openETCS WP3 Model Design Description

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

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

Table Of Contents

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%20Architecture
AndDesign/FirstIteration/openETCSArchitectureAndDesignSpecification.pdf
- https://github.com/openETCS/validation/issues/227
-
https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuF
unctions/ManageLocationRelatedInformation/MLRI_Integration

This document reflects the current implementation status.

- Name: MLRI_Integration.etp
- Description: SUBSET-026, ISSUE : 3.3.0
- Copyright Siemens AG, 2014
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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.

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

Project Library CheckBGConsistency
        CheckPGConsistency_Pkg

Project Library DetermineBG_Orientation_and_LRBG
        DetermineBGOrientation_LRBG

Project Library ManageBaliseInfomation_Integration
        ManageBaliseInfomation_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. ManageBaliseInfomation_Integration_Pkg::ManageBaliseInfomation
    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	Comments: The current odometry values
passedBG	BG_Types_Pkg::passedBG_T	Comments: Input event reporting a balise group during its passage, if there is one.
LRBG	TrainPosition_Types_Pck::positionedBG_T	Comments: The LRBG used for RBC communication.
prevLRBG	TrainPosition_Types_Pck::positionedBG_T	Comments: A previously used LRBG used in RBC communication.
reset	bool	Comments: 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_Pck::trainProperties_T	
rcbComm	ProvidePositionReport_Pkg::RBC_Communication_T	
linkingInfoUsed	ProvidePositionReport_Pkg::LinkingInfoUsedOnBoard	
API_balise	API_Telegram_T	
incenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	
CurrentLRBG_	BG_Types_Pkg::CurrentLRBG	
ListiOfBGs_	BG_Types_Pkg::ListOfBG	

Name	Type	Comments and Information
TrainInfo_	BG_Types_Pkg::TrainToTrackStatus_T	
RBCOrientatioReport_	BG_Types_Pkg::RBCOrientationReport_T	

Table 2: Outputs of LocationRelatedInformation

Name	Type	Comments and Information
posRep	ProvidePositionReport_Pkg::PositionReport_T	
trainPosition	TrainPosition_Types_Pck::trainPosition_T	
trainPosInfo	TrainPosition_Types_Pck::trainPositionInfo_T	Comments: The resulting train position with reference to the LRBG
trainPosErrors	TrainPosition_Types_Pck::positionErrors_T	Comments: Errors and inconsistencies detected by the calculation.
BGs	TrainPosition_Types_Pck::positionedBGs_T	Comments: The collection of currently known BGs.
BG_Message	BG_Types_Pkg::BG_Message_T	
RBCReport_	Radio_TrainToTrack::Train_Position_Report	

3.1.1.3. Locals

Table 3: Locals of LocationRelatedInformation

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

3.1.1.4. Operator Hierarchy

<u>diagram</u> : diagram_LocationRelatedInformation_1

3.1.1.5.   Graphical and Textual Diagrams

3.1.1.5.1.   View of diagram_LocationRelatedInformation_1 (LocationRelatedInformation)
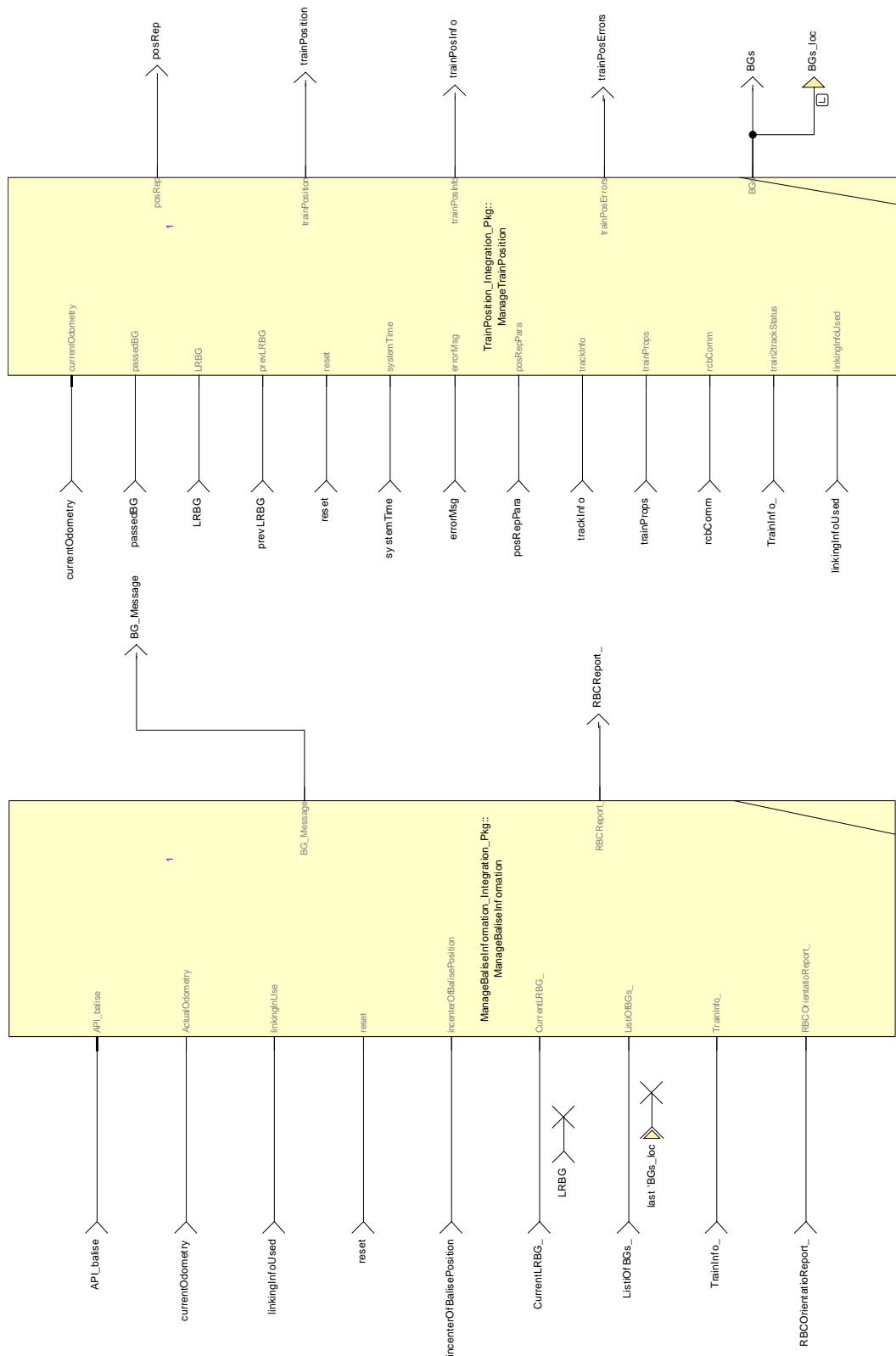
Figure 1: View of diagram_LocationRelatedInformation_1 (LocationRelatedInformation)

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	{addInfo : int, linkingPackets : BG_Types_Pkg::LinkedBGs_T}	Comments: Packets received from balises addInfo Comments: This type is not yet defined
BG_Header_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}	Comments: Common header of the balise group datagram
BG_Message_T	{present : bool, TelegramHeaders : BG_Types_Pkg::TelegramHeaderArray_T, AddInfo : BG_Types_Pkg::AdditionalInformation_T, numberBalises : int, centerOfBalisePosition : BG_Types_Pkg::centerOfBalisePosition_T, BGOrientation : Q_DIRTRAIN}	present Comments: indicates whether the bg-message present is. TelegramHeaders Comments: headers of all received telegrams filled up from the start of the array AddInfo Comments: For all balises of the group: Packets collected into a combined information numberBalises Comments: additional packets received with the balises centerOfBalisePosition Comments: position of the balise group BGOrientation Comments: Orientation of the balise group
centerOfBalisePosition_T	{centerOfBalisePosition : Obu_BasicTypes_Pkg::OdometryLocations_T, BG_centerDetectionInaccuraccuracies : Obu_BasicTypes_Pkg::LocWithInAcc_T, timestamp : Obu_BasicTypes_Pkg::T_internal_Type}	Comments: Gives the information for location and accuracy of measurements centerOfBalisePosition Comments: Location BG_centerDetectionInaccurccuracies Comments: Location inaccuries caused by the balise group center detection timestamp Comments: timestamp when measurement was taken
CurrentLRBG	{filteredBGMessage : BG_Types_Pkg::BG_Message_T, position : BG_Types_Pkg::Position_T}	

Name	Definition	Comments and Information
LinkedBG_T	{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}	Comments: 7.4.2.2: Single, but complete, element from LinkingPacket_Type valid Comments: This element has valid data nid_LRBG Comments: 8.4.4.6.1: ID of the reference LRBG (refers to radio message) nid_packet Comments: Packet identifier: probably not needed here: Packet 5 = constant q_dir Comments: Validity direction of transmitted data with reference to directionality of the balise group sending the information or to directionality of the LRBG l_packet Comments: 7.3.3.2 Number of bits in the packet. q_scale Comments: 7.5.1.129: Qualifier for the distance scale: 10 cm, 1 m, 10 m d_link Comments: 7.5.1.10: Incremental linking distance to next linked balise group q_newcountry Comments: 7.5.1.121: New Country Qualifier nid_c Comments: Identity number of the country or region nid_bg Comments: Identity number of the balise group q_linkorientation Comments: 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. q_linkreaction Comments: 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 q_locacc Comments: 7.5.1.115: defines the absolute value of the accuracy of the Balise location (max +/- 63 m)
LinkedBGs_T	BG_Types_Pkg::LinkedBG_T ^cMaxNoOfLinkedBGs	Comments: Array of linked balise groups. This array replaces the linking packet (TrackToTrain::Linking)
ListOfBG	BG_Types_Pkg::CurrentLRBG ^cMaxListBGs	
Orientation_T	enum {Single_Balise_Group, DIR_Nominal, DIR_Reverse}	

Name	Definition	Comments and Information
passedBG_T	{valid : bool, timestamp : Obu_BasicTypes_Pkg::T_internal_Type, odometrystamp : Obu_BasicTypes_Pkg::OdometryLocations_T, BG_centerDetectionInaccuraccuracies : 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}	Comments: Information reveived from a BG passede odometrystamp Comments: Odometry values when the balise group was passed BG_centerDetectionInaccurac curacies Comments: Location inaccuries caused by the balise group center detection BG_Header Comments: Common header of the balise group datagram linkedBGs Comments: The linked balise groups announced from this BG. noCoordinateSystemHasBeen Assigned Comments: 3.4.2, 3.6.3.1.4: Every balise group has its own co-ordinate system trainOrientationToBG Comments: 3.6.1.3: Orientation of the train in relation to the direction of the BG trainRunningDirectionToBG Comments: 3.6.1.3: Direction of train movement in relation to the BG orientation passingSpeed Comments: Train speed while passing the BG; its sign characterizes the passing direction based on odometry information
Position_T	int	
RBCOrientationReport_T	{assignment_of_coordinate_system : Radio_TrackToTrain::Assignment_of_coordinate_system}	
RBCReport_T	{train_position_report : Radio_TrainToTrack::Train_Position_Report}	
Telegram_T	{present : bool, valid : bool, telegramheader : BG_Types_Pkg::TelegramHeader_T, packets : BG_Types_Pkg::AdditionalInformation_T}	present Comments: Flag indicates whether the parameter is present in the intefaces valid Comments: The element has valid data telegramheader Comments: Information received from the balise packets Comments: Packets received via the balises
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}	Comments: This structure is not "packed" to bit boundaries

Name	Definition	Comments and Information
TelegramHeaderArray_T	BG_Types_Pkg::TelegramHeaderFlag_T ^cMaxNoBalises	
TelegramHeaderFlag_T	{valid : bool, header : BG_Types_Pkg::TelegramHeader_T}	
TrainToTrackStatus_T	{m_mode : M_MODE, m_level : M_LEVEL, m_leveltr : M_LEVELTR, nid_ntc : NID_NTC, q_length : Q_LENGTH}	Comments: structure capturing modi, leves and train integrity

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	{addInfo : 0, 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,	

Name	Type	Value	Comments and Information
		{present : false, valid : false, telegramheader : {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}, packets : {addInfo : 0, 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 :	
cEmpty_BaliseTlg	BG_Types_Pkg::Telegram_T	Q_NEWCOUNTRY_Same_country__or__railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation :	

Name	Type	Value	Comments and Information
		{present : false, TelegramHeaders : [{valid : false, header : {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}} , {valid : false, header : {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}} , {valid : false, header : {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,	

Name	Type	Value	Comments and Information
cEmptyHeader	BG_Types_Pkg::TelegramHeaderFlag_T	{valid : false, header : {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}}	

Name	Type	Value	Comments and Information
		[{valid : false, header : {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}} , {valid : false, header : {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}} , {valid : false, header : {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 :	

Name	Type	Value	Comments and Information
cemptyPosition	BG_Types_Pkg::centerOfBalisePosition_T	{centerOfBalisePosition : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, timestamp : 0}	
cInitOrientation	Q_DIRTRAIN	Q_DIRTRAIN_Unknown	
cInvalidIndex	int	-1	
cMaxDistanceBalisesInGroup	Obu_BasicTypes_Pkg::OdometryLocations_T	{o_nominal : 1200, o_min : 1200, o_max : 1200}	Comments: Maximum distance between balises within a group: Subset 40 section 4.1.1.2
cMaxListBGs	int	20	
cMaxNoBalises	int	8	Comments: Max. number of balises in a balise group
cMaxNoOfLinkedBGs	int	4	Comments: 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	Comments: type NID_BG = int /* MinVal = 0, MaxVal = 16382 */ -- 16383 = Identity_is_unknown_(only_to_be_used_for_Linking_information)
cNID_LRBG_14Bits_Multiplicator	int	16384	Comments: 16384: Serves to calculate NID_LRBG = 16384 * NID_C + NID_BG
cNID_LRBG_unknown	NID_LRBG	16777215	Comments: 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	Comments: Standardized acceleration type for all internal calculations: in 0.01 m/s2
G_internal_Type	int	Comments: Standardized gradient type for all internal gradient calculations: in per 0.1 mill
L_internal_Type	int	Comments: Standardized length type for all internal length, distance and location calculations: in cm
Location_T	Obu_BasicTypes_Pkg::L_internal_Type	Comments: 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}	Comments: Location with +/- tolerance nominal Comments: Nominal location d_min Comments: Min Location = nominal + d_min (typically < 0) d_max Comments: 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}	Comments: Odometry values with time stamp odo Comments: 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}	Comments: Location information provided by odometry o_nominal Comments: Nominal odometry value o_min Comments: Min. distance = o_min2 - o_min1 o_max Comments: Max distance = o_max2 - o_max1
Speed_T	Obu_BasicTypes_Pkg::V_internal_Type	Comments: General speed type: in km/h.

Name	Definition	Comments and Information
T_internal_Type	int	Comments: Standardized system time type used for all internal time calculations: in ms
V_internal_Type	int	Comments: 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}	Comments: 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	
incenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	
CurrentLRBG_	BG_Types_Pkg::CurrentLRBG	
ListiOfBGs_	BG_Types_Pkg::ListOfBG	
TrainInfo_	BG_Types_Pkg::TrainToTrackStatus_T	
RBCOrientatioReport_	BG_Types_Pkg::RBCOrientationReport_T	

Table 9: Outputs of ManageBaliseInfomation

Name	Type	Comments and Information
BG_Message	BG_Types_Pkg::BG_Message_T	
RBCReport_	Radio_TrainToTrack::Train_Position_Report	

6.1.1.2.   Operator Hierarchy

<u>diagram</u> : diagram_ManageBaliseInfomation_1

6.1.1.3.   Graphical and Textual Diagrams

6.1.1.3.1.   View of diagram_ManageBaliseInfomation_1 (ManageBaliseInfomation)
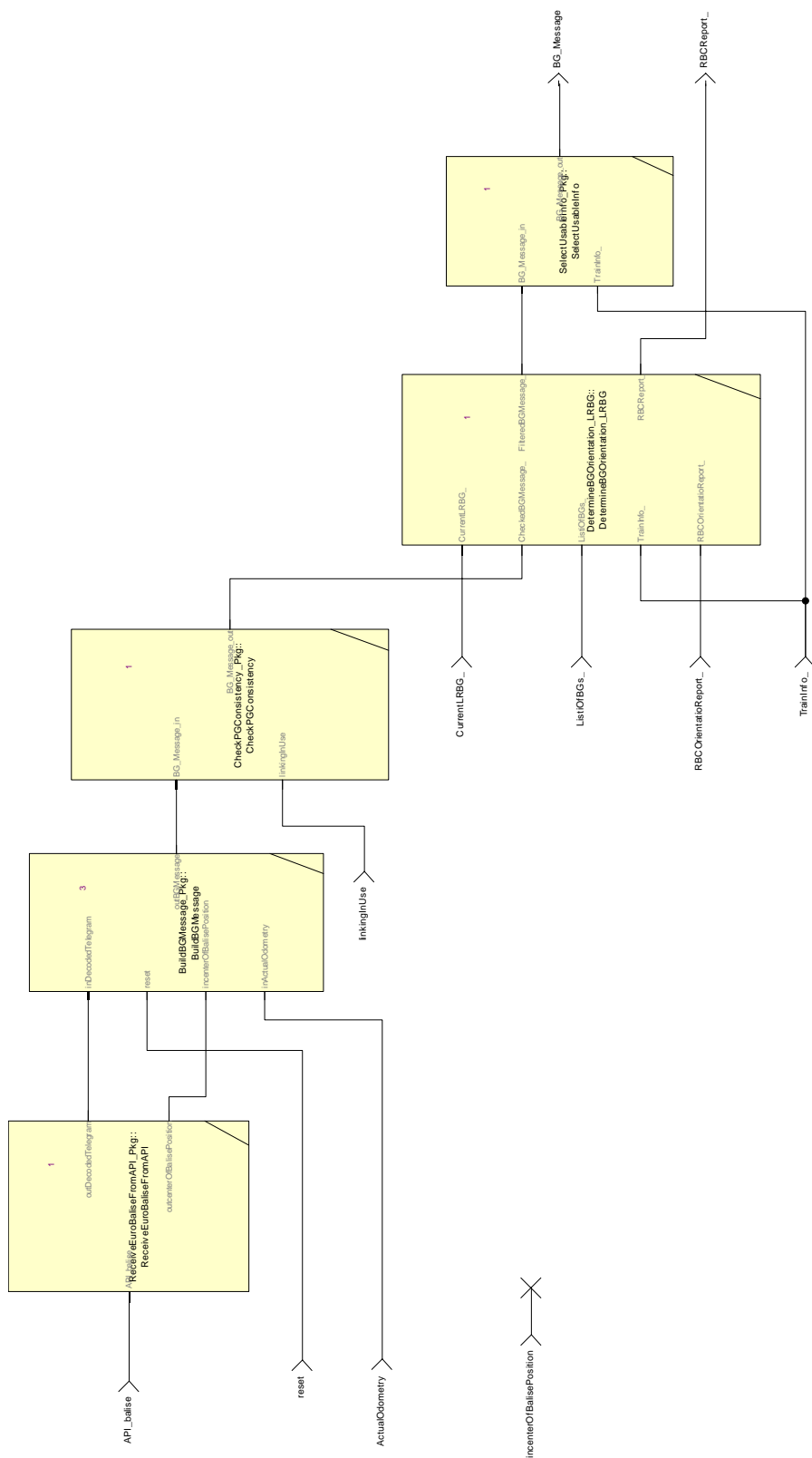
Figure 2: View of diagram_ManageBaliseInfomation_1 (ManageBaliseInfomation)

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	{BG_ID : NID_BG, totalTelegrams : int, balisePosition : BG_Types_Pkg::centerOfBalisePosition_T, collectedTelegrams : int}	Comments: This data structure is used internally to collect balise telegrams balisePosition Comments: Information where the first telegram of the bg has been received. The information will be used to calculate whether a BG is already passed completely. collectedTelegrams Comments: Gives the nuimber of telegrams collected in the bg-message
TelegramStore_T	{valid : bool, telegram : BG_Types_Pkg::Telegram_T, position : BG_Types_Pkg::centerOfBalisePosition_T}	valid Comments: data is valid (i.e., stored by purpose) position Comments: 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	{BG_ID : 0, totalTelegrams : 0, balisePosition : {centerOfBalisePosition : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, timestamp : 0}, collectedTelegrams : 0}	

Name	Type	Value	Comments and Information
		{valid : false, telegram : {present : false, valid : false, telegramheader : {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}, packets : {addInfo : 0, 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,	
BuildBGMessage_Pk			

7.1.4.   addTelegram Operator

Declared as **public function**

7.1.4.1.   Interface

Table 12: Inputs of addTelegram

Name	Type	Comments and Information
newTelegram	BG_Types_Pkg::Telegram_T	
inoldHeaderArray	BG_Types_Pkg::TelegramHeaderArray_T	
inoldAddInfo	BG_Types_Pkg::AdditionalInformation_T	
doUpdate	bool	
inCollector	BuildBGMessage_Pkg::BGCollector_T	

Table 13: Outputs of addTelegram

Name	Type	Comments and Information
outBGisComplete	bool	
outCollector	BuildBGMessage_Pkg::BGCollector_T	
outHeaderArray	BG_Types_Pkg::TelegramHeaderArray_T	
outaddInfo	BG_Types_Pkg::AdditionalInformation_T	

7.1.4.2.   Operator Hierarchy

<u>diagram</u> : diagram_addTelegram_1

7.1.4.3. Graphical and Textual Diagrams

7.1.4.3.1. View of diagram_addTelegram_1 (addTelegram)
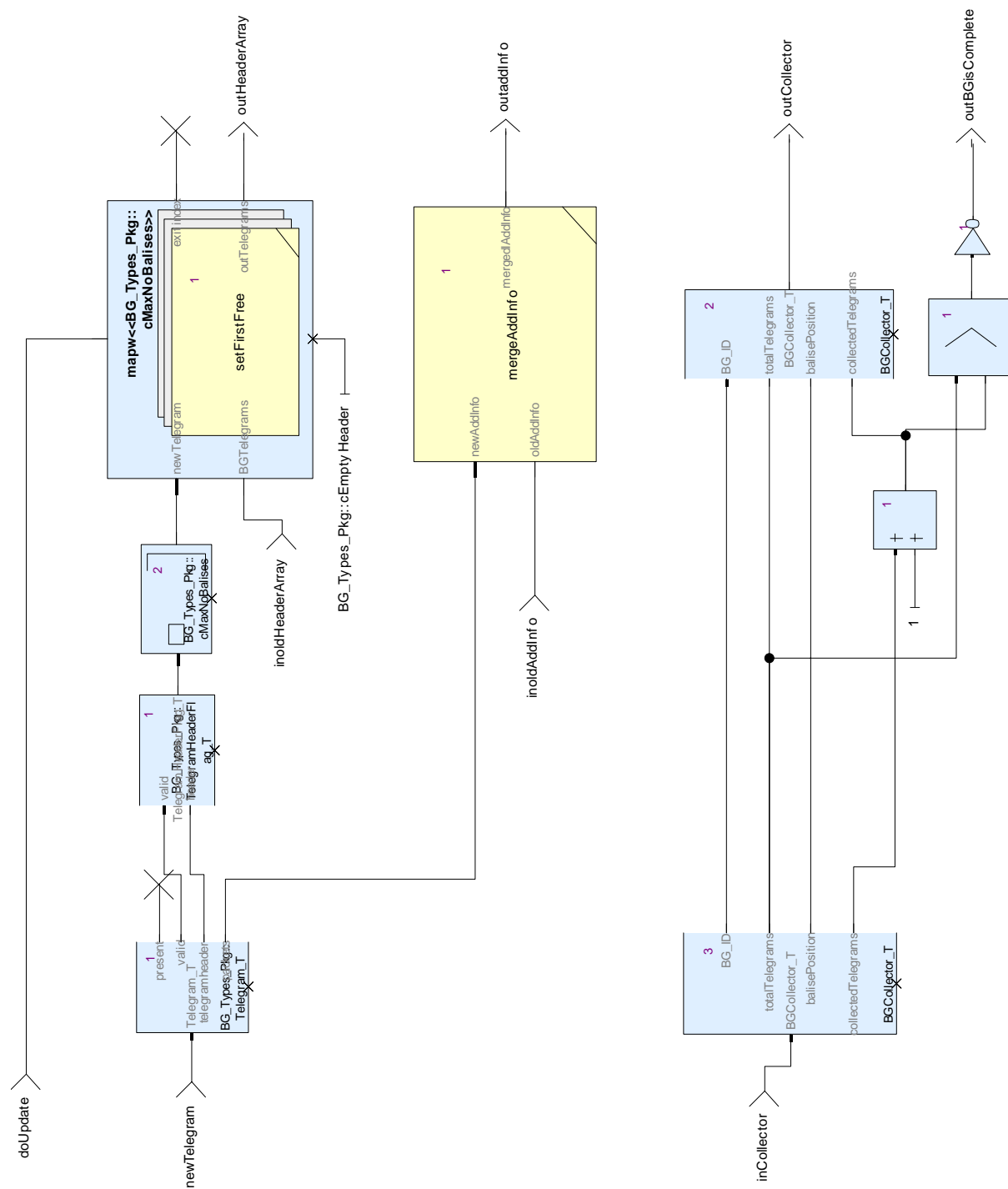
Figure 3: View of diagram_addTelegram_1 (addTelegram)

7.1.5. BuildBGMessage Operator

Declared as **public node**

7.1.5.1.   Interface

Table 14: Inputs of BuildBGMessage

Name	Type	Comments and Information
inDecodedTelegram	BG_Types_Pkg::Telegram_T	
reset	bool	
incenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	
inActualOdometry	Obu_BasicTypes_Pkg::odometry_T	

Table 15: Outputs of BuildBGMessage

Name	Type	Comments and Information
outBGMessage	BG_Types_Pkg::BG_Message_T	

7.1.5.2.   Locals

Table 16: Locals of BuildBGMessage

Name	Type	Properties		Comments and Information
BGisChanged	bool			
BGisComplete	bool			
locStore	BuildBGMessage_Pkg::	default	cemptyStore	Comments:

Name	Type	Properties		Comments and Information
	TelegramStore_T	last	cemptyStore	This memory is used to store an additional telegram. The store is needed when: - the end of the previous BG is indicated by a new bg In this situation, first the new telegram is stored but not immediatly 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 prevous run o the procedure which needs to be taken care of before being able to handle the next one. Practically, this means: - if no (or new odometry info) is present: first empty the store. - if a new telegram is received, swap the telegrams in the store and proceed with the elder telegram.
needTelegramStore	bool			Comments: This flag is used for showing if the data in the telegram store is stil to be used.
positionToUse	BG_Types_Pkg::center OfBalisePosition_T			
storeBGAddInfo	BG_Types_Pkg::Additi onalInformation_T	default	BG_Types_Pk g::cAddInfo	
		last	BG_Types_Pk g::cAddInfo	
storeBGHeaderArray	BG_Types_Pkg::Telegr amHeaderArray_T	default	BG_Types_Pk g::cemptyHe aderArray	
		last	BG_Types_Pk g::cemptyHe aderArray	
storeCollector	BuildBGMessage_Pkg:: BGCollector_T	default	cCollectorInit	
		last	cCollectorInit	
telegramPresent	bool			
telegramToUse	BG_Types_Pkg::Telegr am_T			
tempBGAddInfo	BG_Types_Pkg::Additi onalInformation_T	default	BG_Types_Pk g::cAddInfo	

Name	Type	Properties		Comments and Information
tempBGHeaderArray	BG_Types_Pkg::TelegramHeaderArray_T	default	BG_Types_Pkg::cemptyHeaderArray	
tempCollectorStore	BuildBGMessage_Pkg::BGCollector_T	default	cCollectorInit	

7.1.5.3.   Operator Hierarchy

<u>diagram</u> : diagram_BuildBGMessage_1
       activate if : IfBlock1
              branch : then
              branch : else
       activate if : IfBlock2
              branch : then
              branch : else
              activate if : IfBlock3
                     branch : then
                     branch : else

7.1.5.4. Graphical and Textual Diagrams

7.1.5.4.1. View of diagram_BuildBGMessage_1 (BuildBGMessage)
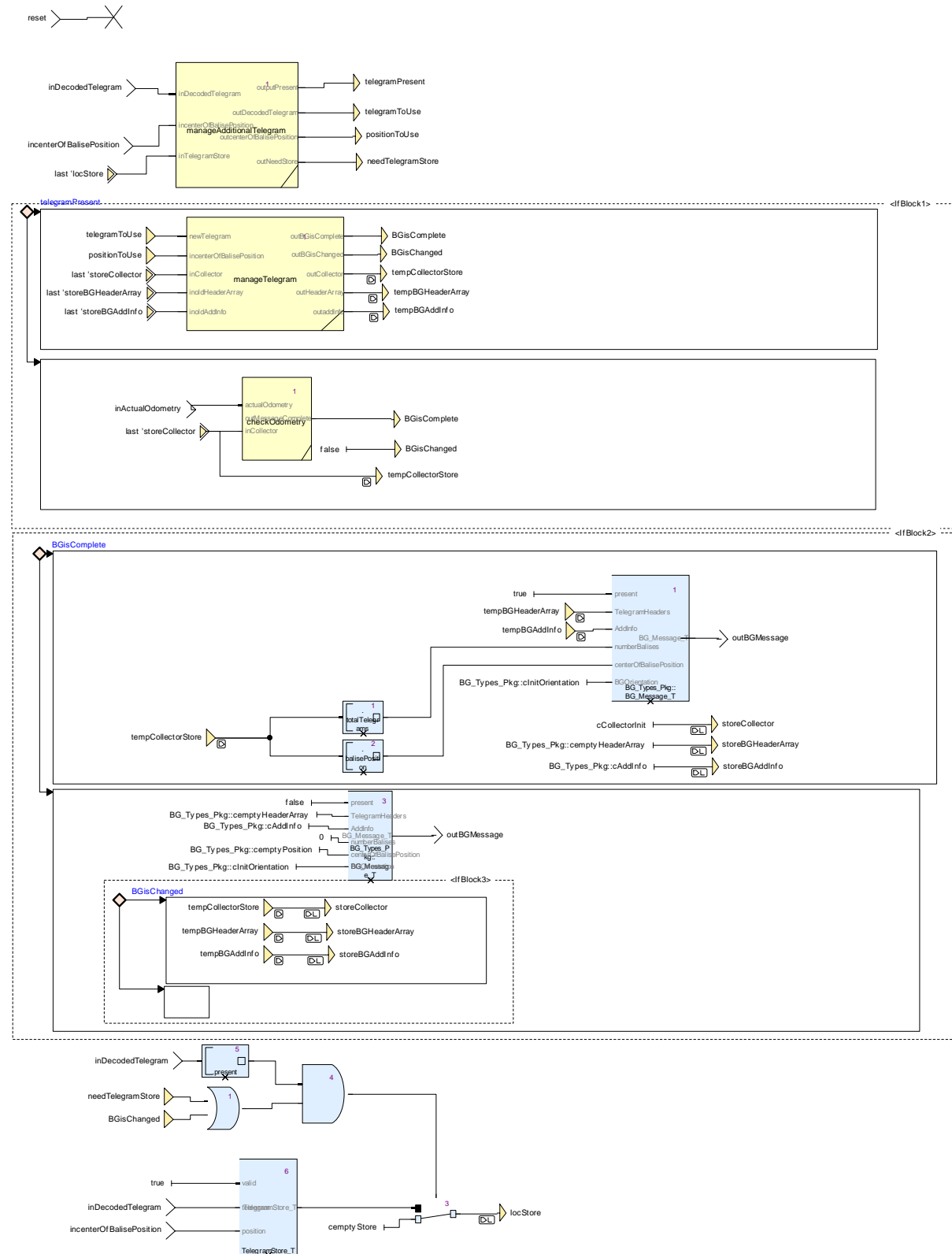
Figure 4: View of diagram_BuildBGMessage_1 (BuildBGMessage)

Table 17: Conditional Blocks of diagram_BuildBGMessage_1

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

Table 18: Actions of diagram_BuildBGMessage_1

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

7.1.6.   checkInit Operator

Declared as **public function**

7.1.6.1.   Comments and Information

checkInit Comments:

- This block check 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 19: Inputs of checkInit

Name	Type	Comments and Information
newTelegram	BG_Types_Pkg::Telegram_T	
inCollector	BuildBGMessage_Pkg::BGCollector_T	
inPosition	BG_Types_Pkg::centerOfBalisePosition_T	

Table 20: Outputs of checkInit

Name	Type	Properties		Comments and Information
outCollector	BuildBGMessage_Pkg::BGCollector_T	default	cCollectorInit	

7.1.6.3.   Locals

Table 21: Locals of checkInit

Name	Type	Comments and Information
isDefined	bool	

7.1.6.4.   Operator Hierarchy

<u>diagram</u> : 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)
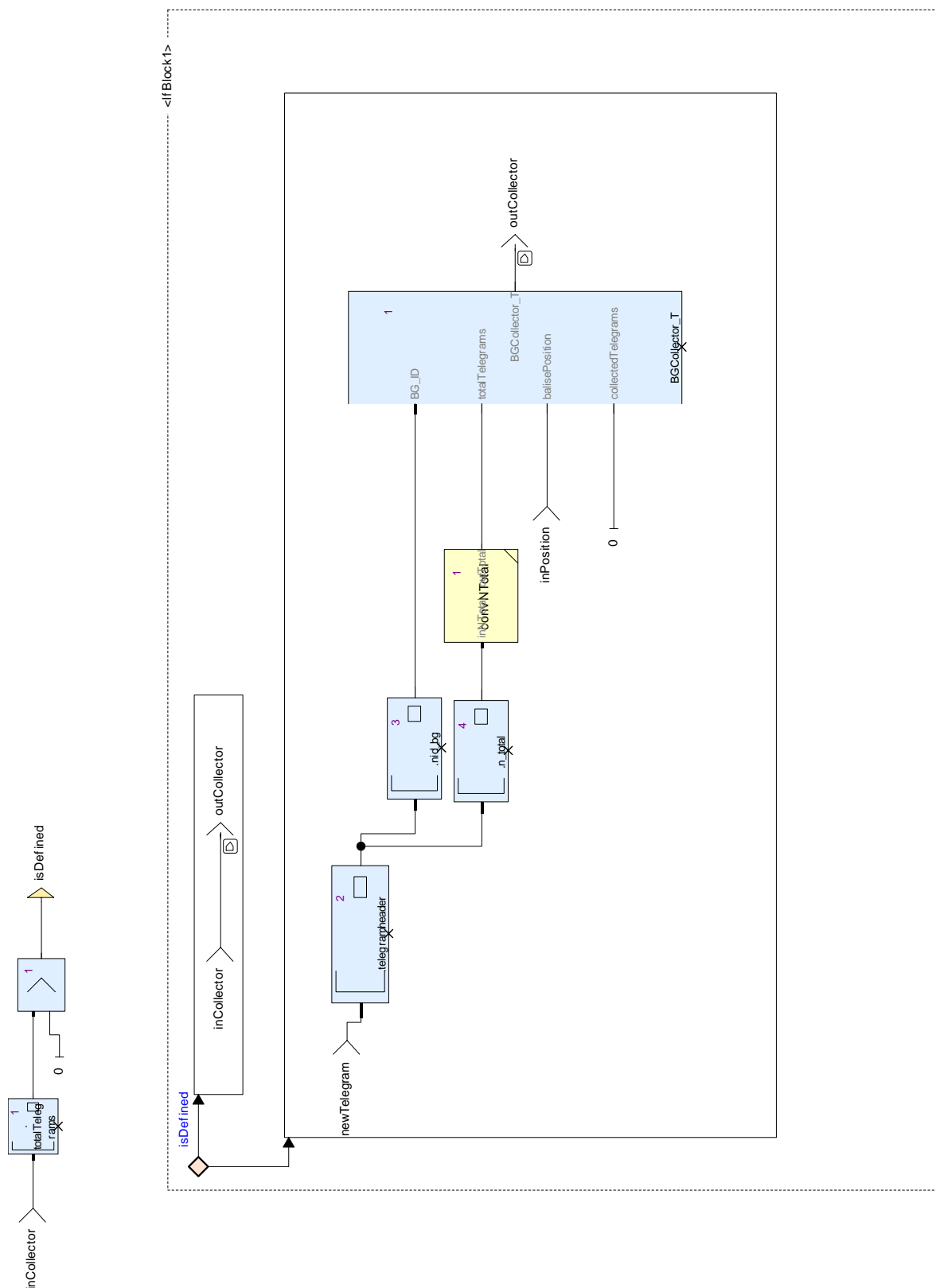
Figure 5: View of diagram_checkInit_1 (checkInit)

Table 22: Conditional Blocks of diagram_checkInit_1

Conditional Block	Comments and Information
IfBlock1	

Table 23: 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 wehther the absolute distance between two odometry values is less then 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 defoned in subset 40 section 4.1.1.2.

7.1.7.2.   Interface

Table 24: Inputs of checkOdometry

Name	Type	Comments and Information
actualOdometry	Obu_BasicTypes_Pkg:: odometry_T	
inCollector	BuildBGMessage_Pkg:: BGCollector_T	

Table 25: Outputs of checkOdometry

Name	Type	Comments and Information
outMessageComplete	bool	

7.1.7.3.   Locals

Table 26: Locals of checkOdometry

Name	Type	Comments and Information
isValid	bool	

7.1.7.4.   Operator Hierarchy

<u>diagram</u> : 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)
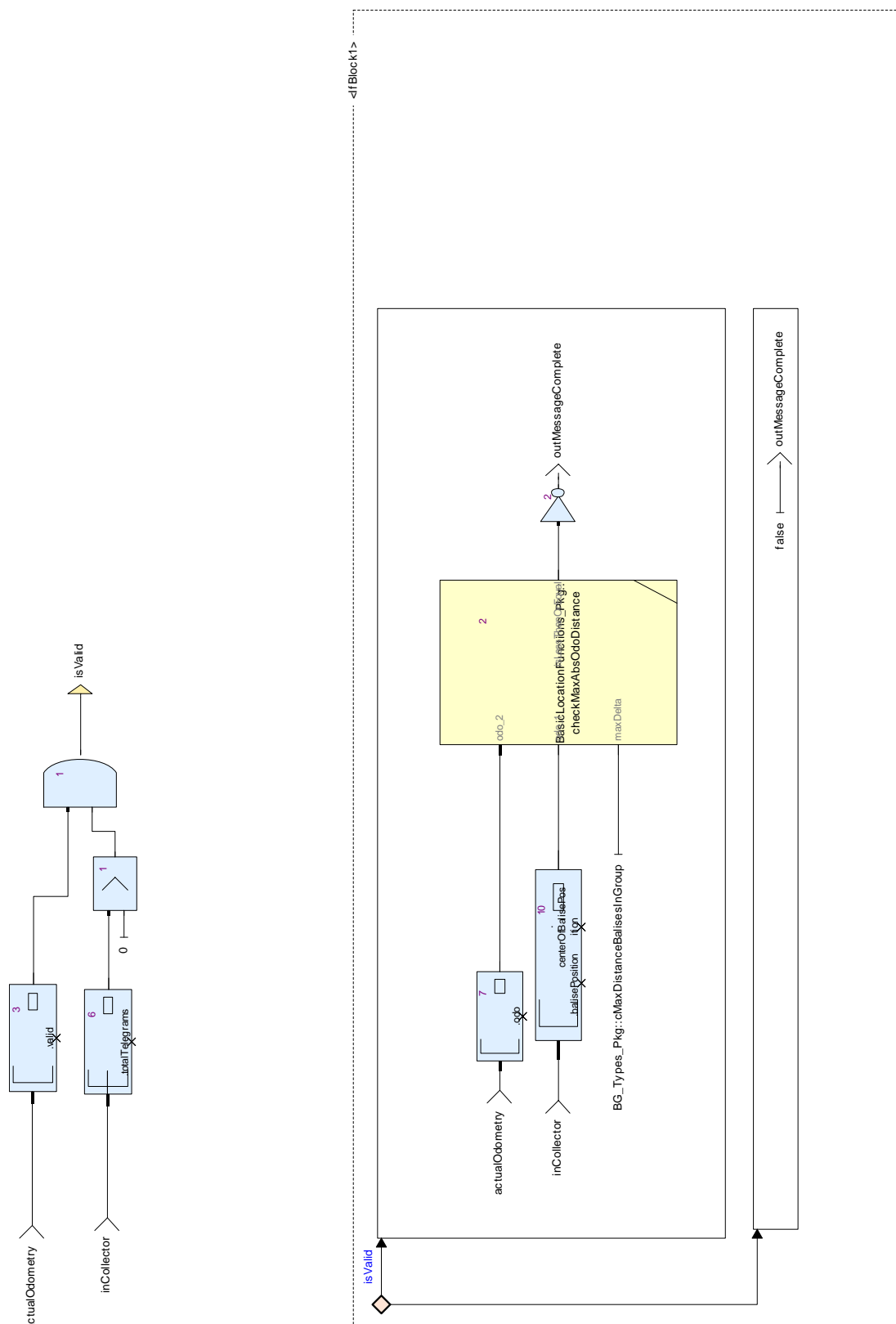
Figure 6: View of diagram_checkOdometry_1 (checkOdometry)

Table 27: Conditional Blocks of diagram_checkOdometry_1

Conditional Block	Comments and Information
IfBlock1	

Table 28: 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 tegram in the group.

7.1.8.2.   Interface

Table 29: Inputs of checkTelegram

Name	Type	Comments and Information
newTelegram	BG_Types_Pkg::Telegram_T	
BGHeaderArray	BG_Types_Pkg::TelegramHeaderArray_T	
BGCollector	BuildBGMessage_Pkg::BGCollector_T	

Table 30: Outputs of checkTelegram

Name	Type	Comments and Information
outTelegramExists	bool	
outBGchanged	bool	
outTelegramIndex	int	

7.1.8.3.   Operator Hierarchy

<u>diagram</u> : diagram_checkTelegram_1

7.1.8.4.   Graphical and Textual Diagrams

7.1.8.4.1.   View of diagram_checkTelegram_1 (checkTelegram)

Figure 7: View of diagram_checkTelegram_1 (checkTelegram)

diagram_checkTelegram_1 Comments:
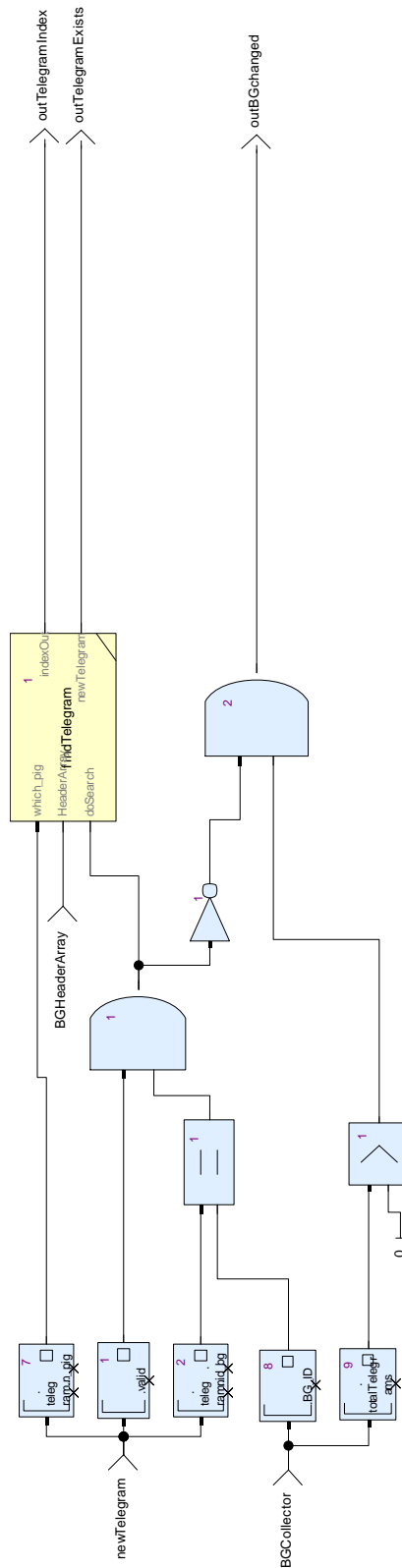
- Provides control data for the balise group collection.

7.1.9. manageAdditionalTelegram Operator

Declared as **public function**

7.1.9.1. Interface

Table 31: Inputs of manageAdditionalTelegram

Name	Type	Comments and Information
inDecodedTelegram	BG_Types_Pkg::Telegram_T	
incenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	
inTelegramStore	BuildBGMessage_Pkg::TelegramStore_T	

Table 32: Outputs of manageAdditionalTelegram

Name	Type	Comments and Information
outputPresent	bool	
outDecodedTelegram	BG_Types_Pkg::Telegram_T	
outcenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	
outNeedStore	bool	

7.1.9.2. Locals

Table 33: Locals of manageAdditionalTelegram

Name	Type	Comments and Information
storeValid	bool	

7.1.9.3. Operator Hierarchy

<u>diagram</u> : diagram_manageAdditionalTelegram_1

7.1.9.4.   Graphical and Textual Diagrams

7.1.9.4.1.   View of diagram_manageAdditionalTelegram_1 (manageAdditionalTelegram)
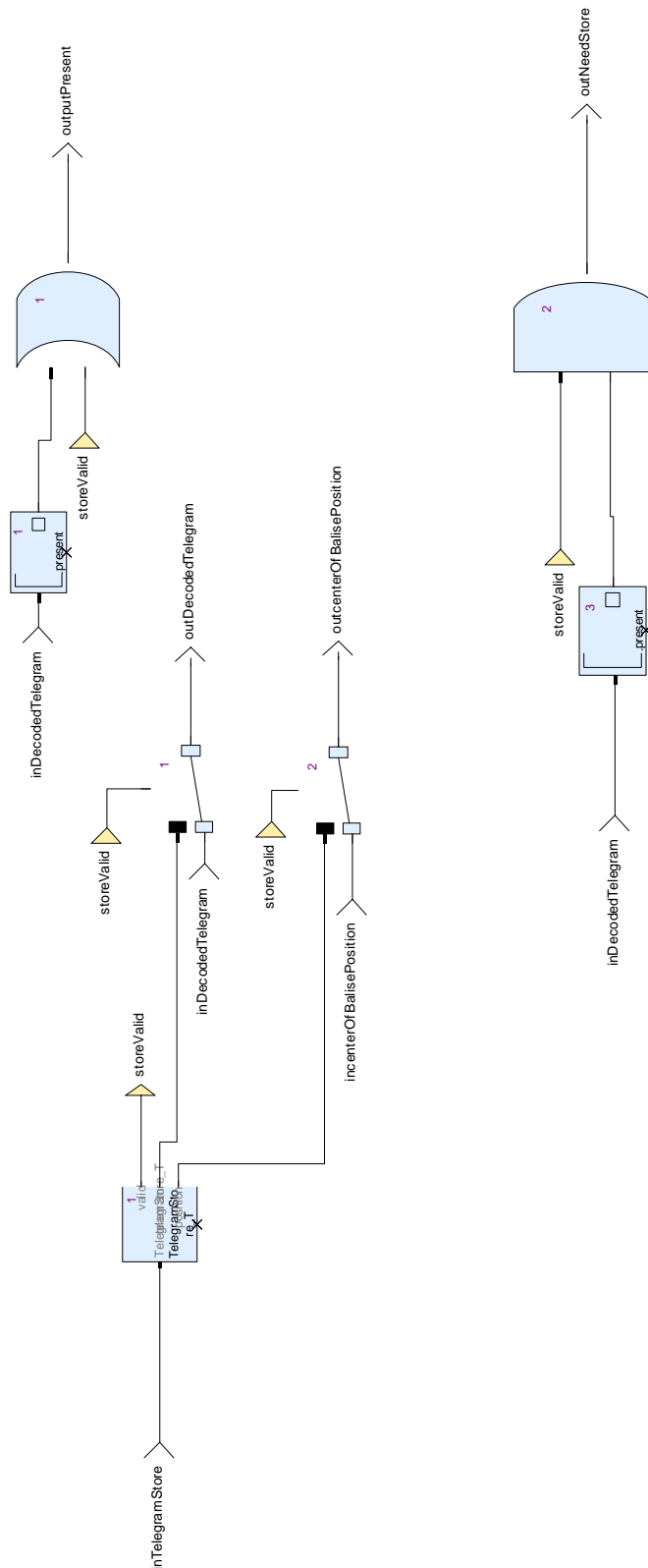
Figure 8: View of diagram_manageAdditionalTelegram_1 (manageAdditionalTelegram)

7.1.10.   manageTelegram Operator

Declared as **public function**

7.1.10.1.   Interface

Table 34: Inputs of manageTelegram

Name	Type	Comments and Information
newTelegram	BG_Types_Pkg::Telegram_T	
incenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	
inCollector	BuildBGMessage_Pkg::BGCollector_T	
inoldHeaderArray	BG_Types_Pkg::TelegramHeaderArray_T	
inoldAddInfo	BG_Types_Pkg::AdditionalInformation_T	

Table 35: Outputs of manageTelegram

Name	Type	Comments and Information
outBGisComplete	bool	
outBGisChanged	bool	
outCollector	BuildBGMessage_Pkg::BGCollector_T	
outHeaderArray	BG_Types_Pkg::TelegramHeaderArray_T	
outaddInfo	BG_Types_Pkg::AdditionalInformation_T	

7.1.10.2.   Operator Hierarchy

diagram : diagram_manageTelegram_1

7.1.10.3. Graphical and Textual Diagrams

7.1.10.3.1. View of diagram_manageTelegram_1 (manageTelegram)
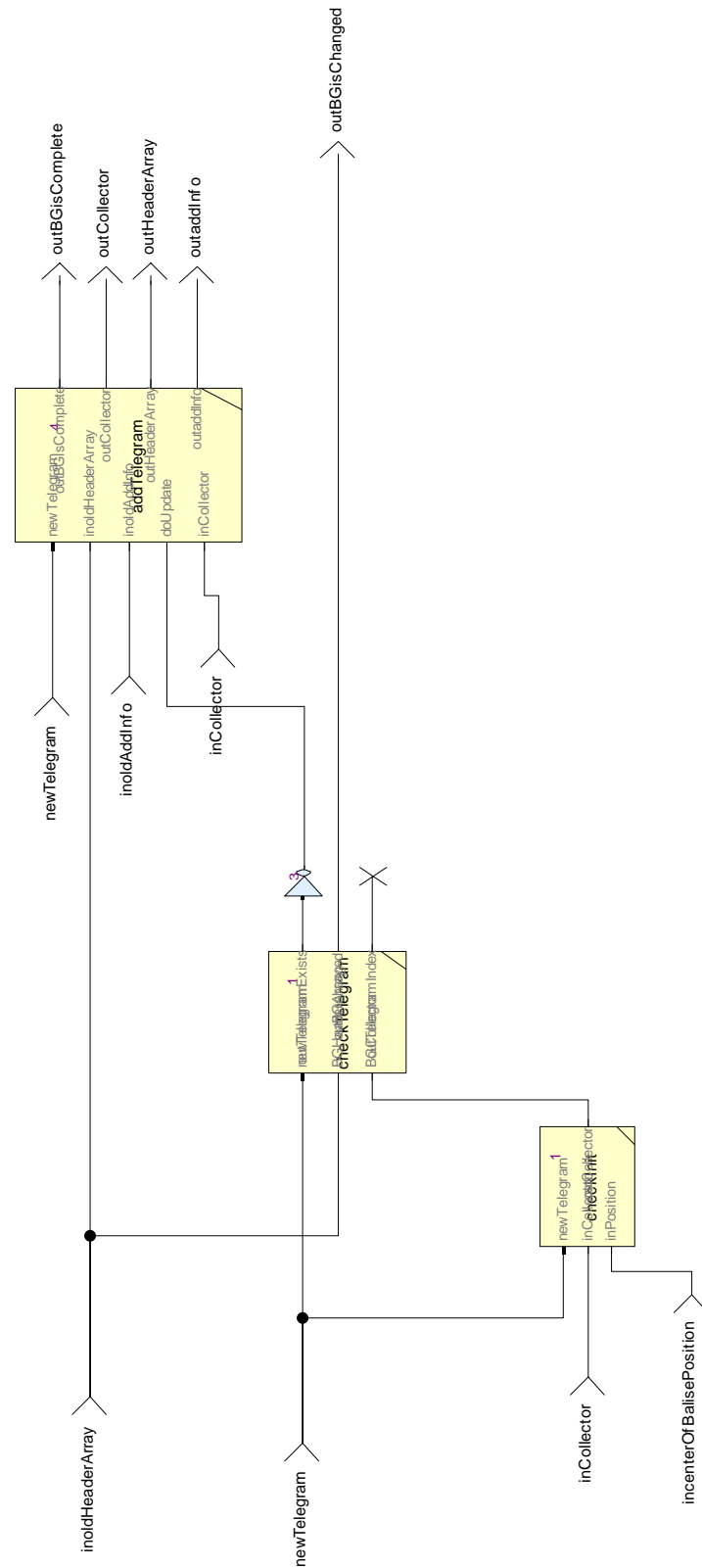
Figure 9: View of diagram_manageTelegram_1 (manageTelegram)

7.1.11.   memBGMessage Operator

Declared as **public node**

7.1.11.1.   Interface

Table 36: Inputs of memBGMessage

Name	Type	Comments and Information
reset	bool	
updatedHeaderArray	BG_Types_Pkg::TelegramHeaderArray_T	
updatedAddInfo	BG_Types_Pkg::AdditionalInformation_T	
storeInfo	bool	

Table 37: Outputs of memBGMessage

Name	Type	Comments and Information
actualHeaderArray	BG_Types_Pkg::TelegramHeaderArray_T	
actualAddInfo	BG_Types_Pkg::AdditionalInformation_T	

7.1.11.2.   Operator Hierarchy

<u>diagram</u> : diagram_memBGMessage_1

7.1.11.3.   Graphical and Textual Diagrams

7.1.11.3.1.   View of diagram_memBGMessage_1 (memBGMessage)
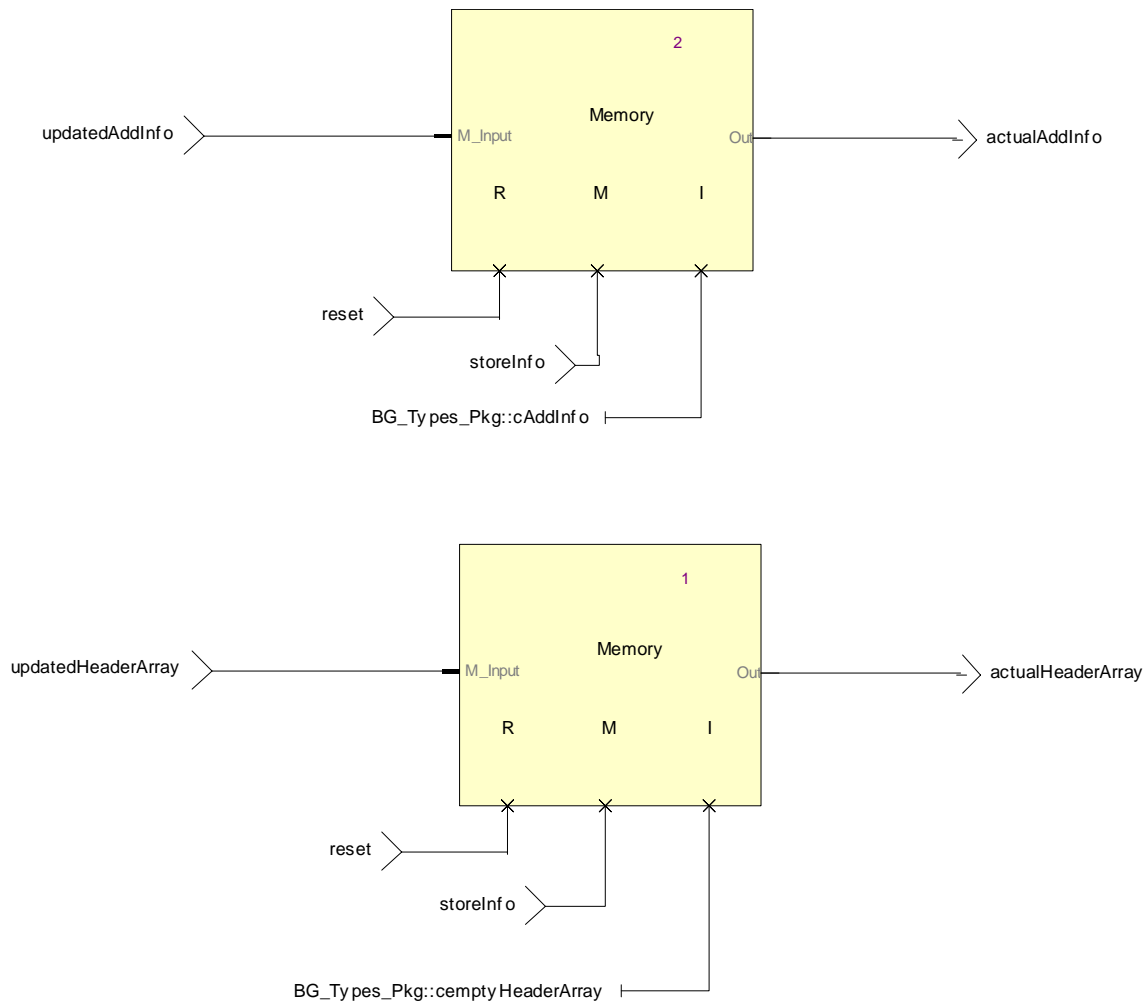
Figure 10: View of diagram_memBGMessage_1 (memBGMessage)

diagram_memBGMessage_1 Comments:

- Provides control data for the balise group collection.

7.2. BuildBGMessage_Pkg::BaliseSupport Package

7.2.1.   Constants

Table 38: Public Constants of BaliseSupport

Name	Type	Value	Comments and Information
cMaxLinking	int	31	Comments: Value corresponds to 5 bit adressing

7.2.2.   convNTotal Operator

Declared as **public function**

7.2.2.1. Interface

Table 39: Inputs of convNTotal

Name	Type	Comments and Information
inNTotal	N_TOTAL	

Table 40: Outputs of convNTotal

Name	Type	Comments and Information
outTotal	int	

7.2.2.2. Operator Hierarchy

<u>diagram</u> : 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

7.2.2.3. Graphical and Textual Diagrams

7.2.2.3.1. View of diagram_convNTotal_1 (convNTotal)
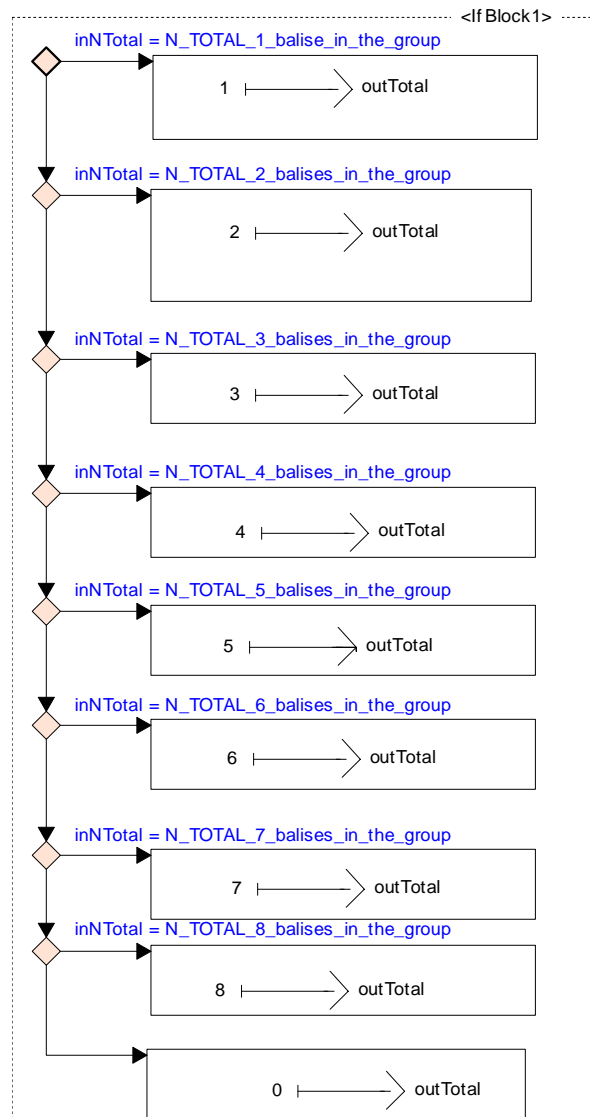
Figure 11: View of diagram_convNTotal_1 (convNTotal)

Table 41: Conditional Blocks of diagram_convNTotal_1

Conditional Block	Comments and Information
IfBlock1	

Table 42: 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:then	
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. Interface

Table 43: Inputs of findTelegram

Name	Type	Comments and Information
which_pig	N_PIG	
HeaderArray	BG_Types_Pkg::TelegramHeaderArray_T	
doSearch	bool	

Table 44: Outputs of findTelegram

Name	Type	Comments and Information
indexOut	int	
newTelegram	bool	

7.2.3.2. Locals

Table 45: Locals of findTelegram

Name	Type	Comments and Information
valid	bool	

7.2.3.3. Operator Hierarchy

diagram : diagram_findTelegram_1
    activate if : IfBlock1
        branch : then
        branch : else

7.2.3.4.   Graphical and Textual Diagrams

7.2.3.4.1.   View of diagram_findTelegram_1 (findTelegram)
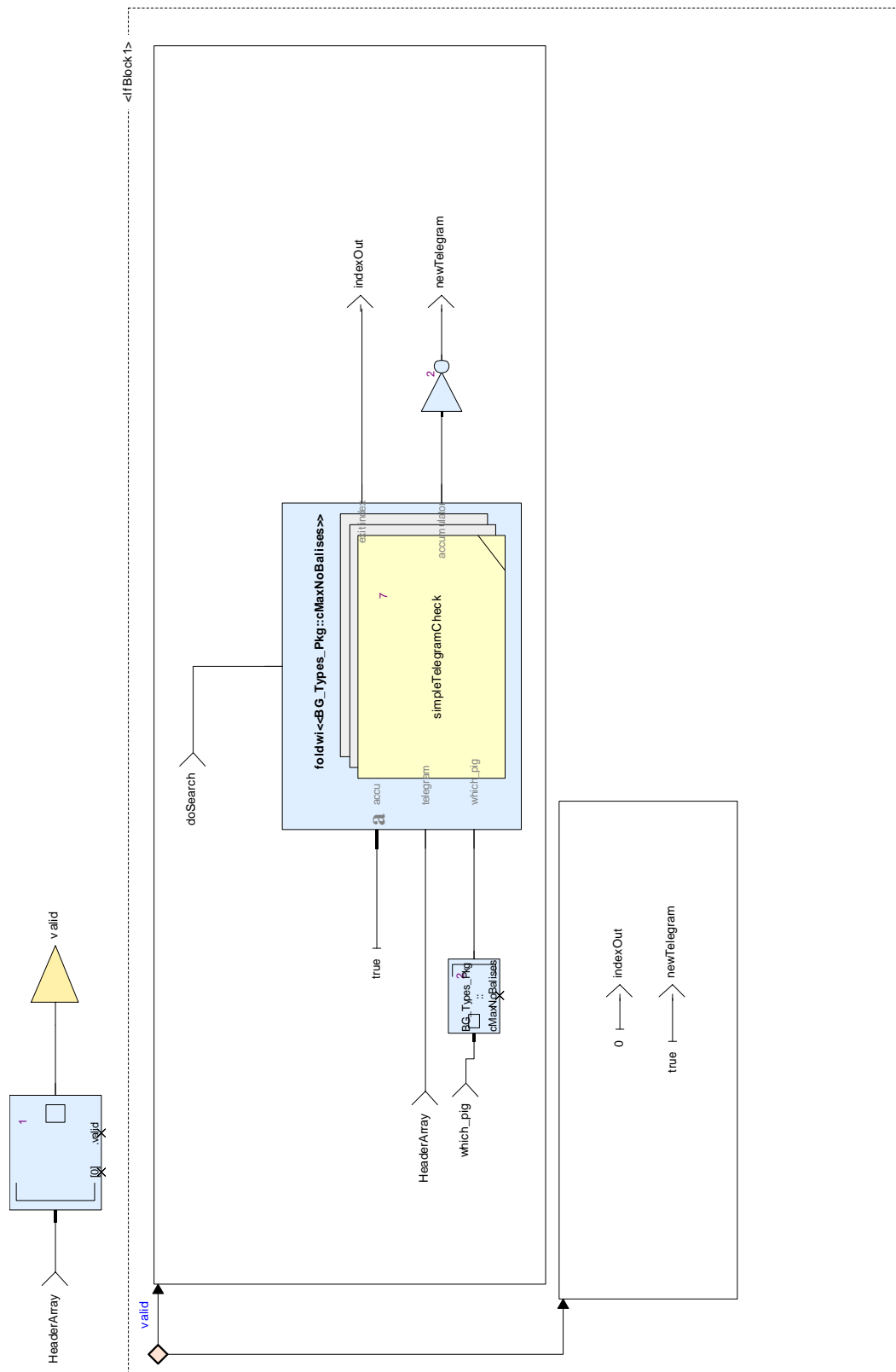
Figure 12: View of diagram_findTelegram_1 (findTelegram)

Table 46: Conditional Blocks of diagram_findTelegram_1

Conditional Block	Comments and Information
IfBlock1	

Table 47: Actions of diagram_findTelegram_1

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

7.2.4.   mergeAddInfo Operator

Declared as **public function**

7.2.4.1.   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.

7.2.4.2.   Interface

Table 48: Inputs of mergeAddInfo

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

Table 49: Outputs of mergeAddInfo

Name	Type	Comments and Information
mergedIAddInfo	BG_Types_Pkg::Additi onalInformation_T	

7.2.4.3.   Operator Hierarchy

diagram : diagram_mergeAddInfo_1

7.2.4.4.   Graphical and Textual Diagrams

7.2.4.4.1.   View of diagram_mergeAddInfo_1 (mergeAddInfo)
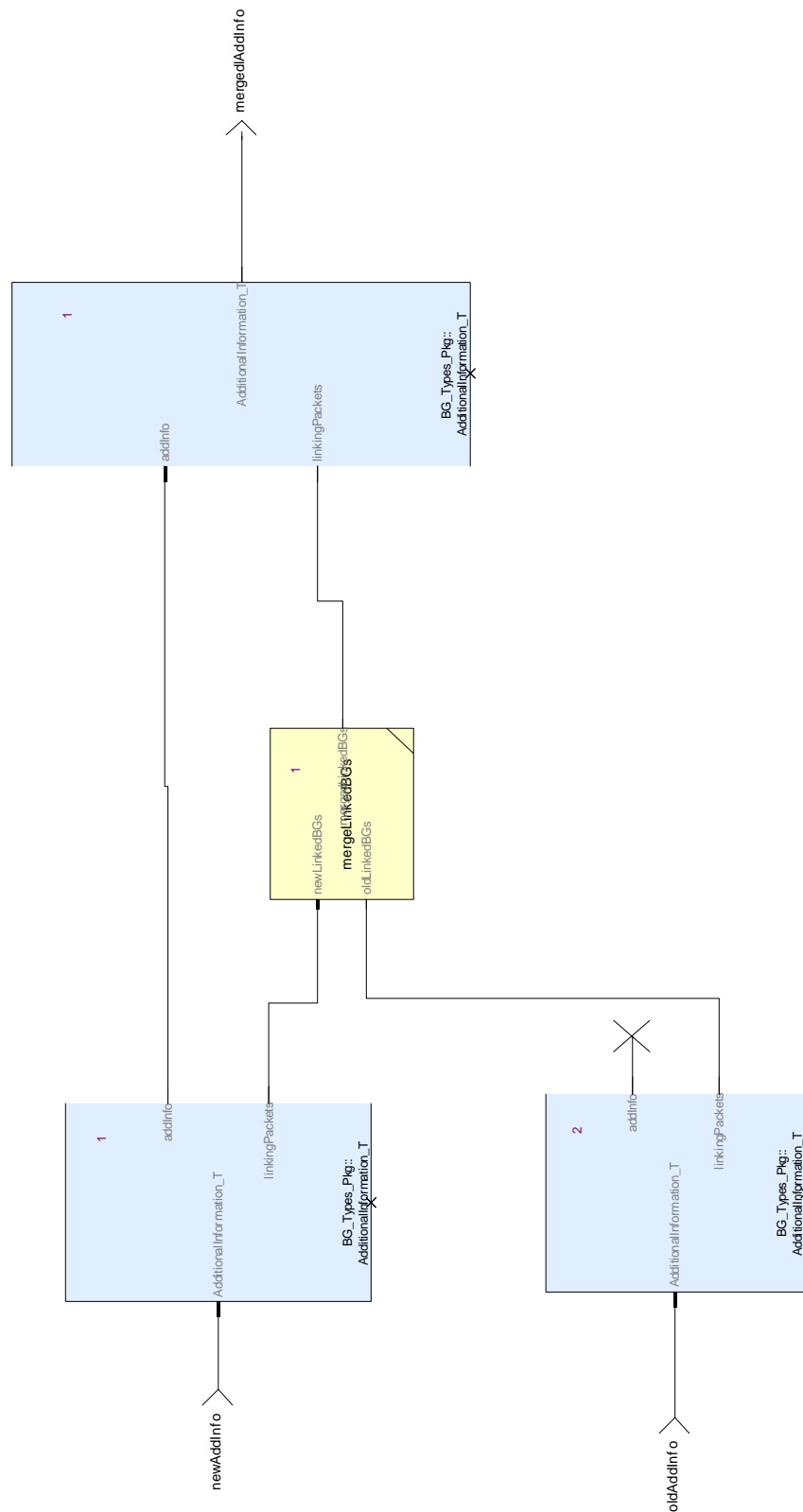
Figure 13: View of diagram_mergeAddInfo_1 (mergeAddInfo)

7.2.5.   mergeLinkedBGs Operator

Declared as **public function**

7.2.5.1.   Comments and Information

mergeLinkedBGs Comments:

- This information is made up of the linkiing 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 nmot allowed to be split accross telegrams.
- Therefore, no special procedure for copiing is needed.
- (only replace whole list if already received entry is not valid).

7.2.5.2.   Interface

Table 50: Inputs of mergeLinkedBGs

Name	Type	Comments and Information
newLinkedBGs	BG_Types_Pkg::Linked BGs_T	
oldLinkedBGs	BG_Types_Pkg::Linked BGs_T	

Table 51: Outputs of mergeLinkedBGs

Name	Type	Comments and Information
mergedLinkedBGs	BG_Types_Pkg::Linked BGs_T	

7.2.5.3.   Operator Hierarchy

<u>diagram</u> : diagram_mergeLinkedBGs_1

7.2.5.4.   Graphical and Textual Diagrams

7.2.5.4.1.   View of diagram_mergeLinkedBGs_1 (mergeLinkedBGs)
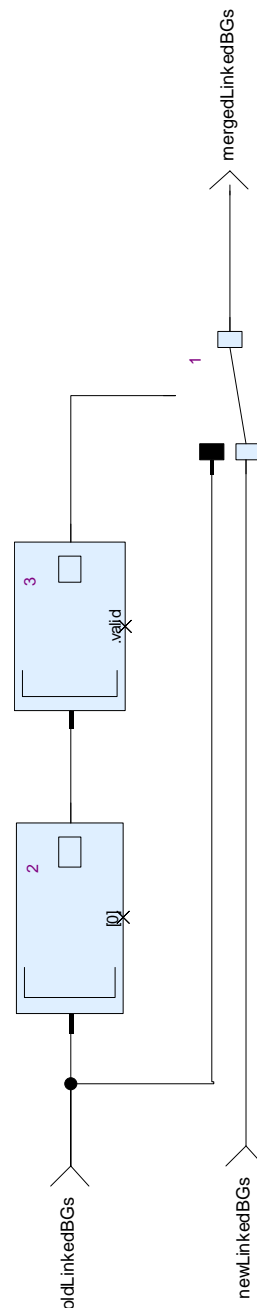
Figure 14: View of diagram_mergeLinkedBGs_1 (mergeLinkedBGs)

7.2.6.   setFirstFree Operator

Declared as **public function**

7.2.6.1.   Interface

Table 52: Inputs of setFirstFree

Name	Type	Comments and Information
newTelegram	BG_Types_Pkg::TelegramHeaderFlag_T	

Name	Type	Comments and Information
BGTelegrams	BG_Types_Pkg::Telegr amHeaderFlag_T	

Table 53: Outputs of setFirstFree

Name	Type	Comments and Information
cont	bool	
outTelegrams	BG_Types_Pkg::Telegr amHeaderFlag_T	

7.2.6.2.   Operator Hierarchy

<u>diagram</u> : diagram_setFirstFree_1

7.2.6.3.   Graphical and Textual Diagrams

7.2.6.3.1.   View of diagram_setFirstFree_1 (setFirstFree)
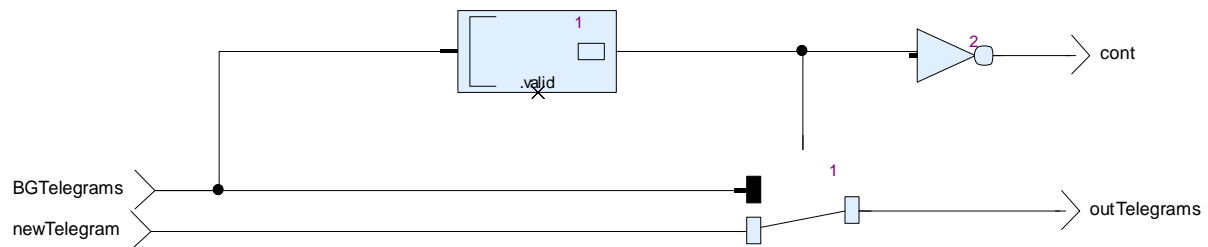
Figure 15: View of diagram_setFirstFree_1 (setFirstFree)

7.2.7.   simpleTelegramCheck Operator

Declared as **public function**

7.2.7.1.   Interface

Table 54: Inputs of simpleTelegramCheck

Name	Type	Comments and Information
iteratorIndex	int	
accu	bool	
telegram	BG_Types_Pkg::Telegr amHeaderFlag_T	
which_pig	N_PIG	

Table 55: Outputs of simpleTelegramCheck

Name	Type	Comments and Information
cont	bool	
found	bool	

7.2.7.2.   Operator Hierarchy

<u>diagram</u> : diagram_simpleTelegramCheck_1

7.2.7.3.   Graphical and Textual Diagrams

7.2.7.3.1.   View of diagram_simpleTelegramCheck_1 (simpleTelegramCheck)
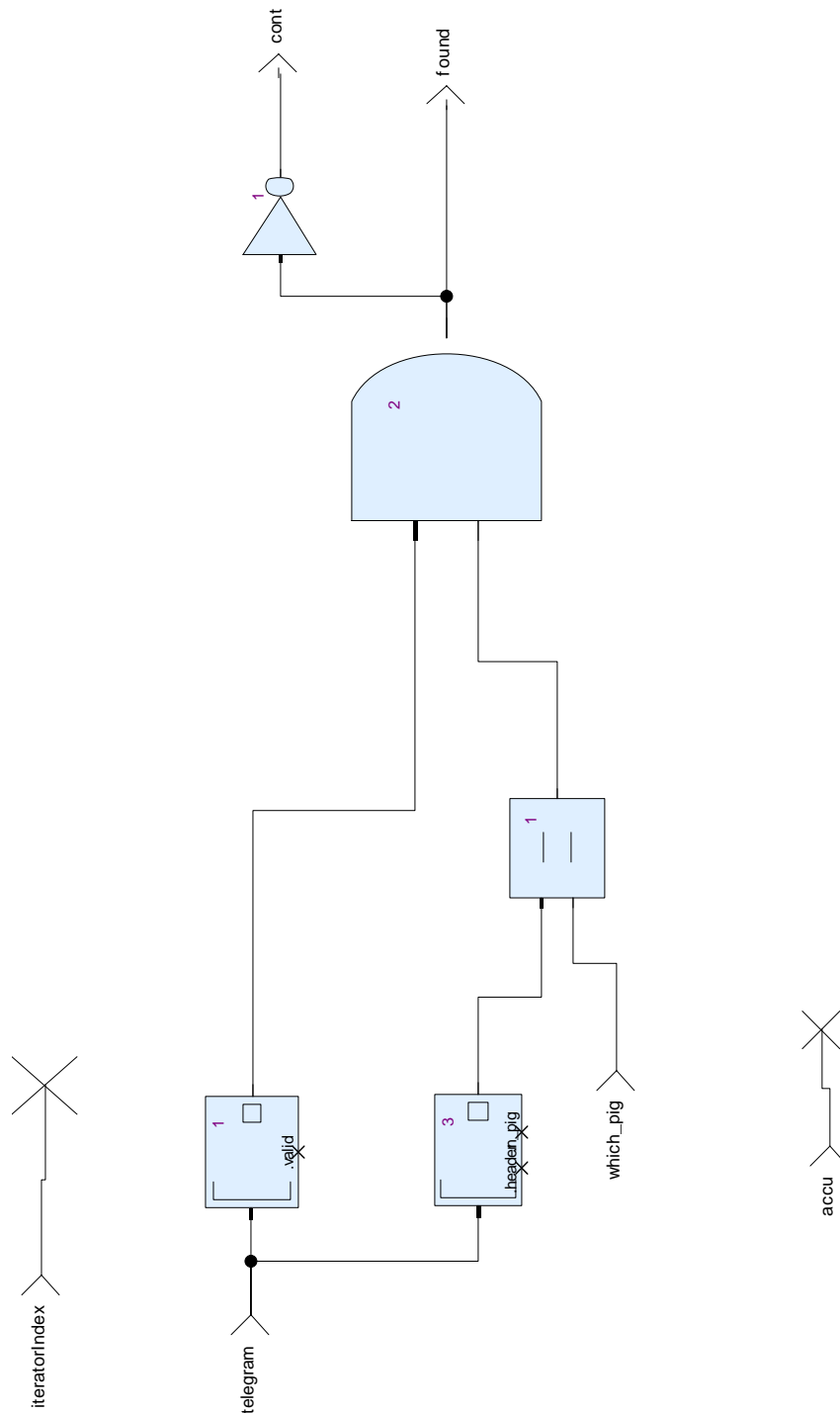
Figure 16: View of diagram_simpleTelegramCheck_1 (simpleTelegramCheck)

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 56: 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 (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.
	to_c	True

8.1.2. Types

Table 57: 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}	Comments: Describes a linked BG as announced from the linking BG. Mainly, this information is taken from the linking packet. nid_bg_fromLinkingBG Comments: ID of the BG, where the linking information originates from expectedLocation Comments: Location, where the BG is expected to be found, calculated from announced linking distance. d_link Comments: Linking distance with inaccuracies, converted from Q_SCALE, D_LINK, Q_LOCACC of the linking packet. linkingInfo Comments: Linking info as announced from the linking BG, where this BG.
linkedBGs_asPositioned BGs_T	TrainPosition_Types_Pck::positionedBG_T ^BG_Types_Pkg::cMaxNoOfLinkedBGs	Comments: 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}	location Comments: The best known location calculated from linking and from passing information seqNoOnTrack Comments: Sequence number: specifies the order of the BG passed or expected to be passed infoFromLinking Comments: If linked, this is the BG info as announced from a linked BG. Most of the data is taken from the linking information. infoFromPassing Comments: If the balise group was passed, this is the relevant information received from the BG.
positionedBGs_T	TrainPosition_Types_Pck::positionedBG_T ^cMaxNoOfStoredBGs	Comments: All balise groups stored for train position calculation
positionErrors_T	{outOfMemSpace : bool, passedBG_notFoundWhereExpected : bool, positionCalculation_inconsistent : bool}	outOfMemSpace Comments: Memory overrun: a passed or announced BG could not be stored passedBG_notFoundWhereExpected Comments: The currently passed linked BG location does not match the expected location positionCalculation_inconsistent Comments: A consistency problem arised during position calculation

Name	Definition	Comments and Information
trainPosition_T	{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, maxSafeFrontEndPostion : 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}	Comments: 3.6.1.3 trainPositionIsUnknown Comments: 3.6.3.1.3.1 noCoordinateSystemHasBeenAssigned Comments: 3.4.2, 3.6.3.1.4: Every balise group has its own co-ordinate system trainPosition Comments: The calculated train position with inaccuracies.# estimatedFrontEndPosition Comments: 3.6.4.4 a): Absolute train front end position since system start minSafeFrontEndPosition Comments: 3.6.4.4 c) :Minimum safe front end position maxSafeFrontEndPostion Comments: 3.6.4.4.b) :Maximum safe front end position nid_LRBG Comments: Identity of last relevant balise group nid_PrvLRB Comments: Identity of previous LRBG (7.4.3.2, 7.5.1.94), for position report based on 2 balise groups nominalOrReverseToLRBG Comments: 7.5.1.106: Q_DLRBG: Qualifier telling on which side of the LRBG the estimated front end is trainOrientationToLRBG Comments: 3.6.1.3: Orientation of the train in relation to the direction of the LRBG trainRunningDirectionToLRBG Comments: 3.6.1.3: Direction of train movement in relation to the LRBG orientation speed Comments: Actual train speed

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}	trainPosition Comments: The best known train position trainPositionDerivedFromLastLinkedBG Comments: The train position measured by odometry behind the positon of the last passed linked BG trainPositionDerivedFromLastUnlinkedBG Comments: The train position measured by odometry behind the positon of the last passed unlinked BG lastPassedLinkedBG Comments: The last passed linked BG lastPassedUnlinkedBG Comments: The last passed unlinked BG speed Comments: 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}	Comments: Static train properties necessary for train position calculation. nid_engine Comments: 7.5.1.88, Onboard ETCS identity. nid_operational Comments: 7.5.1.92, Train Running Number l_train Comments: 7.5.1.56, train length d_baliseAntenna_2_frontend Comments: Distance from the trains balise antenna to the trains front end. d_frontend_2_rearend Comments: Distance from the trains front end to rear end

8.1.3. Constants

Table 58: Public Constants of TrainPosition_Types_Pck

Name	Type	Value	Comments and Information
cMaxNoOfStoredBGs	int	2 * BG_Types_Pkg::cMaxNoOfLinkedBGs	Comments: Max. number of balise groups stored for position calculation
cQ_SCALE_10_cm_resolution	Obu_BasicTypes_Pkg::Location_T	10	Comments: 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	Comments: 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	Comments: 7.5.1.129: Resolution of Q_SCALE::1 m: = 100 cm (Location_Type in cm)

Name	Type	Value	Comments and Information
cQLOCACC_resolution	Obu_BasicTypes_Pkg::Location_T	100	Comments: 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 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 59: 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	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.
	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 dist_2 + dist_1

Table 60: 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	Calculates the sum of 2 distances - 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.
	to_c	True

9.1.2.2.   Interface

Table 61: 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 62: Outputs of add_2_Distances

Name	Type	Comments and Information
distance	Obu_BasicTypes_Pkg::LocWithInAcc_T	

9.1.2.3.   Operator Hierarchy

<u>diagram</u> : 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)
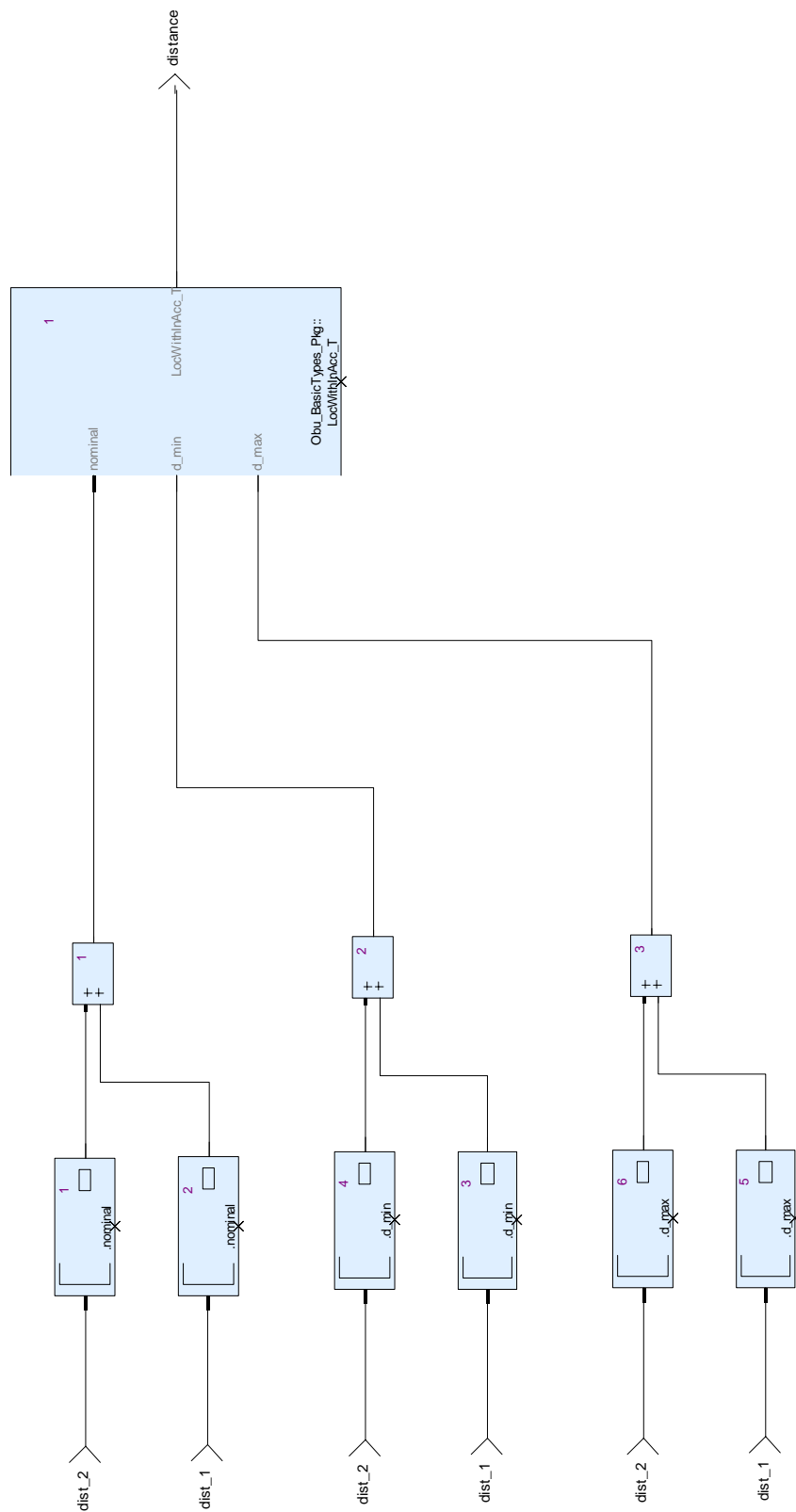
Figure 17: View of diagram_add_2_Distances_1 (add_2_Distances)

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 tracel distance behind it is measured with the odometry.

Table 63: 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	Calculates the target location after a reference location measured by the odometry - 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.
	to_c	True

9.1.3.2.   Interface

Table 64: Inputs of add_odo_2_Location

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

Table 65: Outputs of add_odo_2_Location

Name	Type	Comments and Information
location	Obu_BasicTypes_Pkg:: LocWithInAcc_T	Comments: The target location

9.1.3.3.   Operator Hierarchy

<u>diagram</u> : 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)
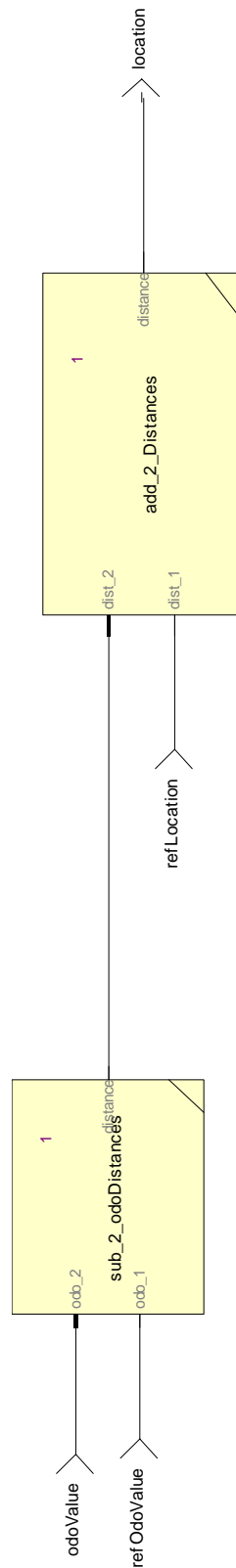
Figure 18: View of diagram_add_odo_2_Location_1 (add_odo_2_Location)

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 66: 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	Calculates the sum of an array of distances - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

9.1.4.2.   Interface

Table 67: Inputs of addDistances

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

Table 68: Outputs of addDistances

Name	Type	Comments and Information
sum	Obu_BasicTypes_Pkg:: LocWithInAcc_T	

Table 69: Size Parameters of addDistances

Name	Comments and Information
noOfSummands	Comments: Number of summands

9.1.4.3.   Operator Hierarchy

<u>diagram</u> : diagram_sumOfDistances_1

9.1.4.4.   Graphical and Textual Diagrams

9.1.4.4.1.   View of diagram_sumOfDistances_1 (addDistances)
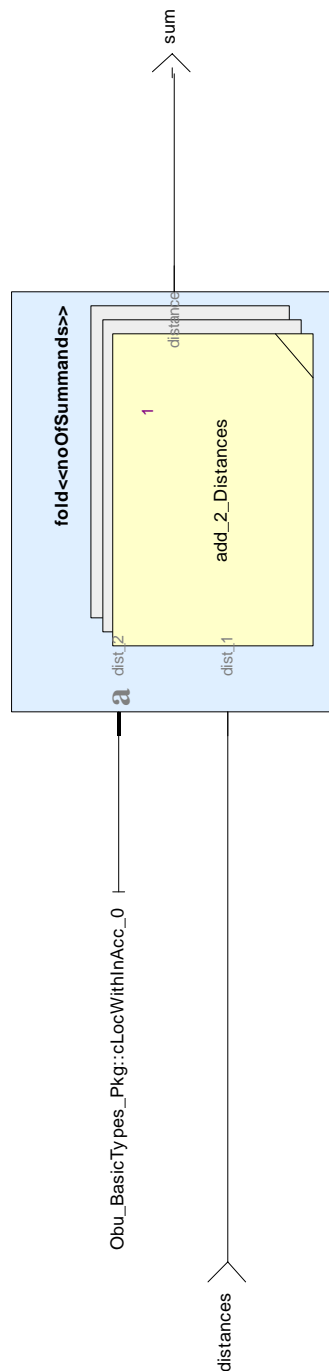
Figure 19: View of diagram_sumOfDistances_1 (addDistances)

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 70: 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	Calculates the distance between linked 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.
	to_c	True

9.1.5.2. Interface

Table 71: Inputs of addDistancesBetwLinkedElements

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

Table 72: Outputs of addDistancesBetwLinkedElements

Name	Type	Comments and Information
sumOfDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T	

Table 73: Size Parameters of addDistancesBetwLinkedElements

Name	Comments and Information
noOfLinkedElements	

9.1.5.3.   Operator Hierarchy

<u>diagram</u> : diagram_distanceBetweenLinkedElements_1

9.1.5.4.   Graphical and Textual Diagrams

9.1.5.4.1.   View of diagram_distanceBetweenLinkedElements_1 (addDistancesBetwLinkedElements)
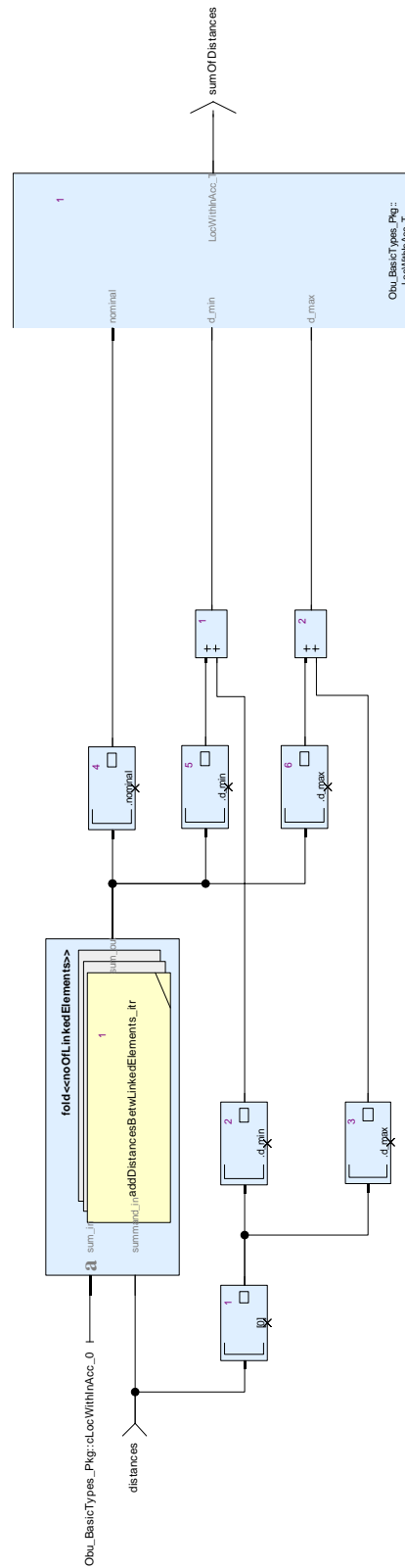
Figure 20: View of diagram_distanceBetweenLinkedElements_1 (addDistancesBetwLinkedElements)

9.1.6.   addDistancesBetwLinkedElements_itr Operator

Declared as **private function**

9.1.6.1.   Comments and Information

addDistancesBetwLinkedElements_itr Comments:

- distanceBetweenLinkedElements_itr is the íterated 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 <> 0 and from the previous sum_in, if == 0.
- This assures that the inaccuracies from the last element in the iteration <> 0 are forward even if not all iterations are filled with valid data.

Table 74: 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	íterated function for the distance calculation between linked 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.
	to_c	True

9.1.6.2.   Interface

Table 75: Inputs of addDistancesBetwLinkedElements_itr

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

Table 76: 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)
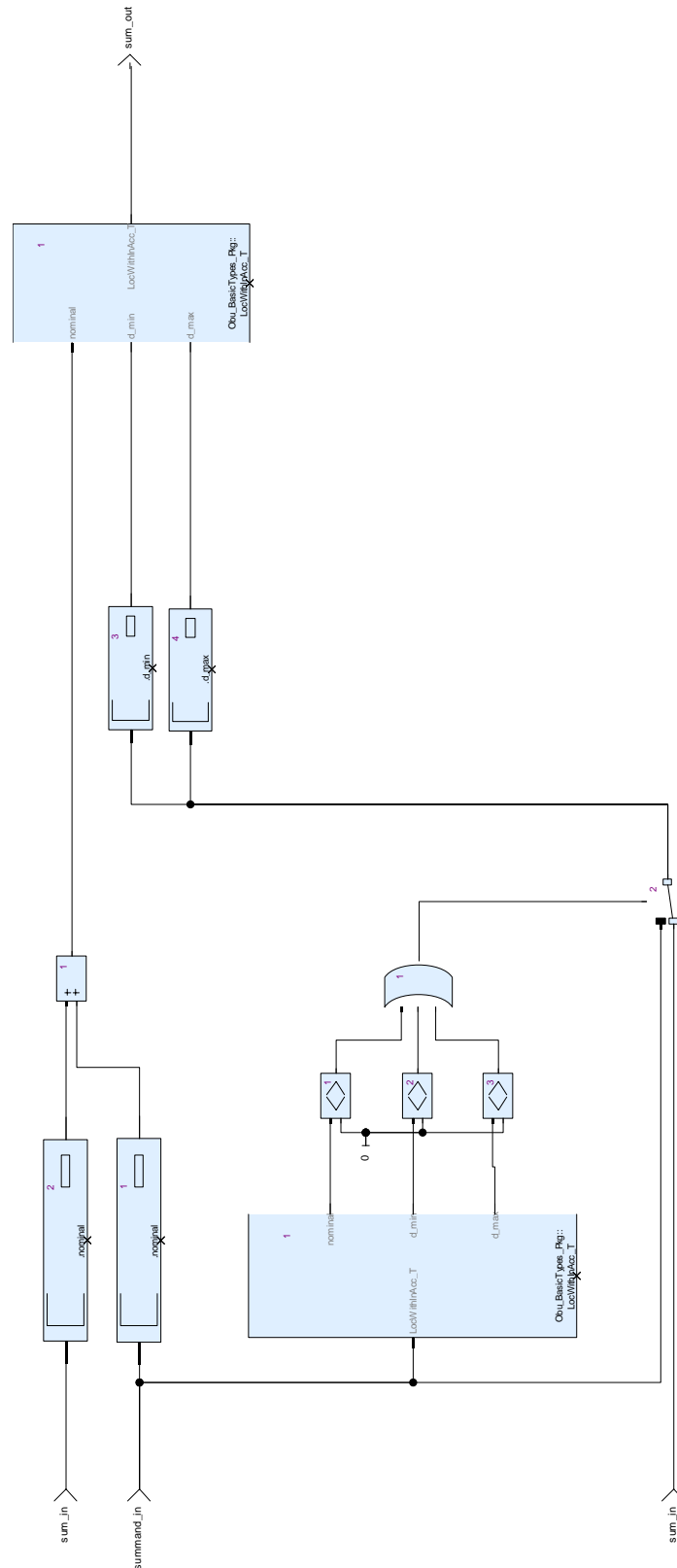
Figure 21: View of diagram_addDistancesBetwLinkedElements_itr_1
(addDistancesBetwLinkedElements_itr)

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 77: Inputs of checkMaxAbsOdoDistance

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

Table 78: Outputs of checkMaxAbsOdoDistance

Name	Type	Comments and Information
isLessThanOrEqual	bool	

9.1.7.3. Operator Hierarchy

<u>diagram</u> : diagram_checkMaxAbsOdoDistance_1

9.1.7.4.   Graphical and Textual Diagrams

9.1.7.4.1.   View of diagram_checkMaxAbsOdoDistance_1 (checkMaxAbsOdoDistance)
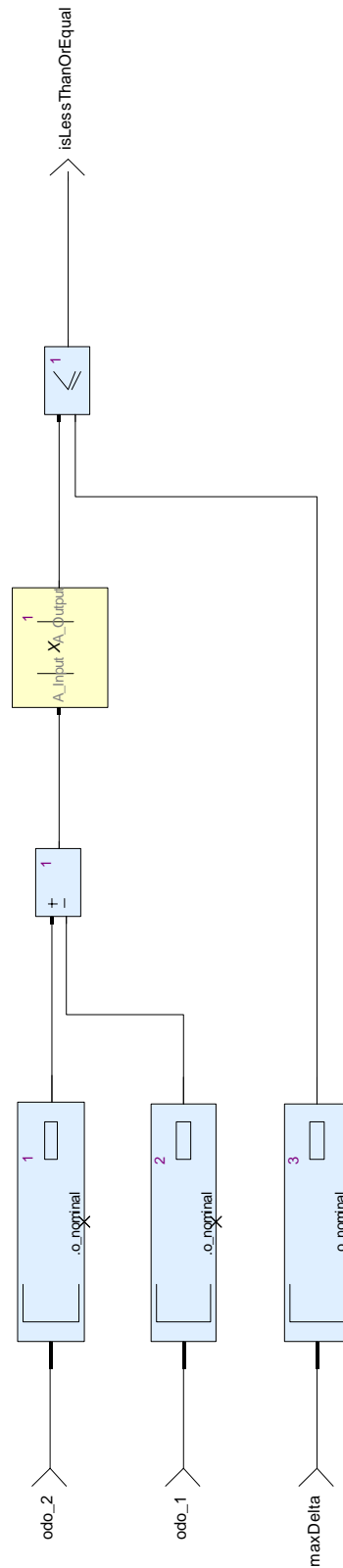
Figure 22: View of diagram_checkMaxAbsOdoDistance_1 (checkMaxAbsOdoDistance)

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 79: 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	Distance from the actual train position to a track element - 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.
	to_c	True

9.1.8.2.   Interface

Table 80: Inputs of dTrain2Trackelem_unlinkedBG

Name	Type	Comments and Information
dLink_unlinkedBG2Trackelem	Obu_BasicTypes_Pkg::LocWithInAcc_T	Comments: Linking distance from a previously passed unlinked balise group to the track element
loc_unlinkedBG	Obu_BasicTypes_Pkg::LocWithInAcc_T	Comments: Location of a previously passed unlinked balise group

Name	Type	Comments and Information
odo_unlinkedBG	Obu_BasicTypes_Pkg:: OdometryLocations_T	Comments: Odometry value at the previously passed unlinked balise group
actOdo_train	Obu_BasicTypes_Pkg:: OdometryLocations_T	Comments: Odometry value at the actual train position

Table 81: Outputs of dTrain2Trackelem_unlinkedBG

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

9.1.8.3.   Operator Hierarchy

<u>diagram</u> : 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)
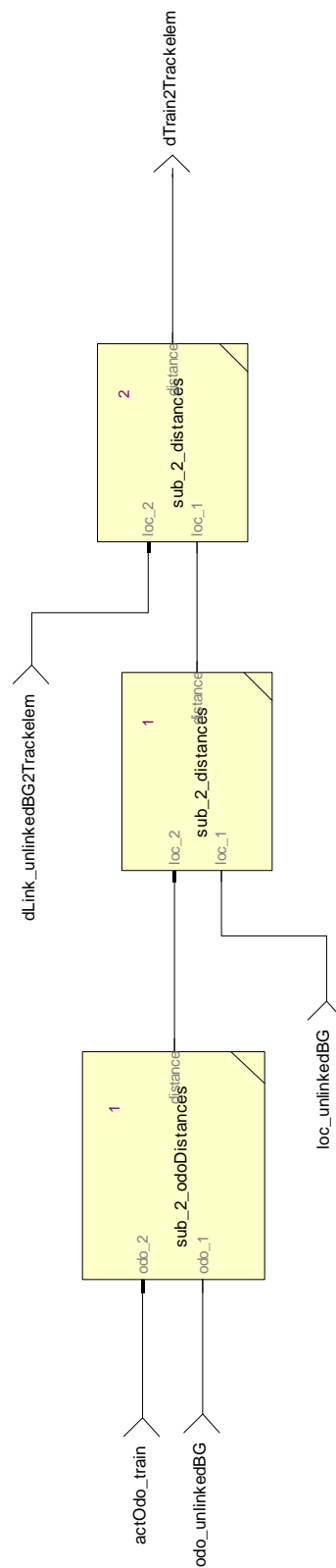
Figure 23: View of diagram_dTrain2Trackelem_unlinkedBG_1 (dTrain2Trackelem_unlinkedBG)

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 82: 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	Determines the location of an element, measured by odometry, with reference to 2 different known reference locations - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

9.1.9.2.   Interface

Table 83: Inputs of odoLoc_2_refLocations

Name	Type	Comments and Information
refLoc_2	Obu_BasicTypes_Pkg:: LocWithInAcc_T	Comments: Reference location 2
refLoc_1	Obu_BasicTypes_Pkg:: LocWithInAcc_T	Comments: Reference location 1

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

Table 84: Outputs of odoLoc_2_refLocations

Name	Type	Comments and Information
location	Obu_BasicTypes_Pkg::LocWithInAcc_T	Comments: The resulting location to be determined

9.1.9.3.   Operator Hierarchy

<u>diagram</u> : 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)
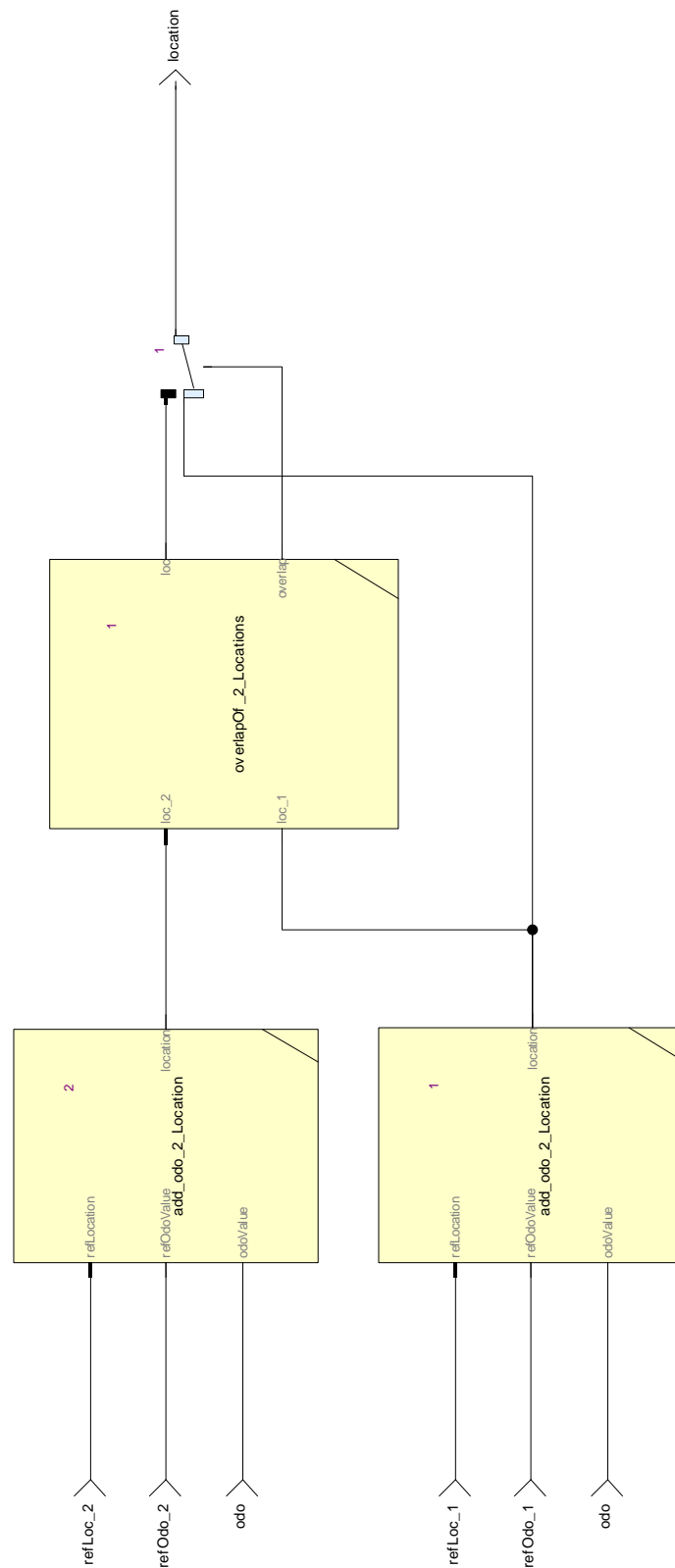
Figure 24: View of diagram_odoLoc_2_refLocations_1 (odoLoc_2_refLocations)

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 overlaping section.
- The overlap output is set to true, if an overlapping part exits.
- The overlapping section is seen as the mostAccurateValueOf both locations.

Table 85: 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	Determines the overlapping section of 2 locations - 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.
	to_c	True

9.1.10.2. Interface

Table 86: 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 87: Outputs of overlapOf_2_Locations

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

9.1.10.3. Operator Hierarchy

<u>diagram</u> : 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)
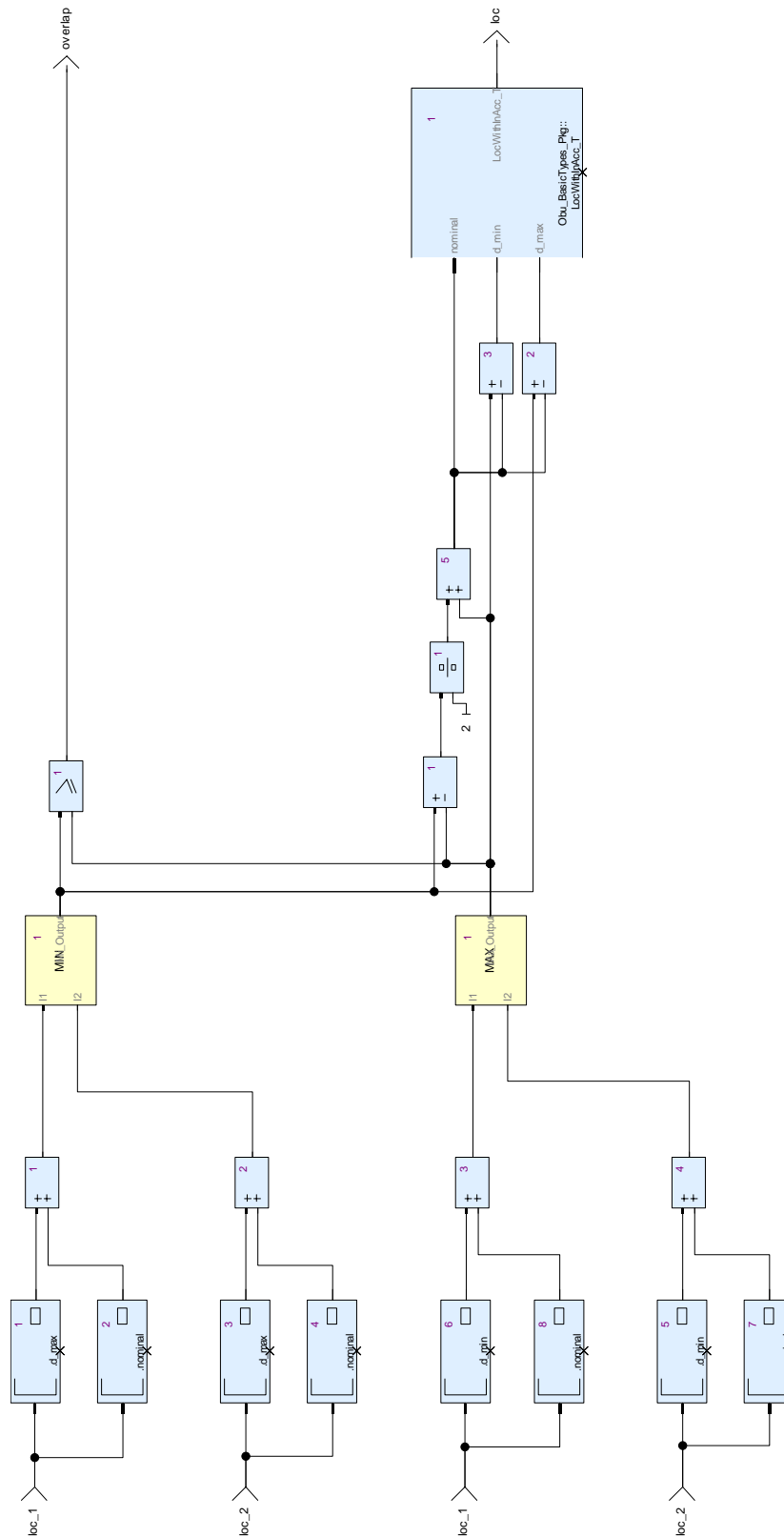
Figure 25: View of diagram_overlapOf_2_Locations_1 (overlapOf_2_Locations)

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 88: 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	Converts the linking distance variables into the uniform distance type - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

9.1.11.2.   Interface

Table 89: Inputs of scaledDLINK_2_dlink

Name	Type	Comments and Information
q_scale	Q_SCALE	
d_link	D_LINK	
q_locacc	Q_LOCACC	

Table 90: 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)
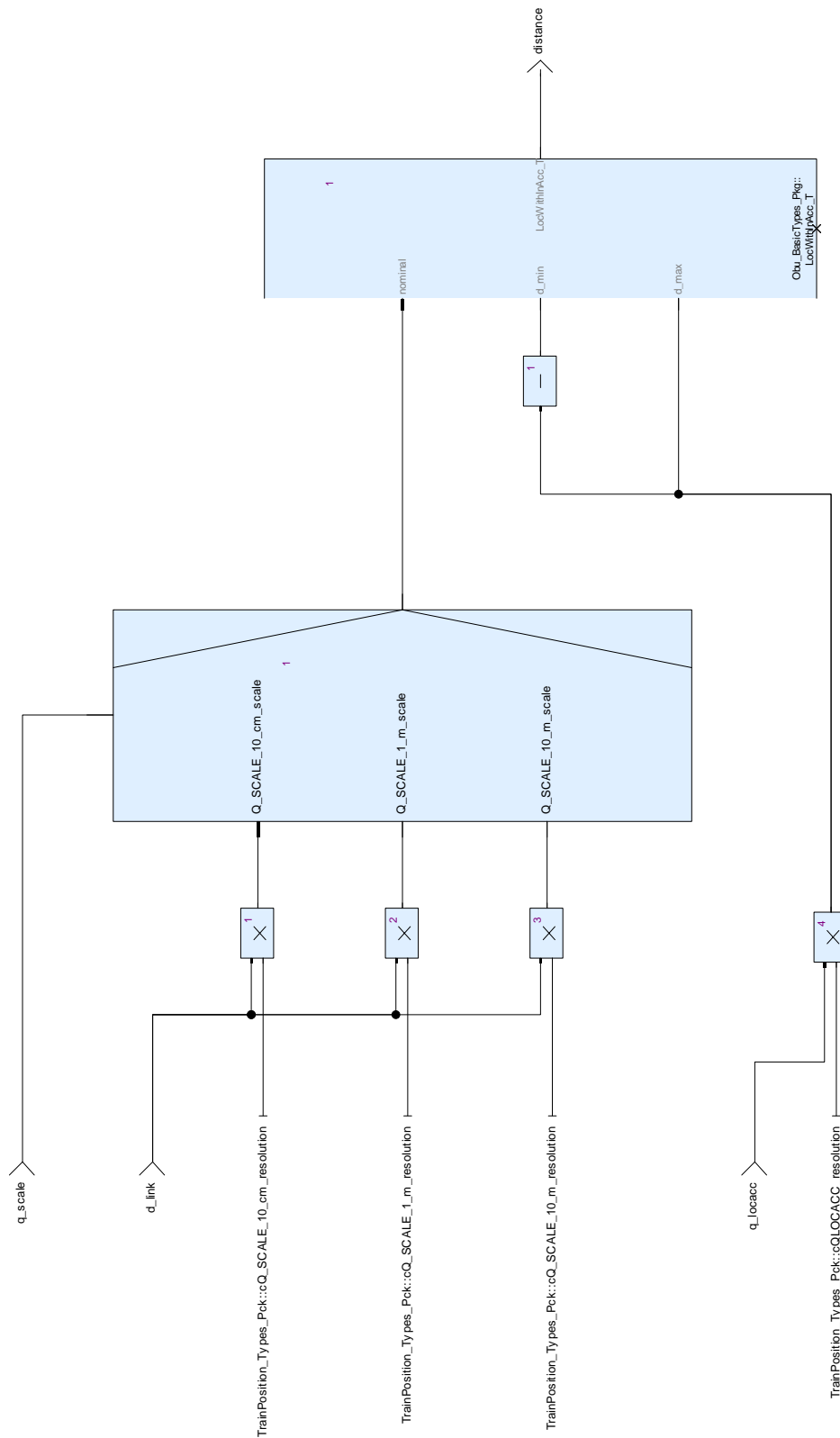
Figure 26: View of diagram_scaledDLINK_2_dlink_1 (scaledDLINK_2_dlink)

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 91: 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	Calculates the distance loc_2 - loc_1 between two locations - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

9.1.12.2.   Interface

Table 92: 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 93: 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)
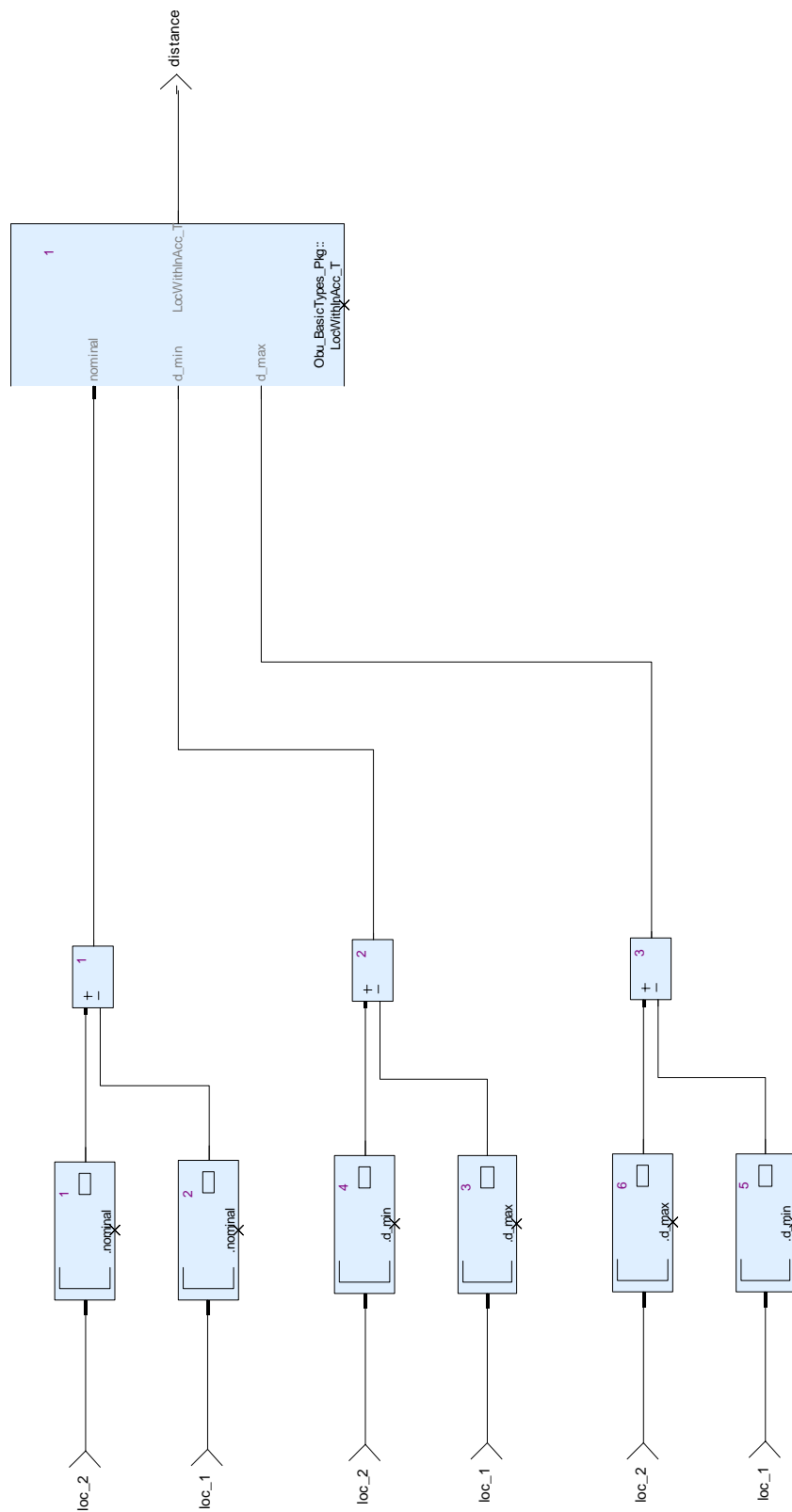
Figure 27: View of diagram_sub_2_distances_1 (sub_2_distances)

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 94: 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	Calculates the distance o2 - o1 based on odometry data - 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.
	to_c	True

9.1.13.2.   Interface

Table 95: 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 96: 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)
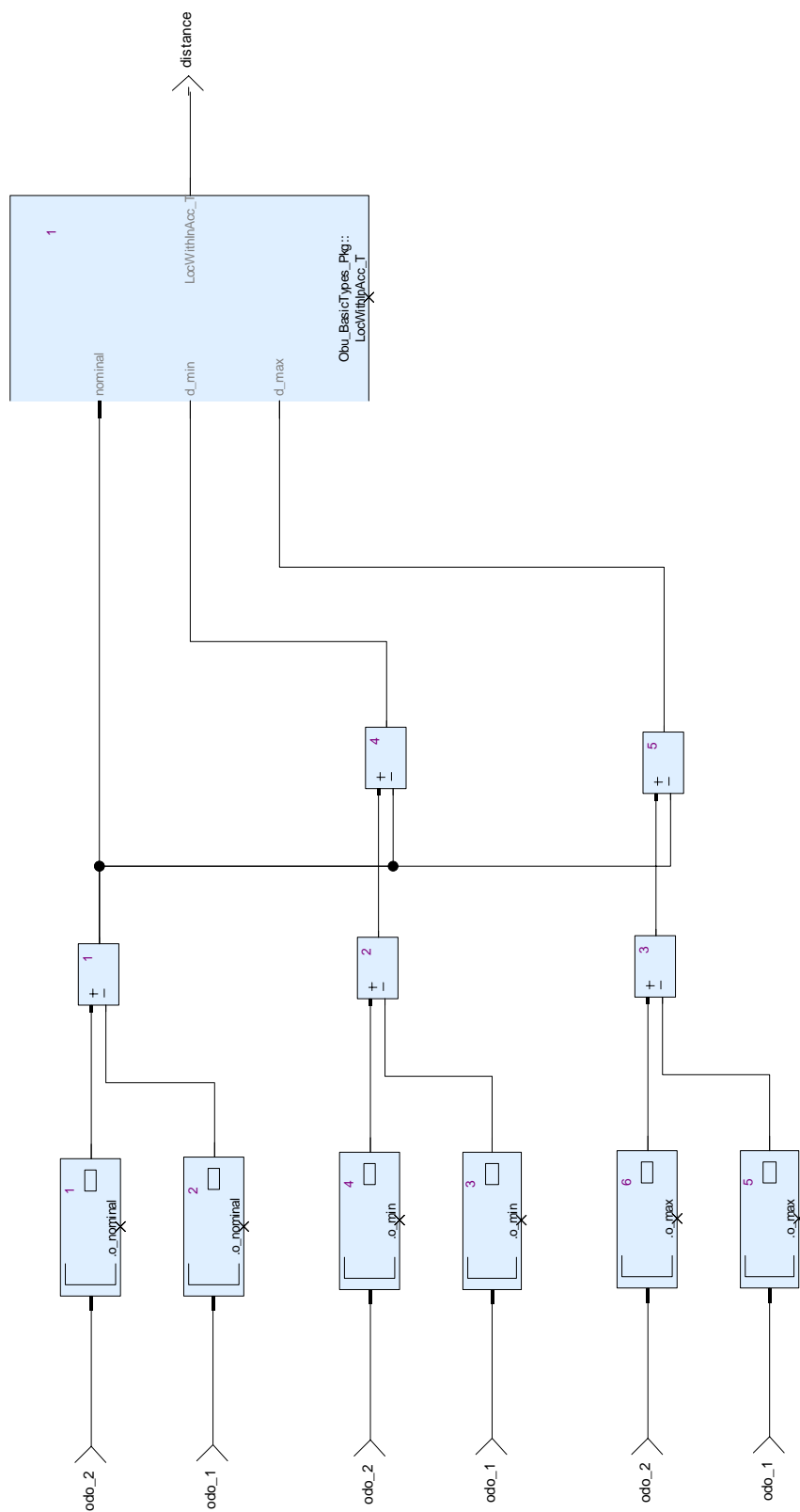
Figure 28: View of diagram_sub_2_odoDistances_1 (sub_2_odoDistances)

10. Project Library: CheckBGConsistency

10.1.   CheckPGConsistency_Pkg Package

10.1.1.   CheckPGConsistency Operator

Declared as **public function**

10.1.1.1.   Interface

Table 97: Inputs of CheckPGConsistency

Name	Type	Comments and Information
BG_Message_in	BG_Types_Pkg::BG_Message_T	
linkingInUse	bool	

Table 98: Outputs of CheckPGConsistency

Name	Type	Comments and Information
BG_Message_out	BG_Types_Pkg::BG_Message_T	

10.1.1.2.   Operator Hierarchy

diagram : diagram_CheckPGConsistency_1

10.1.1.3.   Graphical and Textual Diagrams

10.1.1.3.1.   View of diagram_CheckPGConsistency_1 (CheckPGConsistency)

BG_Message_in ⟩─────────────────────⟩ BG_Message_out

linkingInUse ⟩───────✕
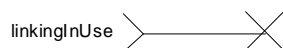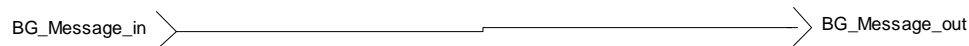
Figure 29: View of diagram_CheckPGConsistency_1 (CheckPGConsistency)

11. Project Library: DetermineBG_Orientation_and_LRBG

11.1. DetermineBGOrientation_LRBG Package

11.1.1. Constants

Table 99: Public Constants of DetermineBGOrientation_LRBG

Name	Type	Value	Comments and Information
cRBCReports	Radio_TrainToTrack ::Train_Position_Report	{NID_MESSAGE : 0, L_MESSAGE : 0, T_TRAIN : 0.0, NID_ENGINE : 0, PADDING3 : 0, Train_Position_Report_OptionalPackets : 0}	

11.1.2. ArrCheck Operator

Declared as **public function**

11.1.2.1. Comments and Information

ArrCheck Comments:

- Gets the orientation of the Balise Group from the position in group parameter of the first valid balise
- The check is valid if the bg is not a single bg.

11.1.2.2. Interface

Table 100: Inputs of ArrCheck

Name	Type	Comments and Information
inPIG	N_PIG	Comments: Position in Group

Table 101: Outputs of ArrCheck

Name	Type	Comments and Information
outOrientation	BG_Types_Pkg::Orientation_T	

11.1.2.3. Operator Hierarchy

<u>diagram</u> : diagram_ArrCheck_1

11.1.2.4.   Graphical and Textual Diagrams

11.1.2.4.1.   View of diagram_ArrCheck_1 (ArrCheck)
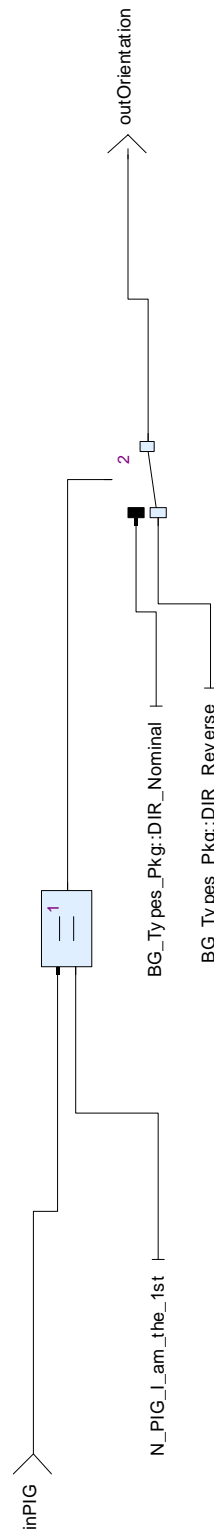
Figure 30: View of diagram_ArrCheck_1 (ArrCheck)

11.1.3.   CheckBaliseGroup Operator

Declared as **public function**

11.1.3.1. Interface

Table 102: Inputs of CheckBaliseGroup

Name	Type	Comments and Information
CurrentLRBG_	BG_Types_Pkg::CurrentLRBG	
ListOfBGs_	BG_Types_Pkg::ListOfBG	
TrainInfo_	BG_Types_Pkg::TrainToTrackStatus_T	
BGOOrientationAndType_	BG_Types_Pkg::Orientation_T	

Table 103: Outputs of CheckBaliseGroup

Name	Type	Comments and Information
Orientation_	Q_DIRTRAIN	

11.1.3.2. Operator Hierarchy

<u>diagram</u> : diagram_internal_structure

11.1.3.3.   Graphical and Textual Diagrams

11.1.3.3.1.   View of diagram_internal_structure (CheckBaliseGroup)
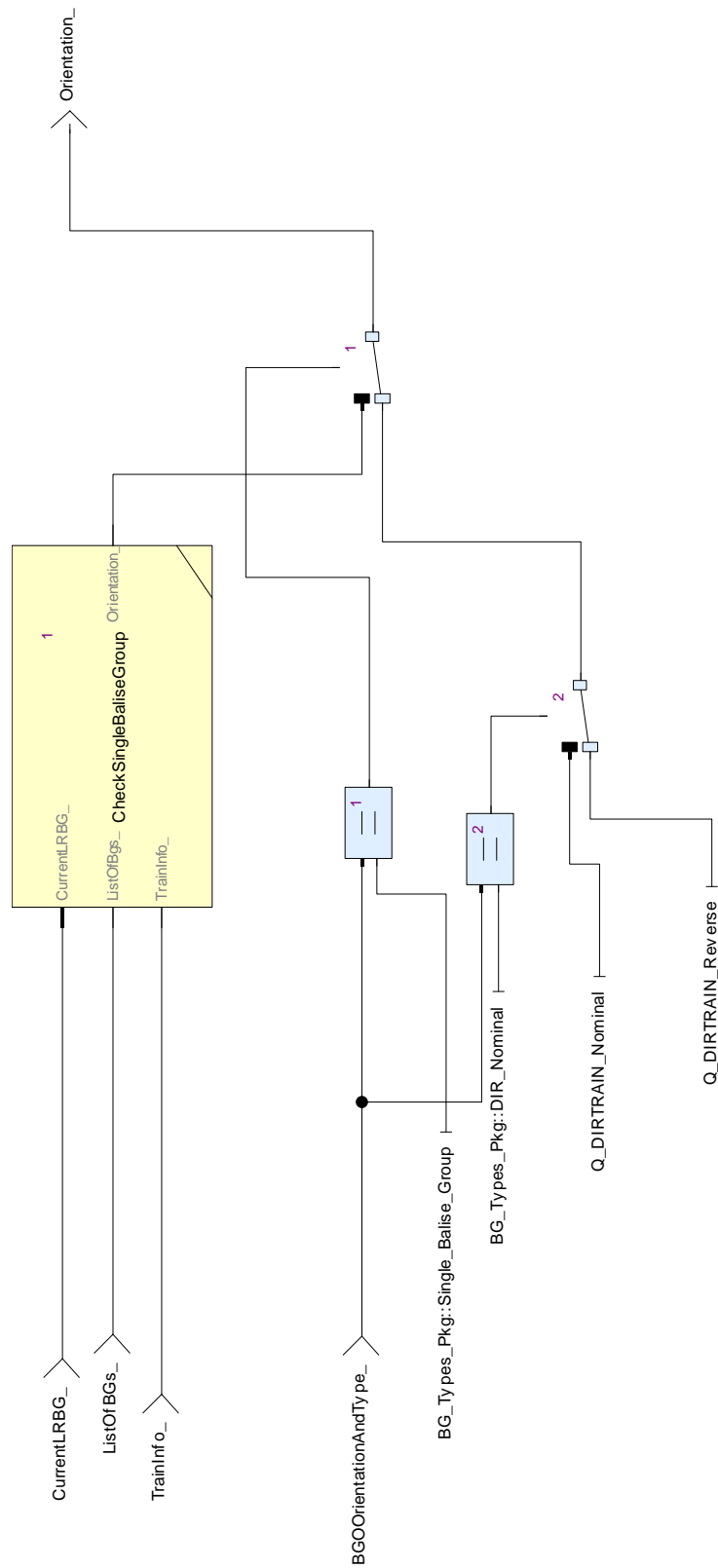
Figure 31: View of diagram_internal_structure (CheckBaliseGroup)

11.1.4. CheckSingleBaliseGroup Operator

Declared as **public function**

11.1.4.1. Interface

Table 104: Inputs of CheckSingleBaliseGroup

Name	Type	Comments and Information
CurrentLRBG_	BG_Types_Pkg::CurrentLRBG	
ListOfBgs_	BG_Types_Pkg::ListOfBG	
TrainInfo_	BG_Types_Pkg::TrainToTrackStatus_T	

Table 105: Outputs of CheckSingleBaliseGroup

Name	Type	Comments and Information
Orientation_	Q_DIRTRAIN	

11.1.4.2. Operator Hierarchy

<u>diagram</u> : diagram_CheckSingleBaliseGroup_1

11.1.4.3.   Graphical and Textual Diagrams

11.1.4.3.1.   View of diagram_CheckSingleBaliseGroup_1 (CheckSingleBaliseGroup)
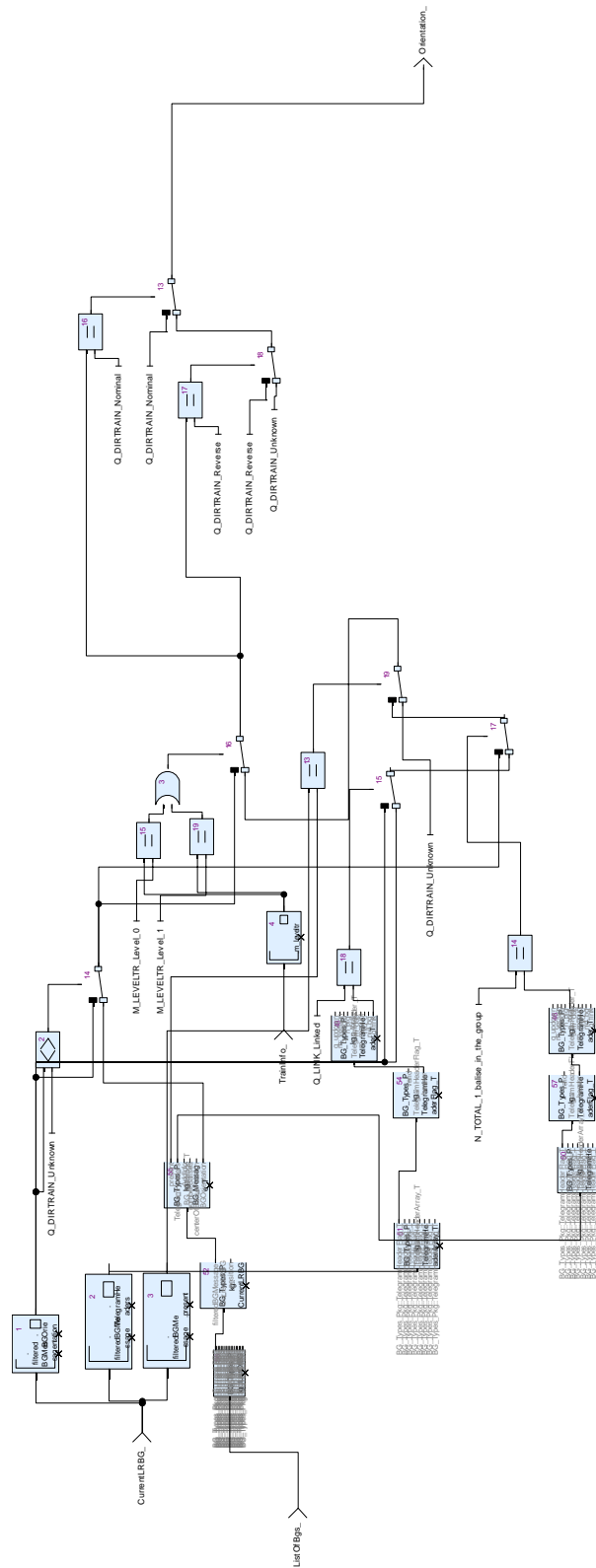
Figure 32: View of diagram_CheckSingleBaliseGroup_1 (CheckSingleBaliseGroup)

11.1.5.   DetermineBGOrientation_LRBG Operator

Declared as **public node**

11.1.5.1. Comments and Information

DetermineBGOrientation_LRBG Comments:

- SRS-Subset 26 section 3.4.2: Defines Balise Group Coordinate system.
- Only section related to Level 1 is implemented in this state.

11.1.5.2. Interface

Table 106: Inputs of DetermineBGOrientation_LRBG

Name	Type	Comments and Information
CurrentLRBG_	BG_Types_Pkg::CurrentLRBG	
CheckedBGMessage_	BG_Types_Pkg::BG_Message_T	
ListiOfBGs_	BG_Types_Pkg::ListOfBG	
TrainInfo_	BG_Types_Pkg::TrainToTrackStatus_T	
RBCOrientatioReport_	BG_Types_Pkg::RBCOrientationReport_T	

Table 107: Outputs of DetermineBGOrientation_LRBG

Name	Type	Properties		Comments and Information
FilteredBGMessage_	BG_Types_Pkg::BG_Message_T			
RBCReport_	Radio_TrainToTrack::Train_Position_Report	default	cRBCReports	

11.1.5.3. Locals

Table 108: Locals of DetermineBGOrientation_LRBG

Name	Type	Comments and Information
isPresent	bool	

11.1.5.4. Operator Hierarchy

<u>diagram</u> : diagram_internal_structure
    activate if : IfBlock1
        branch : then
        branch : else

11.1.5.5.   Graphical and Textual Diagrams

11.1.5.5.1.   View of diagram_internal_structure (DetermineBGOrientation_LRBG)
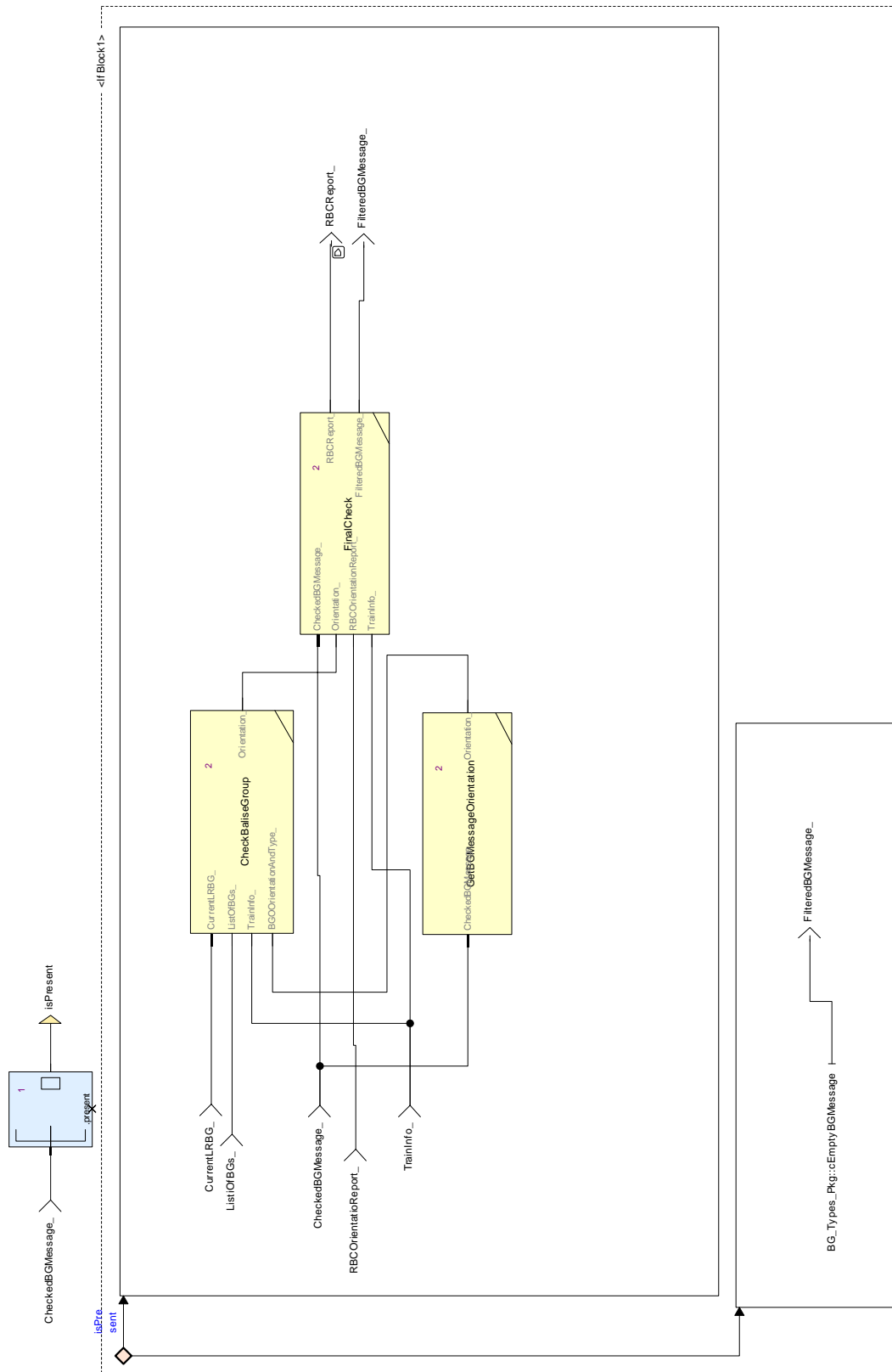
Figure 33: View of diagram_internal_structure (DetermineBGOrientation_LRBG)

Table 109: Conditional Blocks of diagram_internal_structure

Conditional Block	Comments and Information
IfBlock1	

Table 110: Actions of diagram_internal_structure

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

11.1.6.　　FinalCheck Operator

Declared as **public node**

11.1.6.1.　　Interface

Table 111: Inputs of FinalCheck

Name	Type	Comments and Information
CheckedBGMessage_	BG_Types_Pkg::BG_Message_T	
Orientation_	Q_DIRTRAIN	
RBCOrientationReport_	BG_Types_Pkg::RBCOrientationReport_T	
TrainInfo_	BG_Types_Pkg::TrainToTrackStatus_T	

Table 112: Outputs of FinalCheck

Name	Type	Properties		Comments and Information
RBCReport_	Radio_TrainToTrack::Train_Position_Report	default	cRBCReports	
		last	cRBCReports	
FilteredBGMessage_	BG_Types_Pkg::BG_Message_T	default	BG_Types_Pkg::cEmptyBGMessage	

11.1.6.2.　　Operator Hierarchy

diagram : diagram_FinalCheck_1
　　　state-machine : SM1
　　　　　state : Initial
　　　　　state : Level0or1
　　　　　state : Level2or3
　　　　　　　state-machine : SM2
　　　　　　　　state : Ack
　　　　　　　　state : Init
　　　　　　　　state : NoAck

11.1.6.3.   Graphical and Textual Diagrams

11.1.6.3.1.   View of diagram_FinalCheck_1 (FinalCheck)

Figure 34: View of diagram_FinalCheck_1 (FinalCheck)

Table 113: State Machines of diagram_FinalCheck_1

State Machine	Comments and Information
SM1	
SM1:Level2or3:SM2	

Table 114: States of diagram_FinalCheck_1

State	Comments and Information
SM1:Initial	
SM1:Level0or1	
SM1:Level2or3	
SM1:Level2or3:SM2:Ack	
SM1:Level2or3:SM2:Init	
SM1:Level2or3:SM2:NoAck	

Table 115: Transitions of diagram_FinalCheck_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: SM1:Initial Target: SM1:Level0or1	1	Condition: M_LEVELTR_Level_0 = TrainInfo_.m_leveltr or M_LEVELTR_Level_1 = TrainInfo_.m_leveltr	
Source: SM1:Initial Target: SM1:Level2or3	2	Condition: M_LEVELTR_Level_2 = TrainInfo_.m_leveltr or M_LEVELTR_Level_3 = TrainInfo_.m_leveltr	
Source: SM1:Level2or3:SM2:Init Target: SM1:Level2or3:SM2:Ack	1	Condition: RBCOrientationReport_ .assignment_of_coordi nate_system.M_ACK = 1	
Source: SM1:Level2or3:SM2:Init Target: SM1:Level2or3:SM2:NoAck	2	Condition: RBCOrientationReport_ .assignment_of_coordi nate_system.M_ACK = 0	

11.1.7. GetBGMessageOrientation Operator

Declared as **`public function`**

11.1.7.1. Interface

Table 116: Inputs of GetBGMessageOrientation

Name	Type	Comments and Information
CheckedBGMessage_	BG_Types_Pkg::BG_M essage_T	

Table 117: Outputs of GetBGMessageOrientation

Name	Type	Comments and Information
Orientation_	BG_Types_Pkg::Orient ation_T	

11.1.7.2.   Operator Hierarchy

diagram : diagram_GetBGMessageOrientation

11.1.7.3.   Graphical and Textual Diagrams

11.1.7.3.1.   View of diagram_GetBGMessageOrientation (GetBGMessageOrientation)
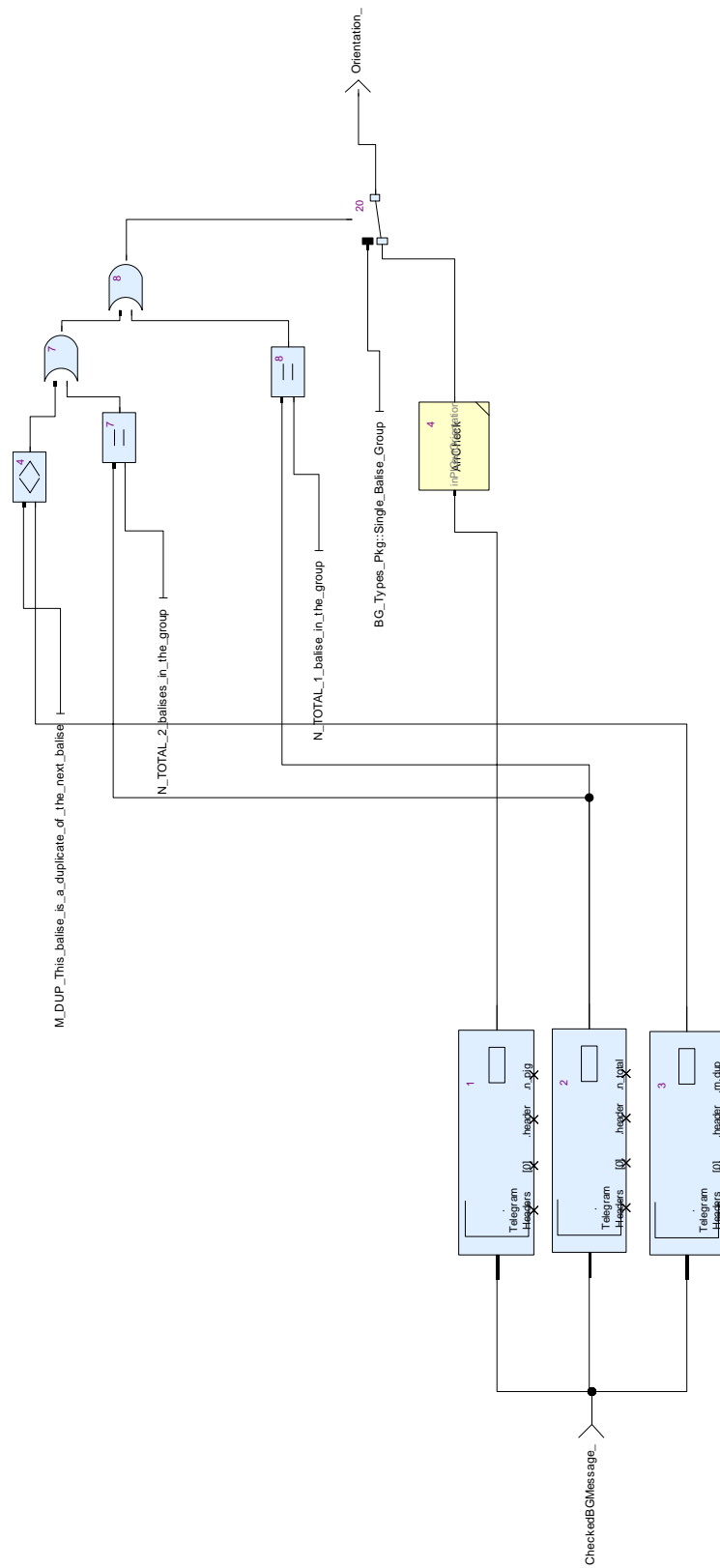
Figure 35: View of diagram_GetBGMessageOrientation (GetBGMessageOrientation)

11.1.8. setOrientation Operator

Declared as **public function**

11.1.8.1. Comments and Information

setOrientation Comments:

- Sets the orintation in a BG-Message base on the input

11.1.8.2. Interface

Table 118: Inputs of setOrientation

Name	Type	Comments and Information
inBGMessage	BG_Types_Pkg::BG_Message_T	
inOrientation	Q_DIRTRAIN	

Table 119: Outputs of setOrientation

Name	Type	Comments and Information
outBGMessage	BG_Types_Pkg::BG_Message_T	

11.1.8.3. Operator Hierarchy

<u>diagram</u> : diagram_setOrientation_1

11.1.8.4.   Graphical and Textual Diagrams

11.1.8.4.1.   View of diagram_setOrientation_1 (setOrientation)
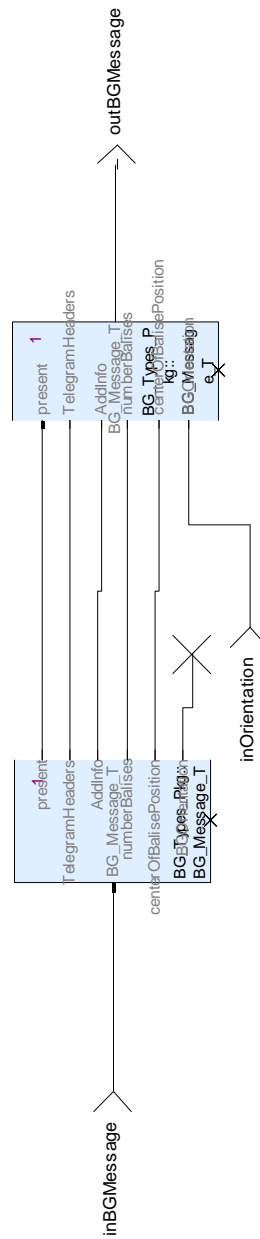
Figure 36: View of diagram_setOrientation_1 (setOrientation)

12. Project Library: ReceiveEuroBaliseFromAPI

12.1.　　　Root Elements

12.1.1.　　Types

Table 120: Public Types of ReceiveEuroBaliseFromAPI

Name	Definition	Comments and Information
API_addInfo_T	{listLinking : BG_Types_Pkg::LinkedBGs_T}	Comments: packet information received via telegram listLinking Comments: Linking information received via packet 5. Information is of variable length.
API_Telegram_T	{present : bool, api_header : BG_Types_Pkg::TelegramHeader_T, api_packets : API_addInfo_T, api_bad_balise_received : bool, centerOfBalisePosition : BG_Types_Pkg::centerOfBalisePosition_T}	Comments: Telegram as received via the API present Comments: Indicates the presence of new and valid information at the start of the routine api_header Comments: Telegram_Header api_packets Comments: Packets received with this balise api_bad_balise_received Comments: inicates, whether a bad balise has been received. In this scenario, dta are not valid. centerOfBalisePosition Comments: actual odometry of where the telegram has been received

12.1.2.   Constants

Table 121: 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}	

Name	Type	Value	Comments and Information
		{present : false, valid : false, telegramheader : {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}, packets : {addInfo : 0, 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 :	
cEmptyBaliseTelegramInit	BG_Types_Pkg::Telegram_T		

Name	Type	Value	Comments and Information
		{addInfo : 0, 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,	

Name	Type	Value	Comments and Information
		{present : false, valid : false, telegramheader : {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}, packets : {addInfo : 0, 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 :	
cInitDecodedTelegram	BG_Types_Pkg::Telegram_T		

Name	Type	Value	Comments and Information
		[{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 : Q_LINKORIENTATIO	

Name	Type	Value	Comments and Information
cInitEmptyPosition	BG_Types_Pkg::centerOfBalisePosition_T	{centerOfBalisePosition : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, timestamp : 0}	

12.2.   btmSupportPkg Package

12.2.1.   transferPackets Operator

Declared as **public function**

12.2.1.1.   Interface

Table 122: Inputs of transferPackets

Name	Type	Comments and Information
api_packets	API_addInfo_T	

Table 123: Outputs of transferPackets

Name	Type	Comments and Information
out_AddInfo	BG_Types_Pkg::AdditionalInformation_T	

12.2.1.2.   Operator Hierarchy

diagram : diagram_transferPackets_1

12.2.1.3. Graphical and Textual Diagrams

12.2.1.3.1. View of diagram_transferPackets_1 (transferPackets)
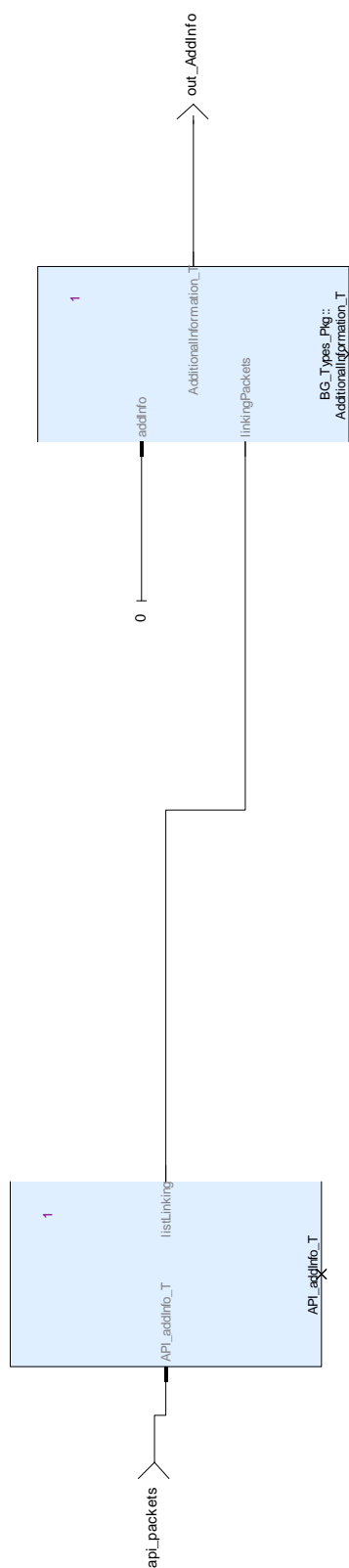
Figure 37: View of diagram_transferPackets_1 (transferPackets)

12.2.2.   transferTelegram Operator

Declared as **public function**

12.2.2.1.   Interface

Table 124: Inputs of transferTelegram

Name	Type	Comments and Information
API_balise	API_Telegram_T	

Table 125: Outputs of transferTelegram

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

12.2.2.2.   Operator Hierarchy

<u>diagram</u> : diagram_transferTelegram_1

12.2.2.3.   Graphical and Textual Diagrams

12.2.2.3.1.   View of diagram_transferTelegram_1 (transferTelegram)
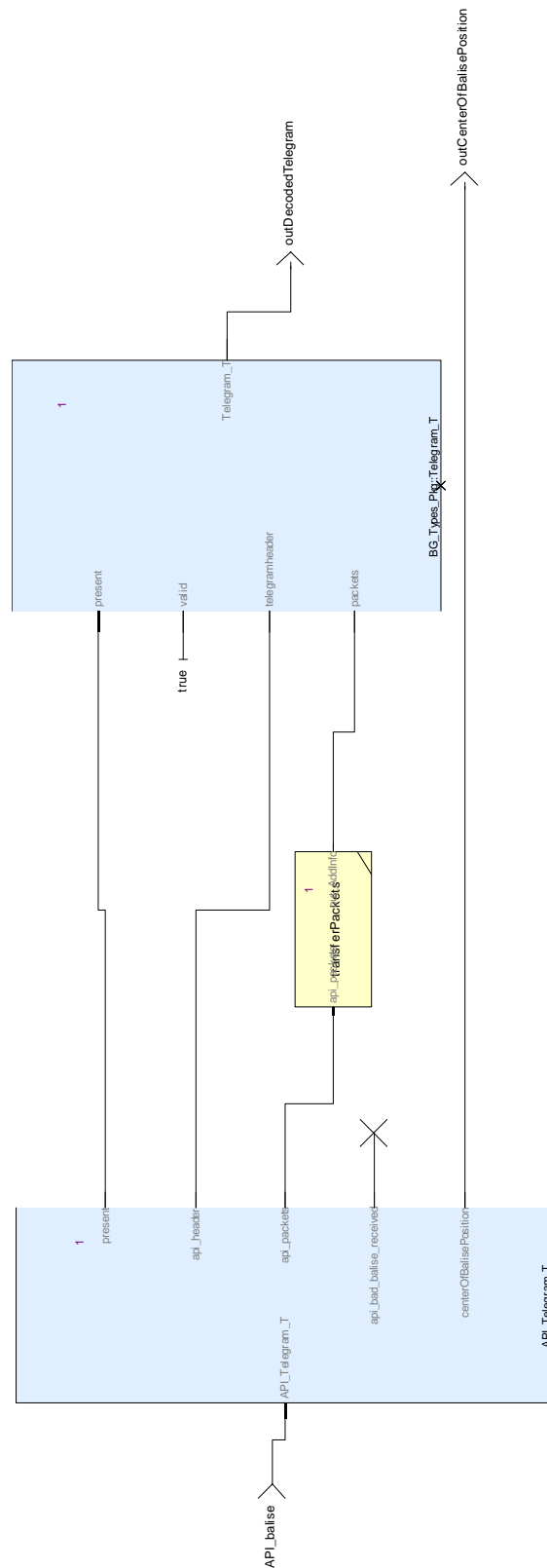
Figure 38: View of diagram_transferTelegram_1 (transferTelegram)

diagram_transferTelegram_1 Comments:

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

12.3. ReceiveEuroBaliseFromAPI_Pkg Package

12.3.1. ReceiveEuroBaliseFromAPI Operator

Declared as **public function**

12.3.1.1. 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

12.3.1.2. Interface

Table 126: Inputs of ReceiveEuroBaliseFromAPI

Name	Type	Comments and Information
API_balise	API_Telegram_T	

Table 127: Outputs of ReceiveEuroBaliseFromAPI

Name	Type	Properties		Comments and Information
outDecodedTelegram	BG_Types_Pkg::Telegram_T	default	cInitDecoded Telegram	
outcenterOfBalisePosition	BG_Types_Pkg::centerOfBalisePosition_T	default	cInitEmptyPosition	

12.3.1.3. Locals

Table 128: Locals of ReceiveEuroBaliseFromAPI

Name	Type	Comments and Information
bad_balise	bool	
is_present	bool	

12.3.1.4. Operator Hierarchy

diagram : diagram_ReceiveEuroBaliseFromAPI_1
    activate if : is_present_blk
        branch : then
            activate if : has_fresh_data_blk
                branch : then
                    diagram : diagram_Then_1
                branch : else
                    diagram : diagram_Else_1
        branch : else

12.3.1.5.   Graphical and Textual Diagrams

12.3.1.5.1.   View of diagram_ReceiveEuroBaliseFromAPI_1 (ReceiveEuroBaliseFromAPI)
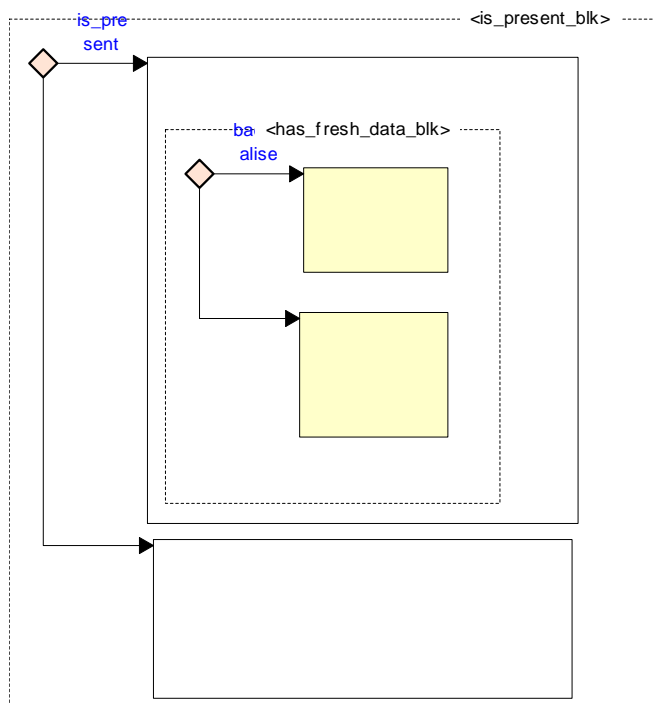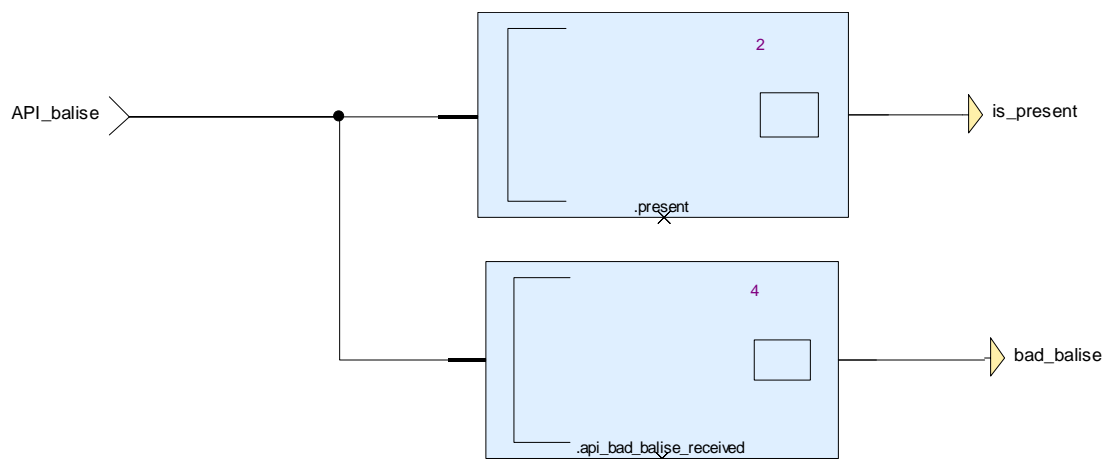
Figure 39: View of diagram_ReceiveEuroBaliseFromAPI_1 (ReceiveEuroBaliseFromAPI)

Table 129: Conditional Blocks of diagram_ReceiveEuroBaliseFromAPI_1

Conditional Block	Comments and Information
is_present_blk	
is_present_blk:then:has_fresh_data_blk	

Table 130: Actions of diagram_ReceiveEuroBaliseFromAPI_1

Conditional Block Action	Comments and Information
is_present_blk:then	

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

12.3.1.5.2.   View of diagram_Then_1
(ReceiveEuroBaliseFromAPI/is_present_blk:then:has_fresh_data_blk:then:)

Owner diagram: diagram_ReceiveEuroBaliseFromAPI_1

Conditional Block Action	Comments and Information

outDecodedTelegram

cEmptyBaliseTelegramInit

centerOfBalisePosition

API_balise

Figure 40: View of diagram_Then_1
(ReceiveEuroBaliseFromAPI/is_present_blk:then:has_fresh_data_blk:then:)

diagram_Then_1 Comments:

- This path is meant to indicate the situation where a bad balise telegram has been received.

- Infomration about the balise is not known.
- However, information about the event has to be passed to the bg-message builder

12.3.1.5.3.   View of diagram_Else_1
(ReceiveEuroBaliseFromAPI/is_present_blk:then:has_fresh_data_blk:else:)

Owner diagram: diagram_ReceiveEuroBaliseFromAPI_1
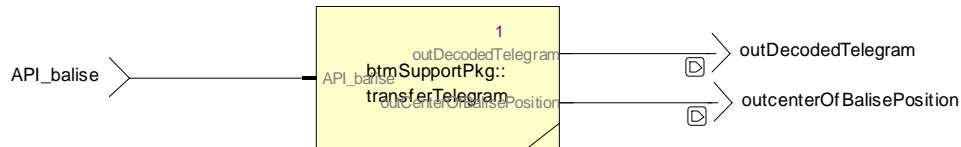
Figure 41: View of diagram_Else_1
(ReceiveEuroBaliseFromAPI/is_present_blk:then:has_fresh_data_blk:else:)

diagram_Else_1 Comments:

- Situation: fresh data have been delivered and balise data are valid.
- In this situation copieng of telegram, odometry and packets is to be done.

13. Project Library: SelectUsableInfo

13.1.   SelectUsableInfo_Pkg Package

13.1.1.   SelectUsableInfo Operator

Declared as **public function**

13.1.1.1.   Interface

Table 131: Inputs of SelectUsableInfo

Name	Type	Comments and Information
BG_Message_in	BG_Types_Pkg::BG_Message_T	
TrainInfo_	BG_Types_Pkg::TrainToTrackStatus_T	

Table 132: Outputs of SelectUsableInfo

Name	Type	Comments and Information
BG_Message_out	BG_Types_Pkg::BG_Message_T	

13.1.1.2.   Operator Hierarchy

diagram : diagram_SelectUsableInfo_1

13.1.1.3.   Graphical and Textual Diagrams

13.1.1.3.1.   View of diagram_SelectUsableInfo_1 (SelectUsableInfo)

BG_Message_in ⟩─────────────⟩ BG_Message_out

TrainInfo_ ⟩──────✕
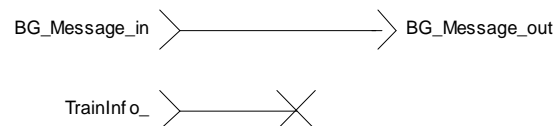
Figure 42: View of diagram_SelectUsableInfo_1 (SelectUsableInfo)

14. Project Library: TrainPosition_Integration

14.1. TrainPosition_Integration_Pkg Package

14.1.1. ManageTrainPosition Operator

Declared as **public node**

14.1.1.1. Interface

Table 133: Inputs of ManageTrainPosition

Name	Type	Comments and Information
currentOdometry	Obu_BasicTypes_Pkg::odometry_T	Comments: The current odometry values
passedBG	BG_Types_Pkg::passedBG_T	Comments: Input event reporting a balise group during its passage, if there is one.
LRBG	TrainPosition_Types_Pck::positionedBG_T	Comments: The LRBG used for RBC communication.
prevLRBG	TrainPosition_Types_Pck::positionedBG_T	Comments: A previously used LRBG used in RBC communication.
reset	bool	Comments: 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_Pck::trainProperties_T	
rcbComm	ProvidePositionReport_Pkg::RBC_Communication_T	
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	
linkingInfoUsed	ProvidePositionReport_Pkg::LinkingInfoUsedOnBoard	

Table 134: Outputs of ManageTrainPosition

Name	Type	Comments and Information
posRep	ProvidePositionReport_Pkg::PositionReport_T	
trainPosition	TrainPosition_Types_Pck::trainPosition_T	
trainPosInfo	TrainPosition_Types_Pck::trainPositionInfo_T	Comments: The resulting train position with reference to the LRBG

Name	Type	Comments and Information
trainPosErrors	TrainPosition_Types_Pck::positionErrors_T	Comments: Errors and inconsistencies detected by the calculation.
BGs	TrainPosition_Types_Pck::positionedBGs_T	Comments: The collection of currently known BGs.

14.1.1.2. Locals

Table 135: Locals of ManageTrainPosition

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

14.1.1.3. Operator Hierarchy

<u>diagram</u> : diagram_ManageTrainPosition_1

14.1.1.4.   Graphical and Textual Diagrams

14.1.1.4.1.   View of diagram_ManageTrainPosition_1 (ManageTrainPosition)
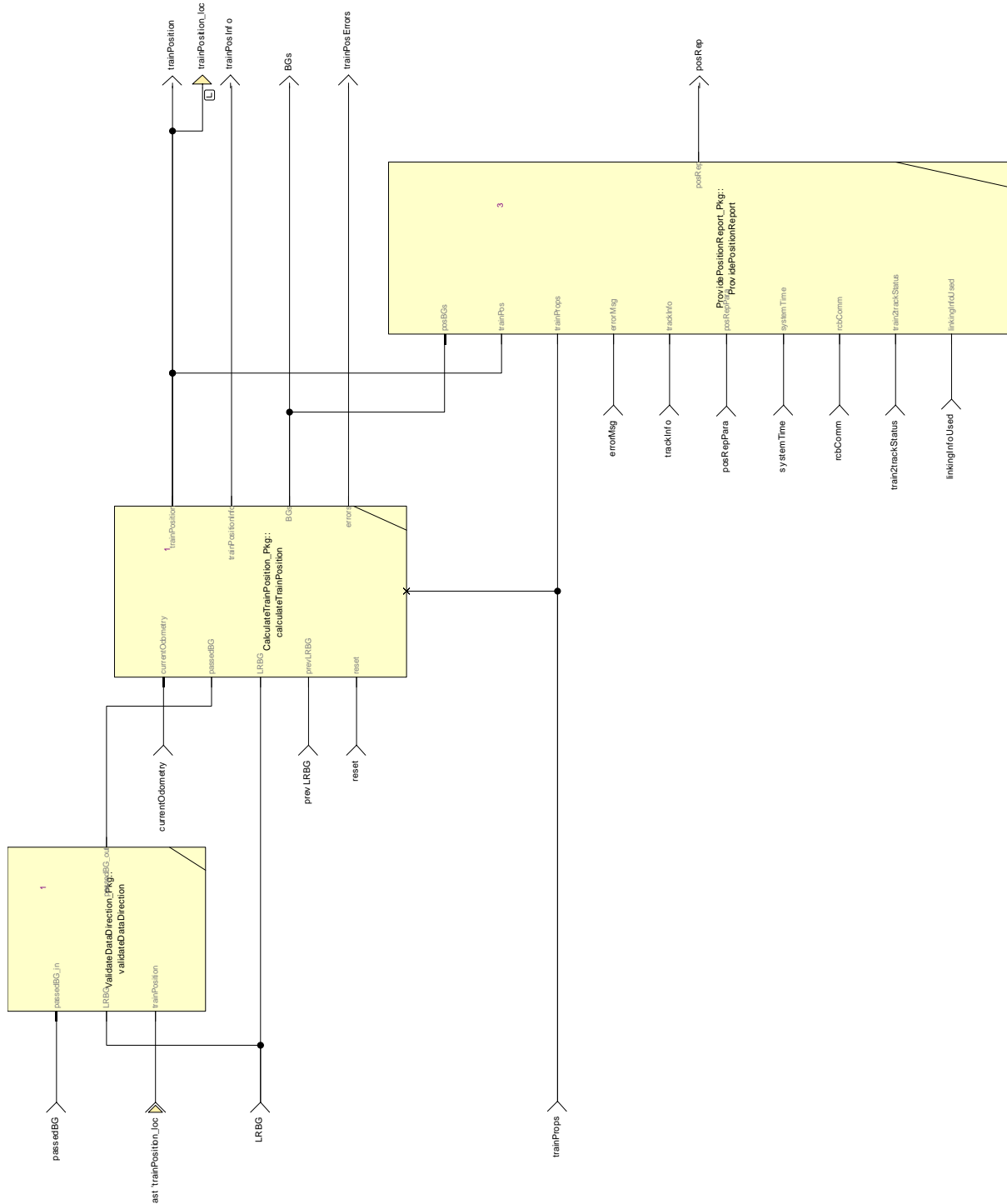
Figure 43: View of diagram_ManageTrainPosition_1 (ManageTrainPosition)

15. Project Library: CalculateTrainPosition

15.1. CalculateTrainPosition_Pkg Package

15.1.1. Comments and Information

CalculateTrainPosition_Pkg Comments:

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

Table 136: 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	CalculateTrainPosition - Description: Calculates the actual train position based on passed balise groups - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

15.1.2. Types

Table 137: Public Types of CalculateTrainPosition_Pkg

Name	Definition	Comments and Information
positionedBGs_w_over run_T	{BGs : TrainPosition_Types_Pck::positionedB Gs_T, overrun : bool}	

15.1.3.   Constants

Table 138: 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	Comments: 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	Comments: Covers ???: Min no of unlinked BGs to be memorized

Name	Type	Value	Comments and Information
		{valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {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}, linkedBGs : [{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_S	

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_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {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 :	

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_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_link_telegram, m_version : M_VERSION_Previous_versions_according_to_e_g_EEIG_S RS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise, n_pig :	

Name	Type	Value	Comments and Information
cNoPositionErrors	TrainPosition_Types _Pck::positionErrors _T	{outOfMemSpace : false, passedBG_notFound WhereExpected : false, positionCalculation_ inconsistent : false}	
cNoValidIndex	int	-1	Comments: 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 stion : 0, nid_LRBG : 0, nid_PrvLRB : 0, nominalOrReverseT oLRBG : Q_DLRBG_Reverse, trainOrientationToL RBG : Q_DIRLRBG_Revers e, trainRunningDirecti onToLRBG : Q_DIRTRAIN_Rever se, speed : 0}	

15.1.4. calculateBGLocations Operator

Declared as **private node**

15.1.4.1. Comments and Information

calculateBGLocations Comments:

- Calculation of the locations of passed and announced BGs

Table 139: 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	The main function calculating the actual train position. - Description: Calculates the actual train position based on passed balise groups - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

15.1.4.2. Interface

Table 140: Inputs of calculateBGLocations

Name	Type	Comments and Information
passedBG	BG_Types_Pkg::passedBG_T	Comments: Input event reporting a balise group during its passage, if there is one.
lastBGs	TrainPosition_Types_Pck::positionedBGs_T	Comments: The last collection of currently known BGs.
reset	bool	Comments: Resets all to an initials state and deletes all stored BGs.

Table 141: Outputs of calculateBGLocations

Name	Type	Comments and Information
BGs	TrainPosition_Types_Pck::positionedBGs_T	Comments: The collection of currently known BGs.
errors	TrainPosition_Types_Pck::positionErrors_T	

15.1.4.3. Locals

Table 142: Locals of calculateBGLocations

Name	Type	Comments and Information
outOfMemSpace	bool	
passedBG_notFoundWhereExpected	bool	

15.1.4.4. Operator Hierarchy

diagram : diagram_errorReporting
diagram : diagram_passing_a_BG

15.1.4.5.　Graphical and Textual Diagrams

15.1.4.5.1.　View of diagram_errorReporting (calculateBGLocations)
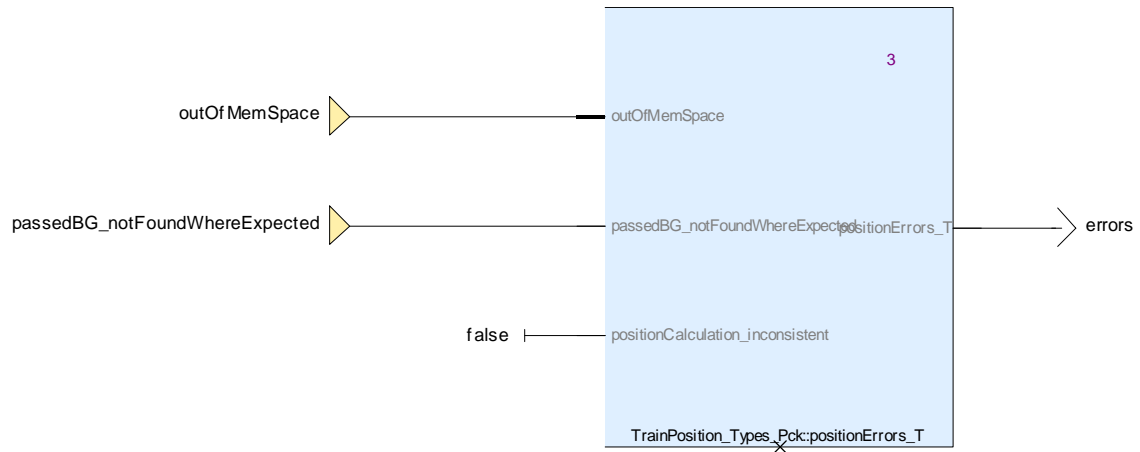
Figure 44: View of diagram_errorReporting (calculateBGLocations)

15.1.4.5.2.   View of diagram_passing_a_BG (calculateBGLocations)
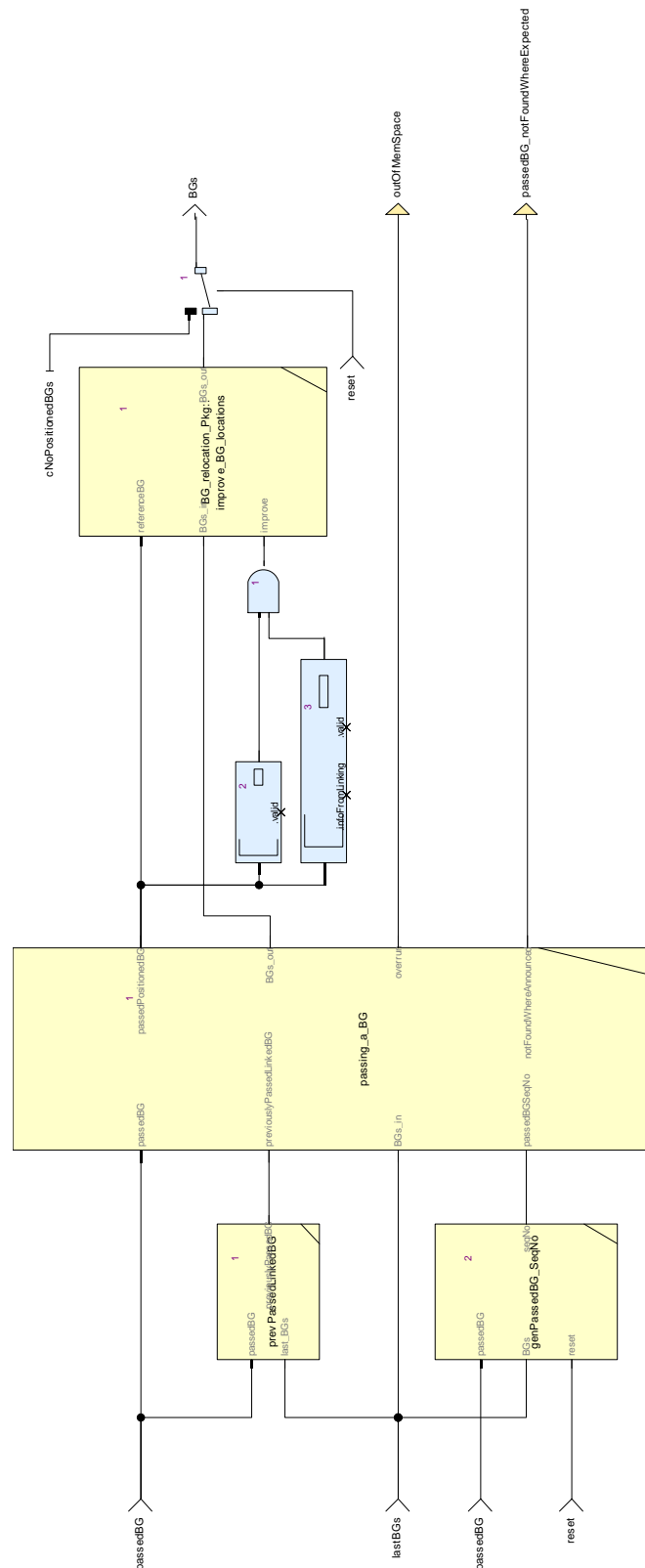
Figure 45: View of diagram_passing_a_BG (calculateBGLocations)

15.1.5.   calculateTrainPosition Operator

Declared as **public node**

15.1.5.1.   Comments and Information

calculateTrainPosition Comments:

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

Table 143: 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	The main function calculating the actual train position. - Description: Calculates the actual train position based on passed balise groups - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

15.1.5.2.   Interface

Table 144: Inputs of calculateTrainPosition

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

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

Table 145: Outputs of calculateTrainPosition

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

15.1.5.3. Locals

Table 146: Locals of calculateTrainPosition

Name	Type	Properties		Comments and Information
BGs_loc	TrainPosition_Types_Pck::positionedBGs_T	last	cNoPositionedBGs	

15.1.5.4. Operator Hierarchy

<u>diagram</u> : diagram_calculateTrainPosition

15.1.5.5.   Graphical and Textual Diagrams

15.1.5.5.1.   View of diagram_calculateTrainPosition (calculateTrainPosition)

Figure 46: View of diagram_calculateTrainPosition (calculateTrainPosition)
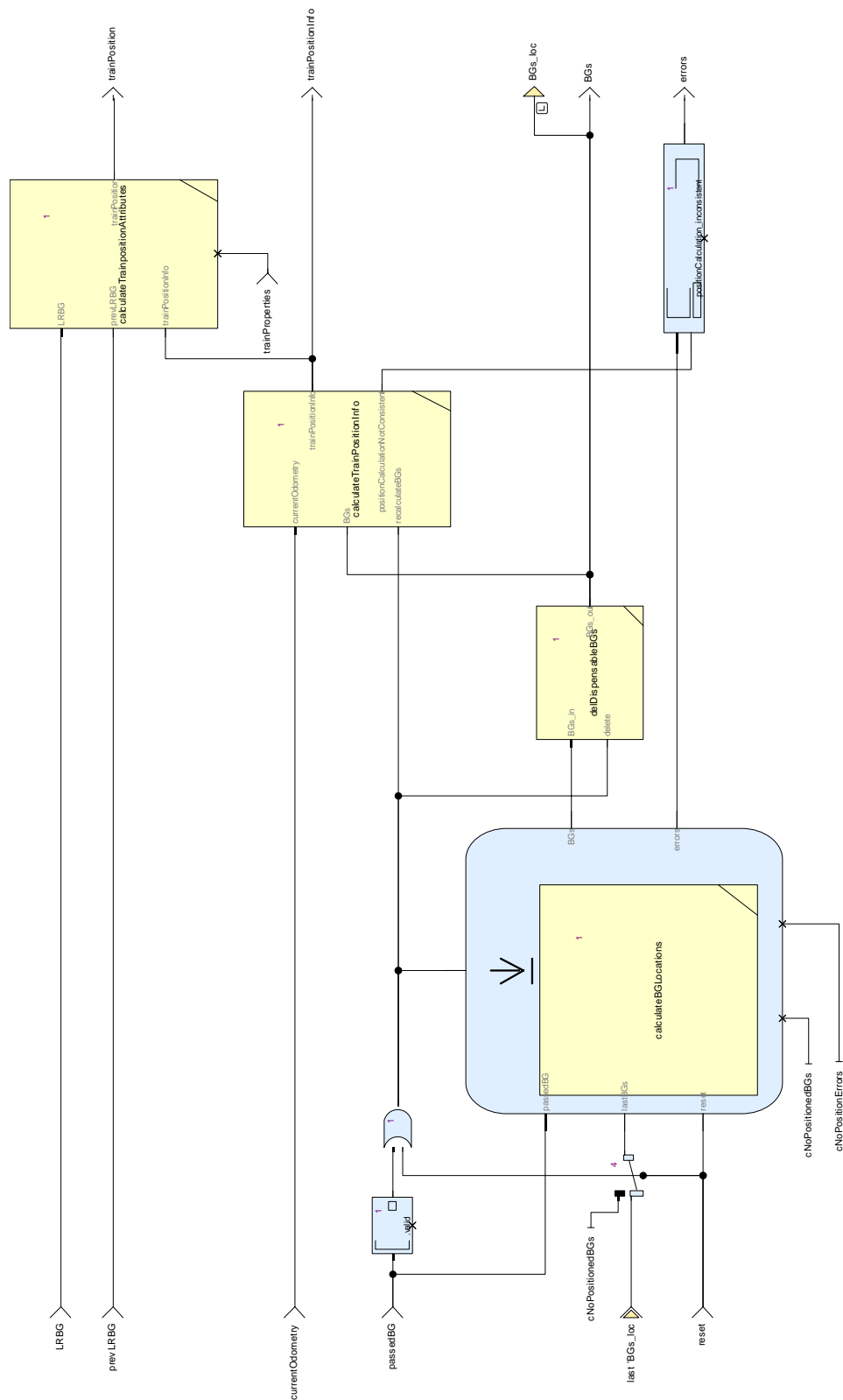
15.1.6.   calculateTrainpositionAttributes Operator

Declared as **private function**

15.1.6.1.   Comments and Information

calculateTrainpositionAttributes Comments:

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

Table 147: 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	The main function calculating the actual train position. - Description: Calculates the actual train position based on passed balise groups - 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.
	to_c	True

15.1.6.2.   Interface

Table 148: Inputs of calculateTrainpositionAttributes

Name	Type	Properties	Comments and Information
LRBG	TrainPosition_Types_Pck::positionedBG_T		Comments: The LRBG used for RBC communication.
prevLRBG	TrainPosition_Types_Pck::positionedBG_T		Comments: A previously used LRBG used in RBC communication.
trainPositionInfo	TrainPosition_Types_Pck::trainPositionInfo_T		Comments: 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	Comments: The trains properties required for train position calculation.

Table 149: Outputs of calculateTrainpositionAttributes

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

15.1.6.3.   Operator Hierarchy

diagram : diagram_calculateTrainpositionAttributes

15.1.6.4.   Graphical and Textual Diagrams

15.1.6.4.1.   View of diagram_calculateTrainpositionAttributes (calculateTrainpositionAttributes)
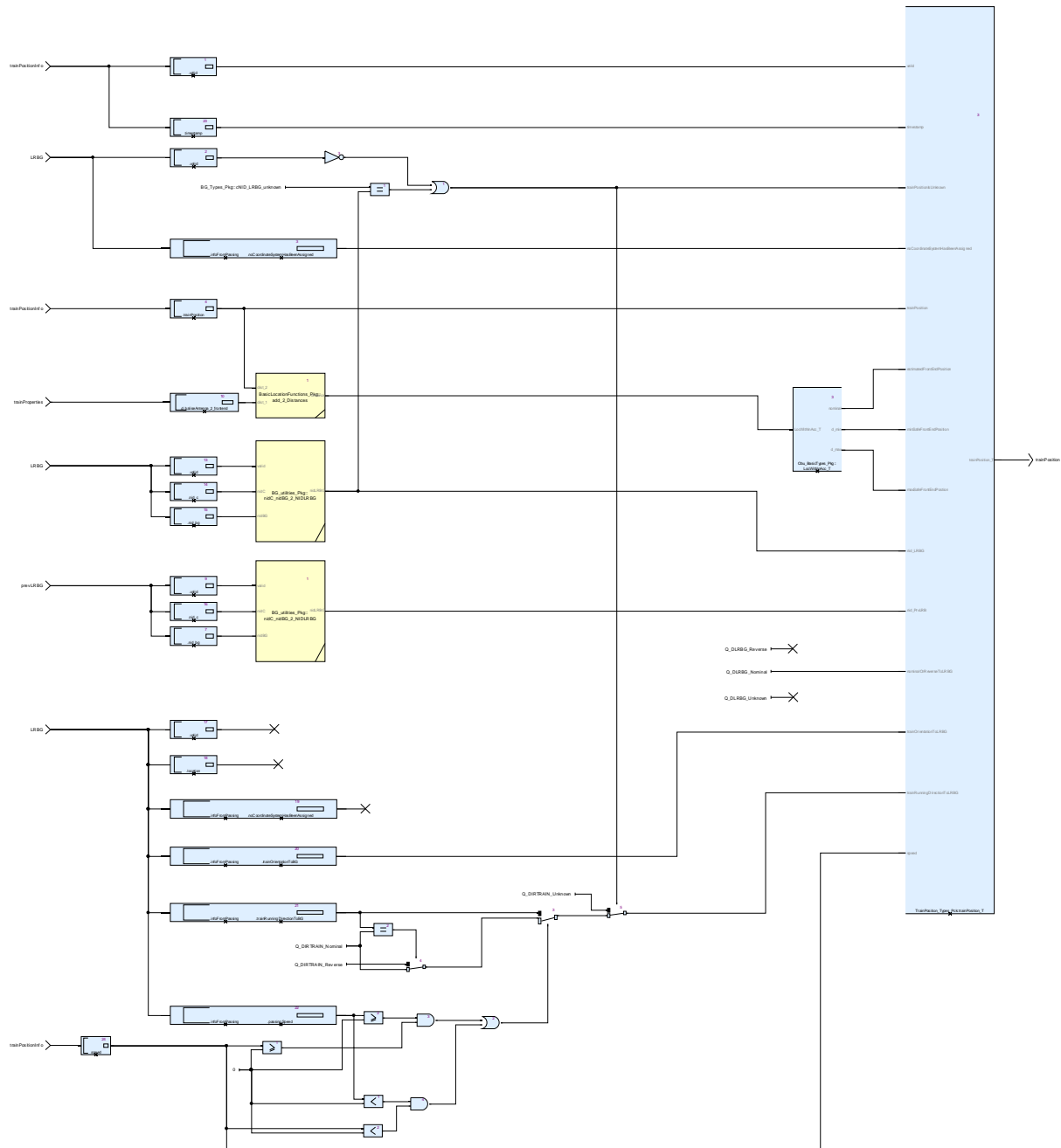
Figure 47: View of diagram_calculateTrainpositionAttributes (calculateTrainpositionAttributes)

15.1.7.   calculateTrainPositionInfo Operator

Declared as **private function**

15.1.7.1.   Comments and Information

calculateTrainPositionInfo Comments:

- Provides the train position information.

15.1.7.2. Interface

Table 150: Inputs of calculateTrainPositionInfo

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

Table 151: Outputs of calculateTrainPositionInfo

Name	Type	Comments and Information
trainPositionInfo	TrainPosition_Types_Pck::trainPositionInfo_T	Comments: The resulting train position with reference to the known list of balise groups.
positionCalculationNot Consistent	bool	

15.1.7.3. Operator Hierarchy

<u>diagram</u> : diagram_calculateTrainPositionInfo_1

15.1.7.4.   Graphical and Textual Diagrams

15.1.7.4.1.   View of diagram_calculateTrainPositionInfo_1 (calculateTrainPositionInfo)
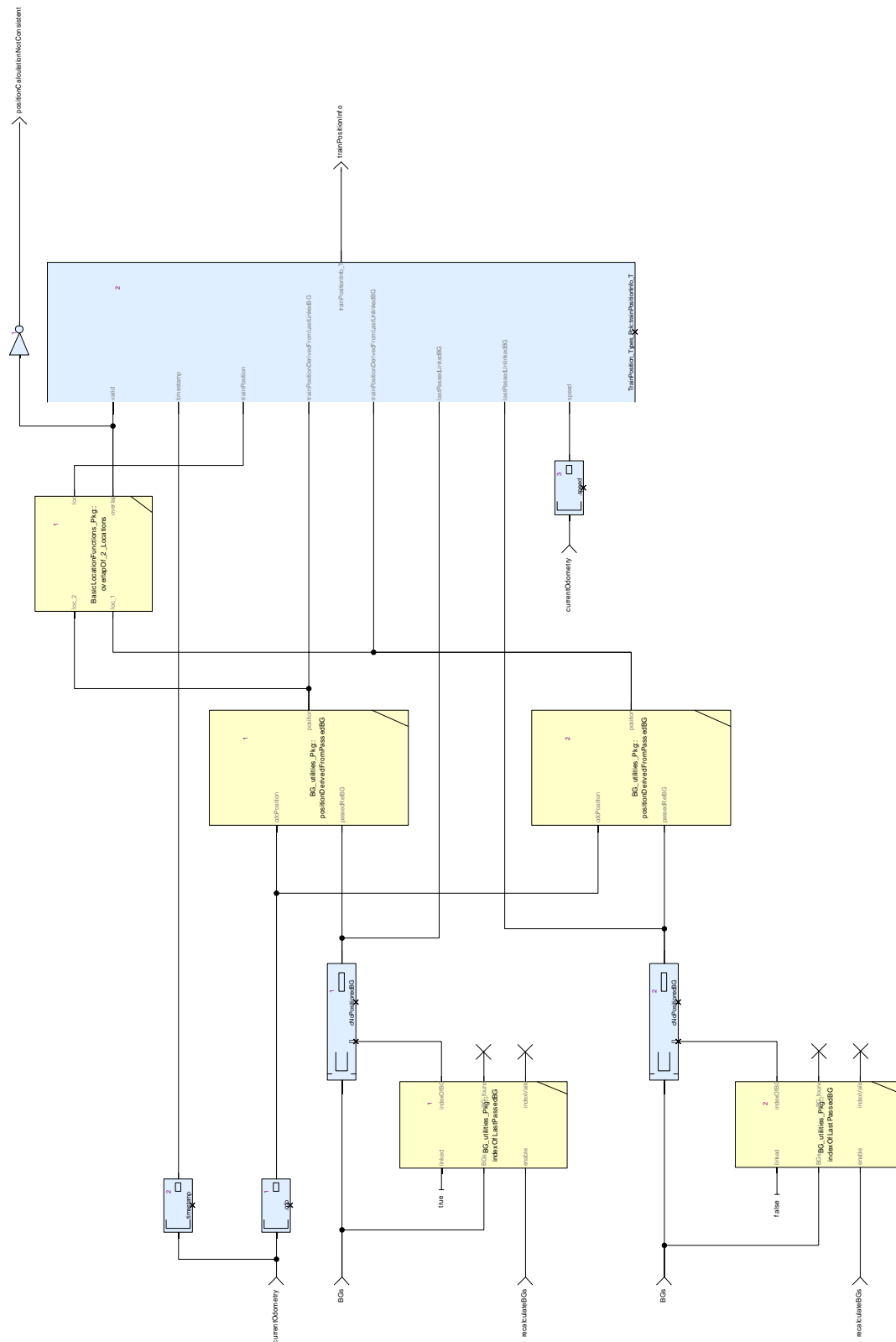
Figure 48: View of diagram_calculateTrainPositionInfo_1 (calculateTrainPositionInfo)

15.1.8.　delDispensableBGs Operator

Declared as **private function**

15.1.8.1.　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.

15.1.8.2.　Interface

Table 152: Inputs of delDispensableBGs

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	Comments: The collection of BGs as known before passedBG was passed.
delete	bool	

Table 153: Outputs of delDispensableBGs

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	Comments: The collection of BGs as known when passedBG was passed.

15.1.8.3.　Locals

Table 154: Locals of delDispensableBGs

Name	Type	Comments and Information
passedLinkedBGsCount	int	
passedUnlinkedBGsCount	int	

15.1.8.4.　Operator Hierarchy

<u>diagram</u> : diagram_delDispensableBGs_1
　　　activate if : IfBlock1
　　　　　branch : then
　　　　　branch : else

15.1.8.5.   Graphical and Textual Diagrams

15.1.8.5.1.   View of diagram_delDispensableBGs_1 (delDispensableBGs)
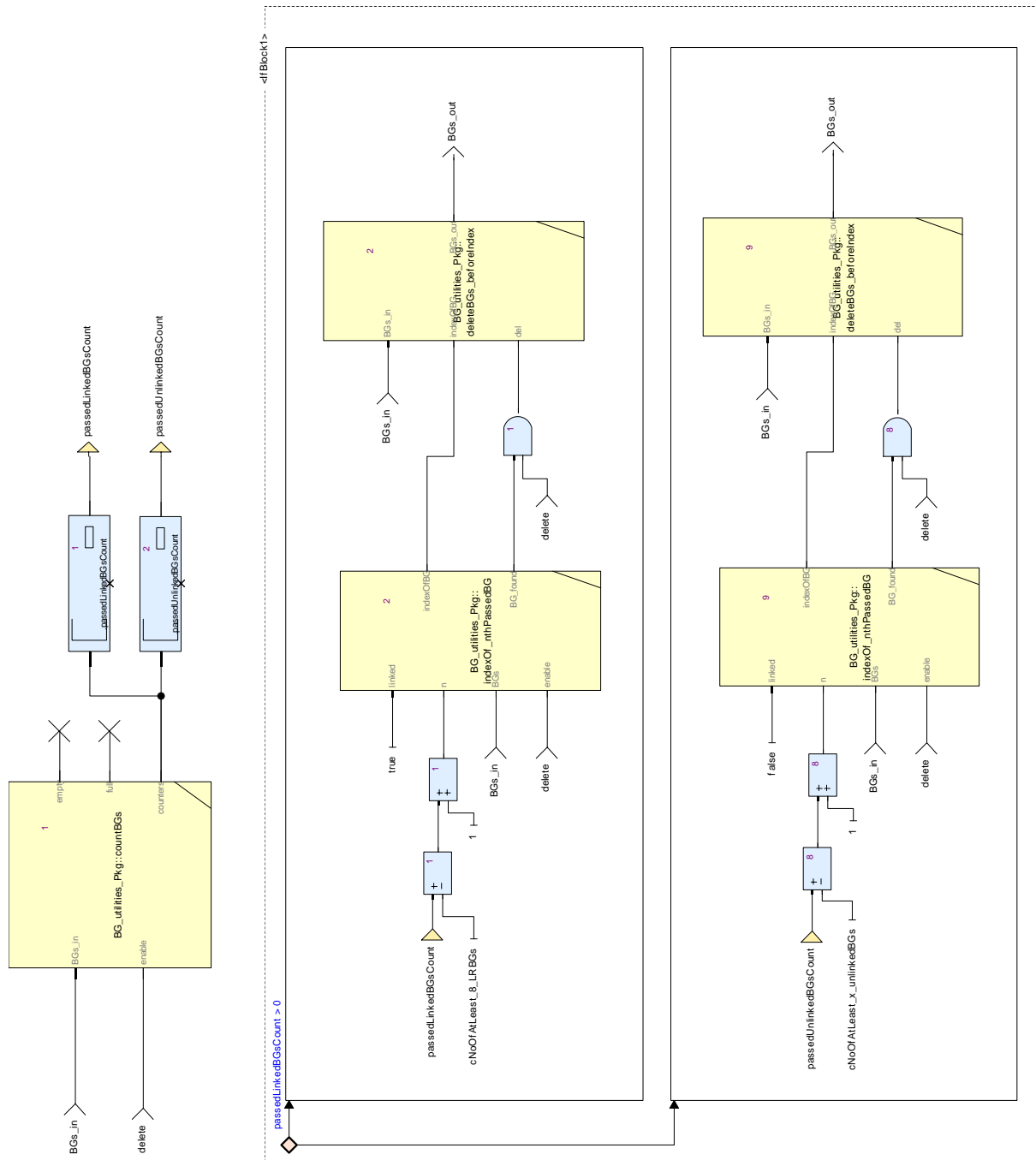
Figure 49: View of diagram_delDispensableBGs_1 (delDispensableBGs)

Table 155: Conditional Blocks of diagram_delDispensableBGs_1

Conditional Block	Comments and Information
IfBlock1	

Table 156: Actions of diagram_delDispensableBGs_1

Conditional Block Action	Comments and Information
IfBlock1:then	

Conditional Block Action	Comments and Information
IfBlock1:else	

15.1.9.   genPassedBG_SeqNo Operator

Declared as **private node**

15.1.9.1.   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.

15.1.9.2.   Interface

Table 157: Inputs of genPassedBG_SeqNo

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

Table 158: Outputs of genPassedBG_SeqNo

Name	Type	Comments and Information
seqNo	int	

15.1.9.3.   Locals

Table 159: Locals of genPassedBG_SeqNo

Name	Type	Comments and Information
incrPassedBGSeqNo	bool	
keepPassedBGSeqNo	bool	

15.1.9.4.   Operator Hierarchy

diagram : diagram_genPassedBG_SeqNo_1

15.1.9.5. Graphical and Textual Diagrams

15.1.9.5.1. View of diagram_genPassedBG_SeqNo_1 (genPassedBG_SeqNo)
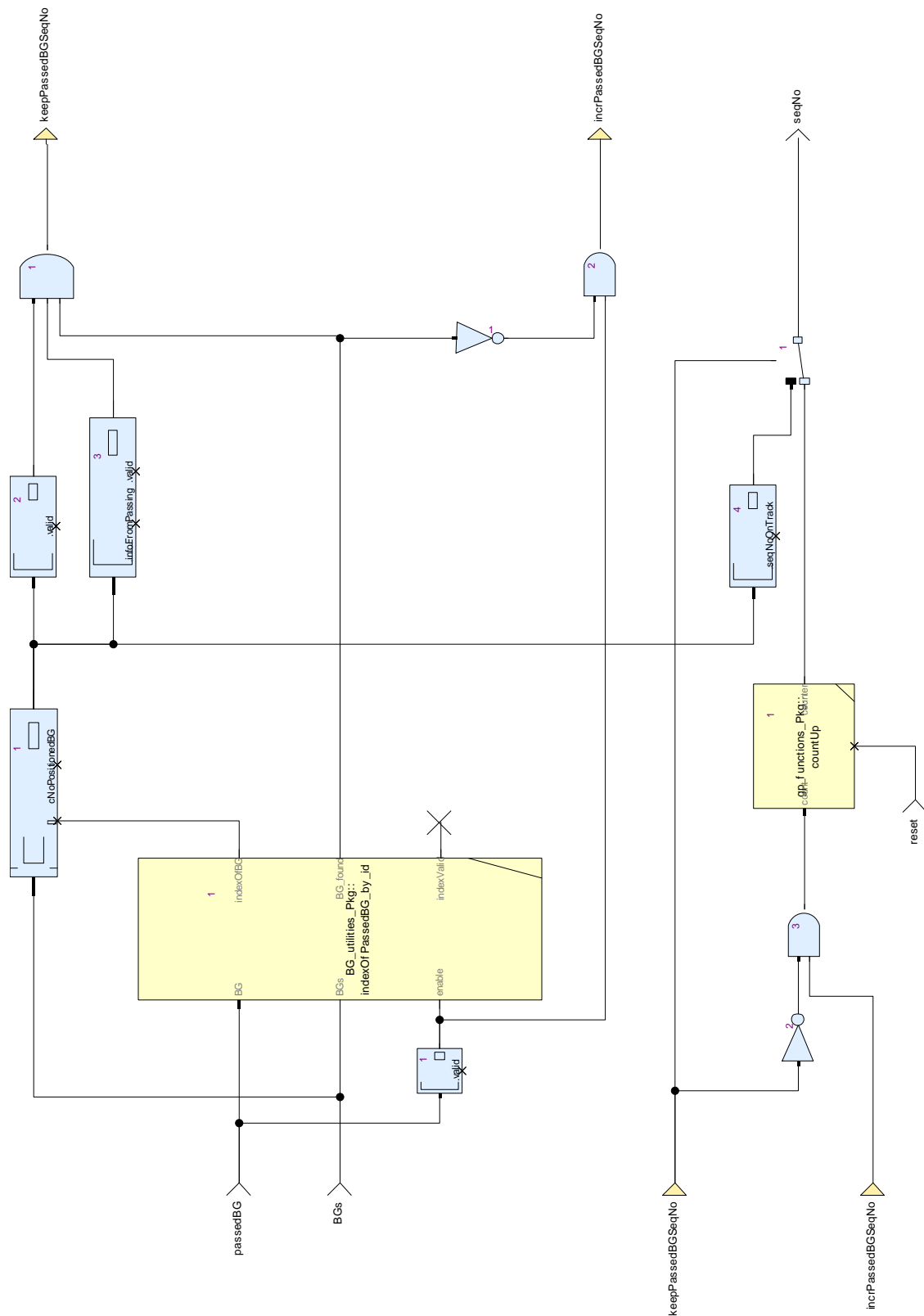
Figure 50: View of diagram_genPassedBG_SeqNo_1 (genPassedBG_SeqNo)

15.1.10.   memPassedBG Operator

Declared as **private node**

15.1.10.1.   Comments and Information

memPassedBG Comments:

- Memorizes the passed linked and unlinked BG

Table 160: 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	Memorizes the passed linked and unlinked BG - 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.
	to_c	True

15.1.10.2.   Interface

Table 161: Inputs of memPassedBG

Name	Type	Comments and Information
passedBG	TrainPosition_Types_Pck::positionedBG_T	
prevPassedLinkedBG	TrainPosition_Types_Pck::positionedBG_T	Comments: The previously passed linked BG as a reference location for improvement of an unlinked BG location.
reset	bool	

Table 162: Outputs of memPassedBG

Name	Type	Comments and Information
passedLinkedBG	TrainPosition_Types_Pck::positionedBG_T	

Name	Type	Comments and Information
passedUnlinkedBG	TrainPosition_Types_Pck::positionedBG_T	

15.1.10.3. Locals

Table 163: Locals of memPassedBG

Name	Type	Properties		Comments and Information
passedUnlinkedBG_loc	TrainPosition_Types_Pck::positionedBG_T	last	cNoPositionedBG	

15.1.10.4. Operator Hierarchy

<u>diagram</u> : diagram_memPassedBG_1

15.1.10.5.　Graphical and Textual Diagrams

15.1.10.5.1.　View of diagram_memPassedBG_1 (memPassedBG)
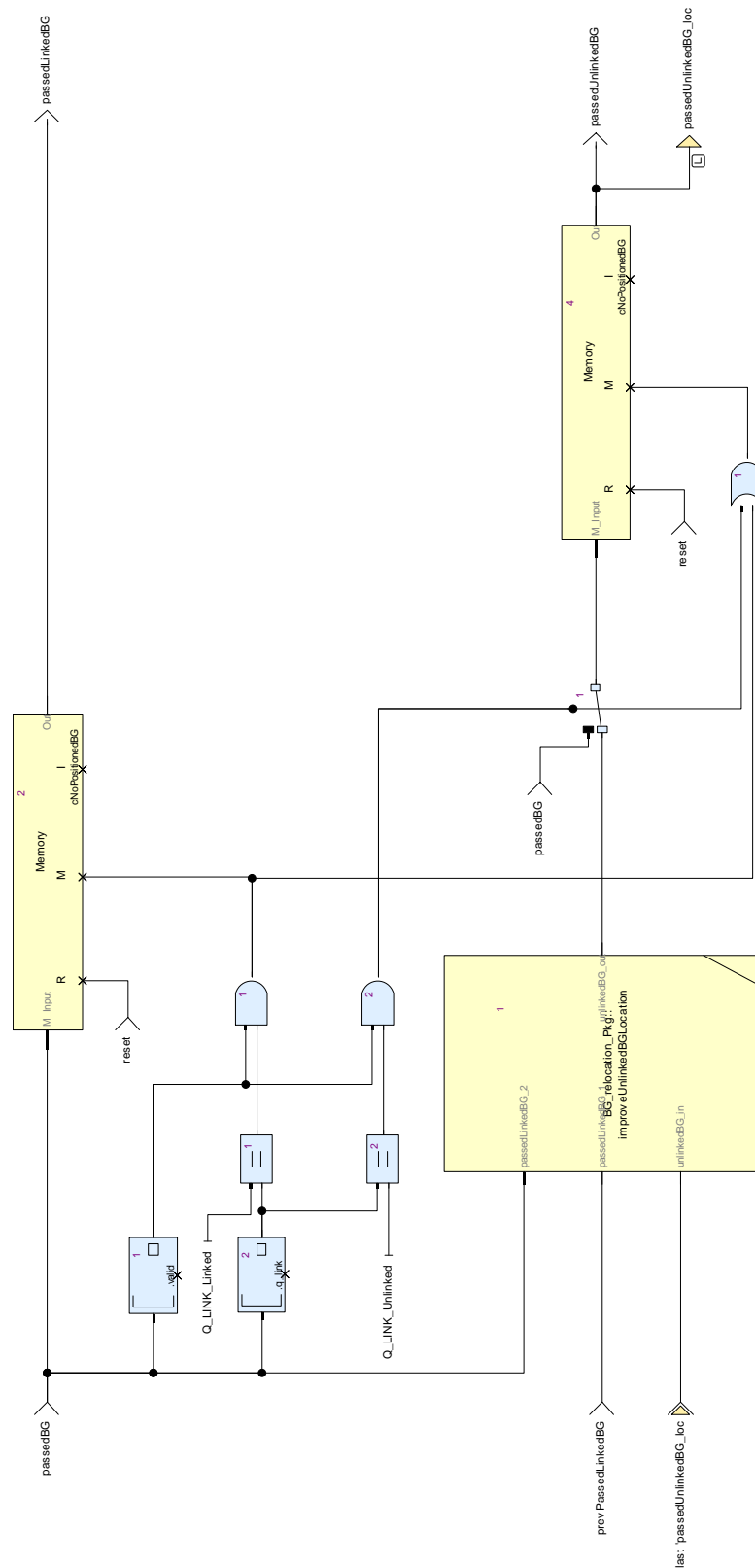
Figure 51: View of diagram_memPassedBG_1 (memPassedBG)

15.1.11. passedBG_2_positionedBG Operator

Declared as **private function**

15.1.11.1. 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 164: 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	Converts a passed balise group to a positioned balise group information - 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.
	to_c	True

15.1.11.2. Interface

Table 165: Inputs of passedBG_2_positionedBG

Name	Type	Comments and Information
passedBG	BG_Types_Pkg::passedBG_T	Comments: The balise group as actually passed.
passedBG_asAnnounced	TrainPosition_Types_Pck::positionedBG_T	Comments: 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.
previouslyPassedLinkedBG	TrainPosition_Types_Pck::positionedBG_T	Comments: The previously passed linked BG, if there is one. Serves a reference point for location calculation.

Name	Type	Comments and Information
passedBGSeqNo	int	Comments: Sequence no of the just passed BG

Table 166: Outputs of passedBG_2_positionedBG

Name	Type	Properties		Comments and Information
passedPositionedBG	TrainPosition_Types_Pck::positionedBG_T			Comments: 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	Comments: 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_Pck::linkedBGs_asPositionedBGs_T			Comments: The balise groups linked with the passed BG.

15.1.11.3.   Locals

Table 167: Locals of passedBG_2_positionedBG

Name	Type	Comments and Information
BG_wasAnnounced	bool	Comments: Indicates, that the BG was previously announced with linking information and the signature is consistent.
location	Obu_BasicTypes_Pkg::LocWithInAcc_T	
passedPositionedBG_loc	TrainPosition_Types_Pck::positionedBG_T	

15.1.11.4.   Operator Hierarchy

<u>diagram</u> : diagram_calculateDistance
    activate if : ifAnnouncedOrABGWasPreviouslyPassed
        branch : then
        branch : else
            branch : then
            branch : else
                branch : then
                branch : else
<u>diagram</u> : diagram_checkAnnouncedInfo

<u>diagram</u> : diagram_passedBG_2_positionedBG
<u>diagram</u> : diagram_positionLinkedBGs

15.1.11.5. Graphical and Textual Diagrams

15.1.11.5.1. View of diagram_calculateDistance (passedBG_2_positionedBG)
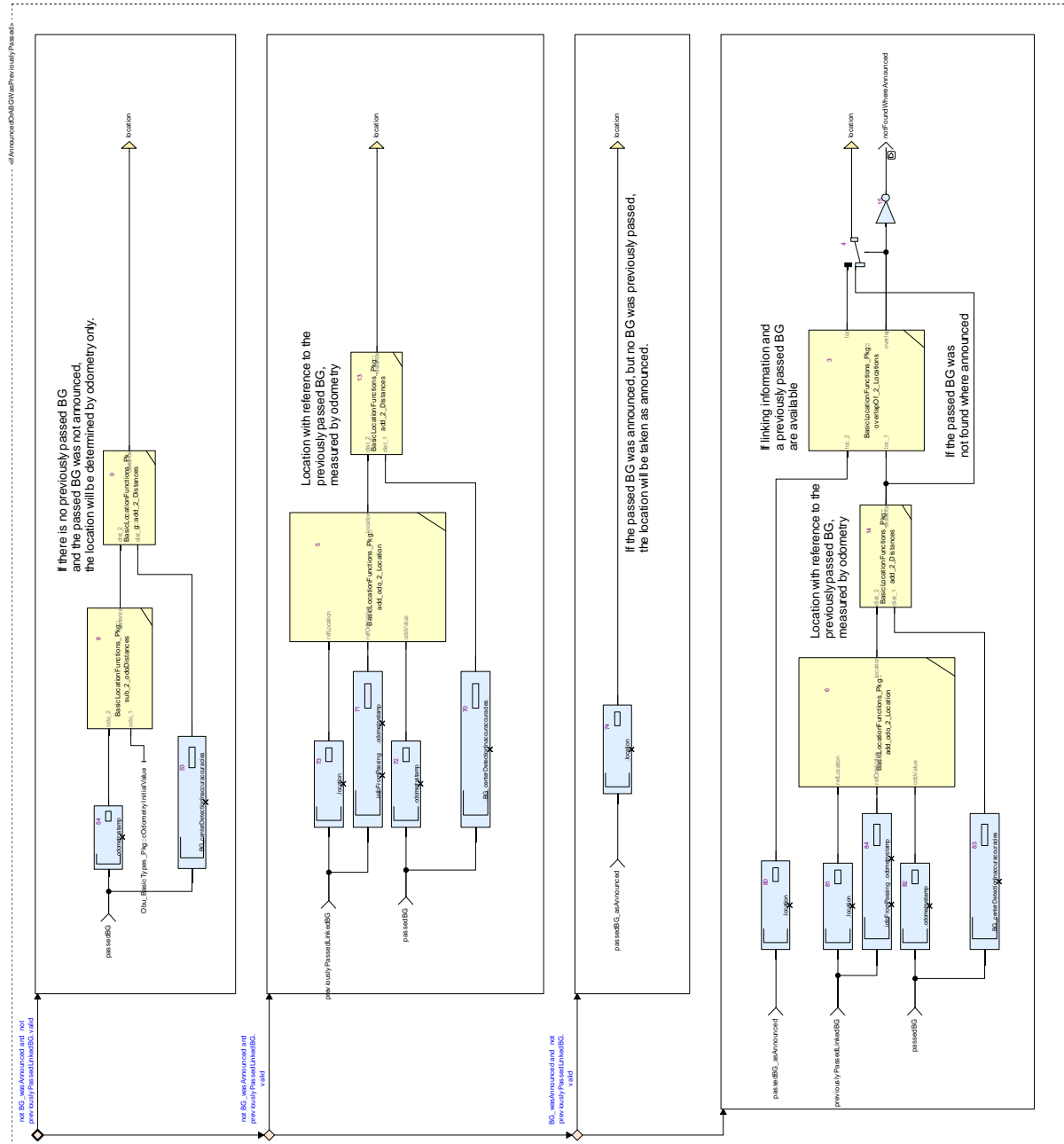
Figure 52: View of diagram_calculateDistance (passedBG_2_positionedBG)

diagram_calculateDistance 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 168: Conditional Blocks of diagram_calculateDistance

Conditional Block	Comments and Information
ifAnnouncedOrABGWasPreviouslyPassed	

Table 169: Actions of diagram_calculateDistance

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

15.1.11.5.2. View of diagram_checkAnnouncedInfo (passedBG_2_positionedBG)
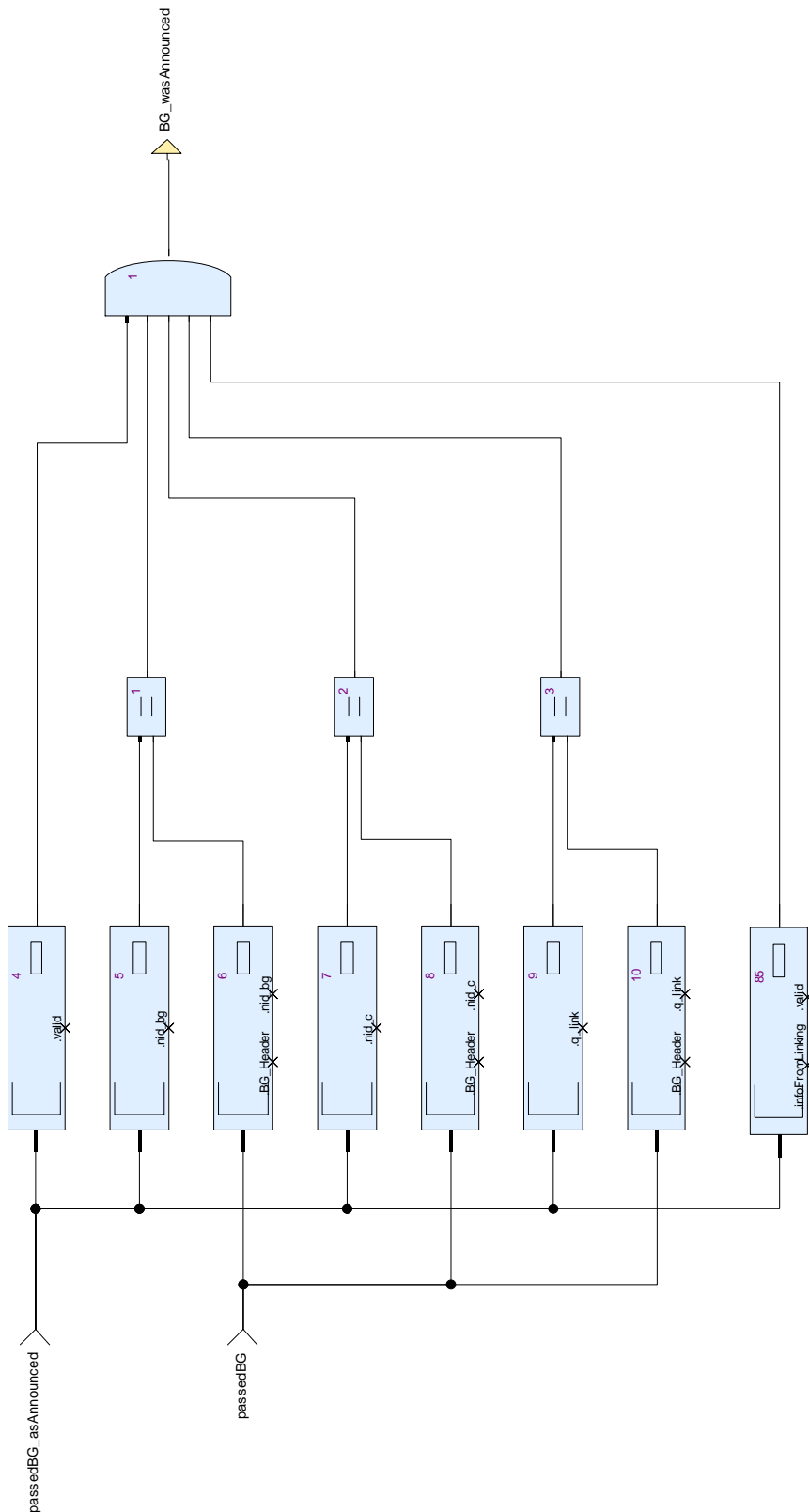
Figure 53: View of diagram_checkAnnouncedInfo (passedBG_2_positionedBG)

diagram_checkAnnouncedInfo Comments:

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

15.1.11.5.3.　View of diagram_passedBG_2_positionedBG (passedBG_2_positionedBG)

Figure 54: View of diagram_passedBG_2_positionedBG (passedBG_2_positionedBG)

15.1.11.5.4. View of diagram_positionLinkedBGs (passedBG_2_positionedBG)
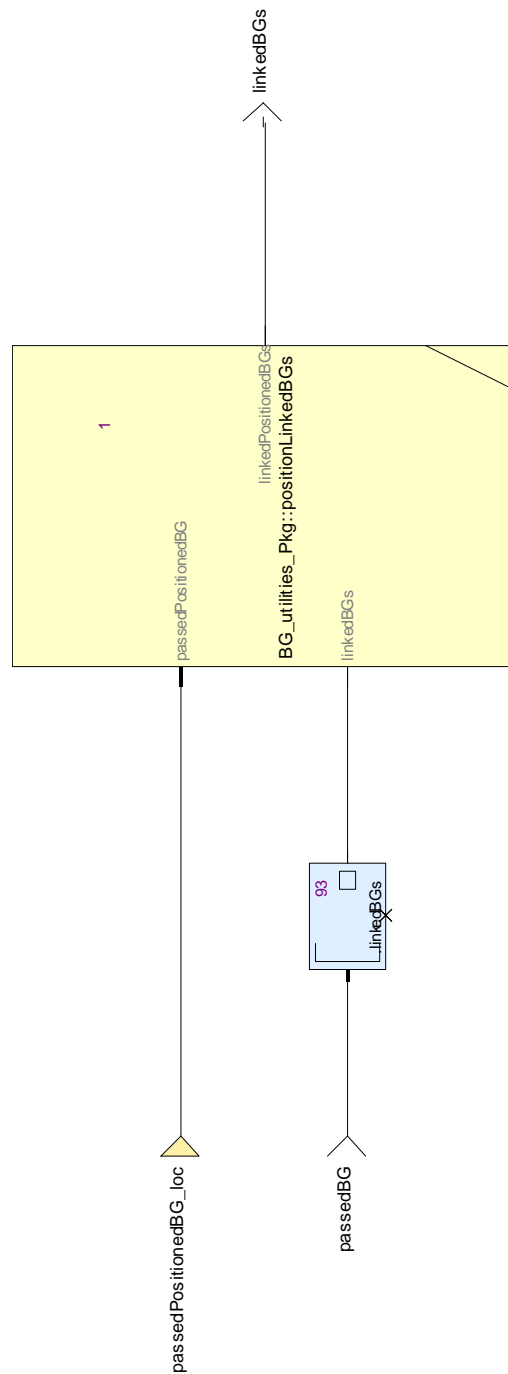
Figure 55: View of diagram_positionLinkedBGs (passedBG_2_positionedBG)

15.1.12.   passing_a_BG Operator

Declared as **private function**

15.1.12.1.   Comments and Information

passing_a_BG Comments:

- Provides the location calculations while passing a BG

Table 170: 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	Provides the location calculations while passing a BG - 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.
	to_c	True

15.1.12.2. Interface

Table 171: Inputs of passing_a_BG

Name	Type	Comments and Information
passedBG	BG_Types_Pkg::passedBG_T	
previouslyPassedLinkedBG	TrainPosition_Types_Pck::positionedBG_T	Comments: The previously passed linked BG, if there is one. Serves a reference point for location calculation.
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	Comments: The collection of BGs as known before passedBG was passed.
passedBGSeqNo	int	Comments: Sequence no of the just passed BG

Table 172: Outputs of passing_a_BG

Name	Type	Comments and Information
passedPositionedBG	TrainPosition_Types_Pck::positionedBG_T	Comments: 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_Pck::positionedBGs_T	Comments: The collection of BGs as known when passedBG was passed.

Name	Type	Comments and Information
overrun	bool	Comments: 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	Comments: Indicates that the location of the passed BG does not fit into the range, where it was expected by the linking information.

15.1.12.3.   Operator Hierarchy

<u>diagram</u> : diagram_passing_a_BG_1

15.1.12.4. Graphical and Textual Diagrams

15.1.12.4.1. View of diagram_passing_a_BG_1 (passing_a_BG)
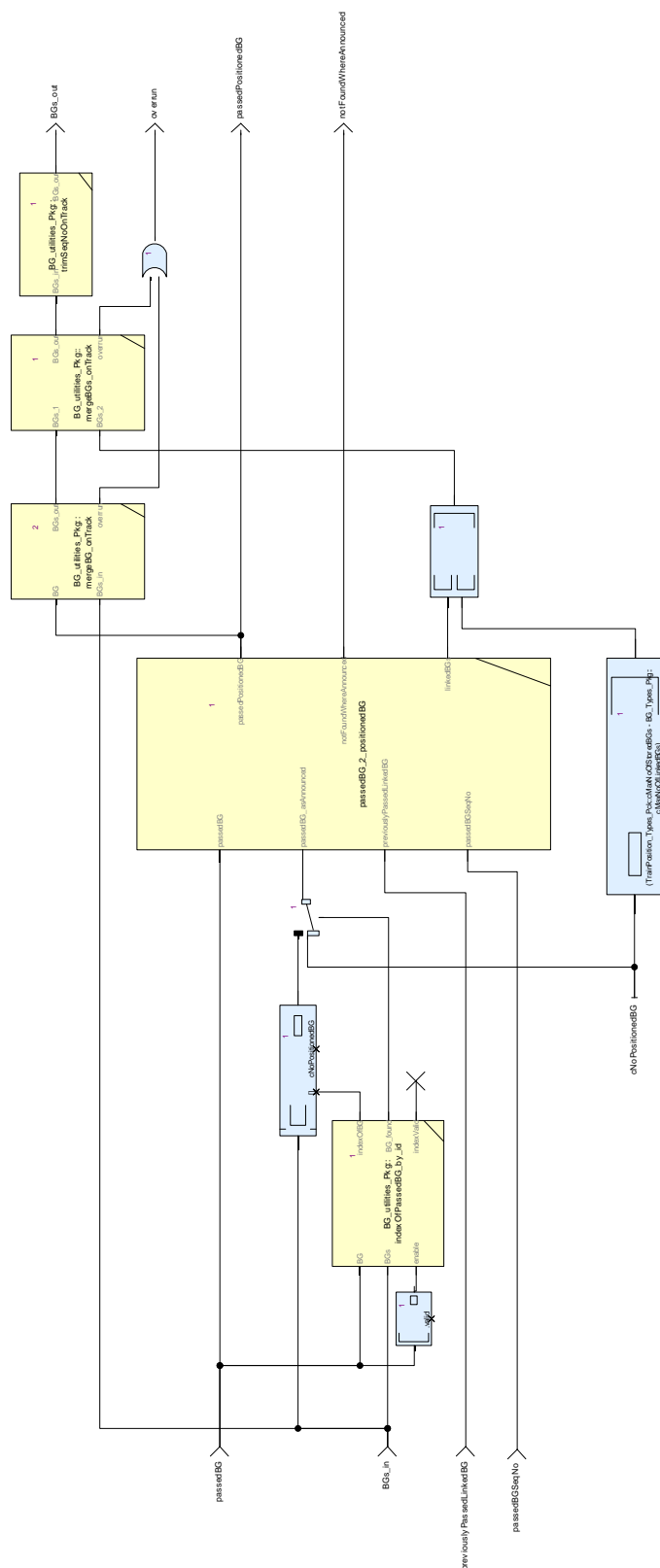
Figure 56: View of diagram_passing_a_BG_1 (passing_a_BG)

15.1.13. prevPassedLinkedBG Operator

Declared as **private function**

15.1.13.1. Comments and Information

prevPassedLinkedBG Comments:

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

Table 173: 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	Memorizes the previously passed BG when a new BG is passed and the IDs are different. - 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.
	to_c	True

15.1.13.2. Interface

Table 174: Inputs of prevPassedLinkedBG

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

Table 175: Outputs of prevPassedLinkedBG

Name	Type	Comments and Information
previouslyPassedBG	TrainPosition_Types_Pck::positionedBG_T	Comments: The previously passed linked BG

15.1.13.3.   Operator Hierarchy

diagram : diagram_prevPassedLinkedBG_1

15.1.13.4.   Graphical and Textual Diagrams

15.1.13.4.1. View of diagram_prevPassedLinkedBG_1 (prevPassedLinkedBG)
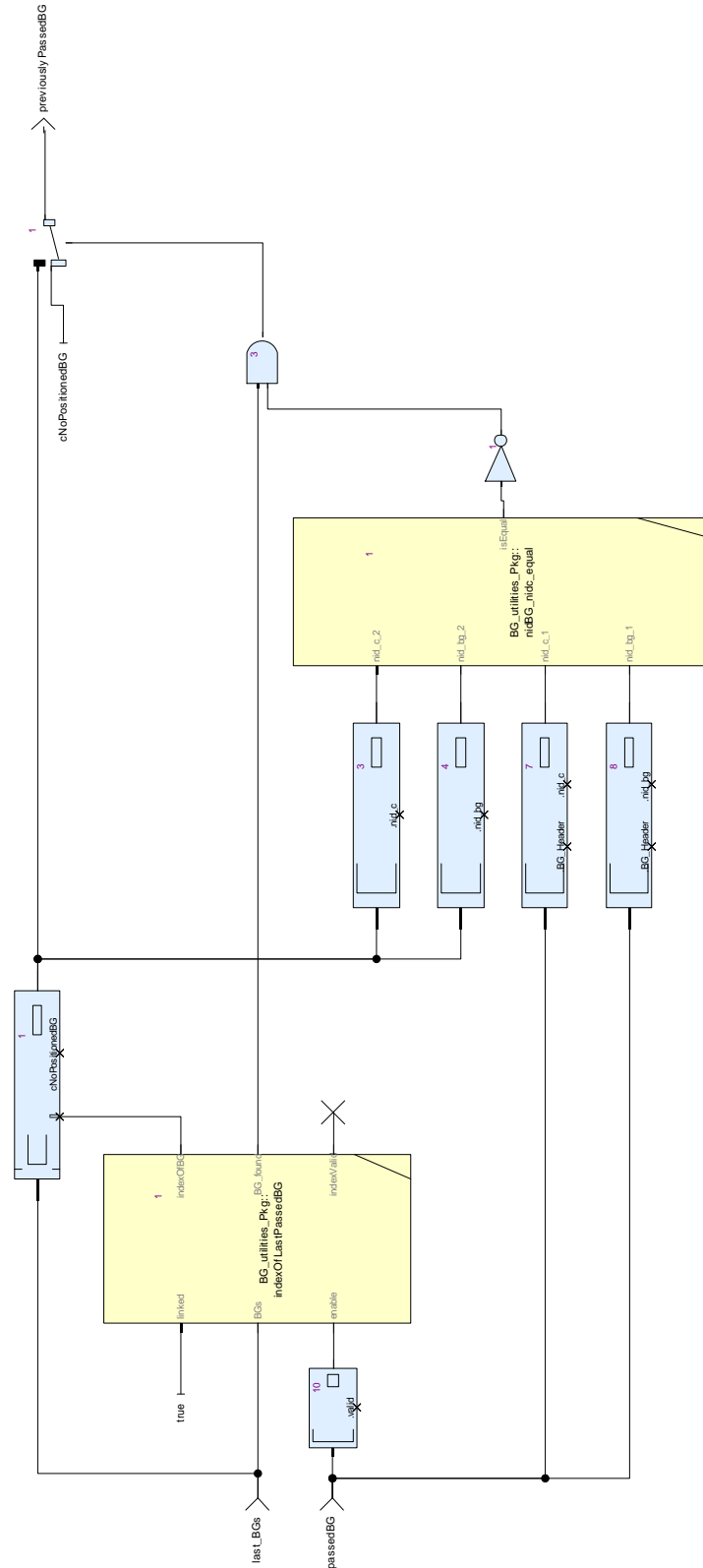
Figure 57: View of diagram_prevPassedLinkedBG_1 (prevPassedLinkedBG)

15.2.   CalculateTrainPosition_Pkg::BG_relocation_Pkg Package

15.2.1.   Types

Table 176: Public Types of BG_relocation_Pkg

Name	Definition	Comments and Information
BGs_forImprovement_T	{prevLinkedBG : TrainPosition_Types_Pck::positionedBG_T, unlinkedBG : TrainPosition_Types_Pck::positionedBG_T, indexOfUnlinkedBG : int}	Comments: Serves to map and fold through the BGs prevLinkedBG Comments: The previous linked BG in the map and fold chain unlinkedBG Comments: The previous unlinked BG in the map and fold chain indexOfUnlinkedBG Comments: Enables the location recalculation for all BGs subsequent to refBG
linkedBG_index_T	{previousLinkedBG_idx : int, currentIndex : int, subsequentLinkedBG_idx : int}	previousLinkedBG_idx Comments: Index of the BG before currentIndex Comments: The current index subsequentLinkedBG_idx Comments: Index of the BG behind
linkedBGs_indices_T	CalculateTrainPosition_Pkg::BG_relocation_Pkg::linkedBG_index_T ^TrainPosition_Types_Pck::cMaxNoOfStoredBGs	
refBGs_T	{refBG : TrainPosition_Types_Pck::positionedBG_T, prevLinkedBG : TrainPosition_Types_Pck::positionedBG_T, prevUnlinkedBG : TrainPosition_Types_Pck::positionedBG_T, recalculate : bool}	Comments: Serves to map and fold through the BGs refBG Comments: The reference BG for the location recalculation. prevLinkedBG Comments: The previous linked BG in the map and fold chain prevUnlinkedBG Comments: The previous unlinked BG in the map and fold chain recalculate Comments: Enables the location recalculation for all BGs subsequent to refBG

15.2.2.　Constants

Table 177: 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
		{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_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_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {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 :	

15.2.3.   findLinkedBG_bckwd_itr Operator

Declared as **private function**

15.2.3.1.   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.

15.2.3.2.   Interface

Table 178: Inputs of findLinkedBG_bckwd_itr

Name	Type	Comments and Information
index_acc_in	CalculateTrainPosition_Pkg::BG_relocation_Pkg::linkedBG_index_T	
index_in	CalculateTrainPosition_Pkg::BG_relocation_Pkg::linkedBG_index_T	
BG_in	TrainPosition_Types_Pck::positionedBG_T	Comments: The unlinked BG that's location shall be improved

Table 179: Outputs of findLinkedBG_bckwd_itr

Name	Type	Comments and Information
index_acc_out	CalculateTrainPosition_Pkg::BG_relocation_Pkg::linkedBG_index_T	
index_out	CalculateTrainPosition_Pkg::BG_relocation_Pkg::linkedBG_index_T	

15.2.3.3.   Operator Hierarchy

diagram : diagram_findLinkedBG_bckwd_itr_1

15.2.3.4.   Graphical and Textual Diagrams

15.2.3.4.1.   View of diagram_findLinkedBG_bckwd_itr_1 (findLinkedBG_bckwd_itr)
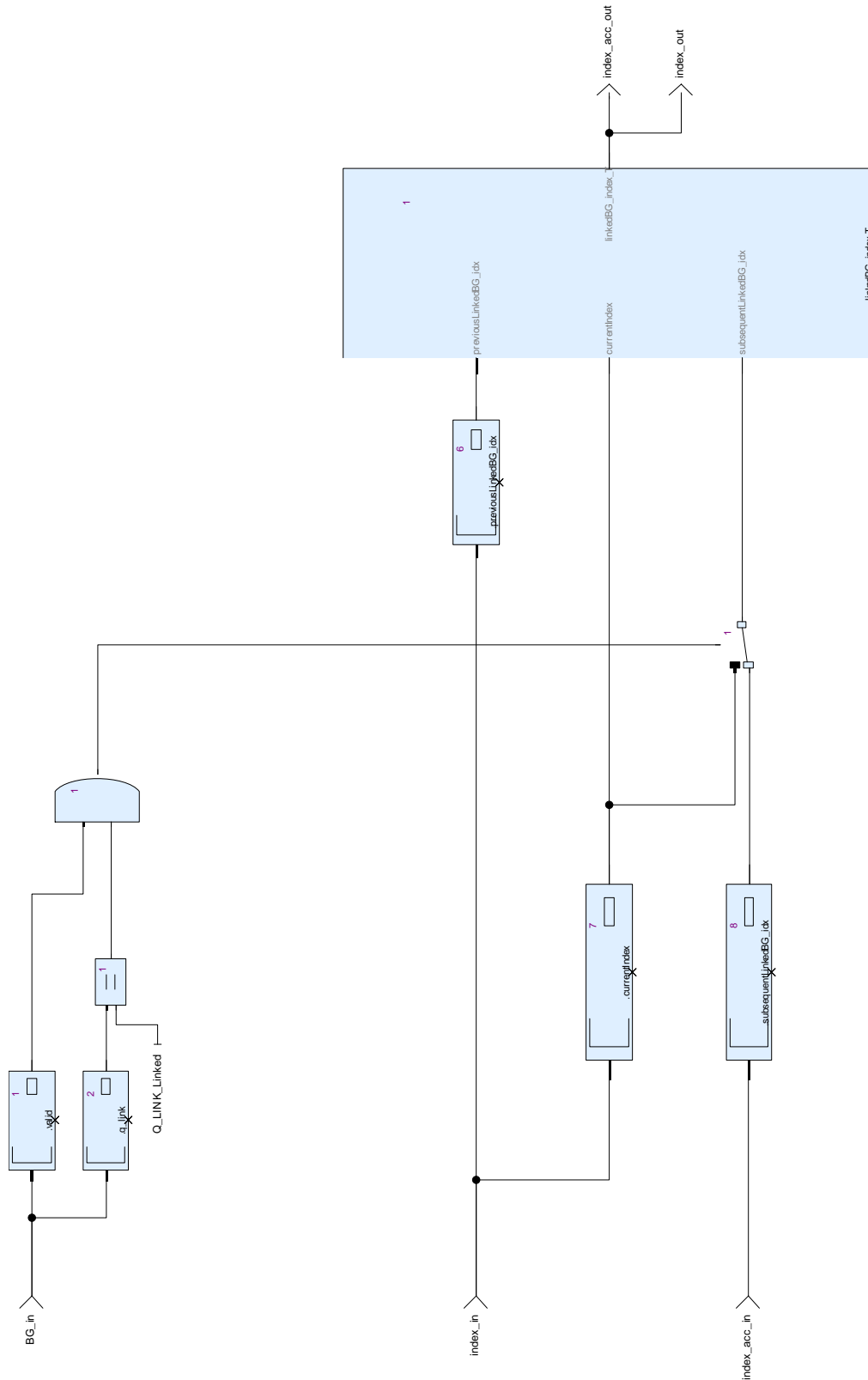
Figure 58: View of diagram_findLinkedBG_bckwd_itr_1 (findLinkedBG_bckwd_itr)

15.2.4. findLinkedBG_fwd_itr Operator

Declared as **private function**

15.2.4.1. 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 be incrementing the index from the previous iteration.
- index_out.subsequentLinkedIndex taken unchanged from index_in.

15.2.4.2. Interface

Table 180: Inputs of findLinkedBG_fwd_itr

Name	Type	Comments and Information
index_in	CalculateTrainPosition_Pkg::BG_relocation_Pkg::linkedBG_index_T	Comments: Indices for the iteration
BG_in	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG to be searched for.

Table 181: Outputs of findLinkedBG_fwd_itr

Name	Type	Comments and Information
index_acc	CalculateTrainPosition_Pkg::BG_relocation_Pkg::linkedBG_index_T	Comments: The results to be tranferred to the next iteration.
index_out	CalculateTrainPosition_Pkg::BG_relocation_Pkg::linkedBG_index_T	Comments: The resulting indices

15.2.4.3. Operator Hierarchy

<u>diagram</u> : diagram_findLinkedBG_fwd_itr_1

15.2.4.4. Graphical and Textual Diagrams

15.2.4.4.1. View of diagram_findLinkedBG_fwd_itr_1 (findLinkedBG_fwd_itr)
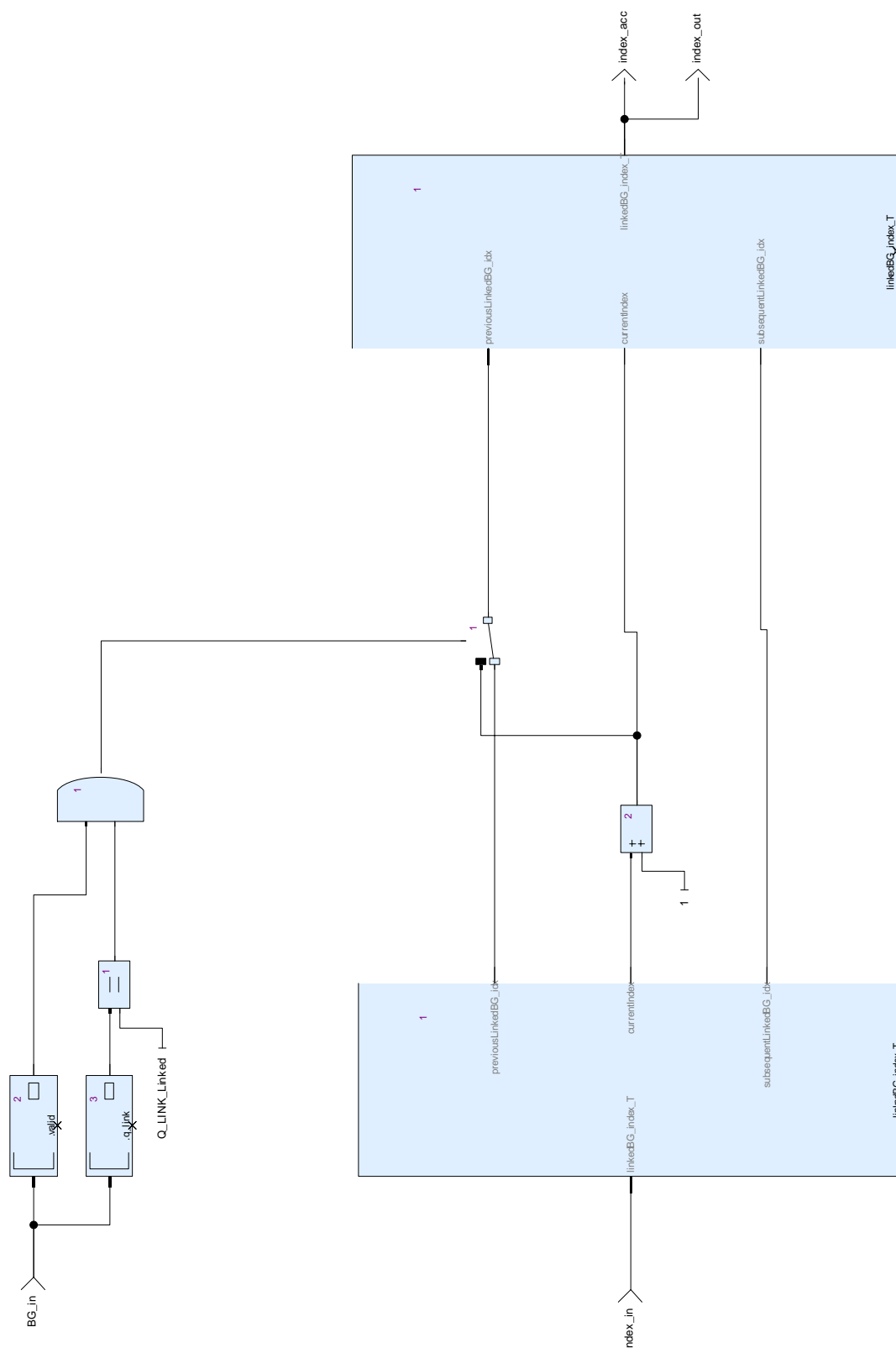
Figure 59: View of diagram_findLinkedBG_fwd_itr_1 (findLinkedBG_fwd_itr)

15.2.5.   findLinkedBGs Operator

Declared as **private function**

15.2.5.1.   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.

15.2.5.2.   Interface

Table 182: Inputs of findLinkedBGs

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	Comments: The BGs to be analyzed.

Table 183: Outputs of findLinkedBGs

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

15.2.5.3.   Operator Hierarchy

<u>diagram</u> : diagram_findLinkedBGs_1

15.2.5.4. Graphical and Textual Diagrams

15.2.5.4.1. View of diagram_findLinkedBGs_1 (findLinkedBGs)
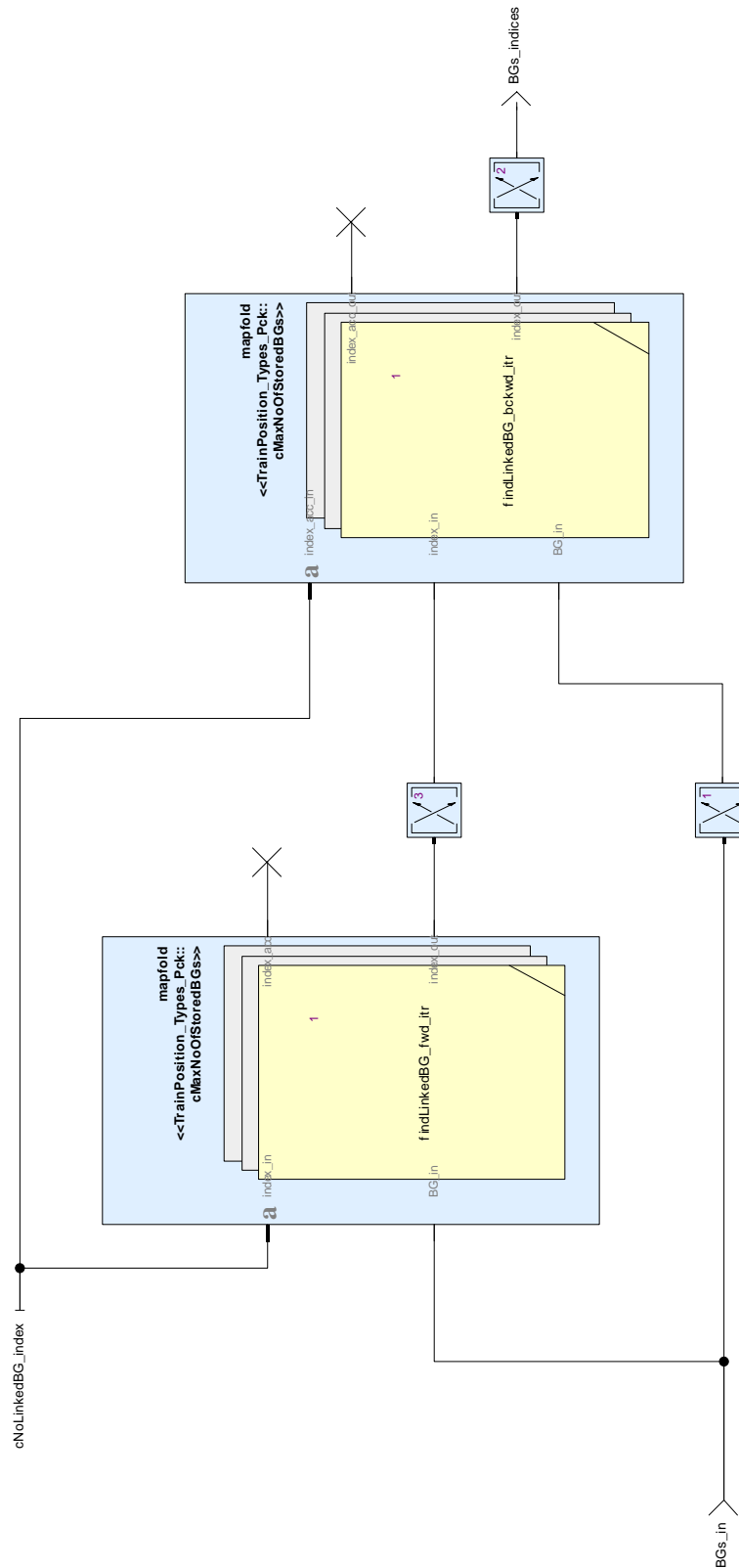
Figure 60: View of diagram_findLinkedBGs_1 (findLinkedBGs)

15.2.6. improve_BG_locations Operator

Declared as **public function**

15.2.6.1. Interface

Table 184: Inputs of improve_BG_locations

Name	Type	Comments and Information
referenceBG	TrainPosition_Types_Pck::positionedBG_T	Comments: Recalculates the locations of all BGs with reference to referenceBG. Reduces the inaccuracy of referenceBG to a minimum, while the inaccuries of all BGs in front and behind are growing in both directions.
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	
improve	bool	

Table 185: Outputs of improve_BG_locations

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

15.2.6.2. Operator Hierarchy

<u>diagram</u> : diagram_recalculate_refBG_location

15.2.6.3. Graphical and Textual Diagrams

15.2.6.3.1. View of diagram_recalculate_refBG_location (improve_BG_locations)
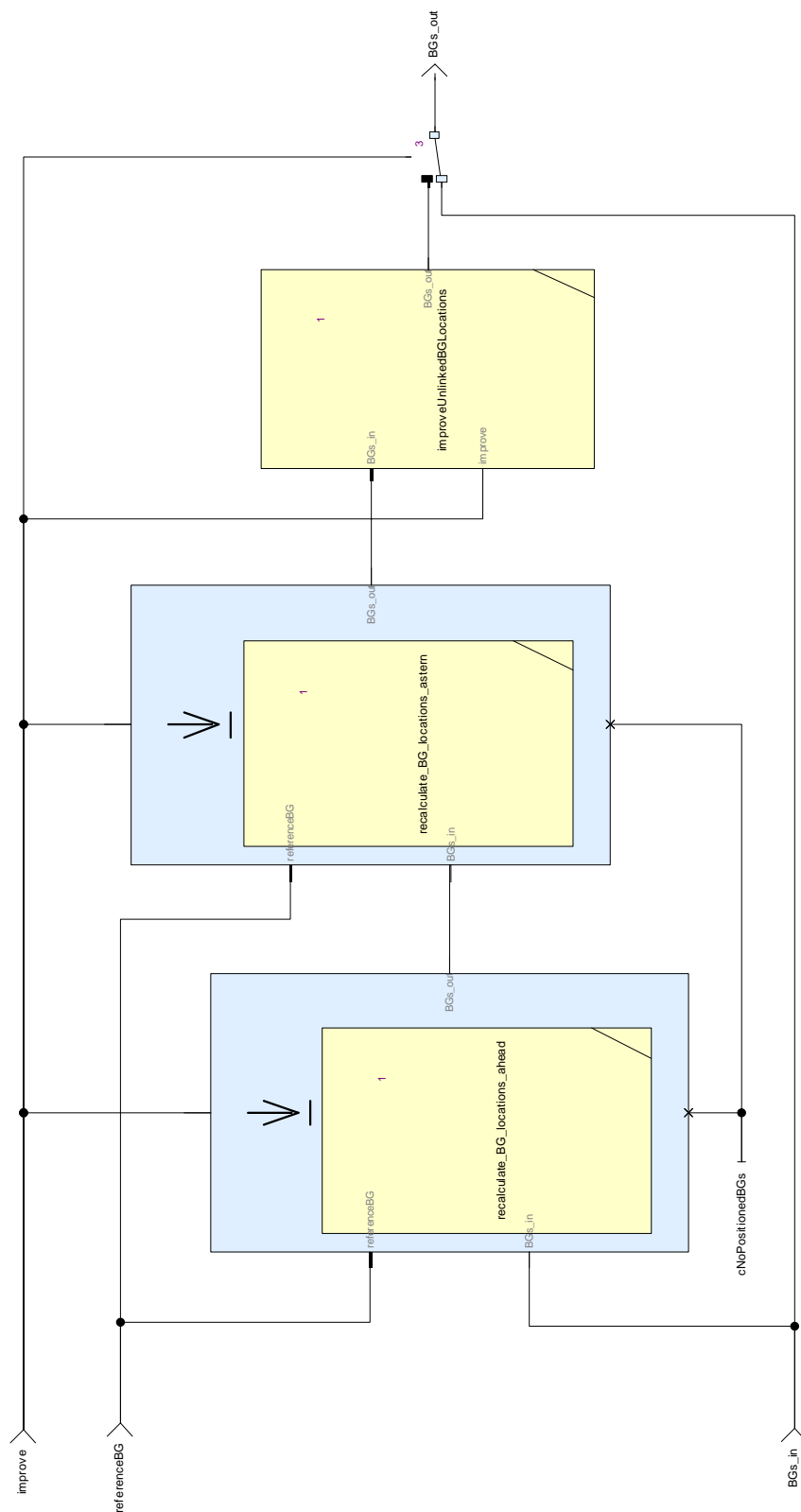
Figure 61: View of diagram_recalculate_refBG_location (improve_BG_locations)

15.2.7.   improveUnlinkedBGLocation Operator

Declared as **public function**

15.2.7.1.   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.

15.2.7.2.   Interface

Table 186: Inputs of improveUnlinkedBGLocation

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

Table 187: Outputs of improveUnlinkedBGLocation

Name	Type	Comments and Information
unlinkedBG_out	TrainPosition_Types_Pck::positionedBG_T	Comments: The unlinked BG that's location might have been improved

15.2.7.3.   Operator Hierarchy

<u>diagram</u> : diagram_improveUnlinkedBGLocation_1

15.2.7.4.   Graphical and Textual Diagrams

15.2.7.4.1.   View of diagram_improveUnlinkedBGLocation_1 (improveUnlinkedBGLocation)
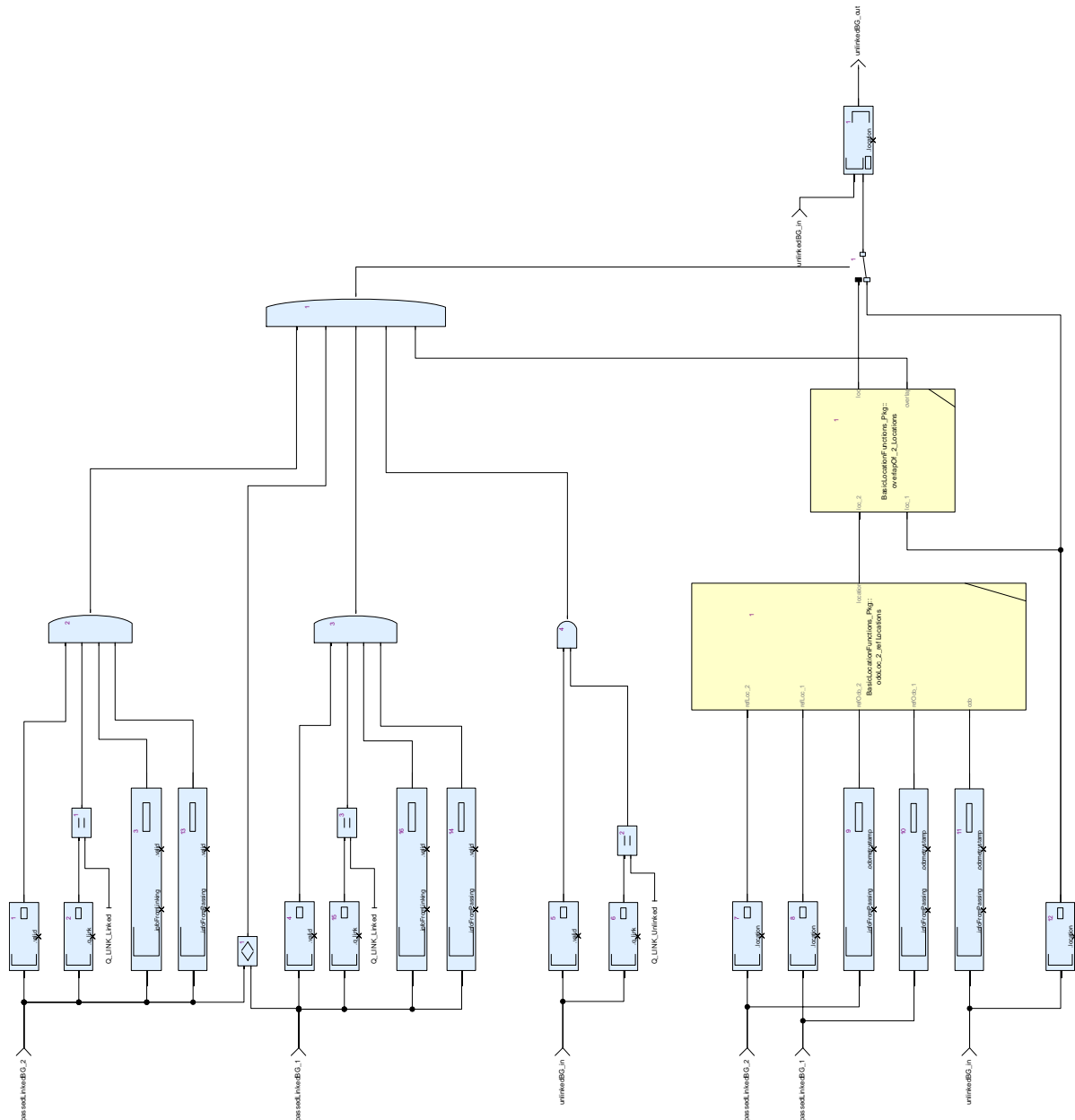
Figure 62: View of diagram_improveUnlinkedBGLocation_1 (improveUnlinkedBGLocation)

15.2.8.   improveUnlinkedBGLocations Operator

Declared as **private function**

15.2.8.1.   Interface

Table 188: Inputs of improveUnlinkedBGLocations

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	
improve	bool	

Table 189: Outputs of improveUnlinkedBGLocations

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

15.2.8.2.   Operator Hierarchy

<u>diagram</u> : diagram_improveUnlinkedBGLocations_1

15.2.8.3. Graphical and Textual Diagrams

15.2.8.3.1. View of diagram_improveUnlinkedBGLocations_1 (improveUnlinkedBGLocations)
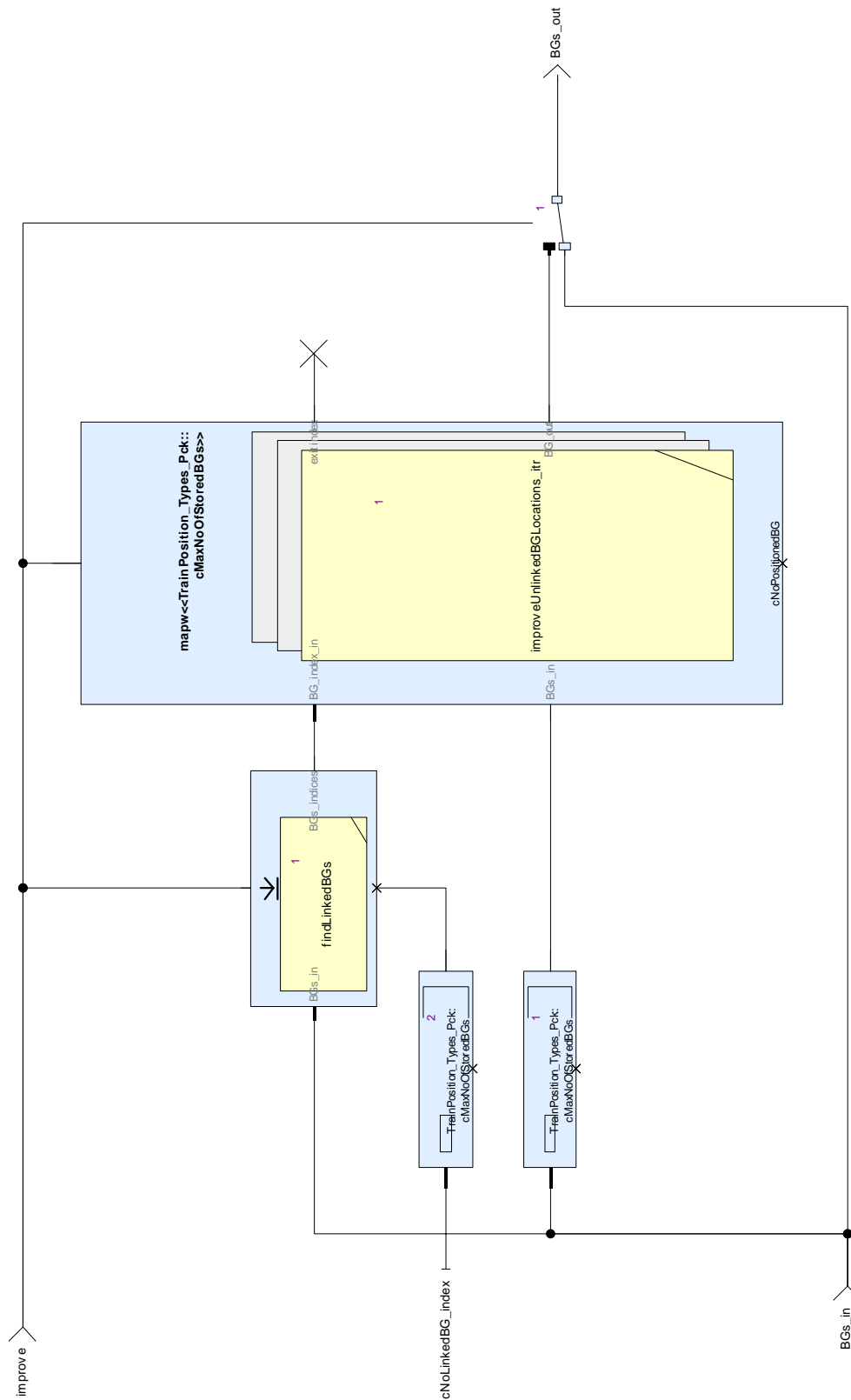
Figure 63: View of diagram_improveUnlinkedBGLocations_1 (improveUnlinkedBGLocations)

15.2.9.   improveUnlinkedBGLocations_itr Operator

Declared as **private function**

15.2.9.1.   Interface

Table 190: Inputs of improveUnlinkedBGLocations_itr

Name	Type	Comments and Information
BG_index_in	CalculateTrainPosition_Pkg::BG_relocation_Pkg::linkedBG_index_T	Comments: Indices for the iteration
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	

Table 191: Outputs of improveUnlinkedBGLocations_itr

Name	Type	Comments and Information
cont	bool	
BG_out	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG to be searched for.

15.2.9.2.   Operator Hierarchy

diagram : diagram_improveUnlinkedBGLocations_itr_1

15.2.9.3.   Graphical and Textual Diagrams

15.2.9.3.1.   View of diagram_improveUnlinkedBGLocations_itr_1
(improveUnlinkedBGLocations_itr)
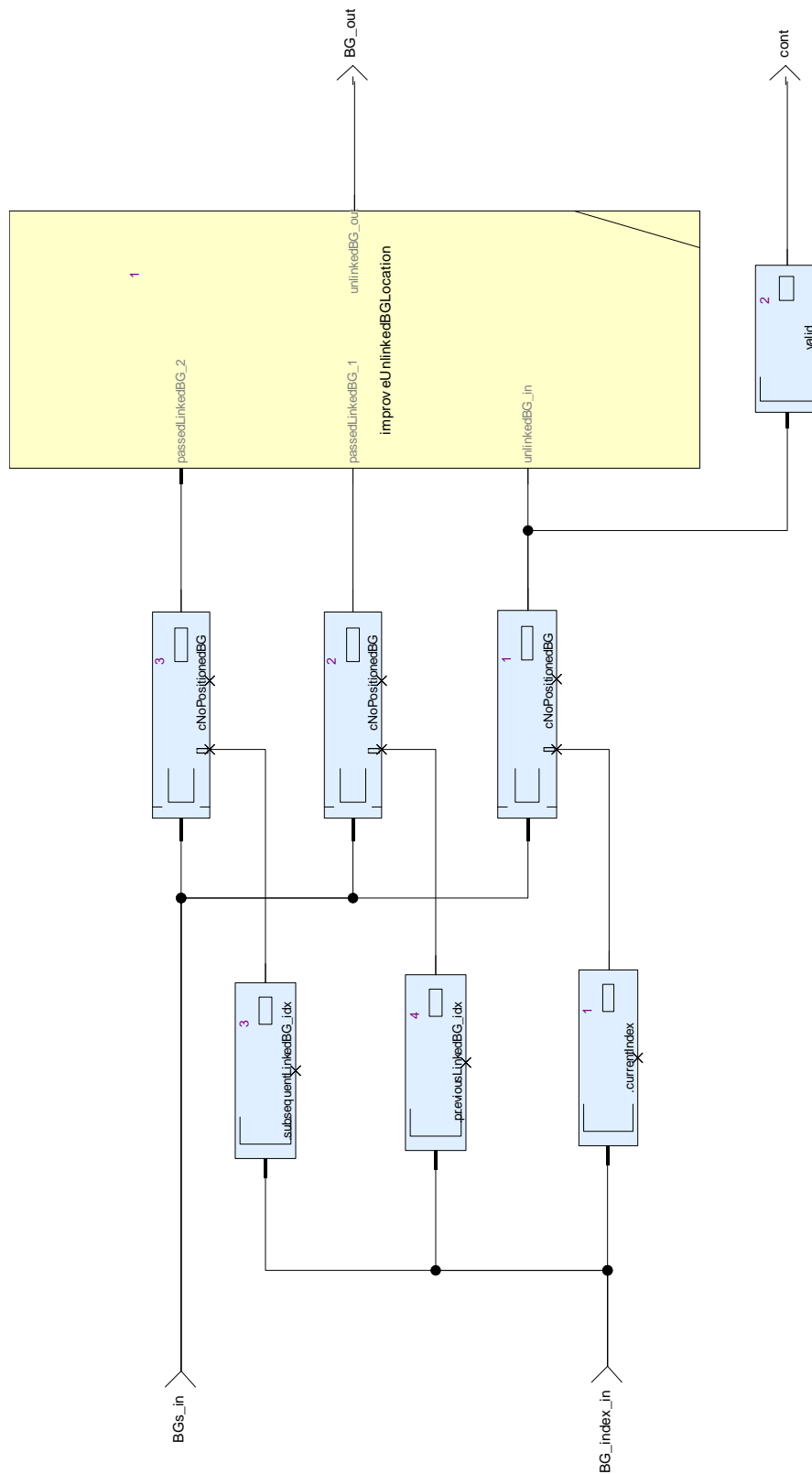
Figure 64: View of diagram_improveUnlinkedBGLocations_itr_1 (improveUnlinkedBGLocations_itr)

15.2.10.   recalculate_BG_location_ahead Operator

Declared as **private function**

15.2.10.1.   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.

15.2.10.2.   Interface

Table 192: Inputs of recalculate_BG_location_ahead

Name	Type	Comments and Information
BG_in	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG that's location has to be recalculated
prevBG	TrainPosition_Types_Pck::positionedBG_T	Comments: The previous BG.

Table 193: Outputs of recalculate_BG_location_ahead

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

15.2.10.3.   Locals

Table 194: Locals of recalculate_BG_location_ahead

Name	Type	Comments and Information
distance	Obu_BasicTypes_Pkg::LocWithInAcc_T	
linked	bool	
linkedAndPassed	bool	
linkedPassedOverlapping	bool	
passed	bool	

15.2.10.4.   Operator Hierarchy

<u>diagram</u> : diagram_decide_linked_passed
<u>diagram</u> : diagram_recalculate_BG_location

15.2.10.5.   Graphical and Textual Diagrams

15.2.10.5.1. View of diagram_decide_linked_passed (recalculate_BG_location_ahead)
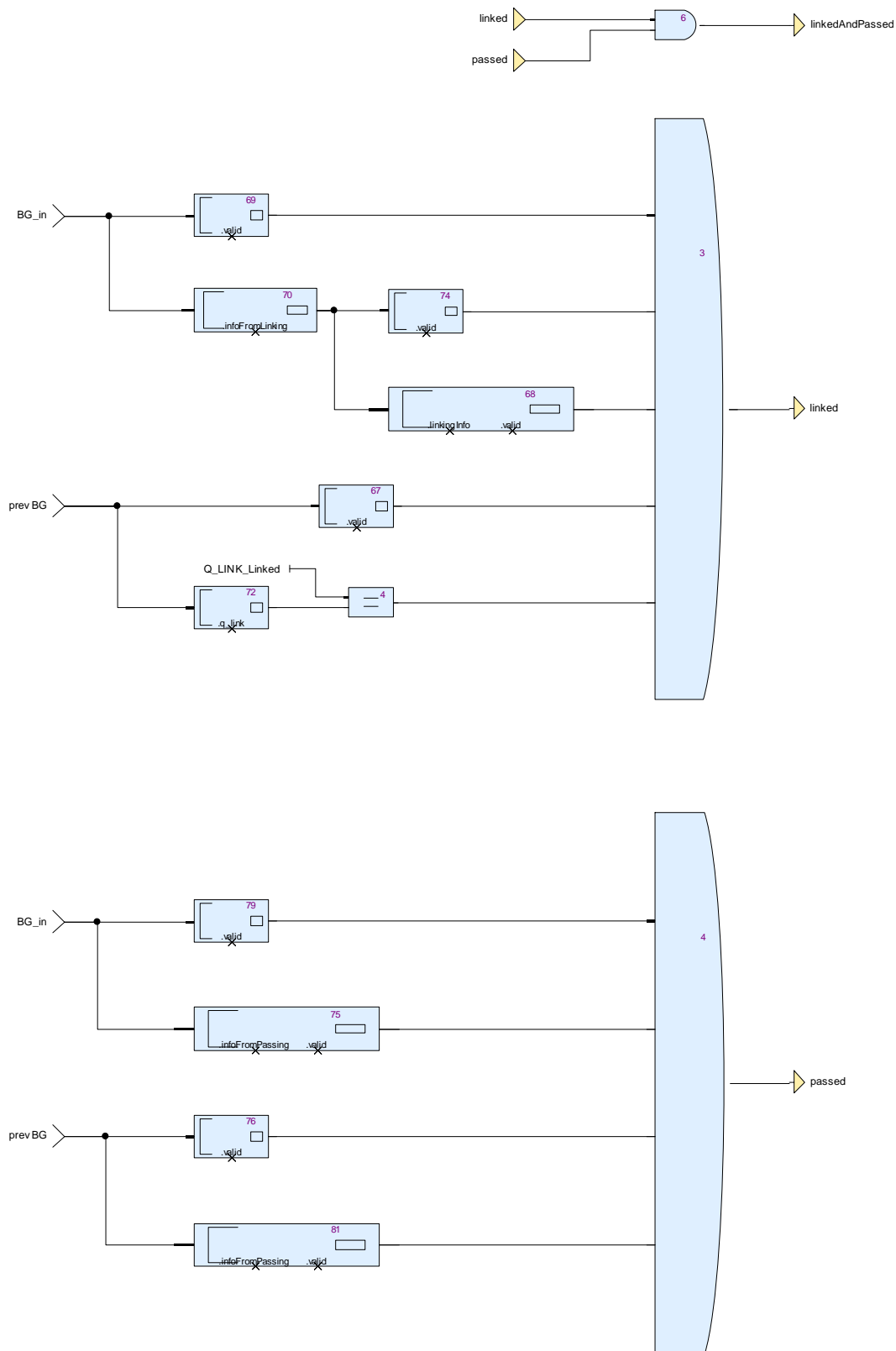
Figure 65: View of diagram_decide_linked_passed (recalculate_BG_location_ahead)

15.2.10.5.2. View of diagram_recalculate_BG_location (recalculate_BG_location_ahead)
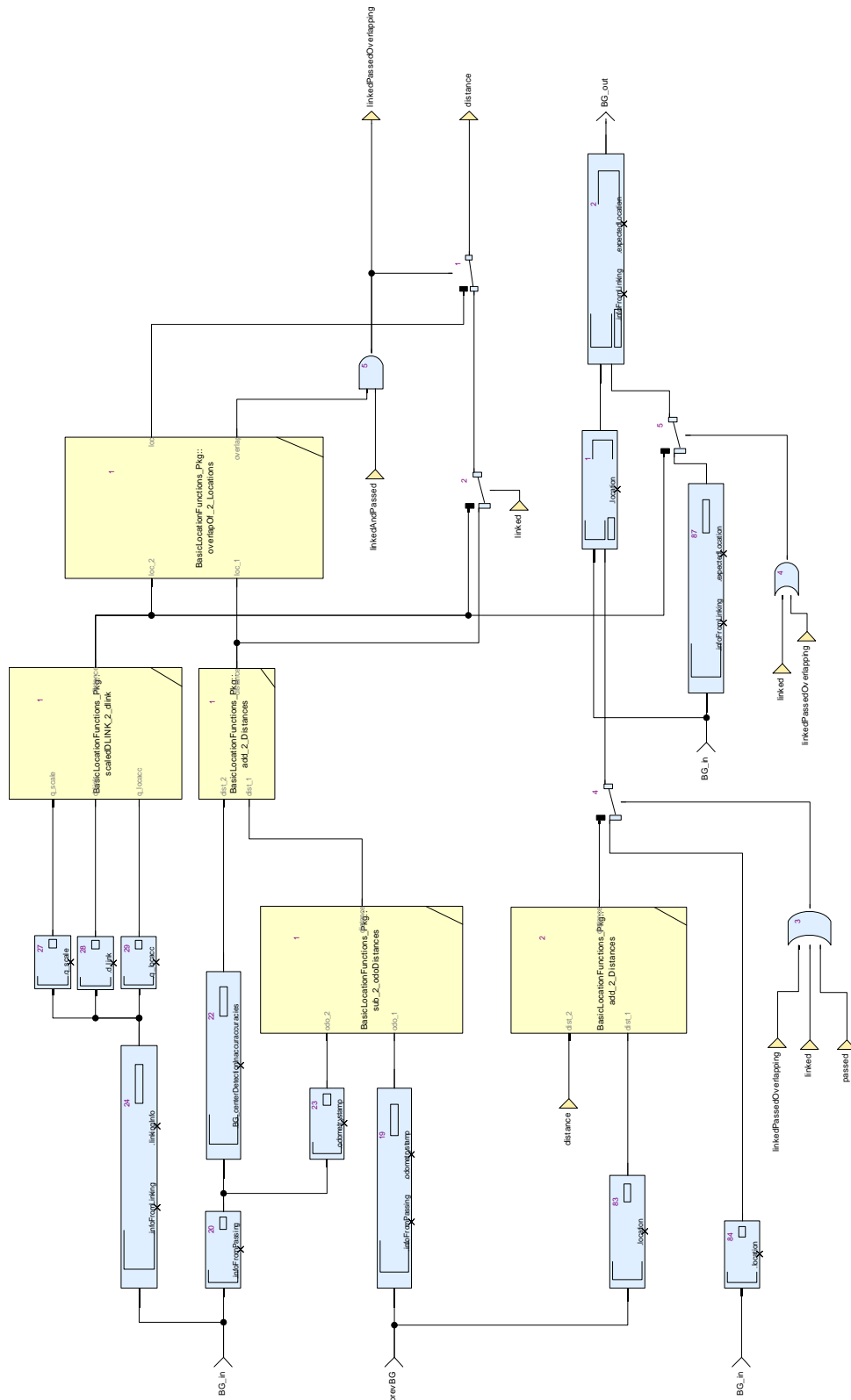
Figure 66: View of diagram_recalculate_BG_location (recalculate_BG_location_ahead)

15.2.11.   recalculate_BG_location_astern Operator

Declared as **private function**

15.2.11.1. Comments and Information

recalculate_BG_location_astern Comments:

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

15.2.11.2. Interface

Table 195: Inputs of recalculate_BG_location_astern

Name	Type	Comments and Information
BG_in	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG that's location has to be recalculated
refBG_ahead	TrainPosition_Types_Pck::positionedBG_T	Comments: The reference BG ahead of BG_in.

Table 196: Outputs of recalculate_BG_location_astern

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

15.2.11.3. Locals

Table 197: Locals of recalculate_BG_location_astern

Name	Type	Comments and Information
distance	Obu_BasicTypes_Pkg::LocWithInAcc_T	
linked	bool	
linkedAndPassed	bool	
linkedPassedOverlapping	bool	
passed	bool	

15.2.11.4. Operator Hierarchy

<u>diagram</u> : diagram_decide_linked_passed
<u>diagram</u> : diagram_recalculate_BG_location

15.2.11.5.   Graphical and Textual Diagrams

15.2.11.5.1. View of diagram_decide_linked_passed (recalculate_BG_location_astern)
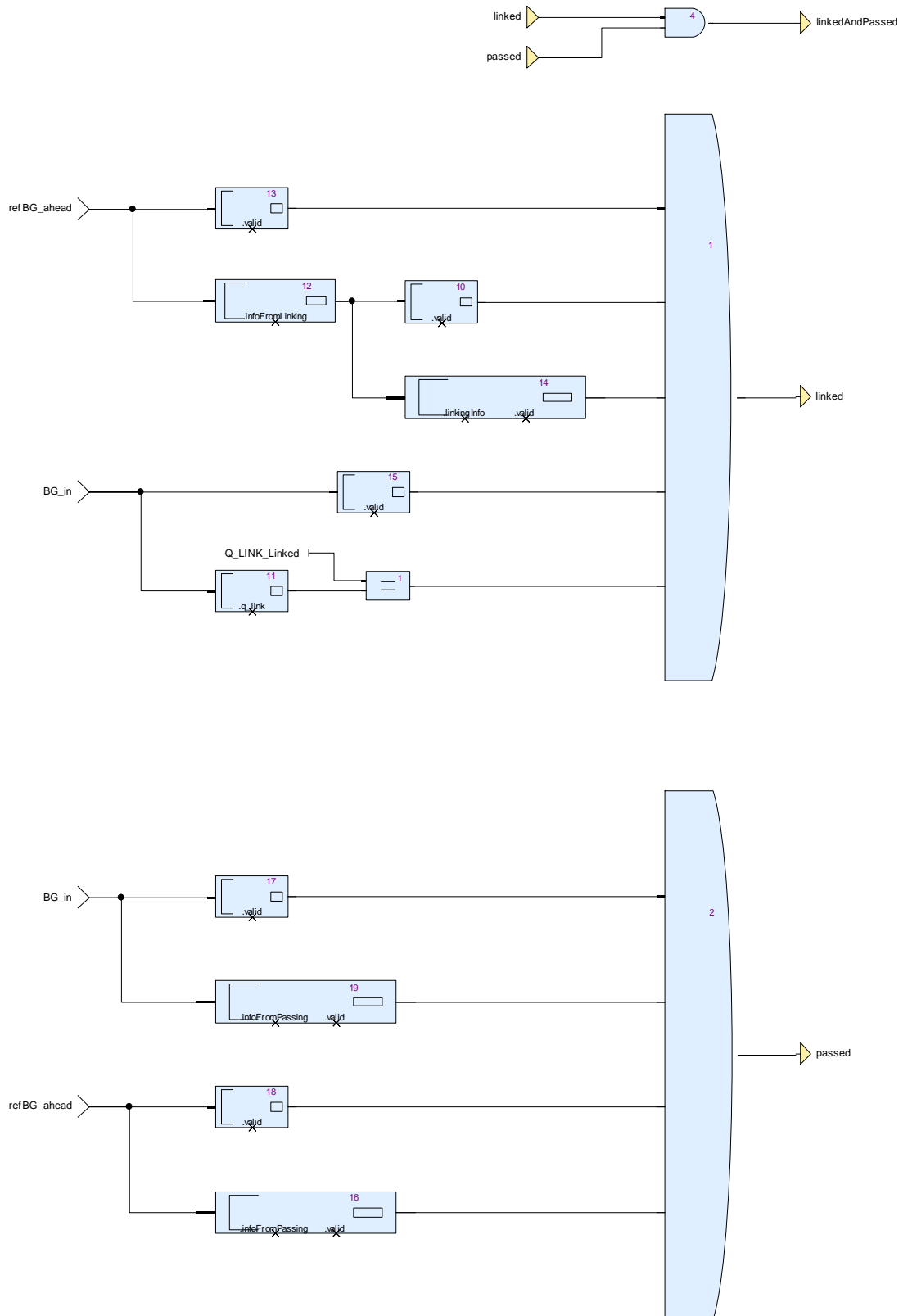
Figure 67: View of diagram_decide_linked_passed (recalculate_BG_location_astern)

15.2.11.5.2. View of diagram_recalculate_BG_location (recalculate_BG_location_astern)
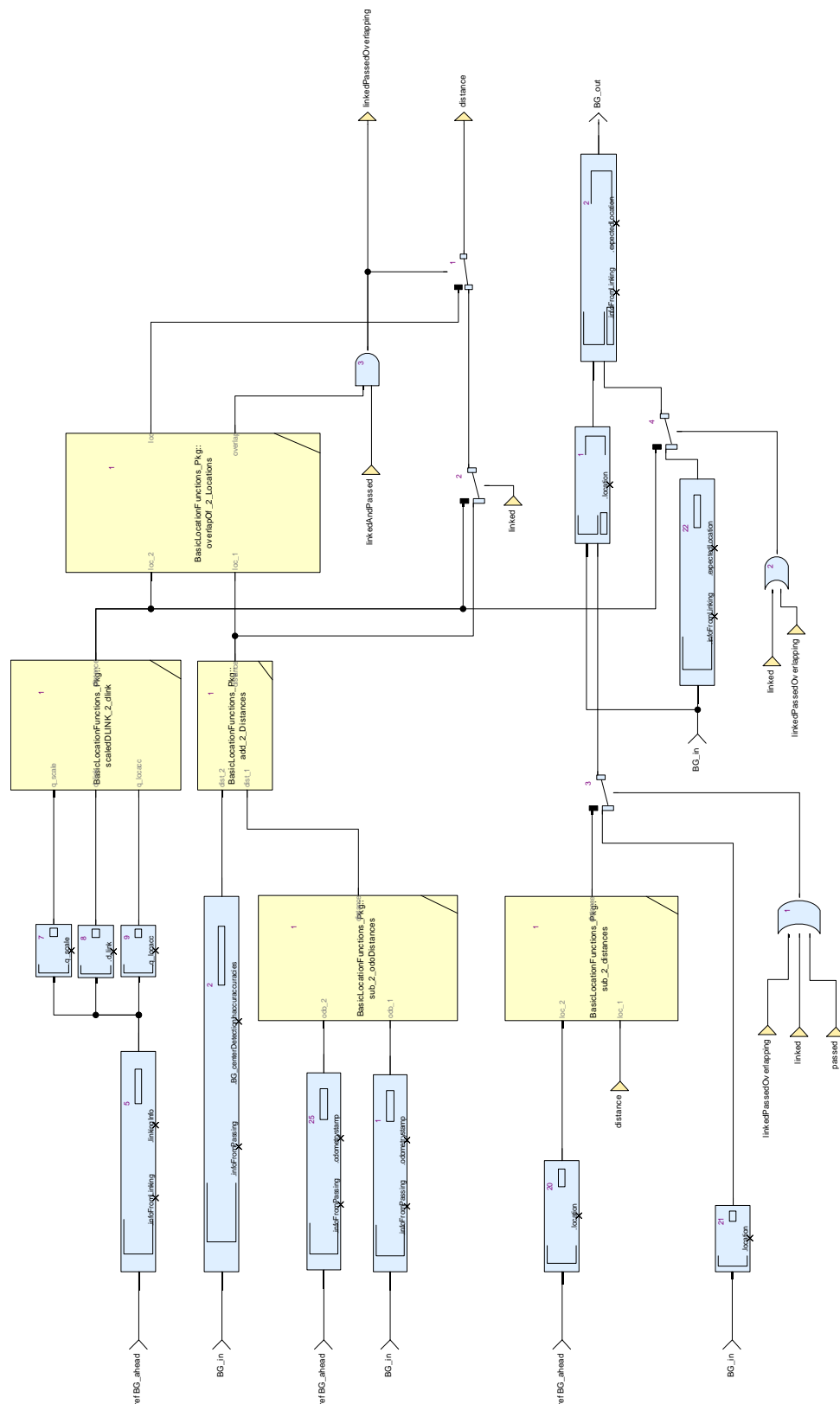
Figure 68: View of diagram_recalculate_BG_location (recalculate_BG_location_astern)

15.2.12.   recalculate_BG_locations_ahead Operator

Declared as **private function**

15.2.12.1. 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.

15.2.12.2. Interface

Table 198: Inputs of recalculate_BG_locations_ahead

Name	Type	Comments and Information
referenceBG	TrainPosition_Types_Pck::positionedBG_T	Comments: 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 inaccuries of all BGs before and after are growing in both directions.
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	

Table 199: Outputs of recalculate_BG_locations_ahead

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

15.2.12.3. Operator Hierarchy

<u>diagram</u> : diagram_recalculate_BG_locations_ahead_1

15.2.12.4.   Graphical and Textual Diagrams

15.2.12.4.1. View of diagram_recalculate_BG_locations_ahead_1 (recalculate_BG_locations_ahead)
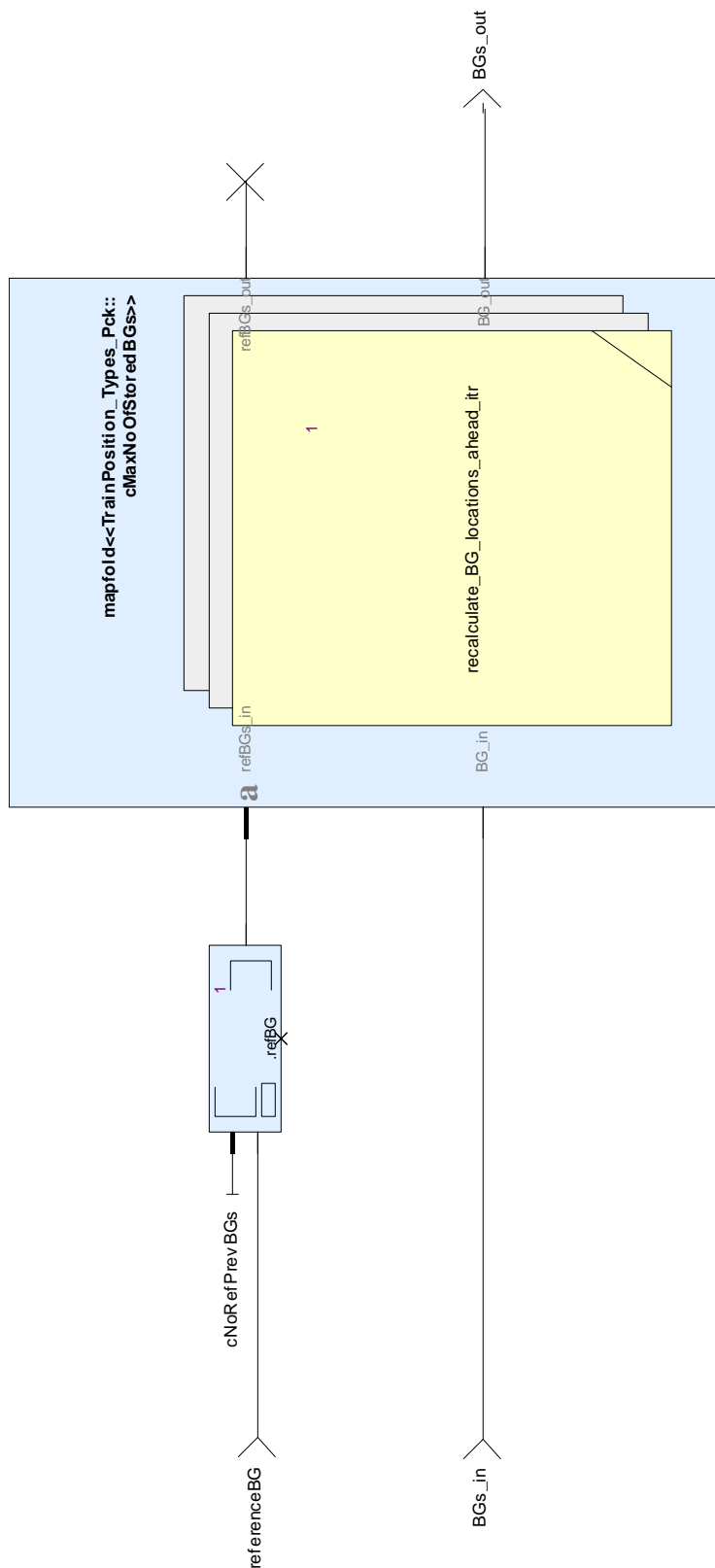
Figure 69: View of diagram_recalculate_BG_locations_ahead_1 (recalculate_BG_locations_ahead)

15.2.13.   recalculate_BG_locations_ahead_itr Operator

Declared as **private function**

15.2.13.1.   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.

15.2.13.2.   Interface

Table 200: Inputs of recalculate_BG_locations_ahead_itr

Name	Type	Comments and Information
refBGs_in	CalculateTrainPosition_Pkg::BG_relocation_Pkg::refBGs_T	
BG_in	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG that's location has to be recalculated

Table 201: 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_Pck::positionedBG_T	Comments: The BG that's location has been recalculated.

15.2.13.3.   Locals

Table 202: Locals of recalculate_BG_locations_ahead_itr

Name	Type	Comments and Information
BGin_is_refBG	bool	
prevLinkedBG	TrainPosition_Types_Pck::positionedBG_T	
prevUnlinkedBG	TrainPosition_Types_Pck::positionedBG_T	
recalculateSubsequentBGs	bool	
refBG	TrainPosition_Types_Pck::positionedBG_T	
refLocation	Obu_BasicTypes_Pkg::LocWithInAcc_T	Comments: The recalculated location of the reference BG.
relocatedBG	TrainPosition_Types_Pck::positionedBG_T	

15.2.13.4. Operator Hierarchy

<u>diagram</u> : diagram_assembleResults
<u>diagram</u> : diagram_assign_refBG
<u>diagram</u> : diagram_determinePreviousLinkedBG
<u>diagram</u> : diagram_determinePreviousUnlinkedBG
<u>diagram</u> : diagram_recalculate_BG_location
<u>diagram</u> : diagram_recalculate_refBG_location

15.2.13.5. Graphical and Textual Diagrams

15.2.13.5.1. View of diagram_assembleResults (recalculate_BG_locations_ahead_itr)
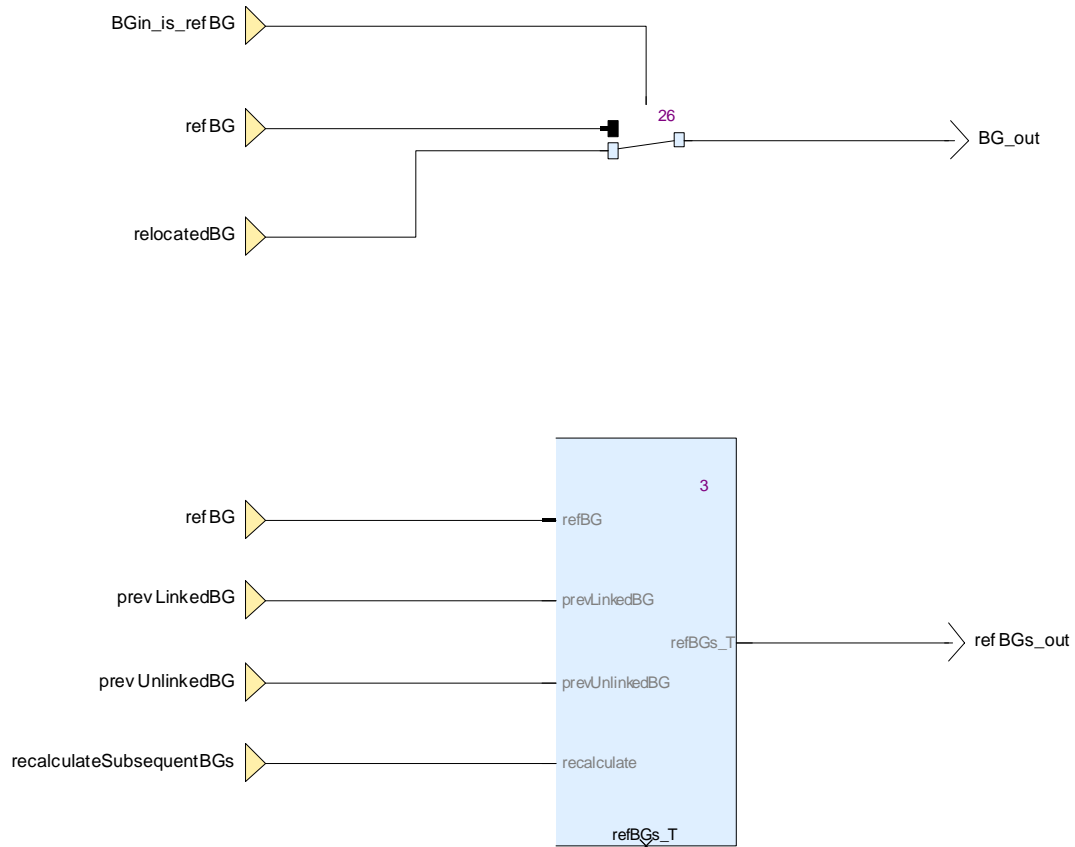
Figure 70: View of diagram_assembleResults (recalculate_BG_locations_ahead_itr)

diagram_assembleResults Comments:

- Assembles the outputs.

15.2.13.5.2. View of diagram_assign_refBG (recalculate_BG_locations_ahead_itr)
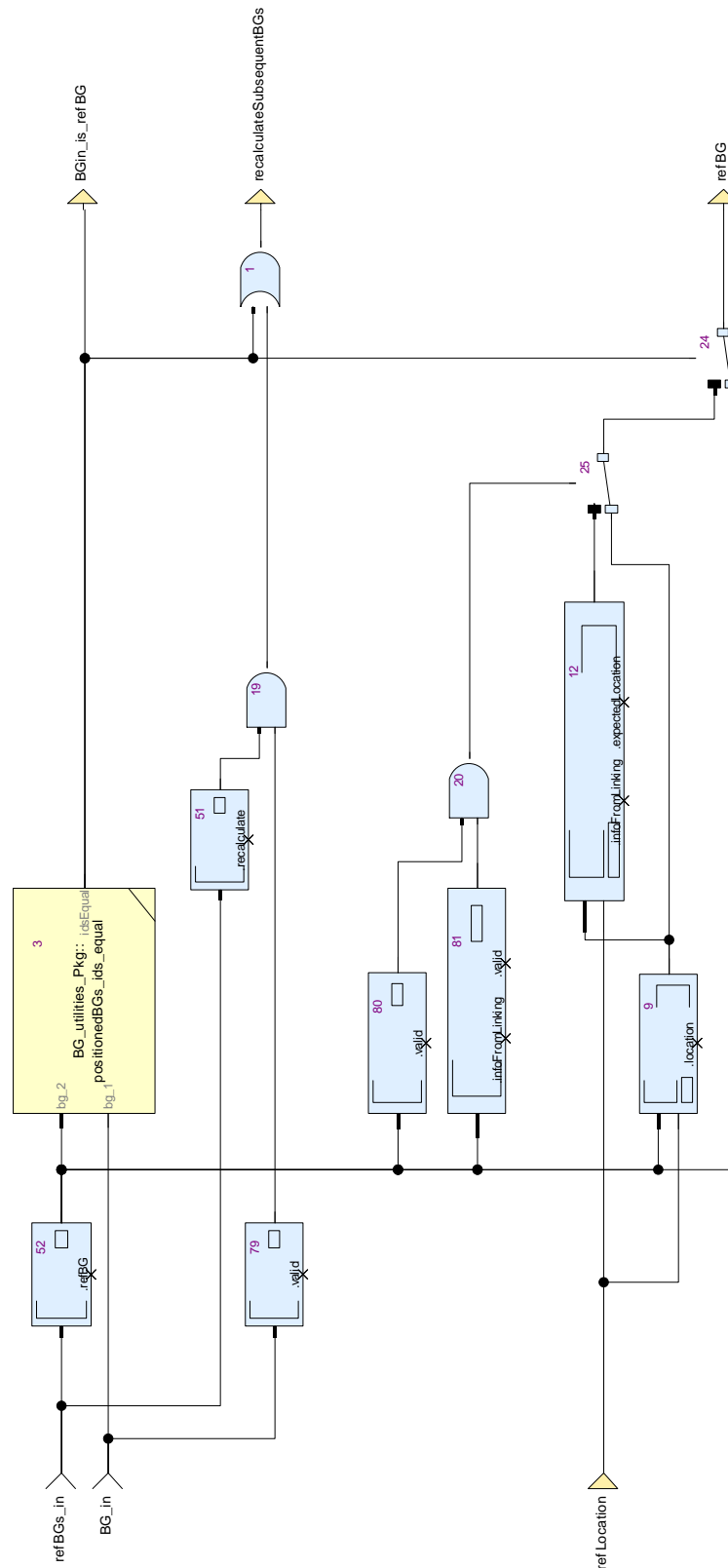
Figure 71: View of diagram_assign_refBG (recalculate_BG_locations_ahead_itr)

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 recalculated.
- For all BGs in the iteration before the reference BGs, the locations are kept unchanged.

15.2.13.5.3. View of diagram_determinePreviousLinkedBG (recalculate_BG_locations_ahead_itr)
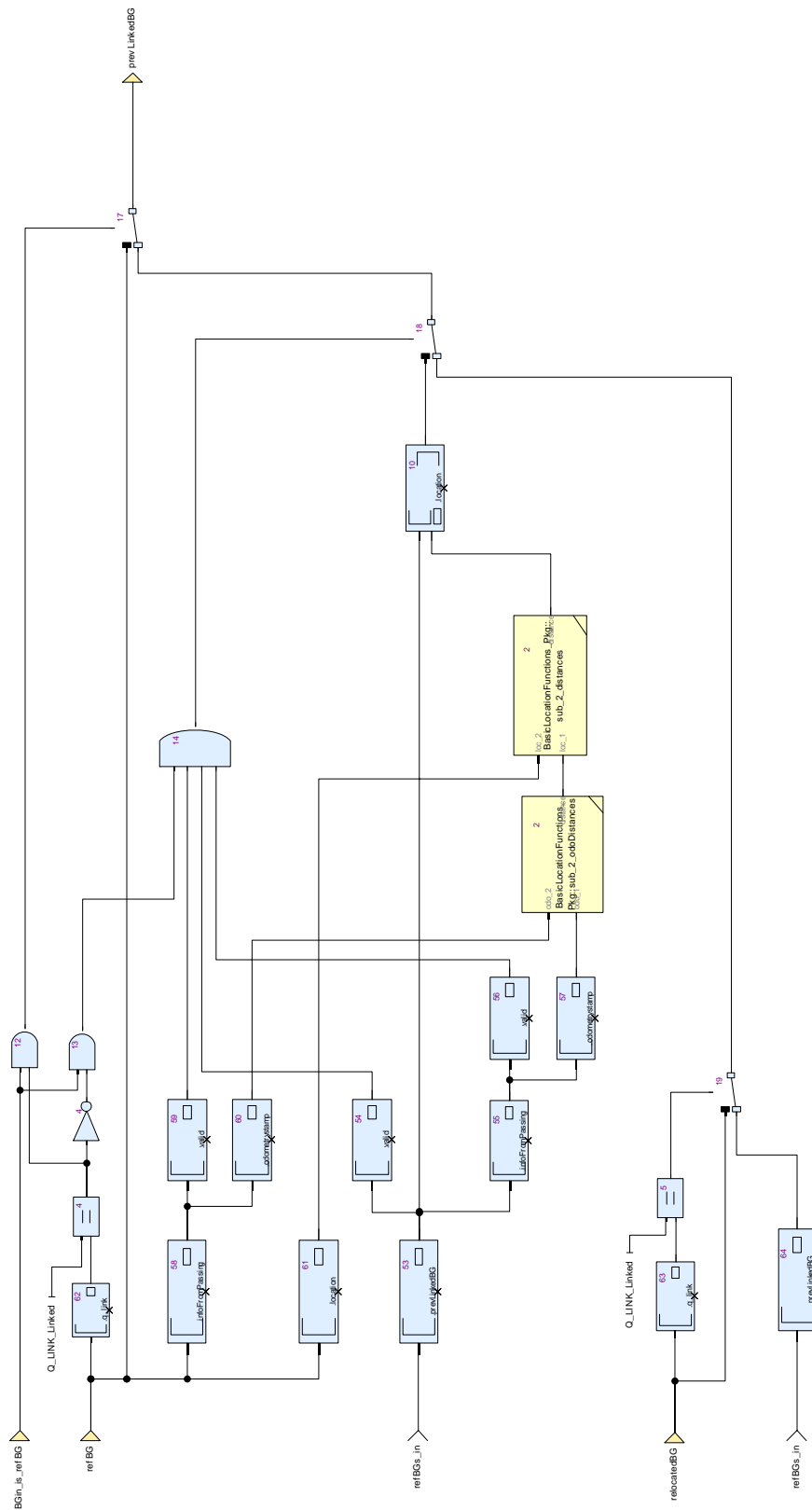
Figure 72: View of diagram_determinePreviousLinkedBG (recalculate_BG_locations_ahead_itr)

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 or a linked BG without linking information, 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.

15.2.13.5.4. View of diagram_determinePreviousUnlinkedBG
(recalculate_BG_locations_ahead_itr)
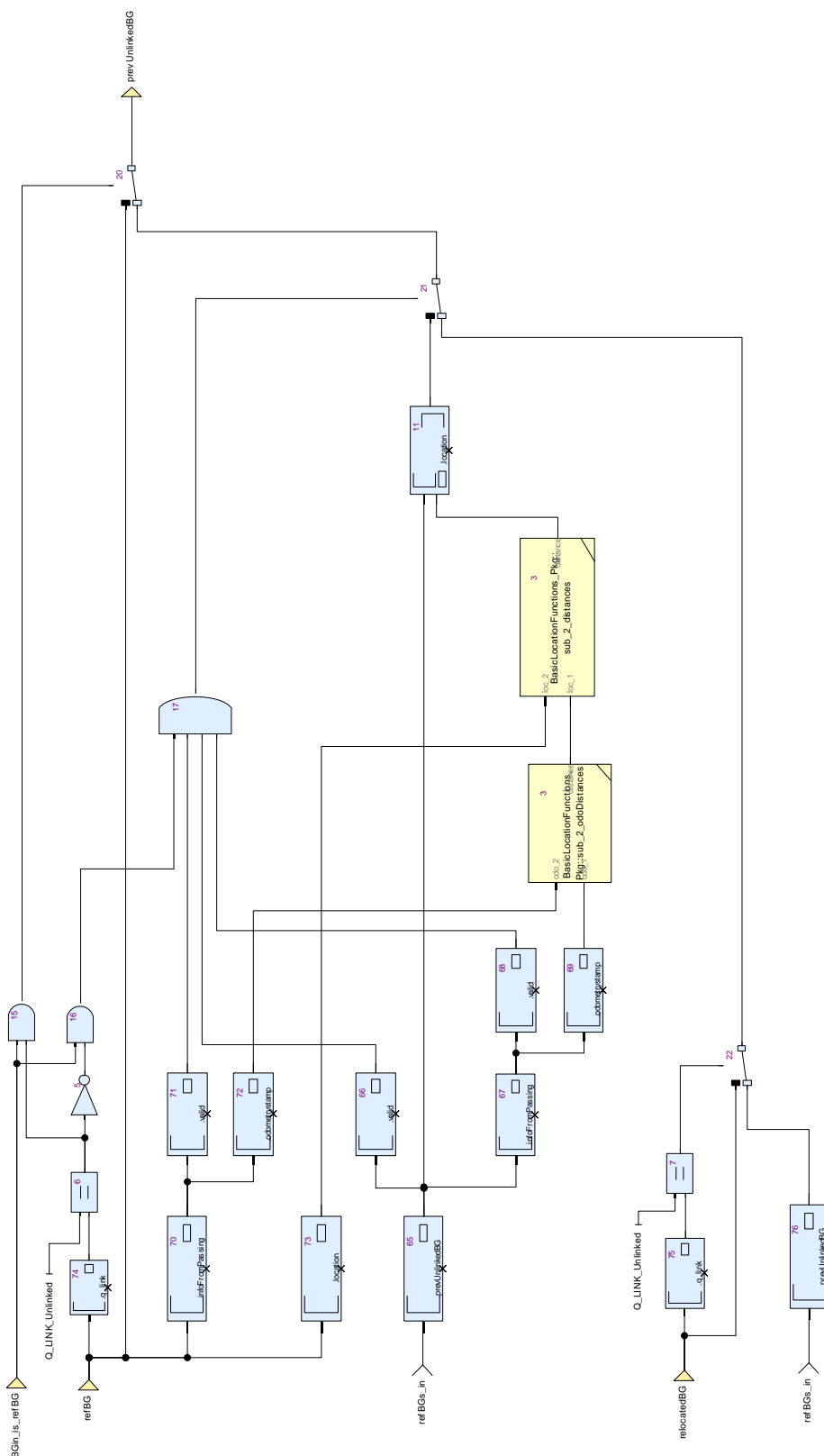
Figure 73: View of diagram_determinePreviousUnlinkedBG (recalculate_BG_locations_ahead_itr)

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.

15.2.13.5.5. View of diagram_recalculate_BG_location (recalculate_BG_locations_ahead_itr)
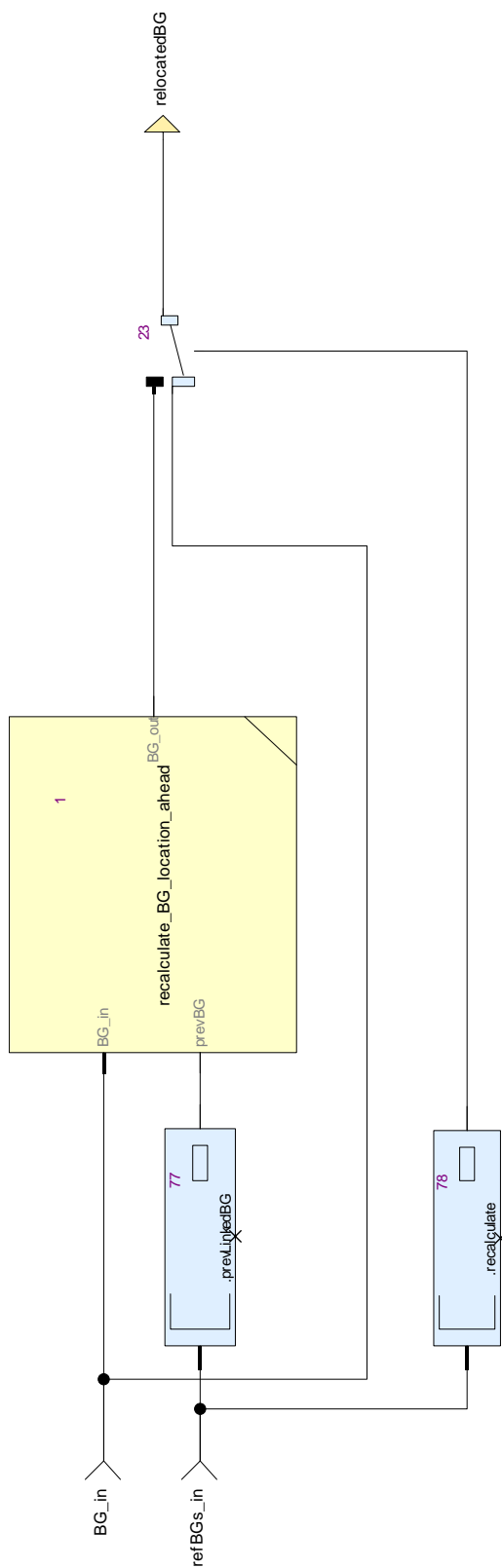
Figure 74: View of diagram_recalculate_BG_location (recalculate_BG_locations_ahead_itr)

15.2.13.5.6. View of diagram_recalculate_refBG_location
(recalculate_BG_locations_ahead_itr)
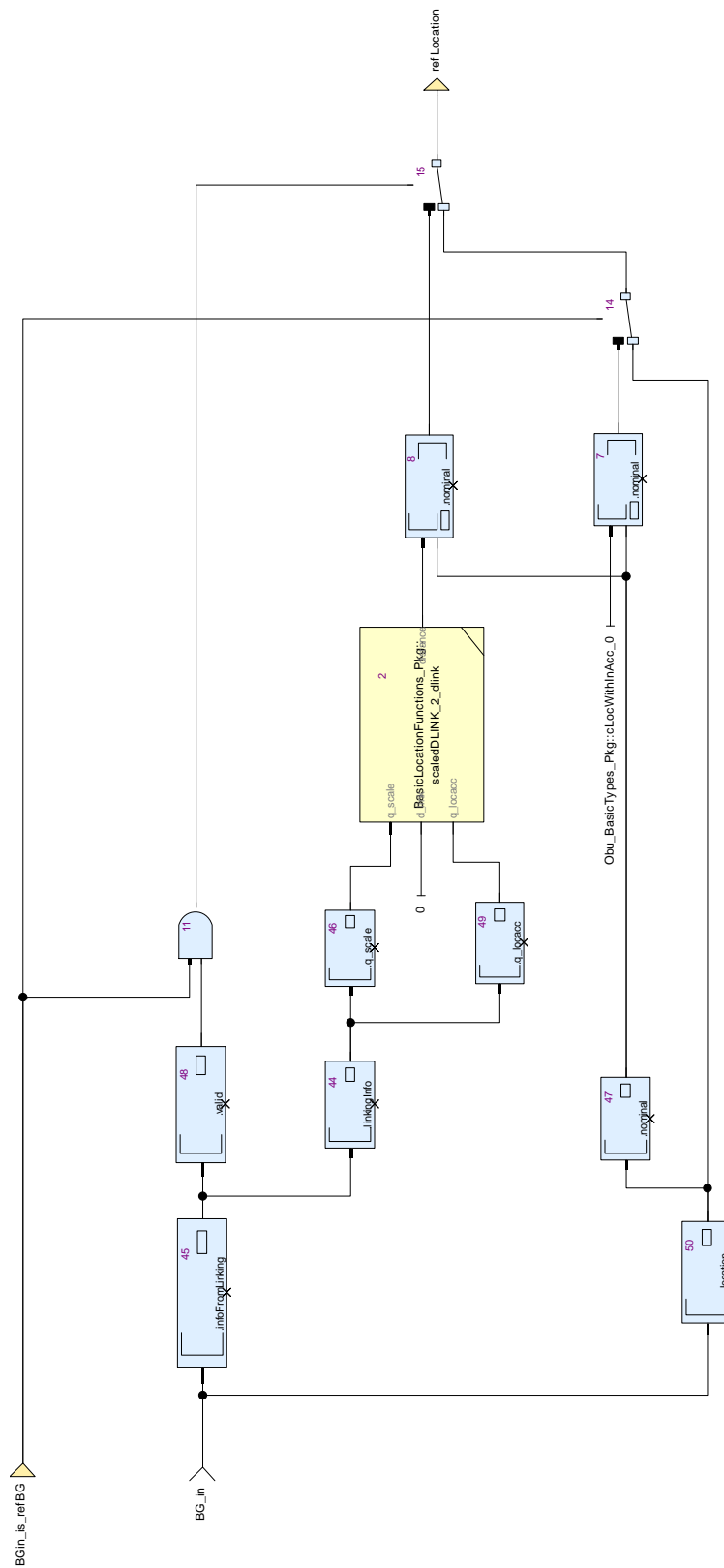
Figure 75: View of diagram_recalculate_refBG_location (recalculate_BG_locations_ahead_itr)

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, its nominal location is kept unchanged with inaccuracies derived from its linking information.
- If the refBG is an unlinked BG or a linked BG without linking information, its nominal location is kept unchanged with inaccuracy 0.

15.2.14. recalculate_BG_locations_astern Operator

Declared as **private function**

15.2.14.1. 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.

15.2.14.2. Interface

Table 203: Inputs of recalculate_BG_locations_astern

Name	Type	Comments and Information
referenceBG	TrainPosition_Types_Pck::positionedBG_T	Comments: 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_Pck::positionedBGs_T	

Table 204: Outputs of recalculate_BG_locations_astern

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

15.2.14.3. Operator Hierarchy

diagram : diagram_recalculate_BG_locations_astern_1

15.2.14.4.　Graphical and Textual Diagrams

15.2.14.4.1.　View of diagram_recalculate_BG_locations_astern_1
(recalculate_BG_locations_astern)
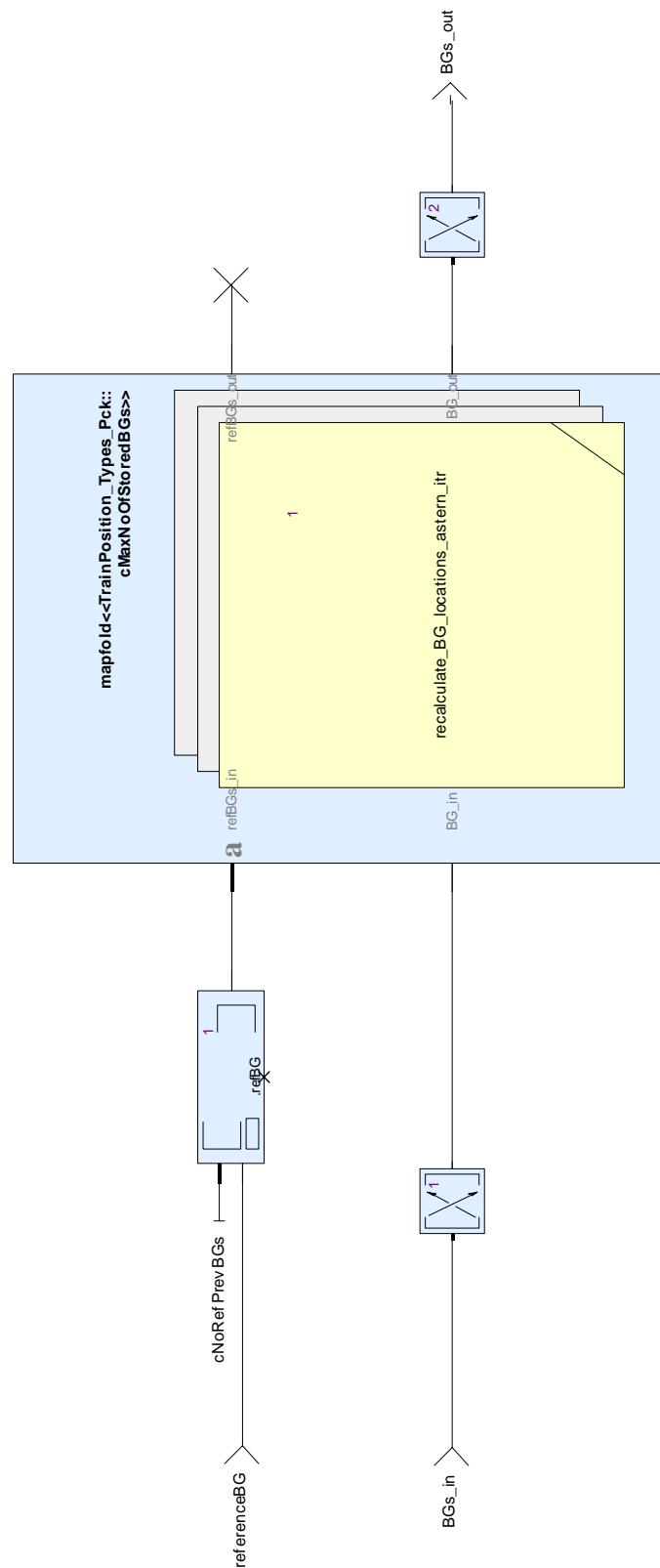
Figure 76: View of diagram_recalculate_BG_locations_astern_1 (recalculate_BG_locations_astern)

15.2.15. recalculate_BG_locations_astern_itr Operator

Declared as **private function**

15.2.15.1. 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.

15.2.15.2. Interface

Table 205: Inputs of recalculate_BG_locations_astern_itr

Name	Type	Comments and Information
refBGs_in	CalculateTrainPosition_Pkg::BG_relocation_Pkg::refBGs_T	Comments: Note: prevUnlinkedBG and prevLinkedBG are previous for the bäckward iteration.
BG_in	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG that's location has to be recalculated

Table 206: 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_Pck::positionedBG_T	Comments: The BG that's location has been recalculated.

15.2.15.3. Locals

Table 207: Locals of recalculate_BG_locations_astern_itr

Name	Type	Comments and Information
BGin_is_refBG	bool	
prevLinkedBG	TrainPosition_Types_Pck::positionedBG_T	
prevUnlinkedBG	TrainPosition_Types_Pck::positionedBG_T	
recalculateSubsequentBGs	bool	
refBG	TrainPosition_Types_Pck::positionedBG_T	
relocatedBG	TrainPosition_Types_Pck::positionedBG_T	

15.2.15.4. Operator Hierarchy

<u>diagram</u> : diagram_assembleResults
<u>diagram</u> : diagram_assign_refBG
<u>diagram</u> : diagram_determinePreviousLinkedBG
<u>diagram</u> : diagram_determinePreviousUnlinkedBG
<u>diagram</u> : diagram_recalculate_BG_location

15.2.15.5. Graphical and Textual Diagrams

#### 15.2.15.5.1. View of diagram_assembleResults (recalculate_BG_locations_astern_itr)
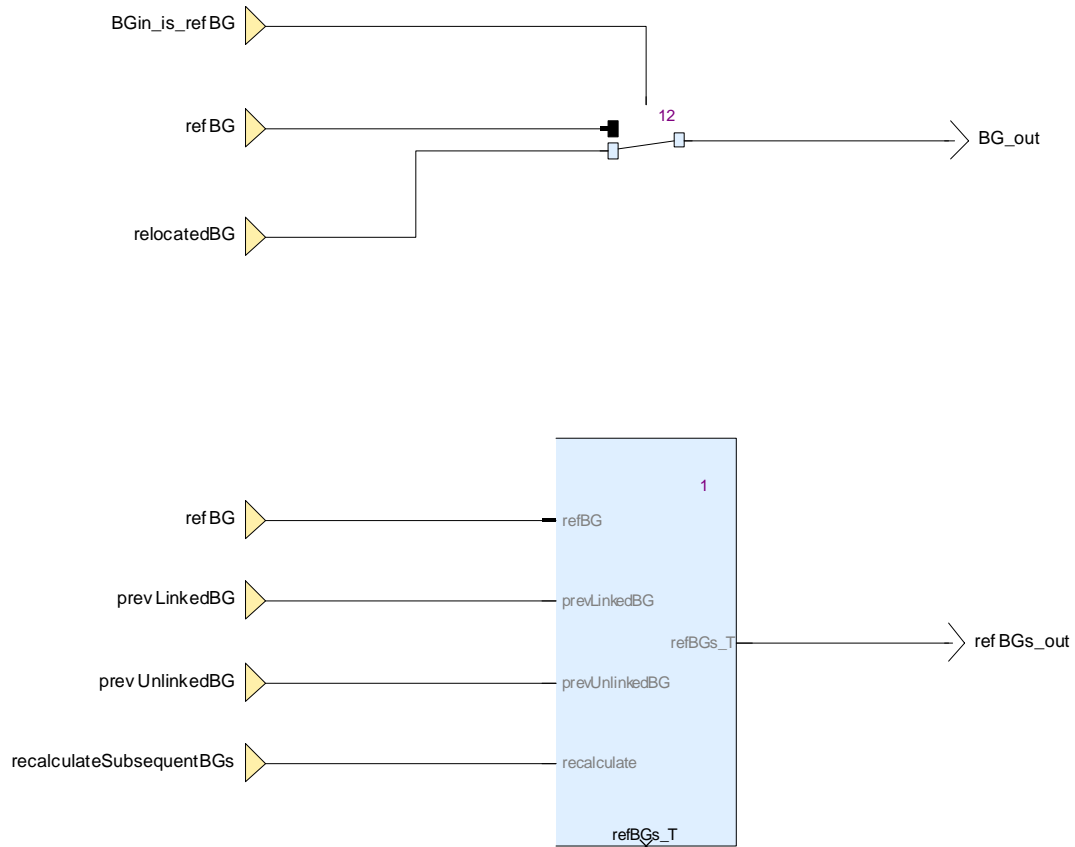
Figure 77: View of diagram_assembleResults (recalculate_BG_locations_astern_itr)

diagram_assembleResults Comments:

- Assembles the outputs.

15.2.15.5.2. View of diagram_assign_refBG (recalculate_BG_locations_astern_itr)
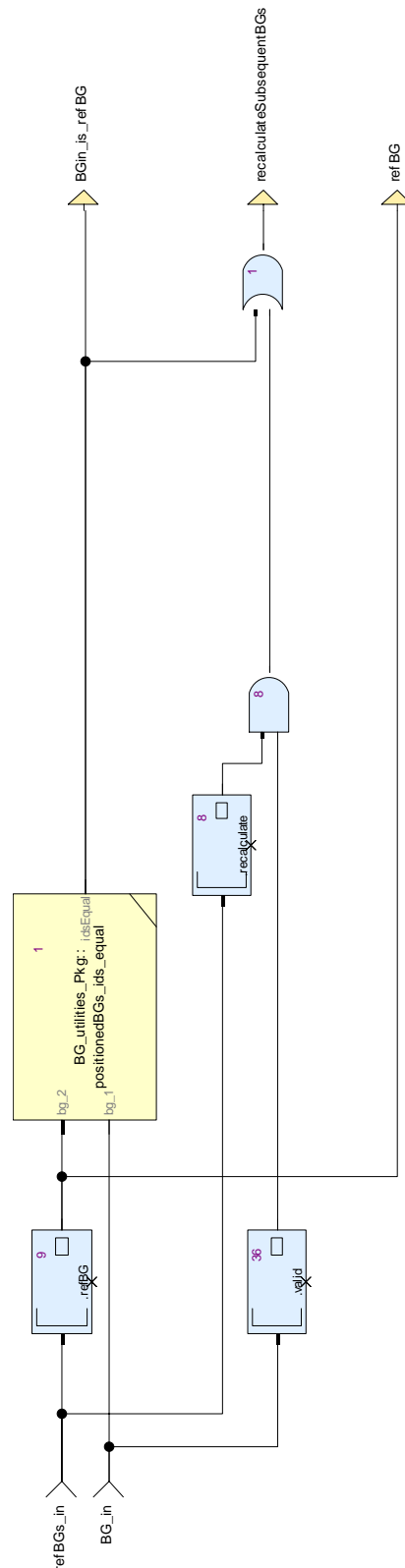
Figure 78: View of diagram_assign_refBG (recalculate_BG_locations_astern_itr)

diagram_assign_refBG Comments:

- Determines if BG_in is the reference BG.
- If yes, the location of the reference BG has to be recalculated.

- For all subsequent BGs in the iteration, the locations have to recalculated.
- For all BGs in the iteration before the reference BGs, the locations are kept unchanged.

15.2.15.5.3. View of diagram_determinePreviousLinkedBG
(recalculate_BG_locations_astern_itr)
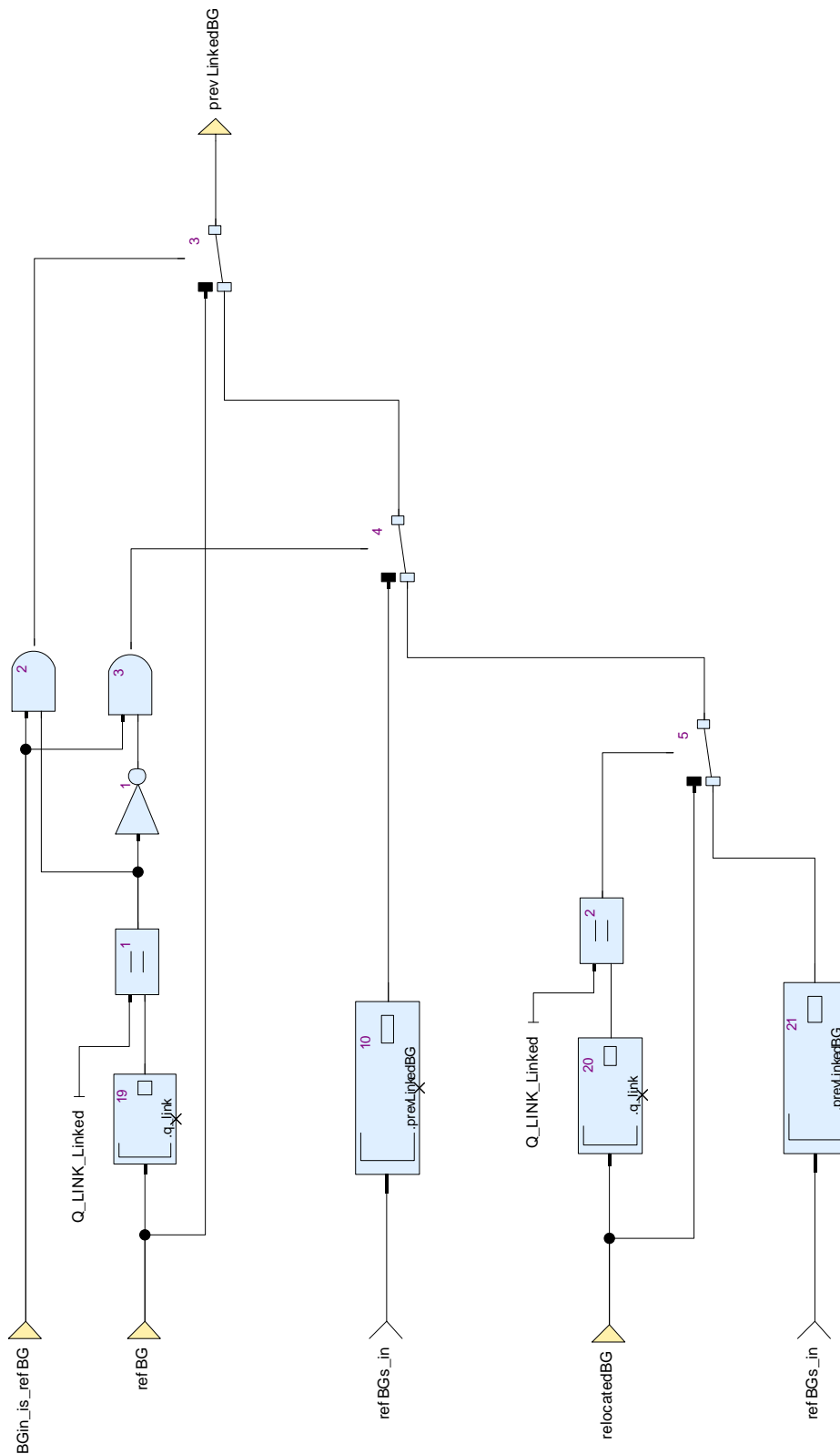
Figure 79: View of diagram_determinePreviousLinkedBG (recalculate_BG_locations_astern_itr)

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 taken from refBGs_in.prevLinkedBG
- 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.

15.2.15.5.4. View of diagram_determinePreviousUnlinkedBG
(recalculate_BG_locations_astern_itr)
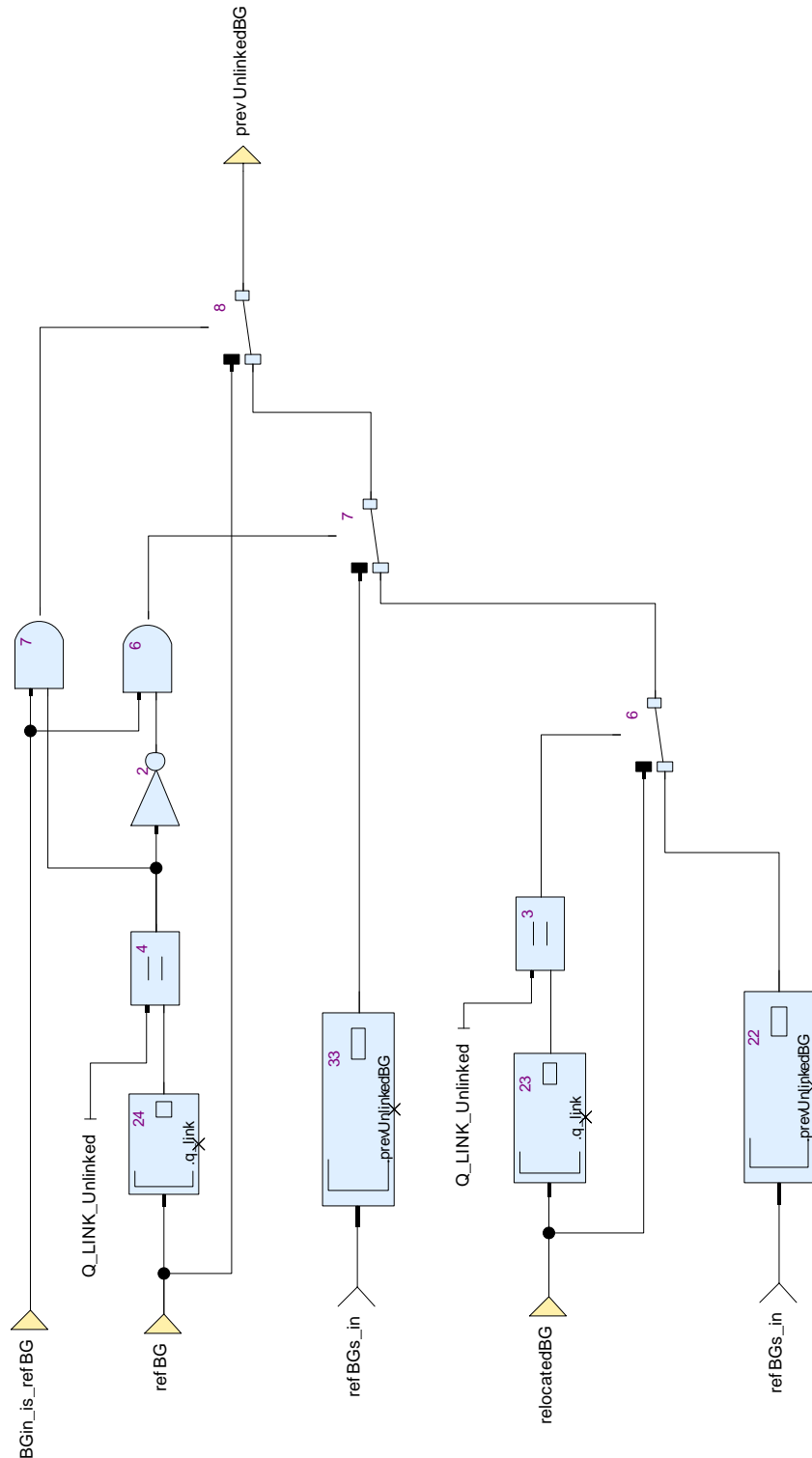
Figure 80: View of diagram_determinePreviousUnlinkedBG (recalculate_BG_locations_astern_itr)

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,   prevUnlinkedBG is taken from refBGs_in.prevUnlinkedBG.
- 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.

15.2.15.5.5. View of diagram_recalculate_BG_location (recalculate_BG_locations_astern_itr)
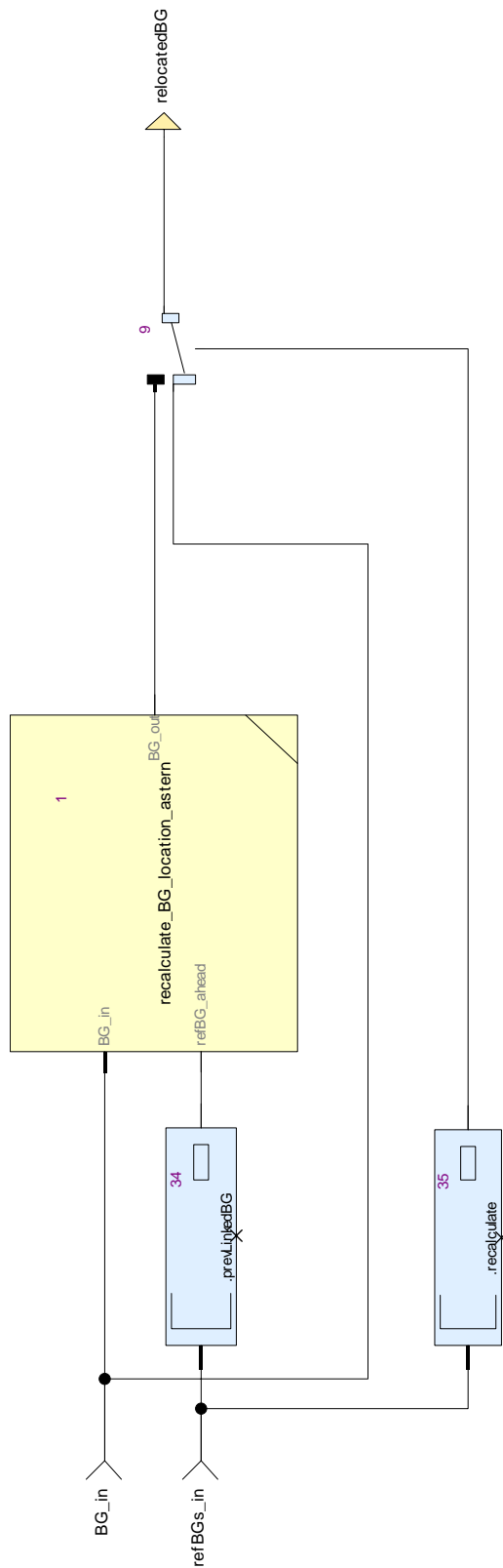
Figure 81: View of diagram_recalculate_BG_location (recalculate_BG_locations_astern_itr)

diagram_recalculate_BG_location Comments:

- Recalculates the location of BG_in.

15.3. CalculateTrainPosition_Pkg::BG_utilities_Pkg Package

15.3.1. Types

Table 208: 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}	Comments: Serves to count the BGs
BG_find_T	{index : int, noOfFoundBGs : int, BGFound : bool}	Comments: Serves to search throug the BGs

15.3.2. Constants

Table 209: 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_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {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 :	

15.3.3.   countBGs Operator

Declared as **public function**

15.3.3.1.   Comments and Information

countBGs Comments:

- Determines the linked, unlinked and total number of BGs in BG_in.

15.3.3.2.   Interface

Table 210: Inputs of countBGs

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

Table 211: Outputs of countBGs

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

15.3.3.3.   Operator Hierarchy

diagram : diagram_countBGs_1

15.3.3.4.   Graphical and Textual Diagrams

15.3.3.4.1.   View of diagram_countBGs_1 (countBGs)
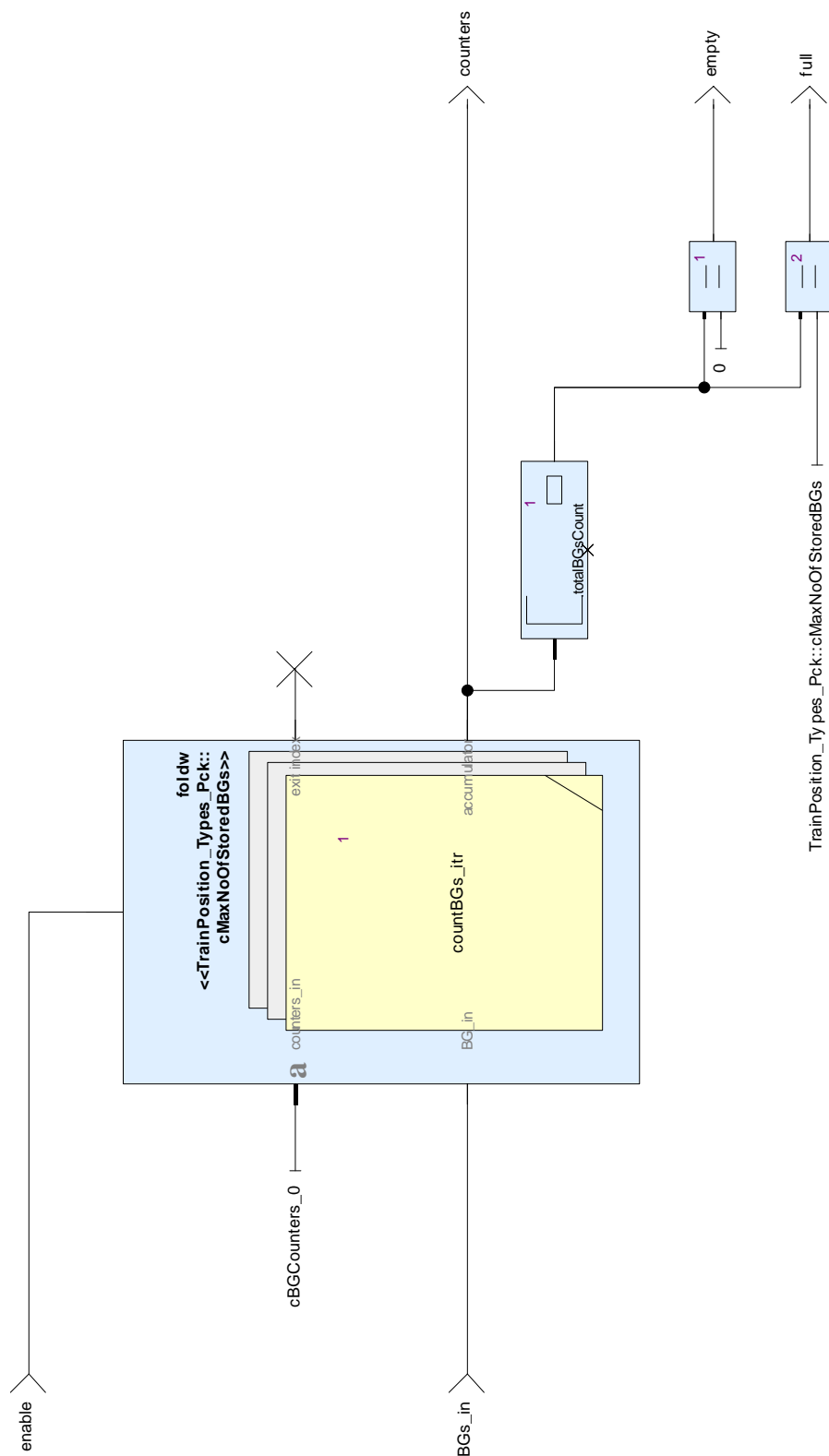
Figure 82: View of diagram_countBGs_1 (countBGs)

15.3.4.   countBGs_itr Operator

Declared as **private function**

15.3.4.1.   Comments and Information

countBGs_itr Comments:

- Iterated function for countBGs

15.3.4.2.   Interface

Table 212: Inputs of countBGs_itr

Name	Type	Comments and Information
counters_in	CalculateTrainPosition_Pkg::BG_utilities_Pkg::BG_counters_T	
BG_in	TrainPosition_Types_Pck::positionedBG_T	

Table 213: Outputs of countBGs_itr

Name	Type	Comments and Information
cont	bool	
counters_out	CalculateTrainPosition_Pkg::BG_utilities_Pkg::BG_counters_T	

15.3.4.3.   Operator Hierarchy

<u>diagram</u> : diagram_countBGs_itr_1

15.3.4.4.   Graphical and Textual Diagrams

15.3.4.4.1.   View of diagram_countBGs_itr_1 (countBGs_itr)
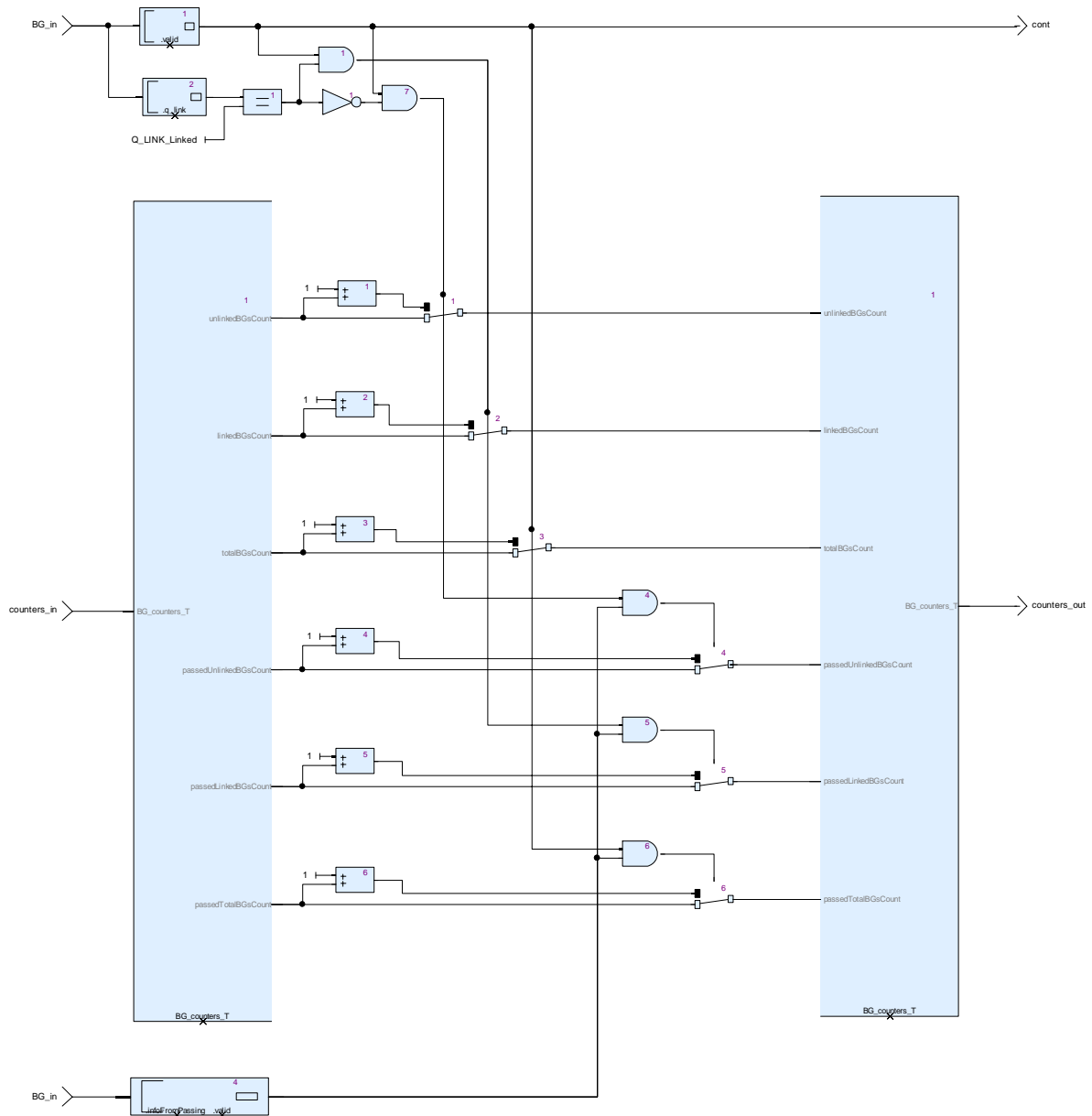
Figure 83: View of diagram_countBGs_itr_1 (countBGs_itr)

15.3.5.   deleteBG_atIndex Operator

Declared as **public function**

15.3.5.1.   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.

15.3.5.2.   Interface

Table 214: Inputs of deleteBG_atIndex

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	
indexOfBG	int	
del	bool	Comments: Delete command. Deletion takes place if del = true.

Table 215: Outputs of deleteBG_atIndex

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

15.3.5.3.   Operator Hierarchy

<u>diagram</u> : diagram_deleteBG_atIndex_1

15.3.5.4. Graphical and Textual Diagrams

15.3.5.4.1. View of diagram_deleteBG_atIndex_1 (deleteBG_atIndex)
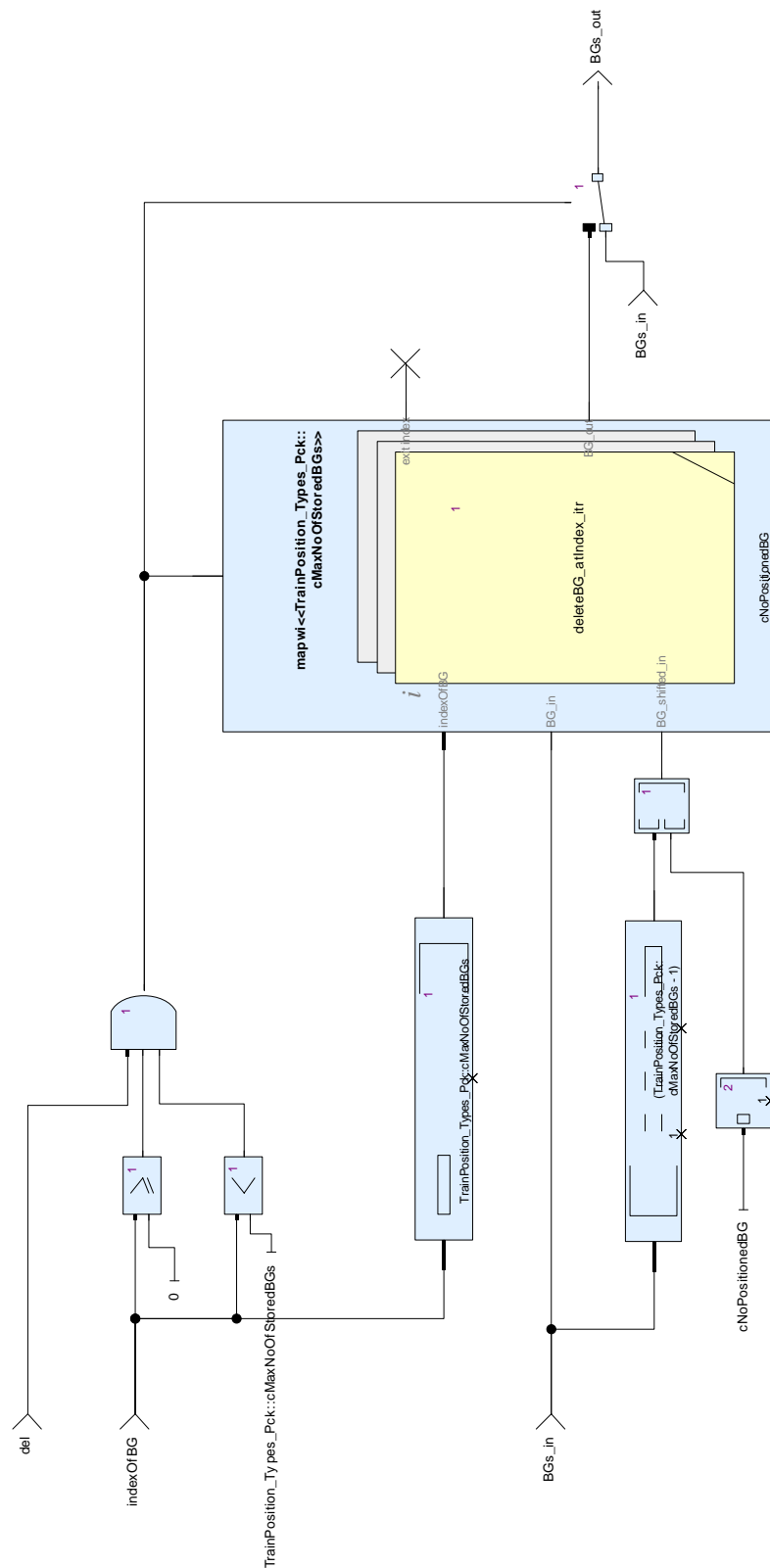
Figure 84: View of diagram_deleteBG_atIndex_1 (deleteBG_atIndex)

15.3.6.   deleteBG_atIndex_itr Operator

Declared as **private function**

15.3.6.1.   Comments and Information

deleteBG_atIndex_itr Comments:

- Iterated function used by deleteBG_atIndex

15.3.6.2.   Interface

Table 216: Inputs of deleteBG_atIndex_itr

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

Table 217: Outputs of deleteBG_atIndex_itr

Name	Type	Comments and Information
cont	bool	
BG_out	TrainPosition_Types_Pck::positionedBG_T	

15.3.6.3.   Operator Hierarchy

diagram : diagram_deleteBG_atIndex_itr_1
     activate if : IfBlock1
         branch : then
         branch : else
             branch : then
             branch : else

15.3.6.4.   Graphical and Textual Diagrams

15.3.6.4.1.   View of diagram_deleteBG_atIndex_itr_1 (deleteBG_atIndex_itr)
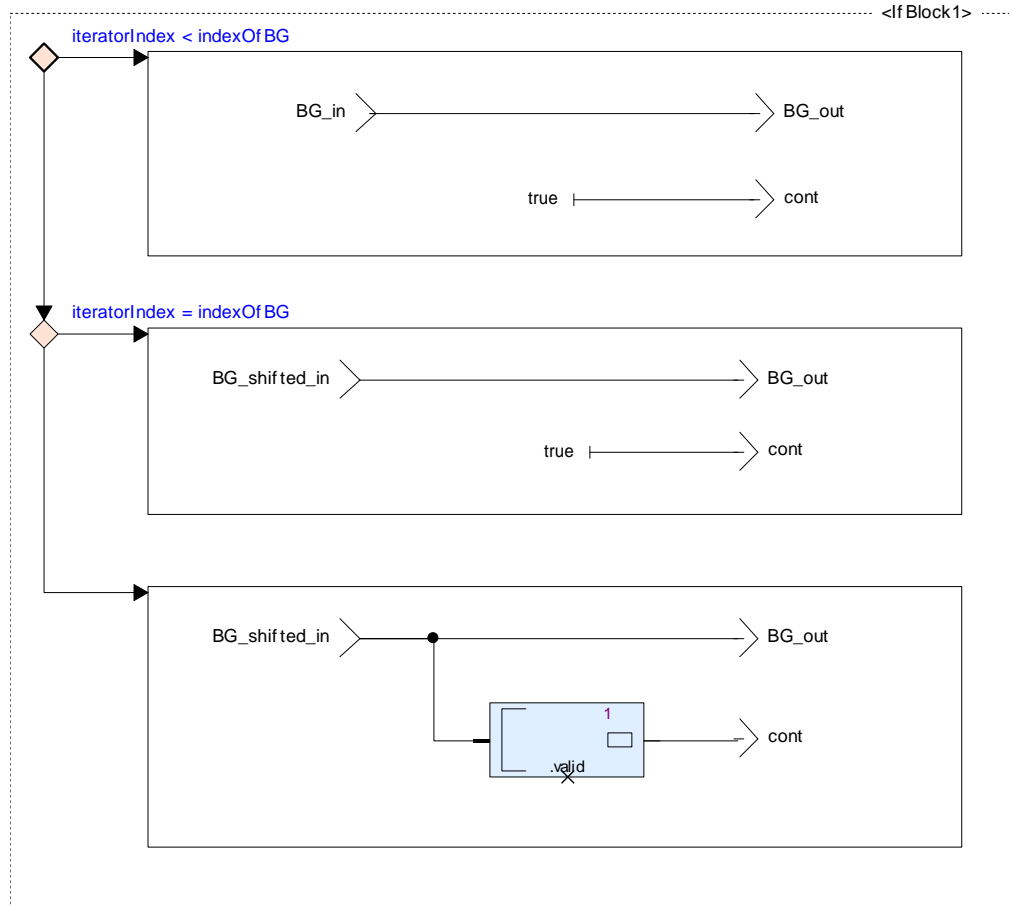
Figure 85: View of diagram_deleteBG_atIndex_itr_1 (deleteBG_atIndex_itr)

Table 218: Conditional Blocks of diagram_deleteBG_atIndex_itr_1

Conditional Block	Comments and Information
IfBlock1	

Table 219: Actions of diagram_deleteBG_atIndex_itr_1

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

15.3.7.   deleteBGs_beforeIndex Operator

Declared as **public function**

15.3.7.1.   Comments and Information

deleteBGs_beforeIndex Comments:

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

15.3.7.2. Interface

Table 220: Inputs of deleteBGs_beforeIndex

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	
indexOfBG	int	
del	bool	Comments: Delete command. Deletion takes place if del = true.

Table 221: Outputs of deleteBGs_beforeIndex

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

15.3.7.3. Operator Hierarchy

<u>diagram</u> : diagram_deleteBGs_beforeIndex_1

15.3.7.4.   Graphical and Textual Diagrams

15.3.7.4.1.   View of diagram_deleteBGs_beforeIndex_1 (deleteBGs_beforeIndex)
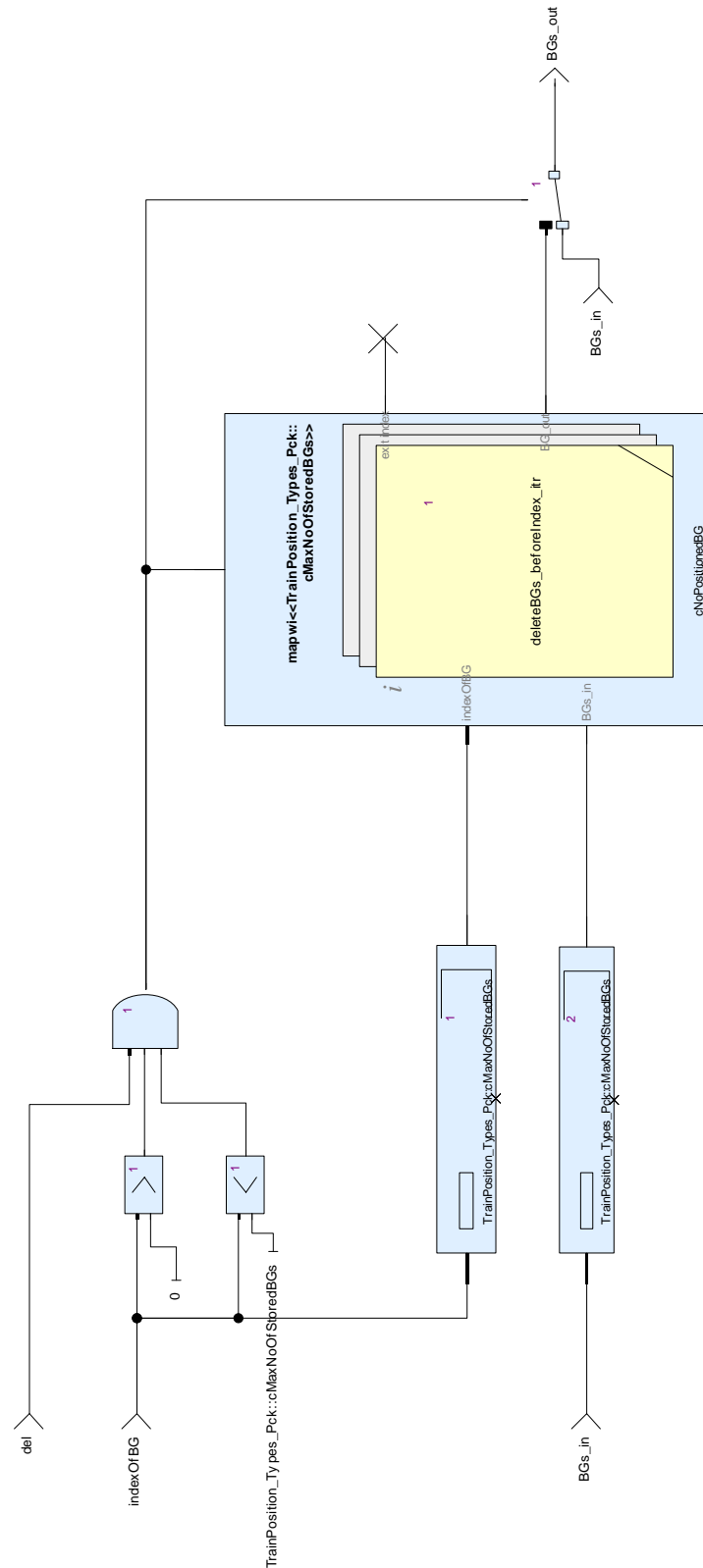
Figure 86: View of diagram_deleteBGs_beforeIndex_1 (deleteBGs_beforeIndex)

15.3.8.   deleteBGs_beforeIndex_itr Operator

Declared as **private function**

15.3.8.1.   Comments and Information

deleteBGs_beforeIndex_itr Comments:

- Iterated function used by deleteBGs_beforeIndex

15.3.8.2.   Interface

Table 222: Inputs of deleteBGs_beforeIndex_itr

Name	Type	Comments and Information
iteratorIndex	int	
indexOfBG	int	
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	

Table 223: Outputs of deleteBGs_beforeIndex_itr

Name	Type	Comments and Information
cont	bool	
BG_out	TrainPosition_Types_Pck::positionedBG_T	

15.3.8.3.   Operator Hierarchy

<u>diagram</u> : diagram_deleteBGs_beforeIndex_itr_1

15.3.8.4.   Graphical and Textual Diagrams

15.3.8.4.1.   View of diagram_deleteBGs_beforeIndex_itr_1 (deleteBGs_beforeIndex_itr)
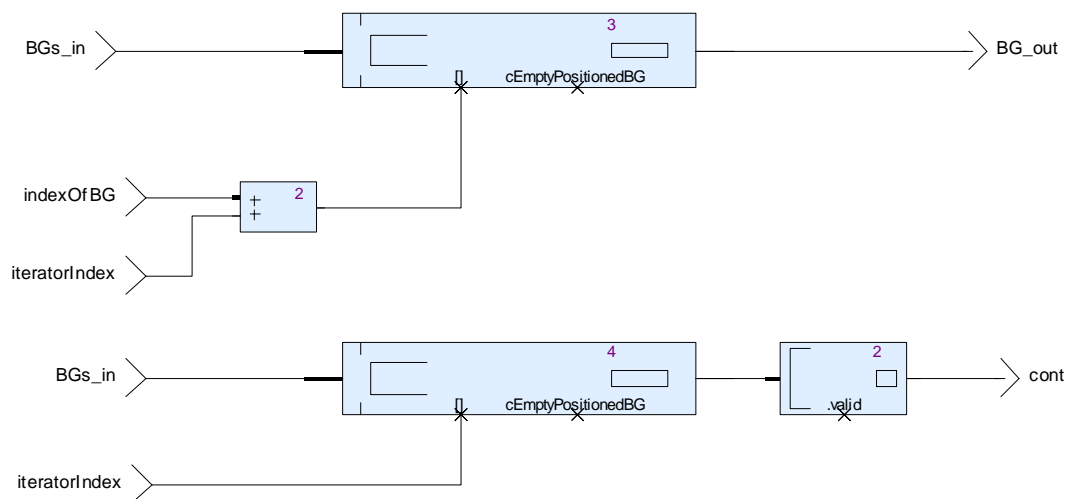
Figure 87: View of diagram_deleteBGs_beforeIndex_itr_1 (deleteBGs_beforeIndex_itr)

15.3.9.   deleteBGs_fromIndex Operator

Declared as **public function**

15.3.9.1.   Comments and Information

deleteBGs_fromIndex Comments:

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

15.3.9.2.   Interface

Table 224: Inputs of deleteBGs_fromIndex

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	
indexOfBG	int	
del	bool	Comments: Delete command. Deletion takes place if del = true.

Table 225: Outputs of deleteBGs_fromIndex

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

15.3.9.3.   Operator Hierarchy

diagram : diagram_deleteBGs_fromIndex_1

15.3.9.4. Graphical and Textual Diagrams

15.3.9.4.1. View of diagram_deleteBGs_fromIndex_1 (deleteBGs_fromIndex)
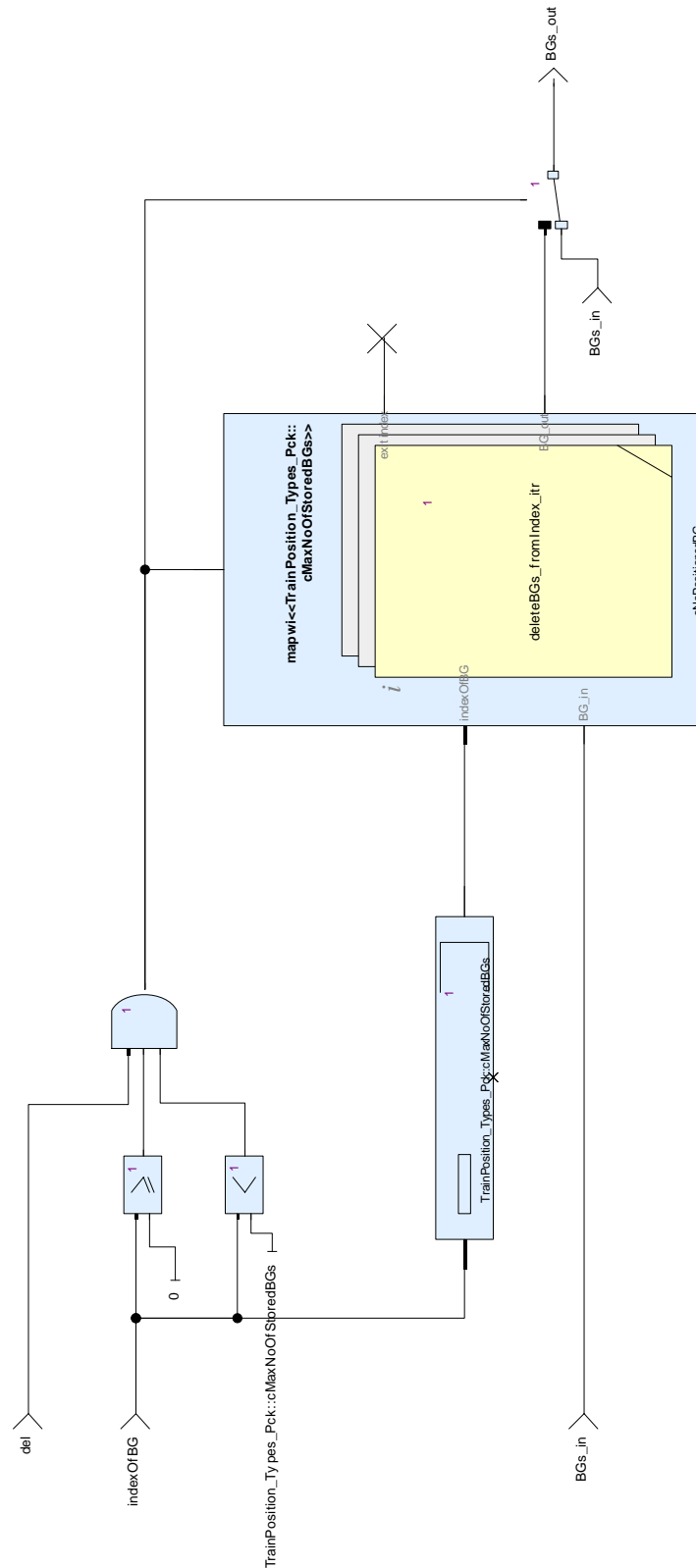
Figure 88: View of diagram_deleteBGs_fromIndex_1 (deleteBGs_fromIndex)

15.3.10.   deleteBGs_fromIndex_itr Operator

Declared as **private function**

15.3.10.1.   Comments and Information

deleteBGs_fromIndex_itr Comments:

- Iterated function used by deleteBGs_fromIndex

15.3.10.2.   Interface

Table 226: Inputs of deleteBGs_fromIndex_itr

Name	Type	Comments and Information
iteratorIndex	int	
indexOfBG	int	
BG_in	TrainPosition_Types_Pck::positionedBG_T	

Table 227: Outputs of deleteBGs_fromIndex_itr

Name	Type	Comments and Information
cont	bool	
BG_out	TrainPosition_Types_Pck::positionedBG_T	

15.3.10.3.   Operator Hierarchy

diagram : diagram_deleteBGs_fromIndex_itr_1
        activate if : IfBlock1
                branch : then
                branch : else
                        branch : then
                        branch : else

15.3.10.4.   Graphical and Textual Diagrams

15.3.10.4.1. View of diagram_deleteBGs_fromIndex_itr_1 (deleteBGs_fromIndex_itr)
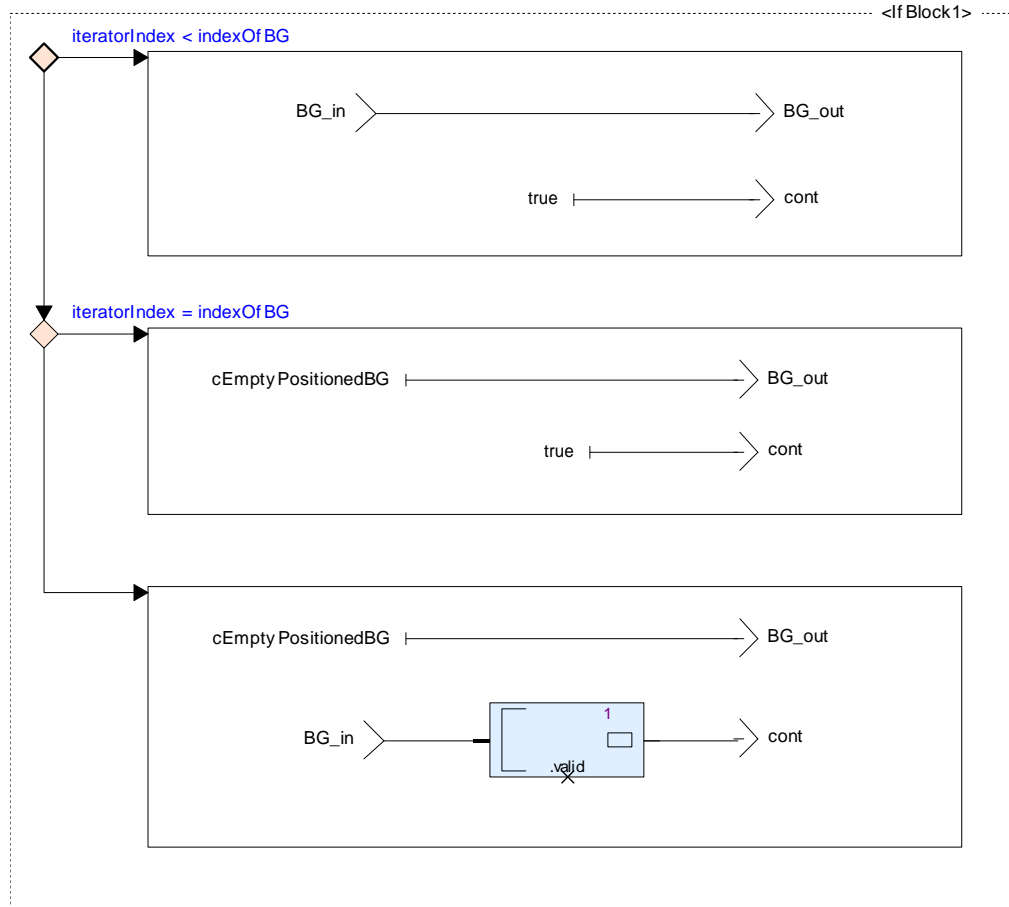
Figure 89: View of diagram_deleteBGs_fromIndex_itr_1 (deleteBGs_fromIndex_itr)

Table 228: Conditional Blocks of diagram_deleteBGs_fromIndex_itr_1

Conditional Block	Comments and Information
IfBlock1	

Table 229: Actions of diagram_deleteBGs_fromIndex_itr_1

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

15.3.11.   indexOf_nthPassedBG Operator

Declared as **public function**

15.3.11.1. Comments and Information

indexOf_nthPassedBG Comments:

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

15.3.11.2. Interface

Table 230: Inputs of indexOf_nthPassedBG

Name	Type	Comments and Information
linked	bool	Comments: Condition if the seach is for a linked or unlinked BG.
n	int	Comments: The n-th BGs will be searched. This is the related number "n".
BGs	TrainPosition_Types_Pck::positionedBGs_T	
enable	bool	

Table 231: Outputs of indexOf_nthPassedBG

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

15.3.11.3. Operator Hierarchy

<u>diagram</u> : diagram_indexOf_nthPassedBG_1

15.3.11.4.   Graphical and Textual Diagrams

15.3.11.4.1. View of diagram_indexOf_nthPassedBG_1 (indexOf_nthPassedBG)
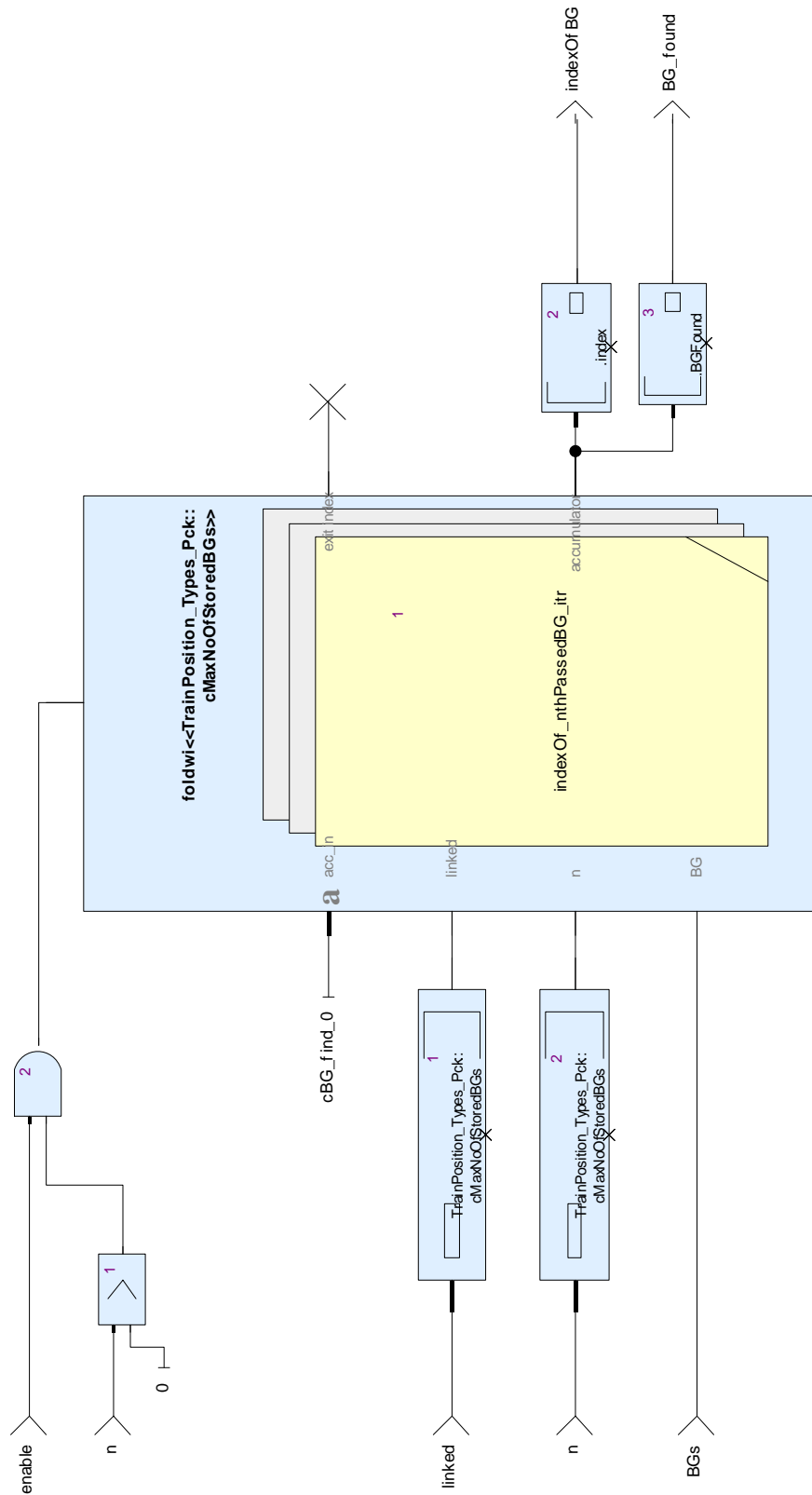
Figure 90: View of diagram_indexOf_nthPassedBG_1 (indexOf_nthPassedBG)

15.3.12. indexOf_nthPassedBG_itr Operator

Declared as **private function**

15.3.12.1. Comments and Information

indexOf_nthPassedBG_itr Comments:

- Iterated function for indexOf_nthPassedBG

Table 232: 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	Iterated function for determing the index of BG in BGs - 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.
	to_c	True

15.3.12.2. Interface

Table 233: Inputs of indexOf_nthPassedBG_itr

Name	Type	Comments and Information
iteratorIndex	int	
acc_in	CalculateTrainPosition_Pkg::BG_utilities_Pkg::BG_find_T	
linked	bool	Comments: Condition if the seach is for a linked or unlinked BG.
n	int	
BG	TrainPosition_Types_Pck::positionedBG_T	

Table 234: Outputs of indexOf_nthPassedBG_itr

Name	Type	Comments and Information
cont	bool	
acc_out	CalculateTrainPosition_Pkg::BG_utilities_Pkg::BG_find_T	

15.3.12.3. Operator Hierarchy

<u>diagram</u> : diagram_indexOf_nthPassedBG_itr_1

15.3.12.4.   Graphical and Textual Diagrams

15.3.12.4.1.   View of diagram_indexOf_nthPassedBG_itr_1 (indexOf_nthPassedBG_itr)
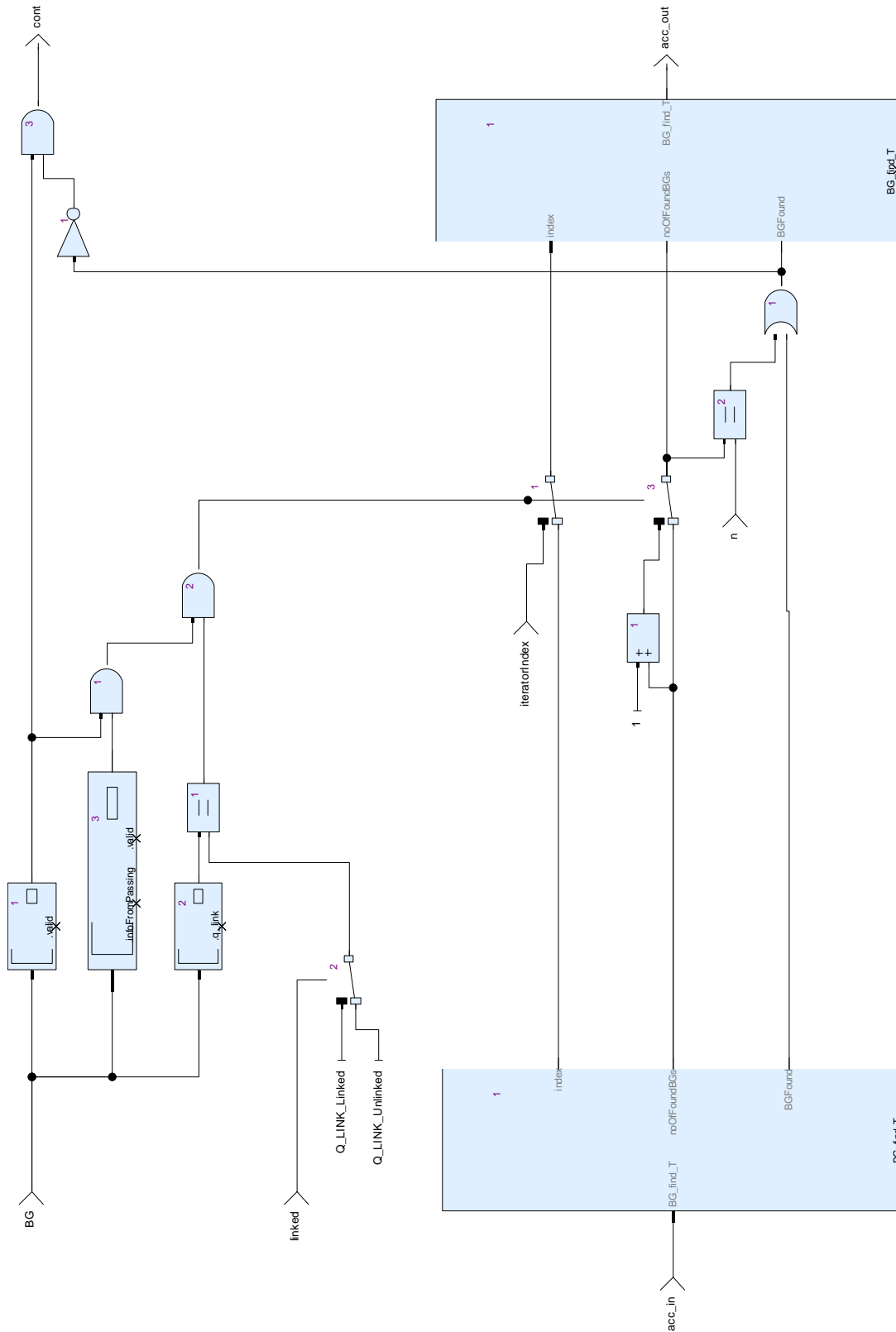
Figure 91: View of diagram_indexOf_nthPassedBG_itr_1 (indexOf_nthPassedBG_itr)

15.3.13. indexOfBG_by_id Operator

Declared as **public function**

15.3.13.1. 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 235: 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	Determines the index of BG in BGs - 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.
	to_c	True

15.3.13.2. Interface

Table 236: 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 237: Outputs of indexOfBG_by_id

Name	Type	Comments and Information
indexOfBG	int	

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

15.3.13.3. Operator Hierarchy

<u>diagram</u> : diagram_indexOfBG_by_id_1

15.3.13.4. Graphical and Textual Diagrams

15.3.13.4.1. View of diagram_indexOfBG_by_id_1 (indexOfBG_by_id)
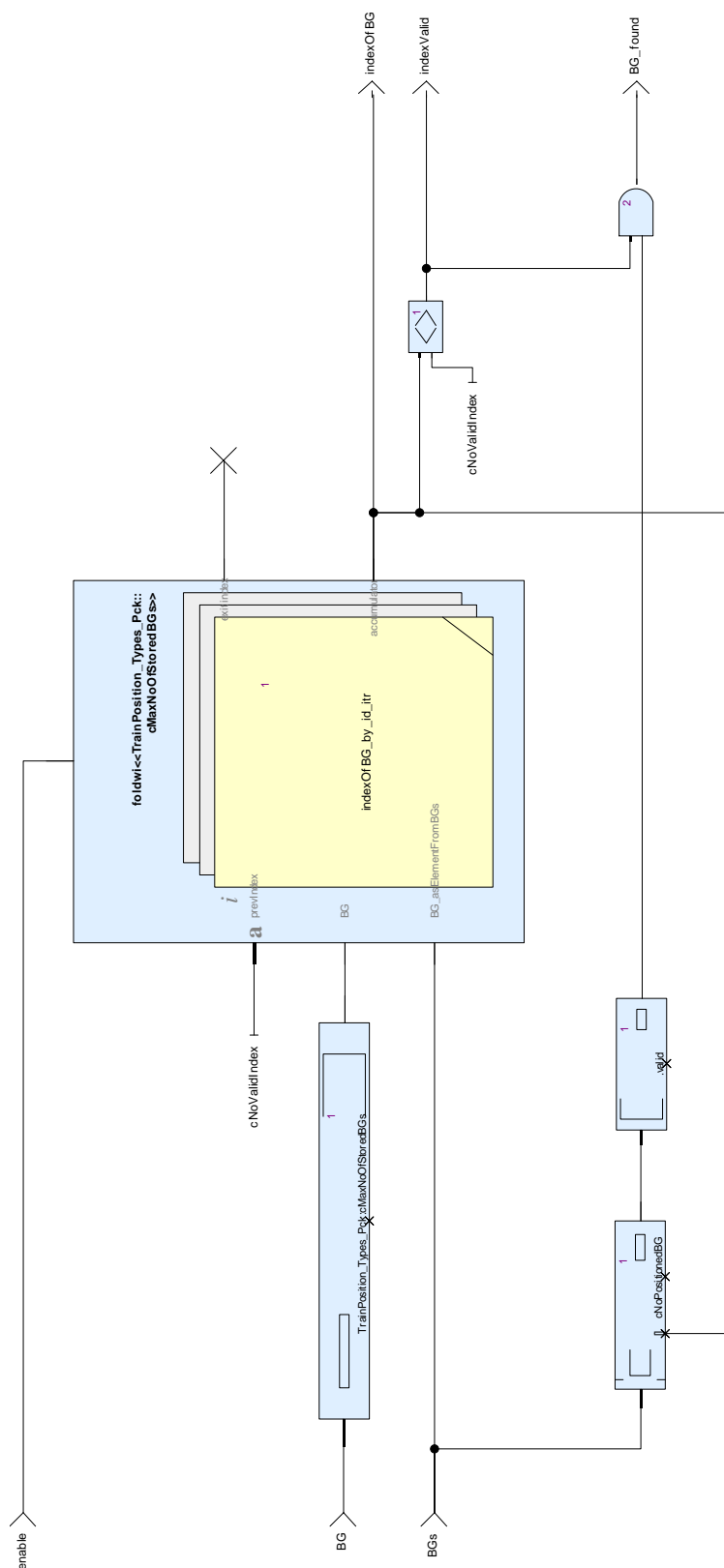
Figure 92: View of diagram_indexOfBG_by_id_1 (indexOfBG_by_id)

15.3.14. indexOfBG_by_id_itr Operator

Declared as **private function**

15.3.14.1. Comments and Information

indexOfBG_by_id_itr Comments:

- Iterated function for determing the index of BG in BGs

Table 238: 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	Iterated function for determing the index of BG in BGs - 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.
	to_c	True

15.3.14.2. Interface

Table 239: 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 240: Outputs of indexOfBG_by_id_itr

Name	Type	Comments and Information
cont	bool	
indexOfBG	int	

15.3.14.3.   Operator Hierarchy

<u>diagram</u> : diagram_indexOfBG_by_id_itr_1

15.3.14.4.   Graphical and Textual Diagrams

15.3.14.4.1. View of diagram_indexOfBG_by_id_itr_1 (indexOfBG_by_id_itr)
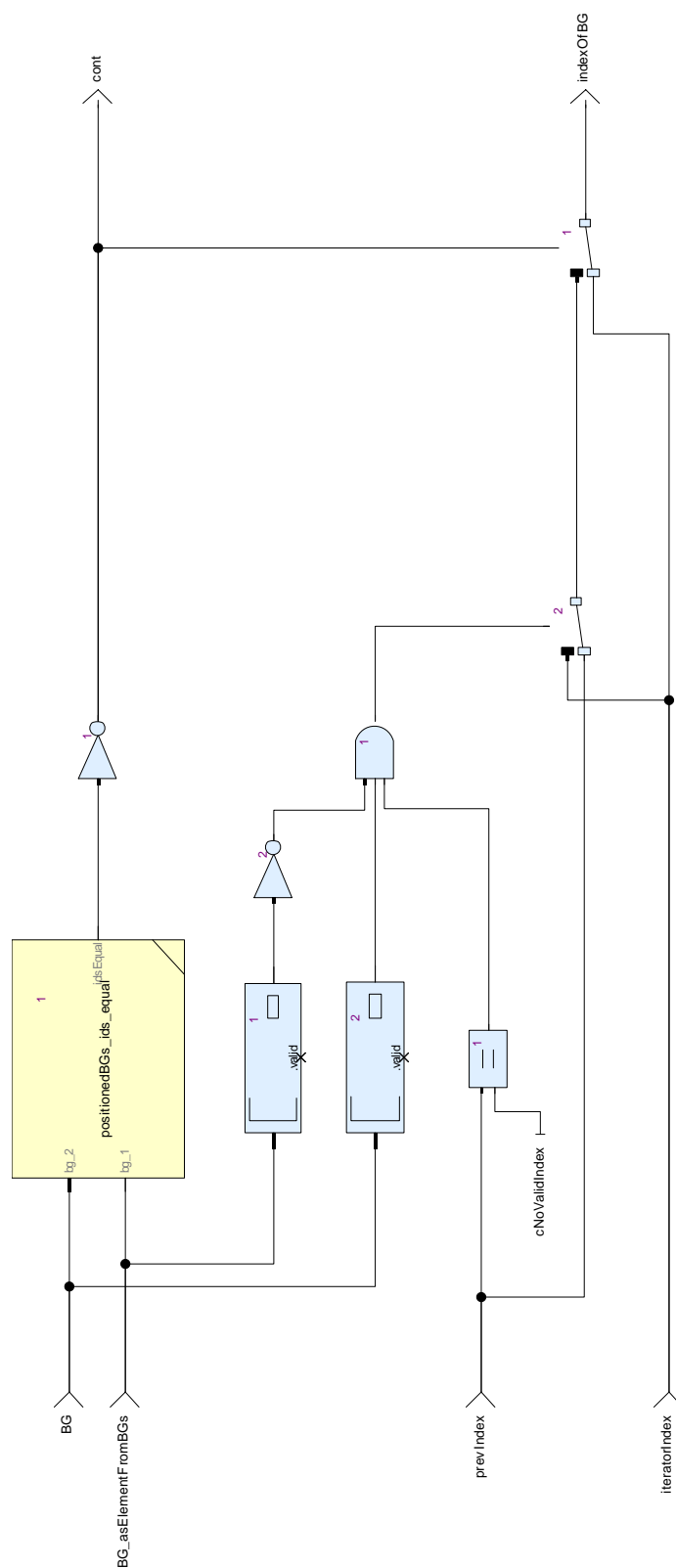
Figure 93: View of diagram_indexOfBG_by_id_itr_1 (indexOfBG_by_id_itr)

15.3.15.   indexOfBG_onTrack Operator

Declared as **public function**

15.3.15.1.   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 241: 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	Determines the index of BG in BGs - 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.
	to_c	True

15.3.15.2.   Interface

Table 242: Inputs of indexOfBG_onTrack

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

Name	Type	Comments and Information
enable	bool	

Table 243: Outputs of indexOfBG_onTrack

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

15.3.15.3.   Operator Hierarchy

<u>diagram</u> : diagram_indexOfBG_onTrack_1

15.3.15.4. Graphical and Textual Diagrams

15.3.15.4.1. View of diagram_indexOfBG_onTrack_1 (indexOfBG_onTrack)
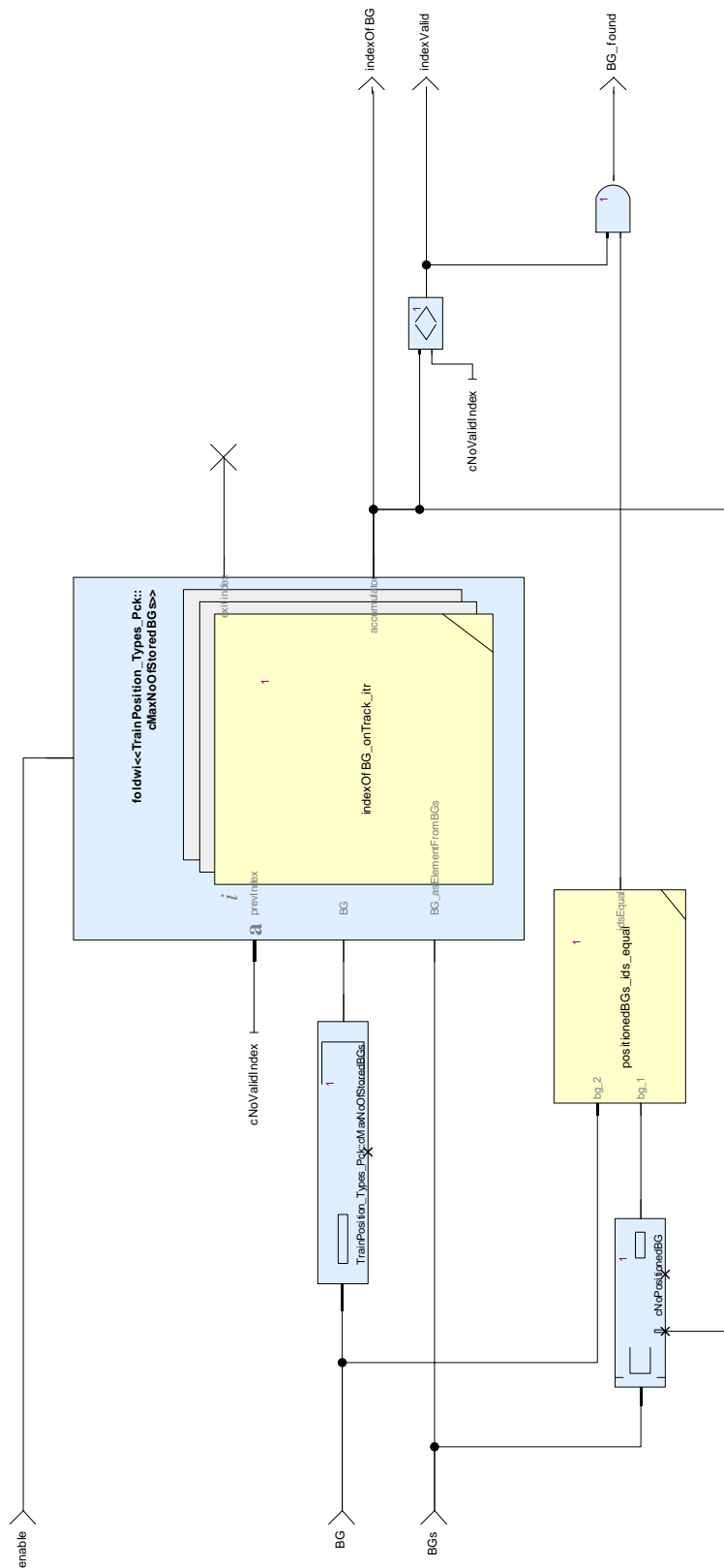
Figure 94: View of diagram_indexOfBG_onTrack_1 (indexOfBG_onTrack)

15.3.16.   indexOfBG_onTrack_itr Operator

Declared as **private function**

15.3.16.1.   Comments and Information

indexOfBG_onTrack_itr Comments:

- Iterated function for determing the index of BG in BGs

Table 244: 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	Iterated function for determing the index of BG in BGs - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

15.3.16.2.   Interface

Table 245: 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 246: Outputs of indexOfBG_onTrack_itr

Name	Type	Comments and Information
cont	bool	
indexOfBG	int	

15.3.16.3. Locals

Table 247: Locals of indexOfBG_onTrack_itr

Name	Type	Comments and Information
invalidateIndex	bool	
stopIteration	bool	

15.3.16.4. Operator Hierarchy

<u>diagram</u> : diagram_setIndex
<u>diagram</u> : diagram_stopIteration

15.3.16.5. Graphical and Textual Diagrams

15.3.16.5.1. View of diagram_setIndex (indexOfBG_onTrack_itr)
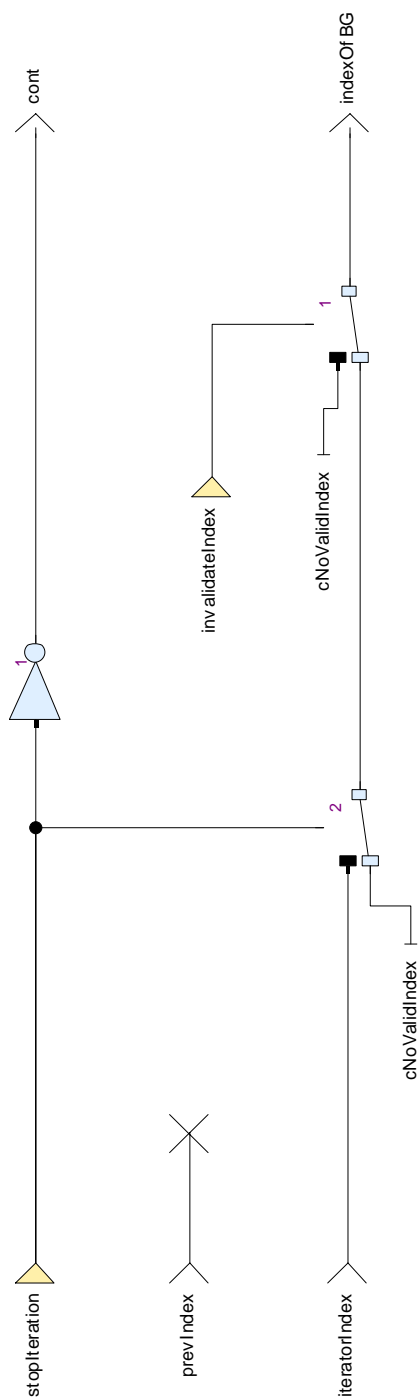
Figure 95: View of diagram_setIndex (indexOfBG_onTrack_itr)

15.3.16.5.2. View of diagram_stopIteration (indexOfBG_onTrack_itr)

Figure 96: View of diagram_stopIteration (indexOfBG_onTrack_itr)

15.3.17.   indexOfLastPassedBG Operator

Declared as **public function**

15.3.17.1. Comments and Information

indexOfLastPassedBG Comments:

- Determines the index of the last (most ahead) linked or unlinked passed BG in BGs.

15.3.17.2. Interface

Table 248: Inputs of indexOfLastPassedBG

Name	Type	Comments and Information
linked	bool	Comments: Condition if the seach is for a linked or unlinked BG.
BGs	TrainPosition_Types_Pck::positionedBGs_T	
enable	bool	

Table 249: Outputs of indexOfLastPassedBG

Name	Type	Comments and Information
indexOfBG	int	
BG_found	bool	Comments: Indicates, that BG exists in BGs.
indexValid	bool	Comments: Indicates, that a valid index was found.

15.3.17.3. Operator Hierarchy

diagram : diagram_indexOfLastPassedBG_1

15.3.17.4.   Graphical and Textual Diagrams

15.3.17.4.1.   View of diagram_indexOfLastPassedBG_1 (indexOfLastPassedBG)
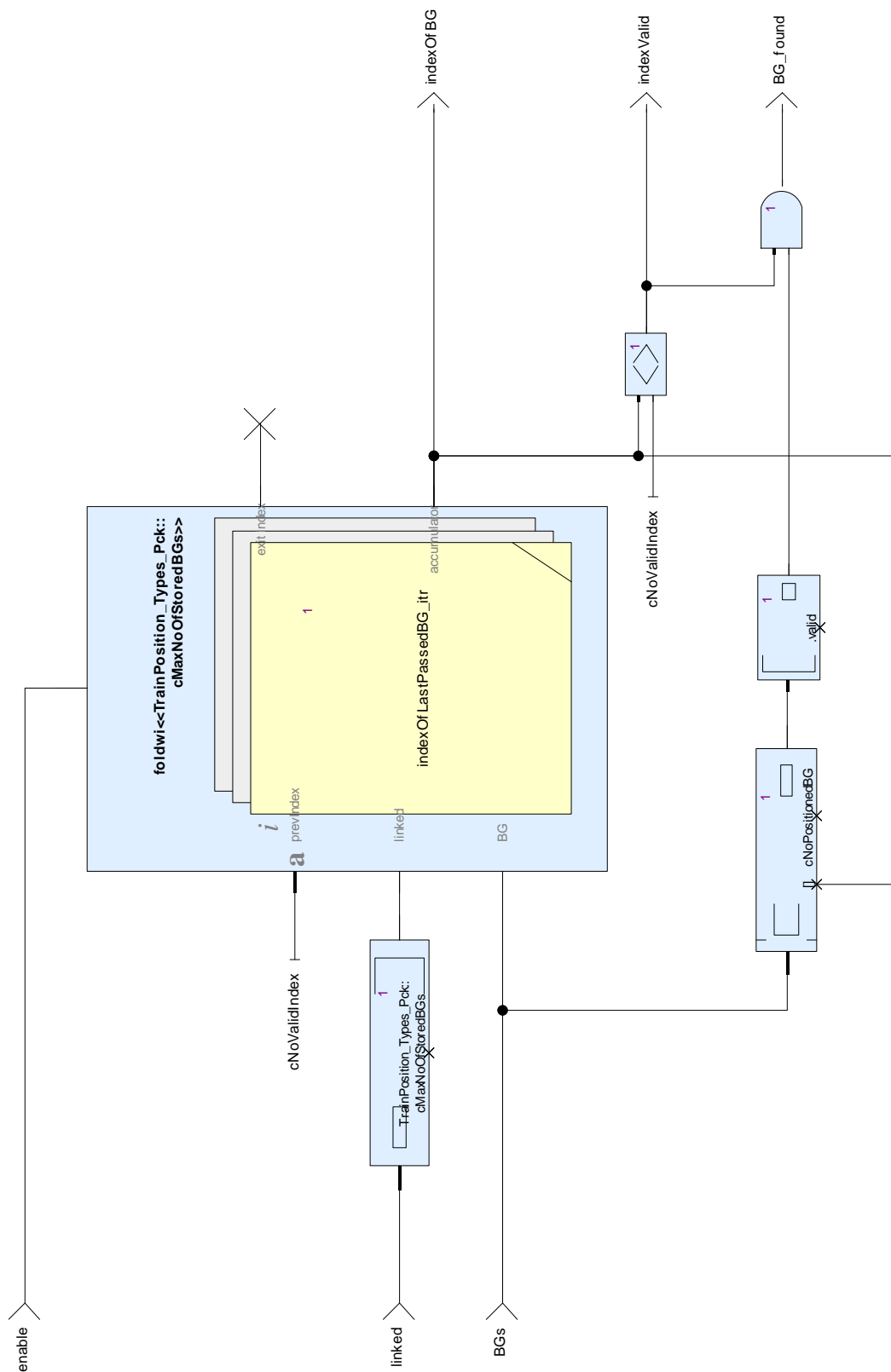
Figure 97: View of diagram_indexOfLastPassedBG_1 (indexOfLastPassedBG)

15.3.18. indexOfLastPassedBG_itr Operator

Declared as **private function**

15.3.18.1. Comments and Information

indexOfLastPassedBG_itr Comments:

- Iterated function for indexOfLastPassedBG

Table 250: 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	Iterated function for determing the index of BG in BGs - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

15.3.18.2. Interface

Table 251: Inputs of indexOfLastPassedBG_itr

Name	Type	Comments and Information
iteratorIndex	int	
prevIndex	int	
linked	bool	Comments: Condition if the seach is for a linked or unlinked BG.
BG	TrainPosition_Types_Pck::positionedBG_T	

Table 252: Outputs of indexOfLastPassedBG_itr

Name	Type	Comments and Information
cont	bool	

Name	Type	Comments and Information
indexOfBG	int	

15.3.18.3. Operator Hierarchy

<u>diagram</u> : diagram_indexOfLastPassedBG_itr_1

15.3.18.4.   Graphical and Textual Diagrams

15.3.18.4.1. View of diagram_indexOfLastPassedBG_itr_1 (indexOfLastPassedBG_itr)
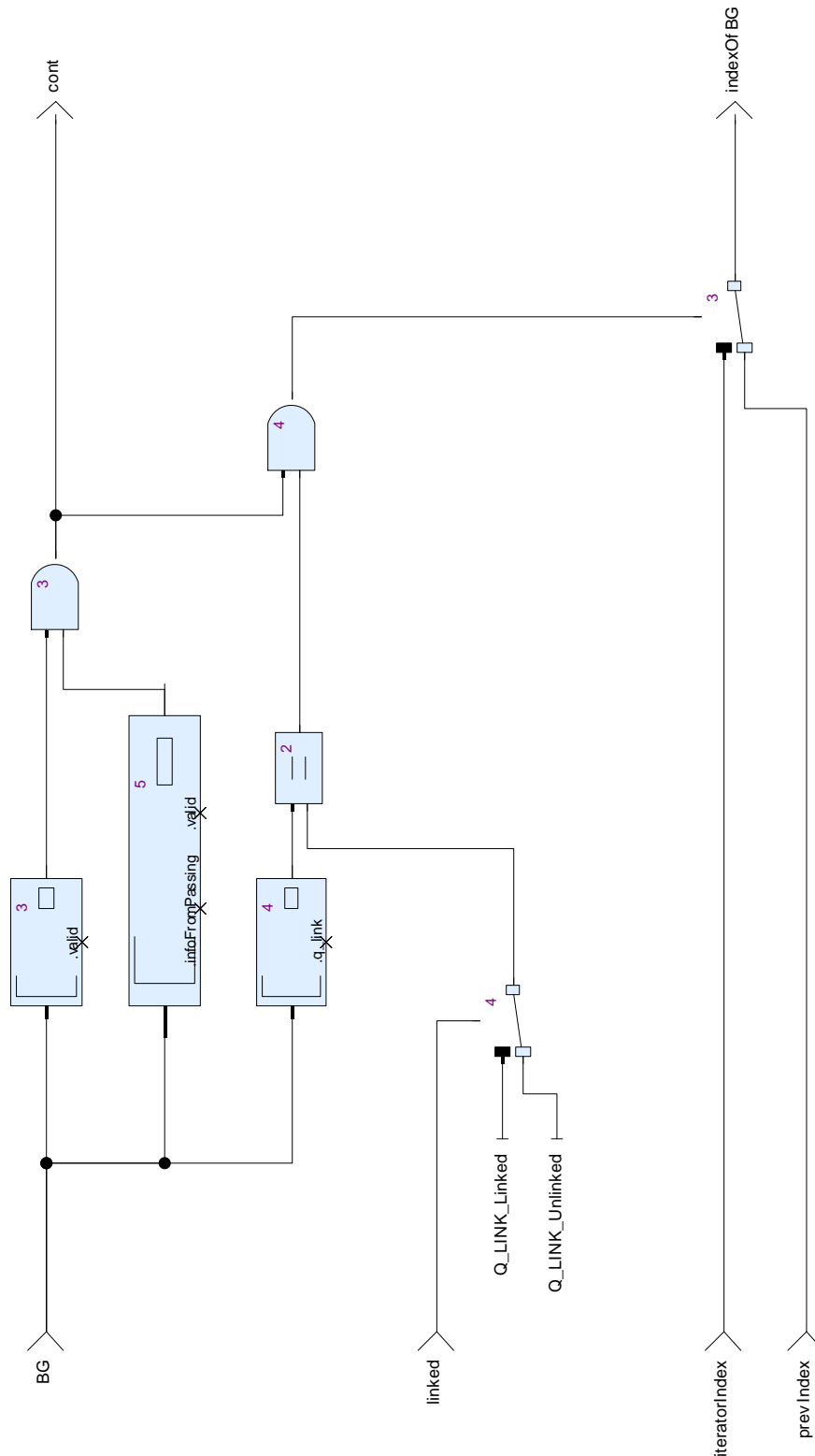
Figure 98: View of diagram_indexOfLastPassedBG_itr_1 (indexOfLastPassedBG_itr)

15.3.19.   indexOfPassedBG_by_id Operator

Declared as **public function**

15.3.19.1. Comments and Information

indexOfPassedBG_by_id Comments:

- Determines the index of a passed BG in BGs by comparing NID_BG and NID_C.

Table 253: 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	Determines the index of a passed BG in BGs - 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.
	to_c	True

15.3.19.2. Interface

Table 254: Inputs of indexOfPassedBG_by_id

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

Table 255: Outputs of indexOfPassedBG_by_id

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

15.3.19.3. Operator Hierarchy

<u>diagram</u> : diagram_indexOfPassedBG_by_id_1

15.3.19.4. Graphical and Textual Diagrams

15.3.19.4.1. View of diagram_indexOfPassedBG_by_id_1 (indexOfPassedBG_by_id)
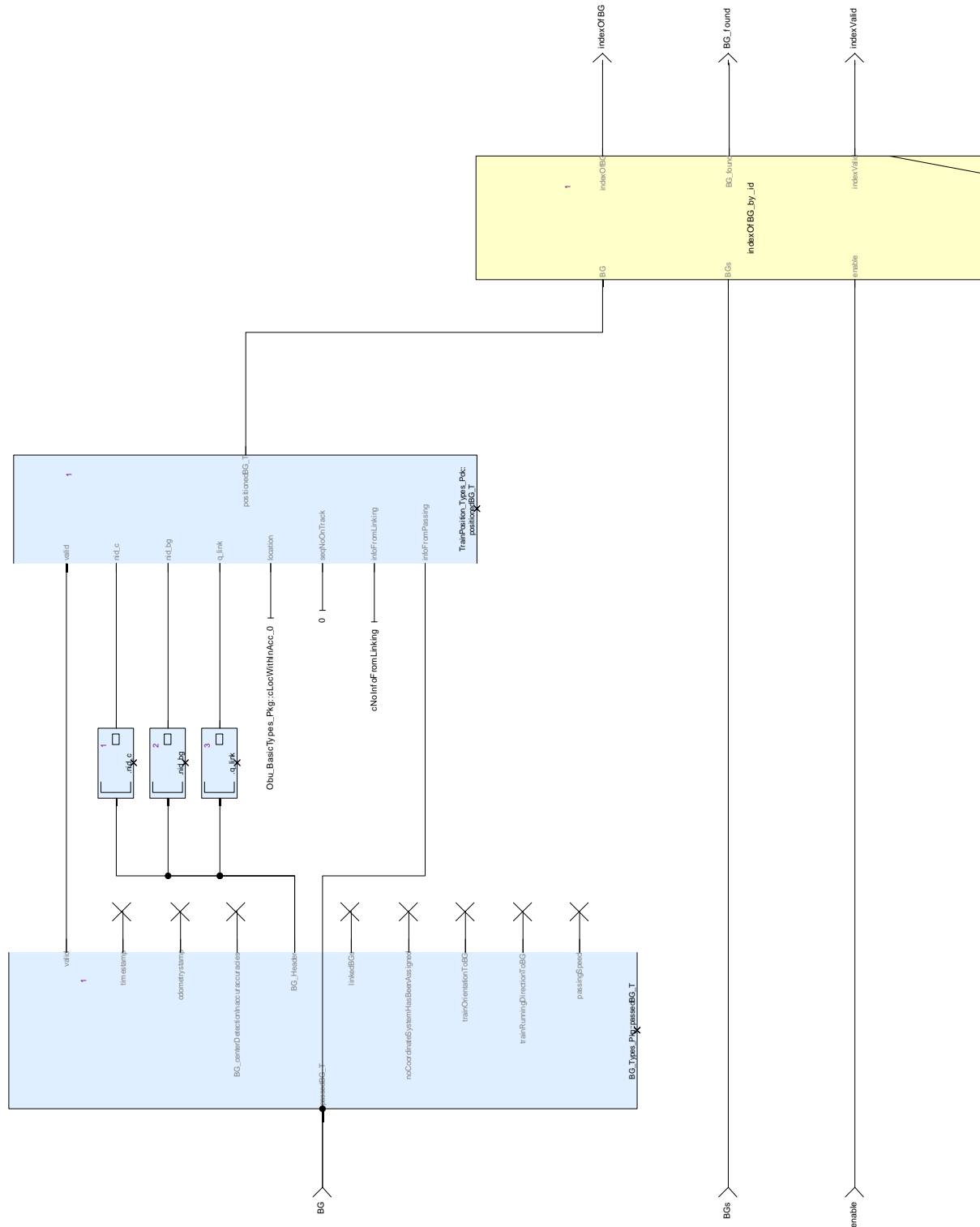
Figure 99: View of diagram_indexOfPassedBG_by_id_1 (indexOfPassedBG_by_id)

15.3.20.   insertBG_atIndex Operator

Declared as **public function**

15.3.20.1.   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.

15.3.20.2.   Interface

Table 256: 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	Comments: insert comannd. Must be true to execute the insertion.

Table 257: Outputs of insertBG_atIndex

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	
overrun	bool	Comments: Indicates, that no merge took place due to no space in BGs_in.

15.3.20.3.   Operator Hierarchy

<u>diagram</u> : diagram_insertBG_atIndex_1

15.3.20.4. Graphical and Textual Diagrams

15.3.20.4.1. View of diagram_insertBG_atIndex_1 (insertBG_atIndex)
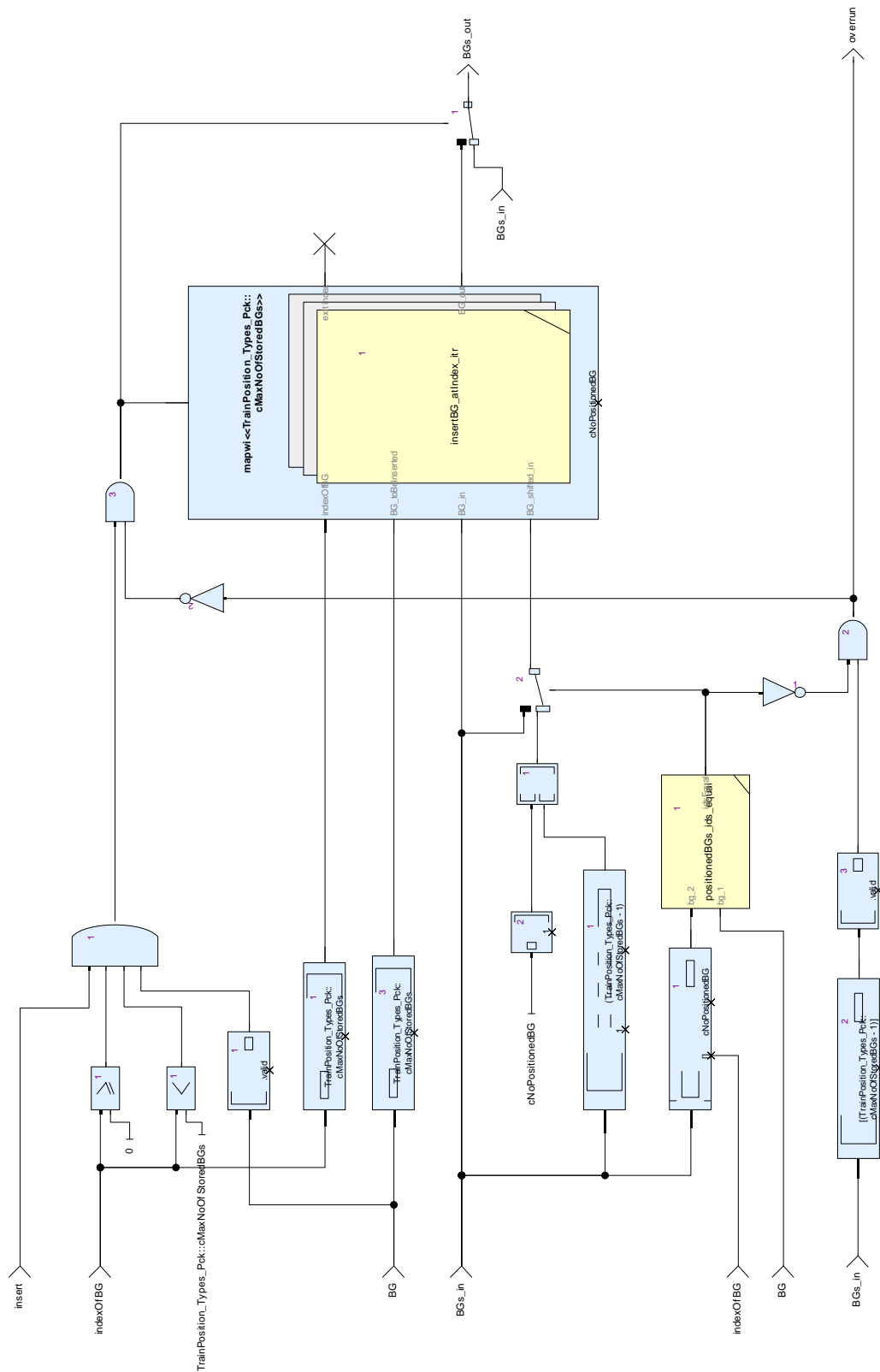
Figure 100: View of diagram_insertBG_atIndex_1 (insertBG_atIndex)

15.3.21.   insertBG_atIndex_itr Operator

Declared as **private function**

15.3.21.1.   Comments and Information

insertBG_atIndex_itr Comments:

- Iterated function for insertBG_atIndex.

15.3.21.2.   Interface

Table 258: Inputs of insertBG_atIndex_itr

Name	Type	Comments and Information
iteratorIndex	int	
indexOfBG	int	
BG_toBeInserted	TrainPosition_Types_Pck::positionedBG_T	
BG_in	TrainPosition_Types_Pck::positionedBG_T	
BG_shifted_in	TrainPosition_Types_Pck::positionedBG_T	

Table 259: Outputs of insertBG_atIndex_itr

Name	Type	Comments and Information
cont	bool	
BG_out	TrainPosition_Types_Pck::positionedBG_T	

15.3.21.3.   Operator Hierarchy

diagram : diagram_insertBG_atIndex_itr_1
    activate if : IfBlock1
        branch : then
        branch : else
            branch : then
            branch : else

15.3.21.4.   Graphical and Textual Diagrams

15.3.21.4.1. View of diagram_insertBG_atIndex_itr_1 (insertBG_atIndex_itr)
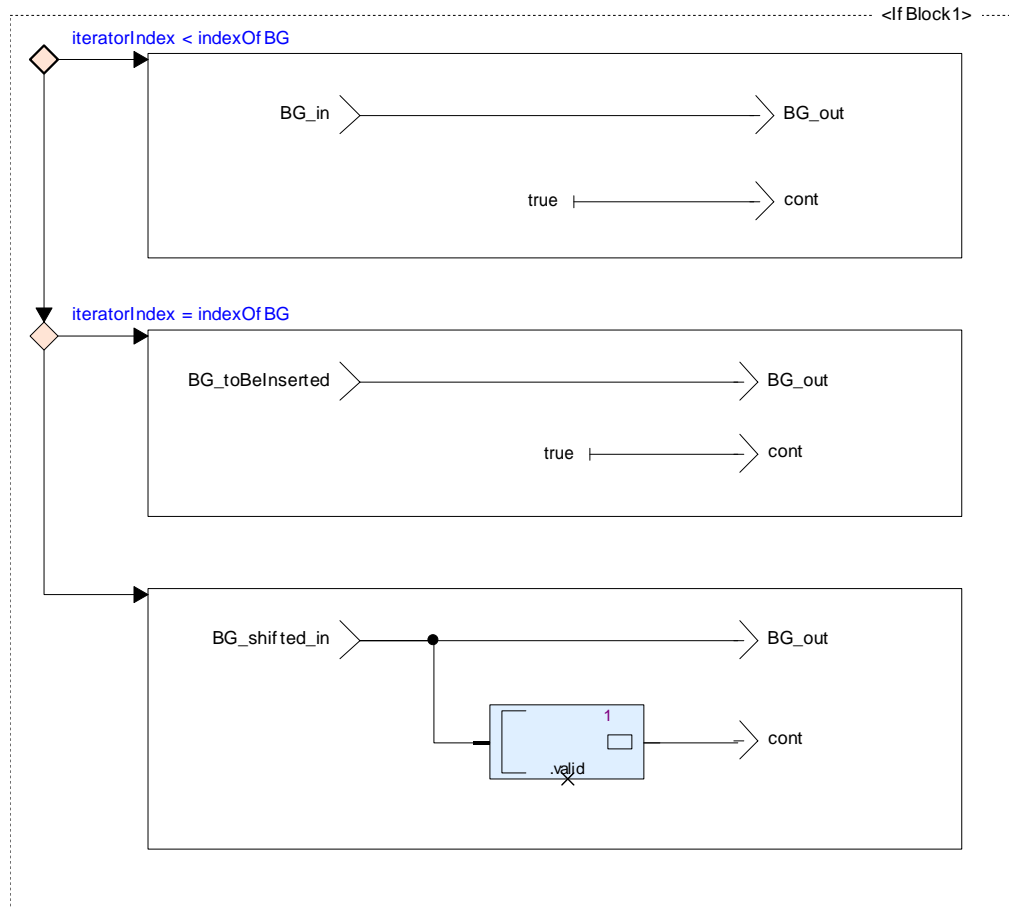
Figure 101: View of diagram_insertBG_atIndex_itr_1 (insertBG_atIndex_itr)

Table 260: Conditional Blocks of diagram_insertBG_atIndex_itr_1

Conditional Block	Comments and Information
IfBlock1	

Table 261: Actions of diagram_insertBG_atIndex_itr_1

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

15.3.22.   mergeBG_by_id Operator

Declared as **private function**

15.3.22.1. 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 262: 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	Merges a BG into an array of BGs - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

15.3.22.2. Interface

Table 263: Inputs of mergeBG_by_id

Name	Type	Comments and Information
BG	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG to be merged.
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	Comments: The BGs where BG is to be merged with.

Table 264: Outputs of mergeBG_by_id

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	Comments: The resulting array of merged BGs.
overrun	bool	Comments: Indicates, that no merge took place due to no space in BGs_in.

15.3.22.3. Operator Hierarchy

<u>diagram</u> : diagram_mergeBG_by_id_1

15.3.22.4.   Graphical and Textual Diagrams

15.3.22.4.1. View of diagram_mergeBG_by_id_1 (mergeBG_by_id)
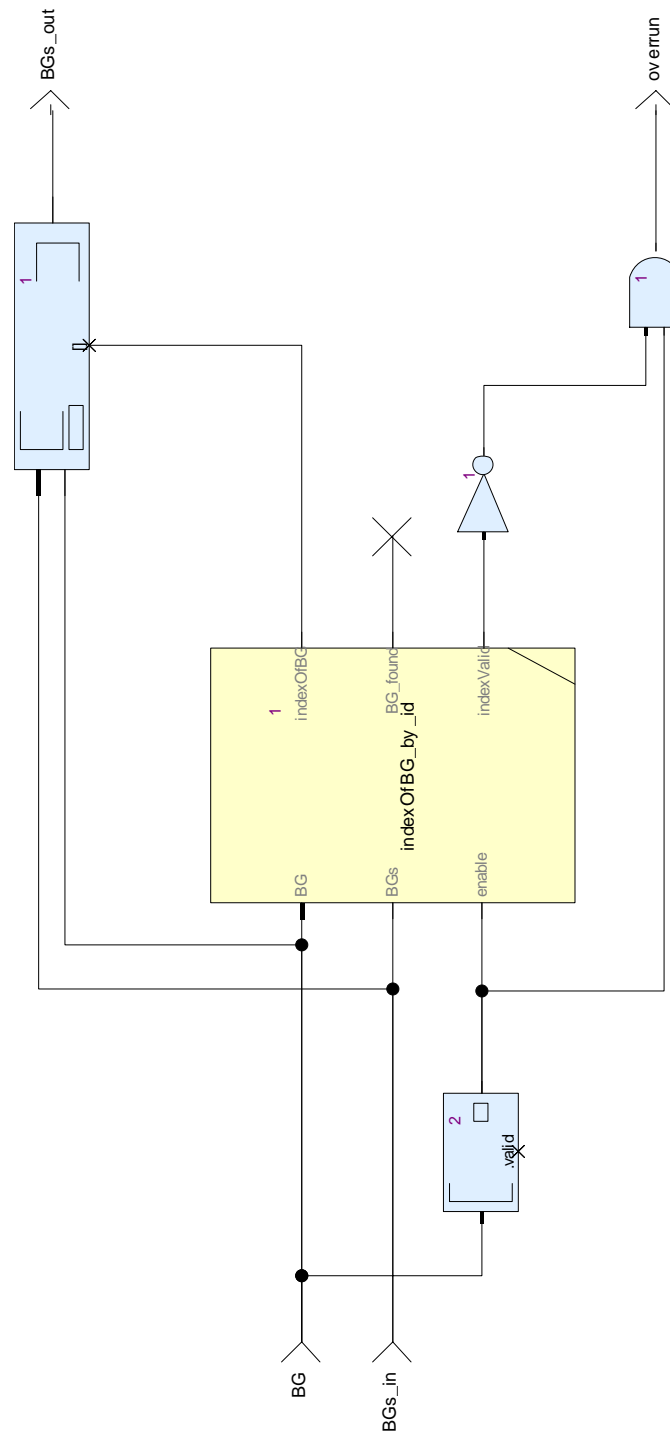
Figure 102: View of diagram_mergeBG_by_id_1 (mergeBG_by_id)

15.3.23.   mergeBG_onTrack Operator

Declared as **public function**

15.3.23.1.   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.

15.3.23.2. Interface

Table 265: Inputs of mergeBG_onTrack

Name	Type	Comments and Information
BG	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG to be merged.
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	Comments: The BGs where BG is to be merged with.

Table 266: Outputs of mergeBG_onTrack

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	Comments: The resulting array of merged BGs.
overrun	bool	Comments: Indicates, that no merge took place due to no space in BGs_in.

15.3.23.3. Operator Hierarchy

<u>diagram</u> : diagram_mergeBG_onTrack_1

15.3.23.4.   Graphical and Textual Diagrams

15.3.23.4.1. View of diagram_mergeBG_onTrack_1 (mergeBG_onTrack)
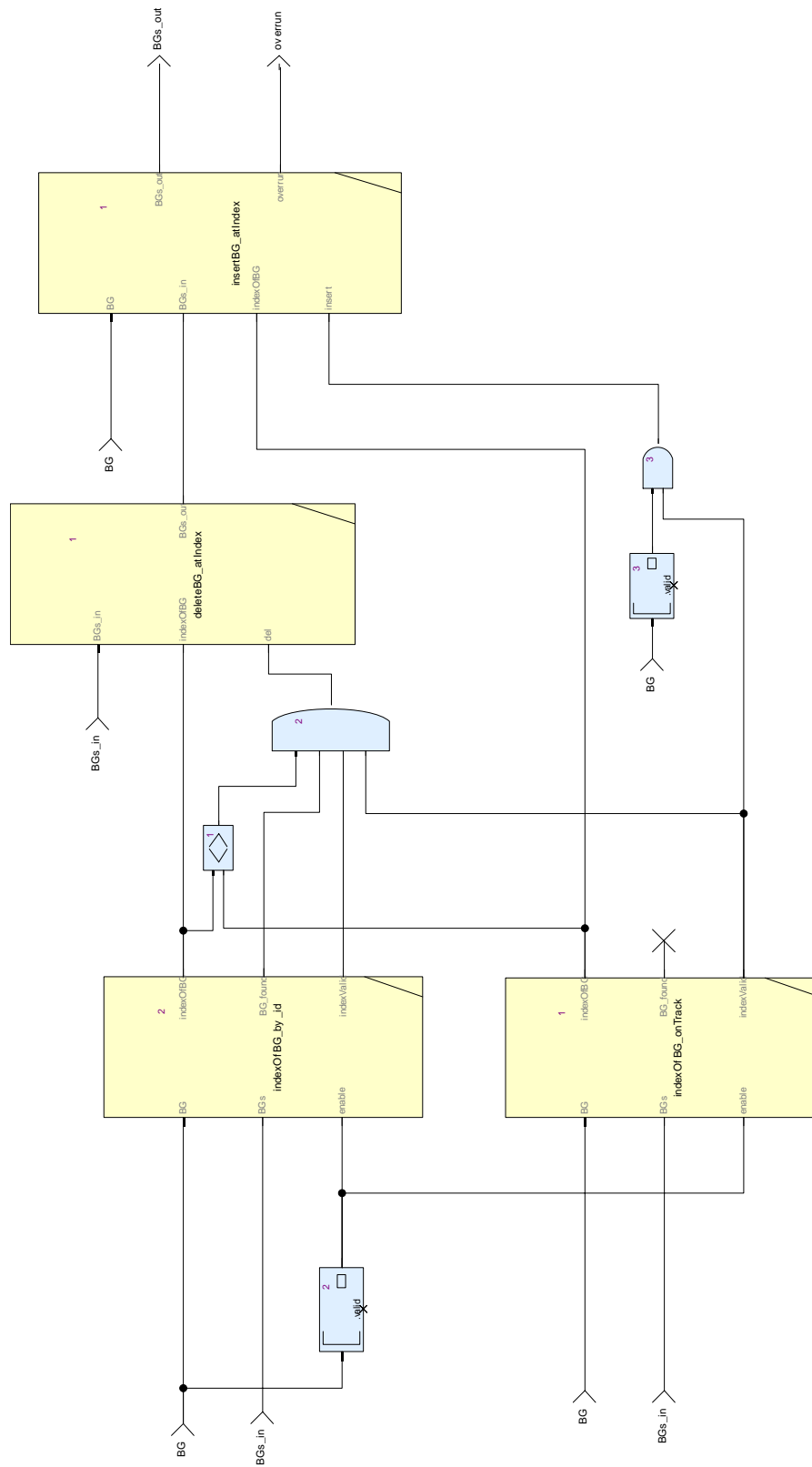
Figure 103: View of diagram_mergeBG_onTrack_1 (mergeBG_onTrack)

15.3.24. mergeBGs_by_id Operator

Declared as **public function**

15.3.24.1. 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 267: 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	Merges two arrays of BGs by id. - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

15.3.24.2. Interface

Table 268: Inputs of mergeBGs_by_id

Name	Type	Comments and Information
BGs_1	TrainPosition_Types_Pck::positionedBGs_T	Comments: The first array of BGs to be merged.
BGs_2	TrainPosition_Types_Pck::positionedBGs_T	Comments: The second array of BGs to be merged.

Table 269: Outputs of mergeBGs_by_id

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	Comments: The resulting array of merged BGs.
overrun	bool	Comments: Indicates, that not all of the elements of BGs_2 could be merged into BGs_out, due to not enough space in BGs_out.

15.3.24.3.   Operator Hierarchy

<u>diagram</u> : diagram_mergeBGs_by_id_1

15.3.24.4.   Graphical and Textual Diagrams

15.3.24.4.1. View of diagram_mergeBGs_by_id_1 (mergeBGs_by_id)
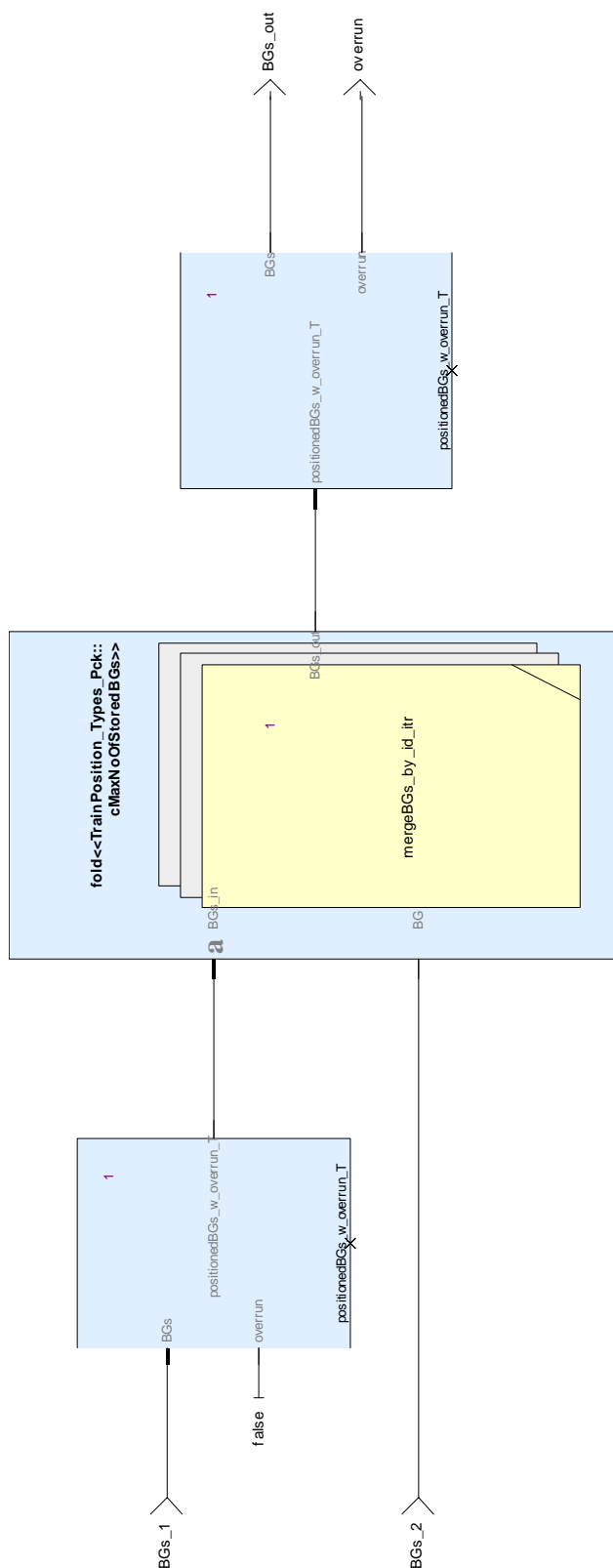
Figure 104: View of diagram_mergeBGs_by_id_1 (mergeBGs_by_id)

15.3.25.   mergeBGs_by_id_itr Operator

Declared as **private function**

15.3.25.1.   Comments and Information

mergeBGs_by_id_itr Comments:

- Iterated function for the merge of a BG into an array of BGs.

Table 270: 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	Iterated function for the merge of a BG into an array of BGs. - Copyright Siemens AG, 2014 - Licensed under the EUPL V.1.1 (http://joinup.ec.europa.eu/software/page/eupl/l icence-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.
	to_c	True

15.3.25.2.   Interface

Table 271: Inputs of mergeBGs_by_id_itr

Name	Type	Comments and Information
BGs_in	CalculateTrainPosition_Pkg::positionedBGs_w_overrun_T	Comments: The BGs where BG is to be merged with.
BG	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG to be merged.

Table 272: Outputs of mergeBGs_by_id_itr

Name	Type	Comments and Information
BGs_out	CalculateTrainPosition_Pkg::positionedBGs_w_overrun_T	Comments: The resulting array of merged BGs.

15.3.25.3. Operator Hierarchy

<u>diagram</u> : diagram_mergeBGs_by_id_itr_1

15.3.25.4.   Graphical and Textual Diagrams

15.3.25.4.1. View of diagram_mergeBGs_by_id_itr_1 (mergeBGs_by_id_itr)
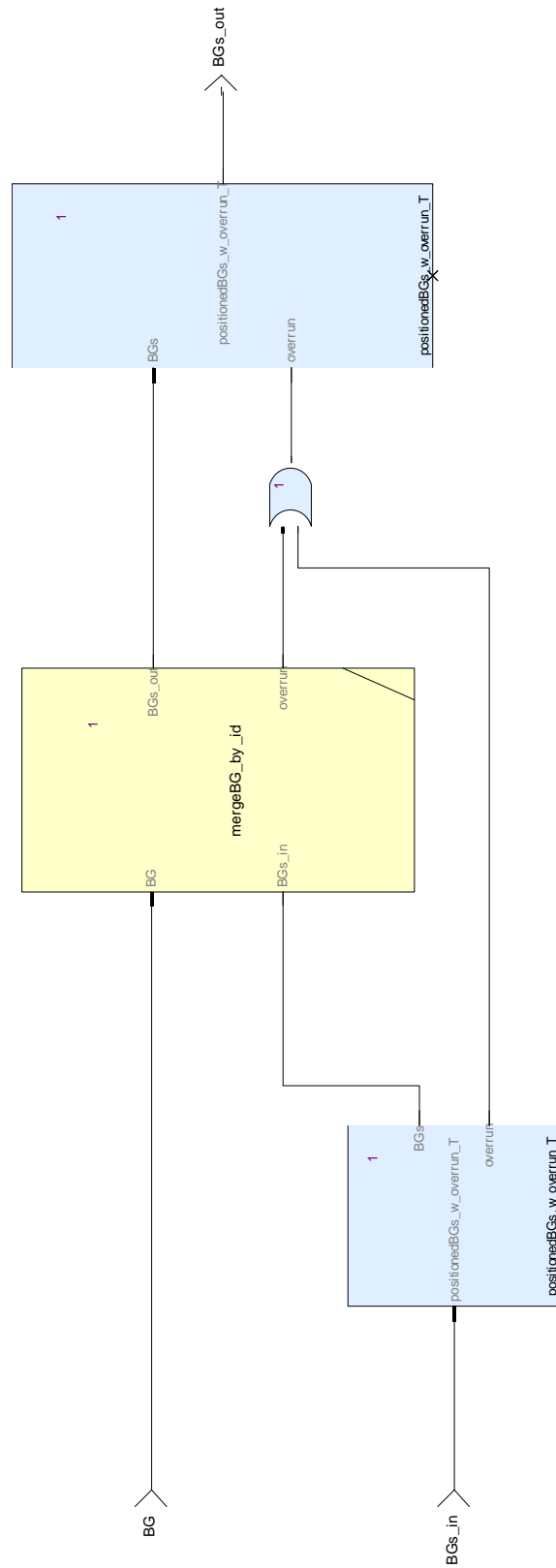
Figure 105: View of diagram_mergeBGs_by_id_itr_1 (mergeBGs_by_id_itr)

15.3.26.   mergeBGs_onTrack Operator

Declared as **public function**

15.3.26.1.   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 273: 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	Merges two arrays of BGs by id. - 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.
	to_c	True

15.3.26.2.   Interface

Table 274: Inputs of mergeBGs_onTrack

Name	Type	Comments and Information
BGs_1	TrainPosition_Types_Pck::positionedBGs_T	Comments: The first array of BGs to be merged.
BGs_2	TrainPosition_Types_Pck::positionedBGs_T	Comments: The second array of BGs to be merged.

Table 275: Outputs of mergeBGs_onTrack

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	Comments: The resulting array of merged BGs.
overrun	bool	Comments: Indicates, that not all of the elements of BGs_2 could be merged into BGs_out, due to not enough space in BGs_out.

15.3.26.3.   Operator Hierarchy

<u>diagram</u> : diagram_mergeBGs_onTrack_1

15.3.26.4. Graphical and Textual Diagrams

15.3.26.4.1. View of diagram_mergeBGs_onTrack_1 (mergeBGs_onTrack)
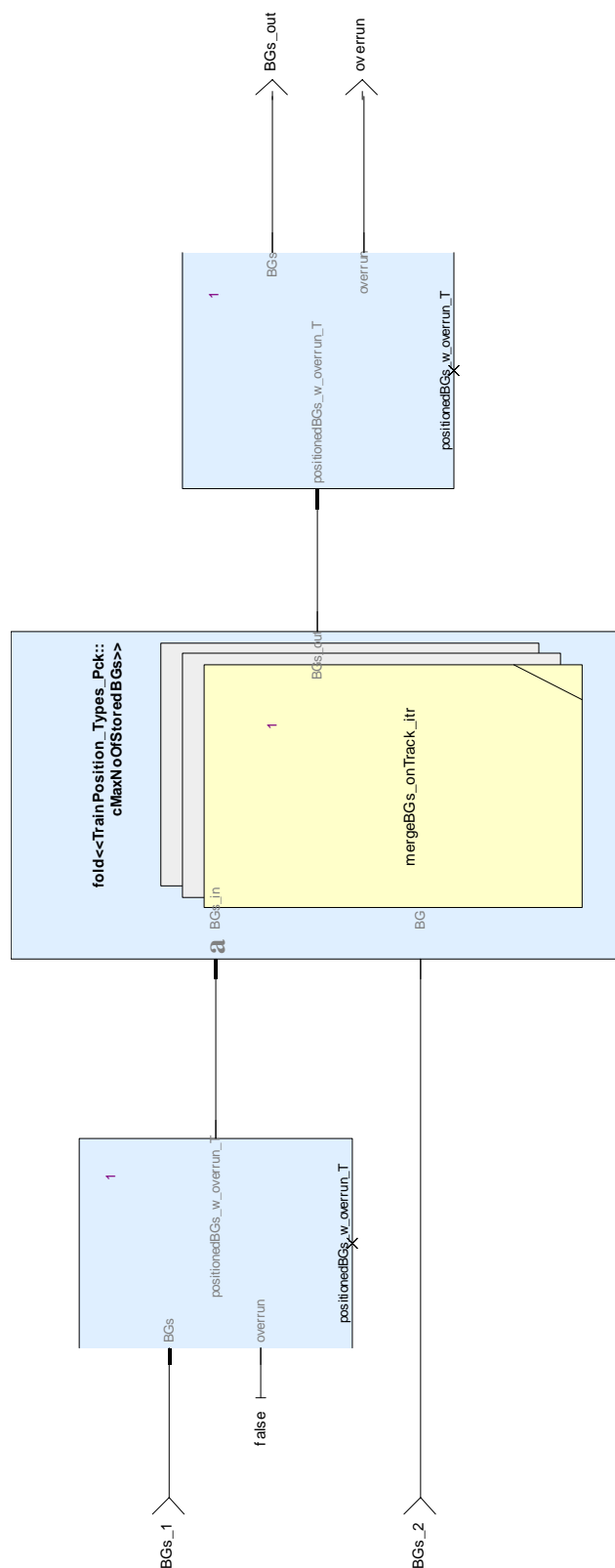
Figure 106: View of diagram_mergeBGs_onTrack_1 (mergeBGs_onTrack)

15.3.27.   mergeBGs_onTrack_itr Operator

Declared as **private function**

15.3.27.1.   Comments and Information

mergeBGs_onTrack_itr Comments:

- Iterated function for the merge of a BG into a sorted array of BGs.

Table 276: 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	Iterated function for the merge of a BG into an array of BGs. - 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.
	to_c	True

15.3.27.2.   Interface

Table 277: Inputs of mergeBGs_onTrack_itr

Name	Type	Comments and Information
BGs_in	CalculateTrainPosition_Pkg::positionedBGs_w_overrun_T	Comments: The BGs where BG is to be merged with.
BG	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG to be merged.

Table 278: Outputs of mergeBGs_onTrack_itr

Name	Type	Comments and Information
BGs_out	CalculateTrainPosition_Pkg::positionedBGs_w_overrun_T	Comments: The resulting array of merged BGs.

15.3.27.3. Operator Hierarchy

diagram : diagram_mergeBGs_onTrack_itr_1

15.3.27.4.   Graphical and Textual Diagrams

15.3.27.4.1. View of diagram_mergeBGs_onTrack_itr_1 (mergeBGs_onTrack_itr)
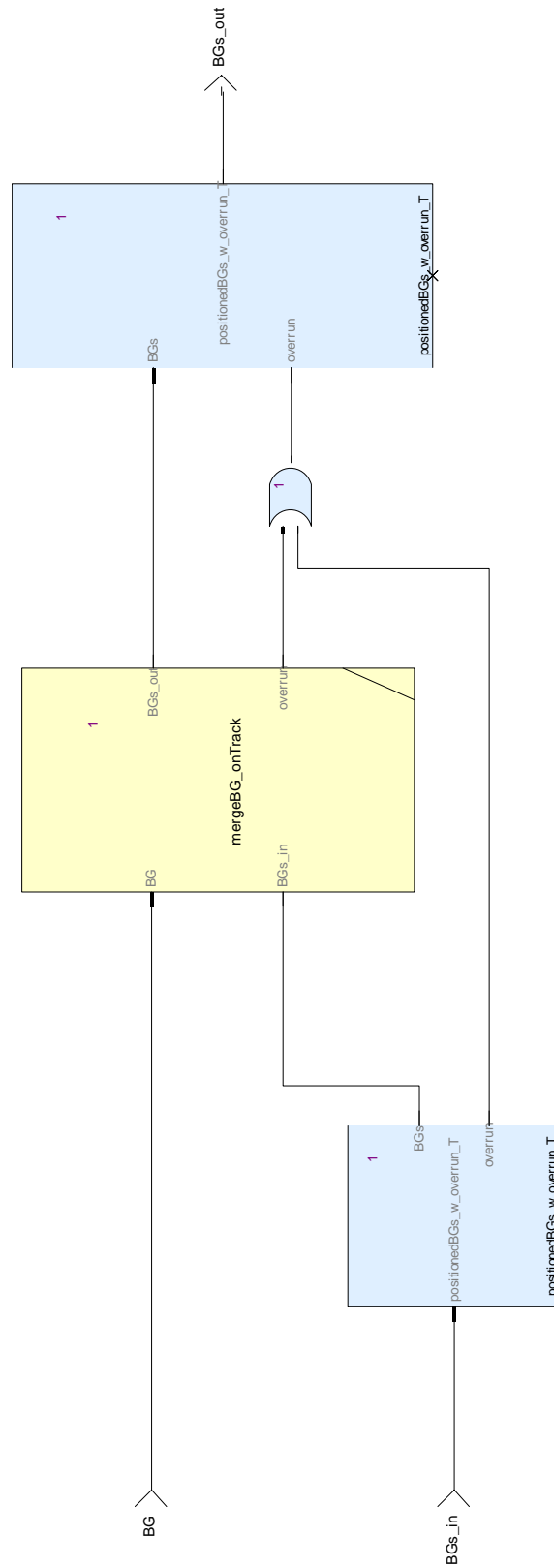
Figure 107: View of diagram_mergeBGs_onTrack_itr_1 (mergeBGs_onTrack_itr)

15.3.28.   nidBG_nidc_equal Operator

Declared as **public function**

15.3.28.1.   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 279: 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	Checks if the ids of 2 BG are equal by comparing their NID_BG and NID_C values - 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.
	to_c	True

15.3.28.2.   Interface

Table 280: 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 281: Outputs of nidBG_nidc_equal

Name	Type	Comments and Information
isEqual	bool	

15.3.28.3.   Operator Hierarchy

diagram : diagram_nidBG_nidc_equal_1

15.3.28.4.   Graphical and Textual Diagrams

15.3.28.4.1. View of diagram_nidBG_nidc_equal_1 (nidBG_nidc_equal)
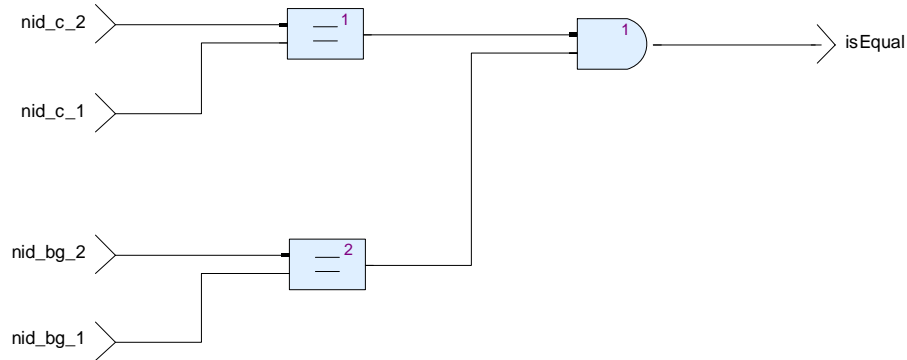
Figure 108: View of diagram_nidBG_nidc_equal_1 (nidBG_nidc_equal)

15.3.29.   nidC_nidBG_2_NIDLRBG Operator

Declared as **public function**

15.3.29.1.   Comments and Information

nidC_nidBG_2_NIDLRBG Comments:

- Constructs an NID_LRBG value from NID_C and NID_BG

15.3.29.2.   Interface

Table 282: Inputs of nidC_nidBG_2_NIDLRBG

Name	Type	Comments and Information
valid	bool	
nidC	NID_C	
nidBG	NID_BG	

Table 283: Outputs of nidC_nidBG_2_NIDLRBG

Name	Type	Comments and Information
nidLRBG	NID_LRBG	

15.3.29.3.   Operator Hierarchy

diagram : diagram_nidC_nidBG_2_NIDLRBG_1

15.3.29.4.   Graphical and Textual Diagrams

15.3.29.4.1. View of diagram_nidC_nidBG_2_NIDLRBG_1 (nidC_nidBG_2_NIDLRBG)
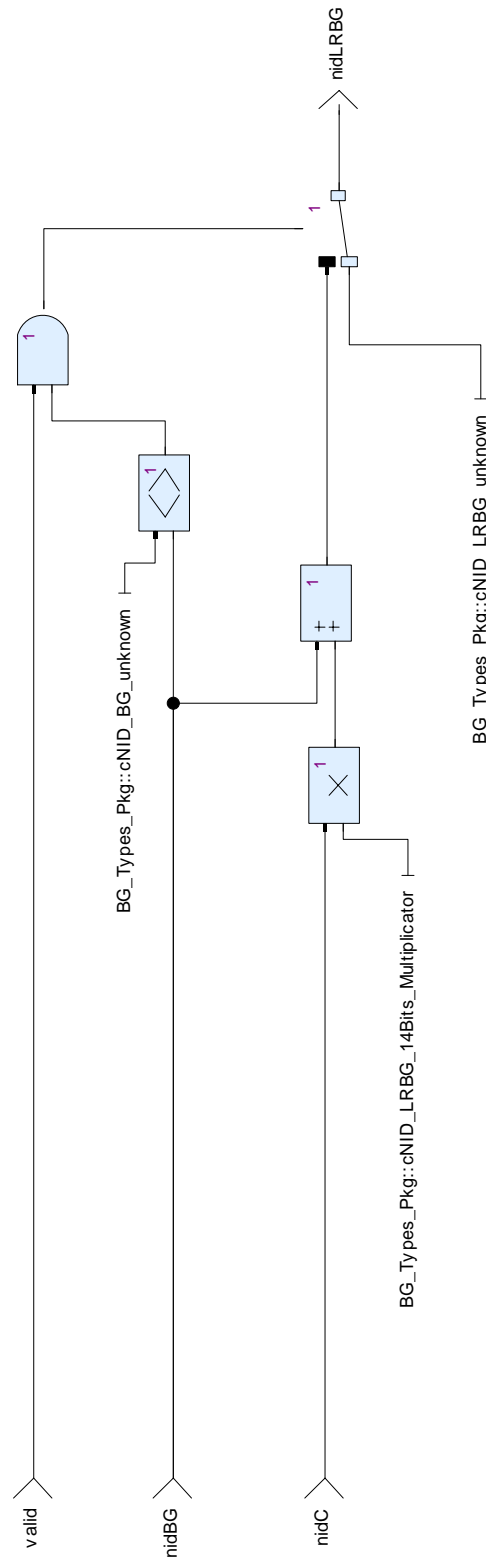
Figure 109: View of diagram_nidC_nidBG_2_NIDLRBG_1 (nidC_nidBG_2_NIDLRBG)

15.3.30.   passedBGs_ids_equal Operator

Declared as **public function**

15.3.30.1. 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 284: 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	Checks if the ids of 2 BG are equal by comparing their NID_BG and NID_C values. - 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.
	to_c	True

15.3.30.2. Interface

Table 285: 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 286: Outputs of passedBGs_ids_equal

Name	Type	Comments and Information
idsEqual	bool	
idsDifferent	bool	

15.3.30.3. Operator Hierarchy

diagram : diagram_passedBGs_ids_equal_1

15.3.30.4.   Graphical and Textual Diagrams

15.3.30.4.1. View of diagram_passedBGs_ids_equal_1 (passedBGs_ids_equal)

Figure 110: View of diagram_passedBGs_ids_equal_1 (passedBGs_ids_equal)

15.3.31.   positionDerivedFromPassedBG Operator

Declared as **public function**

15.3.31.1. 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 287: 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	Calculates the train position on the base of the odometry and a passed reference BG. - 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.
	to_c	True

15.3.31.2. Interface

Table 288: Inputs of positionDerivedFromPassedBG

Name	Type	Comments and Information
odoPosition	Obu_BasicTypes_Pkg::OdometryLocations_T	Comments: The position measured by odometry
passedRefBG	TrainPosition_Types_Pck::positionedBG_T	Comments: The passed reference BG. Important: this BG must have been passed already, since its odometry values must be known.

Table 289: Outputs of positionDerivedFromPassedBG

Name	Type	Comments and Information
position	Obu_BasicTypes_Pkg::LocWithInAcc_T	Comments: The resulting position.

15.3.31.3.   Operator Hierarchy

<u>diagram</u> : diagram_positionDerivedFromPassedBG_1
         activate if : IfBlock1
                  branch : then
                  branch : else

15.3.31.4. Graphical and Textual Diagrams

15.3.31.4.1. View of diagram_positionDerivedFromPassedBG_1 (positionDerivedFromPassedBG)
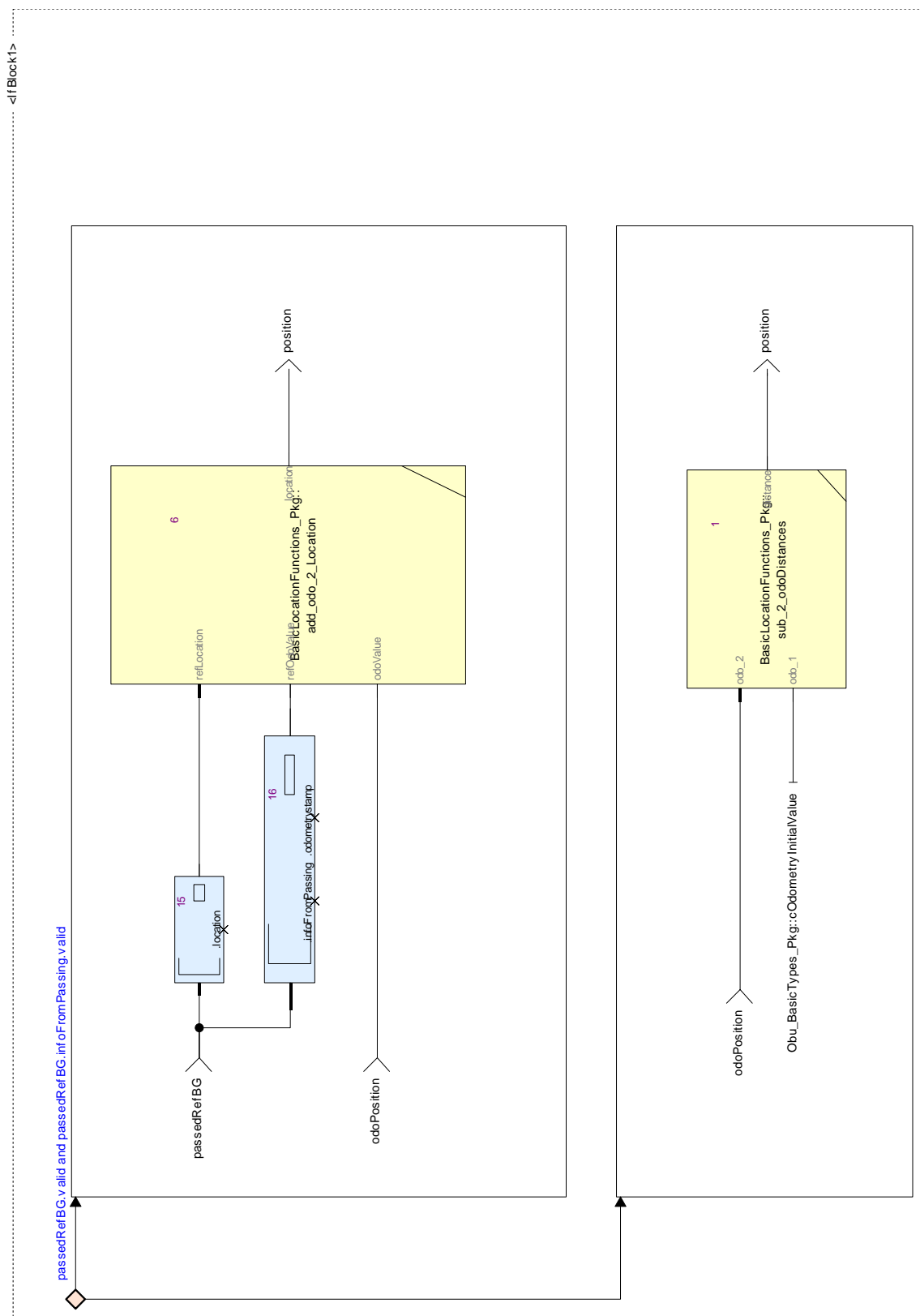
Figure 111: View of diagram_positionDerivedFromPassedBG_1 (positionDerivedFromPassedBG)

Table 290: Conditional Blocks of diagram_positionDerivedFromPassedBG_1

Conditional Block	Comments and Information
IfBlock1	

Table 291: Actions of diagram_positionDerivedFromPassedBG_1

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

15.3.32.   positionedBGs_ids_equal Operator

Declared as **public function**

15.3.32.1.   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 292: 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	Checks if the ids of 2 BG are equal by comparing their NID_BG and NID_C values. - 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.
	to_c	True

15.3.32.2. Interface

Table 293: Inputs of positionedBGs_ids_equal

Name	Type	Comments and Information
bg_2	TrainPosition_Types_Pck::positionedBG_T	
bg_1	TrainPosition_Types_Pck::positionedBG_T	

Table 294: Outputs of positionedBGs_ids_equal

Name	Type	Comments and Information
idsEqual	bool	

15.3.32.3. Operator Hierarchy

<u>diagram</u> : diagram_positionedBGs_ids_equal_1

15.3.32.4.   Graphical and Textual Diagrams

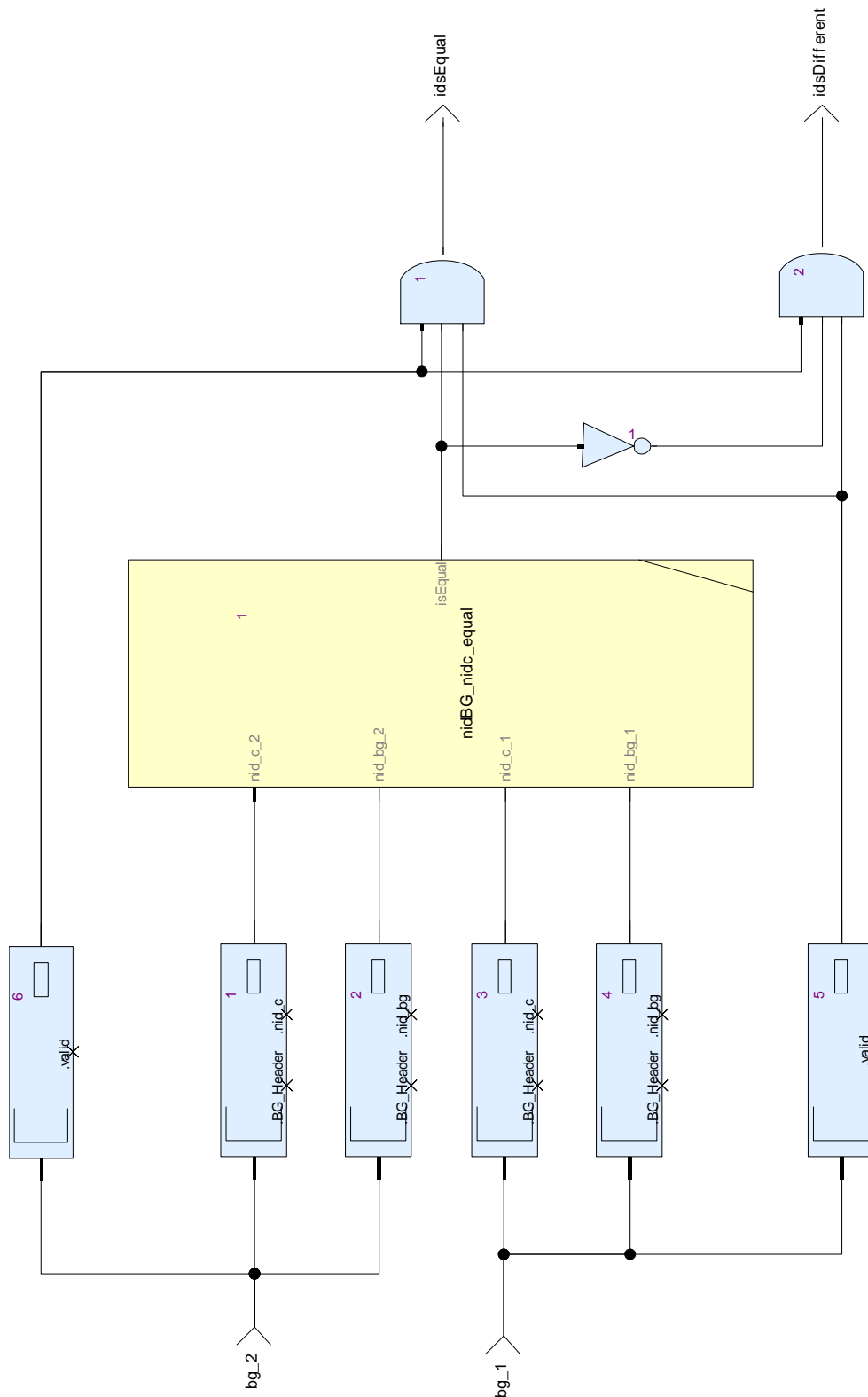### 15.3.32.4.1. View of diagram_positionedBGs_ids_equal_1 (positionedBGs_ids_equal)
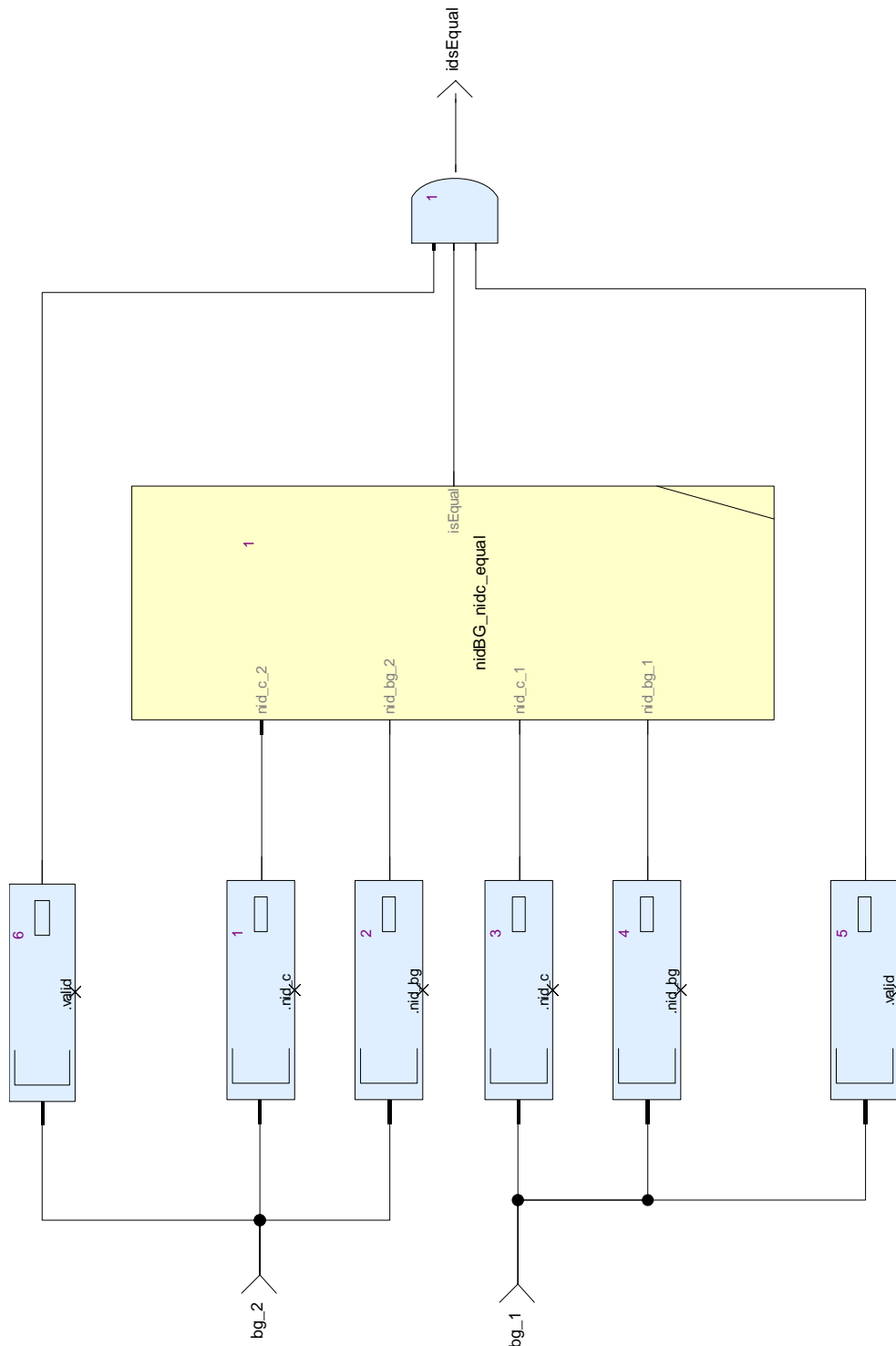
Figure 112: View of diagram_positionedBGs_ids_equal_1 (positionedBGs_ids_equal)

15.3.33.   positionLinkedBGs Operator

Declared as **public function**

15.3.33.1.   Comments and Information

positionLinkedBGs Comments:

- Converts the linking information - received while passing a BG - into announced (= linked positioned) BGs.

Table 295: 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	Converts the linking information, received while passing a BG into an announced (= linked positioned) BG. - 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.
	to_c	True

15.3.33.2.   Interface

Table 296: Inputs of positionLinkedBGs

Name	Type	Comments and Information
passedPositionedBG	TrainPosition_Types_Pck::positionedBG_T	Comments: The actually passed BG, where the linking information originates from.
linkedBGs	BG_Types_Pkg::LinkedBGs_T	

Table 297: Outputs of positionLinkedBGs

Name	Type	Comments and Information
linkedPositionedBGs	TrainPosition_Types_Pck::linkedBGs_asPositionedBGs_T	

15.3.33.3.   Operator Hierarchy

diagram : diagram_positionLinkedBGs_1

15.3.33.4. Graphical and Textual Diagrams

15.3.33.4.1. View of diagram_positionLinkedBGs_1 (positionLinkedBGs)
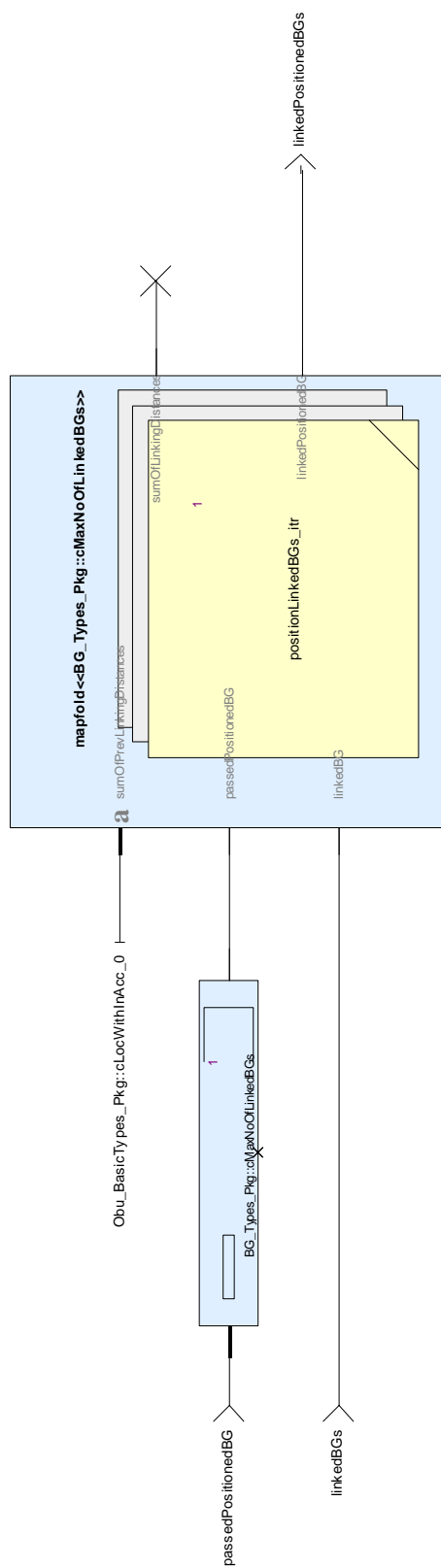
Figure 113: View of diagram_positionLinkedBGs_1 (positionLinkedBGs)

15.3.34.   positionLinkedBGs_itr Operator

Declared as **private function**

15.3.34.1.   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 298: 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	Iterated function for the conversion of the linking information, received while passing a BG into an announced (= linked positioned) BG. - 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.
	to_c	True

15.3.34.2.   Interface

Table 299: Inputs of positionLinkedBGs_itr

Name	Type	Comments and Information
sumOfPrevLinkingDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T	Comments: The sum of the linking distances from the chain of previous linked BGs since the passedPositionedBG.
passedPositionedBG	TrainPosition_Types_Pck::positionedBG_T	Comments: The actually passed BG, where the linking information originates from.
linkedBG	BG_Types_Pkg::LinkedBG_T	Comments: One of the linked BG, announced by the passed BG.

Table 300: Outputs of positionLinkedBGs_itr

Name	Type	Comments and Information
sumOfLinkingDistances	Obu_BasicTypes_Pkg:: LocWithInAcc_T	Comments: Sum of linking distances from the passedPositionedBG until this BG.
linkedPositionedBG	TrainPosition_Types_Pck::positionedBG_T	

15.3.34.3.   Operator Hierarchy

<u>diagram</u> : diagram_positionLinkedBGs_itr_1

15.3.34.4.   Graphical and Textual Diagrams

15.3.34.4.1. View of diagram_positionLinkedBGs_itr_1 (positionLinkedBGs_itr)

Figure 114: View of diagram_positionLinkedBGs_itr_1 (positionLinkedBGs_itr)
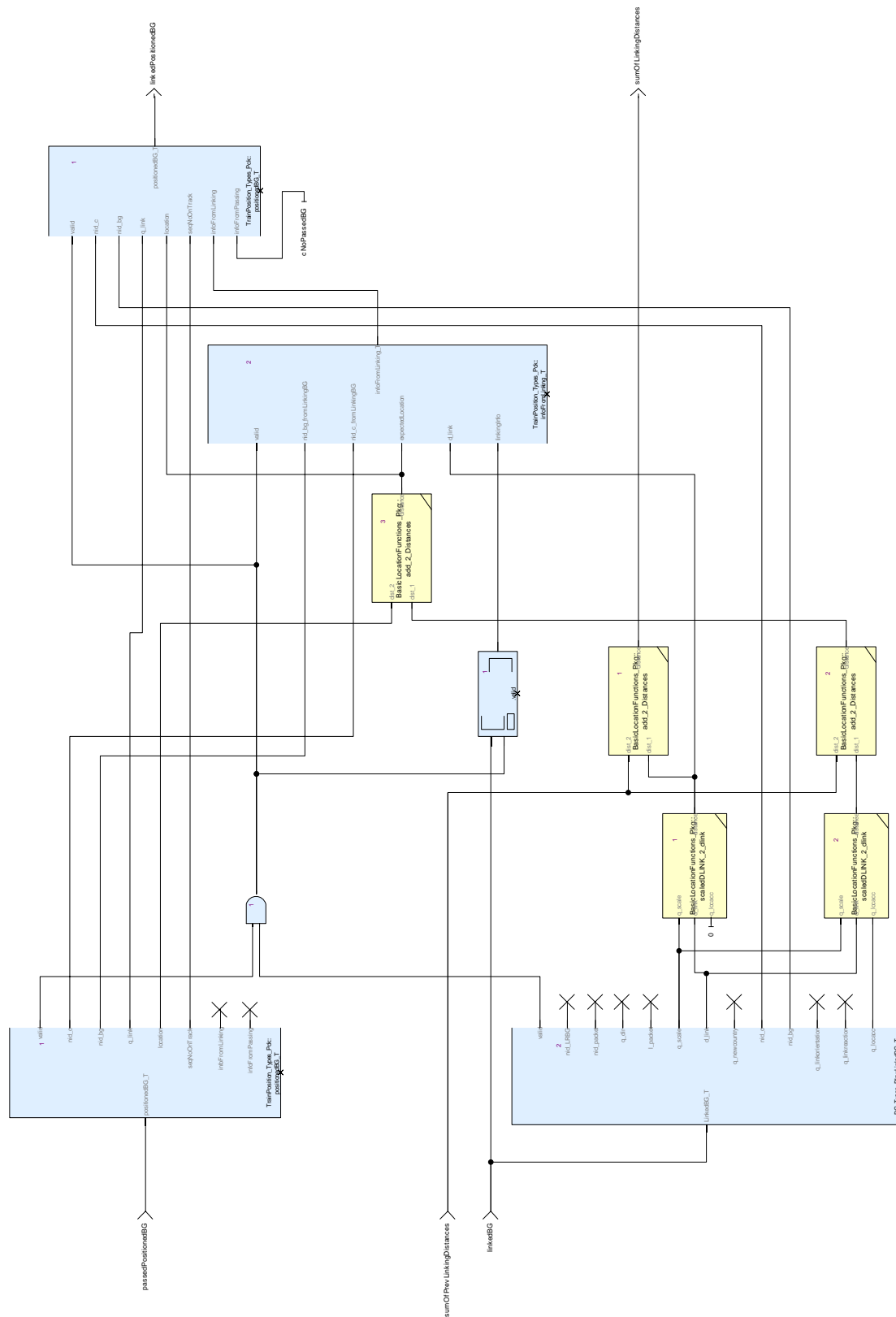
15.3.35. trimSeqNoOnTrack Operator

Declared as **public function**

15.3.35.1. Comments and Information

trimSeqNoOnTrack Comments:

- Adjusts the sequence number (seqNoOnTrack) of announced (not yet passed BGs).

15.3.35.2. Interface

Table 301: Inputs of trimSeqNoOnTrack

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	Comments: The BGs where BG is to be merged with.

Table 302: Outputs of trimSeqNoOnTrack

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	Comments: The resulting array of merged BGs.

15.3.35.3. Operator Hierarchy

diagram : diagram_trimSeqNoOnTrack_1

15.3.35.4. Graphical and Textual Diagrams

15.3.35.4.1. View of diagram_trimSeqNoOnTrack_1 (trimSeqNoOnTrack)
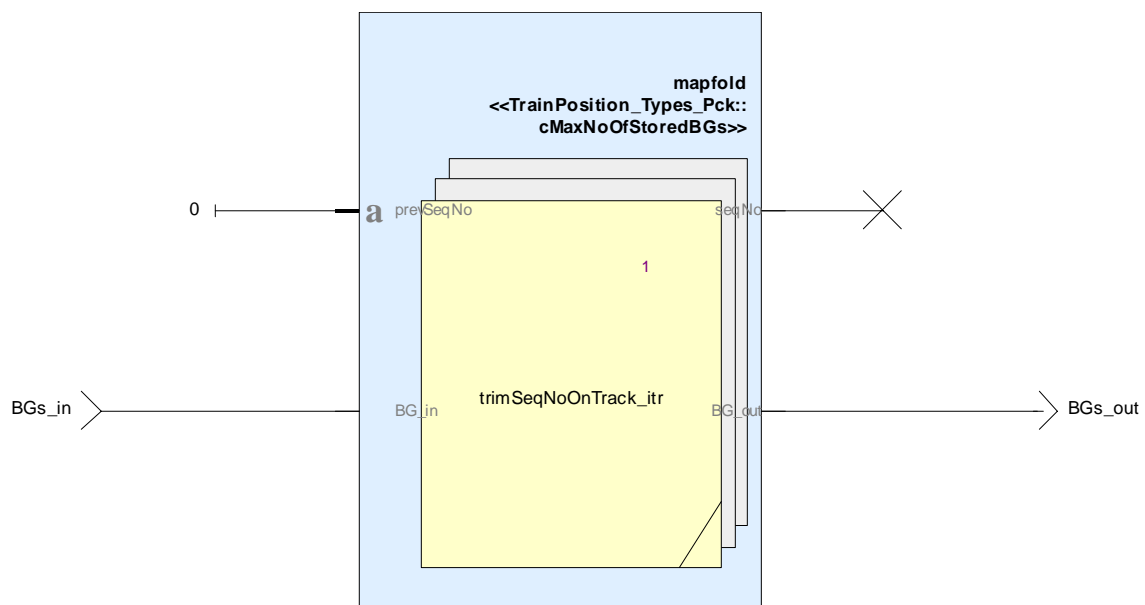
Figure 115: View of diagram_trimSeqNoOnTrack_1 (trimSeqNoOnTrack)

15.3.36. trimSeqNoOnTrack_itr Operator

Declared as **private function**

15.3.36.1.   Comments and Information

trimSeqNoOnTrack_itr Comments:

- Adjusts the sequence number (seqNoOnTrack) of announced (not yet passed BGs).

15.3.36.2.   Interface

Table 303: Inputs of trimSeqNoOnTrack_itr

Name	Type	Comments and Information
prevSeqNo	int	
BG_in	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG to be merged.

Table 304: Outputs of trimSeqNoOnTrack_itr

Name	Type	Comments and Information
seqNo	int	
BG_out	TrainPosition_Types_Pck::positionedBG_T	Comments: The BG to be merged.

15.3.36.3.   Operator Hierarchy

<u>diagram</u> : diagram_trimSeqNoOnTrack_itr_1

15.3.36.4. Graphical and Textual Diagrams

15.3.36.4.1. View of diagram_trimSeqNoOnTrack_itr_1 (trimSeqNoOnTrack_itr)
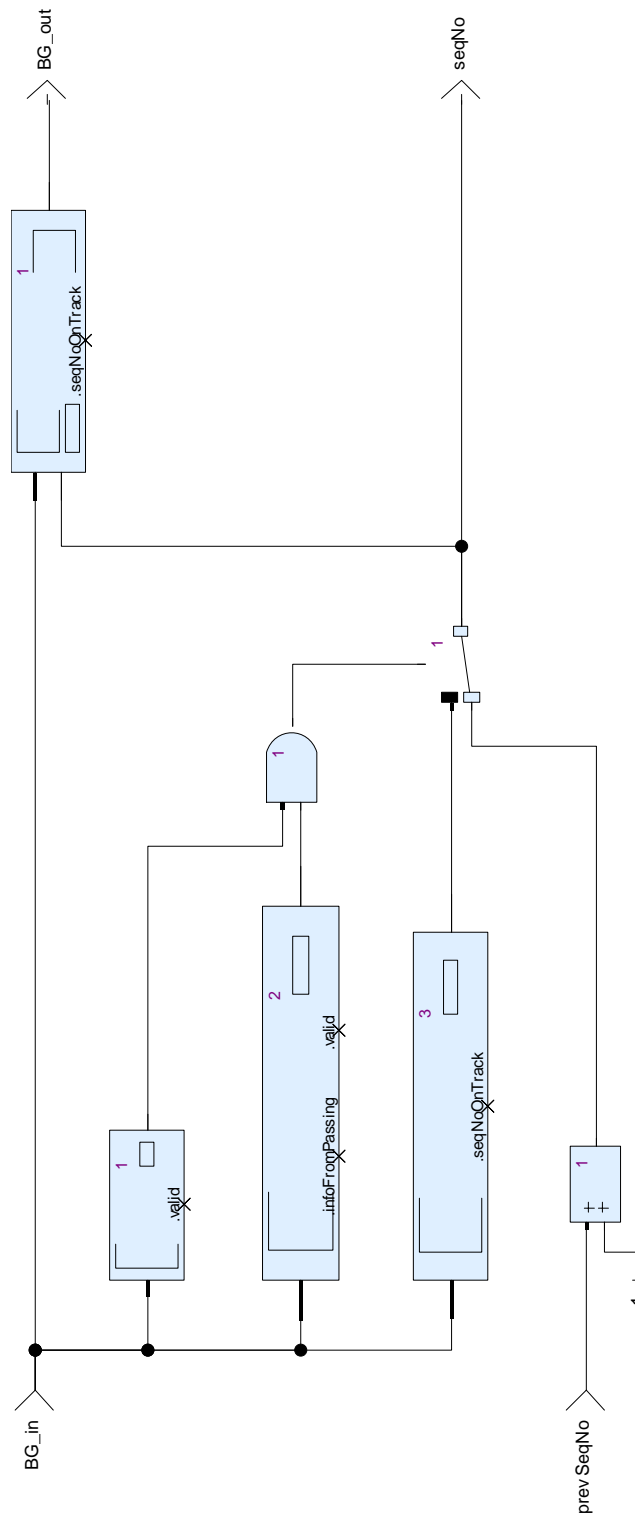
Figure 116: View of diagram_trimSeqNoOnTrack_itr_1 (trimSeqNoOnTrack_itr)

15.4. CalculateTrainPosition_Pkg::gp_functions_Pkg Package

15.4.1. Constants

Table 305: Public Constants of gp_functions_Pkg

Name	Type	Value	Comments and Information
noValidIndex	int	-1	

15.4.2. countUp Operator

Declared as **public node**

15.4.2.1. Comments and Information

countUp Comments:

- Counter counting upwards by one.

15.4.2.2. Interface

Table 306: Inputs of countUp

Name	Type	Properties	Comments and Information
count	bool		Comments: Enables counting.
reset	bool	hidden	Comments: Resets the counter value to 0.

Table 307: Outputs of countUp

Name	Type	Comments and Information
counter	int	Comments: The counter value.

15.4.2.3. Operator Hierarchy

diagram : diagram_countUp_1

15.4.2.4.   Graphical and Textual Diagrams

15.4.2.4.1.   View of diagram_countUp_1 (countUp)
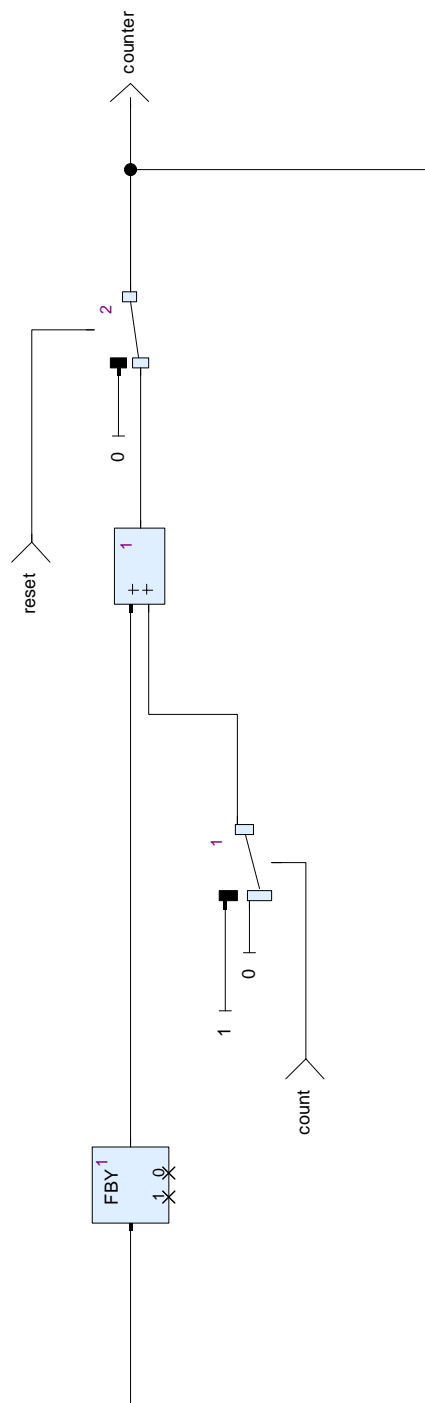
Figure 117: View of diagram_countUp_1 (countUp)

16. Project Library: ProvidePositionReport

16.1.   ProvidePositionReport_Pkg Package

16.1.1.   Types

Table 308: Public Types of ProvidePositionReport_Pkg

Name	Definition	Comments and Information
ErrorMessage_T	{present : bool, errorType : M_ERROR}	Comments: 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	Comments: Defined in 3.4.4.2.1.1; probably added to PositionedBG_T
MemorizedErrorMsg_T	{valid : bool, errorType : M_ERROR}	Comments: internal data structre
Packet0_T	{valid : bool, packet0 : TrainToTrack::Position_Report}	Comments: Adding a valid flag to Packet 0
Packet1_T	{valid : bool, packet1 : TrainToTrack::Position_Report_based _on_two_balise_groups}	Comments: Adding a valid flag to packet 1.
Packet4_T	{valid : bool, packet4 : TrainToTrack::Error_reporting}	Comments: 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, interPacket58List : ProvidePositionReport_Pkg::IterPacket58List_T}	
Packet5_T	{valid : bool, packet5 : TrainToTrack::Train_running_number }	Comments: 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}	Comments: 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}	Comments: Position report header
PositionReportParameter_T	{present : bool, packet58 : ProvidePositionReport_Pkg::Packet58_T}	
PresentxMLOC_T	{present : bool, m_loc : M_LOC}	Comments: Crossproduct of present flag and M_LOC; internal memory representation

Name	Definition	Comments and Information
RBC_Communication_T	{newSessionEstablished : bool}	Comments: variables necessary for the communication with the RBC newSessionEstablished Comments: to decide 3.6.5.1.4.h
SystemTime_T	Obu_BasicTypes_Pkg::T_internal_Type	Comments: global system time
TrackInfo_T	{minSafeRearEndPassed : bool, maxSafeFrontEndPassed : bool, levelTransitionBorderPassed : bool}	Comments: Information necessary to calculate whether event triggering the sending of a position report evaluates to true. minSafeRearEndPassed Comments: to decide 3.6.5.1.4.e maxSafeFrontEndPassed Comments: to decide 3.6.5.1.4.k levelTransitionBorderPassed Comments: to decide 3.6.5.1.4.f

16.1.2. Constants

Table 309: 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	Comments: value is bound to 32
cL_MESSAGE	L_MESSAGE	0	
cMinSafeRearEnd	int	0	
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}	Comments: used as intial value

Name	Type	Value	Comments and Information
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_PrvLRB : 0, nominalOrReverseToLRBG : Q_DLRBG_Reverse, trainOrientationToLRBG : Q_DIRLRBG_Reverse, trainRunningDirectionToLRBG : Q_DIRTRAIN_Reverse, speed : 0}	Comments: used as initial value
cTrigger	bool	false	
cUnknownLRBG	int	16777215	

16.1.3. AggregateHeader Operator

Declared as **public function**

16.1.3.1. Comments and Information

AggregateHeader Comments:

- Aggregates values necessary for the position report header. Used default value for L_MESSAGE and T_TRAIN.

16.1.3.2. Interface

Table 310: Inputs of AggregateHeader

Name	Type	Comments and Information
trainProps	TrainPosition_Types_Pck::trainProperties_T	

Table 311: Outputs of AggregateHeader

Name	Type	Comments and Information
posRepHeader	ProvidePositionReport_Pkg::PositionReportHeader_T	

16.1.3.3. Operator Hierarchy

diagram : diagram_AggregateHeader_1

16.1.3.4. Graphical and Textual Diagrams

16.1.3.4.1. View of diagram_AggregateHeader_1 (AggregateHeader)

Figure 118: View of diagram_AggregateHeader_1 (AggregateHeader)

16.1.4. AggregatePacket_0 Operator

Declared as **public function**

16.1.4.1. Comments and Information

AggregatePacket_0 Comments:

- Aggregates all values necessary for report packet 0.

16.1.4.2. Interface

Table 312: Inputs of AggregatePacket_0

Name	Type	Comments and Information
posBGs	TrainPosition_Types_Pck::positionedBG_T	
trainPos	TrainPosition_Types_Pck::trainPosition_T	
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	
TrainRearEndPos3	L_TRAININT	

Table 313: Outputs of AggregatePacket_0

Name	Type	Comments and Information
packet0	ProvidePositionReport_Pkg::Packet0_T	

16.1.4.3. Operator Hierarchy

diagram : diagram_AggregatePacket_0_1

16.1.4.4.   Graphical and Textual Diagrams

16.1.4.4.1.   View of diagram_AggregatePacket_0_1 (AggregatePacket_0)

Figure 119: View of diagram_AggregatePacket_0_1 (AggregatePacket_0)

16.1.5.   AggregatePacket_1 Operator

Declared as **public function**

16.1.5.1.   Comments and Information

AggregatePacket_1 Comments:

- Aggregates all values necessary for report packet 1.

16.1.5.2. Interface

Table 314: Inputs of AggregatePacket_1

Name	Type	Comments and Information
posBGs	TrainPosition_Types_Pck::positionedBG_T	
trainPos	TrainPosition_Types_Pck::trainPosition_T	
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	
TrainRearEndPos4	L_TRAININT	

Table 315: Outputs of AggregatePacket_1

Name	Type	Comments and Information
packet1	ProvidePositionReport_Pkg::Packet1_T	

16.1.5.3. Operator Hierarchy

<u>diagram</u> : diagram_AggregatePacket_1_1

16.1.5.4.   Graphical and Textual Diagrams

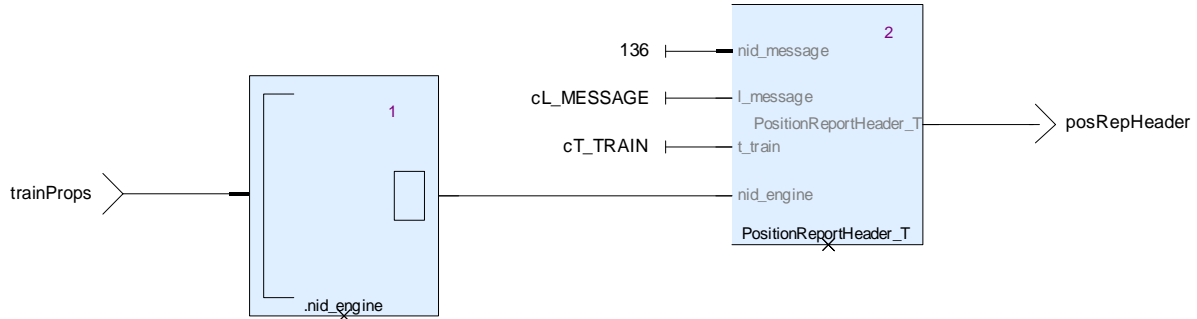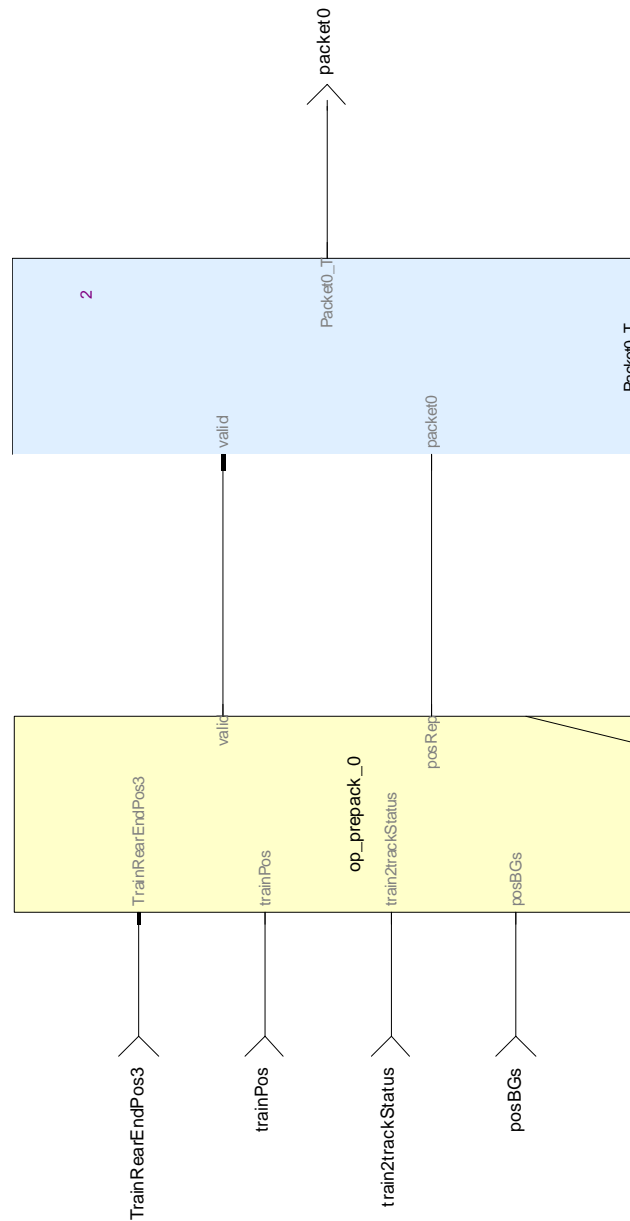### 16.1.5.4.1.   View of diagram_AggregatePacket_1_1 (AggregatePacket_1)

Figure 120: View of diagram_AggregatePacket_1_1 (AggregatePacket_1)

16.1.6.   AggregatePacket_4 Operator

Declared as **public node**

16.1.6.1.   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.

16.1.6.2.   Interface

Table 316: Inputs of AggregatePacket_4

Name	Type	Properties		Comments and Information
errorMsg	ProvidePositionReport_ Pkg::ErrorMessage_T	last	cErrorMessage	
trigger	bool	last	cTrigger	

Table 317: Outputs of AggregatePacket_4

Name	Type	Comments and Information
packet4	ProvidePositionReport_ Pkg::Packet4_T	

16.1.6.3.   Locals

Table 318: Locals of AggregatePacket_4

Name	Type	Properties		Comments and Information
empty	bool	default	true	
intermediate	bool	default	false	
valid	bool			

16.1.6.4.   Operator Hierarchy

<u>diagram</u> : diagram_AggregatePacket_4_1
　　　state-machine : SM1
　　　　　state : emptyStorage
　　　　　state : filledStorage
　　　　　state : init
　　　　　state : intermediate

16.1.6.5.   Graphical and Textual Diagrams

16.1.6.5.1.   View of diagram_AggregatePacket_4_1 (AggregatePacket_4)
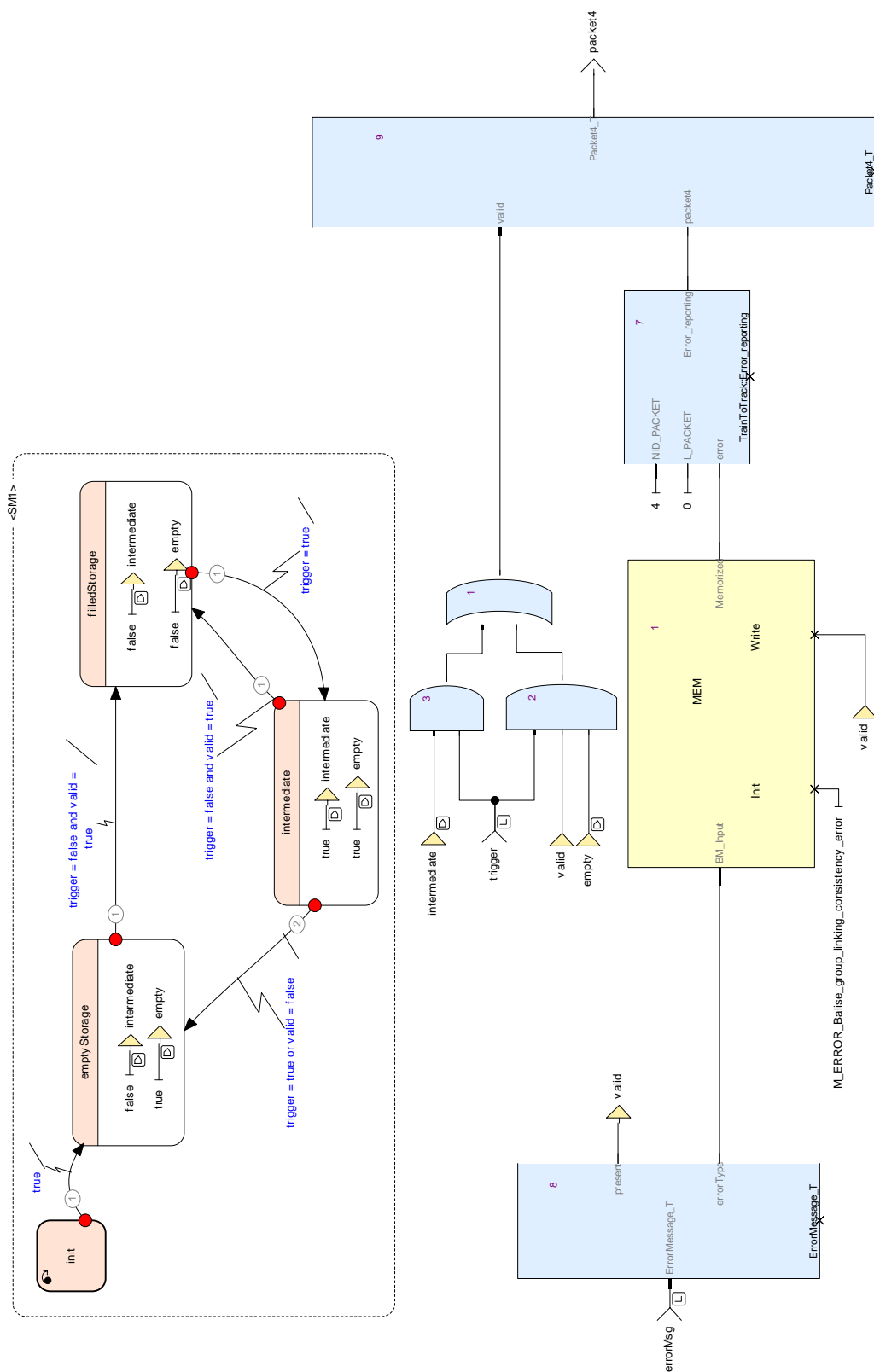
Figure 121: View of diagram_AggregatePacket_4_1 (AggregatePacket_4)

Table 319: State Machines of diagram_AggregatePacket_4_1

State Machine	Comments and Information
SM1	

Table 320: States of diagram_AggregatePacket_4_1

State	Comments and Information
SM1:emptyStorage	
SM1:filledStorage	
SM1:init	
SM1:intermediate	

Table 321: Transitions of diagram_AggregatePacket_4_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: SM1:emptyStorage Target: SM1:filledStorage	1	Condition: trigger = false and valid = true	
Source: SM1:filledStorage Target: SM1:intermediate	1	Condition: trigger = true	
Source: SM1:init Target: SM1:emptyStorage	1	Condition: true	
Source: SM1:intermediate Target: SM1:filledStorage	1	Condition: trigger = false and valid = true	
Source: SM1:intermediate Target: SM1:emptyStorage	2	Condition: trigger = true or valid = false	

16.1.7.   AggregatePacket_5 Operator

Declared as **public function**

16.1.7.1.   Comments and Information

AggregatePacket_5 Comments:

- Aggregates all values necessary for report packet 5. As train information data is
- always avaliable, the valid flag is always set to true.

16.1.7.2.   Interface

Table 322: Inputs of AggregatePacket_5

Name	Type	Comments and Information
trainProps	TrainPosition_Types_Pck::trainProperties_T	

Table 323: Outputs of AggregatePacket_5

Name	Type	Comments and Information
packet5	ProvidePositionReport_Pkg::Packet5_T	

16.1.7.3.   Operator Hierarchy

diagram : diagram_AggregatePacket_5_1

16.1.7.4. Graphical and Textual Diagrams

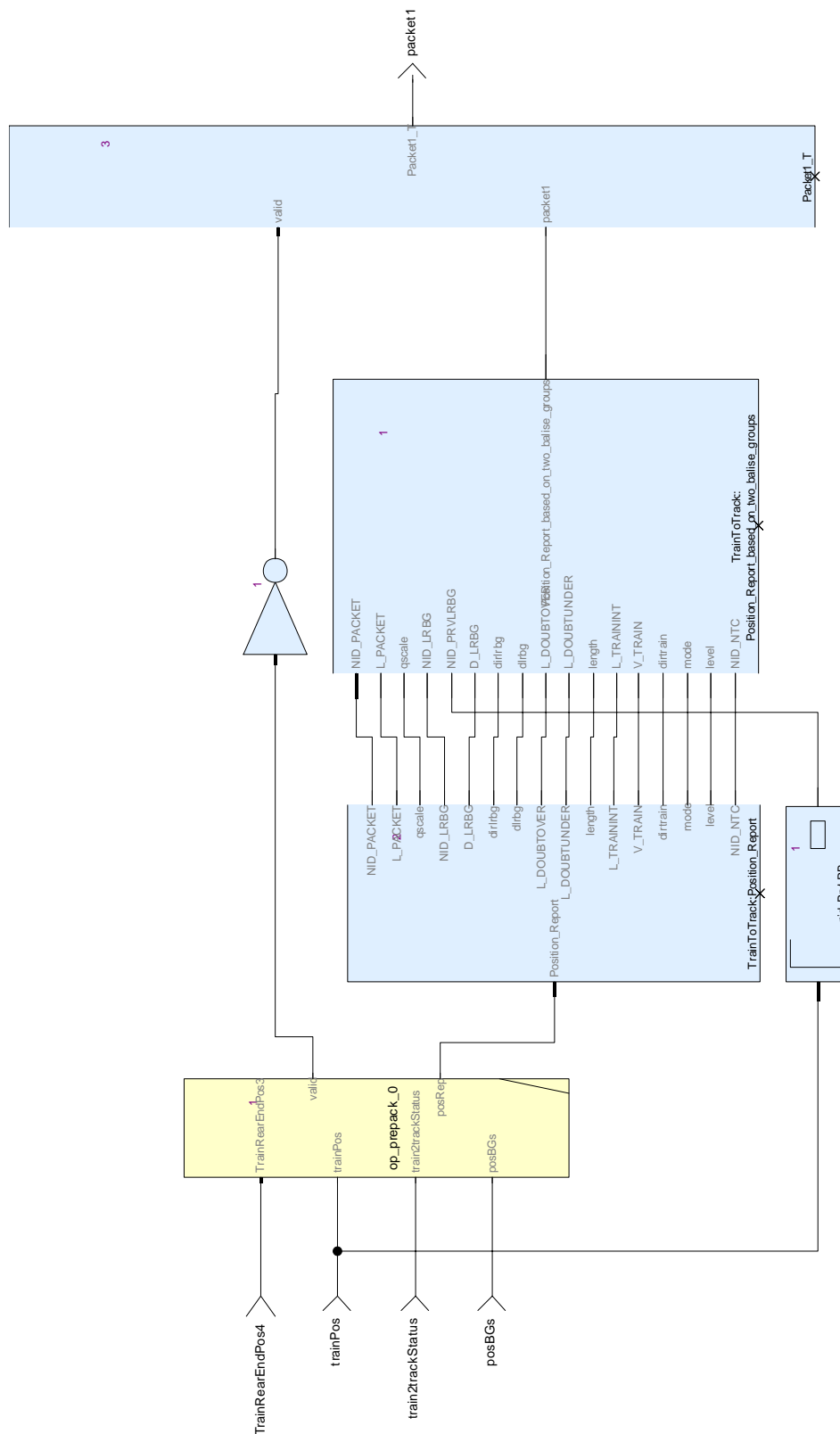### 16.1.7.4.1. View of diagram_AggregatePacket_5_1 (AggregatePacket_5)
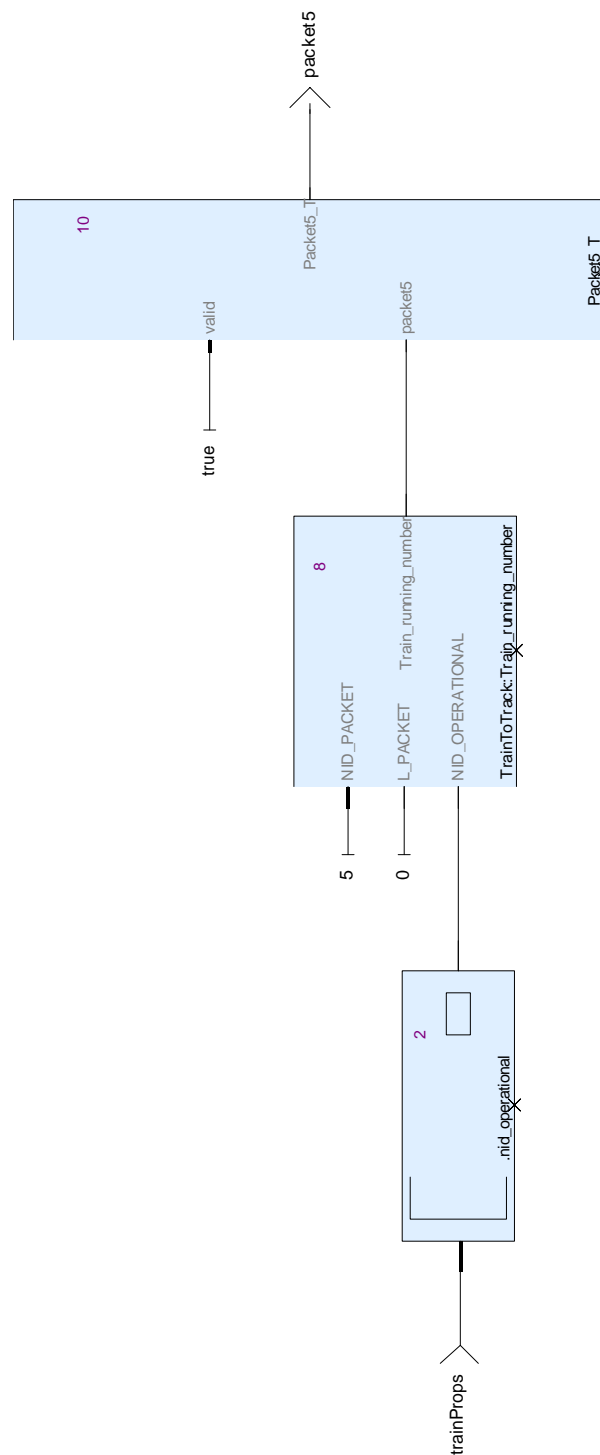
Figure 122: View of diagram_AggregatePacket_5_1 (AggregatePacket_5)

16.1.8. CalculateSafeTrainLength Operator

Declared as **public node**

16.1.8.1. Comments and Information

CalculateSafeTrainLength Comments:

- Calculates the the safeTrainLength according to 3.6.5.2.4/5.
- safeTrainLength = absolute(EstimatedFrontEndPosition - MinSafeRearEnd) , where
- MinSafeRearEnd = minSafeFrontEndPosition - L_TRAIN

16.1.8.2.   Interface

Table 324: Inputs of CalculateSafeTrainLength

Name	Type	Comments and Information
trainProps	TrainPosition_Types_Pck::trainProperties_T	
trainPosition	TrainPosition_Types_Pck::trainPosition_T	

Table 325: Outputs of CalculateSafeTrainLength

Name	Type	Comments and Information
safeTrainLength	L_TRAININT	

16.1.8.3.   Operator Hierarchy

<u>diagram</u> : diagram_CalculateSafeTrainLength_1

16.1.8.4.   Graphical and Textual Diagrams

16.1.8.4.1.   View of diagram_CalculateSafeTrainLength_1 (CalculateSafeTrainLength)
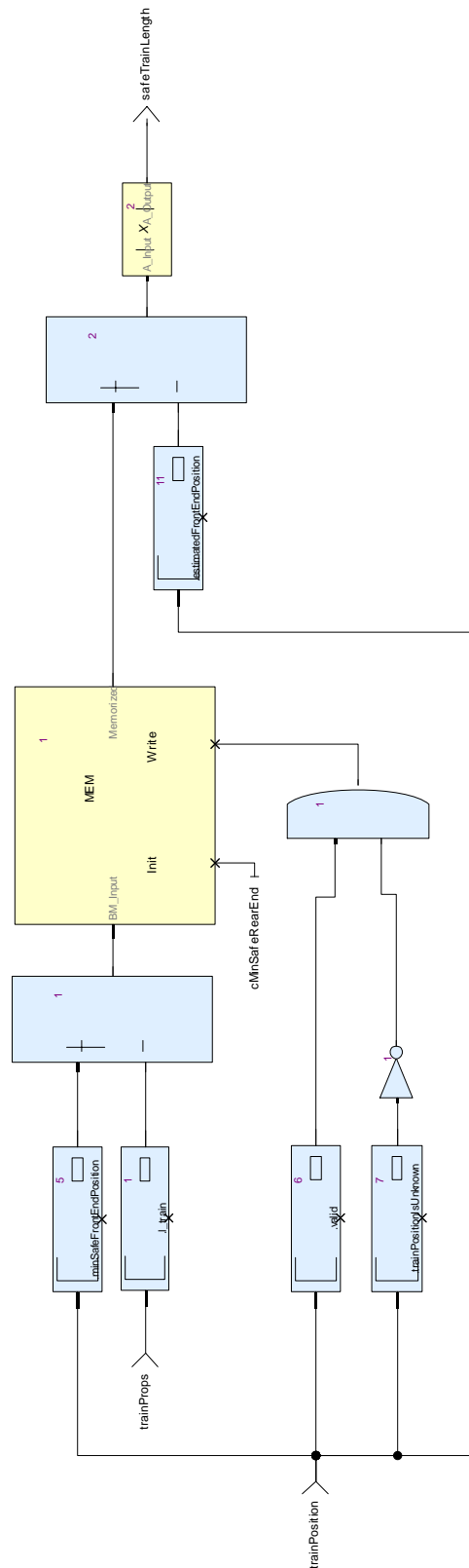
Figure 123: View of diagram_CalculateSafeTrainLength_1 (CalculateSafeTrainLength)

16.1.9.   CollectData Operator

Declared as **public node**

16.1.9.1.   Comments and Information

CollectData Comments:

- In this operation, data of packets 0 -5 and the header is aggregated to a position report.

16.1.9.2.   Interface

Table 326: Inputs of CollectData

Name	Type	Comments and Information
posBGs	TrainPosition_Types_Pck::positionedBG_T	
trainPos	TrainPosition_Types_Pck::trainPosition_T	
trainProps	TrainPosition_Types_Pck::trainProperties_T	
TrainRearEndPos	L_TRAININT	
trigger	bool	
errorMsg	ProvidePositionReport_Pkg::ErrorMessage_T	
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	

Table 327: Outputs of CollectData

Name	Type	Comments and Information
posRep	ProvidePositionReport_Pkg::PositionReport_T	

16.1.9.3.   Operator Hierarchy

<u>diagram</u> : diagram_CollectData_1

16.1.9.4.   Graphical and Textual Diagrams

16.1.9.4.1.   View of diagram_CollectData_1 (CollectData)
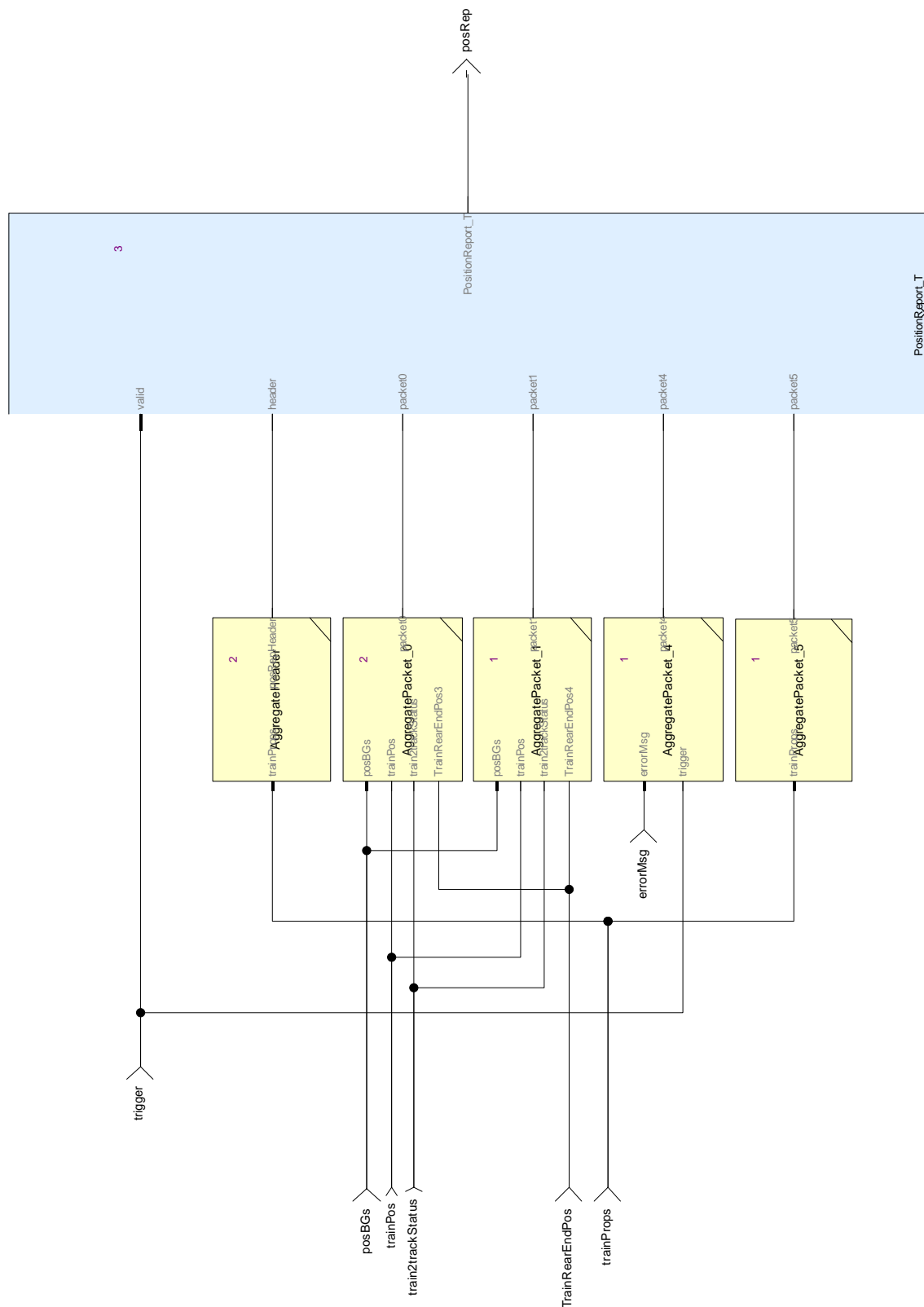
Figure 124: View of diagram_CollectData_1 (CollectData)

16.1.10.   EvaluateEvents Operator

Declared as **public node**

16.1.10.1.   Comments and Information

EvaluateEvents Comments:

- Evaluates whether one of the events described in 3.6.5.1.4 holds.

16.1.10.2.   Interface

Table 328: Inputs of EvaluateEvents

Name	Type	Comments and Information
trackInfo	ProvidePositionReport_Pkg::TrackInfo_T	
trainPos	TrainPosition_Types_Pck::trainPosition_T	
posBGs	TrainPosition_Types_Pck::positionedBG_T	
rbcComm	ProvidePositionReport_Pkg::RBC_Communication_T	
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	
linkingInfoUsed	ProvidePositionReport_Pkg::LinkingInfoUsedOnBoard	

Table 329: Outputs of EvaluateEvents

Name	Type	Comments and Information
result	bool	

16.1.10.3.   Operator Hierarchy

<u>diagram</u> : diagram_EvaluateEvents_1

16.1.10.4.   Graphical and Textual Diagrams

16.1.10.4.1. View of diagram_EvaluateEvents_1 (EvaluateEvents)
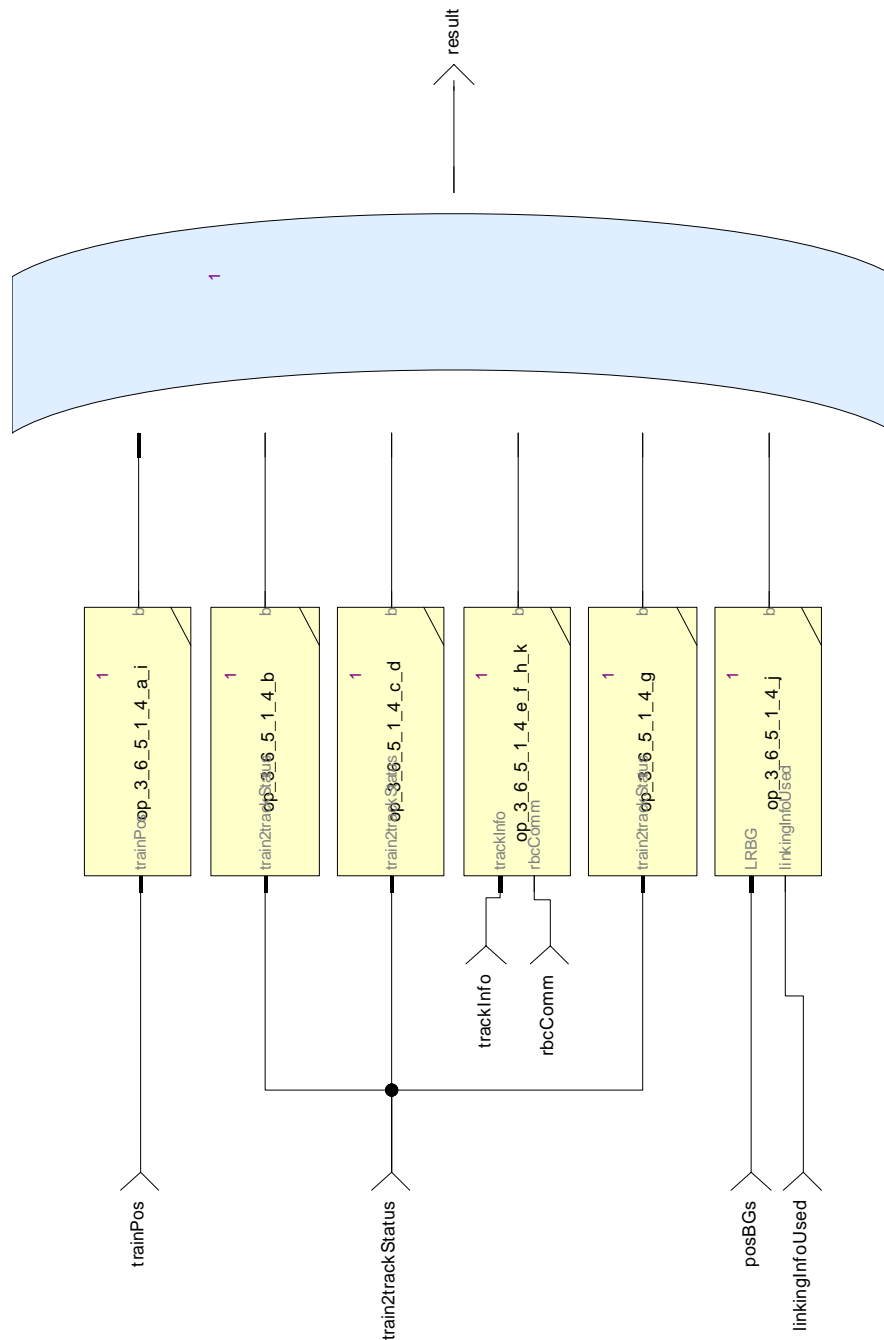
Figure 125: View of diagram_EvaluateEvents_1 (EvaluateEvents)

16.1.11.   EvaluateTrigger Operator

Declared as **public node**

16.1.11.1. 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.

16.1.11.2. Interface

Table 330: Inputs of EvaluateTrigger

Name	Type	Comments and Information
linkingInfoUsed	ProvidePositionReport_Pkg::LinkingInfoUsedOnBoard	
posBGs	TrainPosition_Types_Pck::positionedBG_T	
trainPos	TrainPosition_Types_Pck::trainPosition_T	
posRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	
systemTime	ProvidePositionReport_Pkg::SystemTime_T	

Table 331: Outputs of EvaluateTrigger

Name	Type	Comments and Information
result	bool	

16.1.11.3. Operator Hierarchy

<u>diagram</u> : diagram_EvaluateTrigger_1

16.1.11.4. Graphical and Textual Diagrams

16.1.11.4.1. View of diagram_EvaluateTrigger_1 (EvaluateTrigger)

Figure 126: View of diagram_EvaluateTrigger_1 (EvaluateTrigger)

16.1.12. EvaluateTriggerAndEvents Operator

Declared as **public node**

16.1.12.1. Comments and Information

EvaluateTriggerAndEvents Comments:

- conjunction of the evaluation of triggers and events.

16.1.12.2. Interface

Table 332: Inputs of EvaluateTriggerAndEvents

Name	Type	Comments and Information
trackInfo	ProvidePositionReport_Pkg::TrackInfo_T	
trainPos	TrainPosition_Types_Pck::trainPosition_T	
posRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	
posBGs	TrainPosition_Types_Pck::positionedBG_T	
systemTime	ProvidePositionReport_Pkg::SystemTime_T	
rbcComm	ProvidePositionReport_Pkg::RBC_Communication_T	
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	
linkingInfoUsed	ProvidePositionReport_Pkg::LinkingInfoUsedOnBoard	

Table 333: Outputs of EvaluateTriggerAndEvents

Name	Type	Comments and Information
trigger	bool	

16.1.12.3. Operator Hierarchy

<u>diagram</u> : diagram_EvaluateTriggerAndEvents_1

16.1.12.4.   Graphical and Textual Diagrams
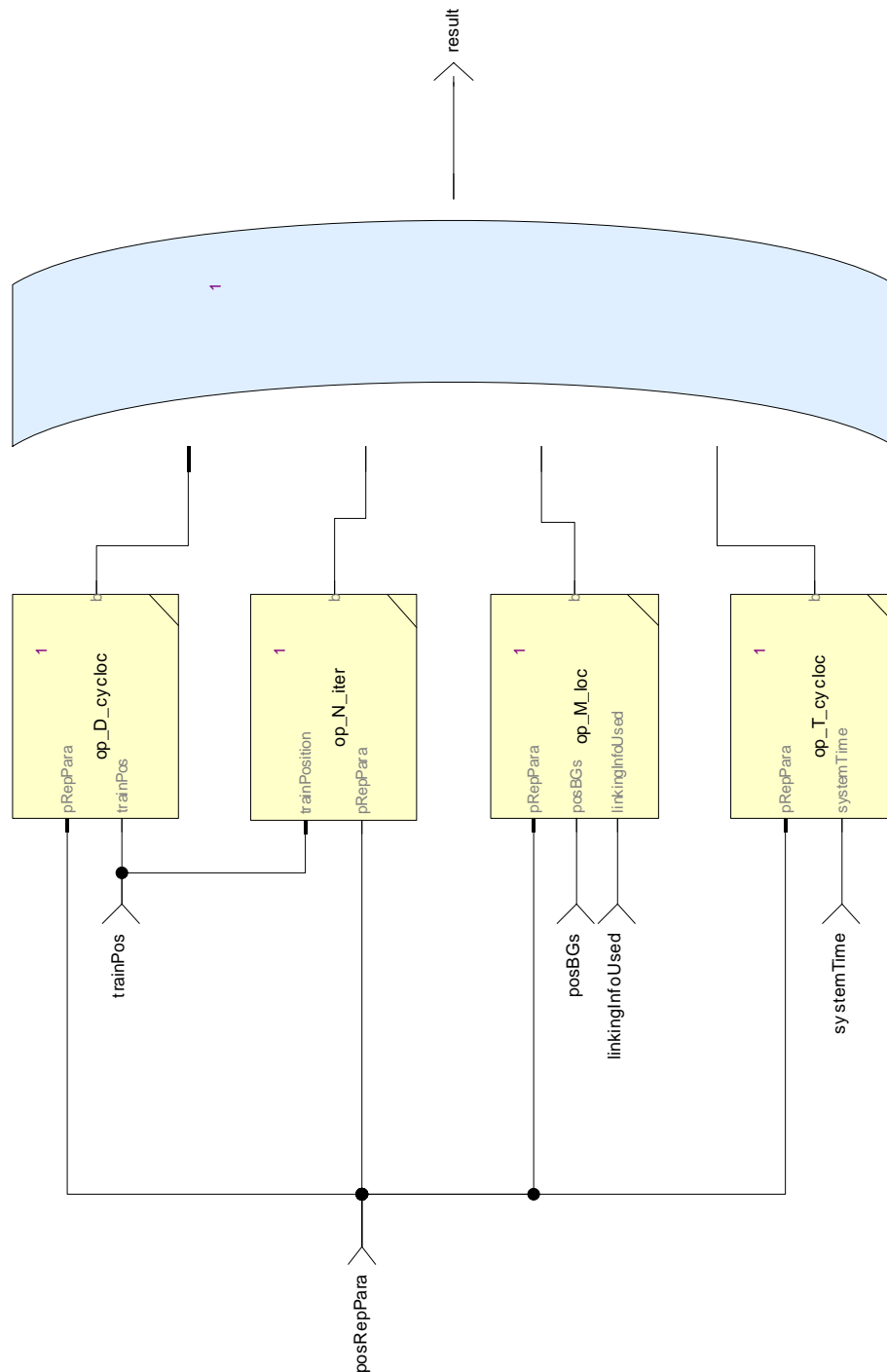
16.1.12.4.1. View of diagram_EvaluateTriggerAndEvents_1 (EvaluateTriggerAndEvents)
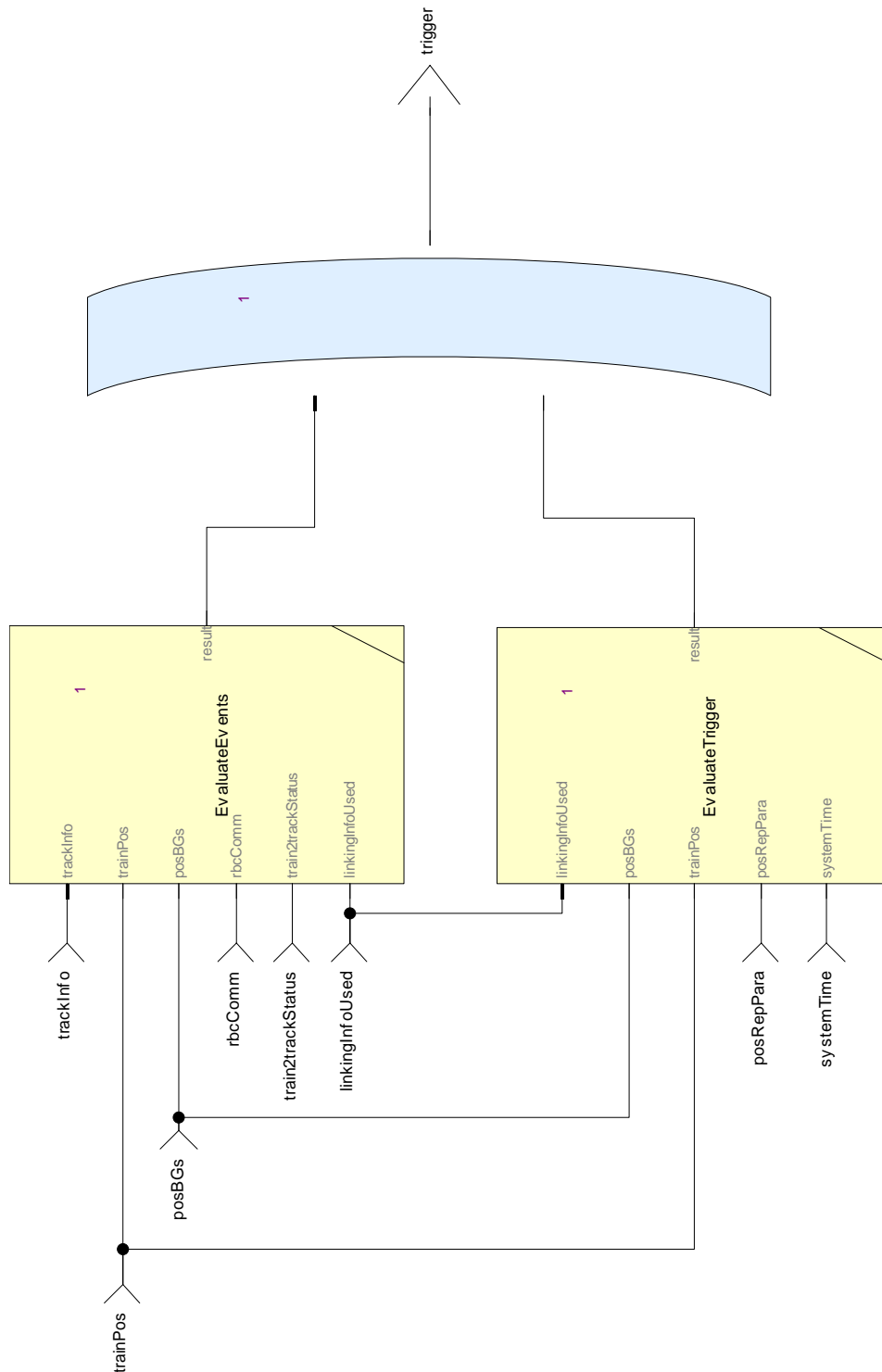
Figure 127: View of diagram_EvaluateTriggerAndEvents_1 (EvaluateTriggerAndEvents)

16.1.13.   op_3_6_5_1_4_a_i Operator

Declared as **public node**

16.1.13.1.   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),

16.1.13.2.   Interface

Table 334: Inputs of op_3_6_5_1_4_a_i

Name	Type	Properties		Comments and Information
trainPos	TrainPosition_Types_Pck::trainPosition_T	last	cTrainPosition	

Table 335: Outputs of op_3_6_5_1_4_a_i

Name	Type	Comments and Information
b	bool	

16.1.13.3.   Operator Hierarchy

<u>diagram</u> : diagram_op_3_6_5_1_4_a_i_1

16.1.13.4.   Graphical and Textual Diagrams

16.1.13.4.1.   View of diagram_op_3_6_5_1_4_a_i_1 (op_3_6_5_1_4_a_i)

Figure 128: View of diagram_op_3_6_5_1_4_a_i_1 (op_3_6_5_1_4_a_i)

16.1.14.   op_3_6_5_1_4_b Operator

Declared as **public node**

16.1.14.1.   Comments and Information

op_3_6_5_1_4_b Comments:

- Models event as listed in 3.6.5.1.4 b),

16.1.14.2.   Interface

Table 336: Inputs of op_3_6_5_1_4_b

Name	Type	Properties		Comments and Information
train2trackStatus	BG_Types_Pkg::TrainT oTrackStatus_T	last	cTrack2Train Status	

Table 337: Outputs of op_3_6_5_1_4_b

Name	Type	Comments and Information
b	bool	

16.1.14.3.   Operator Hierarchy

<u>diagram</u> : diagram_op_3_6_5_1_4_b_1

16.1.14.4.   Graphical and Textual Diagrams

16.1.14.4.1. View of diagram_op_3_6_5_1_4_b_1 (op_3_6_5_1_4_b)

Figure 129: View of diagram_op_3_6_5_1_4_b_1 (op_3_6_5_1_4_b)

16.1.15.   op_3_6_5_1_4_c_d Operator

Declared as **public function**

16.1.15.1.   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),

16.1.15.2.   Interface

Table 338: Inputs of op_3_6_5_1_4_c_d

Name	Type	Comments and Information
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	

Table 339: Outputs of op_3_6_5_1_4_c_d

Name	Type	Comments and Information
b	bool	

16.1.15.3.   Operator Hierarchy

<u>diagram</u> : diagram_op_3_6_5_1_4_c_d_1

16.1.15.4.   Graphical and Textual Diagrams

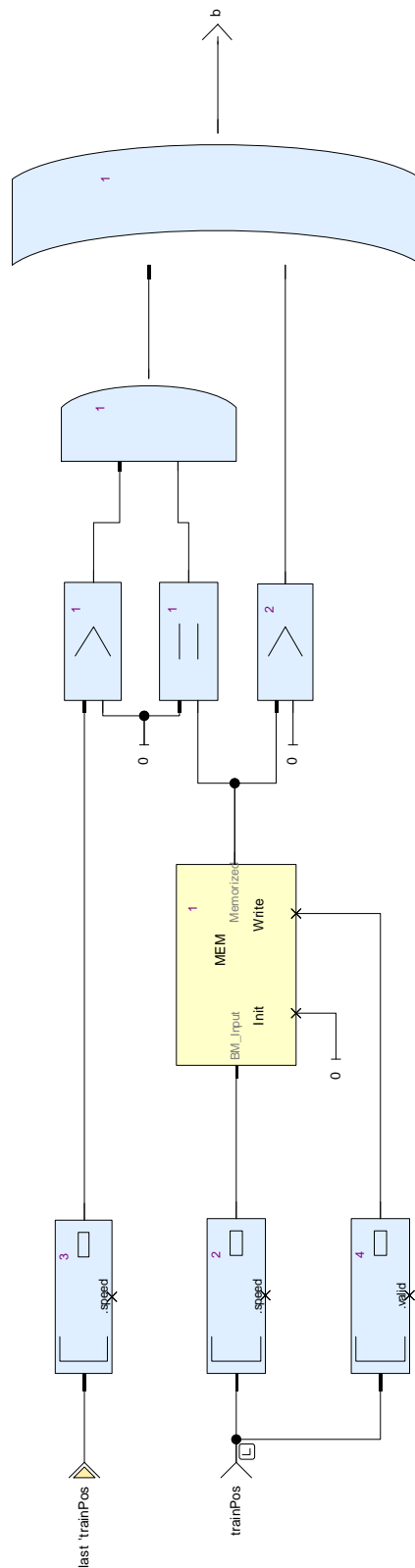### 16.1.15.4.1. View of diagram_op_3_6_5_1_4_c_d_1 (op_3_6_5_1_4_c_d)

Figure 130: View of diagram_op_3_6_5_1_4_c_d_1 (op_3_6_5_1_4_c_d)

16.1.16.   op_3_6_5_1_4_e_f_h_k Operator

Declared as **public function**

16.1.16.1.   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),

16.1.16.2. Interface

Table 340: 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 341: Outputs of op_3_6_5_1_4_e_f_h_k

Name	Type	Comments and Information
b	bool	

16.1.16.3. Operator Hierarchy

<u>diagram</u> : diagram_op_3_6_5_1_4_e_f_h_k_1

16.1.16.4. Graphical and Textual Diagrams
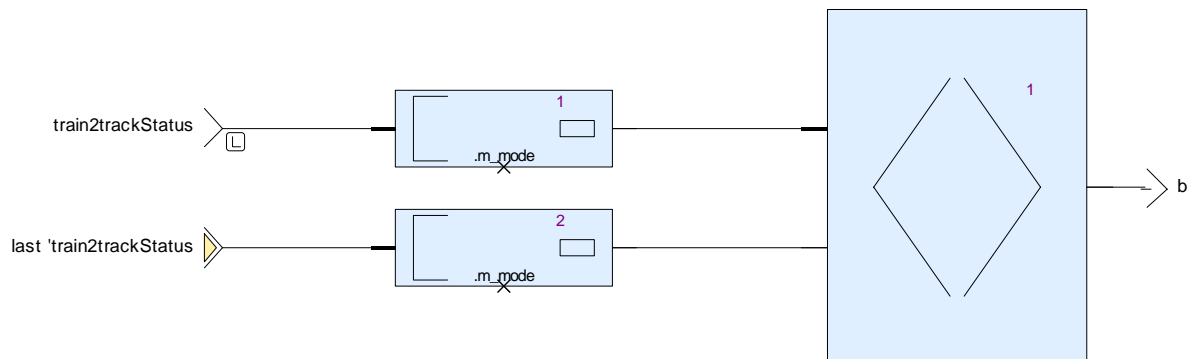
16.1.16.4.1. View of diagram_op_3_6_5_1_4_e_f_h_k_1 (op_3_6_5_1_4_e_f_h_k)

Figure 131: View of diagram_op_3_6_5_1_4_e_f_h_k_1 (op_3_6_5_1_4_e_f_h_k)

16.1.17. op_3_6_5_1_4_g Operator

Declared as **public node**

16.1.17.1. Comments and Information

op_3_6_5_1_4_g Comments:

- Models the event as listed in 3.6.5.1.4 g),

16.1.17.2. Interface

Table 342: Inputs of op_3_6_5_1_4_g

Name	Type	Properties		Comments and Information
train2trackStatus	BG_Types_Pkg::TrainToTrackStatus_T	last	cTrack2TrainStatus	

Table 343: Outputs of op_3_6_5_1_4_g

Name	Type	Comments and Information
b	bool	

16.1.17.3.   Operator Hierarchy

<u>diagram</u> : diagram_op_3_6_5_1_4_g_1

16.1.17.4.   Graphical and Textual Diagrams

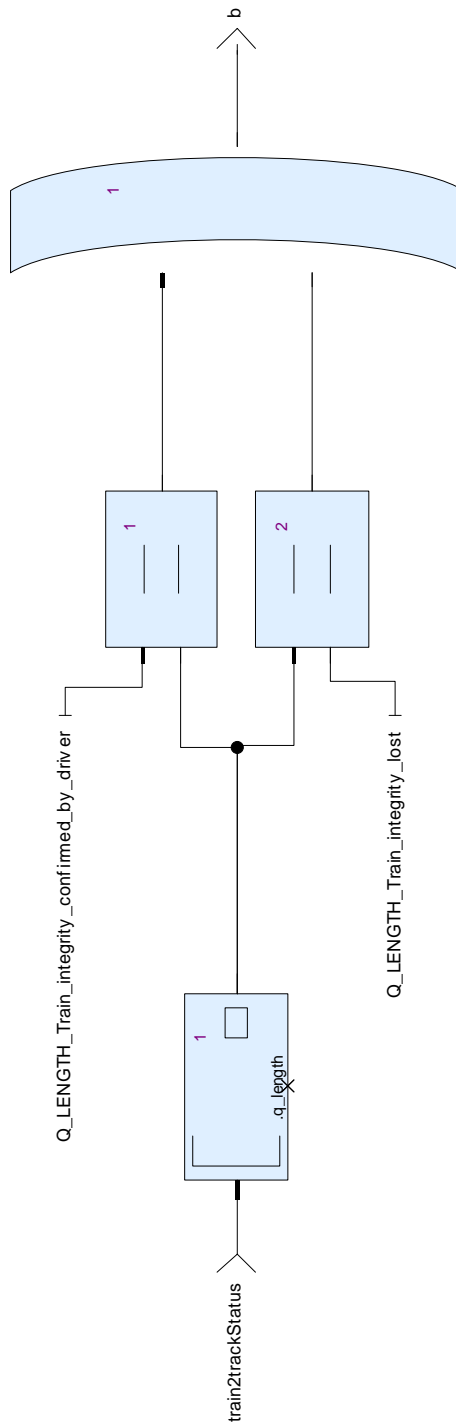#### 16.1.17.4.1. View of diagram_op_3_6_5_1_4_g_1 (op_3_6_5_1_4_g)

Figure 132: View of diagram_op_3_6_5_1_4_g_1 (op_3_6_5_1_4_g)

16.1.18.   op_3_6_5_1_4_j Operator

Declared as **public function**

16.1.18.1.   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 tothe definition in 3.6.2.2.2.a

16.1.18.2.   Interface

Table 344: Inputs of op_3_6_5_1_4_j

Name	Type	Comments and Information
LRBG	TrainPosition_Types_Pck::positionedBG_T	
linkingInfoUsed	ProvidePositionReport_Pkg::LinkingInfoUsedOnBoard	

Table 345: Outputs of op_3_6_5_1_4_j

Name	Type	Comments and Information
b	bool	

16.1.18.3.   Operator Hierarchy

<u>diagram</u> : diagram_op_3_6_5_1_4_j_1

16.1.18.4.   Graphical and Textual Diagrams

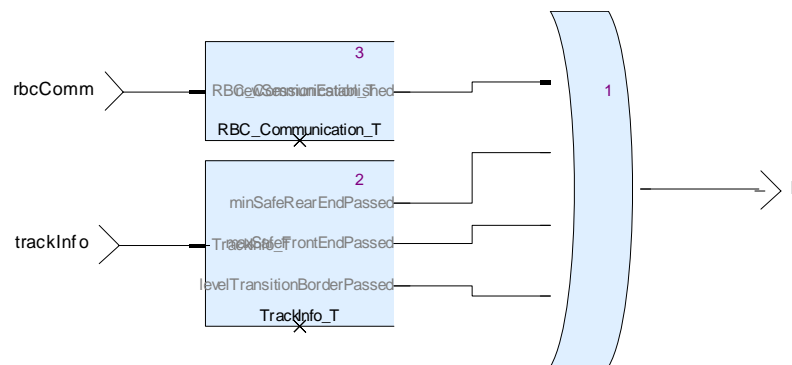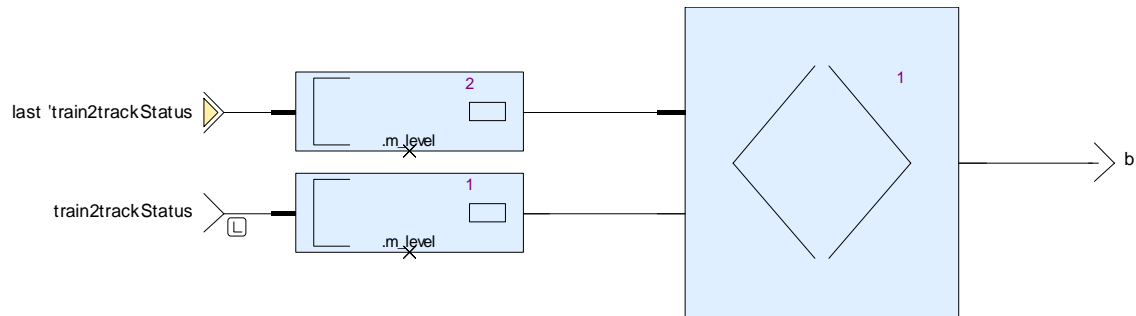### 16.1.18.4.1. View of diagram_op_3_6_5_1_4_j_1 (op_3_6_5_1_4_j)
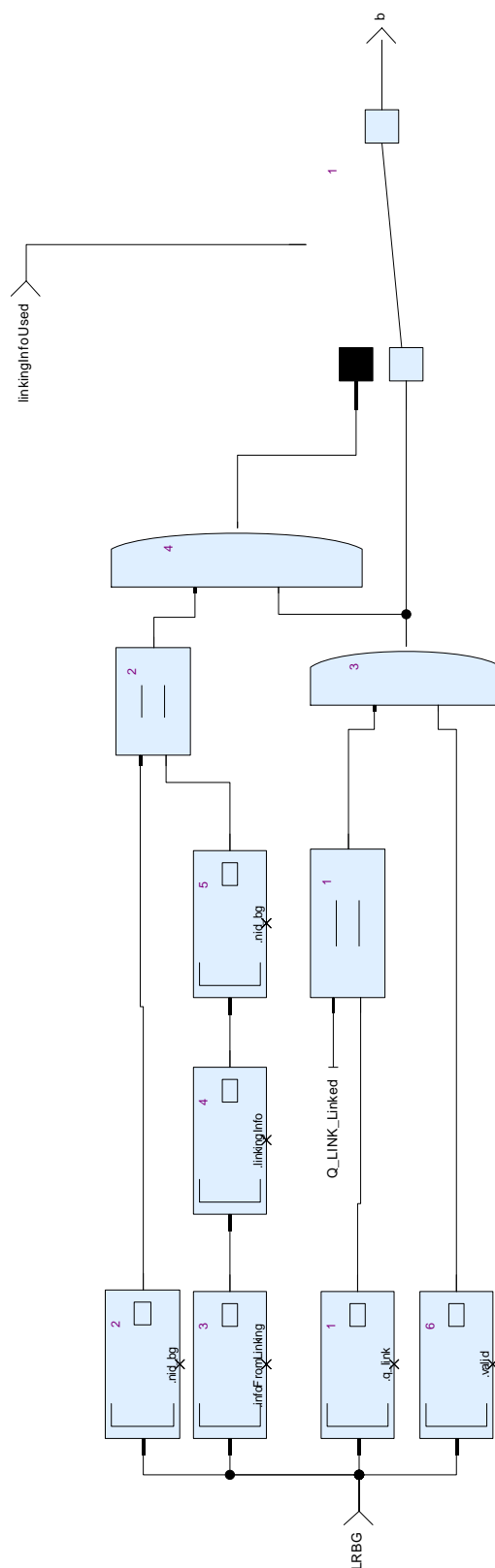

Figure 133: View of diagram_op_3_6_5_1_4_j_1 (op_3_6_5_1_4_j)

16.1.19.   op_D_cycloc Operator

Declared as **public node**

16.1.19.1.   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 goven 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 $\wedge$ D_CYCLOC $\neq$ 32766 $\wedge$ valid $\wedge$ $\neq$ unknownPosition
- $\wedge$ in_state_SimpleCase then write trainPosition into Mem2
- (i.e., at the occurence of a new PositionReportParameter, the current train position is written into Mem2)
- - if $\neg$ present $\wedge$ D_CYCLOC $\neq$ 32766 $\wedge$ valid $\wedge$ $\neq$ unknownPosition $\wedge$
- trainPosition $\geq$ currDistiance + D_CYCLOC $\wedge$ in_state_SimpleCase, then write
- 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 $\neg$ present $\wedge$ D_CYCLOC $\neq$ 32766 $\wedge$ valid $\wedge$ $\neq$ unknownPosition $\wedge$
- 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 he following condition when Mem2 must be written:
- - D_CYCLOC $\neq$ 32766 $\wedge$ valid $\wedge$ $\neq$ unknownPosition $\wedge$ \new in_state_SpecialCase
- $\wedge$ trainPosition $\geq$ input(Mem2) (i.e., we only write currDistance + D_CYCLOC into Mem2 iff it is $\leq$
- the trainPosition))

16.1.19.2.   Interface

Table 346: Inputs of op_D_cycloc

Name	Type	Comments and Information
pRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	
trainPos	TrainPosition_Types_Pck::trainPosition_T	

Table 347: Outputs of op_D_cycloc

Name	Type	Comments and Information
b	bool	

16.1.19.3.   Locals

Table 348: 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			

16.1.19.4.   Operator Hierarchy

<u>diagram</u> : diagram_op_D_cycloc_1

    state-machine : SM1

        state : Init

        state : Intermediate

        state : SimpleCase

        state : SpecialCase

16.1.19.5.   Graphical and Textual Diagrams

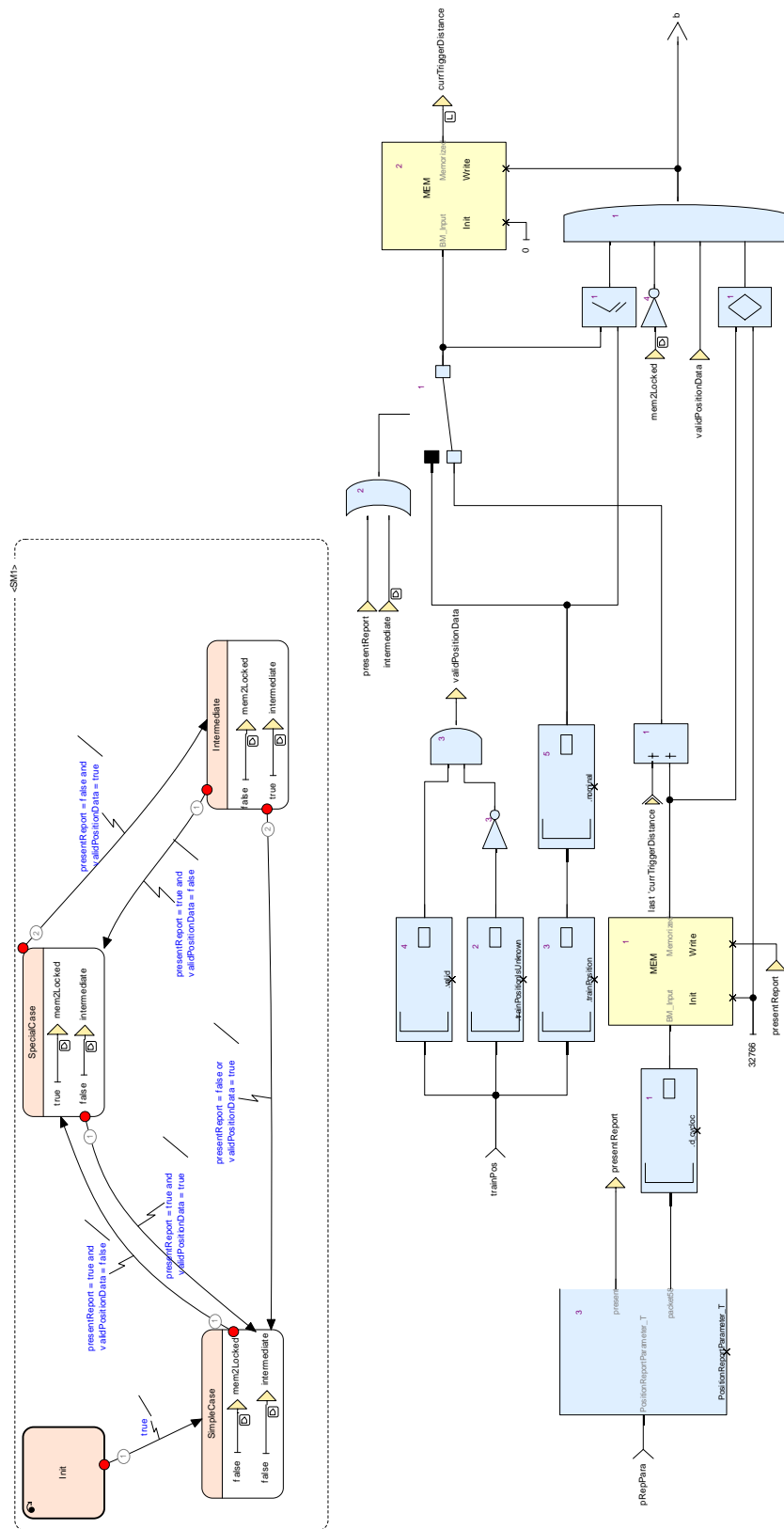### 16.1.19.5.1. View of diagram_op_D_cycloc_1 (op_D_cycloc)

Figure 134: View of diagram_op_D_cycloc_1 (op_D_cycloc)

Table 349: State Machines of diagram_op_D_cycloc_1

State Machine	Comments and Information
SM1	

Table 350: States of diagram_op_D_cycloc_1

State	Comments and Information
SM1:Init	
SM1:Intermediate	
SM1:SimpleCase	
SM1:SpecialCase	

Table 351: Transitions of diagram_op_D_cycloc_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: SM1:Init Target: SM1:SimpleCase	1	Condition: true	
Source: SM1:Intermediate Target: SM1:SpecialCase	1	Condition: presentReport = true and validPositionData = false	
Source: SM1:Intermediate Target: SM1:SimpleCase	2	Condition: presentReport = false or validPositionData = true	
Source: SM1:SimpleCase Target: SM1:SpecialCase	1	Condition: presentReport = true and validPositionData = false	
Source: SM1:SpecialCase Target: SM1:SimpleCase	1	Condition: presentReport = true and validPositionData = true	
Source: SM1:SpecialCase Target: SM1:Intermediate	2	Condition: presentReport = false and validPositionData = true	

16.1.20.   op_DOUBTOVER Operator

Declared as **public function**

16.1.20.1.   Comments and Information

op_DOUBTOVER Comments:

- Calculates L_DOUBTOVER = absolute(estimated front end - min safe front end)

16.1.20.2. Interface

Table 352: Inputs of op_DOUBTOVER

Name	Type	Comments and Information
trainPos	TrainPosition_Types_Pck::trainPosition_T	

Table 353: Outputs of op_DOUBTOVER

Name	Type	Comments and Information
l_doubtover	L_DOUBTOVER	

16.1.20.3. Operator Hierarchy

<u>diagram</u> : diagram_op_DOUBTOVER_1

16.1.20.4. Graphical and Textual Diagrams

16.1.20.4.1. View of diagram_op_DOUBTOVER_1 (op_DOUBTOVER)
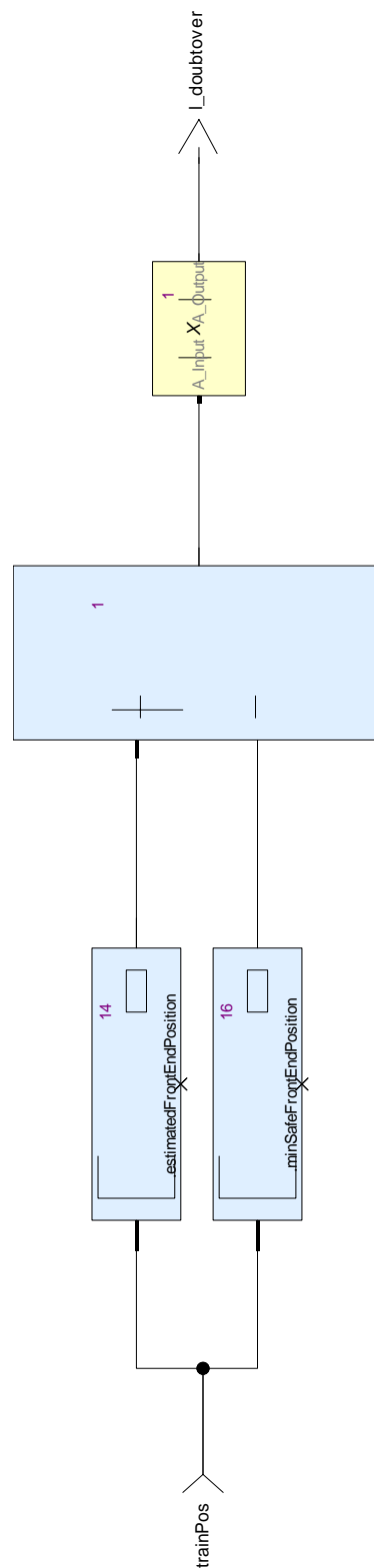

Figure 135: View of diagram_op_DOUBTOVER_1 (op_DOUBTOVER)

16.1.21. op_DOUBTUNDER Operator

Declared as **public function**

16.1.21.1.   Comments and Information

op_DOUBTUNDER Comments:

- Calculates L_DOUBTUNDER = absolute(max safe front end - estimimated front end)

16.1.21.2.   Interface

Table 354: Inputs of op_DOUBTUNDER

Name	Type	Comments and Information
trainPos	TrainPosition_Types_Pck::trainPosition_T	

Table 355: Outputs of op_DOUBTUNDER

Name	Type	Comments and Information
l_doubtunder	L_DOUBTUNDER	

16.1.21.3.   Operator Hierarchy

diagram : diagram_op_DOUBTUNDER_1

16.1.21.4. Graphical and Textual Diagrams

16.1.21.4.1. View of diagram_op_DOUBTUNDER_1 (op_DOUBTUNDER)
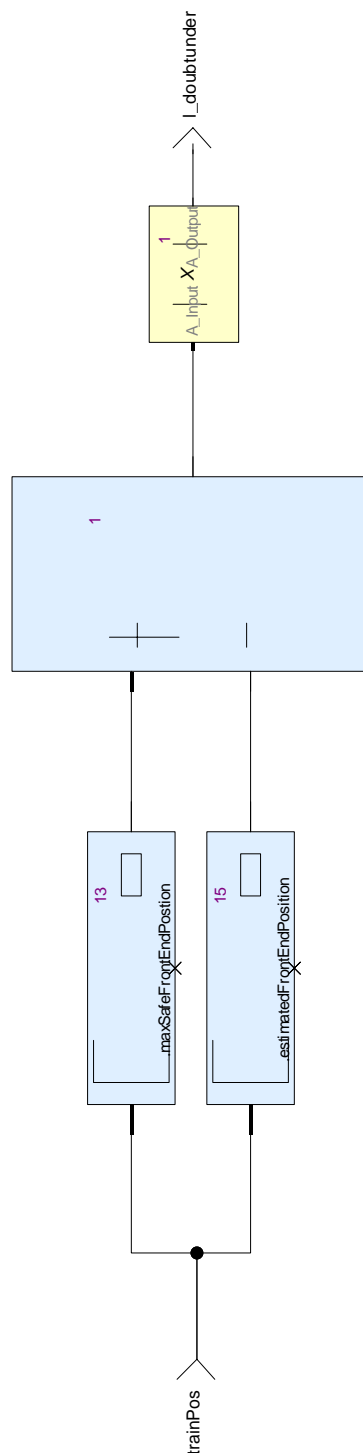

Figure 136: View of diagram_op_DOUBTUNDER_1 (op_DOUBTUNDER)

16.1.22.   op_LRBG Operator

Declared as **public function**

16.1.22.1. Comments and Information

op_LRBG Comments:

- If input data are validate, then D_LRBG = |nominal(trainPosition) - nominal(BG_location)|;
- otherwise unknown is assigned to D_LRBG

16.1.22.2. Interface

Table 356: Inputs of op_LRBG

Name	Type	Comments and Information
posBG	TrainPosition_Types_Pck::positionedBG_T	
trainPos	TrainPosition_Types_Pck::trainPosition_T	

Table 357: Outputs of op_LRBG

Name	Type	Comments and Information
d_lrbg	int	

16.1.22.3. Operator Hierarchy

diagram : diagram_op_LRBG_1

16.1.22.4.   Graphical and Textual Diagrams

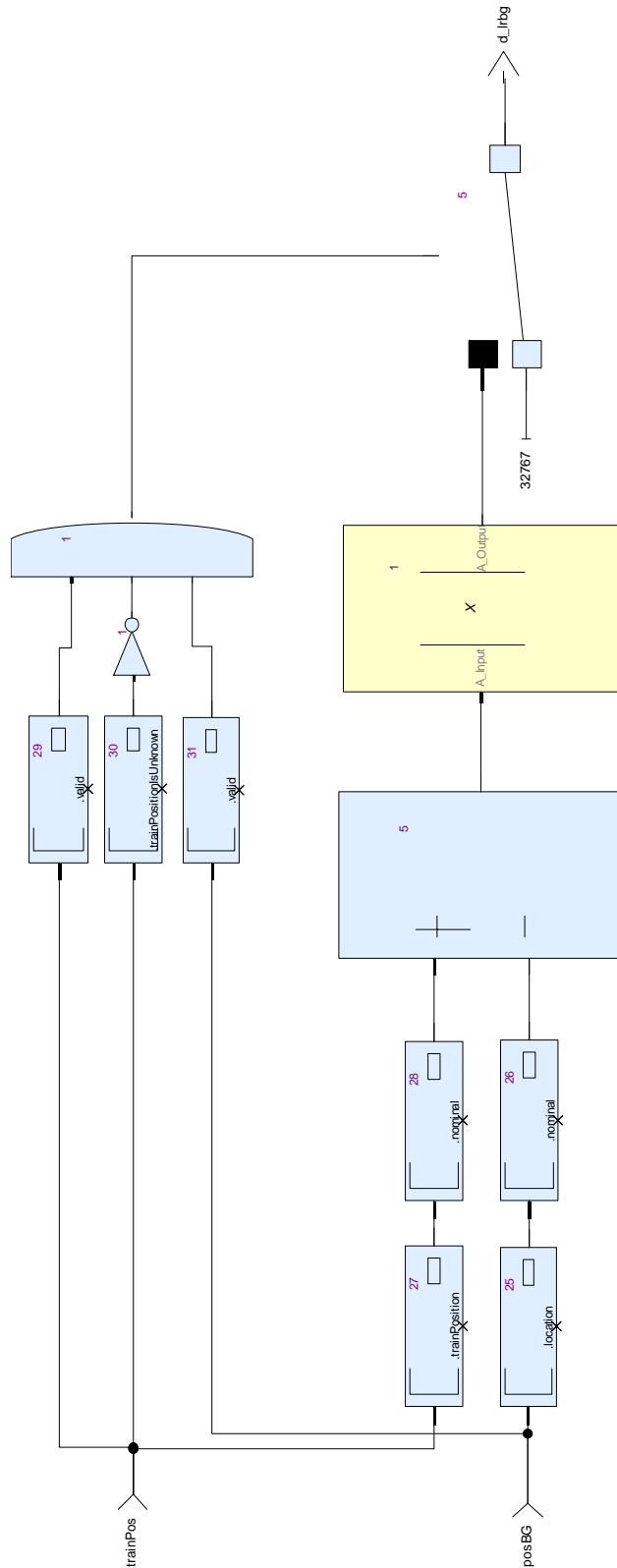### 16.1.22.4.1. View of diagram_op_LRBG_1 (op_LRBG)

Figure 137: View of diagram_op_LRBG_1 (op_LRBG)

16.1.23.   op_M_loc Operator

Declared as **public node**

16.1.23.1.   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.

16.1.23.2.   Interface

Table 358: Inputs of op_M_loc

Name	Type	Comments and Information
pRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	
posBGs	TrainPosition_Types_Pck::positionedBG_T	
linkingInfoUsed	ProvidePositionReport_Pkg::LinkingInfoUsedOnBoard	

Table 359: Outputs of op_M_loc

Name	Type	Comments and Information
b	bool	

16.1.23.3.   Operator Hierarchy

<u>diagram</u> : diagram_op_M_loc_1

16.1.23.4. Graphical and Textual Diagrams

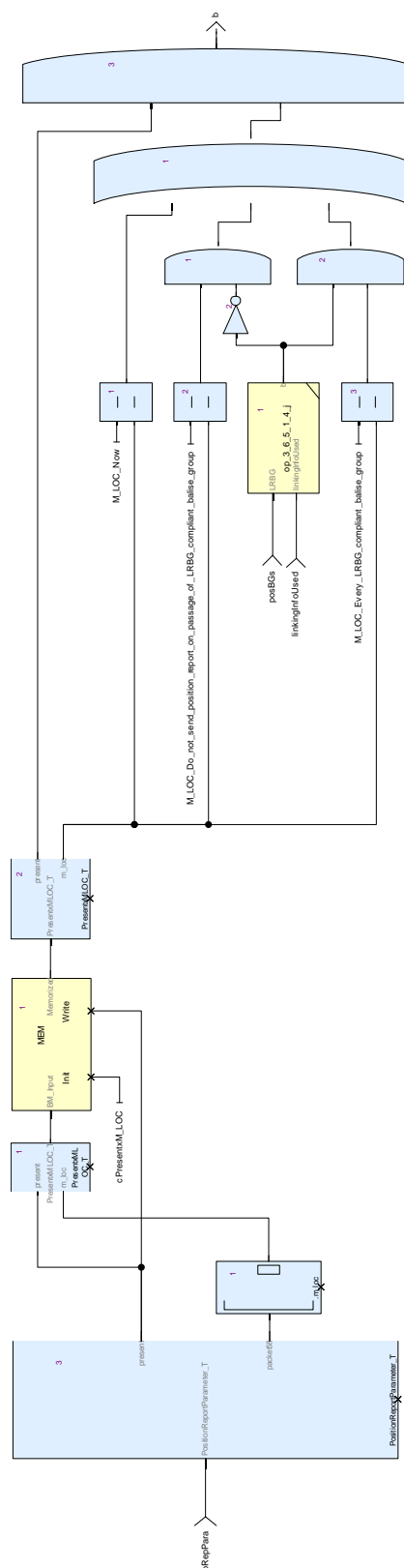### 16.1.23.4.1. View of diagram_op_M_loc_1 (op_M_loc)

Figure 138: View of diagram_op_M_loc_1 (op_M_loc)

16.1.24.   op_N_iter Operator

Declared as **public function**

16.1.24.1.   Interface

Table 360: Inputs of op_N_iter

Name	Type	Comments and Information
trainPosition	TrainPosition_Types_Pck::trainPosition_T	
pRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	

Table 361: Outputs of op_N_iter

Name	Type	Comments and Information
b	bool	

16.1.24.2.   Operator Hierarchy

<u>diagram</u> : diagram_op_N_iter_1

16.1.24.3.   Graphical and Textual Diagrams

16.1.24.3.1. View of diagram_op_N_iter_1 (op_N_iter)

Figure 139: View of diagram_op_N_iter_1 (op_N_iter)

16.1.25.   op_prepack_0 Operator

Declared as **public function**

16.1.25.1.   Interface

Table 362: 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::positionedBG_T	

Table 363: Outputs of op_prepack_0

Name	Type	Comments and Information
valid	bool	
posRep	TrainToTrack::Position_Report	

16.1.25.2.   Operator Hierarchy

<u>diagram</u> : diagram_op_prepack_0_1

16.1.25.3.   Graphical and Textual Diagrams

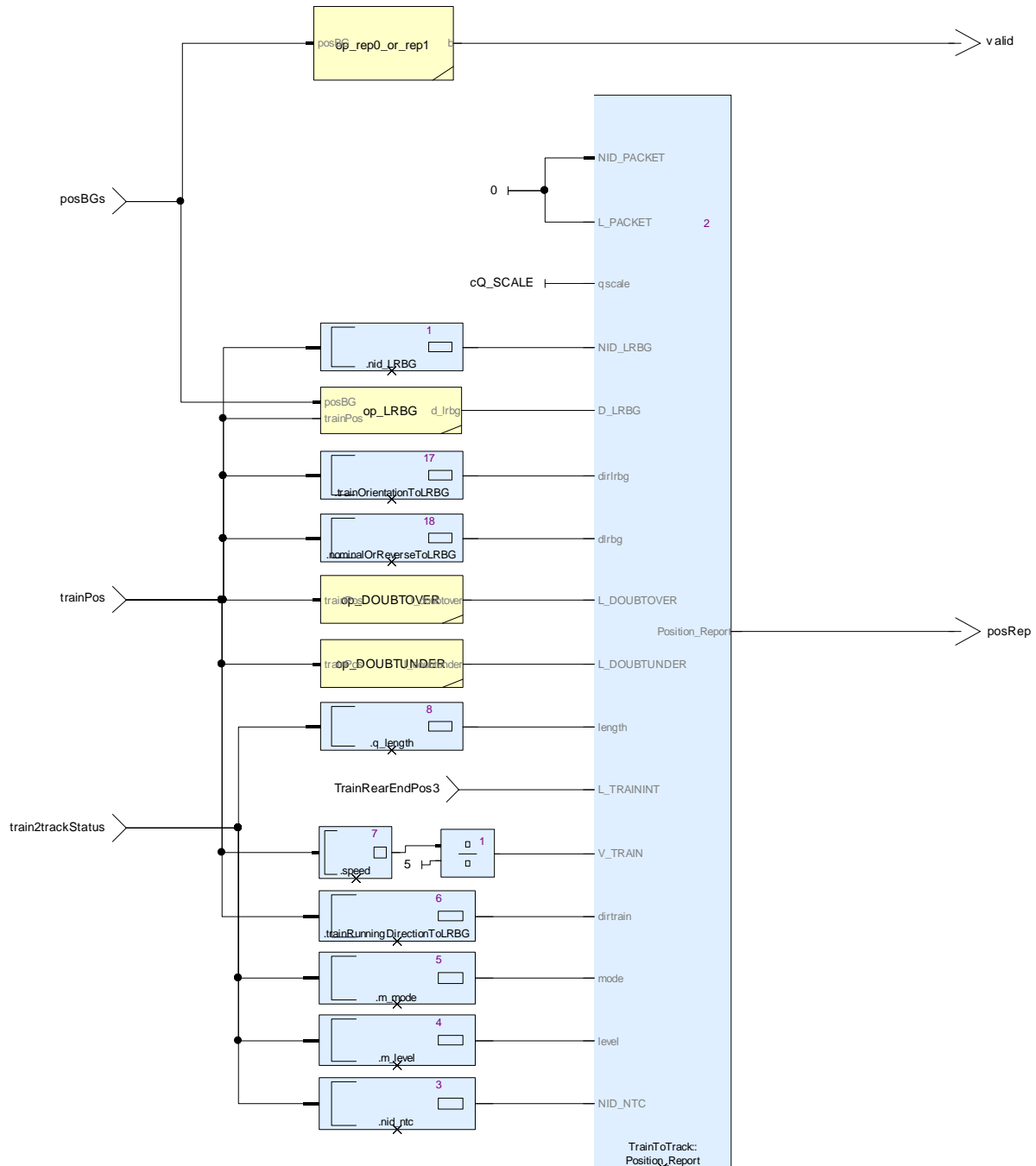#### 16.1.25.3.1. View of diagram_op_prepack_0_1 (op_prepack_0)

Figure 140: View of diagram_op_prepack_0_1 (op_prepack_0)

16.1.26.   op_rep0_or_rep1 Operator

Declared as **public function**

16.1.26.1. Comments and Information

op_rep0_or_rep1 Comments:

- 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.

16.1.26.2.   Interface

Table 364: Inputs of op_rep0_or_rep1

Name	Type	Comments and Information
posBG	TrainPosition_Types_Pck::positionedBG_T	

Table 365: Outputs of op_rep0_or_rep1

Name	Type	Comments and Information
b	bool	

16.1.26.3.   Operator Hierarchy

<u>diagram</u> : diagram_op_rep0_or_rep1_1

16.1.26.4.   Graphical and Textual Diagrams

16.1.26.4.1. View of diagram_op_rep0_or_rep1_1 (op_rep0_or_rep1)
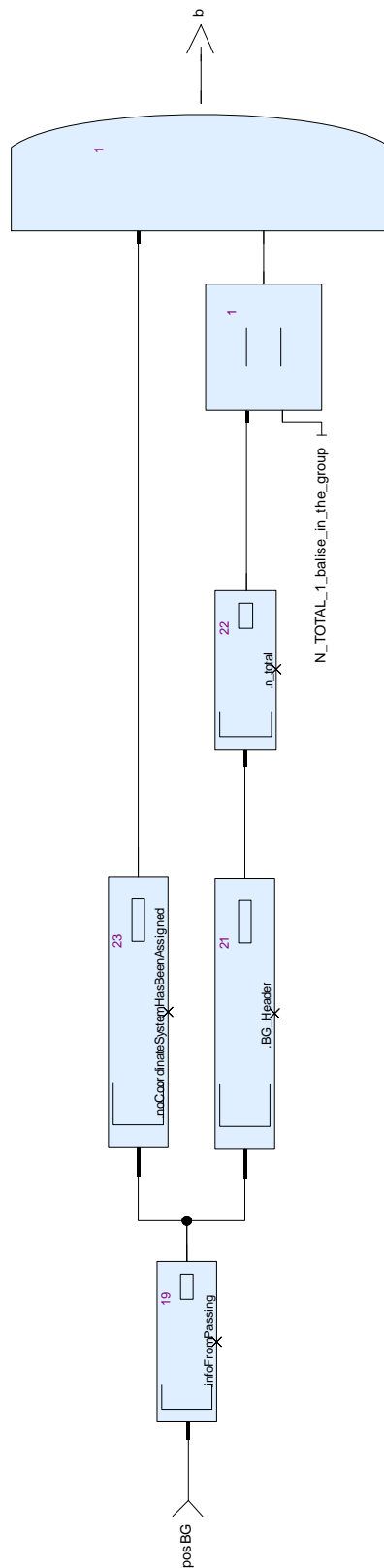

Figure 141: View of diagram_op_rep0_or_rep1_1 (op_rep0_or_rep1)

16.1.27.   op_T_cycloc Operator

Declared as **public node**

16.1.27.1.   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.

16.1.27.2.   Interface

Table 366: Inputs of op_T_cycloc

Name	Type	Comments and Information
pRepPara	ProvidePositionReport_Pkg::PositionReportParameter_T	
systemTime	ProvidePositionReport_Pkg::SystemTime_T	

Table 367: Outputs of op_T_cycloc

Name	Type	Comments and Information
b	bool	

16.1.27.3.   Locals

Table 368: Locals of op_T_cycloc

Name	Type	Properties		Comments and Information
Local1	int	last	0	

16.1.27.4.   Operator Hierarchy

diagram : diagram_op_T_cycloc_1

16.1.27.5.   Graphical and Textual Diagrams

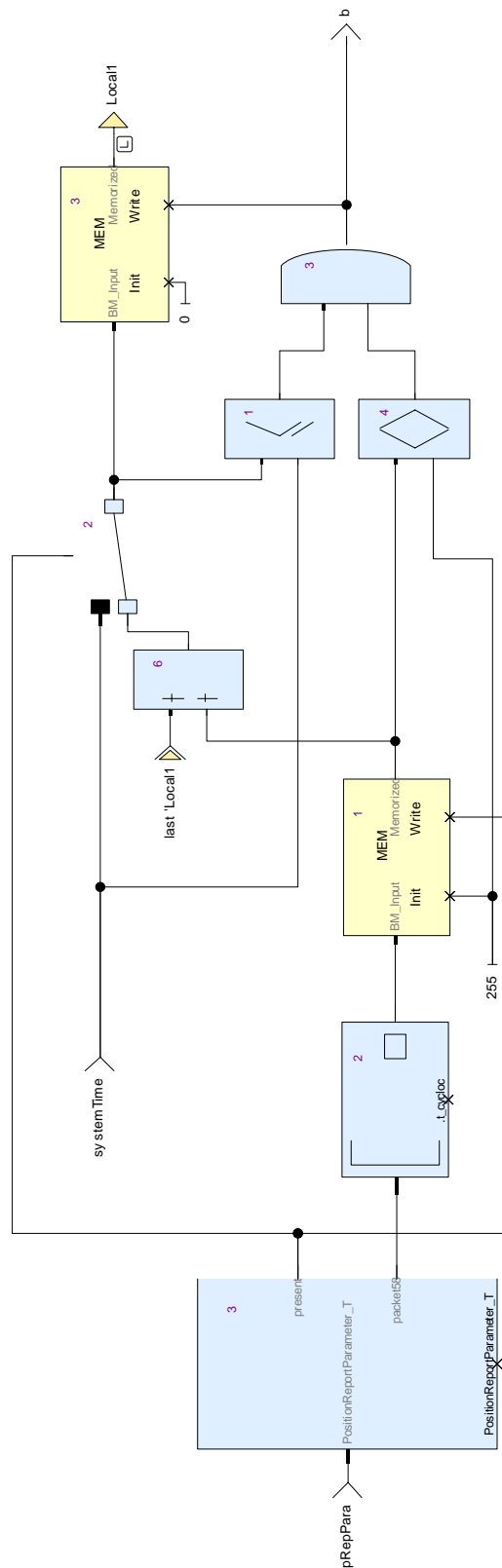### 16.1.27.5.1. View of diagram_op_T_cycloc_1 (op_T_cycloc)

Figure 142: View of diagram_op_T_cycloc_1 (op_T_cycloc)

16.1.28.   ProvidePositionReport Operator

Declared as **public node**

16.1.28.1.   Comments and Information

ProvidePositionReport Comments:

- Assumption: BGs in PositionedBGs_T are ordered with the last seen BG being the first element of the arry.

16.1.28.2.   Interface

Table 369: Inputs of ProvidePositionReport

Name	Type	Comments and Information
posBGs	TrainPosition_Types_Pck::positionedBGs_T	
trainPos	TrainPosition_Types_Pck::trainPosition_T	
trainProps	TrainPosition_Types_Pck::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	

Table 370: Outputs of ProvidePositionReport

Name	Type	Comments and Information
posRep	ProvidePositionReport_Pkg::PositionReport_T	

16.1.28.3.   Operator Hierarchy

diagram : diagram_ProvidePositionReport_1

16.1.28.4.   Graphical and Textual Diagrams

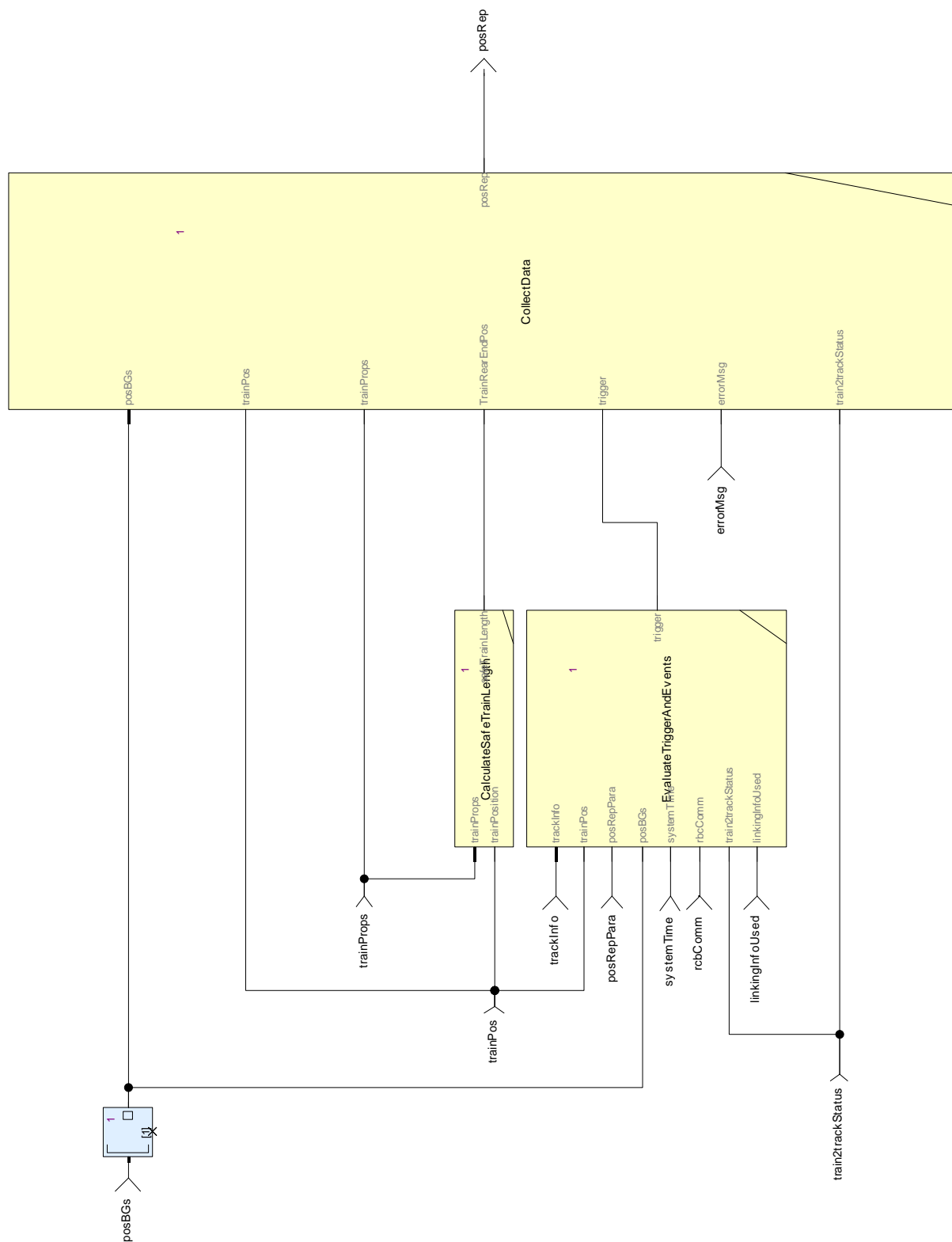### 16.1.28.4.1. View of diagram_ProvidePositionReport_1 (ProvidePositionReport)

Figure 143: View of diagram_ProvidePositionReport_1 (ProvidePositionReport)

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17. Project Library: ValidateDataDirection

17.1.   ValidateDataDirection_Pkg Package

17.1.1.   validateDataDirection Operator

Declared as **public function**

17.1.1.1.   Interface

Table 371: Inputs of validateDataDirection

Name	Type	Comments and Information
passedBG_in	BG_Types_Pkg::passedBG_T	Comments: Input event reporting a balise group during its passage, if there is one.
LRBG	TrainPosition_Types_Pck::positionedBG_T	Comments: The LRBG used for RBC communication.
trainPosition	TrainPosition_Types_Pck::trainPosition_T	Comments: The resulting train position with reference to the LRBG

Table 372: Outputs of validateDataDirection

Name	Type	Comments and Information
passedBG_out	BG_Types_Pkg::passedBG_T	Comments: Input event reporting a balise group during its passage, if there is one.

17.1.1.2.   Operator Hierarchy

<u>diagram</u> : diagram_validateDataDirection_1

17.1.1.3.   Graphical and Textual Diagrams

17.1.1.3.1.   View of diagram_validateDataDirection_1 (validateDataDirection)
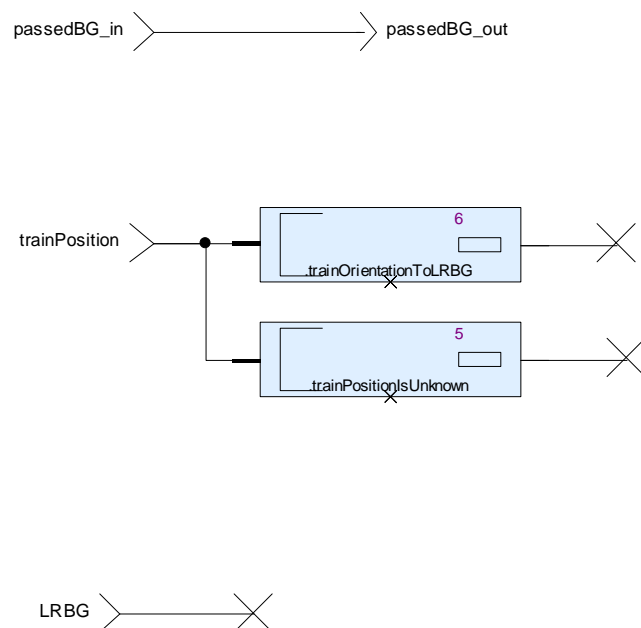

Figure 144: View of diagram_validateDataDirection_1 (validateDataDirection)

End of document.

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