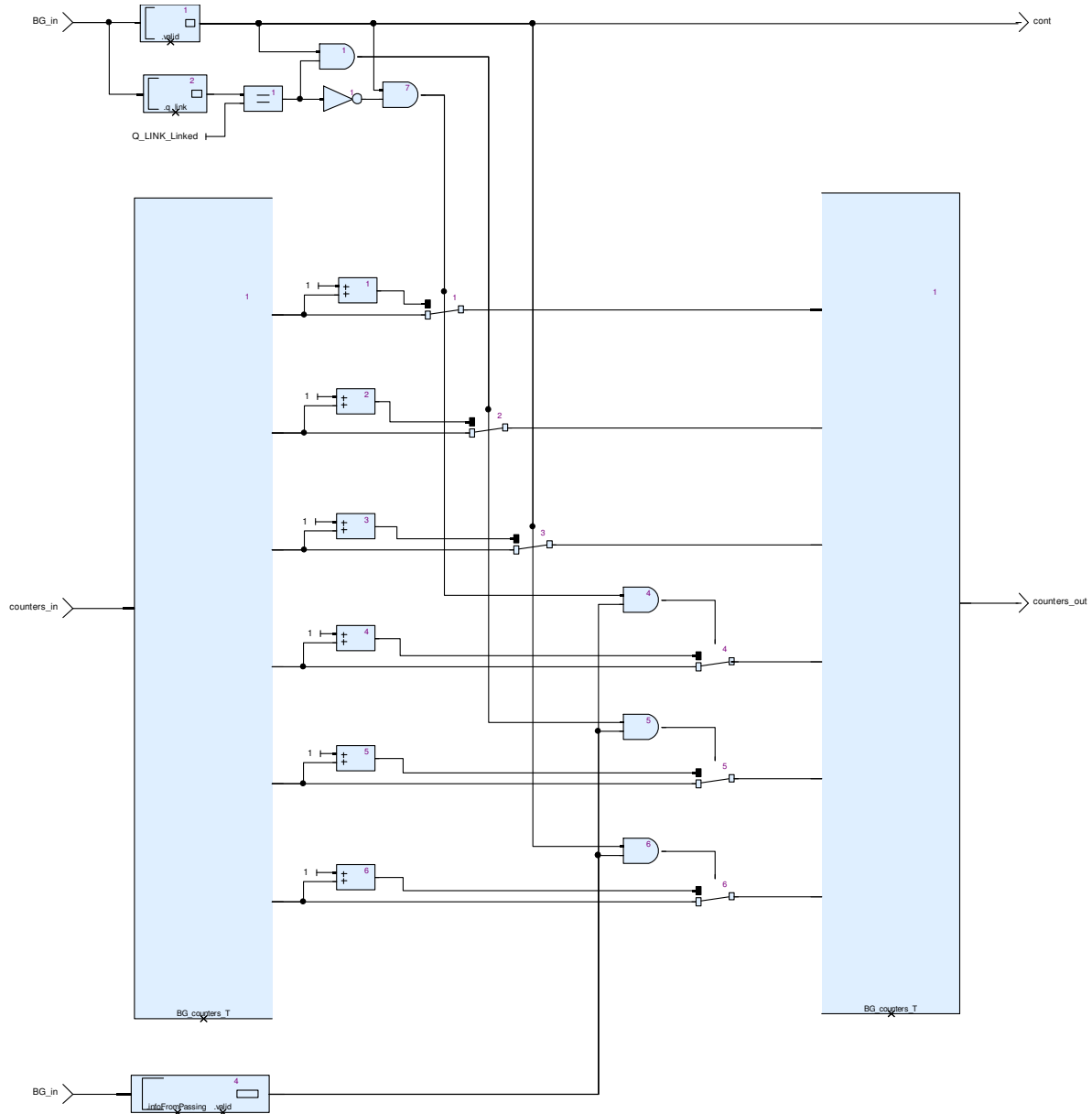


Figure 102: View of diagram\_countBGs\_itr\_1 (countBGs\_itr)

#### 14.3.5. deleteBG\_atIndex Operator

Declared as **public function**

##### 14.3.5.1. Comments and Information

###### deleteBG\_atIndex Comments:

- Deletes a BG in BGs, designated by indexOfBG.
- The hole caused by the deletion is filled afterwards by shifting the higher part of BGs down by 1, so that no hole is left in BGs\_out afterwards.

#### 14.3.5.2. Interface

**Table 277: Inputs of deleteBG\_atIndex**

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T	
indexOfBG	int	
del	bool	<b>Comments:</b> Delete command. Deletion takes place if del = true.

**Table 278: Outputs of deleteBG\_atIndex**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	

#### 14.3.5.3. Operator Hierarchy

diagram : diagram\_deleteBG\_atIndex\_1

#### 14.3.5.4. Graphical and Textual Diagrams

##### 14.3.5.4.1. View of diagram\_deleteBG\_atIndex\_1 (deleteBG\_atIndex)

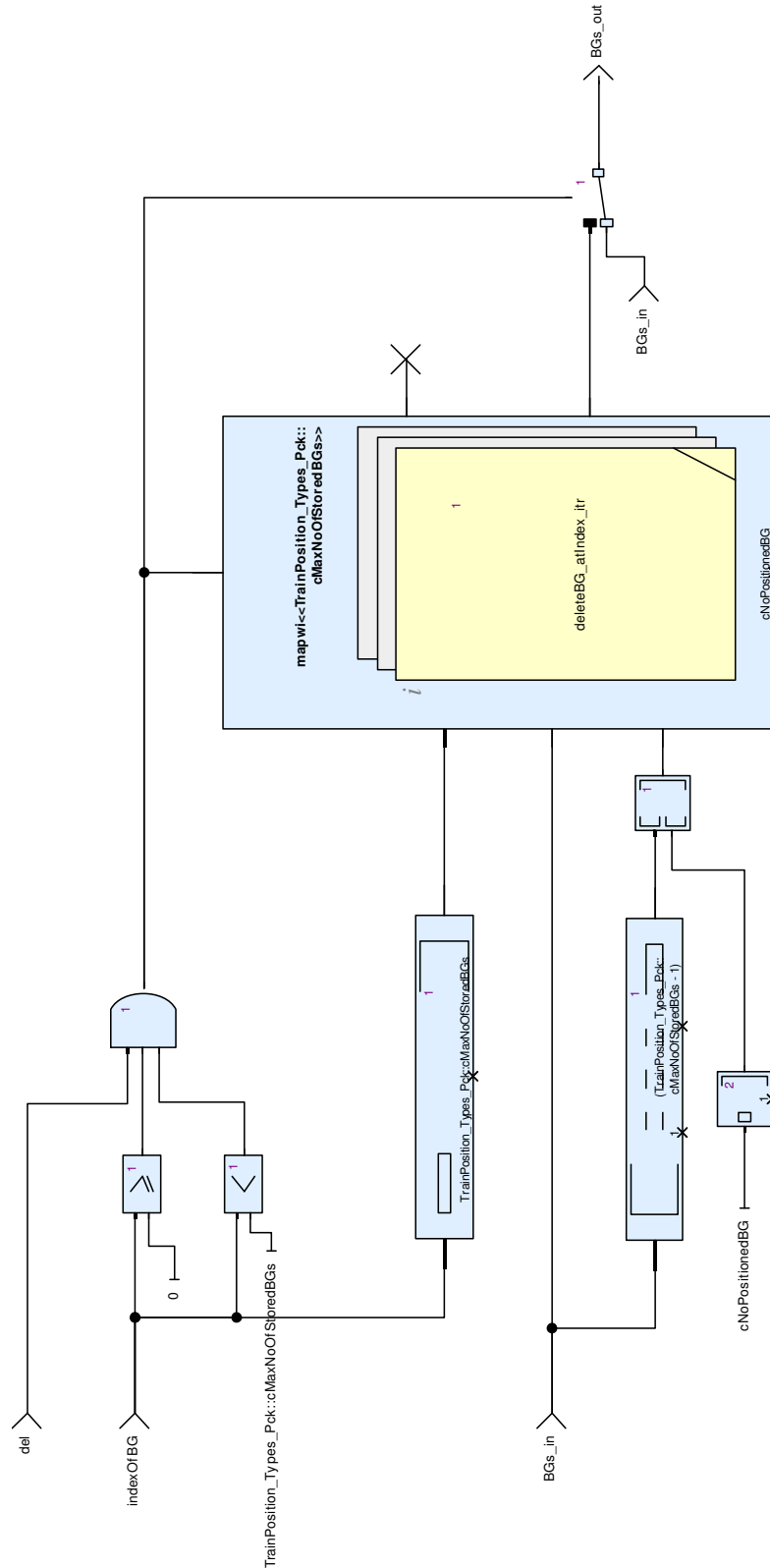


Figure 103: View of diagram\_deleteBG\_atIndex\_1 (deleteBG\_atIndex)

### 14.3.6. deleteBG\_atIndex\_itr Operator

Declared as **private function**

#### 14.3.6.1. Comments and Information

##### **deleteBG\_atIndex\_itr Comments:**

- Iterated function used by deleteBG\_atIndex

#### 14.3.6.2. Interface

**Table 279: Inputs of deleteBG\_atIndex\_itr**

Name	Type	Comments and Information
iteratorIndex	int	
indexOfBG	int	
BG_in	TrainPosition_Types_Pc k::positionedBG_T	
BG_shifted_in	TrainPosition_Types_Pc k::positionedBG_T	

**Table 280: Outputs of deleteBG\_atIndex\_itr**

Name	Type	Comments and Information
cont	bool	
BG_out	TrainPosition_Types_Pc k::positionedBG_T	

#### 14.3.6.3. Operator Hierarchy

diagram : diagram\_deleteBG\_atIndex\_itr\_1

```
activate if : IfBlock1
  branch : then
  branch : else
    branch : then
    branch : else
```

#### 14.3.6.4. Graphical and Textual Diagrams

##### 14.3.6.4.1. View of diagram\_deleteBG\_atIndex\_itr\_1 (deleteBG\_atIndex\_itr)

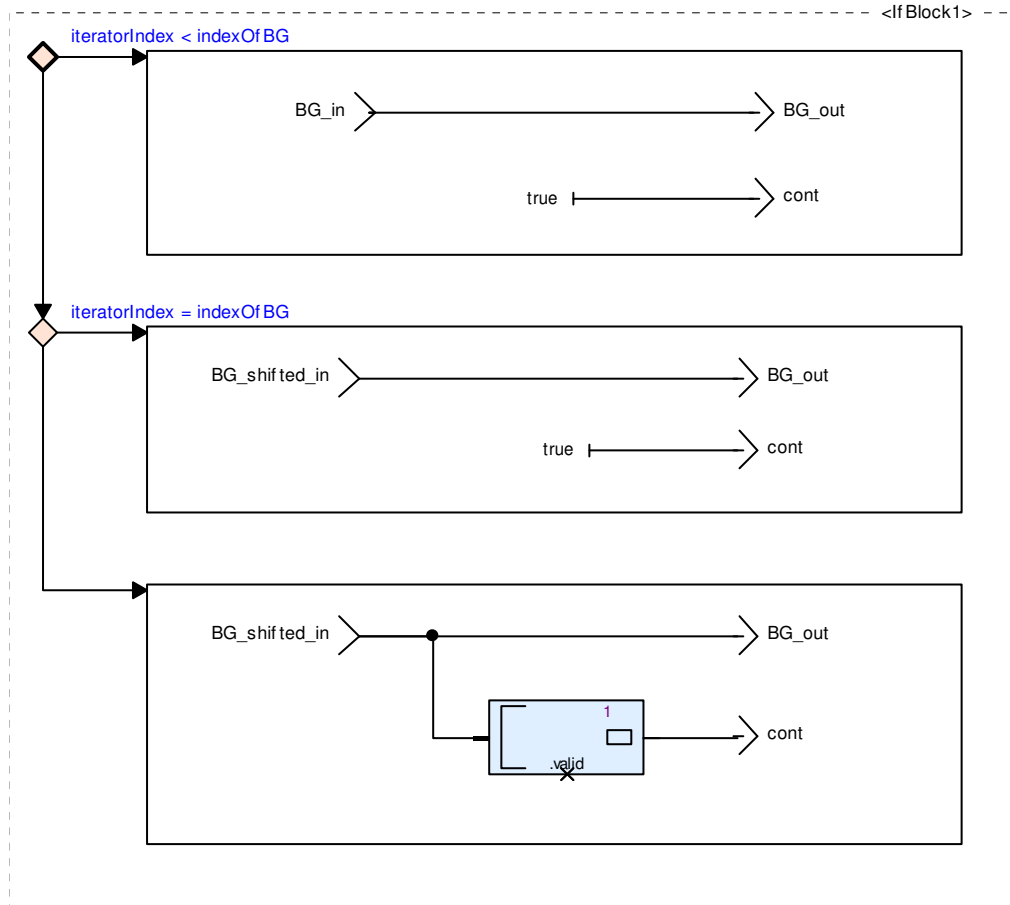


Figure 104: View of diagram\_deleteBG\_atIndex\_itr\_1 (deleteBG\_atIndex\_itr)

Table 281: Conditional Blocks of diagram\_deleteBG\_atIndex\_itr\_1

Conditional Block	Comments and Information
IfBlock1	

Table 282: Actions of diagram\_deleteBG\_atIndex\_itr\_1

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

#### 14.3.7. deleteBGs\_beforeIndex Operator

Declared as **public function**

##### 14.3.7.1. Comments and Information

###### deleteBGs\_beforeIndex Comments:

- Deletes all BGs in BGs, starting with index 0 until (indexOfBG - 1).

### 14.3.7.2. Interface

**Table 283: Inputs of deleteBGs\_beforeIndex**

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T	
indexOfBG	int	
del	bool	<b>Comments:</b> Delete command. Deletion takes place if del = true.

**Table 284: Outputs of deleteBGs\_beforeIndex**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	

### 14.3.7.3. Operator Hierarchy

diagram : diagram\_deleteBGs\_beforeIndex\_1

#### 14.3.7.4. Graphical and Textual Diagrams

##### 14.3.7.4.1. View of diagram\_deleteBGs\_beforeIndex\_1 (deleteBGs\_beforeIndex)

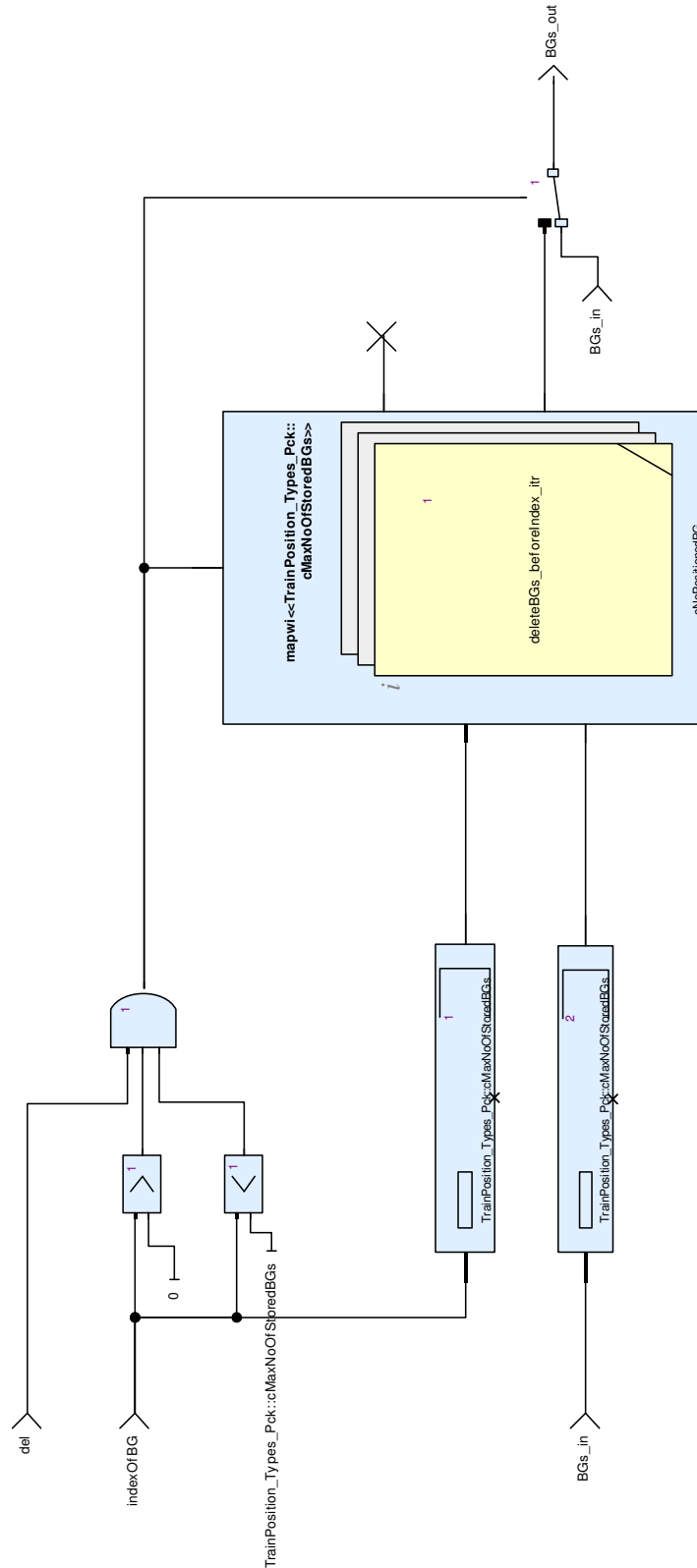


Figure 105: View of diagram\_deleteBGs\_beforeIndex\_1 (deleteBGs\_beforeIndex)

### 14.3.8. deleteBGs\_beforeIndex\_itr Operator

Declared as **private function**

#### 14.3.8.1. Comments and Information

##### deleteBGs\_beforeIndex\_itr Comments:

- Iterated function used by deleteBGs\_beforeIndex

#### 14.3.8.2. Interface

**Table 285: Inputs of deleteBGs\_beforeIndex\_itr**

Name	Type	Comments and Information
iteratorIndex	int	
indexOfBG	int	
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T	

**Table 286: Outputs of deleteBGs\_beforeIndex\_itr**

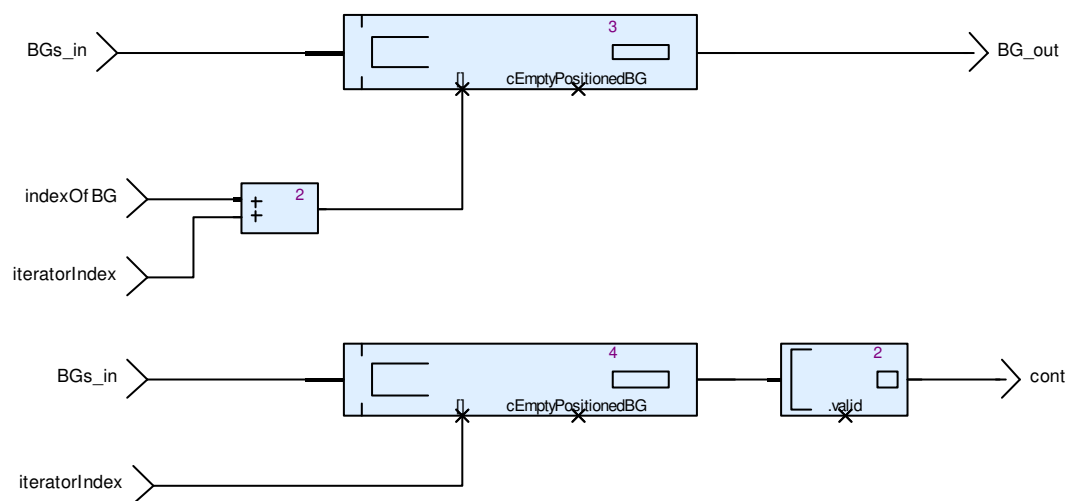
Name	Type	Comments and Information
cont	bool	
BG_out	TrainPosition_Types_Pc k::positionedBG_T	

#### 14.3.8.3. Operator Hierarchy

diagram : diagram\_deleteBGs\_beforeIndex\_itr\_1

#### 14.3.8.4. Graphical and Textual Diagrams

##### 14.3.8.4.1. View of diagram\_deleteBGs\_beforeIndex\_itr\_1 (deleteBGs\_beforeIndex\_itr)



**Figure 106: View of diagram\_deleteBGs\_beforeIndex\_itr\_1 (deleteBGs\_beforeIndex\_itr)**



### 14.3.9. deleteBGs\_fromIndex Operator

Declared as **public function**

#### 14.3.9.1. Comments and Information

##### **deleteBGs\_fromIndex Comments:**

- Deletes all BGs in BGs, starting with indexOfBG until the end of the list.

#### 14.3.9.2. Interface

**Table 287: Inputs of deleteBGs\_fromIndex**

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T	
indexOfBG	int	
del	bool	<b>Comments:</b> Delete command. Deletion takes place if del = true.

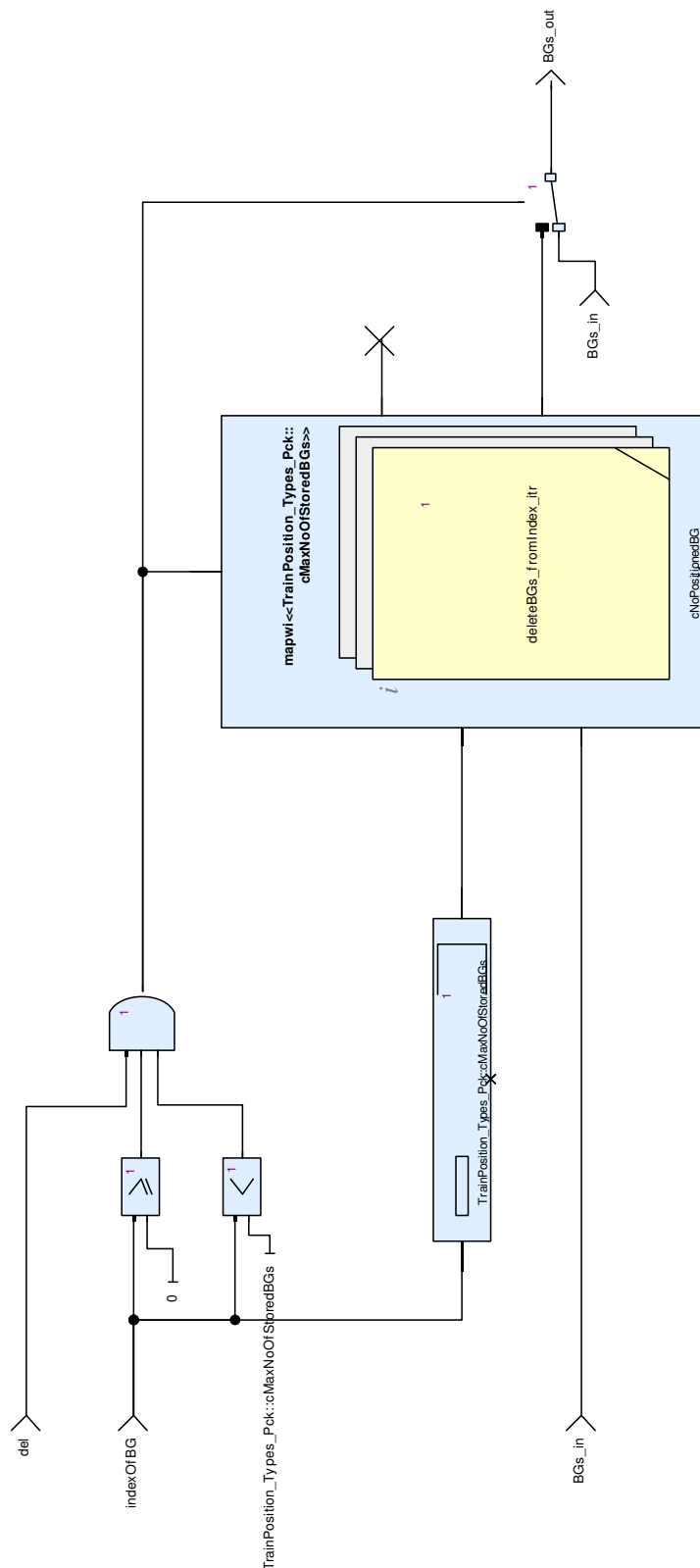
**Table 288: Outputs of deleteBGs\_fromIndex**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	

#### 14.3.9.3. Operator Hierarchy

diagram : diagram\_deleteBGs\_fromIndex\_1

14.3.9.4.1. View of diagram\_deleteBGs\_fromIndex\_1 (deleteBGs\_fromIndex)



**Figure 107: View of diagram\_deleteBGs\_fromIndex\_1 (deleteBGs\_fromIndex)**

### 14.3.10. deleteBGs\_fromIndex\_itr Operator

Declared as **private function**

#### 14.3.10.1. Comments and Information

##### **deleteBGs\_fromIndex\_itr Comments:**

- Iterated function used by deleteBGs\_fromIndex

#### 14.3.10.2. Interface

**Table 289: Inputs of deleteBGs\_fromIndex\_itr**

Name	Type	Comments and Information
iteratorIndex	int	
indexOfBG	int	
BG_in	TrainPosition_Types_Pc k::positionedBG_T	

**Table 290: Outputs of deleteBGs\_fromIndex\_itr**

Name	Type	Comments and Information
cont	bool	
BG_out	TrainPosition_Types_Pc k::positionedBG_T	

#### 14.3.10.3. Operator Hierarchy

diagram : diagram\_deleteBGs\_fromIndex\_itr\_1

```
activate if : IfBlock1
  branch : then
  branch : else
    branch : then
    branch : else
```

#### 14.3.10.4. Graphical and Textual Diagrams

##### 14.3.10.4.1. View of diagram\_deleteBGs\_fromIndex\_itr\_1 (deleteBGs\_fromIndex\_itr)

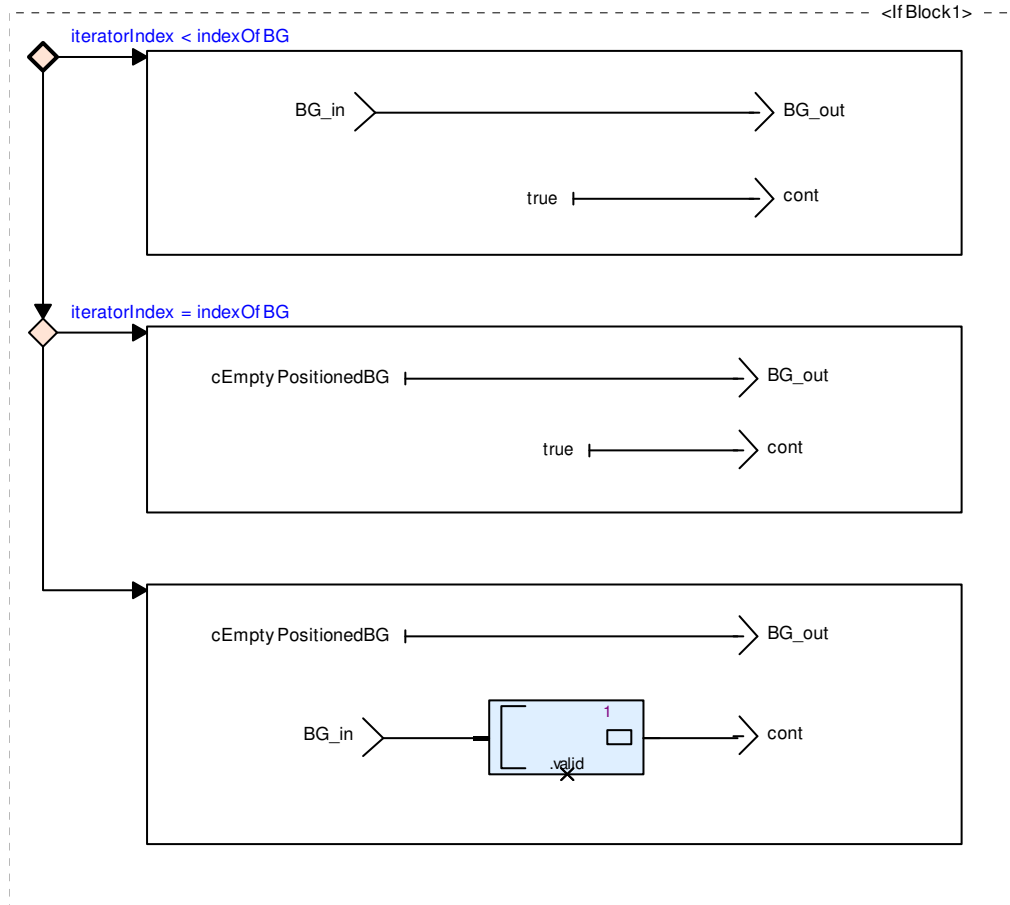


Figure 108: View of diagram\_deleteBGs\_fromIndex\_itr\_1 (deleteBGs\_fromIndex\_itr)

Table 291: Conditional Blocks of diagram\_deleteBGs\_fromIndex\_itr\_1

Conditional Block	Comments and Information
IfBlock1	

Table 292: Actions of diagram\_deleteBGs\_fromIndex\_itr\_1

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

#### 14.3.11. indexOf\_nthPassedBG Operator

Declared as **public function**

##### 14.3.11.1. Comments and Information

**indexOf\_nthPassedBG Comments:**

- Determines the index of the n-th linked or unlinked passed BG in BGs.

#### 14.3.11.2. Interface

**Table 293: Inputs of indexOf\_nthPassedBG**

Name	Type	Comments and Information
linked	bool	<b>Comments:</b> Condition if the search is for a linked or unlinked BG.
n	int	<b>Comments:</b> The n-th BGs will be searched. This is the related number "n".
BGs	TrainPosition_Types_Pc k::positionedBGs_T	
enable	bool	

**Table 294: Outputs of indexOf\_nthPassedBG**

Name	Type	Comments and Information
indexOfBG	int	
BG_found	bool	<b>Comments:</b> Indicates, that BG exists in BGs.

#### 14.3.11.3. Operator Hierarchy

diagram : diagram\_indexOf\_nthPassedBG\_1

#### 14.3.11.4. Graphical and Textual Diagrams

##### 14.3.11.4.1. View of diagram\_indexOf\_nthPassedBG\_1 (indexOf\_nthPassedBG)

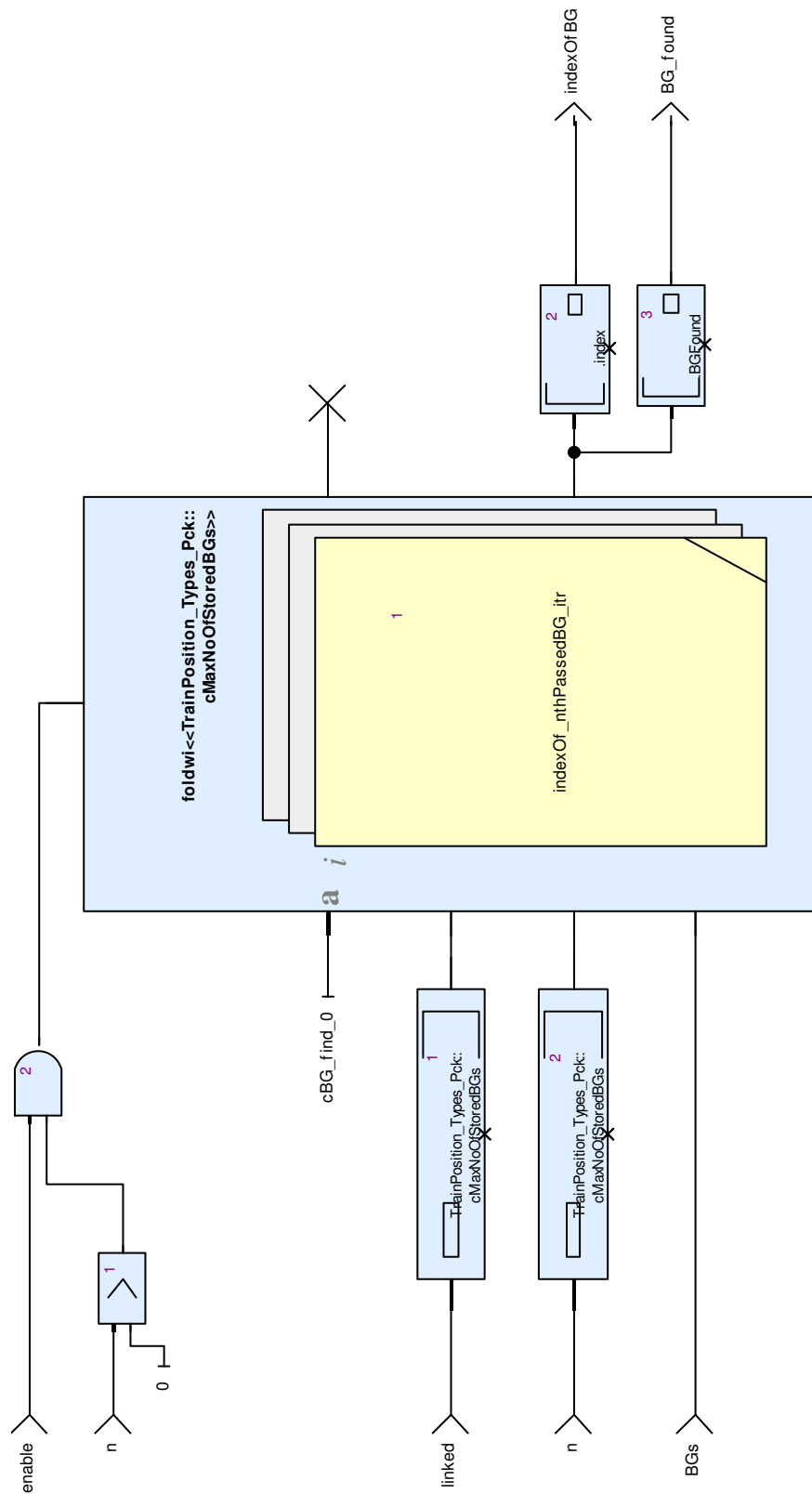


Figure 109: View of diagram\_indexOf\_nthPassedBG\_1 (indexOf\_nthPassedBG)

### 14.3.12. indexOf\_nthPassedBG\_itr Operator

Declared as **private function**

#### 14.3.12.1. Comments and Information

##### indexOf\_nthPassedBG\_itr Comments:

- Iterated function for indexOf\_nthPassedBG

**Table 295: indexOf\_nthPassedBG\_itr Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	Version : 00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for determining the index of BG in BGs</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.12.2. Interface

**Table 296: Inputs of indexOf\_nthPassedBG\_itr**

Name	Type	Comments and Information
iteratorIndex	int	
acc_in	CalculateTrainPosition_ Pkg::BG_utilities_Pkg:: BG_find_T	
linked	bool	<b>Comments:</b> Condition if the search is for a linked or unlinked BG.
n	int	
BG	TrainPosition_Types_Pc k::positionedBG_T	

**Table 297: Outputs of indexOf\_nthPassedBG\_itr**

Name	Type	Comments and Information
cont	bool	
acc_out	CalculateTrainPosition_ Pkg::BG_utilities_Pkg:: BG_find_T	

#### 14.3.12.3. Operator Hierarchy

diagram : diagram\_indexOf\_nthPassedBG\_itr\_1





### 14.3.13. indexOfBG\_by\_id Operator

Declared as **public function**

#### 14.3.13.1. Comments and Information

##### indexOfBG\_by\_id Comments:

- Determines the index of BG in BGs by comparing NID\_BG and NID\_C.
- If BG is found, the output BG\_found is set, otherwise unset.
- If BG is not found, the output indexOfBG is set to a free cell in BGs.
- If BG is not found and no free cell is available in BGs, indexValid is unset.

**Table 298: indexOfBG\_by\_id Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	Version : 00.02.00
	to_c	True
Remark_1	Description	<p>Determines the index of BG in BGs</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications.  It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.  THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.13.2. Interface

**Table 299: Inputs of indexOfBG\_by\_id**

Name	Type	Comments and Information
BG	TrainPosition_Types_Pck::positionedBG_T	
BGs	TrainPosition_Types_Pck::positionedBGs_T	
enable	bool	

**Table 300: Outputs of indexOfBG\_by\_id**

Name	Type	Comments and Information
indexOfBG	int	
BG_found	bool	<b>Comments:</b> Indicates, that BG exists in BGs.
indexValid	bool	<b>Comments:</b> Indicates, that no valid index could be assigned to BG. Practically, this means that there could no place be assigned to BG in BGs.

#### 14.3.13.3. Operator Hierarchy

diagram : diagram\_indexOfBG\_by\_id\_1

#### 14.3.13.4. Graphical and Textual Diagrams

##### 14.3.13.4.1. View of diagram\_indexOfBG\_by\_id\_1 (indexOfBG\_by\_id)

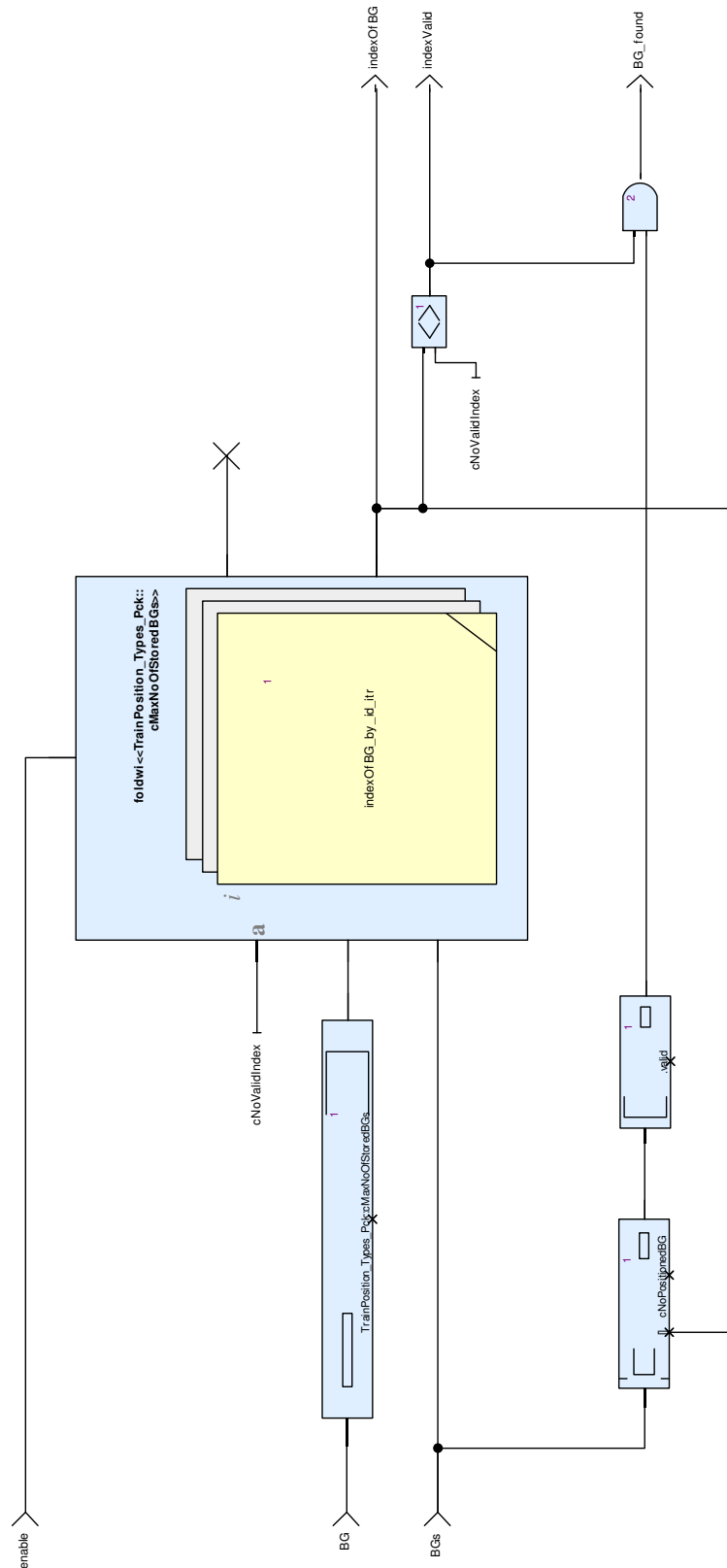


Figure 111: View of diagram\_indexOfBG\_by\_id\_1 (indexOfBG\_by\_id)

#### 14.3.14. indexOfBG\_by\_id\_itr Operator

Declared as **private function**

##### 14.3.14.1. Comments and Information

###### indexOfBG\_by\_id\_itr Comments:

- Iterated function for determining the index of BG in BGs

**Table 301: indexOfBG\_by\_id\_itr Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	Version : 00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for determining the index of BG in BGs</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

##### 14.3.14.2. Interface

**Table 302: Inputs of indexOfBG\_by\_id\_itr**

Name	Type	Comments and Information
iteratorIndex	int	
prevIndex	int	
BG	TrainPosition_Types_Pck::positionedBG_T	
BG_asElementFromBGs	TrainPosition_Types_Pck::positionedBG_T	

**Table 303: Outputs of indexOfBG\_by\_id\_itr**

Name	Type	Comments and Information
cont	bool	

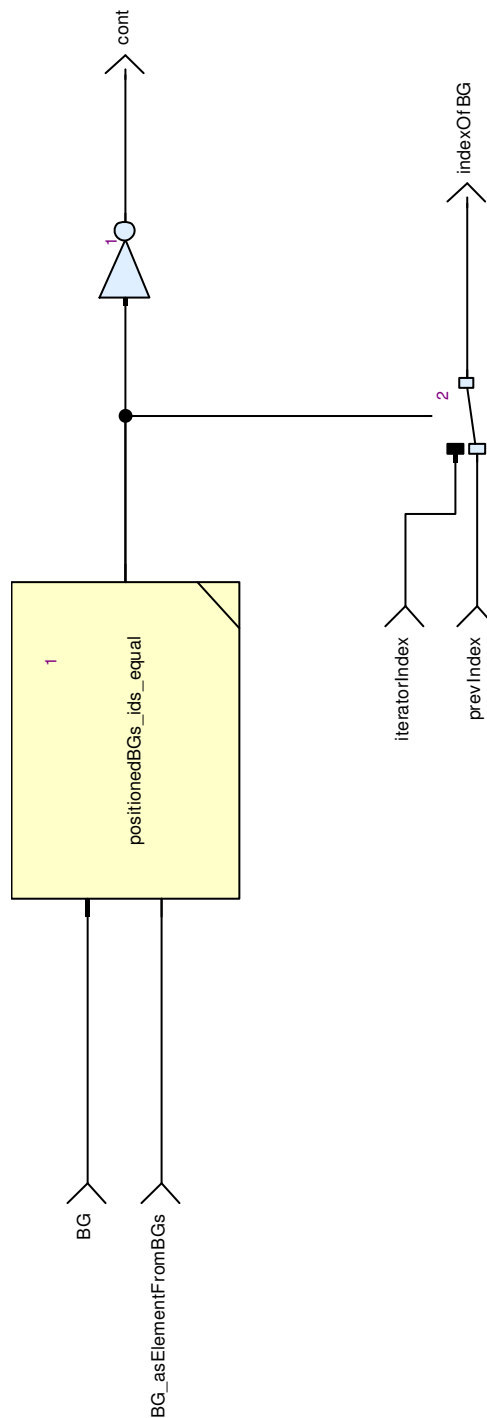
Name	Type	Comments and Information
indexOfBG	int	

#### 14.3.14.3. Operator Hierarchy

diagram : diagram\_indexOfBG\_by\_id\_itr\_1

#### 14.3.14.4. Graphical and Textual Diagrams

##### 14.3.14.4.1. View of diagram\_indexOfBG\_by\_id\_itr\_1 (indexOfBG\_by\_id\_itr)



**Figure 112: View of diagram\_indexOfBG\_by\_id\_itr\_1 (indexOfBG\_by\_id\_itr)**

### 14.3.15. indexOfBG\_onTrack Operator

Declared as **public function**

#### 14.3.15.1. Comments and Information

##### indexOfBG\_onTrack Comments:

- Determines the must index of BG in BGs.
- If BG is a passed BG, the index is determined by the order of the sequence no (seqNoOnTrack).
- If BG is an announced (linked) BG (not yet passed), the index is determined by the expected nominal location.
- If BG already exists in BGs at that index, BG\_found is set, otherwise unset.
- If no index can be assigned, indexValid is unset.
- Note:
- indexOfBG may point to a cell in BGs already occupied by a different BG.
- It is not checked, if BG is already stored in BGs at a different index.

**Table 304: indexOfBG\_onTrack Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	Version : 00.02.00
	to_c	True
Remark_1	Description	<p>Determines the index of BG in BGs</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.15.2. Interface

**Table 305: Inputs of indexOfBG\_onTrack**

Name	Type	Comments and Information
BG	TrainPosition_Types_Pc k::positionedBG_T	

Name	Type	Comments and Information
BGs	TrainPosition_Types_Pc k::positionedBGs_T	
enable	bool	

**Table 306: Outputs of indexOfBG\_onTrack**

Name	Type	Comments and Information
indexOfBG	int	
BG_found	bool	<b>Comments:</b> Indicates, that BG exists in BGs.
indexValid	bool	<b>Comments:</b> Indicates, that no valid index could be assigned to BG. Practically, this means that no cell could be assigned to BG in BGs.

#### 14.3.15.3. Operator Hierarchy

diagram : diagram\_indexOfBG\_onTrack\_1



#### 14.3.15.4. Graphical and Textual Diagrams

##### 14.3.15.4.1. View of diagram\_indexOfBG\_onTrack\_1 (indexOfBG\_onTrack)

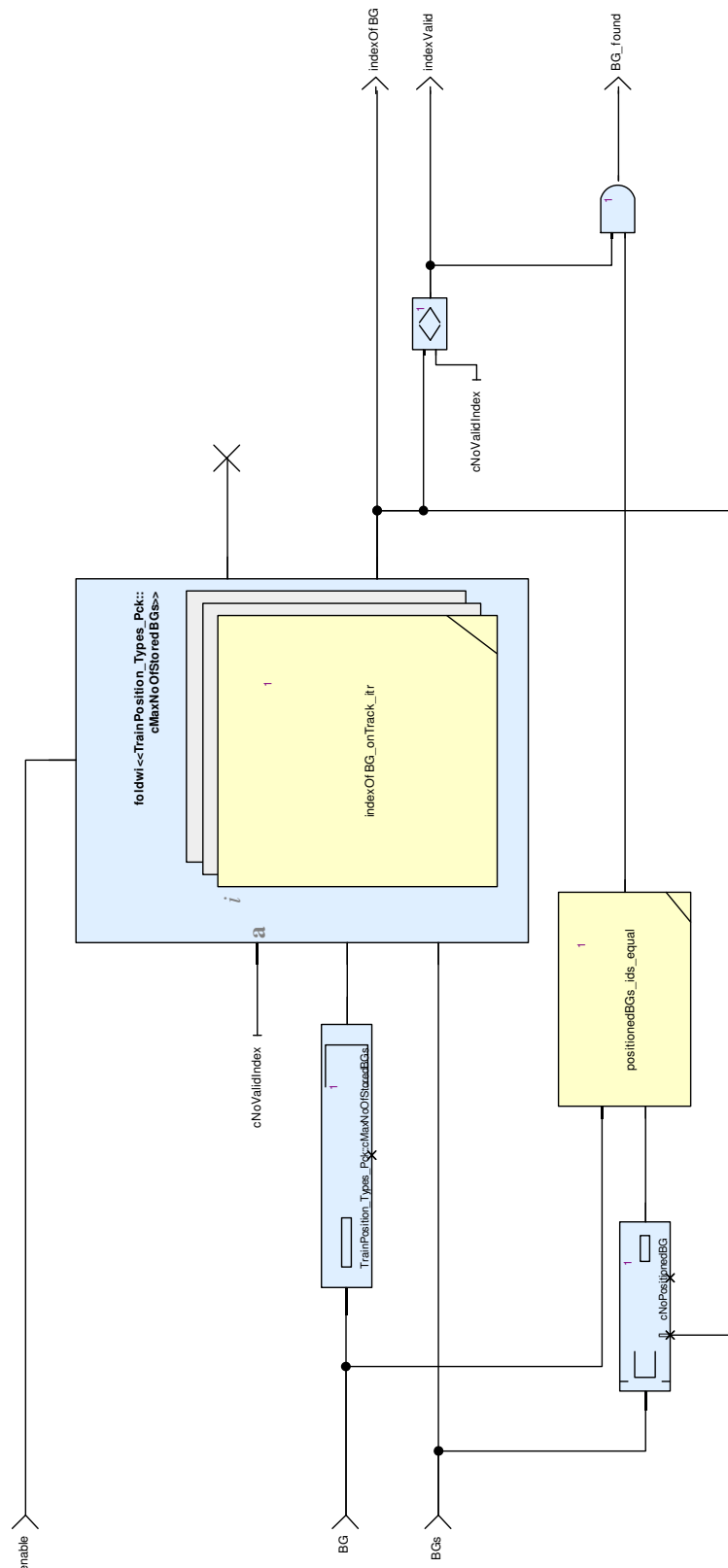


Figure 113: View of diagram\_indexOfBG\_onTrack\_1 (indexOfBG\_onTrack)

### 14.3.16. indexOfBG\_onTrack\_itr Operator

Declared as **private function**

#### 14.3.16.1. Comments and Information

##### indexOfBG\_onTrack\_itr Comments:

- Iterated function for determining the index of BG in BGs

**Table 307: indexOfBG\_onTrack\_itr Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	Version : 00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for determining the index of BG in BGs</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.16.2. Interface

**Table 308: Inputs of indexOfBG\_onTrack\_itr**

Name	Type	Comments and Information
iteratorIndex	int	
prevIndex	int	
BG	TrainPosition_Types_Pck::positionedBG_T	
BG_asElementFromBGs	TrainPosition_Types_Pck::positionedBG_T	

**Table 309: Outputs of indexOfBG\_onTrack\_itr**

Name	Type	Comments and Information
cont	bool	

Name	Type	Comments and Information
indexOfBG	int	

#### 14.3.16.3. Locals

**Table 310: Locals of indexOfBG\_onTrack\_itr**

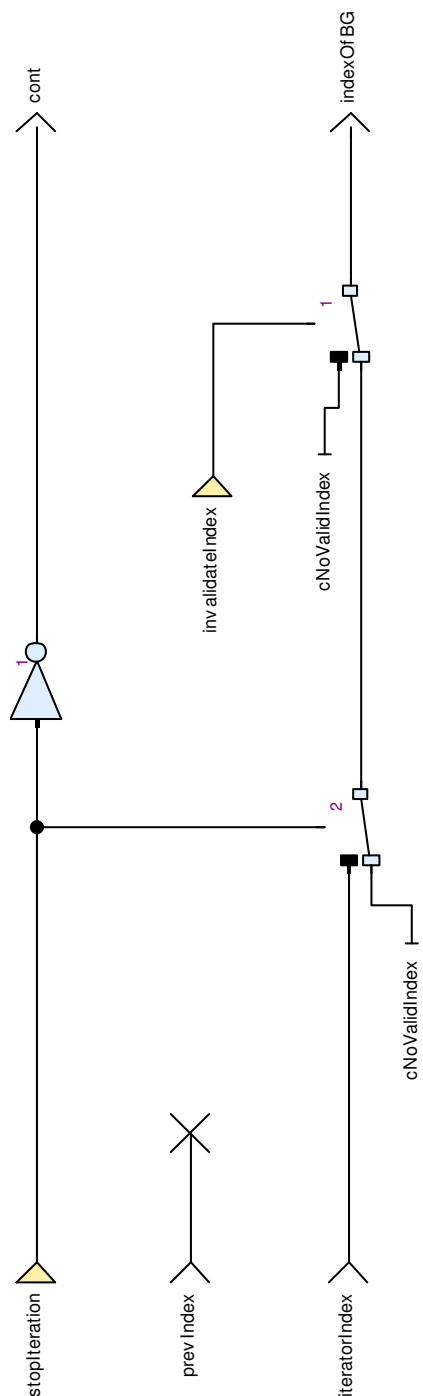
Name	Type	Comments and Information
invalidateIndex	bool	
stopIteration	bool	

#### 14.3.16.4. Operator Hierarchy

diagram : diagram\_setIndex

diagram : diagram\_stopIteration

#### 14.3.16.5.1. View of diagram\_setIndex (indexOfBG\_onTrack\_itr)



**Figure 114: View of diagram\_setIndex (indexOfBG\_onTrack\_itr)**

#### 14.3.16.5.2. View of diagram\_stopIteration (indexOfBG\_onTrack\_itr)

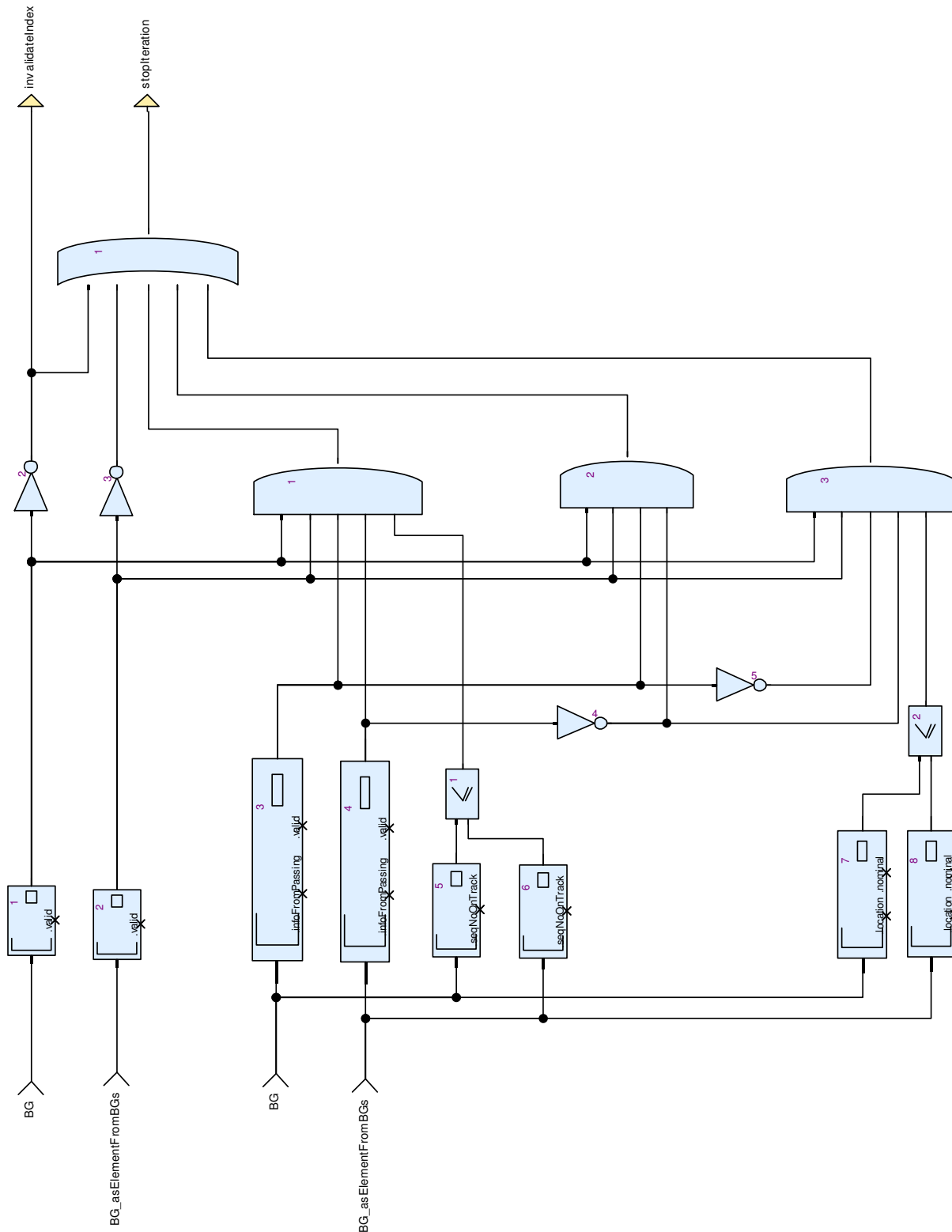


Figure 115: View of diagram\_stopIteration (indexOfBG\_onTrack\_itr)

#### 14.3.17. indexOfLastPassedBG Operator

Declared as **public function**

#### 14.3.17.1. Comments and Information

##### **indexOfLastPassedBG Comments:**

- Determines the index of the last (most ahead) linked or unlinked passed BG in BGs.

#### 14.3.17.2. Interface

**Table 311: Inputs of indexOfLastPassedBG**

Name	Type	Comments and Information
linked	bool	<b>Comments:</b> Condition if the search is for a linked or unlinked BG.
BGs	TrainPosition_Types_Pc k::positionedBGs_T	
enable	bool	

**Table 312: Outputs of indexOfLastPassedBG**

Name	Type	Comments and Information
indexOfBG	int	
BG_found	bool	<b>Comments:</b> Indicates, that BG exists in BGs.
indexValid	bool	<b>Comments:</b> Indicates, that a valid index was found.

#### 14.3.17.3. Operator Hierarchy

diagram : diagram\_indexOfLastPassedBG\_1



### 14.3.18. indexOfLastPassedBG\_itr Operator

Declared as **private function**

#### 14.3.18.1. Comments and Information

##### **indexOfLastPassedBG\_itr Comments:**

- Iterated function for indexOfLastPassedBG

**Table 313: indexOfLastPassedBG\_itr Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	Version : 00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for determining the index of BG in BGs</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications.  It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.  THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.18.2. Interface

**Table 314: Inputs of indexOfLastPassedBG\_itr**

Name	Type	Comments and Information
iteratorIndex	int	
prevIndex	int	
linked	bool	<b>Comments:</b> Condition if the seach is for a linked or unlinked BG.
BG	TrainPosition_Types_Pc k::positionedBG_T	



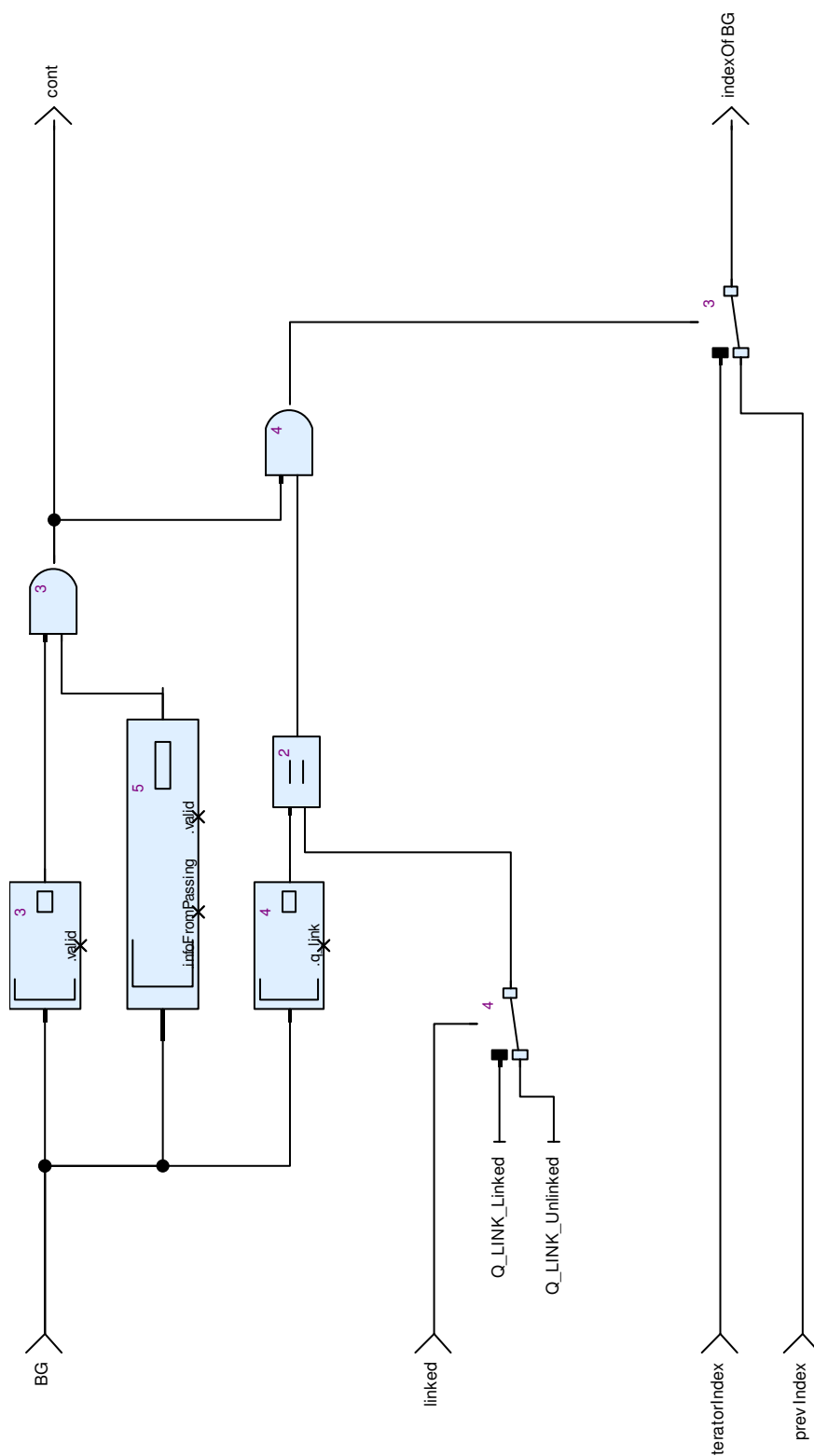
**Table 315: Outputs of indexOfLastPassedBG\_itr**

Name	Type	Comments and Information
cont	bool	
indexOfBG	int	

#### 14.3.18.3. Operator Hierarchy

diagram : diagram\_indexOfLastPassedBG\_itr\_1

14.3.18.4.1. View of diagram\_indexOfLastPassedBG\_itr\_1 (indexOfLastPassedBG\_itr)



**Figure 117: View of diagram\_indexOfLastPassedBG\_itr\_1 (indexOfLastPassedBG\_itr)**

### 14.3.19. indexOfPassedBG\_by\_id Operator

Declared as **public function**

#### 14.3.19.1. Comments and Information

##### indexOfPassedBG\_by\_id Comments:

- Determines the index of a passed BG in BGs by comparing NID\_BG and NID\_C.

**Table 316: indexOfPassedBG\_by\_id Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Determines the index of a passed BG in BGs</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.19.2. Interface

**Table 317: Inputs of indexOfPassedBG\_by\_id**

Name	Type	Comments and Information
BG	BG_Types_Pkg::passedBG_T	
BGs	TrainPosition_Types_Pkg::positionedBGs_T	
enable	bool	

**Table 318: Outputs of indexOfPassedBG\_by\_id**

Name	Type	Comments and Information
indexOfBG	int	

Name	Type	Comments and Information
BG_found	bool	<b>Comments:</b> Indicates, that BG exists in BGs.
indexValid	bool	<b>Comments:</b> Indicates, that no valid index could be assigned to BG. Practically, this means that there could no place be assigned to BG in BGs.

#### 14.3.19.3. Operator Hierarchy

diagram : diagram\_indexOfPassedBG\_by\_id\_1

#### 14.3.19.4. Graphical and Textual Diagrams

##### 14.3.19.4.1. View of diagram\_indexOfPassedBG\_by\_id\_1 (indexOfPassedBG\_by\_id)

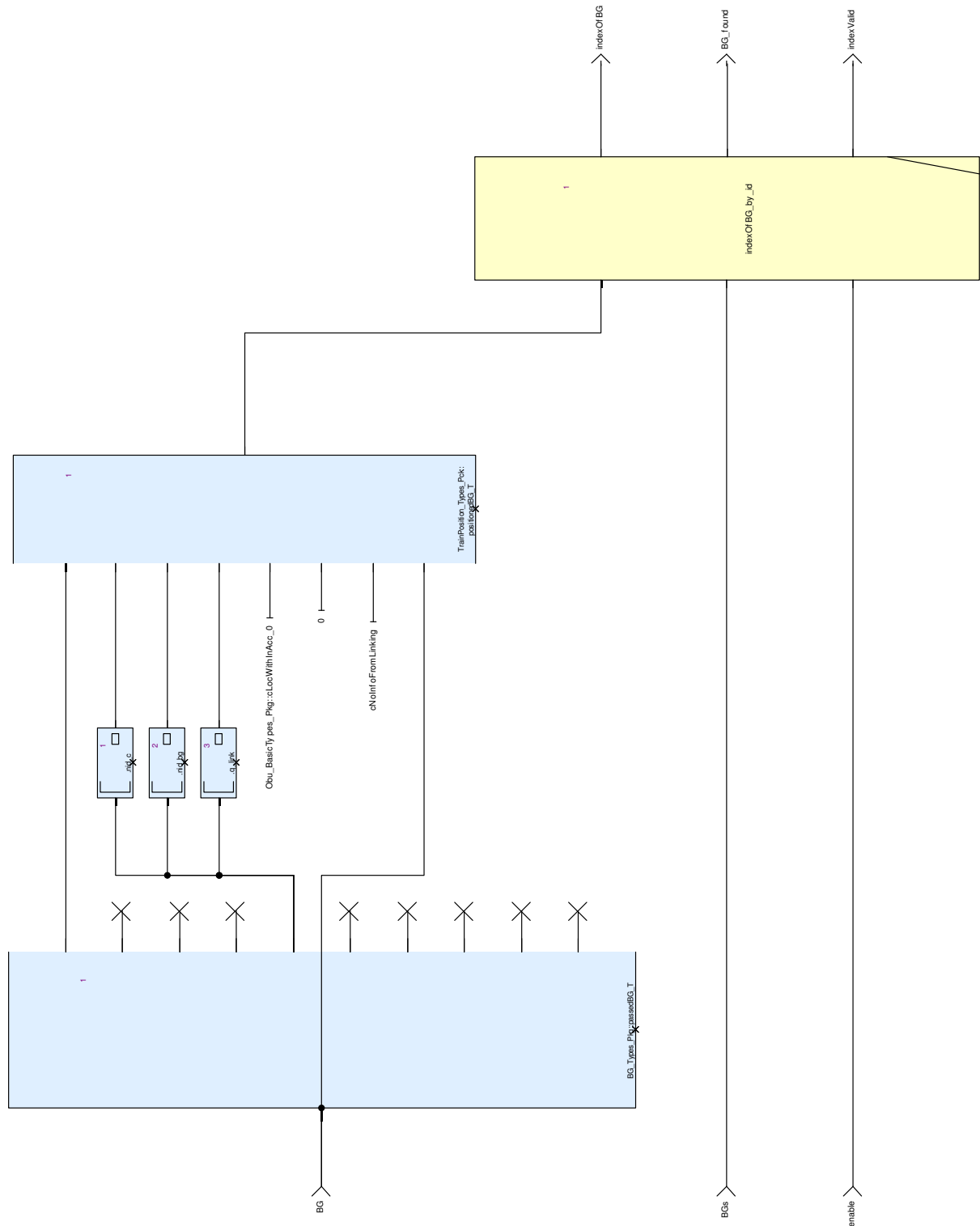


Figure 118: View of diagram\_indexOfPassedBG\_by\_id\_1 (indexOfPassedBG\_by\_id)

#### 14.3.20. insertBG\_atIndex Operator

Declared as **public function**

#### 14.3.20.1. Comments and Information

##### **insertBG\_atIndex Comments:**

- Inserts BG in BGs\_in at the cell given by indexOfBG.
- The BGs above BG are shifted upwards by 1.
- If a BG with the same ID already exists in BGs at the same cell, BG will replace it.
- If there is no space in BGs\_in for the insertion, overrun will be set and no insertion performed.

#### 14.3.20.2. Interface

**Table 319: Inputs of insertBG\_atIndex**

Name	Type	Comments and Information
BG	TrainPosition_Types_Pck::positionedBG_T	
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	
indexOfBG	int	
insert	bool	<b>Comments:</b> insert comand. Must be true to execute the insertion.

**Table 320: Outputs of insertBG\_atIndex**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	
overrun	bool	<b>Comments:</b> Indicates, that no merge took place due to no space in BGs_in.

#### 14.3.20.3. Operator Hierarchy

diagram : diagram\_insertBG\_atIndex\_1

## 14.3.20.4. Graphical and Textual Diagrams

### 14.3.20.4.1. View of diagram\_insertBG\_atIndex\_1 (insertBG\_atIndex)

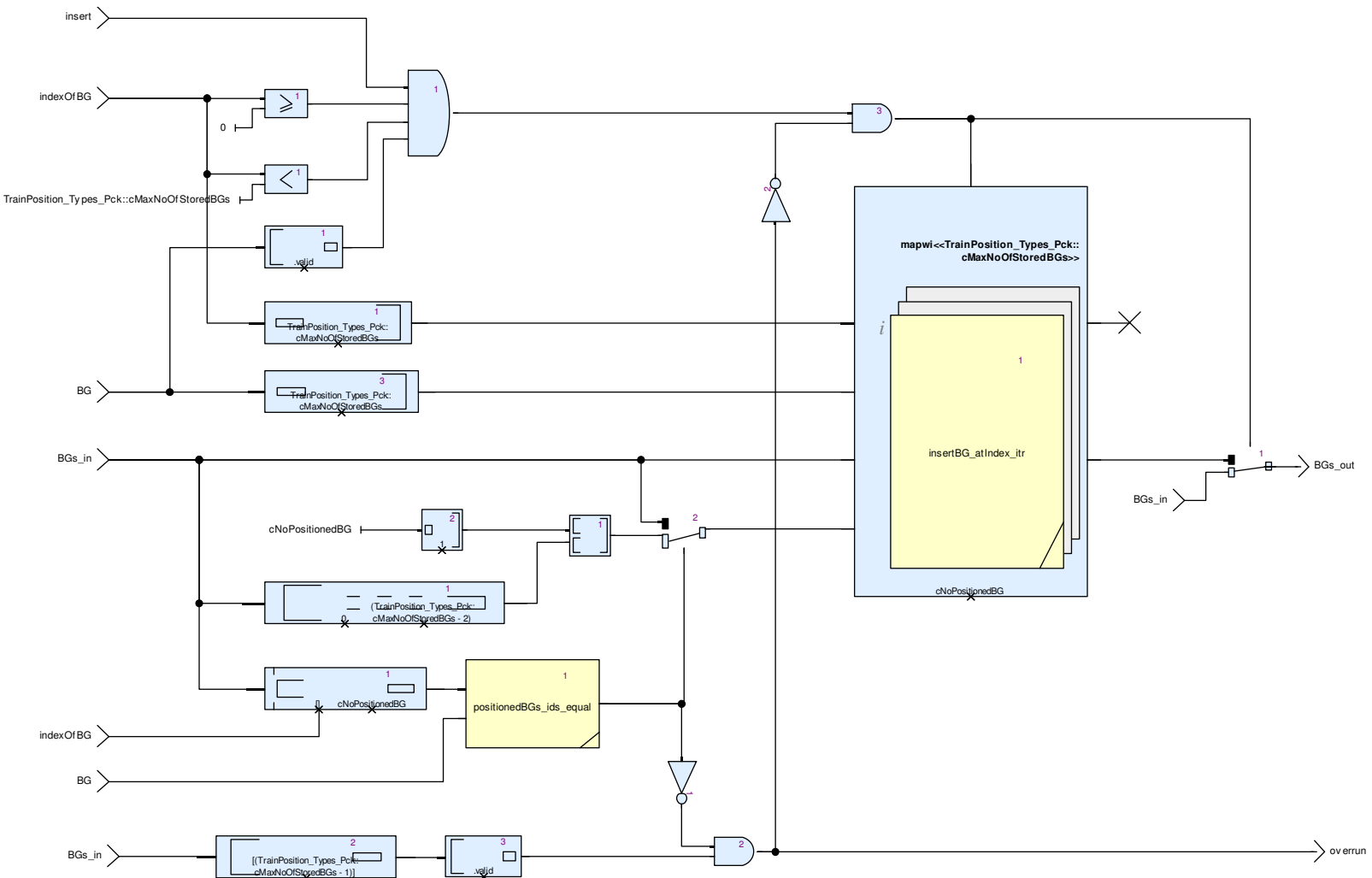


Figure 119: View of diagram\_insertBG\_atIndex\_1 (insertBG\_atIndex)

### 14.3.21. insertBG\_atIndex\_itr Operator

Declared as **private function**

#### 14.3.21.1. Comments and Information

##### **insertBG\_atIndex\_itr Comments:**

- Iterated function for insertBG\_atIndex.

#### 14.3.21.2. Interface

**Table 321: Inputs of insertBG\_atIndex\_itr**

Name	Type	Comments and Information
iteratorIndex	int	
indexOfBG	int	
BG_toBeInserted	TrainPosition_Types_Pc k::positionedBG_T	
BG_in	TrainPosition_Types_Pc k::positionedBG_T	
BG_shifted_in	TrainPosition_Types_Pc k::positionedBG_T	

**Table 322: Outputs of insertBG\_atIndex\_itr**

Name	Type	Comments and Information
cont	bool	
BG_out	TrainPosition_Types_Pc k::positionedBG_T	

#### 14.3.21.3. Operator Hierarchy

diagram : diagram\_insertBG\_atIndex\_itr\_1

```
activate if : IfBlock1
  branch : then
  branch : else
    branch : then
    branch : else
```



#### 14.3.21.4. Graphical and Textual Diagrams

##### 14.3.21.4.1. View of diagram\_insertBG\_atIndex\_itr\_1 (insertBG\_atIndex\_itr)

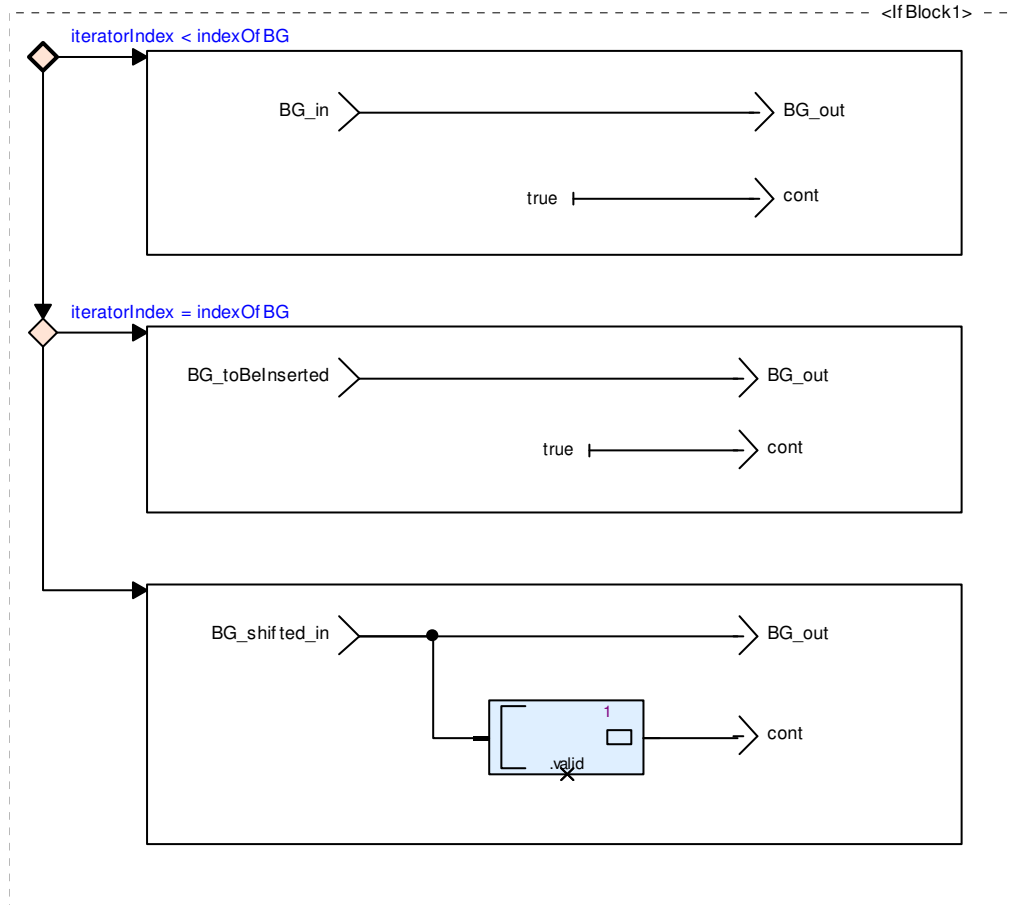


Figure 120: View of diagram\_insertBG\_atIndex\_itr\_1 (insertBG\_atIndex\_itr)

Table 323: Conditional Blocks of diagram\_insertBG\_atIndex\_itr\_1

Conditional Block	Comments and Information
IfBlock1	

Table 324: Actions of diagram\_insertBG\_atIndex\_itr\_1

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

#### 14.3.22. mergeBG\_by\_id Operator

Declared as **private function**

##### 14.3.22.1. Comments and Information

###### mergeBG\_by\_id Comments:

- Merges a BG into an array of BGs.

- If an element in BGs exists in BGs with the same ID as BG, the element in BGs will be replaced by BG.

**Table 325: mergeBG\_by\_id Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Merges a BG into an array of BGs</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.22.2. Interface

**Table 326: Inputs of mergeBG\_by\_id**

Name	Type	Comments and Information
BG	TrainPosition_Types_Pck::positionedBG_T	<b>Comments:</b> The BG to be merged.
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	<b>Comments:</b> The BGs where BG is to be merged with.

**Table 327: Outputs of mergeBG\_by\_id**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	<b>Comments:</b> The resulting array of merged BGs.
overrun	bool	<b>Comments:</b> Indicates, that no merge took place due to no space in BGs_in.

#### 14.3.22.3. Operator Hierarchy

diagram : diagram\_mergeBG\_by\_id\_1

#### 14.3.22.4. Graphical and Textual Diagrams

##### 14.3.22.4.1. View of diagram\_mergeBG\_by\_id\_1 (mergeBG\_by\_id)

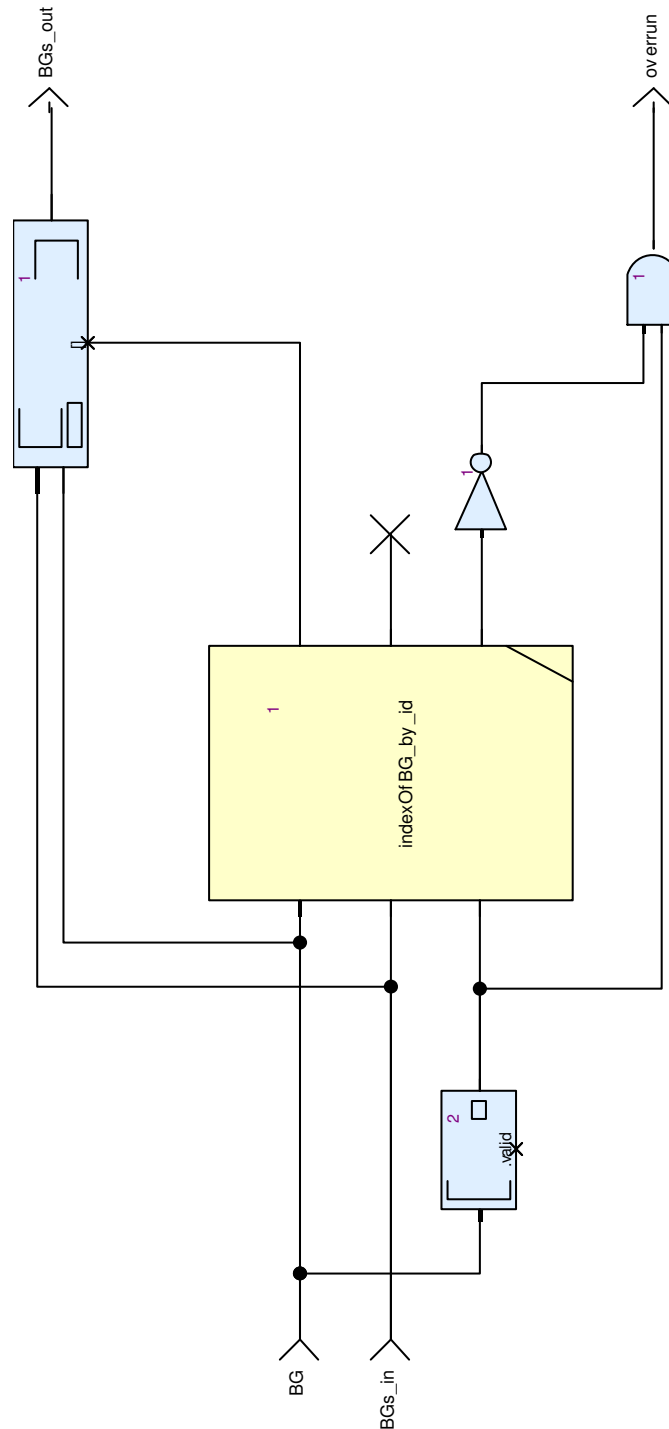


Figure 121: View of diagram\_mergeBG\_by\_id\_1 (mergeBG\_by\_id)

#### 14.3.23. mergeBG\_onTrack Operator

Declared as **public function**

#### 14.3.23.1. Comments and Information

##### **mergeBG\_onTrack Comments:**

- Inserts BG into the collection of BGs.
- If BG has been passed already, it will be sorted by its seqNoOnTrack within all other passed BGs.
- If the passed BG was an announced BG in BGs before, it will replace this announced BG, if necessary on a different position in BGs.
- If BG is an announced BG, it will be sorted by its nominal location within all other announced BGs.
- BGs\_in and BGs\_out comprise all passed BGs followed by all announced BGs.

#### 14.3.23.2. Interface

**Table 328: Inputs of mergeBG\_onTrack**

Name	Type	Comments and Information
BG	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The BG to be merged.
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T	<b>Comments:</b> The BGs where BG is to be merged with.

**Table 329: Outputs of mergeBG\_onTrack**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	<b>Comments:</b> The resulting array of merged BGs.
overrun	bool	<b>Comments:</b> Indicates, that no merge took place due to no space in BGs_in.

#### 14.3.23.3. Operator Hierarchy

diagram : diagram\_mergeBG\_onTrack\_1

#### 14.3.23.4. Graphical and Textual Diagrams

##### 14.3.23.4.1. View of diagram\_mergeBG\_onTrack\_1 (mergeBG\_onTrack)

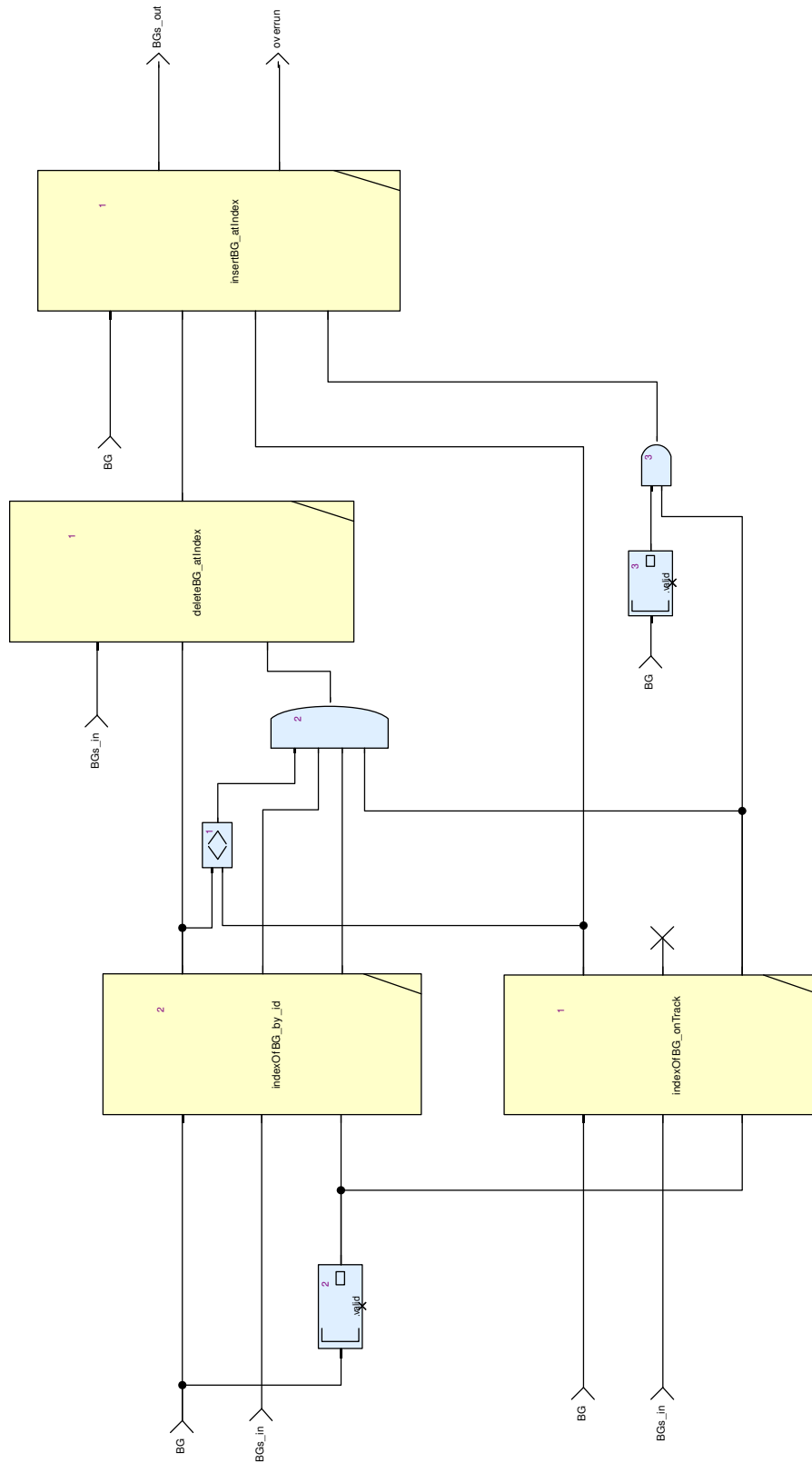


Figure 122: View of diagram\_mergeBG\_onTrack\_1 (mergeBG\_onTrack)

#### 14.3.24. mergeBGs\_by\_id Operator

Declared as **public function**

##### 14.3.24.1. Comments and Information

###### mergeBGs\_by\_id Comments:

- Merges two arrays of BGs by id.
- If a BG with the same id exists in BGs\_1 and BGs\_2, the BG from BGs\_2 will override the element in BGs\_1.
- Otherwise, the valid elements of BGs\_2 will be stored in empty slices of BGs\_1.
- Overrun indicates not enough space for merging.

**Table 330: mergeBGs\_by\_id Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Merges two arrays of BGs by id.</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications.  It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.  THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

##### 14.3.24.2. Interface

**Table 331: Inputs of mergeBGs\_by\_id**

Name	Type	Comments and Information
BGs_1	TrainPosition_Types_Pck::positionedBGs_T	<b>Comments:</b> The first array of BGs to be merged.
BGs_2	TrainPosition_Types_Pck::positionedBGs_T	<b>Comments:</b> The second array of BGs to be merged.

**Table 332: Outputs of mergeBGs\_by\_id**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	<b>Comments:</b> The resulting array of merged BGs.
overrun	bool	<b>Comments:</b> Indicates, that not all of the elements of BGs_2 could be merged into BGs_out, due to not enough space in BGs_out.

#### 14.3.24.3. Operator Hierarchy

diagram : diagram\_mergeBGs\_by\_id\_1

#### 14.3.24.4. Graphical and Textual Diagrams

##### 14.3.24.4.1. View of diagram\_mergeBGs\_by\_id\_1 (mergeBGs\_by\_id)

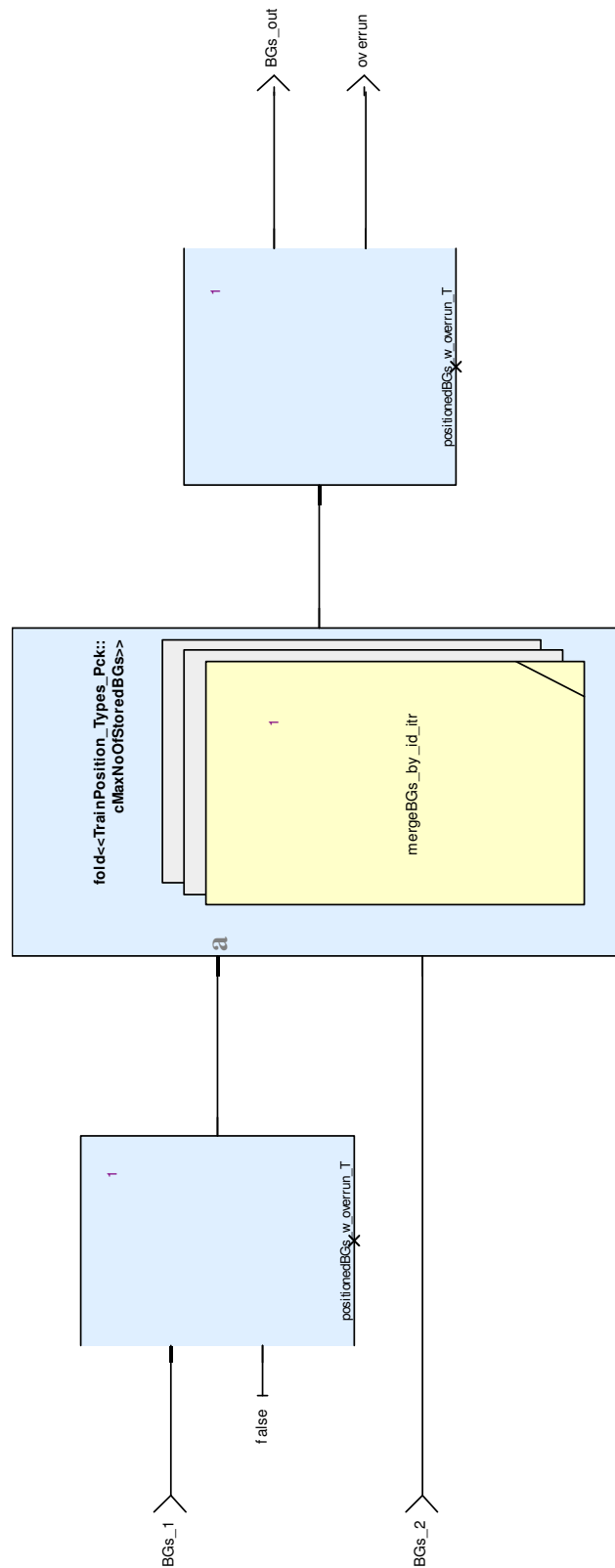


Figure 123: View of diagram\_mergeBGs\_by\_id\_1 (mergeBGs\_by\_id)



### 14.3.25. mergeBGs\_by\_id\_itr Operator

Declared as **private function**

#### 14.3.25.1. Comments and Information

##### mergeBGs\_by\_id\_itr Comments:

- Iterated function for the merge of a BG into an array of BGs.

**Table 333: mergeBGs\_by\_id\_itr Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for the merge of a BG into an array of BGs.</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.25.2. Interface

**Table 334: Inputs of mergeBGs\_by\_id\_itr**

Name	Type	Comments and Information
BGs_in	CalculateTrainPosition_Pkg::positionedBGs_w_overrun_T	<b>Comments:</b> The BGs where BG is to be merged with.
BG	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> The BG to be merged.

**Table 335: Outputs of mergeBGs\_by\_id\_itr**

Name	Type	Comments and Information
BGs_out	CalculateTrainPosition_Pkg::positionedBGs_w_overrun_T	<b>Comments:</b> The resulting array of merged BGs.

#### 14.3.25.3. Operator Hierarchy

diagram : diagram\_mergeBGs\_by\_id\_itr\_1

#### 14.3.25.4. Graphical and Textual Diagrams

##### 14.3.25.4.1. View of diagram\_mergeBGs\_by\_id\_itr\_1 (mergeBGs\_by\_id\_itr)

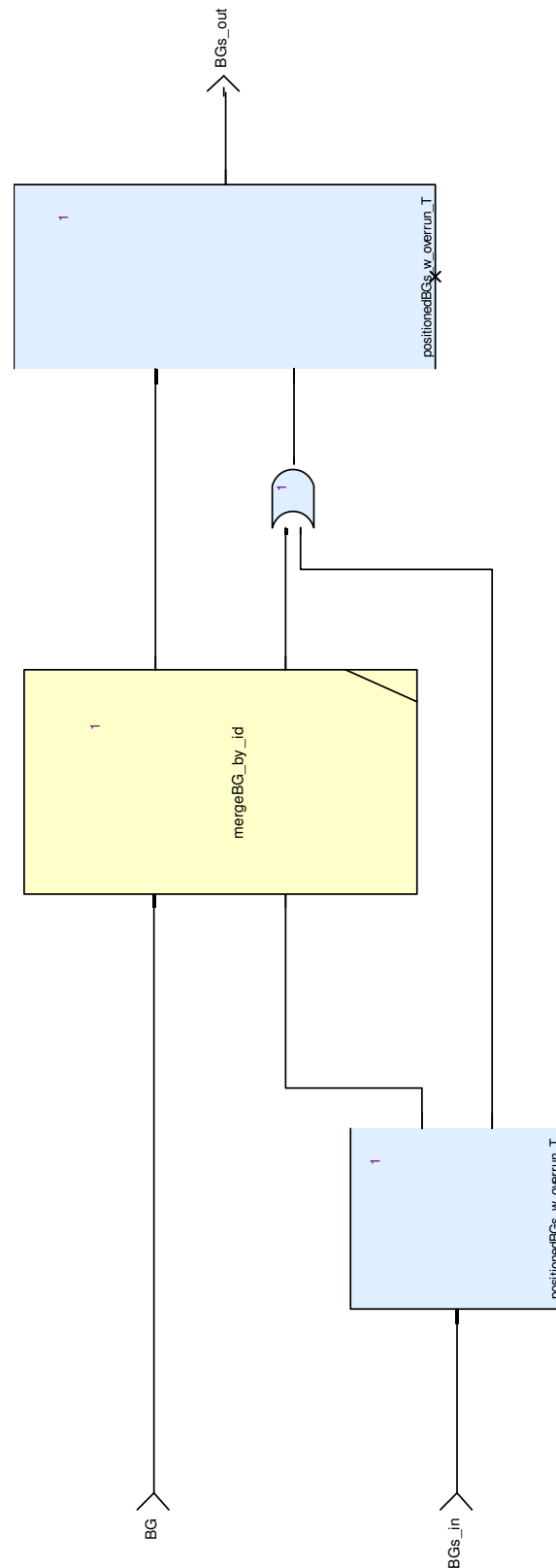


Figure 124: View of diagram\_mergeBGs\_by\_id\_itr\_1 (mergeBGs\_by\_id\_itr)

### 14.3.26. mergeBGs\_onTrack Operator

Declared as **public function**

#### 14.3.26.1. Comments and Information

##### mergeBGs\_onTrack Comments:

- Merges two arrays of BGs and sorting their sequence by seqNoOnTrack (passed BGs) and nominal location announced BGs)
- If a BG with the same id exists in BGs\_1 and BGs\_2, the BG from BGs\_2 will override the element in BGs\_1.
- Otherwise, the valid elements of BGs\_2 will be stored in empty slices of BGs\_1.
- Overrun indicates not enough space for merging.

**Table 336: mergeBGs\_onTrack Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Merges two arrays of BGs by id.            - Copyright Siemens AG, 2014            - Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )            - Gist URL: ---            - Cryptography: No            - Author(s): Uwe Steinke</p> <p>The use of this software is limited to non-vital applications.            It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.            THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.26.2. Interface

**Table 337: Inputs of mergeBGs\_onTrack**

Name	Type	Comments and Information
BGs_1	TrainPosition_Types_Pc k::positionedBGs_T	<b>Comments:</b> The first array of BGs to be merged.
BGs_2	TrainPosition_Types_Pc k::positionedBGs_T	<b>Comments:</b> The second array of BGs to be merged.

**Table 338: Outputs of mergeBGs\_onTrack**

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	<b>Comments:</b> The resulting array of merged BGs.
overrun	bool	<b>Comments:</b> Indicates, that not all of the elements of BGs_2 could be merged into BGs_out, due to not enough space in BGs_out.

#### 14.3.26.3. Operator Hierarchy

diagram : diagram\_mergeBGs\_onTrack\_1

#### 14.3.26.4. Graphical and Textual Diagrams

##### 14.3.26.4.1. View of diagram\_mergeBGs\_onTrack\_1 (mergeBGs\_onTrack)

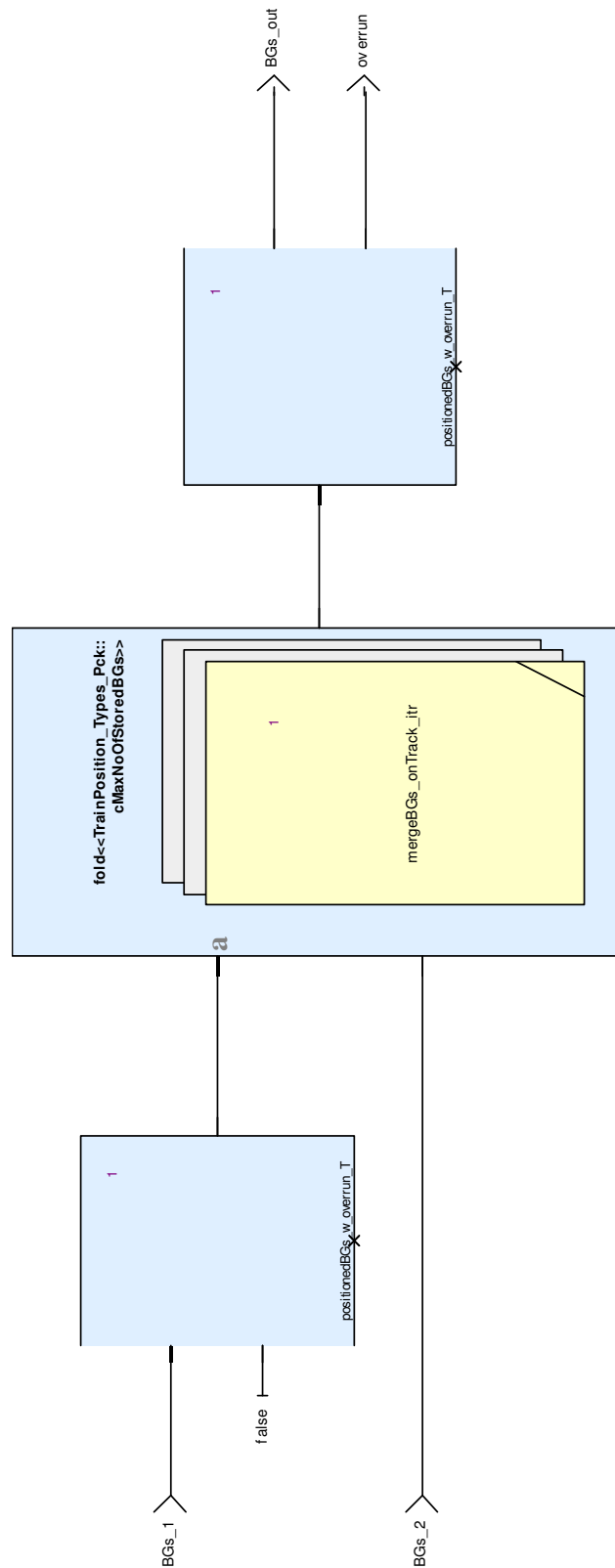


Figure 125: View of diagram\_mergeBGs\_onTrack\_1 (mergeBGs\_onTrack)

### 14.3.27. mergeBGs\_onTrack\_itr Operator

Declared as **private function**

#### 14.3.27.1. Comments and Information

##### mergeBGs\_onTrack\_itr Comments:

- Iterated function for the merge of a BG into a sorted array of BGs.

**Table 339: mergeBGs\_onTrack\_itr Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for the merge of a BG into an array of BGs.</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.27.2. Interface

**Table 340: Inputs of mergeBGs\_onTrack\_itr**

Name	Type	Comments and Information
BGs_in	CalculateTrainPosition_Pkg::positionedBGs_w_overn_T	<b>Comments:</b> The BGs where BG is to be merged with.
BG	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> The BG to be merged.

**Table 341: Outputs of mergeBGs\_onTrack\_itr**

Name	Type	Comments and Information
BGs_out	CalculateTrainPosition_Pkg::positionedBGs_w_overn_T	<b>Comments:</b> The resulting array of merged BGs.

#### 14.3.27.3. Operator Hierarchy

diagram : diagram\_mergeBGs\_onTrack\_itr\_1



#### 14.3.27.4. Graphical and Textual Diagrams

##### 14.3.27.4.1. View of diagram\_mergeBGs\_onTrack\_itr\_1 (mergeBGs\_onTrack\_itr)

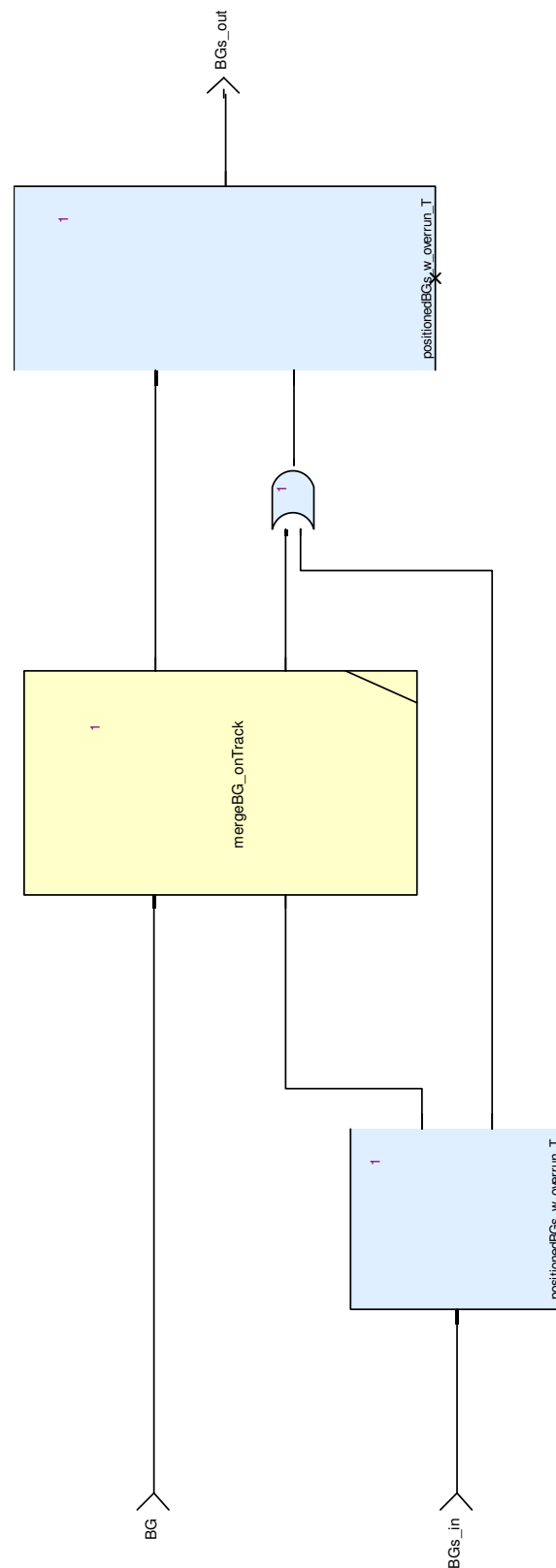


Figure 126: View of diagram\_mergeBGs\_onTrack\_itr\_1 (mergeBGs\_onTrack\_itr)

### 14.3.28. nidBG\_nidc\_equal Operator

Declared as **public function**

#### 14.3.28.1. Comments and Information

##### **nidBG\_nidc\_equal Comments:**

- Checks if the ids of 2 BG are equal by comparing their NID\_BG and NID\_C values.

**Table 342: nidBG\_nidc\_equal Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Checks if the ids of 2 BG are equal by comparing their NID_BG and NID_C values</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.28.2. Interface

**Table 343: Inputs of nidBG\_nidc\_equal**

Name	Type	Comments and Information
nid_c_2	NID_C	
nid_bg_2	NID_BG	
nid_c_1	NID_C	
nid_bg_1	NID_BG	

**Table 344: Outputs of nidBG\_nidc\_equal**

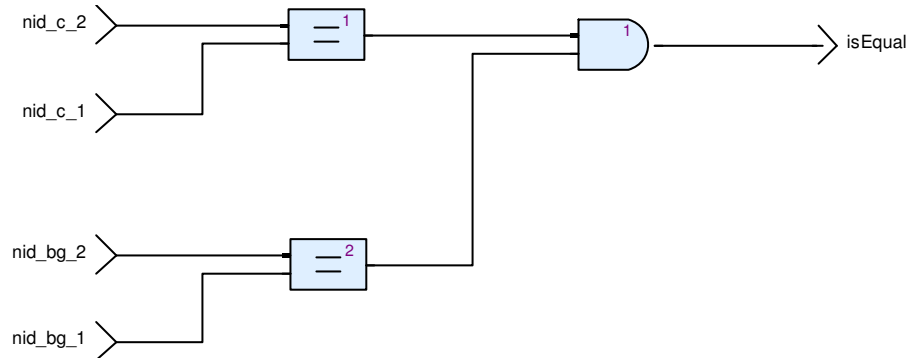
Name	Type	Comments and Information
isEqual	bool	

### 14.3.28.3. Operator Hierarchy

diagram : diagram\_nidBG\_nidc\_equal\_1

### 14.3.28.4. Graphical and Textual Diagrams

#### 14.3.28.4.1. View of diagram\_nidBG\_nidc\_equal\_1 (nidBG\_nidc\_equal)



**Figure 127: View of diagram\_nidBG\_nidc\_equal\_1 (nidBG\_nidc\_equal)**

### 14.3.29. nidC\_nidBG\_2\_NIDLRBG Operator

Declared as **public function**

#### 14.3.29.1. Comments and Information

##### **nidC\_nidBG\_2\_NIDLRBG Comments:**

- Constructs an NID\_LRBG value from NID\_C and NID\_BG

#### 14.3.29.2. Interface

**Table 345: Inputs of nidC\_nidBG\_2\_NIDLRBG**

Name	Type	Comments and Information
valid	bool	
nidC	NID_C	
nidBG	NID_BG	

**Table 346: Outputs of nidC\_nidBG\_2\_NIDLRBG**

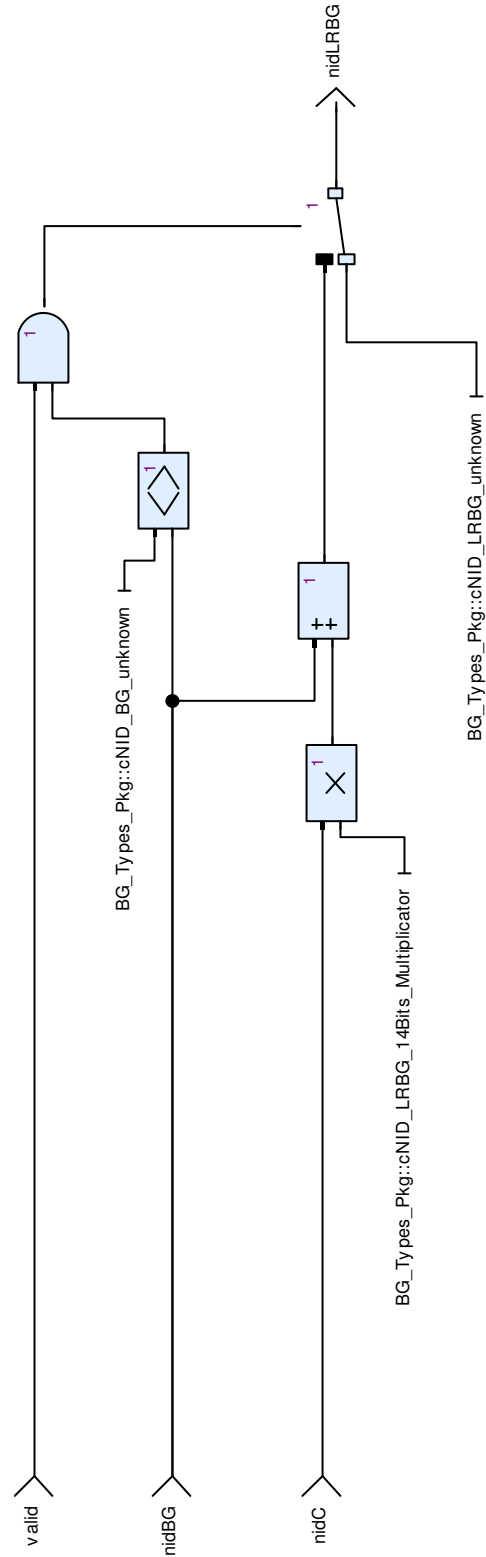
Name	Type	Comments and Information
nidLRBG	NID_LRBG	

### 14.3.29.3. Operator Hierarchy

diagram : diagram\_nidC\_nidBG\_2\_NIDLRBG\_1

#### 14.3.29.4. Graphical and Textual Diagrams

##### 14.3.29.4.1. View of diagram\_nidC\_nidBG\_2\_NIDLRBG\_1 (nidC\_nidBG\_2\_NIDLRBG)



**Figure 128: View of diagram\_nidC\_nidBG\_2\_NIDLRBG\_1 (nidC\_nidBG\_2\_NIDLRBG)**

### 14.3.30. passedBGs\_ids\_equal Operator

Declared as **public function**

#### 14.3.30.1. Comments and Information

##### passedBGs\_ids\_equal Comments:

- Checks if the ids of 2 BG are equal by comparing their NID\_BG and NID\_C values.

**Table 347: passedBGs\_ids\_equal Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Checks if the ids of 2 BG are equal by comparing their NID_BG and NID_C values.</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.30.2. Interface

**Table 348: Inputs of passedBGs\_ids\_equal**

Name	Type	Comments and Information
bg_2	BG_Types_Pkg::passedBG_T	
bg_1	BG_Types_Pkg::passedBG_T	

**Table 349: Outputs of passedBGs\_ids\_equal**

Name	Type	Comments and Information
idsEqual	bool	
idsDifferent	bool	

#### 14.3.30.3. Operator Hierarchy

diagram : diagram\_passedBGs\_ids\_equal\_1

#### 14.3.30.4. Graphical and Textual Diagrams

##### 14.3.30.4.1. View of diagram\_passedBGs\_ids\_equal\_1 (passedBGs\_ids\_equal)

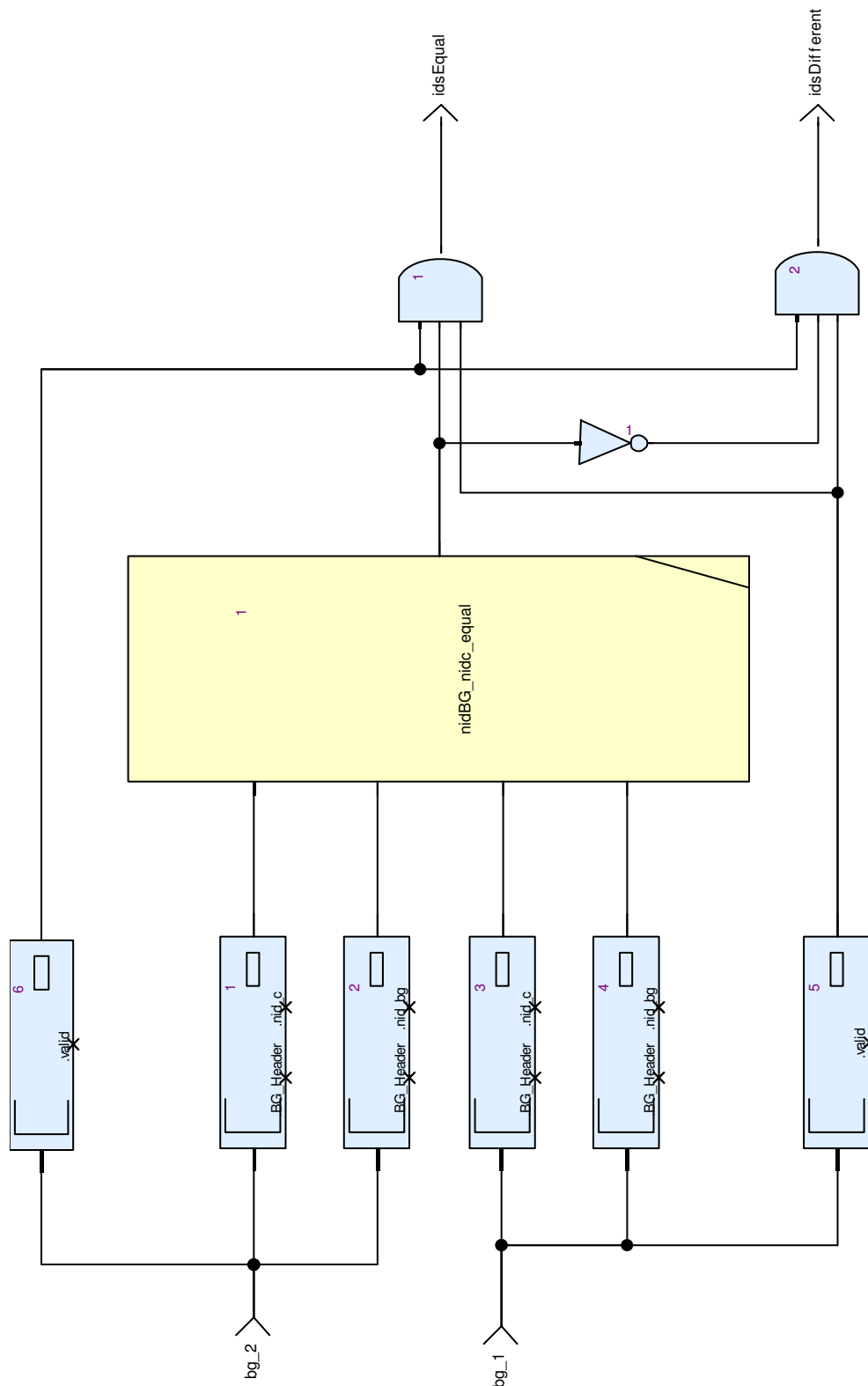


Figure 129: View of diagram\_passedBGs\_ids\_equal\_1 (passedBGs\_ids\_equal)

### 14.3.31. positionDerivedFromPassedBG Operator

Declared as **public function**

#### 14.3.31.1. Comments and Information

##### positionDerivedFromPassedBG Comments:

- Calculates the train position on the base of the odometry and a passed reference BG.
- If there is no reference BG or the reference BG had not been passed, the odoPosition will simply be converted into a position.

**Table 350: positionDerivedFromPassedBG Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the train position on the base of the odometry and a passed reference BG.</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.31.2. Interface

**Table 351: Inputs of positionDerivedFromPassedBG**

Name	Type	Comments and Information
odoPosition	Obu_BasicTypes_Pkg::OdometryLocations_T	<b>Comments:</b> The position measured by odometry
passedRefBG	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> The passed reference BG. Important: this BG must have been passed already, since its odometry values must be known.



**Table 352: Outputs of positionDerivedFromPassedBG**

Name	Type	Comments and Information
position	Obu_BasicTypes_Pkg:: LocWithInAcc_T	<b>Comments:</b> The resulting position.

#### 14.3.31.3. Operator Hierarchy

diagram : diagram\_positionDerivedFromPassedBG\_1

*activate if* : IfBlock1

        branch : then

        branch : else

#### 14.3.31.4. Graphical and Textual Diagrams

##### 14.3.31.4.1. View of diagram\_positionDerivedFromPassedBG\_1 (positionDerivedFromPassedBG)

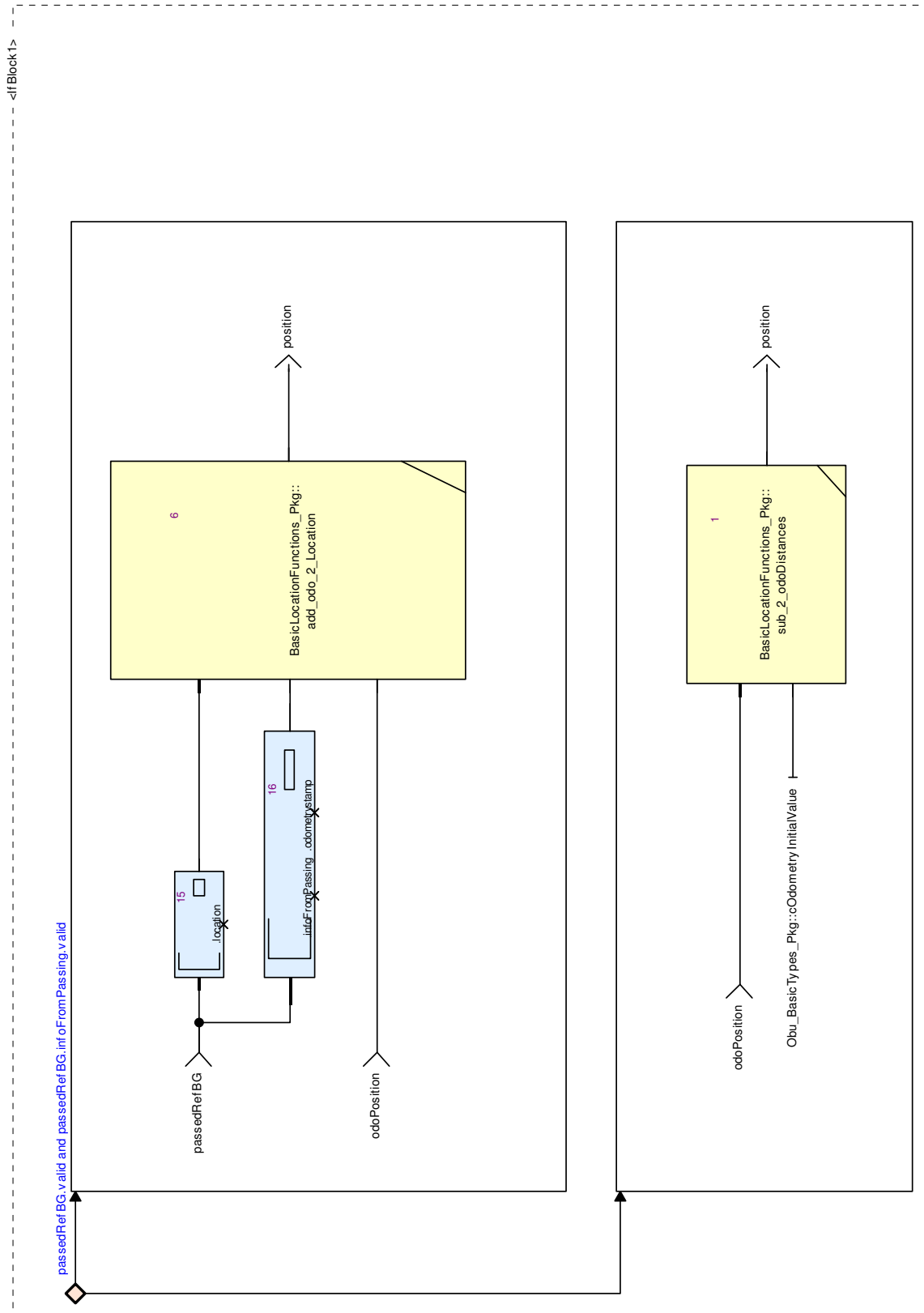


Figure 130: View of diagram\_positionDerivedFromPassedBG\_1 (positionDerivedFromPassedBG)

**Table 353: Conditional Blocks of diagram\_positionDerivedFromPassedBG\_1**

Conditional Block	Comments and Information
IfBlock1	

**Table 354: Actions of diagram\_positionDerivedFromPassedBG\_1**

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

### 14.3.32. positionedBGs\_ids\_equal Operator

Declared as **public function**

#### 14.3.32.1. Comments and Information

**positionedBGs\_ids\_equal Comments:**

- Checks if the ids of 2 BG are equal by comparing their NID\_BG and NID\_C values.

**Table 355: positionedBGs\_ids\_equal Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Checks if the ids of 2 BG are equal by comparing their NID_BG and NID_C values.</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.32.2. Interface

**Table 356: Inputs of positionedBGs\_ids\_equal**

Name	Type	Comments and Information
bg_2	TrainPosition_Types_Pc k::positionedBG_T	
bg_1	TrainPosition_Types_Pc k::positionedBG_T	

**Table 357: Outputs of positionedBGs\_ids\_equal**

Name	Type	Comments and Information
idsEqual	bool	

#### 14.3.32.3. Operator Hierarchy

diagram : diagram\_positionedBGs\_ids\_equal\_1

#### 14.3.32.4. Graphical and Textual Diagrams

##### 14.3.32.4.1. View of diagram\_positionedBGs\_ids\_equal\_1 (positionedBGs\_ids\_equal)

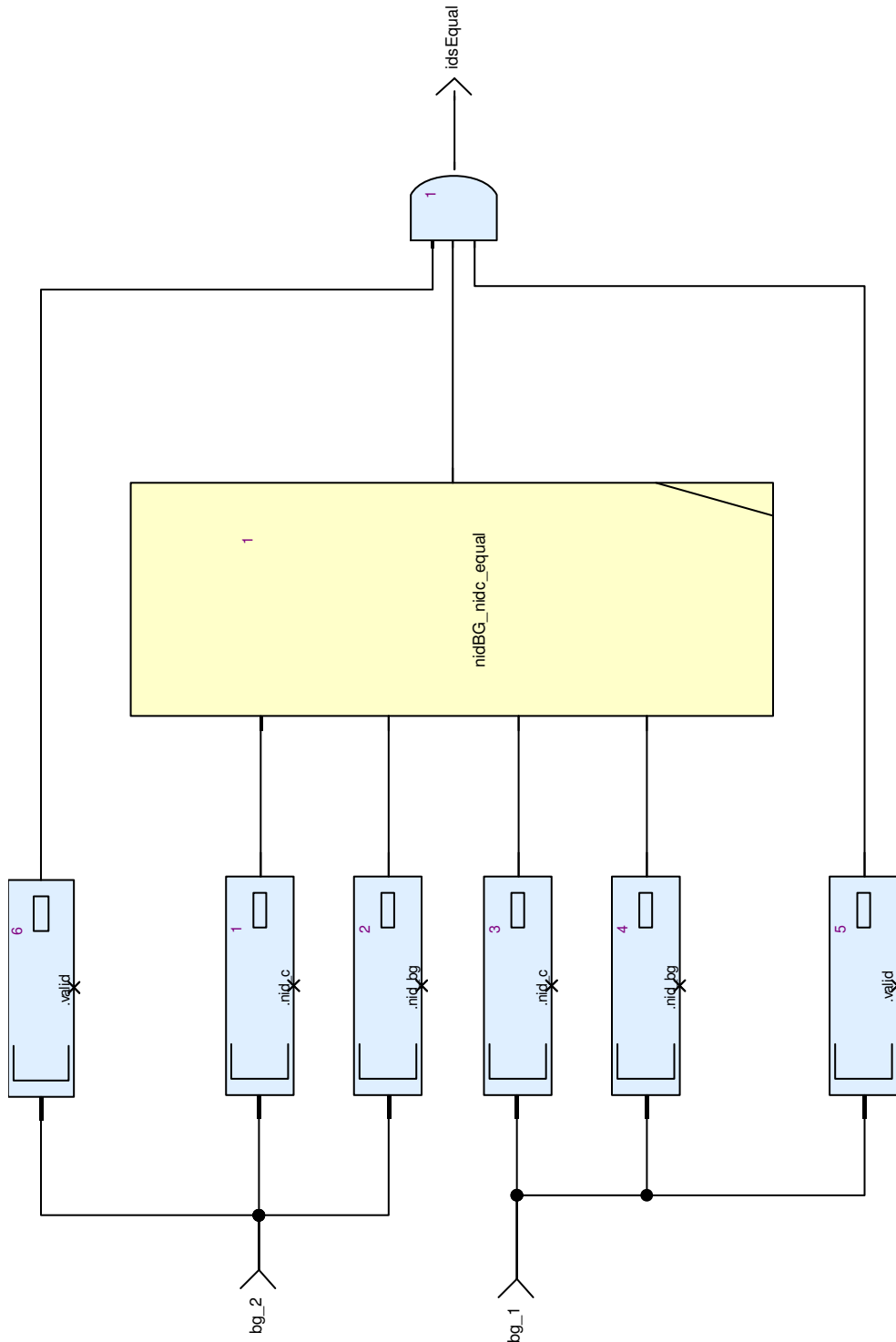


Figure 131: View of diagram\_positionedBGs\_ids\_equal\_1 (positionedBGs\_ids\_equal)

#### 14.3.33. positionLinkedBGs Operator

Declared as **public function**

#### 14.3.33.1. Comments and Information

##### positionLinkedBGs Comments:

- Converts the linking information - received while passing a BG - into announced (= linked positioned) BGs.

**Table 358: positionLinkedBGs Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Converts the linking information, received while passing a BG into an announced (= linked positioned) BG.</p> <p>- Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> ) - Gist URL: --- - Cryptography: No - Author(s): Uwe Steinke</p> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

#### 14.3.33.2. Interface

**Table 359: Inputs of positionLinkedBGs**

Name	Type	Properties	Comments and Information
passedPositionedBG	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The actually passed BG, where the linking information originates from.
linkedBGs	BG_Types_Pkg::LinkedBGs_T		
trainProperties	TrainPosition_Types_Pkg::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 360: Outputs of positionLinkedBGs**

Name	Type	Comments and Information
linkedPositionedBGs	TrainPosition_Types_Pc k::linkedBGs_asPositio nedBGs_T	

#### 14.3.33.3. Operator Hierarchy

diagram : diagram\_positionLinkedBGs\_1

#### 14.3.33.4. Graphical and Textual Diagrams

##### 14.3.33.4.1. View of diagram\_positionLinkedBGs\_1 (positionLinkedBGs)

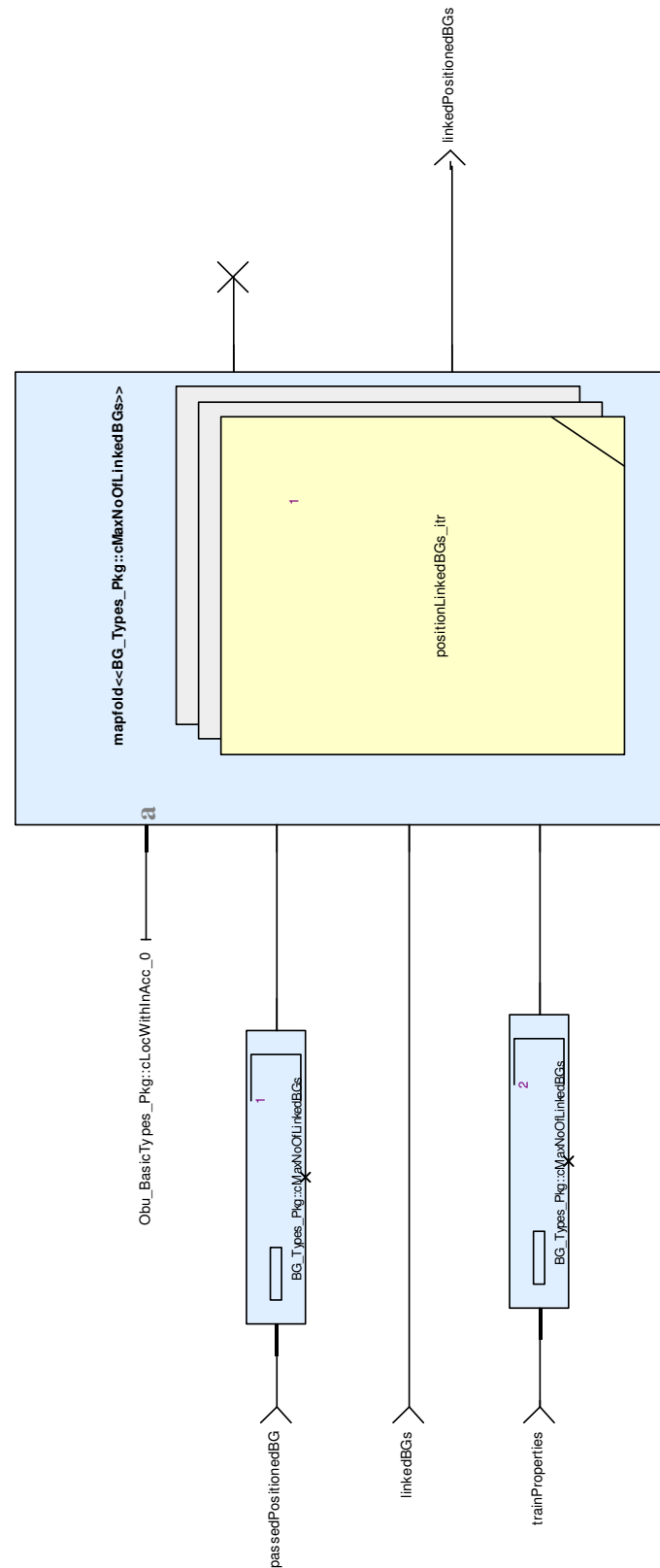


Figure 132: View of diagram\_positionLinkedBGs\_1 (positionLinkedBGs)



#### 14.3.34. positionLinkedBGs\_itr Operator

Declared as **private function**

##### 14.3.34.1. Comments and Information

###### positionLinkedBGs\_itr Comments:

- Iterated function for the conversion of the linking information - received while passing a BG - into an announced (= linked positioned) BG.

**Table 361: positionLinkedBGs\_itr Annotations**

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for the conversion of the linking information, received while passing a BG into an announced (= linked positioned) BG.</p> <ul style="list-style-type: none"> <li>- Copyright Siemens AG, 2014</li> <li>- Licensed under the EUPL V.1.1 ( <a href="http://joinup.ec.europa.eu/software/page/eupl/licence-eupl">http://joinup.ec.europa.eu/software/page/eupl/licence-eupl</a> )</li> <li>- Gist URL: ---</li> <li>- Cryptography: No</li> <li>- Author(s): Uwe Steinke</li> </ul> <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

##### 14.3.34.2. Interface

**Table 362: Inputs of positionLinkedBGs\_itr**

Name	Type	Properties	Comments and Information
sumOfPrevLinkingDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T		<b>Comments:</b> The sum of the linking distances from the chain of previous linked BGs since the passedPositionedBG.
passedPositionedBG	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The actually passed BG, where the linking information originates from.

Name	Type	Properties	Comments and Information
linkedBG	BG_Types_Pkg::LinkedBG_T		<b>Comments:</b> One of the linked BG, announced by the passed BG.
trainProperties	TrainPosition_Types_Pkg::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 363: Outputs of positionLinkedBGs\_itr**

Name	Type	Comments and Information
sumOfLinkingDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T	<b>Comments:</b> Sum of linking distances from the passedPositionedBG until this BG.
linkedPositionedBG	TrainPosition_Types_Pkg::positionedBG_T	

#### 14.3.34.3. Operator Hierarchy

diagram : diagram\_positionLinkedBGs\_itr\_1

## 14.3.34.4. Graphical and Textual Diagrams

### 14.3.34.4.1. View of diagram\_positionLinkedBGs\_itr\_1 (positionLinkedBGs\_itr)

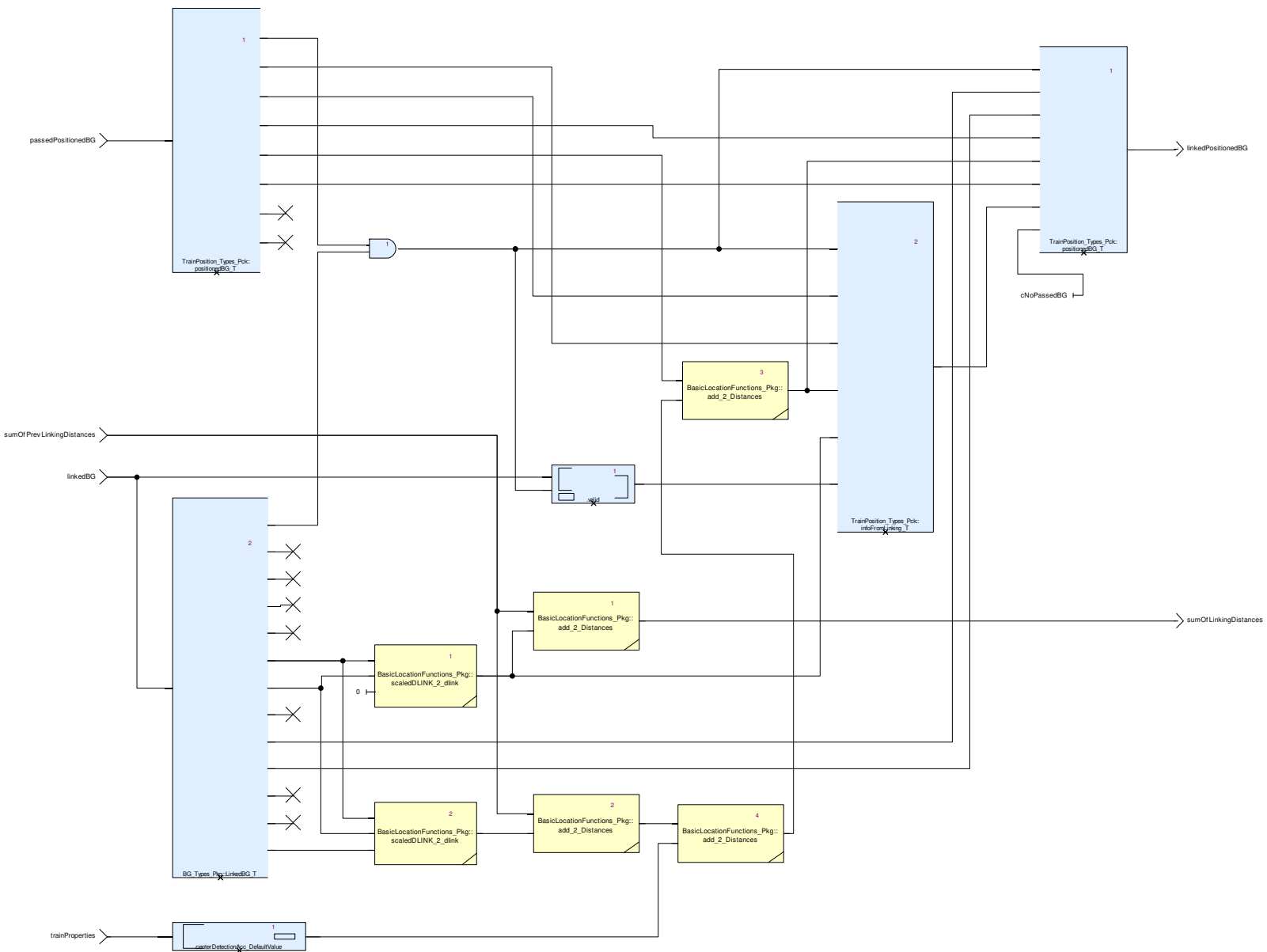


Figure 133: View of diagram\_positionLinkedBGs\_itr\_1 (positionLinkedBGs\_itr)

### 14.3.35. trimSeqNoOnTrack Operator

Declared as **public function**

#### 14.3.35.1. Comments and Information

##### trimSeqNoOnTrack Comments:

- Adjusts the sequence number (seqNoOnTrack) of announced (not yet passed BGs).

#### 14.3.35.2. Interface

**Table 364: Inputs of trimSeqNoOnTrack**

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	<b>Comments:</b> The BGs where BG is to be merged with.

**Table 365: Outputs of trimSeqNoOnTrack**

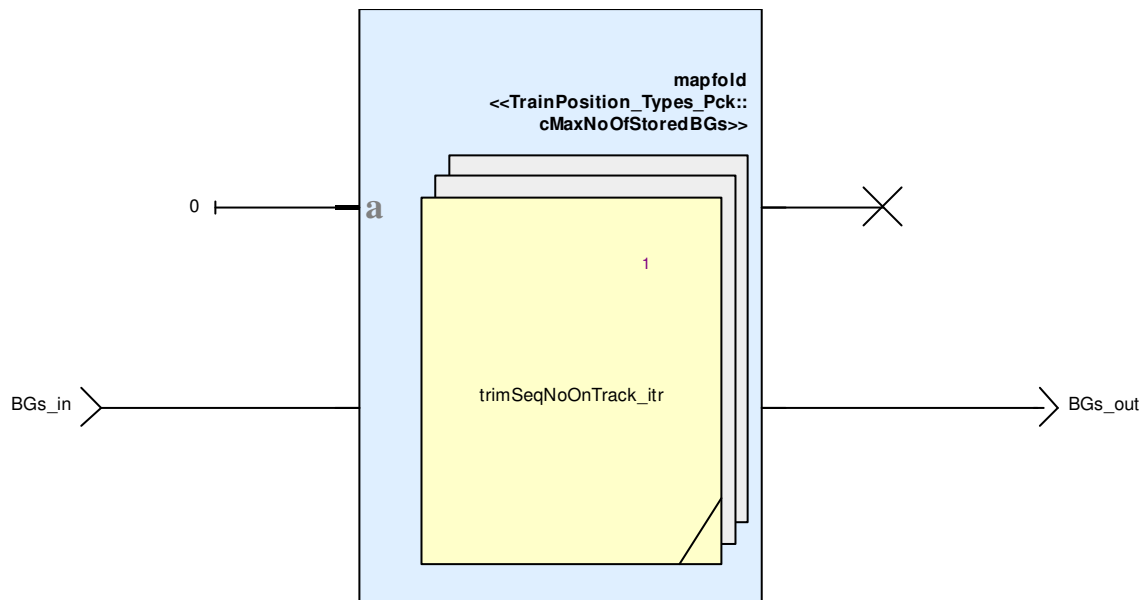
Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	<b>Comments:</b> The resulting array of merged BGs.

#### 14.3.35.3. Operator Hierarchy

diagram : diagram\_trimSeqNoOnTrack\_1

#### 14.3.35.4. Graphical and Textual Diagrams

##### 14.3.35.4.1. View of diagram\_trimSeqNoOnTrack\_1 (trimSeqNoOnTrack)



**Figure 134: View of diagram\_trimSeqNoOnTrack\_1 (trimSeqNoOnTrack)**

### 14.3.36. trimSeqNoOnTrack\_itr Operator

Declared as **private function**

#### 14.3.36.1. Comments and Information

##### **trimSeqNoOnTrack\_itr Comments:**

- Adjusts the sequence number (seqNoOnTrack) of announced (not yet passed BGs).

#### 14.3.36.2. Interface

**Table 366: Inputs of trimSeqNoOnTrack\_itr**

Name	Type	Comments and Information
prevSeqNo	int	
BG_in	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The BG to be merged.

**Table 367: Outputs of trimSeqNoOnTrack\_itr**

Name	Type	Comments and Information
seqNo	int	
BG_out	TrainPosition_Types_Pc k::positionedBG_T	<b>Comments:</b> The BG to be merged.

#### 14.3.36.3. Operator Hierarchy

diagram : diagram\_trimSeqNoOnTrack\_itr\_1

#### 14.3.36.4. Graphical and Textual Diagrams

##### 14.3.36.4.1. View of diagram\_trimSeqNoOnTrack\_itr\_1 (trimSeqNoOnTrack\_itr)

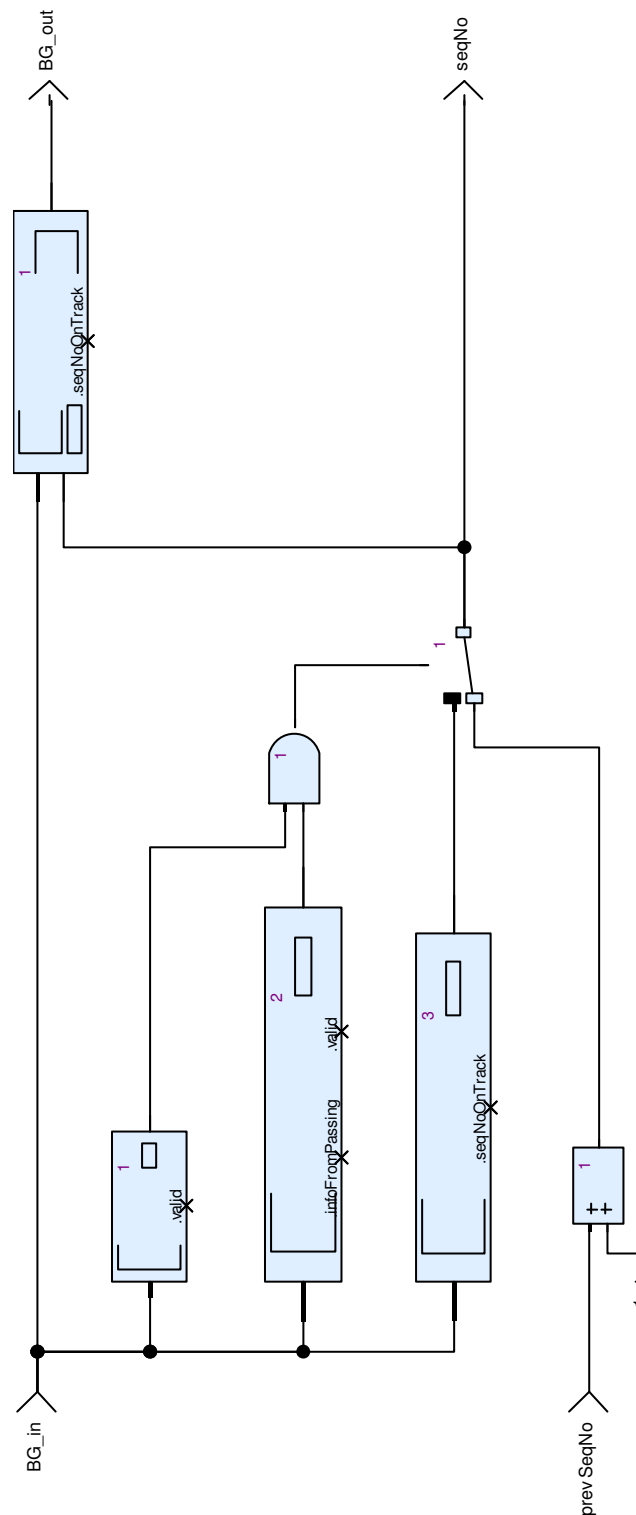


Figure 135: View of diagram\_trimSeqNoOnTrack\_itr\_1 (trimSeqNoOnTrack\_itr)

## 14.4. CalculateTrainPosition\_Pkg::gp\_functions\_Pkg Package

### 14.4.1. Constants

**Table 368: Public Constants of gp\_functions\_Pkg**

Name	Type	Value	Comments and Information
noValidIndex	int	-1	

### 14.4.2. countUp Operator

Declared as **public node**

#### 14.4.2.1. Comments and Information

**countUp Comments:**

- Counter counting upwards by one.

#### 14.4.2.2. Interface

**Table 369: Inputs of countUp**

Name	Type	Properties	Comments and Information
count	bool		<b>Comments:</b> Enables counting.
reset	bool	hidden	<b>Comments:</b> Resets the counter value to 0.

**Table 370: Outputs of countUp**

Name	Type	Comments and Information
counter	int	<b>Comments:</b> The counter value.

#### 14.4.2.3. Operator Hierarchy

diagram : diagram\_countUp\_1

#### 14.4.2.4. Graphical and Textual Diagrams

##### 14.4.2.4.1. View of diagram\_countUp\_1 (countUp)

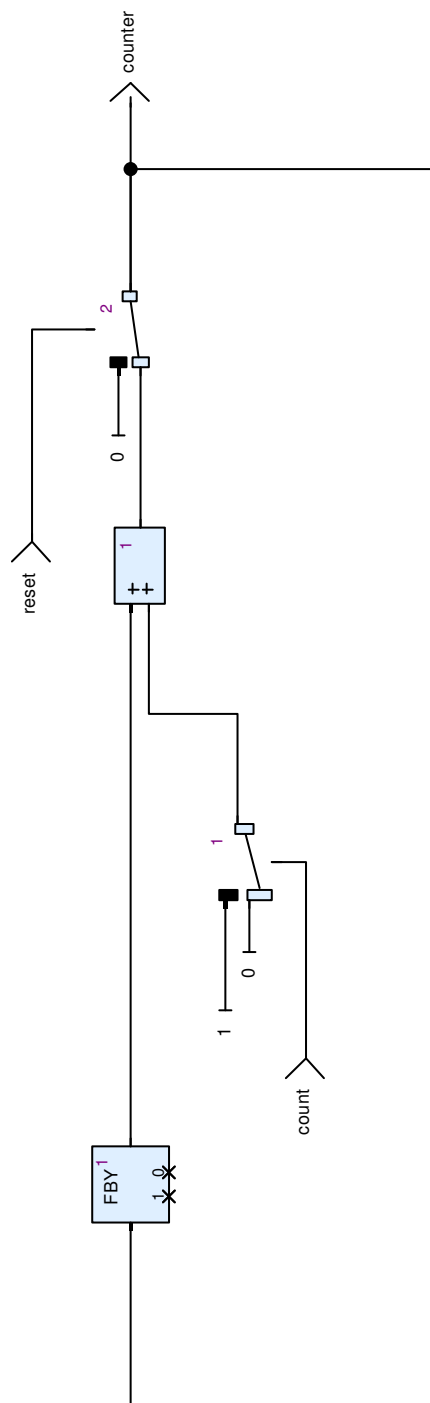


Figure 136: View of diagram\_countUp\_1 (countUp)



## 14.5. CalculateTrainPosition\_Pkg::Pos\_Pkg Package

### 14.5.1. Types

**Table 371: Public Types of Pos\_Pkg**

Name	Definition	Comments and Information
trainMovementDir_T	enum {trm_unknown, trm_standstill, trm_increasing, trm_decreasing}	<b>Comments:</b> Train direction related to the OBU coordinate system <b>trm_unknown Comments:</b> Direction unknown <b>trm_standstill Comments:</b> No movement: train stands still <b>trm_increasing Comments:</b> Train moves towards increasing locations of the OBU coordinate system <b>trm_decreasing Comments:</b> Train moves towards decreasing locations of the OBU coordinate system

### 14.5.2. Constants

**Table 372: Public Constants of Pos\_Pkg**

Name	Type	Value	Comments and Information
cOdometryStartVal	Obu_BasicTypes_Pkg::odometry_T	{valid : false, timestamp : 0, odo : {o_nominal : 0, o_min : 0, o_max : 0}, speed : 0}	
cSpeed_0	Obu_BasicTypes_Pkg::Speed_T	0	

### 14.5.3. frontendToLRBG Operator

Declared as **public function**

#### 14.5.3.1. Comments and Information

**frontendToLRBG Comments:**

- Calculates on which side of the LRBG the estimated front end is

#### 14.5.3.2. Interface

**Table 373: Inputs of frontendToLRBG**

Name	Type	Properties	Comments and Information
LRBG	TrainPosition_Types_Pkg::positionedBG_T		<b>Comments:</b> The LRBG
trainPositionInfo	TrainPosition_Types_Pkg::trainPositionInfo_T		<b>Comments:</b> The resulting train position with reference to the known list of balise groups.

Name	Type	Properties	Comments and Information
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	<b>Comments:</b> The trains properties required for train position calculation.

**Table 374: Outputs of frontendToLRBG**

Name	Type	Comments and Information
nominalOrReverseToLRBG	Q_DLRBG	

#### 14.5.3.3. Locals

**Table 375: Locals of frontendToLRBG**

Name	Type	Comments and Information
estimated_d_LRBGToFrontend	Obu_BasicTypes_Pkg::L_internal_Type	<b>Comments:</b> Estimated (nominal) distance from train front end to LRBG (typically astern to the front end)
trainOrientationToLRBG	Q_DIRLRBG	

#### 14.5.3.4. Operator Hierarchy

diagram : diagram\_frontendToLRBG\_1

```

activate if : IfBlock1
  branch : then
  branch : else
    branch : then
    branch : else

```

14.5.3.5. Graphical and Textual Diagrams

14.5.3.5.1. View of diagram\_frontendToLRBG\_1 (frontendToLRBG)

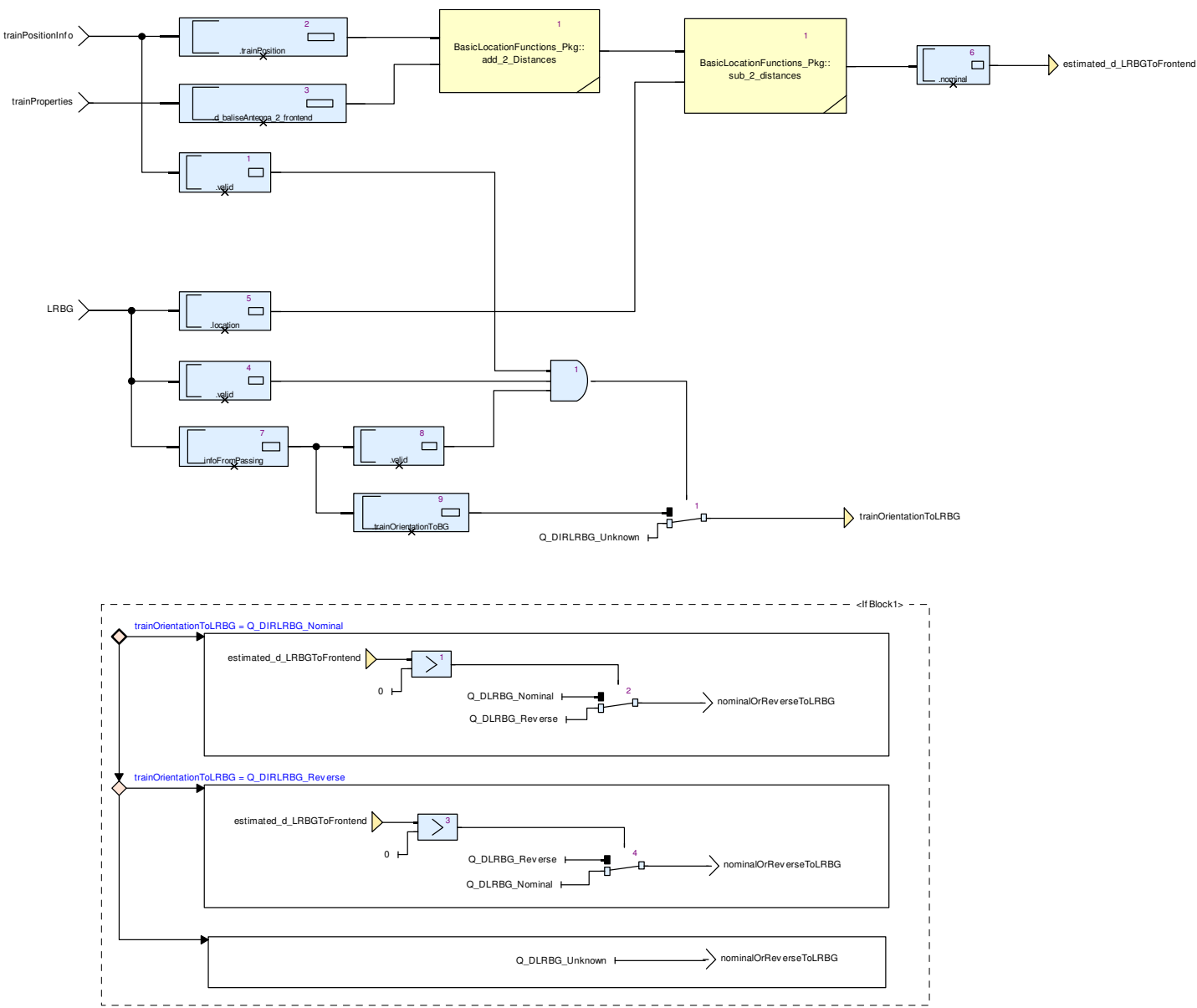


Figure 137: View of diagram\_frontendToLRBG\_1 (frontendToLRBG)

Table 376: Conditional Blocks of diagram\_frontendToLRBG\_1

Conditional Block	Comments and Information
IfBlock1	

**Table 377: Actions of diagram\_frontendToLRBG\_1**

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

#### 14.5.4. runningDirectionVsRef Operator

Declared as **public node**

##### 14.5.4.1. Comments and Information

###### **runningDirectionVsRef Comments:**

- Determines the current train running direction compared to a known reference running direction and speed.

##### 14.5.4.2. Interface

**Table 378: Inputs of runningDirectionVsRef**

Name	Type	Comments and Information
refTrainRunningDirection	Q_DIRTRAIN	<b>Comments:</b> Train running direction at the reference location
refSpeed	Obu_BasicTypes_Pkg::Speed_T	<b>Comments:</b> Speed at the reference location
currentOdometry	Obu_BasicTypes_Pkg::odometry_T	<b>Comments:</b> The current odometry with the current speed

**Table 379: Outputs of runningDirectionVsRef**

Name	Type	Comments and Information
trainRunningDirection	Q_DIRTRAIN	<b>Comments:</b> The current train running direction

##### 14.5.4.3. Locals

**Table 380: Locals of runningDirectionVsRef**

Name	Type	Comments and Information
currentDir	CalculateTrainPosition_Pkg::Pos_Pkg::trainMovementDir_T	
refDir	CalculateTrainPosition_Pkg::Pos_Pkg::trainMovementDir_T	

##### 14.5.4.4. Operator Hierarchy

diagram : diagram\_runningDirectionVsRef\_1

*activate if* : IfBlock1

        branch : then

        branch : else

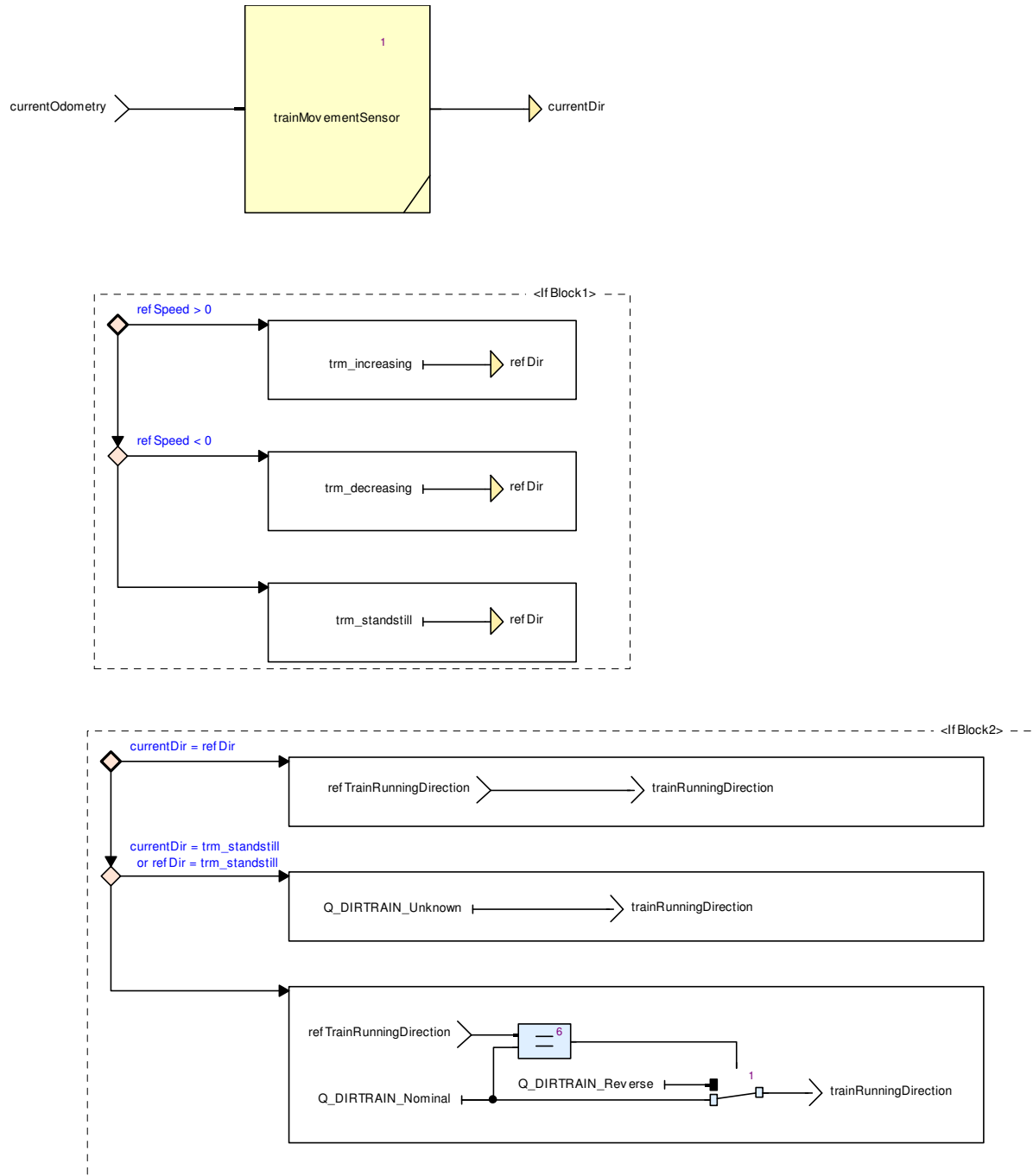
            branch : then

            branch : else

*activate if* : IfBlock2  
branch : then  
branch : else  
branch : then  
branch : else

#### 14.5.4.5. Graphical and Textual Diagrams

##### 14.5.4.5.1. View of diagram\_runningDirectionVsRef\_1 (runningDirectionVsRef)



**Figure 138: View of diagram\_runningDirectionVsRef\_1 (runningDirectionVsRef)**

**Table 381: Conditional Blocks of diagram\_runningDirectionVsRef\_1**

Conditional Block	Comments and Information
IfBlock1	
IfBlock2	

**Table 382: Actions of diagram\_runningDirectionVsRef\_1**

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

#### 14.5.5. trainMovementSensor Operator

Declared as **private node**

##### 14.5.5.1. Comments and Information

**trainMovementSensor Comments:**

- Determines the movement direction of the train based on odometry.

##### 14.5.5.2. Interface

**Table 383: Inputs of trainMovementSensor**

Name	Type	Properties		Comments and Information
currentOdometry	Obu_BasicTypes_Pkg::odometry_T	last	cOdometryStartVal	<b>Comments:</b> The current odometry values

**Table 384: Outputs of trainMovementSensor**

Name	Type	Comments and Information
direction	CalculateTrainPosition_Pkg::Pos_Pkg::trainMovementDir_T	<b>Comments:</b> The movement related to the OBU coordination system.

##### 14.5.5.3. Locals

**Table 385: Locals of trainMovementSensor**

Name	Type	Comments and Information
direction_loc	CalculateTrainPosition_Pkg::Pos_Pkg::trainMovementDir_T	
standstillDetected	bool	

#### 14.5.5.4. Operator Hierarchy

diagram : diagram\_trainMovementSensor\_1

*state-machine* : SM1

state : Decreasing

state : Increasing

state : Standstill

state : Unknown

14.5.5.5. Graphical and Textual Diagrams

14.5.5.5.1. View of diagram\_trainMovementSensor\_1 (trainMovementSensor)

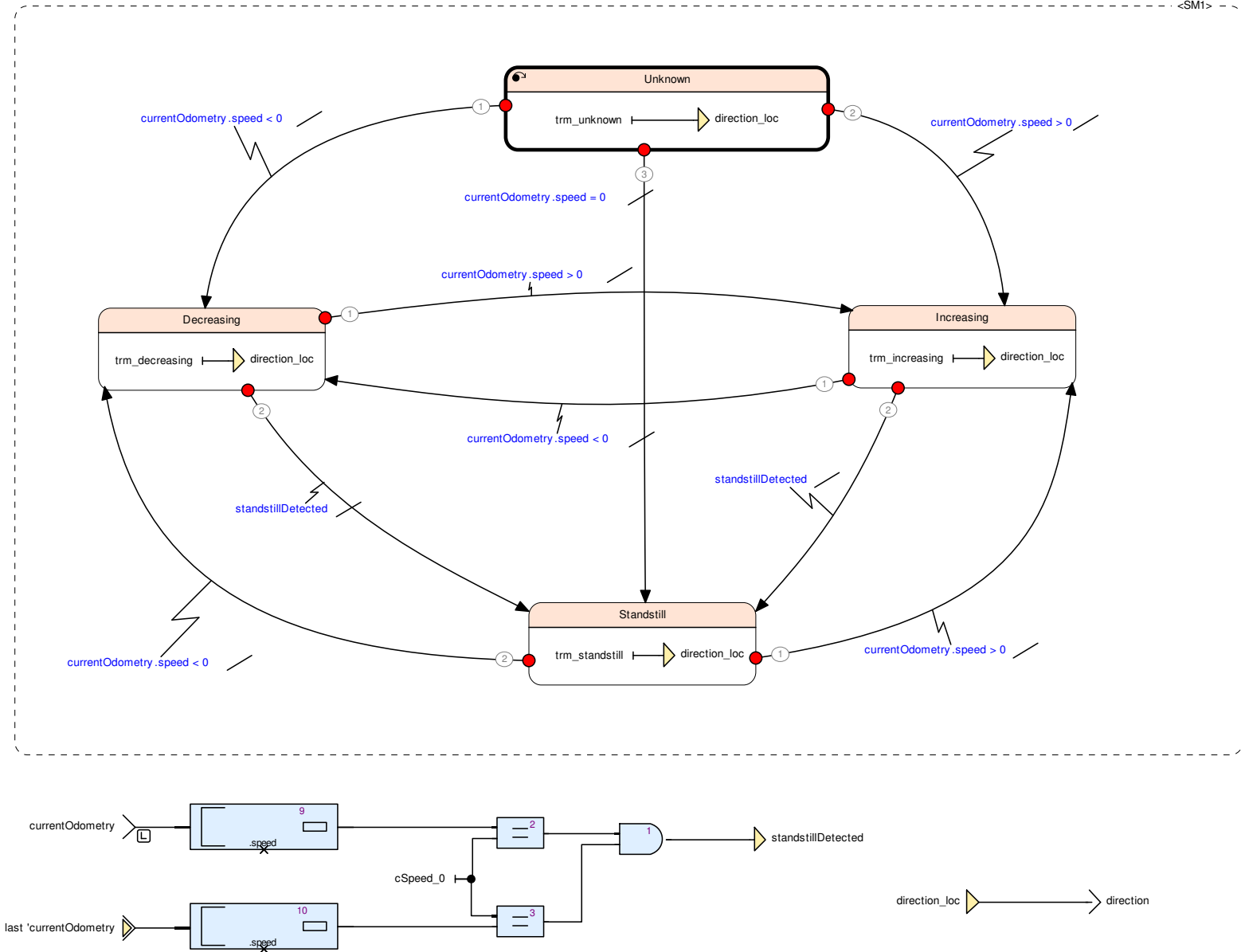


Figure 139: View of diagram\_trainMovementSensor\_1 (trainMovementSensor)



**Table 386: State Machines of diagram\_trainMovementSensor\_1**

State Machine	Comments and Information
SM1	

**Table 387: States of diagram\_trainMovementSensor\_1**

State	Comments and Information
SM1:Decreasing	
SM1:Increasing	
SM1:Standstill	
SM1:Unknown	

**Table 388: Transitions of diagram\_trainMovementSensor\_1**

Source/Target	#	Conditions/Actions	Comments and Information
<b>Source:</b> SM1:Decreasing <b>Target:</b> SM1:Increasing	1	<b>Condition:</b> currentOdometry.speed > 0	
<b>Source:</b> SM1:Decreasing <b>Target:</b> SM1:Standstill	2	<b>Condition:</b> standstillDetected	
<b>Source:</b> SM1:Increasing <b>Target:</b> SM1:Decreasing	1	<b>Condition:</b> currentOdometry.speed < 0	
<b>Source:</b> SM1:Increasing <b>Target:</b> SM1:Standstill	2	<b>Condition:</b> standstillDetected	
<b>Source:</b> SM1:Standstill <b>Target:</b> SM1:Increasing	1	<b>Condition:</b> currentOdometry.speed > 0	
<b>Source:</b> SM1:Standstill <b>Target:</b> SM1:Decreasing	2	<b>Condition:</b> currentOdometry.speed < 0	
<b>Source:</b> SM1:Unknown <b>Target:</b> SM1:Decreasing	1	<b>Condition:</b> currentOdometry.speed < 0	
<b>Source:</b> SM1:Unknown <b>Target:</b> SM1:Increasing	2	<b>Condition:</b> currentOdometry.speed > 0	
<b>Source:</b> SM1:Unknown <b>Target:</b> SM1:Standstill	3	<b>Condition:</b> currentOdometry.speed = 0	

## 15. Project Library: ProvidePositionReport

### 15.1. ProvidePositionReport\_Pkg Package

#### 15.1.1. Types

**Table 389: Public Types of ProvidePositionReport\_Pkg**

Name	Definition	Comments and Information
BG_Orientation_T	enum {orientation_reverse, orientation_nominal, orientation_unknown}	<b>Comments:</b> Orientation of a balise group (needed for 3.4.2.3.3.2)
ErrorMessage_T	{present : bool, errorType : M_ERROR}	<b>Comments:</b> Combining M_ERROR and the present flag.
IterPacket58_T	{d_loc : D_LOC, q_lgtloc : Q_LGTLOC}	
IterPacket58List_T	ProvidePositionReport_Pkg::IterPacket58_T ^cIterPacket58	
LinkingInfoUsedOnBoard	bool	<b>Comments:</b> Defined in 3.4.4.2.1.1; probably added to PositionedBG_T
MemorizedErrorMsg_T	{valid : bool, errorType : M_ERROR}	<b>Comments:</b> internal data structre
Packet0_T	{valid : bool, packet0 : TrainToTrack::Position_Report}	<b>Comments:</b> Adding a valid flag to Packet 0
Packet1_T	{valid : bool, packet1 : TrainToTrack::Position_Report_based_on_two_balise_groups}	<b>Comments:</b> Adding a valid flag to packet 1.
Packet4_T	{valid : bool, packet4 : TrainToTrack::Error_reporting}	<b>Comments:</b> Adding a valid flag to packet 4.
Packet58_T	{nid_packet : NID_PACKET, q_dir : Q_DIR, l_packet : L_PACKET, q_scale : Q_SCALE, t_cycloc : T_CYCLOC, d_cycloc : D_CYCLOC, m_loc : M_LOC, n_iter : N_ITER, iterPacket58List : ProvidePositionReport_Pkg::IterPacket58List_T}	
Packet5_T	{valid : bool, packet5 : TrainToTrack::Train_running_number}	<b>Comments:</b> Adding a valid flag to packet 5.
PositionReport_T	{valid : bool, header : ProvidePositionReport_Pkg::PositionReportHeader_T, packet0 : ProvidePositionReport_Pkg::Packet0_T, packet1 : ProvidePositionReport_Pkg::Packet1_T, packet4 : ProvidePositionReport_Pkg::Packet4_T, packet5 : ProvidePositionReport_Pkg::Packet5_T}	<b>Comments:</b> Position report: either packet 0 or packet 1 has valid flag set to true.
PositionReportHeader_T	{nid_message : NID_MESSAGE, l_message : L_MESSAGE, t_train : T_TRAIN, nid_engine : NID_ENGINE}	<b>Comments:</b> Position report header

Name	Definition	Comments and Information
PositionReportParameter_T	{present : bool, nidBG : NID_BG, bgLocation : Obu_BasicTypes_Pkg::Location_T, packet58 : ProvidePositionReport_Pkg::Packet58_T}	<b>nidBG Comments:</b> BG that has been sent Packet58 or, in case Packet58 has been sent by the RBC, the reference BG <b>bgLocation Comments:</b> location of the BG
PresentxMLOC_T	{present : bool, m_loc : M_LOC}	<b>Comments:</b> Crossproduct of present flag and M_LOC; internal memory representation
RBC_Communication_T	{newSessionEstablished : bool}	<b>Comments:</b> variables necessary for the communication with the RBC <b>newSessionEstablished Comments:</b> to decide 3.6.5.1.4.h
SystemTime_T	Obu_BasicTypes_Pkg::T_internal_Type	<b>Comments:</b> global system time
TrackInfo_T	{minSafeRearEndPassed : bool, maxSafeFrontEndPassed : bool, levelTransitionBorderPassed : bool}	<b>Comments:</b> Information necessary to calculate whether event triggering the sending of a position report evaluates to true. <b>minSafeRearEndPassed Comments:</b> to decide 3.6.5.1.4.e <b>maxSafeFrontEndPassed Comments:</b> to decide 3.6.5.1.4.k <b>levelTransitionBorderPassed Comments:</b> to decide 3.6.5.1.4.f

### 15.1.2. Constants

**Table 390: Public Constants of ProvidePositionReport\_Pkg**

Name	Type	Value	Comments and Information
cErrorMessage	ProvidePositionReport_Pkg::ErrorMessage_T	{present : false, errorType : M_ERROR_Balise_group_linking_consistency_error}	
cIterPacket58	int	2	<b>Comments:</b> value is bound to 32
cL_MESSAGE	L_MESSAGE	0	
cMinSafeRearEnd	int	0	
cNITER_List	ProvidePositionReport_Pkg::IterPacket58List_T	[{d_loc : 0, q_lgtloc : Q_LGTLOC_Min_safe_rear_end}, {d_loc : 0, q_lgtloc : Q_LGTLOC_Min_safe_rear_end}]	

Name	Type	Value	Comments and Information
cNITER_Pair	ProvidePositionReport_Pkg::IterPacket58_T	{d_loc : 0, q_lgtloc : Q_LGTLOC_Min_saf e_rear_end}	

Name	Type	Value	Comments and Information
		<pre>{valid : false, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked, location : {nominal : 0, d_min : 0, d_max : 0}, seqNoOnTrack : 0, infoFromLinking : {valid : false, nid_bg_fromLinking BG : 0, nid_c_fromLinkingB G : 0, expectedLocation : {nominal : 0, d_min : 0, d_max : 0}, d_link : {nominal : 0, d_min : 0, d_max : 0}, linkingInfo : {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_s cale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S ame_country_or_ railway_administrati on_no_NID_C_follo ws, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATIO N_The_balise_grou p_is_seen_by_the_t rain_in_reverse_dir ection, q_linkreaction : Q_LINKREACTION_ Train_trip, q_locacc : 0}}, infoFromPassing : {valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise,</pre>	

Name	Type	Value	Comments and Information
cPresentxM_LOC	ProvidePositionReport_Pkg::PresentxMLOC_T	{present : false, m_loc : M_LOC_Now}	
cQ_SCALE	Q_SCALE	Q_SCALE_10_cm_scale	
cT_TRAIN	T_TRAIN	0.0	
cTrack2TrainStatus	BG_Types_Pkg::TrainToTrackStatus_T	{m_mode : M_MODE_Full_Supervision, m_level : M_LEVEL_Level_0, m_leveltr : M_LEVELTR_Level_0, nid_ntc : 0, q_length : Q_LENGTH_No_train_integrity_information_available}	<b>Comments:</b> used as initial value
cTrainPosition	TrainPosition_Types_Pck::trainPosition_T	{valid : false, timestamp : 0, trainPositionIsUnknown : false, noCoordinateSystemHasBeenAssigned : false, trainPosition : {nominal : 0, d_min : 0, d_max : 0}, estimatedFrontEndPosition : 0, minSafeFrontEndPosition : 0, maxSafeFrontEndPosition : 0, nid_LRBG : 0, nid_PrivLRB : 0, nominalOrReverseToLRBG : Q_DLRBG_Reverse, trainOrientationToLRBG : Q_DIRLRBG_Reverse, trainRunningDirectionToLRBG : Q_DIRTRAIN_Reverse, speed : 0}	<b>Comments:</b> used as initial value
cTrigger	bool	false	
cUnknownLRBG	int	16777215	

### 15.1.3. AggregateHeader Operator

Declared as **public function**

#### 15.1.3.1. Comments and Information

**AggregateHeader Comments:**

- Aggregates values necessary for the position report header. Used default value for L\_MESSAGE and T\_TRAIN.

#### 15.1.3.2. Interface

**Table 391: Inputs of AggregateHeader**

Name	Type	Comments and Information
trainProps	TrainPosition_Types_Pkg::trainProperties_T	

**Table 392: Outputs of AggregateHeader**

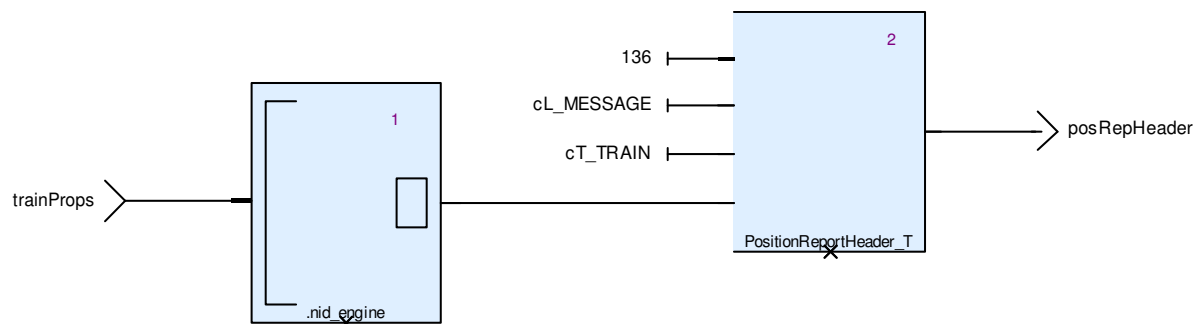
Name	Type	Comments and Information
posRepHeader	ProvidePositionReport_Pkg::PositionReportHeader_T	

#### 15.1.3.3. Operator Hierarchy

diagram : diagram\_AggregateHeader\_1

#### 15.1.3.4. Graphical and Textual Diagrams

##### 15.1.3.4.1. View of diagram\_AggregateHeader\_1 (AggregateHeader)



**Figure 140: View of diagram\_AggregateHeader\_1 (AggregateHeader)**

#### 15.1.4. AggregatePacket\_0 Operator

Declared as **public function**

##### 15.1.4.1. Comments and Information

###### **AggregatePacket\_0 Comments:**

- Aggregates all values necessary for report packet 0.

#### 15.1.4.2. Interface

**Table 393: Inputs of AggregatePacket\_0**

Name	Type	Comments and Information
posBGs	TrainPosition_Types_Pkg::positionedBGs_T	
trainPos	TrainPosition_Types_Pkg::trainPosition_T	

Name	Type	Comments and Information
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	
TrainRearEndPos3	L_TRAININT	

**Table 394: Outputs of AggregatePacket\_0**

Name	Type	Comments and Information
packet0	ProvidePositionReport_Pkg::Packet0_T	

#### 15.1.4.3. Operator Hierarchy

diagram : diagram\_AggregatePacket\_0\_1



#### 15.1.4.4. Graphical and Textual Diagrams

##### 15.1.4.4.1. View of diagram\_AggregatePacket\_0\_1 (AggregatePacket\_0)

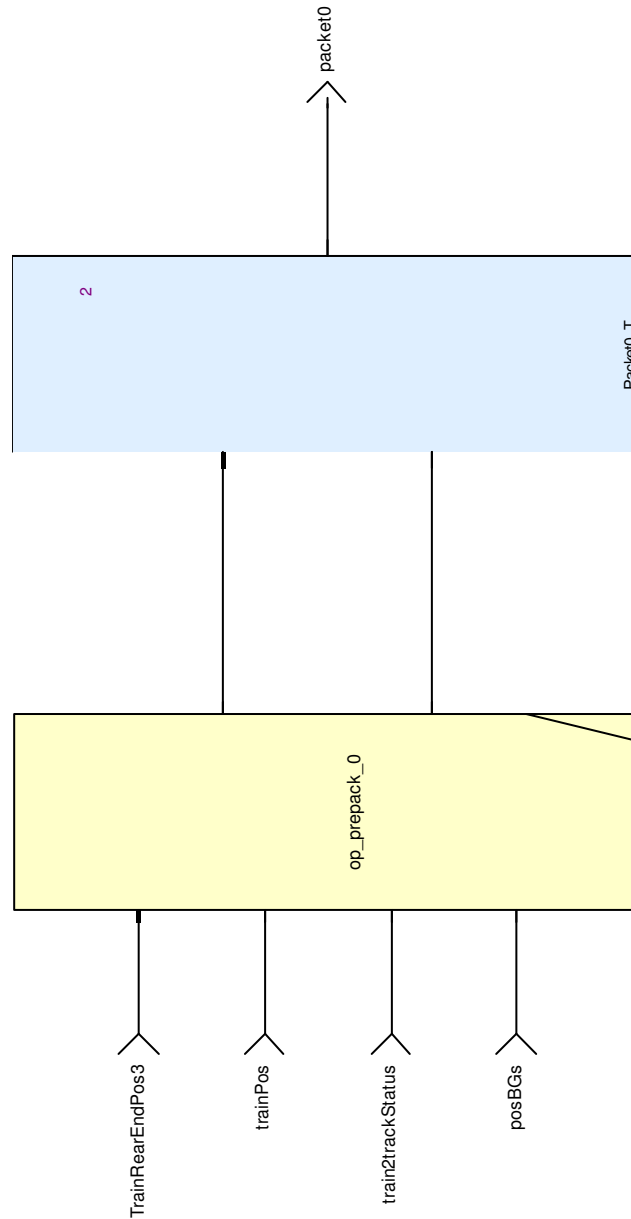


Figure 141: View of diagram\_AggregatePacket\_0\_1 (AggregatePacket\_0)

#### 15.1.5. AggregatePacket\_1 Operator

Declared as **public node**

##### 15.1.5.1. Comments and Information

###### AggregatePacket\_1 Comments:

- Aggregates all values necessary for report packet 1.

### 15.1.5.2. Interface

**Table 395: Inputs of AggregatePacket\_1**

Name	Type	Comments and Information
posBGs	TrainPosition_Types_Pck::positionedBGs_T	
trainPos	TrainPosition_Types_Pck::trainPosition_T	
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	
TrainRearEndPos4	L_TRAININT	
directionLRBG	ProvidePositionReport_Pkg::BG_Orientation_T	
prvDirTrain	Q_DIRTRAIN	

**Table 396: Outputs of AggregatePacket\_1**

Name	Type	Comments and Information
sendNoReport	bool	<b>Comments:</b> Models condition 3.4.2.3.3.5; in this case, no report shall be sent to the RBC.
packet1	ProvidePositionReport_Pkg::Packet1_T	

### 15.1.5.3. Locals

**Table 397: Locals of AggregatePacket\_1**

Name	Type	Properties		Comments and Information
cond_3_4_2_3_3_2	bool			
cond_3_4_2_3_3_3	bool			
cond_3_4_2_3_3_4	bool			
dirLRBG	ProvidePositionReport_Pkg::BG_Orientation_T			
in_dirlrbg	Q_DIRLRBG	default	Q_DIRLRBG_Unknown	
in_dirtrain	Q_DIRTRAIN	default	Q_DIRTRAIN_Unknown	
in_dlrbg	Q_DLRBG	default	Q_DLRBG_Unknown	

### 15.1.5.4. Operator Hierarchy

diagram : diagram\_AggregatePacket\_1\_1

*state-machine* : SM1

state : State1

state : State2

state : State3

state : State4

state : State5

## 15.1.5.5. Graphical and Textual Diagrams

### 15.1.5.5.1. View of diagram\_AggregatePacket\_1\_1 (AggregatePacket\_1)

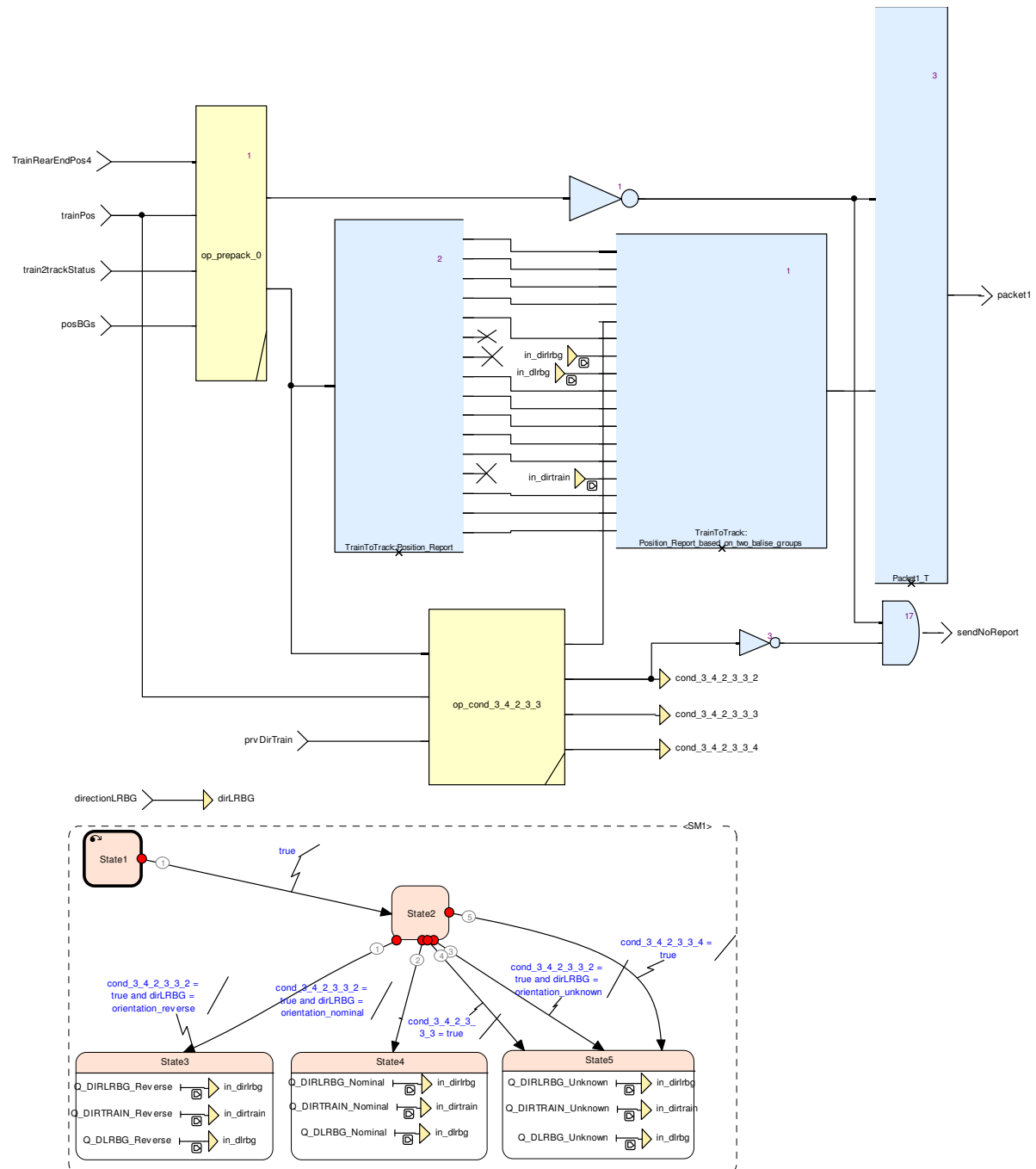


Figure 142: View of diagram\_AggregatePacket\_1\_1 (AggregatePacket\_1)

Table 398: State Machines of diagram\_AggregatePacket\_1\_1

State Machine	Comments and Information
SM1	

Table 399: States of diagram\_AggregatePacket\_1\_1

State	Comments and Information
SM1:State1	

State	Comments and Information
SM1:State2	
SM1:State3	
SM1:State4	
SM1:State5	

**Table 400: Transitions of diagram\_AggregatePacket\_1\_1**

Source/Target	#	Conditions/Actions	Comments and Information
<b>Source:</b> SM1:State1 <b>Target:</b> SM1:State2	1	<b>Condition:</b> true	
<b>Source:</b> SM1:State2 <b>Target:</b> SM1:State3	1	<b>Condition:</b> cond_3_4_2_3_3_2 = true and dirLRBG = orientation_reverse	
<b>Source:</b> SM1:State2 <b>Target:</b> SM1:State4	2	<b>Condition:</b> cond_3_4_2_3_3_2 = true and dirLRBG = orientation_nominal	
<b>Source:</b> SM1:State2 <b>Target:</b> SM1:State5	3	<b>Condition:</b> cond_3_4_2_3_3_2 = true and dirLRBG = orientation_unknown	
<b>Source:</b> SM1:State2 <b>Target:</b> SM1:State5	4	<b>Condition:</b> cond_3_4_2_3_3_3 = true	
<b>Source:</b> SM1:State2 <b>Target:</b> SM1:State5	5	<b>Condition:</b> cond_3_4_2_3_3_4 = true	

#### 15.1.6. AggregatePacket\_4 Operator

Declared as **public node**

##### 15.1.6.1. Comments and Information

###### **AggregatePacket\_4 Comments:**

- Aggregates all values necessary for report packet 4.
- The memory stores one error. If another error is reported before the position report has been sent,
- the first error is overwritten by the last error. The error is stored until a position report is sent (trigger=true)
- or it is overwritten.
- With the help of the state machine, we can ensure that a stored error is reported with the next trigger message.

### 15.1.6.2. Interface

**Table 401: Inputs of AggregatePacket\_4**

Name	Type	Properties		Comments and Information
errorMsg	ProvidePositionReport_Pkg::ErrorMessage_T	last	cErrorMessage	
trigger	bool	last	cTrigger	

**Table 402: Outputs of AggregatePacket\_4**

Name	Type	Comments and Information		
packet4	ProvidePositionReport_Pkg::Packet4_T			

### 15.1.6.3. Locals

**Table 403: Locals of AggregatePacket\_4**

Name	Type	Properties		Comments and Information
empty	bool	default	true	
intermediate	bool	default	false	
valid	bool			

### 15.1.6.4. Operator Hierarchy

diagram : diagram\_AggregatePacket\_4\_1

*state-machine* : SM1

state : emptyStorage

state : filledStorage

state : init

state : intermediate

15.1.6.5. Graphical and Textual Diagrams

15.1.6.5.1. View of diagram\_AggregatePacket\_4\_1 (AggregatePacket\_4)

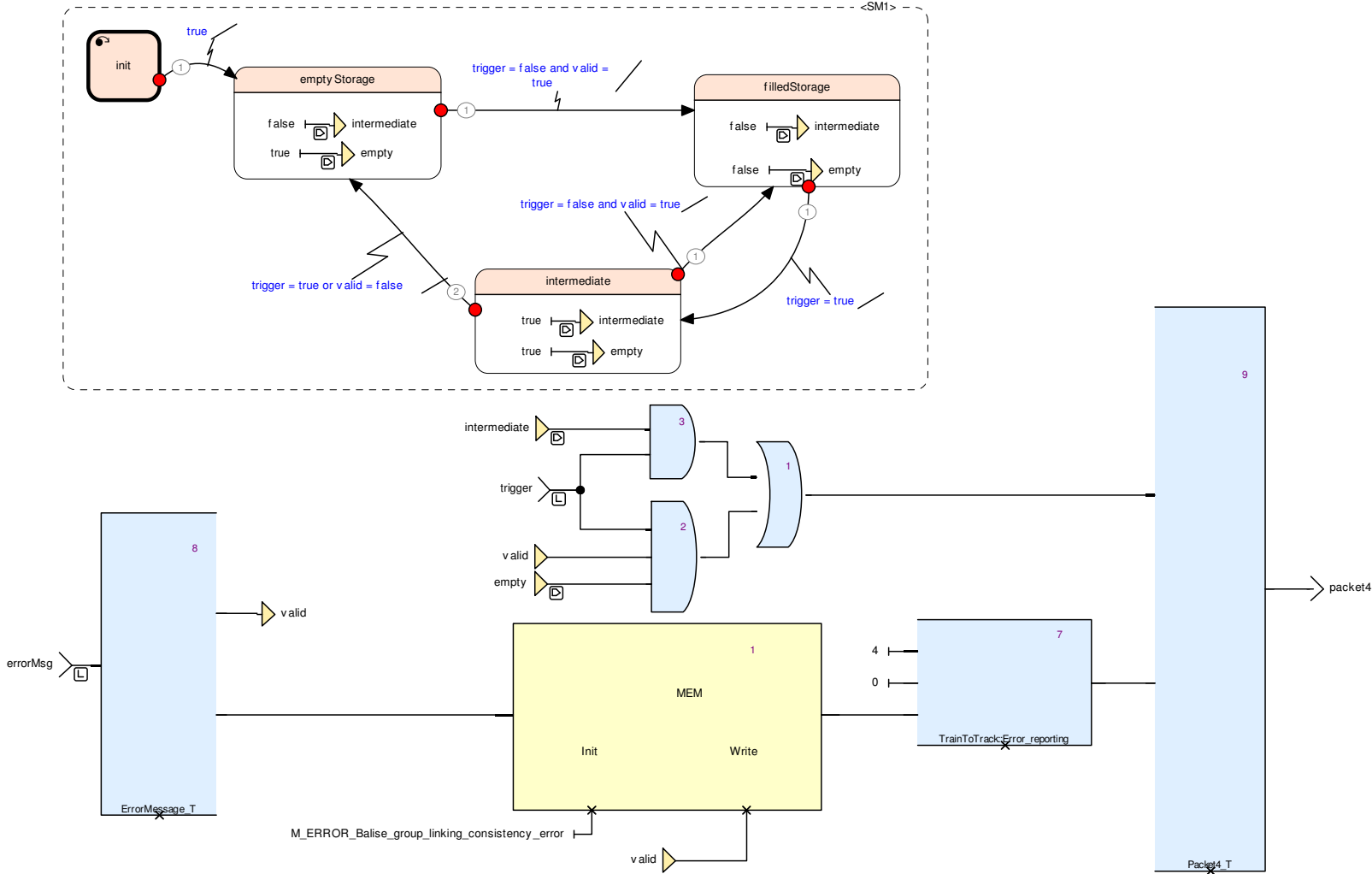


Figure 143: View of diagram\_AggregatePacket\_4\_1 (AggregatePacket\_4)

**Table 404: State Machines of diagram\_AggregatePacket\_4\_1**

State Machine	Comments and Information
SM1	

**Table 405: States of diagram\_AggregatePacket\_4\_1**

State	Comments and Information
SM1:emptyStorage	
SM1:filledStorage	
SM1:init	
SM1:intermediate	

**Table 406: Transitions of diagram\_AggregatePacket\_4\_1**

Source/Target	#	Conditions/Actions	Comments and Information
<b>Source:</b> SM1:emptyStorage <b>Target:</b> SM1:filledStorage	1	<b>Condition:</b> trigger = false and valid = true	
<b>Source:</b> SM1:filledStorage <b>Target:</b> SM1:intermediate	1	<b>Condition:</b> trigger = true	
<b>Source:</b> SM1:init <b>Target:</b> SM1:emptyStorage	1	<b>Condition:</b> true	
<b>Source:</b> SM1:intermediate <b>Target:</b> SM1:filledStorage	1	<b>Condition:</b> trigger = false and valid = true	
<b>Source:</b> SM1:intermediate <b>Target:</b> SM1:emptyStorage	2	<b>Condition:</b> trigger = true or valid = false	

### 15.1.7. AggregatePacket\_5 Operator

Declared as **public function**

#### 15.1.7.1. Comments and Information

##### **AggregatePacket\_5 Comments:**

- Aggregates all values necessary for report packet 5. As train information data is
- always available, the valid flag is always set to true.

#### 15.1.7.2. Interface

**Table 407: Inputs of AggregatePacket\_5**

Name	Type	Comments and Information
trainProps	TrainPosition_Types_Pc k::trainProperties_T	

**Table 408: Outputs of AggregatePacket\_5**

Name	Type	Comments and Information
packet5	ProvidePositionReport_ Pkg::Packet5_T	

#### 15.1.7.3. Operator Hierarchy

diagram : diagram\_AggregatePacket\_5\_1



#### 15.1.7.4. Graphical and Textual Diagrams

##### 15.1.7.4.1. View of diagram\_AggregatePacket\_5\_1 (AggregatePacket\_5)

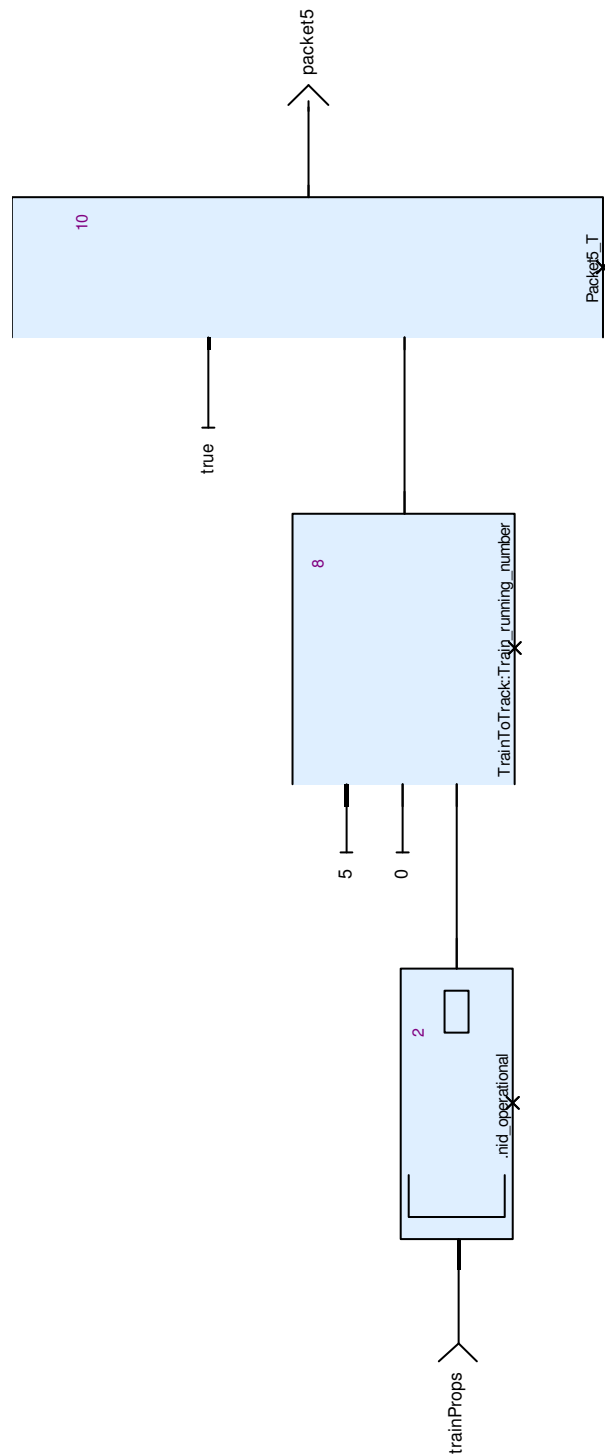


Figure 144: View of diagram\_AggregatePacket\_5\_1 (AggregatePacket\_5)

#### 15.1.8. CalculateSafeTrainLength Operator

Declared as **public node**

#### 15.1.8.1. Comments and Information

##### **CalculateSafeTrainLength Comments:**

- Calculates the the safeTrainLength according to 3.6.5.2.4/5 and the MinSafeRearEnd.
- $\text{safeTrainLength} = \text{absolute}(\text{EstimatedFrontEndPosition} - \text{MinSafeRearEnd})$   
, where
- $\text{MinSafeRearEnd} = \text{minSafeFrontEndPosition} - L\_TRAIN$

#### 15.1.8.2. Interface

**Table 409: Inputs of CalculateSafeTrainLength**

Name	Type	Comments and Information
trainProps	TrainPosition_Types_Pck::trainProperties_T	
trainPosition	TrainPosition_Types_Pck::trainPosition_T	

**Table 410: Outputs of CalculateSafeTrainLength**

Name	Type	Comments and Information
safeTrainLength	L_TRAININT	
minSafeRearEnd	int	

#### 15.1.8.3. Operator Hierarchy

diagram : diagram\_CalculateSafeTrainLength\_1

#### 15.1.8.4. Graphical and Textual Diagrams

##### 15.1.8.4.1. View of diagram\_CalculateSafeTrainLength\_1 (CalculateSafeTrainLength)

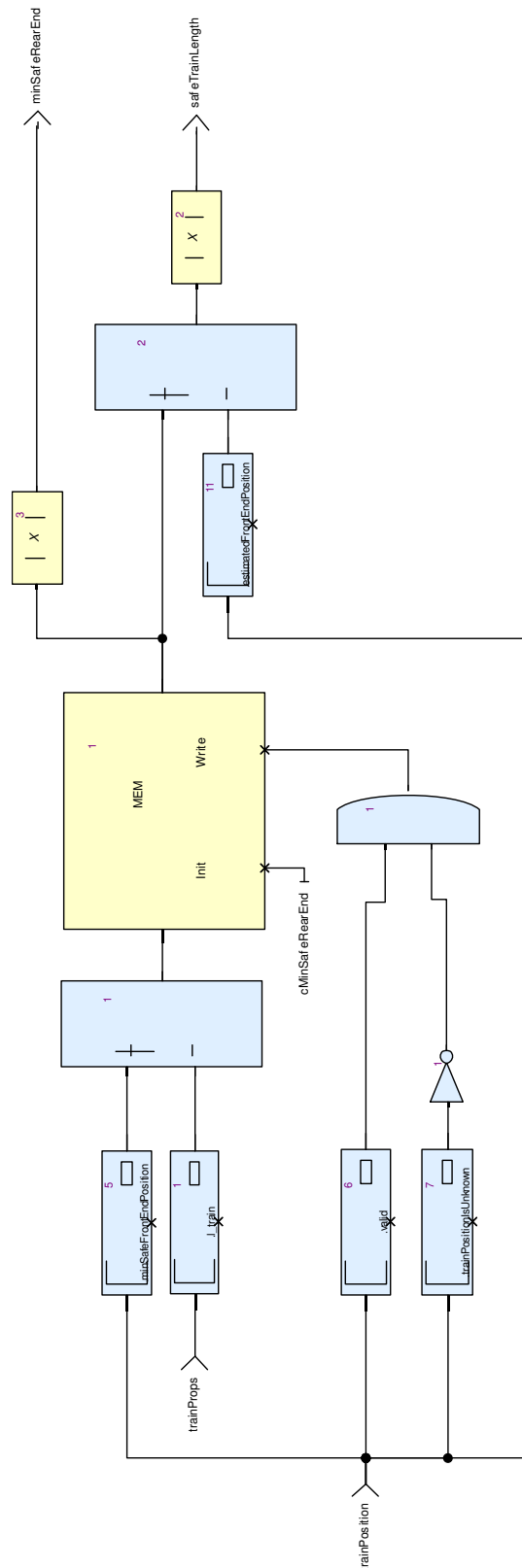


Figure 145: View of diagram\_CalculateSafeTrainLength\_1 (CalculateSafeTrainLength)

### 15.1.9. CollectData Operator

Declared as **public node**

#### 15.1.9.1. Comments and Information

##### **CollectData Comments:**

- In this operation, data of packets 0 -5 and the header is aggregated to a position report.

#### 15.1.9.2. Interface

**Table 411: Inputs of CollectData**

Name	Type	Comments and Information
posBGs	TrainPosition_Types_Pkg::positionedBGs_T	
trainPos	TrainPosition_Types_Pkg::trainPosition_T	
trainProps	TrainPosition_Types_Pkg::trainProperties_T	
TrainRearEndPos	L_TRAININT	
trigger	bool	
errorMsg	ProvidePositionReport_Pkg::ErrorMessage_T	
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	
directionLRBG	ProvidePositionReport_Pkg::BG_Orientation_T	
prvDirTrain	Q_DIRTRAIN	

**Table 412: Outputs of CollectData**

Name	Type	Comments and Information
posRep	ProvidePositionReport_Pkg::PositionReport_T	

#### 15.1.9.3. Operator Hierarchy

diagram : diagram\_CollectData\_1

#### 15.1.9.4. Graphical and Textual Diagrams

##### 15.1.9.4.1. View of diagram\_CollectData\_1 (CollectData)

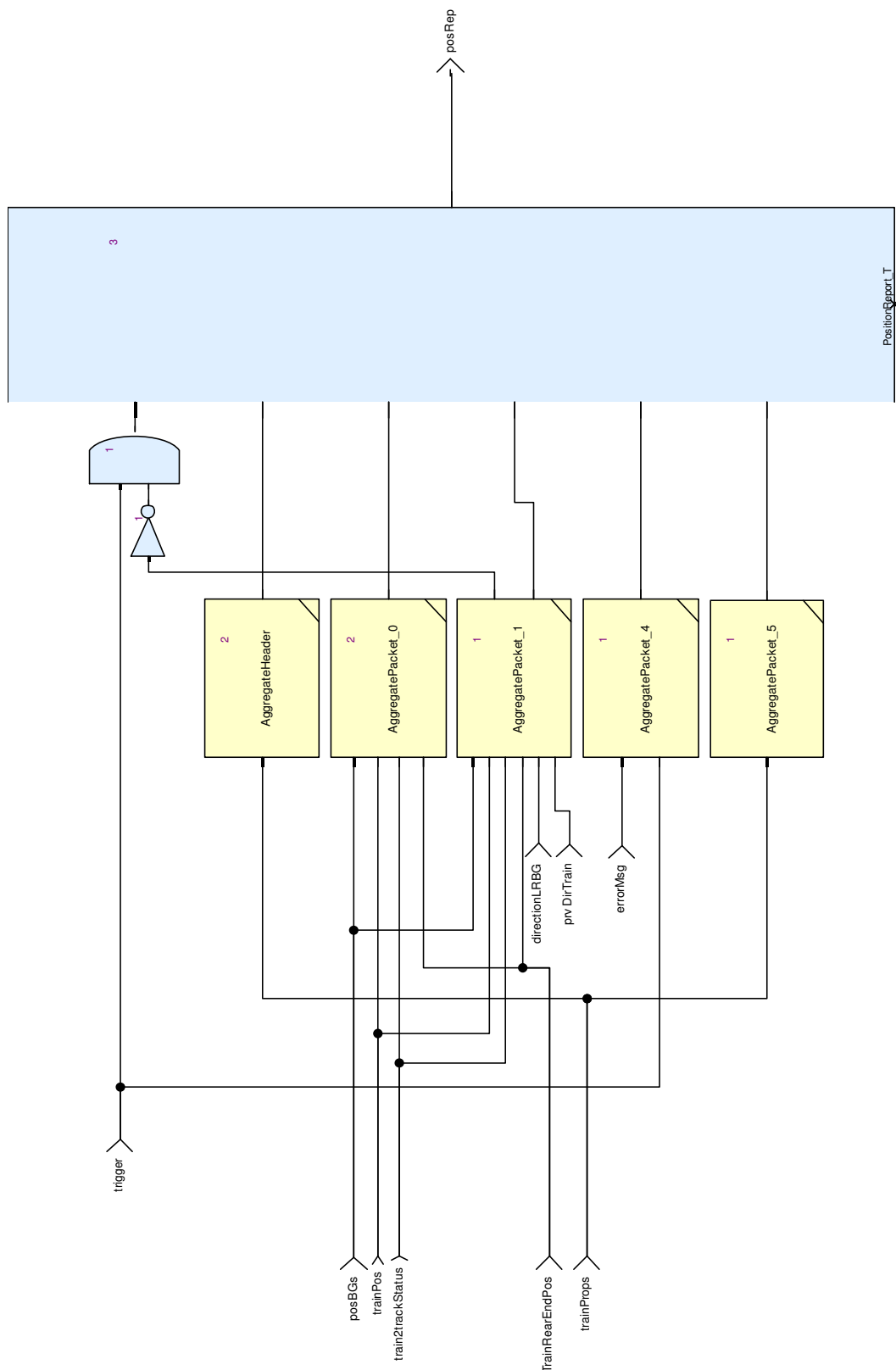


Figure 146: View of diagram\_CollectData\_1 (CollectData)

## 15.1.10. EvaluateEvents Operator

Declared as **public node**

### 15.1.10.1. Comments and Information

#### **EvaluateEvents Comments:**

- Evaluates whether one of the events described in 3.6.5.1.4 holds.

### 15.1.10.2. Interface

**Table 413: Inputs of EvaluateEvents**

Name	Type	Comments and Information
trackInfo	ProvidePositionReport_ Pkg::TrackInfo_T	
trainPos	TrainPosition_Types_Pc k::trainPosition_T	
posBGs	TrainPosition_Types_Pc k::positionedBGs_T	
rbcComm	ProvidePositionReport_ Pkg::RBC_Communicat ion_T	
train2trackStatus	BG_Types_Pkg::TrainT oTrackStatus_T	
linkingInfoUsed	ProvidePositionReport_ Pkg::LinkingInfoUsedO nBoard	

**Table 414: Outputs of EvaluateEvents**

Name	Type	Comments and Information
result	bool	

### 15.1.10.3. Operator Hierarchy

diagram : diagram\_EvaluateEvents\_1

#### 15.1.10.4. Graphical and Textual Diagrams

##### 15.1.10.4.1. View of diagram\_EvaluateEvents\_1 (EvaluateEvents)

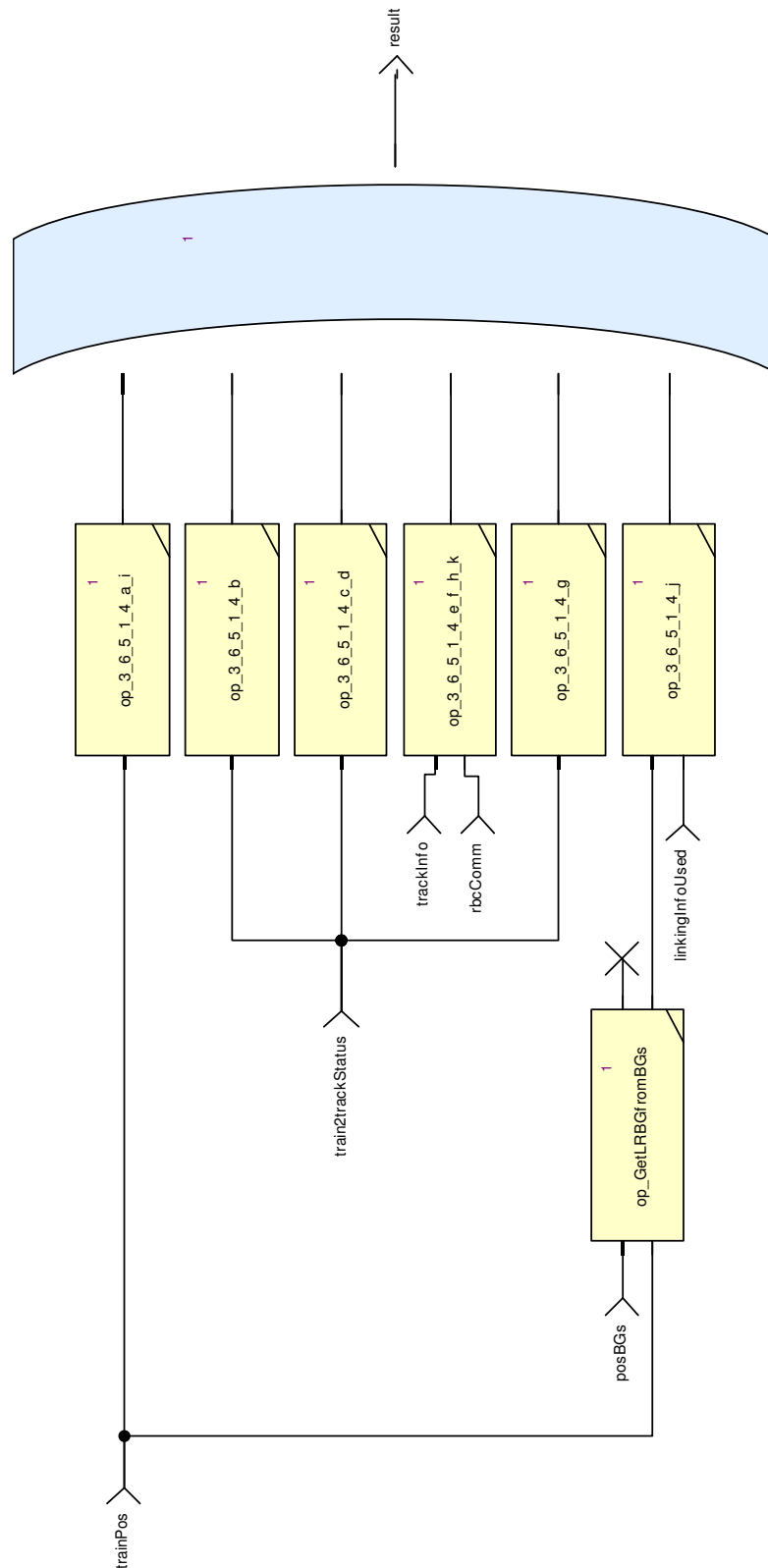


Figure 147: View of diagram\_EvaluateEvents\_1 (EvaluateEvents)

### 15.1.11. EvaluateTrigger Operator

Declared as **public node**

#### 15.1.11.1. Comments and Information

##### **EvaluateTrigger Comments:**

- Evaluates whether one of the triggers as specified by the trigger parameters evaluates to true.
- Trigger parameters are sent by the RBC using packet 58.

#### 15.1.11.2. Interface

**Table 415: Inputs of EvaluateTrigger**

Name	Type	Comments and Information
linkingInfoUsed	ProvidePositionReport_ Pkg::LinkingInfoUsedO nBoard	
posBGs	TrainPosition_Types_Pc k::positionedBGs_T	
trainPos	TrainPosition_Types_Pc k::trainPosition_T	
posRepPara	ProvidePositionReport_ Pkg::PositionReportPar ameter_T	
systemTime	ProvidePositionReport_ Pkg::SystemTime_T	
minSafeRearEnd	int	

**Table 416: Outputs of EvaluateTrigger**

Name	Type	Comments and Information
result	bool	

#### 15.1.11.3. Operator Hierarchy

diagram : diagram\_EvaluateTrigger\_1



#### 15.1.11.4. Graphical and Textual Diagrams

##### 15.1.11.4.1. View of diagram\_EvaluateTrigger\_1 (EvaluateTrigger)

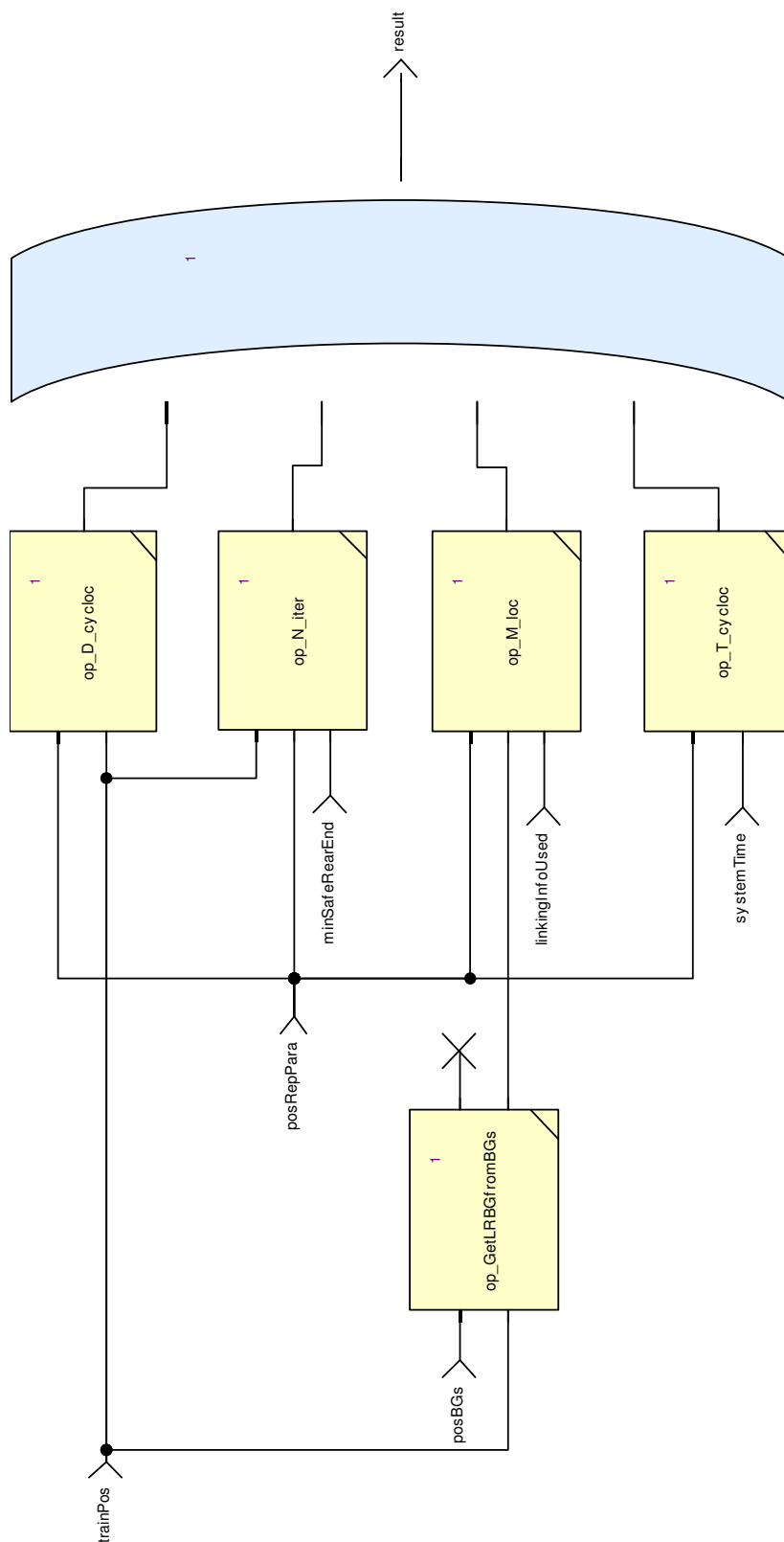


Figure 148: View of diagram\_EvaluateTrigger\_1 (EvaluateTrigger)

## 15.1.12. EvaluateTriggerAndEvents Operator

Declared as **public node**

### 15.1.12.1. Comments and Information

#### **EvaluateTriggerAndEvents Comments:**

- conjunction of the evaluation of triggers and events.

### 15.1.12.2. Interface

**Table 417: Inputs of EvaluateTriggerAndEvents**

Name	Type	Comments and Information
trackInfo	ProvidePositionReport_ Pkg::TrackInfo_T	
trainPos	TrainPosition_Types_Pc k::trainPosition_T	
posRepPara	ProvidePositionReport_ Pkg::PositionReportPar ameter_T	
posBGs	TrainPosition_Types_Pc k::positionedBGs_T	
systemTime	ProvidePositionReport_ Pkg::SystemTime_T	
rbcComm	ProvidePositionReport_ Pkg::RBC_Communicat ion_T	
train2trackStatus	BG_Types_Pkg::TrainT oTrackStatus_T	
linkingInfoUsed	ProvidePositionReport_ Pkg::LinkingInfoUsedO nBoard	
minSafeRearEnd	int	

**Table 418: Outputs of EvaluateTriggerAndEvents**

Name	Type	Comments and Information
trigger	bool	

### 15.1.12.3. Operator Hierarchy

diagram : diagram\_EvaluateTriggerAndEvents\_1

#### 15.1.12.4. Graphical and Textual Diagrams

##### 15.1.12.4.1. View of diagram\_EvaluateTriggerAndEvents\_1 (EvaluateTriggerAndEvents)

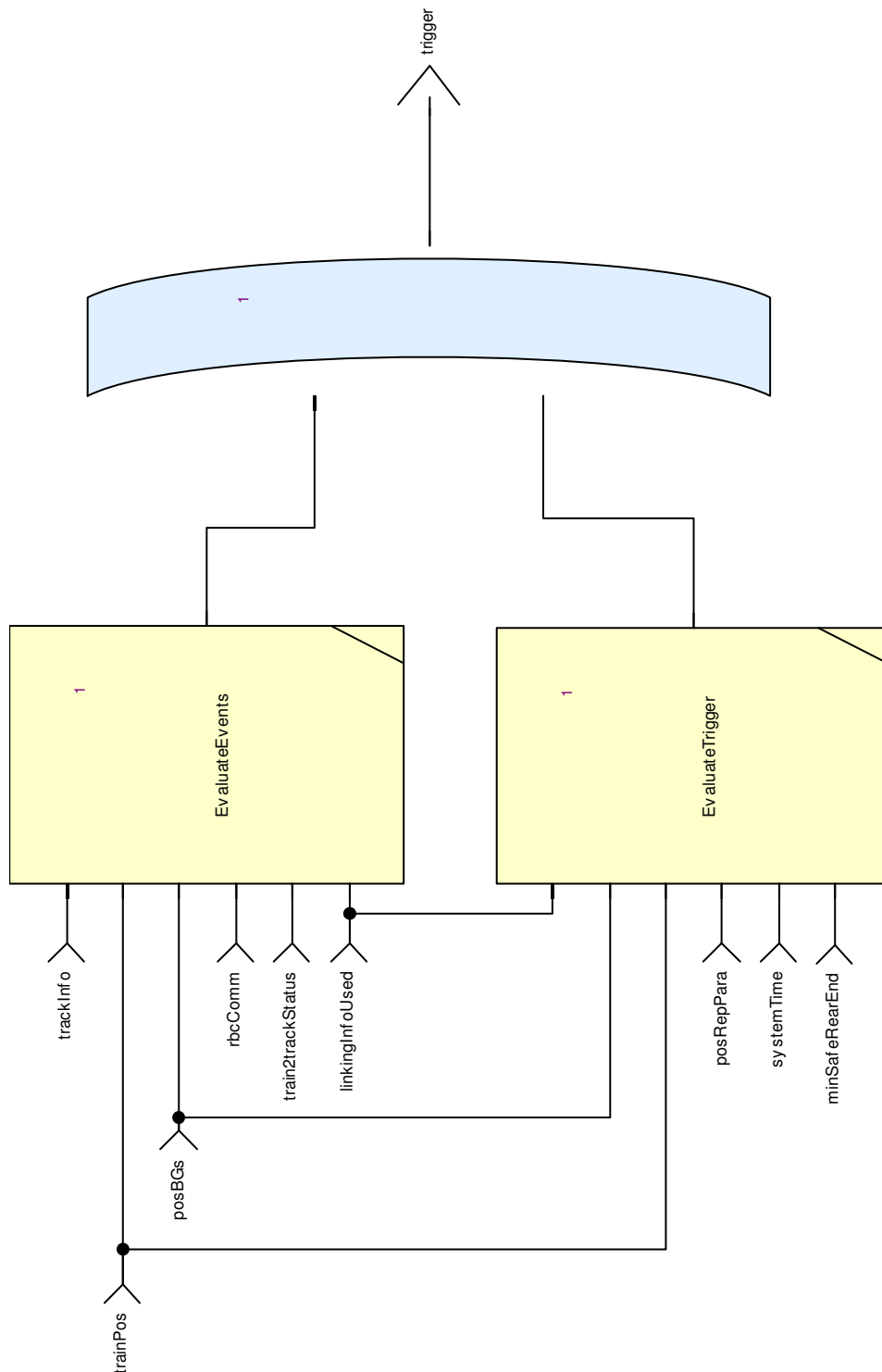


Figure 149: View of diagram\_EvaluateTriggerAndEvents\_1 (EvaluateTriggerAndEvents)

#### 15.1.13. op\_3\_6\_5\_1\_4\_a\_i Operator

Declared as **public node**

#### 15.1.13.1. Comments and Information

##### **op\_3\_6\_5\_1\_4\_a\_i Comments:**

- Models events as listed in 3.6.5.1.4 a) and i),

#### 15.1.13.2. Interface

**Table 419: Inputs of op\_3\_6\_5\_1\_4\_a\_i**

Name	Type	Properties		Comments and Information
trainPos	TrainPosition_Types_Pc k::trainPosition_T	last	cTrainPosition	

**Table 420: Outputs of op\_3\_6\_5\_1\_4\_a\_i**

Name	Type	Comments and Information
b	bool	

#### 15.1.13.3. Operator Hierarchy

diagram : diagram\_op\_3\_6\_5\_1\_4\_a\_i\_1



#### 15.1.14. op\_3\_6\_5\_1\_4\_b Operator

Declared as **public node**

##### 15.1.14.1. Comments and Information

###### op\_3\_6\_5\_1\_4\_b Comments:

- Models event as listed in 3.6.5.1.4 b),

##### 15.1.14.2. Interface

**Table 421: Inputs of op\_3\_6\_5\_1\_4\_b**

Name	Type	Properties		Comments and Information
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	last	cTrack2TrainStatus	

**Table 422: Outputs of op\_3\_6\_5\_1\_4\_b**

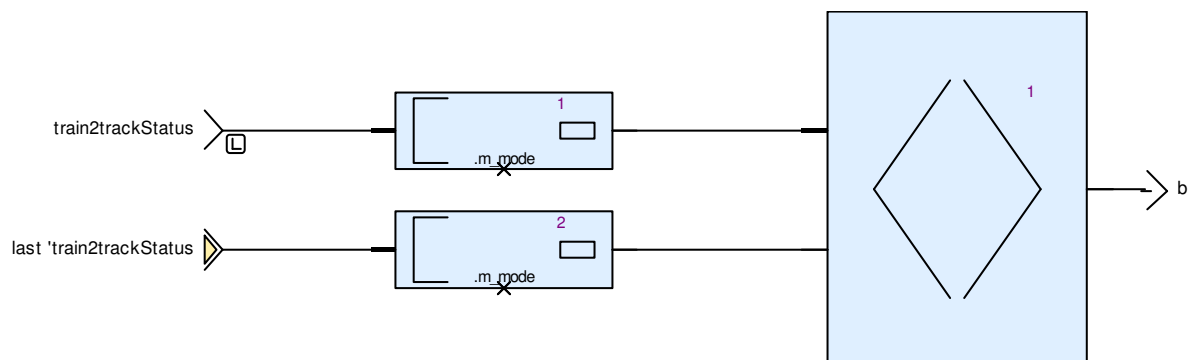
Name	Type	Comments and Information
b	bool	

##### 15.1.14.3. Operator Hierarchy

diagram : diagram\_op\_3\_6\_5\_1\_4\_b\_1

##### 15.1.14.4. Graphical and Textual Diagrams

###### 15.1.14.4.1. View of diagram\_op\_3\_6\_5\_1\_4\_b\_1 (op\_3\_6\_5\_1\_4\_b)



**Figure 151: View of diagram\_op\_3\_6\_5\_1\_4\_b\_1 (op\_3\_6\_5\_1\_4\_b)**

#### 15.1.15. op\_3\_6\_5\_1\_4\_c\_d Operator

Declared as **public function**

##### 15.1.15.1. Comments and Information

###### op\_3\_6\_5\_1\_4\_c\_d Comments:

- Models events as listed in 3.6.5.1.4 c) and d),

### 15.1.15.2. Interface

**Table 423: Inputs of op\_3\_6\_5\_1\_4\_c\_d**

Name	Type	Comments and Information
train2trackStatus	BG_Types_Pkg::TrainT oTrackStatus_T	

**Table 424: Outputs of op\_3\_6\_5\_1\_4\_c\_d**

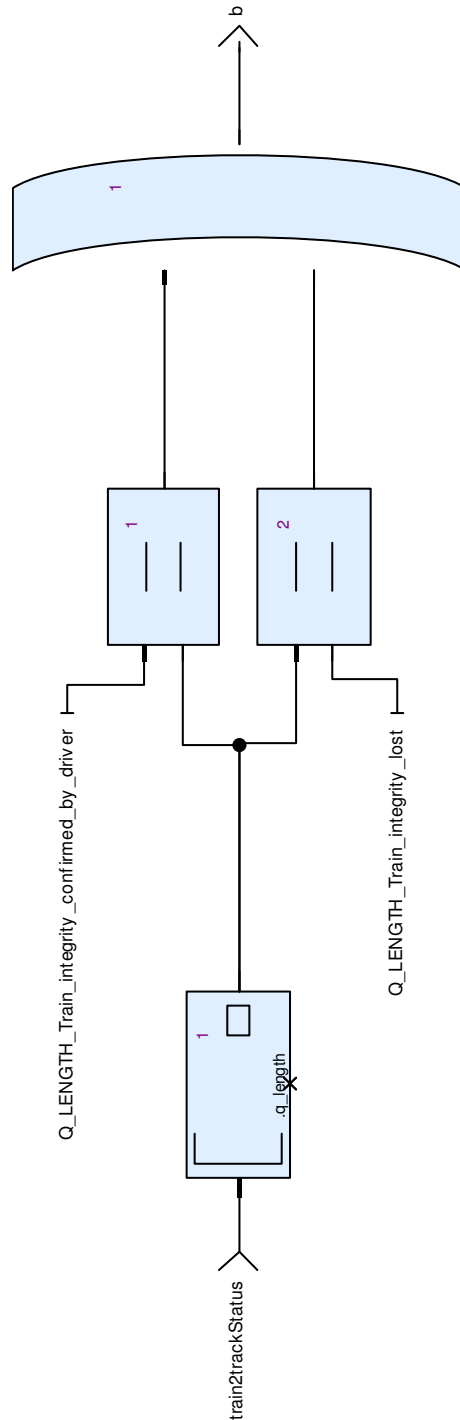
Name	Type	Comments and Information
b	bool	

### 15.1.15.3. Operator Hierarchy

diagram : diagram\_op\_3\_6\_5\_1\_4\_c\_d\_1

#### 15.1.15.4. Graphical and Textual Diagrams

##### 15.1.15.4.1. View of diagram\_op\_3\_6\_5\_1\_4\_c\_d\_1 (op\_3\_6\_5\_1\_4\_c\_d)



**Figure 152: View of diagram\_op\_3\_6\_5\_1\_4\_c\_d\_1 (op\_3\_6\_5\_1\_4\_c\_d)**

#### 15.1.16. op\_3\_6\_5\_1\_4\_e\_f\_h\_k Operator

Declared as **public function**

##### 15.1.16.1. Comments and Information

**op\_3\_6\_5\_1\_4\_e\_f\_h\_k Comments:**



- Models events as listed in 3.6.5.1.4 e), f), h) and k),

#### 15.1.16.2. Interface

**Table 425: Inputs of op\_3\_6\_5\_1\_4\_e\_f\_h\_k**

Name	Type	Comments and Information
trackInfo	ProvidePositionReport_Pkg::TrackInfo_T	
rbcComm	ProvidePositionReport_Pkg::RBC_Communication_T	

**Table 426: Outputs of op\_3\_6\_5\_1\_4\_e\_f\_h\_k**

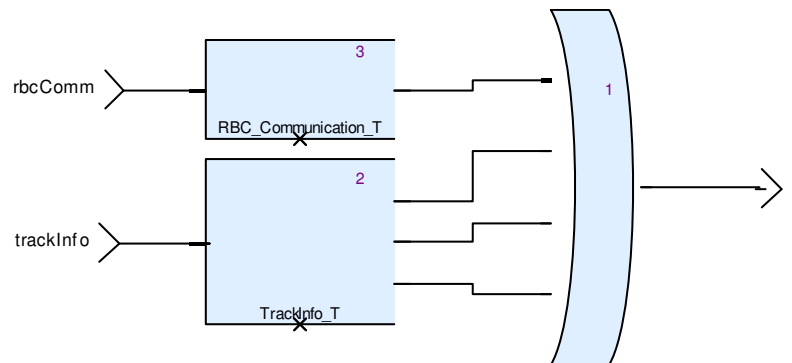
Name	Type	Comments and Information
b	bool	

#### 15.1.16.3. Operator Hierarchy

diagram : diagram\_op\_3\_6\_5\_1\_4\_e\_f\_h\_k\_1

#### 15.1.16.4. Graphical and Textual Diagrams

##### 15.1.16.4.1. View of diagram\_op\_3\_6\_5\_1\_4\_e\_f\_h\_k\_1 (op\_3\_6\_5\_1\_4\_e\_f\_h\_k)



**Figure 153: View of diagram\_op\_3\_6\_5\_1\_4\_e\_f\_h\_k\_1 (op\_3\_6\_5\_1\_4\_e\_f\_h\_k)**

#### 15.1.17. op\_3\_6\_5\_1\_4\_g Operator

Declared as **public node**

##### 15.1.17.1. Comments and Information

**op\_3\_6\_5\_1\_4\_g Comments:**

- Models the event as listed in 3.6.5.1.4 g),

#### 15.1.17.2. Interface

**Table 427: Inputs of op\_3\_6\_5\_1\_4\_g**

Name	Type	Properties		Comments and Information
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	last	cTrack2TrainStatus	

**Table 428: Outputs of op\_3\_6\_5\_1\_4\_g**

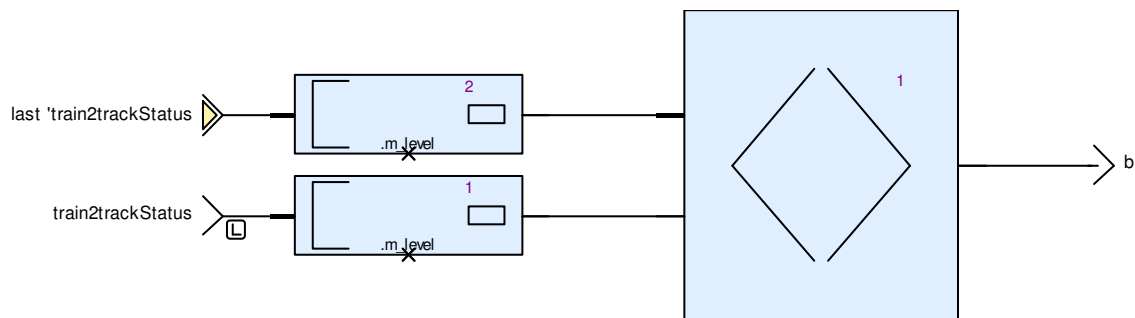
Name	Type	Comments and Information
b	bool	

#### 15.1.17.3. Operator Hierarchy

diagram : diagram\_op\_3\_6\_5\_1\_4\_g\_1

#### 15.1.17.4. Graphical and Textual Diagrams

##### 15.1.17.4.1. View of diagram\_op\_3\_6\_5\_1\_4\_g\_1 (op\_3\_6\_5\_1\_4\_g)



**Figure 154: View of diagram\_op\_3\_6\_5\_1\_4\_g\_1 (op\_3\_6\_5\_1\_4\_g)**

#### 15.1.18. op\_3\_6\_5\_1\_4\_j Operator

Declared as **public function**

##### 15.1.18.1. Comments and Information

###### op\_3\_6\_5\_1\_4\_j Comments:

- Models the event as listed in 3.6.5.1.4 j),
- A balise group is compliant according to the definition in 3.6.2.2.2.a

##### 15.1.18.2. Interface

**Table 429: Inputs of op\_3\_6\_5\_1\_4\_j**

Name	Type	Comments and Information
LRBG	TrainPosition_Types_Pkg::positionedBG_T	
linkingInfoUsed	ProvidePositionReport_Pkg::LinkingInfoUsedOnBoard	

**Table 430: Outputs of op\_3\_6\_5\_1\_4\_j**

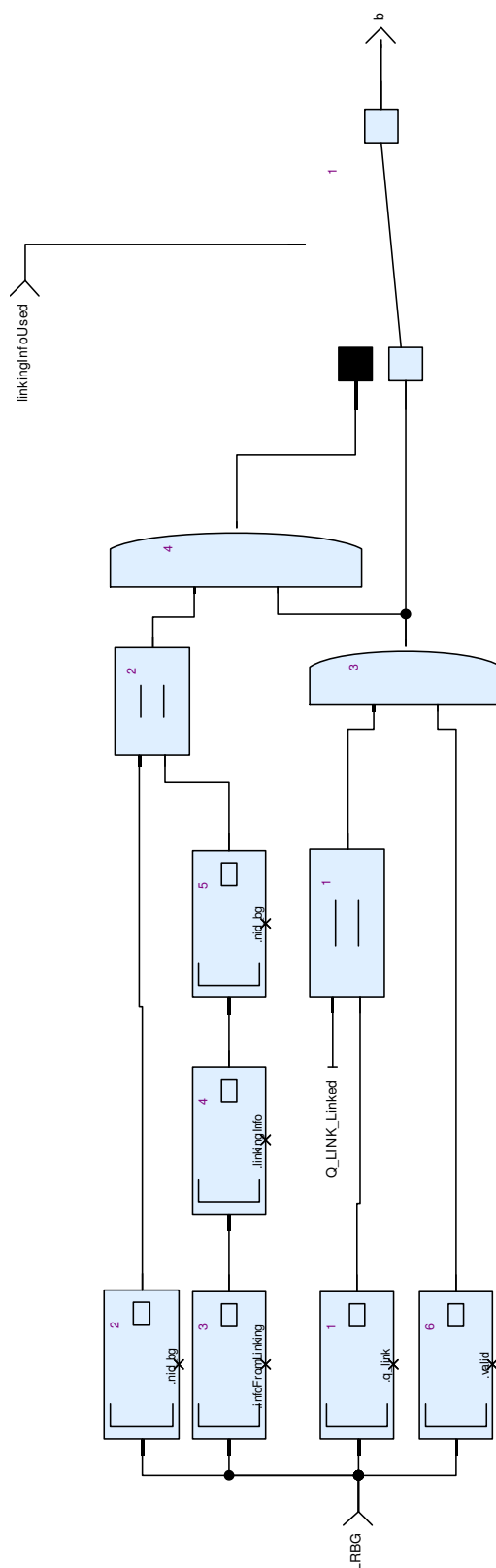
Name	Type	Comments and Information
b	bool	

#### 15.1.18.3. Operator Hierarchy

diagram : diagram\_op\_3\_6\_5\_1\_4\_j\_1

#### 15.1.18.4. Graphical and Textual Diagrams

15.1.18.4.1. View of diagram\_op\_3\_6\_5\_1\_4\_j\_1 (op\_3\_6\_5\_1\_4\_j)



**Figure 155: View of diagram\_op\_3\_6\_5\_1\_4\_j\_1 (op\_3\_6\_5\_1\_4\_j)**

### 15.1.19. op\_cond\_3\_4\_2\_3\_3 Operator

Declared as **public function**

#### 15.1.19.1. Comments and Information

##### **op\_cond\_3\_4\_2\_3\_3 Comments:**

- This block calculates the preconditions specified in 3.4.2.3.3.2 - 3.4.2.3.3.4.

#### 15.1.19.2. Interface

**Table 431: Inputs of op\_cond\_3\_4\_2\_3\_3**

Name	Type	Comments and Information
posRep	TrainToTrack::Position_Report	
trainPos	TrainPosition_Types_Pc k::trainPosition_T	
prvDirTrain	Q_DIRTRAIN	

**Table 432: Outputs of op\_cond\_3\_4\_2\_3\_3**

Name	Type	Comments and Information
nidPrvLrbg	int	
cond_3_4_2_3_3_2	bool	
cond_3_4_2_3_3_3	bool	
cond_3_4_2_3_3_4	bool	

#### 15.1.19.3. Operator Hierarchy

diagram : diagram\_op\_cond\_3\_4\_2\_3\_3\_1

#### 15.1.19.4. Graphical and Textual Diagrams

##### 15.1.19.4.1. View of diagram\_op\_cond\_3\_4\_2\_3\_3\_1 (op\_cond\_3\_4\_2\_3\_3)

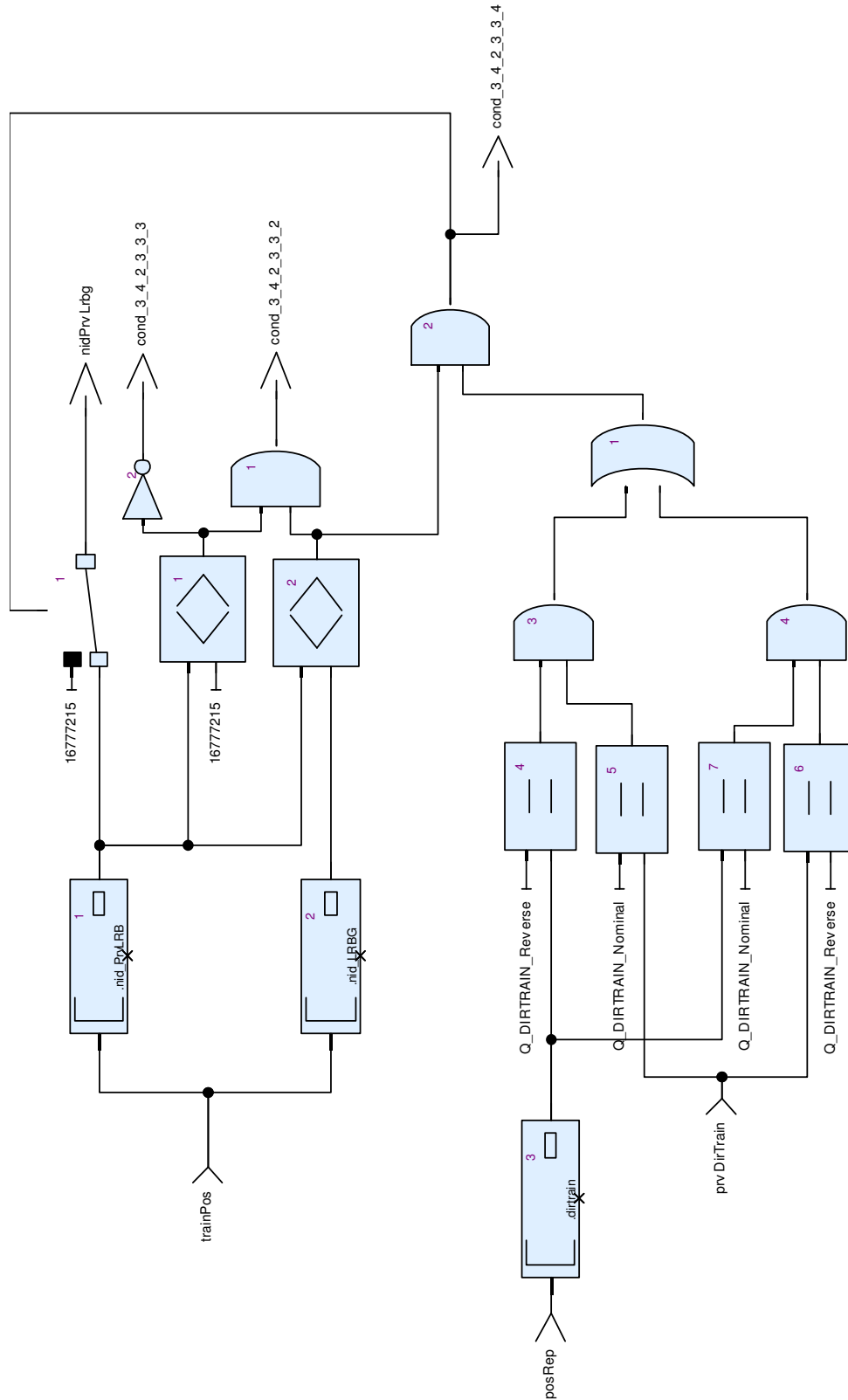


Figure 156: View of diagram\_op\_cond\_3\_4\_2\_3\_3\_1 (op\_cond\_3\_4\_2\_3\_3)

## 15.1.20. op\_D\_cycloc Operator

Declared as **public node**

### 15.1.20.1. Comments and Information

#### op\_D\_cycloc Comments:

- Models parameter D\_CYCLOC that specifies a distance between two position reports.
- The model:
  - - Mem1 stores the value of D\_CYCLOC
  - - Mem2 stores the position relative to interval given by D\_CYCLOC when the last report has been sent.
- If the clock is too slow and D\_CYCLOC too small, too few reports will be sent.
- A value is written into Mem2:
  - - if present  $\neg D\_CYCLOC \neq 32766 \wedge \text{valid} \wedge \neg \text{unknownPosition}$
  - $\neg \text{in\_state\_SimpleCase}$  then write trainPosition into Mem2
  - (i.e., at the occurrence of a new PositionReportParameter, the current train position is written into Mem2)
  - - if  $\neg \text{present} \wedge D\_CYCLOC \neq 32766 \wedge \text{valid} \wedge \neg \text{unknownPosition} \wedge$   
 $\text{trainPosition} \geq \text{currDistance} + D\_CYCLOC \wedge \text{in\_state\_SimpleCase}$ , then write  
 $\text{currDistance} + D\_CYCLOC$  into Mem2
  - (i.e., if the train has passed the next level of the interval--currDistance + D\_CYCLOC--increment currDistance by D\_CYCLOC)
  - - if  $\neg \text{present} \wedge D\_CYCLOC \neq 32766 \wedge \text{valid} \wedge \neg \text{unknownPosition} \wedge$   
 $\text{in\_state\_Intermediate}$ , then write trainPosition into Mem2
  - (i.e., the first time we have a trainPosition after a PositionReportParameter has been received, we initialize Mem2 with trainPosition)
- From these three conditions, we derive the following condition when Mem2 must be written:
  - -  $D\_CYCLOC \neq 32766 \wedge \text{valid} \wedge \neg \text{unknownPosition} \wedge \neg \text{in\_state\_SpecialCase}$
  - $\neg \text{trainPosition} \geq \text{input}(\text{Mem2})$  (i.e., we only write currDistance + D\_CYCLOC into Mem2 iff it is  $\leq$  the trainPosition))

### 15.1.20.2. Interface

**Table 433: Inputs of op\_D\_cycloc**

Name	Type	Comments and Information
pRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	
trainPos	TrainPosition_Types_Pkg::trainPosition_T	

**Table 434: Outputs of op\_D\_cycloc**

Name	Type	Comments and Information
b	bool	

### 15.1.20.3. Locals

**Table 435: Locals of op\_D\_cycloc**

Name	Type	Properties		Comments and Information
currTriggerDistance	int	last	0	
intermediate	bool	default	false	
mem2Locked	bool	default	false	
presentReport	bool			
validPositionData	bool			

### 15.1.20.4. Operator Hierarchy

diagram : diagram\_op\_D\_cycloc\_1

*state-machine* : SM1

state : Init

state : Intermediate

state : SimpleCase

state : SpecialCase

## 15.1.20.5. Graphical and Textual Diagrams

### 15.1.20.5.1. View of diagram\_op\_D\_cycloc\_1 (op\_D\_cycloc)

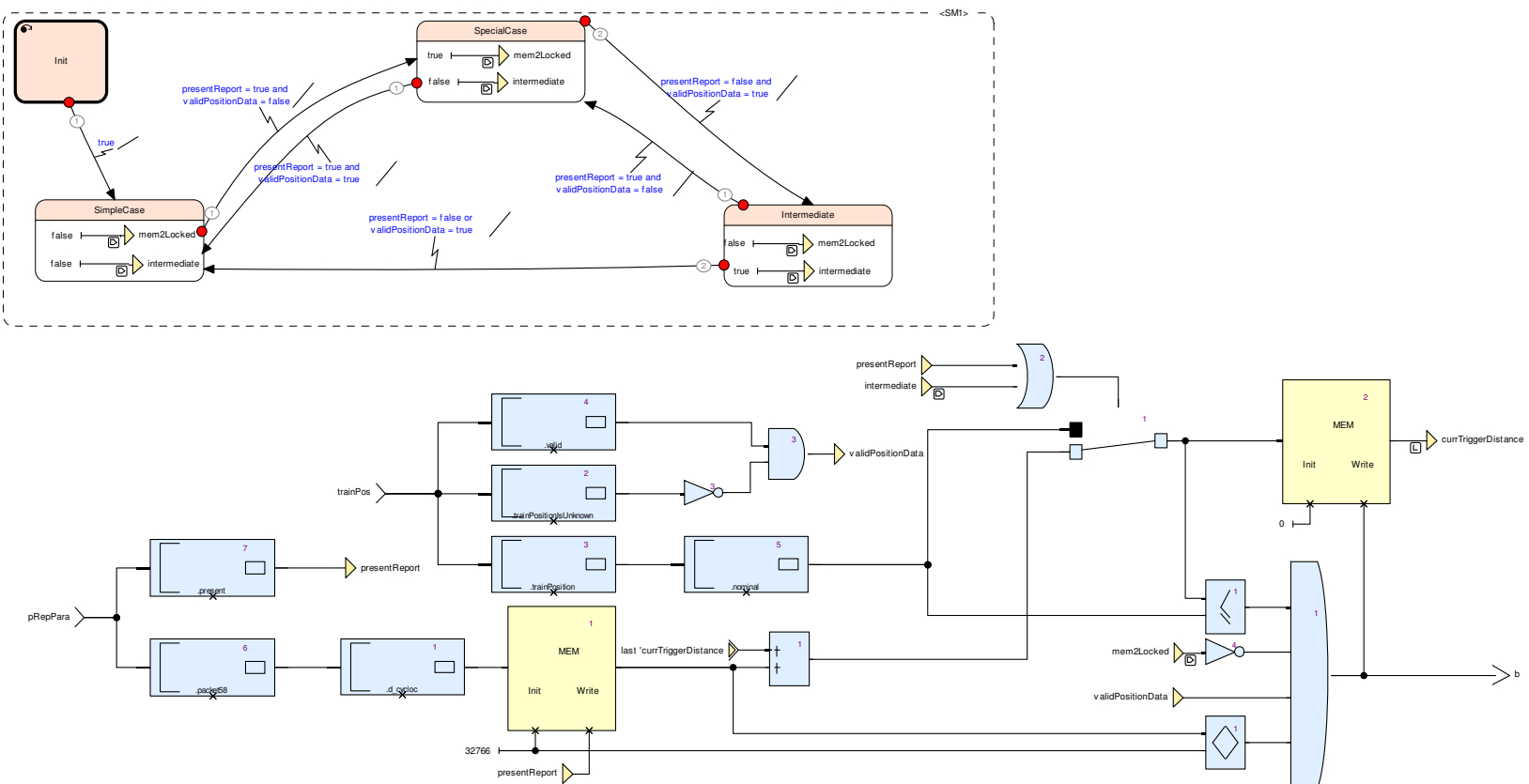


Figure 157: View of diagram\_op\_D\_cycloc\_1 (op\_D\_cycloc)



**Table 436: State Machines of diagram\_op\_D\_cycloc\_1**

State Machine	Comments and Information
SM1	

**Table 437: States of diagram\_op\_D\_cycloc\_1**

State	Comments and Information
SM1:Init	
SM1:Intermediate	
SM1:SimpleCase	
SM1:SpecialCase	

**Table 438: Transitions of diagram\_op\_D\_cycloc\_1**

Source/Target	#	Conditions/Actions	Comments and Information
<b>Source:</b> SM1:Init <b>Target:</b> SM1:SimpleCase	1	<b>Condition:</b> true	
<b>Source:</b> SM1:Intermediate <b>Target:</b> SM1:SpecialCase	1	<b>Condition:</b> presentReport = true and validPositionData = false	
<b>Source:</b> SM1:Intermediate <b>Target:</b> SM1:SimpleCase	2	<b>Condition:</b> presentReport = false or validPositionData = true	
<b>Source:</b> SM1:SimpleCase <b>Target:</b> SM1:SpecialCase	1	<b>Condition:</b> presentReport = true and validPositionData = false	
<b>Source:</b> SM1:SpecialCase <b>Target:</b> SM1:SimpleCase	1	<b>Condition:</b> presentReport = true and validPositionData = true	
<b>Source:</b> SM1:SpecialCase <b>Target:</b> SM1:Intermediate	2	<b>Condition:</b> presentReport = false and validPositionData = true	

### 15.1.21. op\_DOUBTOVER Operator

Declared as **public function**

#### 15.1.21.1. Comments and Information

##### **op\_DOUBTOVER Comments:**

- Calculates L\_DOUBTOVER = absolute(estimated front end - min safe front end)

### 15.1.21.2. Interface

**Table 439: Inputs of op\_DOUBTOVER**

Name	Type	Comments and Information
trainPos	TrainPosition_Types_Pc k::trainPosition_T	

**Table 440: Outputs of op\_DOUBTOVER**

Name	Type	Comments and Information
I_doubtover	L_DOUBTOVER	

### 15.1.21.3. Operator Hierarchy

diagram : diagram\_op\_DOUBTOVER\_1

#### 15.1.21.4. Graphical and Textual Diagrams

##### 15.1.21.4.1. View of diagram\_op\_DOUBTOVER\_1 (op\_DOUBTOVER)

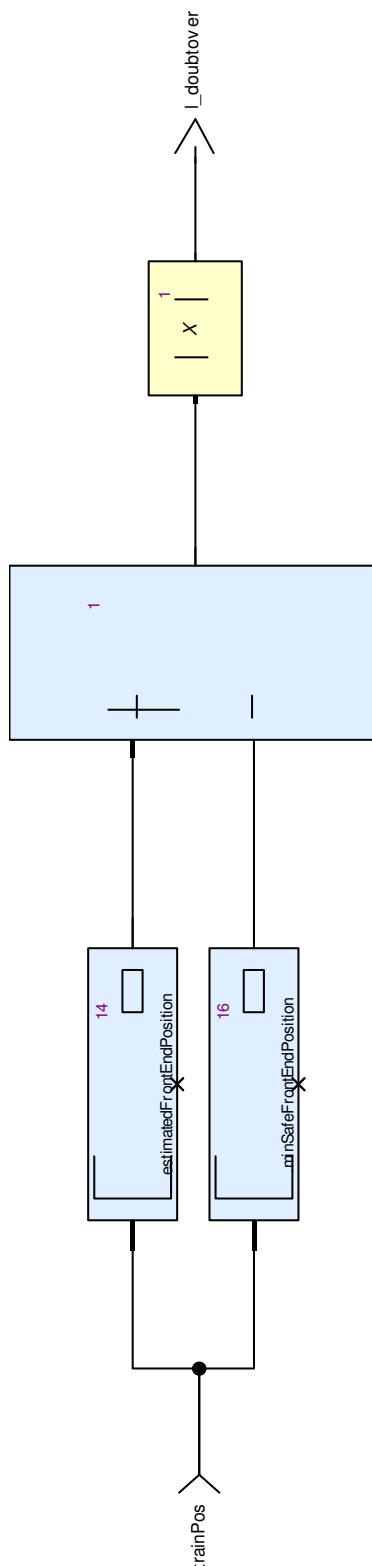


Figure 158: View of diagram\_op\_DOUBTOVER\_1 (op\_DOUBTOVER)

## 15.1.22. op\_DOUBTUNDER Operator

Declared as **public function**

### 15.1.22.1. Comments and Information

#### **op\_DOUBTUNDER Comments:**

- Calculates  $L\_DOUBTUNDER = \text{absolute}(\text{max safe front end} - \text{estimated front end})$

### 15.1.22.2. Interface

**Table 441: Inputs of op\_DOUBTUNDER**

Name	Type	Comments and Information
trainPos	TrainPosition_Types_Pc k::trainPosition_T	

**Table 442: Outputs of op\_DOUBTUNDER**

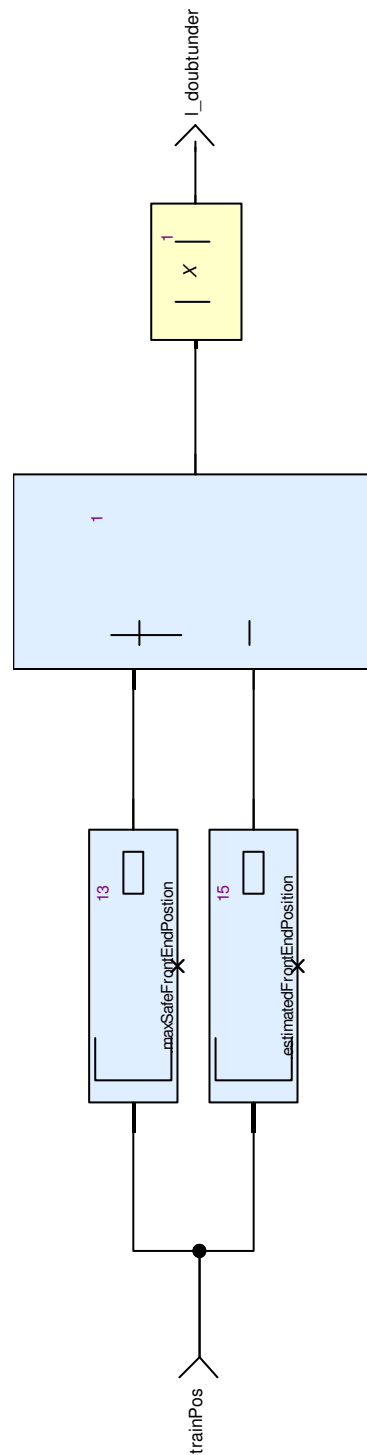
Name	Type	Comments and Information
l_doubtunder	L_DOUBTUNDER	

### 15.1.22.3. Operator Hierarchy

diagram : diagram\_op\_DOUBTUNDER\_1

#### 15.1.22.4. Graphical and Textual Diagrams

##### 15.1.22.4.1. View of diagram\_op\_DOUBTUNDER\_1 (op\_DOUBTUNDER)



**Figure 159: View of diagram\_op\_DOUBTUNDER\_1 (op\_DOUBTUNDER)**

#### 15.1.23. op\_findBG Operator

Declared as **public function**

### 15.1.23.1. Interface

**Table 443: Inputs of op\_findBG**

Name	Type	Comments and Information
acc	bool	
Input_BG	TrainPosition_Types_Pc k::positionedBG_T	
Input_BG_IDToCheck	NID_BG	

**Table 444: Outputs of op\_findBG**

Name	Type	Comments and Information
fd	bool	
cond	bool	

### 15.1.23.2. Operator Hierarchy

diagram : diagram\_op\_findBG\_1

### 15.1.23.3. Graphical and Textual Diagrams

#### 15.1.23.3.1. View of diagram\_op\_findBG\_1 (op\_findBG)

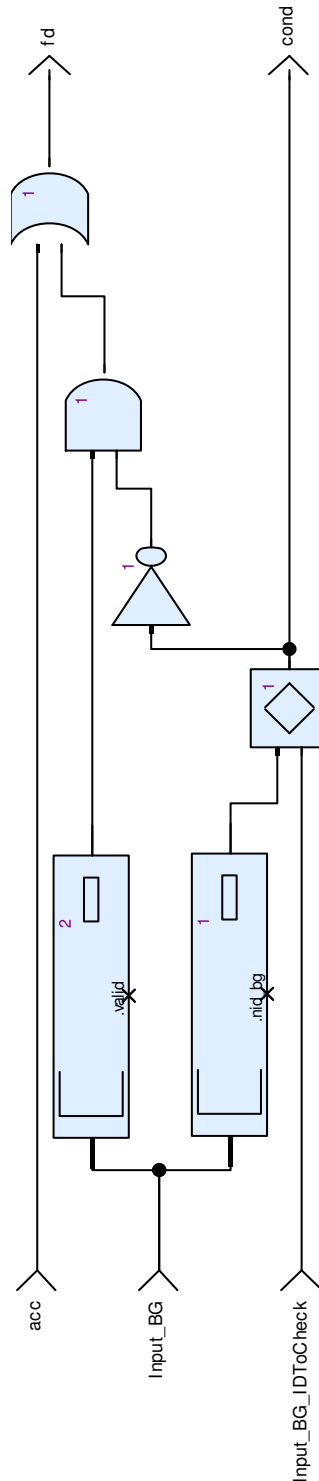


Figure 160: View of diagram\_op\_findBG\_1 (op\_findBG)

### 15.1.24. op\_GetLRBGfromBGs Operator

Declared as **public function**

#### 15.1.24.1. Interface

**Table 445: Inputs of op\_GetLRBGfromBGs**

Name	Type	Comments and Information
posBGs	TrainPosition_Types_Pc k::positionedBGs_T	
trainPos	TrainPosition_Types_Pc k::trainPosition_T	

**Table 446: Outputs of op\_GetLRBGfromBGs**

Name	Type	Comments and Information
found	bool	
lrbg	TrainPosition_Types_Pc k::positionedBG_T	

#### 15.1.24.2. Operator Hierarchy

diagram : diagram\_op\_GetLRBGfromBGs\_1





## 15.1.25. op\_LRBG Operator

Declared as **public function**

### 15.1.25.1. Comments and Information

#### **op\_LRBG Comments:**

- Calculate D\_LRBG:
- tPosition.valid \wedge tPosition.trainPositionUnknown= false \wedge we find in positionedBGs\_T
- an BG with NID\_BG=tPosition.NID\_LRBG,
- then calculate |estimatedFrontEndPosition-positionedBG.location|.nominal;
- otherwise unknown is assigned to D\_LRBG

### 15.1.25.2. Interface

**Table 447: Inputs of op\_LRBG**

Name	Type	Comments and Information
posBGs	TrainPosition_Types_Pck::positionedBGs_T	
trainPos	TrainPosition_Types_Pck::trainPosition_T	

**Table 448: Outputs of op\_LRBG**

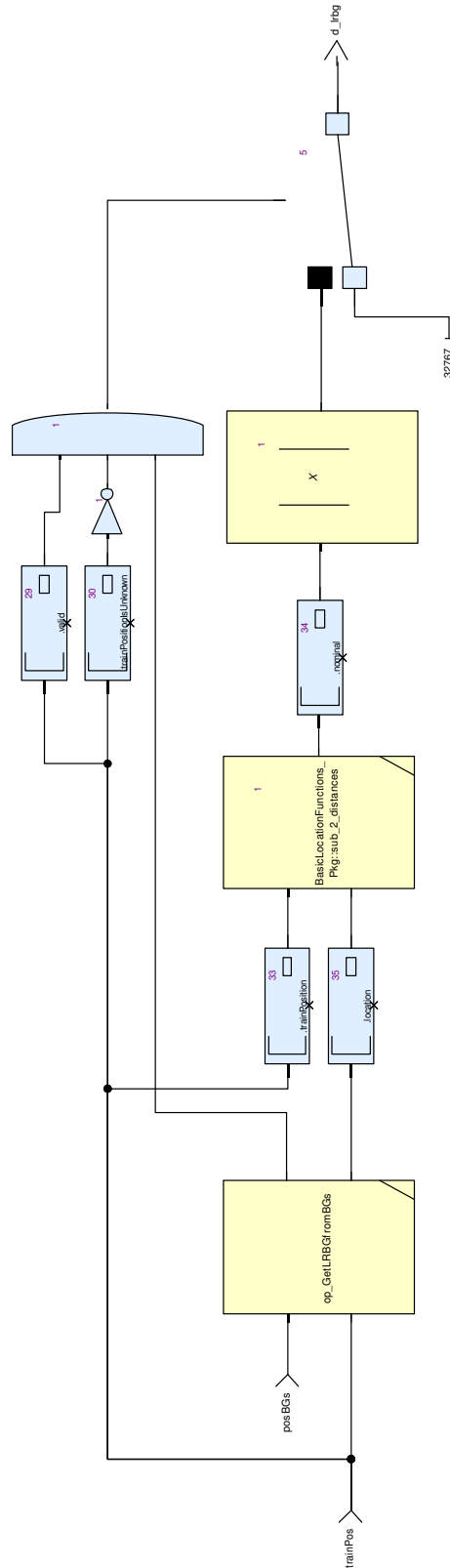
Name	Type	Comments and Information
d_lrbg	int	

### 15.1.25.3. Operator Hierarchy

diagram : diagram\_op\_LRBG\_1

#### 15.1.25.4. Graphical and Textual Diagrams

##### 15.1.25.4.1. View of diagram\_op\_LRBG\_1 (op\_LRBG)



**Figure 162: View of diagram\_op\_LRBG\_1 (op\_LRBG)**

## 15.1.26. op\_M\_loc Operator

Declared as **public node**

### 15.1.26.1. Comments and Information

#### **op\_M\_loc Comments:**

- Models trigger based on parameter M\_LOC; that is, locations and situations
- where the train has to report its position.

### 15.1.26.2. Interface

**Table 449: Inputs of op\_M\_loc**

Name	Type	Comments and Information
pRepPara	ProvidePositionReport_ Pkg::PositionReportPar ameter_T	
posBGs	TrainPosition_Types_Pc k::positionedBG_T	
linkingInfoUsed	ProvidePositionReport_ Pkg::LinkingInfoUsedO nBoard	

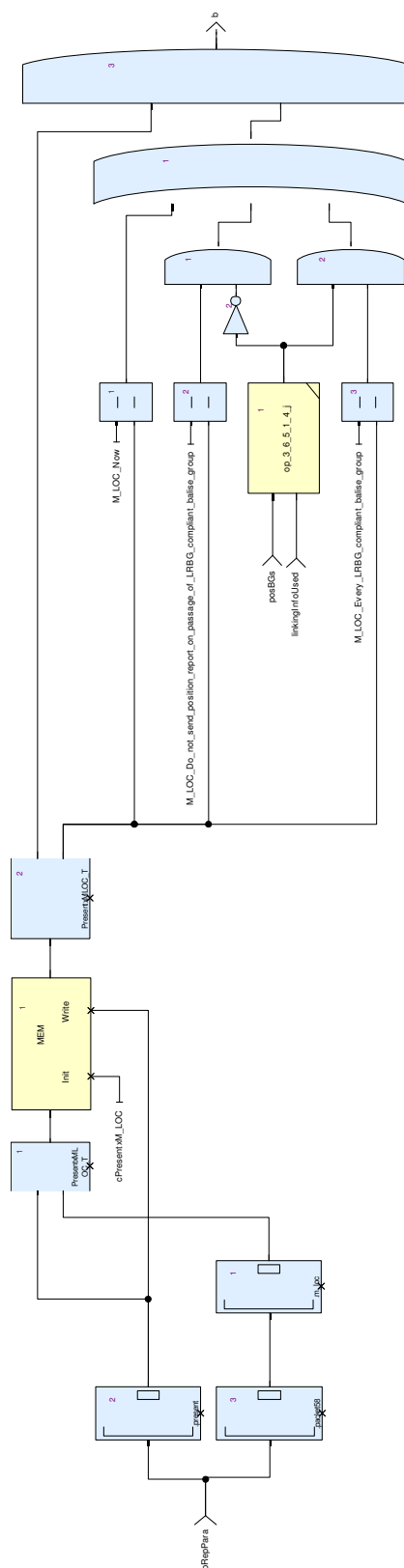
**Table 450: Outputs of op\_M\_loc**

Name	Type	Comments and Information
b	bool	

### 15.1.26.3. Operator Hierarchy

diagram : diagram\_op\_M\_loc\_1

15.1.26.4.1. View of diagram\_op\_M\_loc\_1 (op\_M\_loc)



**Figure 163: View of diagram\_op\_M\_loc\_1 (op\_M\_loc)**

## 15.1.27. op\_N\_iter Operator

Declared as **public node**

### 15.1.27.1. Comments and Information

#### op\_N\_iter Comments:

- Models trigger based on parameter N\_ITER; that is, a list of pairs (distance, trainPosition) where the distance
- is specified wrt. to a reference point. We calculate
- $\text{ref} + \text{LOC}(1) + \text{LOC}(2) + \dots$  where ref is the location of the reference BG and LOC(i) is the distance
- at position i of the list
- The model is similar to the one in op\_D\_cycloc. The memory stores the current trigger distance.
- The first trigger is at  $\text{ref} + \text{LOC}(1)$ . As soon as we know ref, the value is written into the memory. With the passing
- of  $\text{ref} + \text{LOC}(1) + \dots + \text{LOC}(i)$  the respective value is written into the memory (if the train position and thus
- the minSafeRearEnd is known and valid and the current list index is not out of bound).

### 15.1.27.2. Interface

**Table 451: Inputs of op\_N\_iter**

Name	Type	Comments and Information
trainPosition	TrainPosition_Types_Pck::trainPosition_T	
pRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	
minSafeRearEnd	int	

**Table 452: Outputs of op\_N\_iter**

Name	Type	Comments and Information
b	bool	

### 15.1.27.3. Locals

**Table 453: Locals of op\_N\_iter**

Name	Type	Properties		Comments and Information
counterToBeIncremented	bool	last	false	
currTriggerDistance	int	default	0	
		last	0	

### 15.1.27.4. Operator Hierarchy

diagram : diagram\_op\_N\_iter\_1

## 15.1.27.5. Graphical and Textual Diagrams

### 15.1.27.5.1. View of diagram\_op\_N\_iter\_1 (op\_N\_iter)

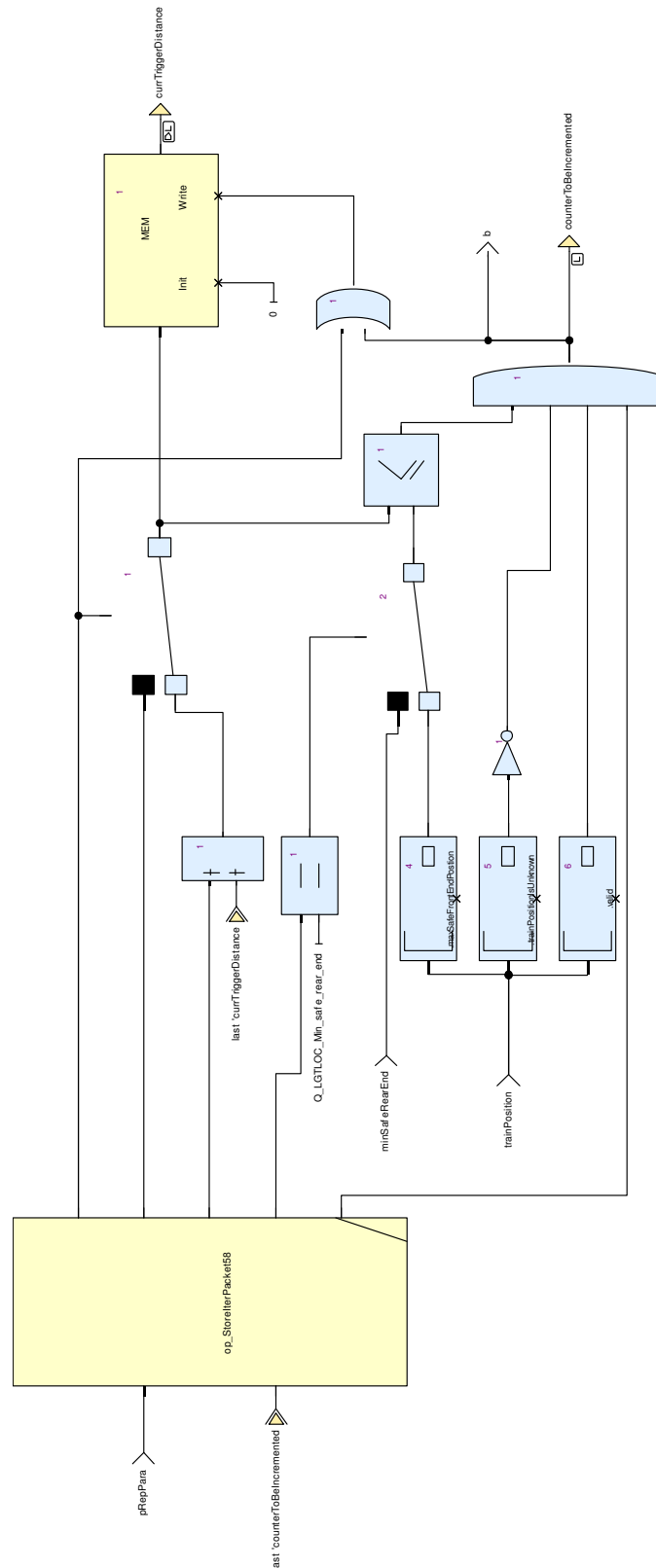


Figure 164: View of diagram\_op\_N\_iter\_1 (op\_N\_iter)

## 15.1.28. op\_prepack\_0 Operator

Declared as **public function**

### 15.1.28.1. Interface

**Table 454: Inputs of op\_prepack\_0**

Name	Type	Comments and Information
TrainRearEndPos3	L_TRAININT	
trainPos	TrainPosition_Types_Pck::trainPosition_T	
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	
posBGs	TrainPosition_Types_Pck::positionedBGs_T	

**Table 455: Outputs of op\_prepack\_0**

Name	Type	Comments and Information
valid	bool	
posRep	TrainToTrack::Position_Report	

### 15.1.28.2. Operator Hierarchy

diagram : diagram\_op\_prepack\_0\_1





- returns true if packet 0 has to be contained in the position report and false if packet 1 has to be contained.
- Decision based on 3.6.2.2.2.a; currently only 3.6.2.2.2.a.i is modeled.

#### 15.1.29.2. Interface

**Table 456: Inputs of op\_rep0\_or\_rep1**

Name	Type	Comments and Information
posBG	TrainPosition_Types_Pc k::positionedBG_T	

**Table 457: Outputs of op\_rep0\_or\_rep1**

Name	Type	Comments and Information
b	bool	

#### 15.1.29.3. Operator Hierarchy

diagram : diagram\_op\_rep0\_or\_rep1\_1

#### 15.1.29.4. Graphical and Textual Diagrams

##### 15.1.29.4.1. View of diagram\_op\_rep0\_or\_rep1\_1 (op\_rep0\_or\_rep1)

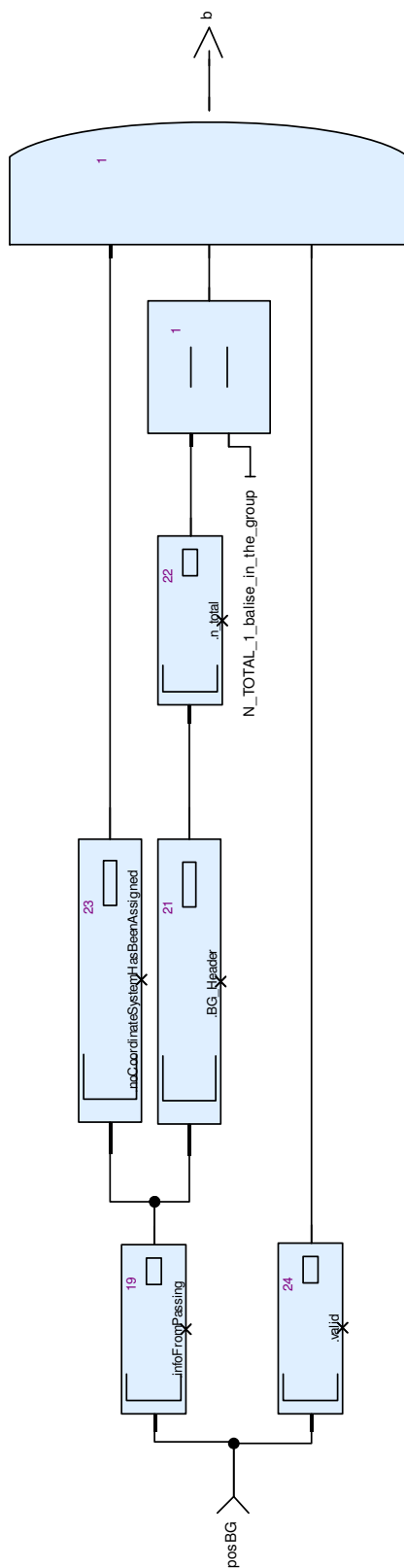


Figure 166: View of diagram\_op\_rep0\_or\_rep1\_1 (op\_rep0\_or\_rep1)

### 15.1.30. op\_StoreIterPacket58 Operator

Declared as **public node**

#### 15.1.30.1. Comments and Information

##### op\_StoreIterPacket58 Comments:

- This operation stores the list of pairs (D\_LOC, D\_LGTLOC) in a memory. With a second memory, we store the
- the current list position; that is, the pair that has to be handled next. Using a reset, the latter memory can be
- set to 0 if the next packet58 is received.

#### 15.1.30.2. Interface

**Table 458: Inputs of op\_StoreIterPacket58**

Name	Type	Properties		Comments and Information
pRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T			
incrCounter	bool	last	false	<b>Comments:</b> true if in the last cycle a position according to an element n of the list has been passed implying the counter of the NITER list has to be incremented and the next pair has to be considered

**Table 459: Outputs of op\_StoreIterPacket58**

Name	Type	Comments and Information	
newN_ITER	bool	<b>Comments:</b> true if a new packet58 has been received and N_ITER>0	
initialLocation	Obu_BasicTypes_Pkg::Location_T	<b>Comments:</b> gives the reference point for the calculation; that is, the location of the reference BG	
currDLOC	D_LOC	<b>Comments:</b> current D_LOC	
currLGTLOC	Q_LGTLOC	<b>Comments:</b> current LGTLOC	
valid	bool	<b>Comments:</b> true if current array index <= N_ITER (i.e., index is valid); otherwise false	

#### 15.1.30.3. Locals

**Table 460: Locals of op\_StoreIterPacket58**

Name	Type	Properties		Comments and Information
counter	int	last	0	

#### 15.1.30.4. Operator Hierarchy

diagram : diagram\_op\_StoreIterPacket58\_1

### 15.1.30.5. Graphical and Textual Diagrams

#### 15.1.30.5.1. View of diagram\_op\_StoreIterPacket58\_1 (op\_StoreIterPacket58)

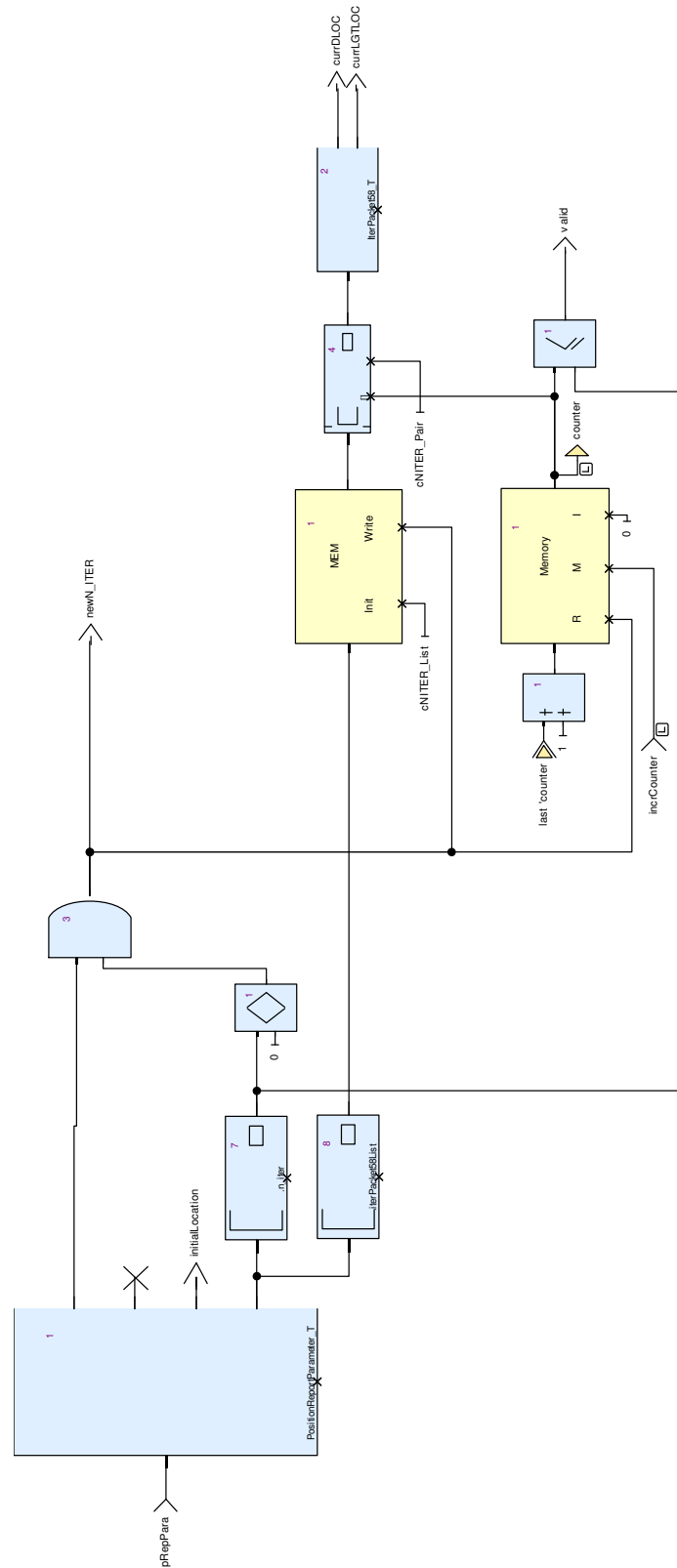


Figure 167: View of diagram\_op\_StoreIterPacket58\_1 (op\_StoreIterPacket58)

### 15.1.31. op\_T\_cycloc Operator

Declared as **public node**

#### 15.1.31.1. Comments and Information

##### op\_T\_cycloc Comments:

- Models parameter T\_CYCLOC which specifies a time interval
- between two position reports to be sent
- Output is equal to T\_CYCLOC < 255 AND (present or last local1 + T\_CYCLOC)
- This implies that the output is true when a valid posRepPara appears.
- If present = true, then we store the current time in the memory; otherwise, the stored value is incremented by
- T\_CYCLOC.

#### 15.1.31.2. Interface

**Table 461: Inputs of op\_T\_cycloc**

Name	Type	Comments and Information
pRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	
systemTime	ProvidePositionReport_Pkg::SystemTime_T	

**Table 462: Outputs of op\_T\_cycloc**

Name	Type	Comments and Information
b	bool	

#### 15.1.31.3. Locals

**Table 463: Locals of op\_T\_cycloc**

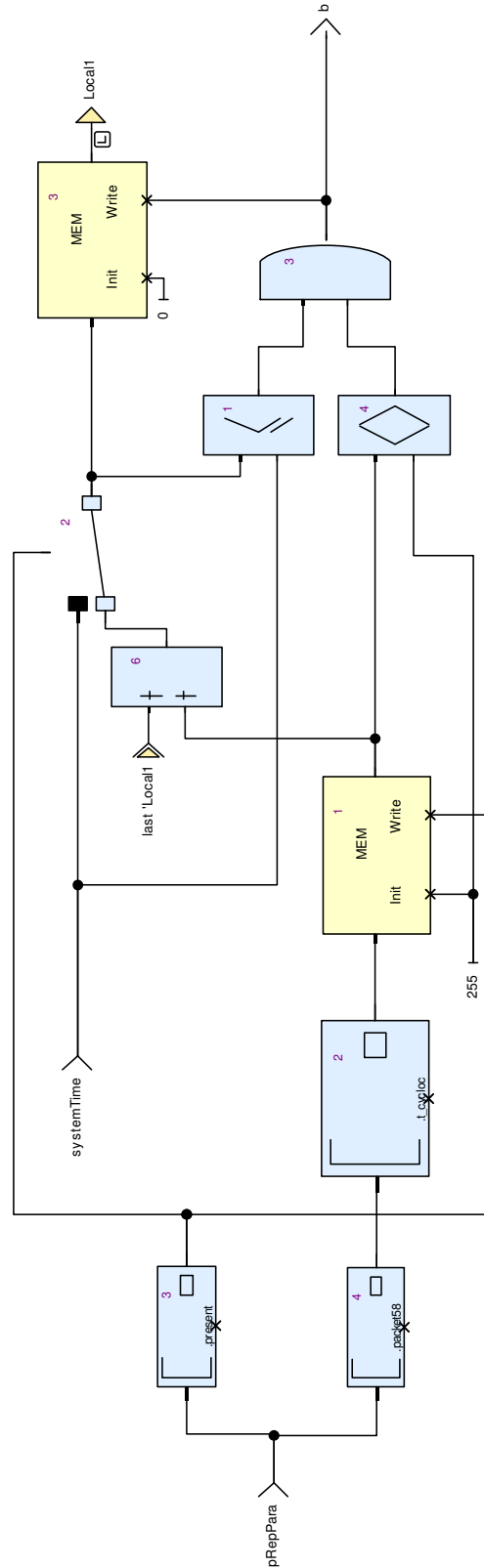
Name	Type	Properties		Comments and Information
Local1	int	last	0	

#### 15.1.31.4. Operator Hierarchy

diagram : diagram\_op\_T\_cycloc\_1

### 15.1.31.5. Graphical and Textual Diagrams

#### 15.1.31.5.1. View of diagram\_op\_T\_cycloc\_1 (op\_T\_cycloc)



**Figure 168: View of diagram\_op\_T\_cycloc\_1 (op\_T\_cycloc)**



## 15.1.32. ProvidePositionReport Operator

Declared as **public node**

### 15.1.32.1. Comments and Information

#### ProvidePositionReport Comments:

- Assumption: BGs in PositionedBGs\_T are ordered with the last seen BG being the first element of the array.

### 15.1.32.2. Interface

**Table 464: Inputs of ProvidePositionReport**

Name	Type	Comments and Information
posBGs	TrainPosition_Types_Pkg::positionedBGs_T	
trainPos	TrainPosition_Types_Pkg::trainPosition_T	
trainProps	TrainPosition_Types_Pkg::trainProperties_T	
errorMsg	ProvidePositionReport_Pkg::ErrorMessage_T	
trackInfo	ProvidePositionReport_Pkg::TrackInfo_T	
posRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	
systemTime	ProvidePositionReport_Pkg::SystemTime_T	
rcbComm	ProvidePositionReport_Pkg::RBC_Communication_T	
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	
linkingInfoUsed	ProvidePositionReport_Pkg::LinkingInfoUsedOnBoard	
directionLRBG	ProvidePositionReport_Pkg::BG_Orientation_T	
prvDirTrain	Q_DIRTRAIN	

**Table 465: Outputs of ProvidePositionReport**

Name	Type	Comments and Information
posRep	ProvidePositionReport_Pkg::PositionReport_T	

### 15.1.32.3. Operator Hierarchy

diagram : diagram\_ProvidePositionReport\_1

#### 15.1.32.4. Graphical and Textual Diagrams

##### 15.1.32.4.1. View of diagram\_ProvidePositionReport\_1 (ProvidePositionReport)

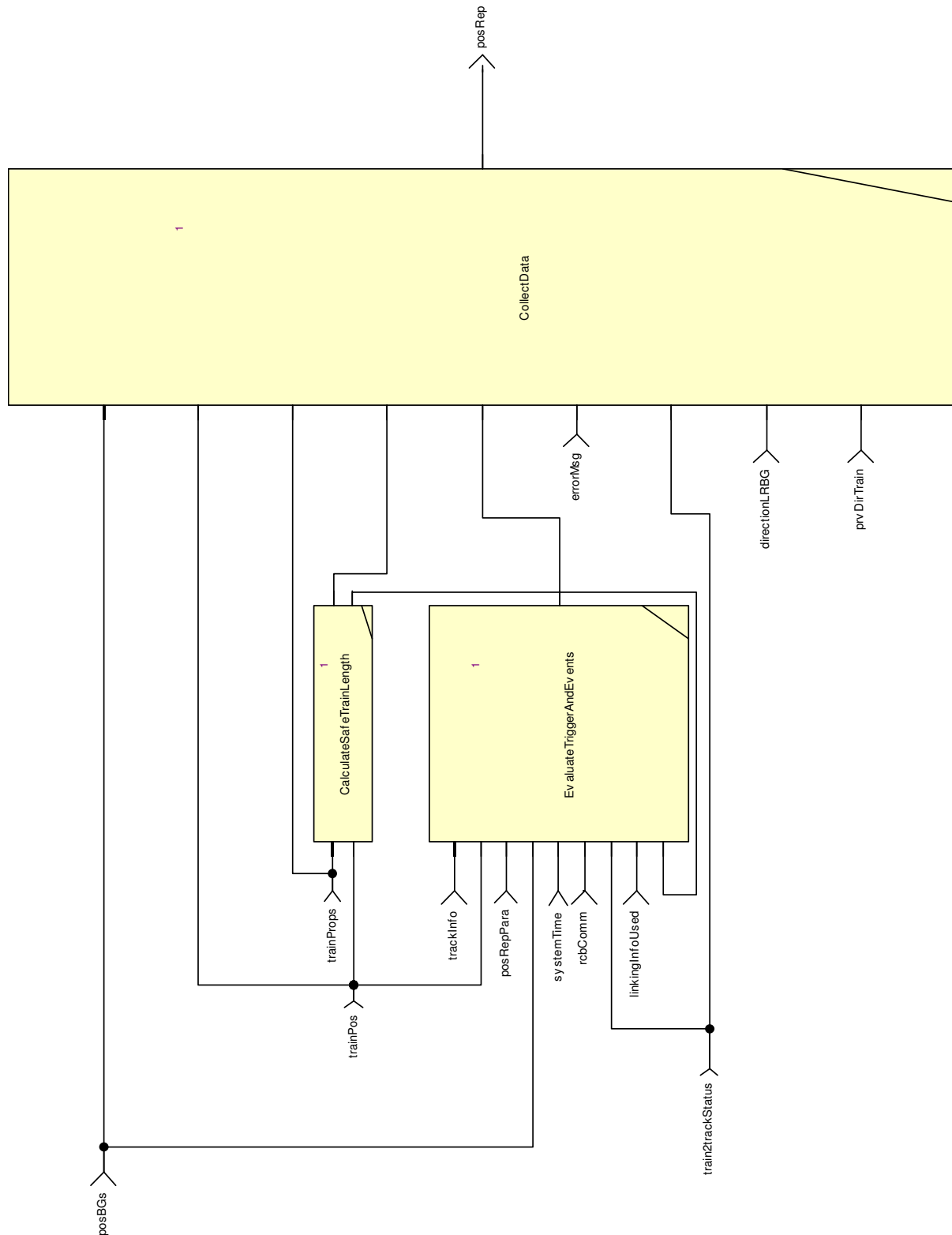


Figure 169: View of diagram\_ProvidePositionReport\_1 (ProvidePositionReport)

## 16. Project Library: ValidateDataDirection

### 16.1. ValidateDataDirection\_Pkg Package

#### 16.1.1. validateDataDirection Operator

Declared as **public function**

##### 16.1.1.1. Interface

**Table 466: Inputs of validateDataDirection**

Name	Type	Comments and Information
passedBG_in	BG_Types_Pkg::passedBG_T	<b>Comments:</b> Input event reporting a balise group during its passage, if there is one.
LRBG	TrainPosition_Types_Pkg::positionedBG_T	<b>Comments:</b> The LRBG used for RBC communication.
trainPosition	TrainPosition_Types_Pkg::trainPosition_T	<b>Comments:</b> The resulting train position with reference to the LRBG

**Table 467: Outputs of validateDataDirection**

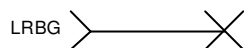
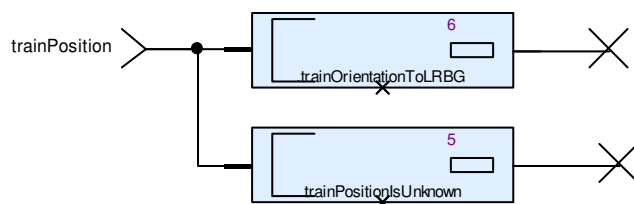
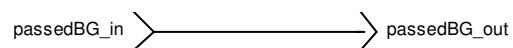
Name	Type	Comments and Information
passedBG_out	BG_Types_Pkg::passedBG_T	<b>Comments:</b> Input event reporting a balise group during its passage, if there is one.

##### 16.1.1.2. Operator Hierarchy

diagram : diagram\_validateDataDirection\_1

### 16.1.1.3. Graphical and Textual Diagrams

#### 16.1.1.3.1. View of diagram\_validateDataDirection\_1 (validateDataDirection)



**Figure 170: View of diagram\_validateDataDirection\_1 (validateDataDirection)**

End of document.