<document classification>

openETCS / UNISIG Subset-026-3.6

Calculate the balise group locations and the actual train position

Summary:
<summary>

Company: Siemens AG
Authors: Uwe Steinke
Reference: UNISIG Subset026-3.6 “Location principles, train position and train orientation”
Index: Version No 00.20.00
Date: 2014-12-09

Distribution List: <distribution list>

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1. General Project Description

This model serves to determine the train location information as specified in Subset026-3.6 “Location principles, train position and train orientation”.
It receives the information from passed balise groups including linking information and location references and makes up a list of balise groups in front of the train and calculates the actual position of the train and it's orientation, related to the “Last relevant balise group” LRBG.
During a train trip, it receives odometry data and keeps on track with passed balise groups and so determines the acual train position.

The idea of the chosen solution is based on a “nominal location” starting with value 0 when the OBU is switched on. All distances announced by linking information are mapped to their appropriate nominal location by signed additions of the distances.

The top level of this model is represented by the node “calculateTrainPosition” (see 3.1.6 in this document) .

D3.6 Location Principles, Train Position and Train Orientation.

- Name: CalculateTrainPosition.etp
- Description: SUBSET-026-3, ISSUE : 3.3.0, 3.6 “Determine Train Location Information”

- 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 CalculateTrainPosition
    CalculateTrainPosition_Pkg
        BG_relocation_Pkg
        BG_utilities_Pkg
        gp_functions_Pkg
        Pos_Pkg

Project Library BasicLocationFunctions
    BasicLocationFunctions_Pkg

Project Library BG_Types
    BG_Types_Pkg
    Packet_Types_Pkg
    Radio_Types_Pkg

Project Library Obu_BasicTypes
    Obu_BasicTypes_Pkg

Project Library TrainPosition_Types
    TrainPosition_Types_Pck

2.2. Call Graph

This Call Graph displays the dependency tree of model operators.

1. CalculateTrainPosition_Pkg::BG_utilities_Pkg::deleteBGs_fromIndex
    1.1. CalculateTrainPosition_Pkg::BG_utilities_Pkg::deleteBGs_fromIndex_itr
2. CalculateTrainPosition_Pkg::BG_utilities_Pkg::mergeBGs_by_id
    2.1. CalculateTrainPosition_Pkg::BG_utilities_Pkg::mergeBGs_by_id_itr
        2.1.1. CalculateTrainPosition_Pkg::BG_utilities_Pkg::mergeBG_by_id
            2.1.1.1. CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfBG_by_id
                2.1.1.1.1. CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfBG_by_id_itr
                    2.1.1.1.1.1. CalculateTrainPosition_Pkg::BG_utilities_Pkg::positionedBGs_ids_equal
                        2.1.1.1.1.1.1. CalculateTrainPosition_Pkg::BG_utilities_Pkg::nidBG_nidc_equal
3. CalculateTrainPosition_Pkg::BG_utilities_Pkg::passedBGs_ids_equal
    3.1. CalculateTrainPosition_Pkg::BG_utilities_Pkg::nidBG_nidc_equal
4. CalculateTrainPosition_Pkg::calculateTrainPosition
    4.1. CalculateTrainPosition_Pkg::calculateBGLocations
        4.1.1. CalculateTrainPosition_Pkg::BG_relocation_Pkg::improve_BG_locations
            4.1.1.1. CalculateTrainPosition_Pkg::BG_relocation_Pkg::improveUnlinkedBGLocations
                4.1.1.1.1.

4.1.3.2.1.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::deleteBG_atIndex_itr
4.1.3.2.2.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfBG_by_id
4.1.3.2.2.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfBG_by_id_itr
4.1.3.2.2.1.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::positionedBGs_ids_equal
4.1.3.2.2.1.1.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::nidBG_nidc_equal
4.1.3.2.3.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfBG_onTrack
4.1.3.2.3.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfBG_onTrack_itr
4.1.3.2.3.2.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::positionedBGs_ids_equal
4.1.3.2.3.2.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::nidBG_nidc_equal
4.1.3.2.4.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::insertBG_atIndex
4.1.3.2.4.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::insertBG_atIndex_itr
4.1.3.2.4.2.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::positionedBGs_ids_equal
4.1.3.2.4.2.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::nidBG_nidc_equal
4.1.3.3.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::mergeBGs_onTrack
4.1.3.3.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::mergeBGs_onTrack_itr
4.1.3.3.1.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::mergeBG_onTrack
4.1.3.3.1.1.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::deleteBG_atIndex
4.1.3.3.1.1.1.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::deleteBG_atIndex_itr
4.1.3.3.1.1.2.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfBG_by_id
4.1.3.3.1.1.2.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfBG_by_id_itr
4.1.3.3.1.1.2.1.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::positionedBGs_ids_equal
4.1.3.3.1.1.2.1.1.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::nidBG_nidc_equal
4.1.3.3.1.1.3.
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4.1.3.3.1.1.3.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfBG_onTrack_itr
4.1.3.3.1.1.3.2.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::positionedBGs_ids_equal
4.1.3.3.1.1.3.2.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::nidBG_nidc_equal

3. CalculateTrainPosition Project

3.1. CalculateTrainPosition_Pkg Package

3.1.1. Comments and Information

CalculateTrainPosition_Pkg Comments:

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

Table 1: 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/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

3.1.2. Types

Table 2: Public Types of CalculateTrainPosition_Pkg

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

3.1.3. Constants

Table 3: 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, q_dir : Q_DIR_Reverse, 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, bgPosition : {valid : false, timestamp : 0, odo : {o_nominal : 0, o_min : 0, o_max : 0}, speed : 0, acceleration : 0, motionState : Obu_BasicTypes_Pkg::noMotion, motionDirection : Obu_BasicTypes_Pkg::unknownDirection}, BG_centerDetection Inaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, q_nvlocacc : 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_total : N_TOTAL_1_balise_in_the_group, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, linkedBGs : [{valid : false, nid_LRBG : 0, q_dir : Q_DIR_Reverse, 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, q_dir : Q_DIR_Reverse, 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, q_dir : Q_DIR_Reverse, 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, bgPosition : {valid : false, timestamp : 0, odo : {o_nominal : 0, o_min : 0, o_max : 0}, speed : 0, acceleration : 0, motionState : Obu_BasicTypes_Pkg::noMotion, motionDirection : Obu_BasicTypes_Pkg::unknownDirection}, BG_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, q_nvlocacc : 0, BG_Header : {q_updown : Q_UPDOWN_Down_link_telegram, m_version : M_VERSION_Previo	

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, q_dir : Q_DIR_Reverse, 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, bgPosition : {valid : false, timestamp : 0, odo : {o_nominal : 0, o_min : 0, o_max : 0}, speed : 0, acceleration : 0, motionState : Obu_BasicTypes_Pkg::noMotion, motionDirection : Obu_BasicTypes_Pkg::unknownDirection}, BG_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, q_nvlocacc : 0, BG_Header : {q_updown : Q_UPDOWN_Down_link_telegram, m_version : M_VERSION_Previo	

Name	Type	Value	Comments and Information
cNoPositionErrors	TrainPosition_Types_Pck::positionErrors_T	{outOfMemSpace : false, passedBG_notFoundWhereExpected : false, positionCalculation_inconsistent : false, BG_LinkingConsistencyError : false, DoubleLinkingError : false, DoubleRepositioningError : false}	
cNoValidIndex	int	-1	Comments: An invalid index.

Name	Type	Value	Comments and Information
		{valid : false, timestamp : 0, trainPositionIsUnknown : false, noCoordinateSystemHasBeenAssigned : false, trainPosition : {nominal : 0, d_min : 0, d_max : 0}, estimatedFrontEndPosition : 0, minSafeFrontEndPosition : 0, maxSafeFrontEndPostion : 0, LRBG : {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, q_dir : Q_DIR_Reverse, 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, bgPosition : {valid : false, timestamp : 0, odo : {o_nominal : 0, o_min : 0, o_max : 0}, speed : 0, acceleration : 0, motionState : Obu_BasicTypes_Pk	

3.1.4. calculateBGLocations Operator

Declared as **`private node`**

3.1.4.1. Comments and Information

calculateBGLocations Comments:

- Calculation of the locations of passed and announced BGs

Table 4: 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
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

3.1.4.2. Interface

Table 5: Inputs of calculateBGLocations

Name	Type	Properties	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.

Name	Type	Properties	Comments and Information
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	Comments: The trains properties required for train position calculation.

Table 6: 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	

3.1.4.3. Locals

Table 7: Locals of calculateBGLocations

Name	Type	Comments and Information
outOfMemSpace	bool	
passedBG_notFoundWhereExpected	bool	

3.1.4.4. Operator Hierarchy

diagram : diagram_errorReporting
diagram : diagram_passing_a_BG

3.1.4.5. Graphical and Textual Diagrams

3.1.4.5.1. View of diagram_errorReporting (calculateBGLocations)

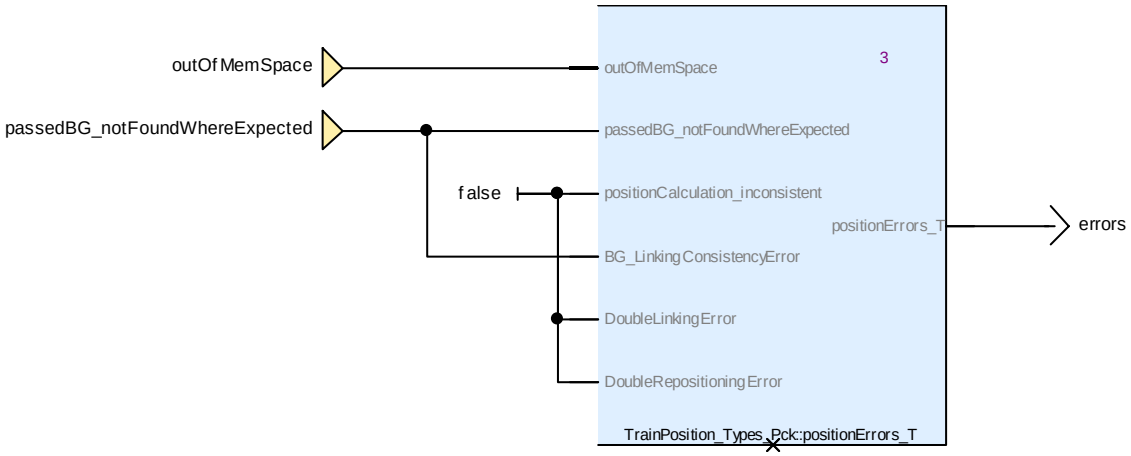

Figure 1: View of diagram_errorReporting (calculateBGLocations)

3.1.4.5.2. View of diagram_passing_a_BG (calculateBGLocations)

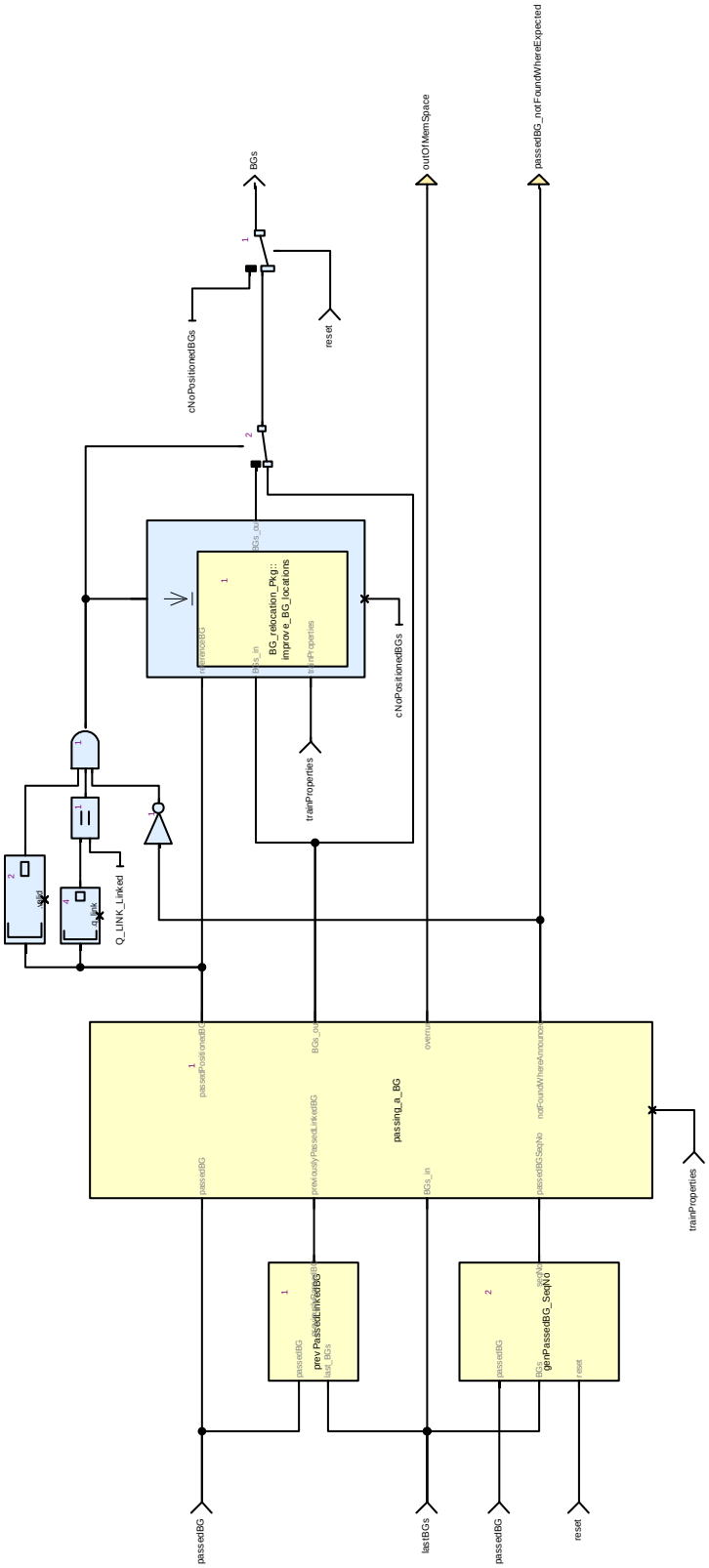

Figure 2: View of diagram_passing_a_BG (calculateBGLocations)

3.1.5. calculateTrainPosition Operator

Declared as **`public node`**

3.1.5.1. Comments and Information

calculateTrainPosition Comments:

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

Table 8: 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/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

3.1.5.2. Interface

Table 9: Inputs of calculateTrainPosition

Name	Type	Properties	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.
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 10: Outputs of calculateTrainPosition

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

3.1.5.3. Locals

Table 11: Locals of calculateTrainPosition

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

3.1.5.4. Operator Hierarchy

diagram : diagram_calculateTrainPosition

3.1.5.5. Graphical and Textual Diagrams

3.1.5.5.1. View of diagram_calculateTrainPosition (calculateTrainPosition)

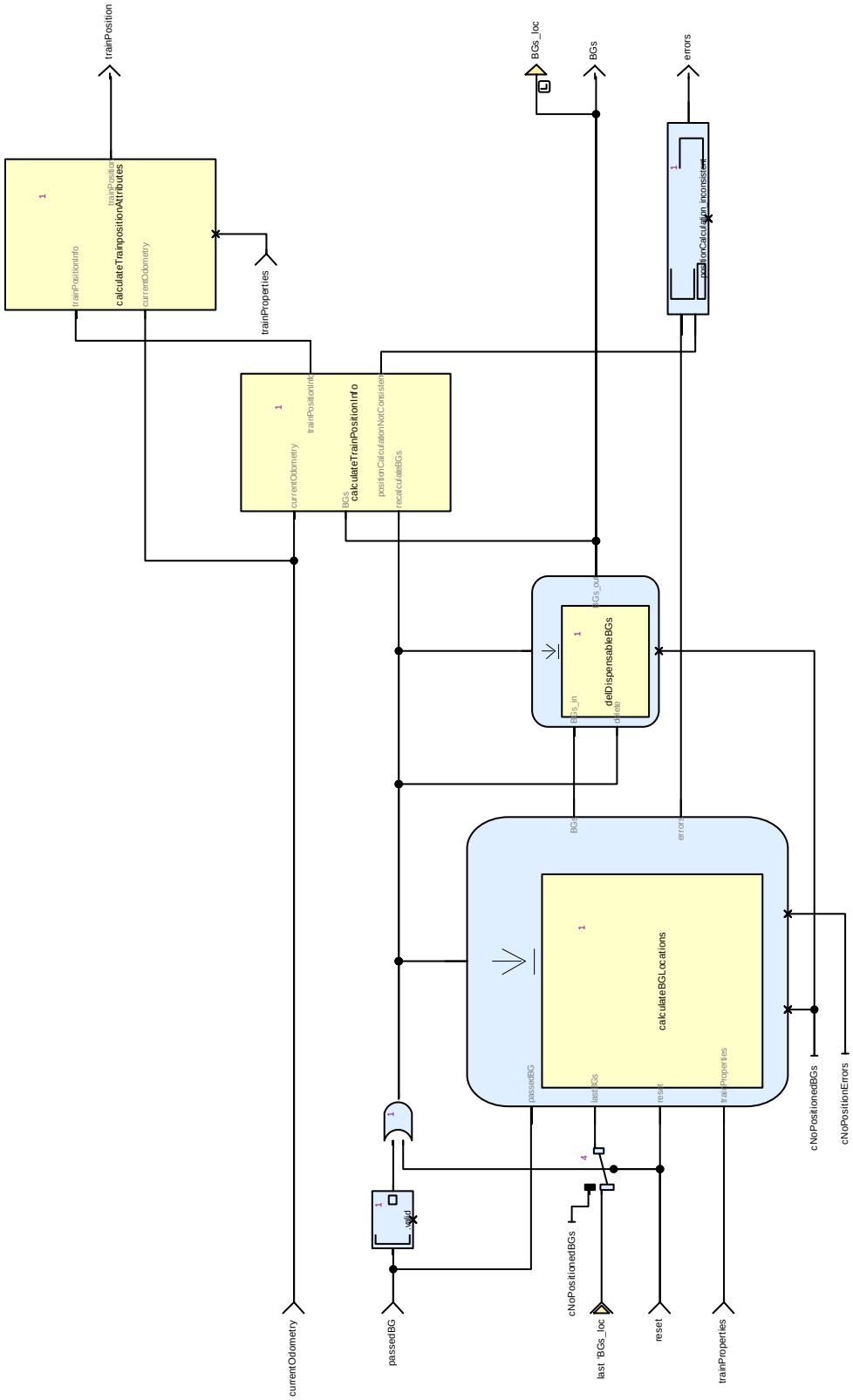

Figure 3: View of diagram_calculateTrainPosition (calculateTrainPosition)

3.1.6. calculateTrainpositionAttributes Operator

Declared as **`private node`**

3.1.6.1. Comments and Information

calculateTrainpositionAttributes Comments:

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

Table 12: 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

3.1.6.2. Interface

Table 13: Inputs of calculateTrainpositionAttributes

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

Table 14: Outputs of calculateTrainpositionAttributes

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

3.1.6.3. Locals

Table 15: Locals of calculateTrainpositionAttributes

Name	Type	Comments and Information
LRBG_loc	TrainPosition_Types_Pck::positionedBG_T	

3.1.6.4. Operator Hierarchy

diagram : diagram_calculateTrainpositionAttributes

3.1.6.5. Graphical and Textual Diagrams

3.1.6.5.1. View of diagram_calculateTrainpositionAttributes (calculateTrainpositionAttributes)

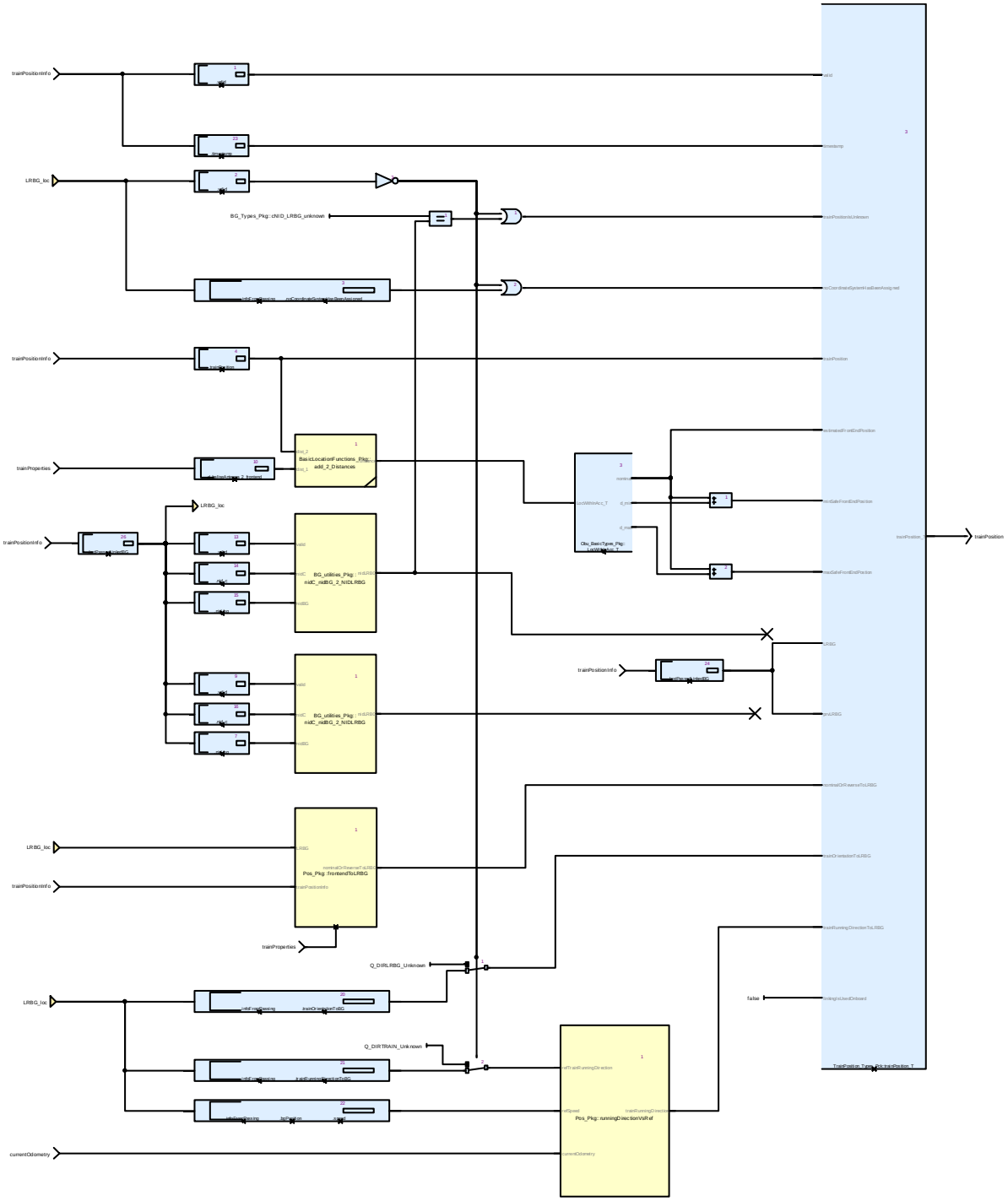

Figure 4: View of diagram_calculateTrainpositionAttributes (calculateTrainpositionAttributes)

3.1.7. calculateTrainPositionInfo Operator

Declared as **`private node`**

3.1.7.1. Comments and Information

calculateTrainPositionInfo Comments:

- Provides the train position information.

3.1.7.2. Interface

Table 16: 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 17: 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.
positionCalculationNotConsistent	bool	

3.1.7.3. Operator Hierarchy

diagram : diagram_calculateTrainPositionInfo_1

3.1.7.4. Graphical and Textual Diagrams

3.1.7.4.1. View of diagram_calculateTrainPositionInfo_1 (calculateTrainPositionInfo)

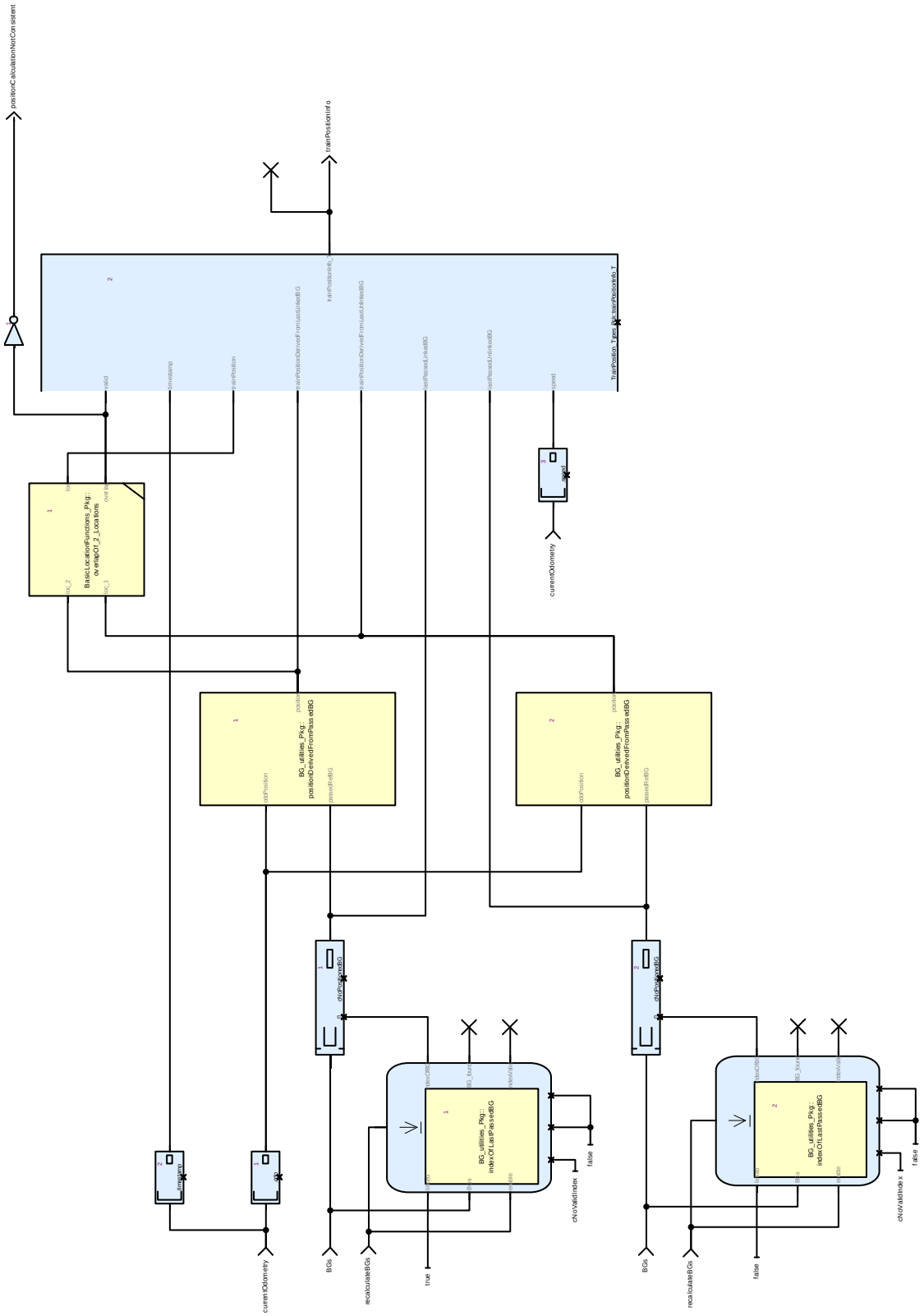

Figure 5: View of diagram_calculateTrainPositionInfo_1 (calculateTrainPositionInfo)

3.1.8. delDispensableBGs Operator

Declared as **`private function`**

3.1.8.1. 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.

3.1.8.2. Interface

Table 18: 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 19: 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.

3.1.8.3. Locals

Table 20: Locals of delDispensableBGs

Name	Type	Comments and Information
passedLinkedBGsCount	int	
passedUnlinkedBGsCount	int	

3.1.8.4. Operator Hierarchy

diagram : diagram_delDispensableBGs_1
activate if : IfBlock1
branch : then
branch : else

3.1.8.5. Graphical and Textual Diagrams

3.1.8.5.1. View of diagram_delDispensableBGs_1 (delDispensableBGs)

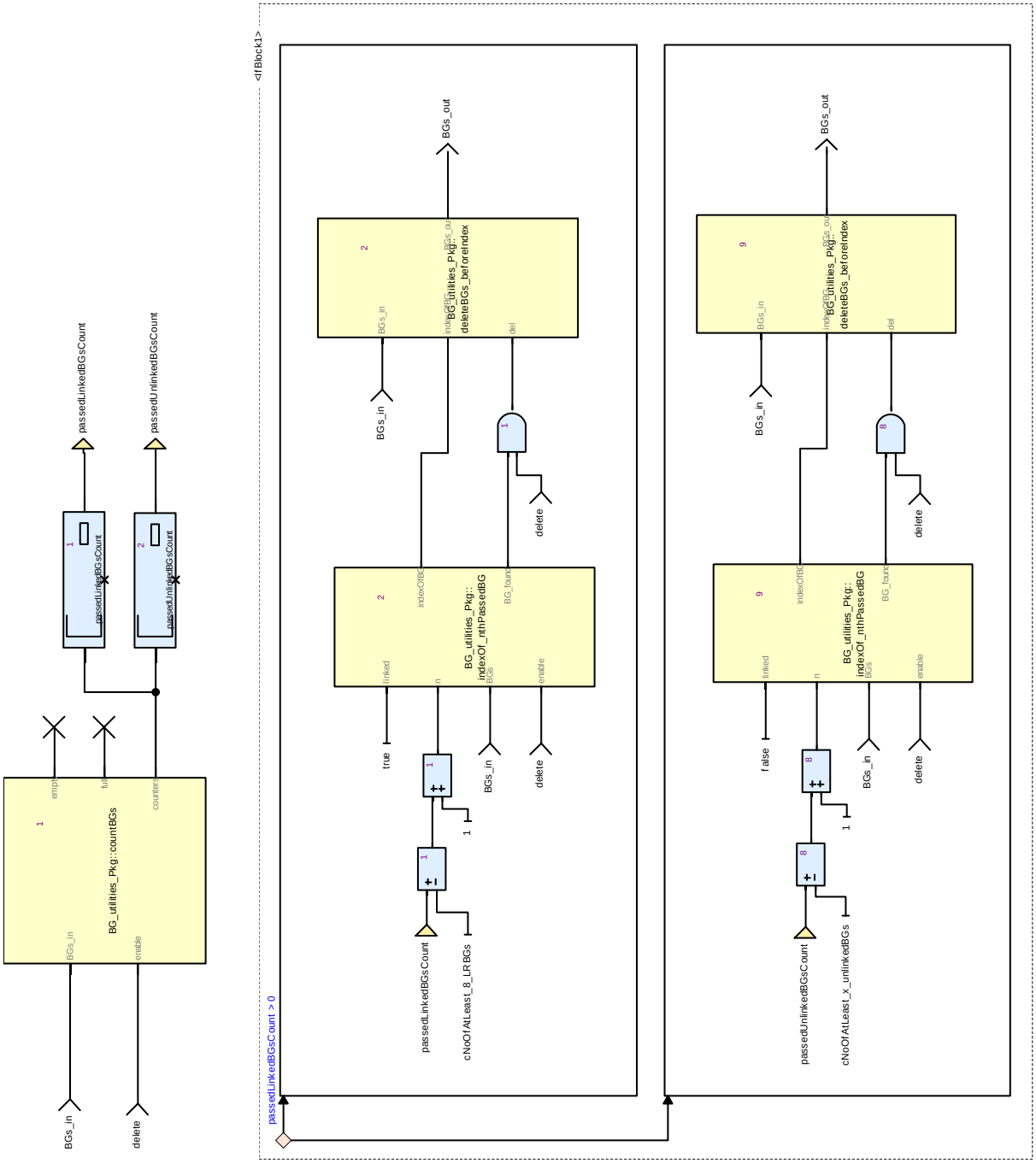

Figure 6: View of diagram_delDispensableBGs_1 (delDispensableBGs)

Table 21: Conditional Blocks of diagram_delDispensableBGs_1

Conditional Block	Comments and Information
IfBlock1	

Table 22: Actions of diagram_delDispensableBGs_1

Conditional Block Action	Comments and Information
IfBlock1:then	

Conditional Block Action	Comments and Information
IfBlock1:else	

3.1.9. genPassedBG_SeqNo Operator

Declared as **`private node`**

3.1.9.1. 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.

3.1.9.2. Interface

Table 23: 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 24: Outputs of genPassedBG_SeqNo

Name	Type	Comments and Information
seqNo	int	

3.1.9.3. Locals

Table 25: Locals of genPassedBG_SeqNo

Name	Type	Comments and Information
incrPassedBGSeqNo	bool	
keepPassedBGSeqNo	bool	

3.1.9.4. Operator Hierarchy

diagram : diagram_genPassedBG_SeqNo_1

3.1.9.5. Graphical and Textual Diagrams

3.1.9.5.1. View of diagram_genPassedBG_SeqNo_1 (genPassedBG_SeqNo)

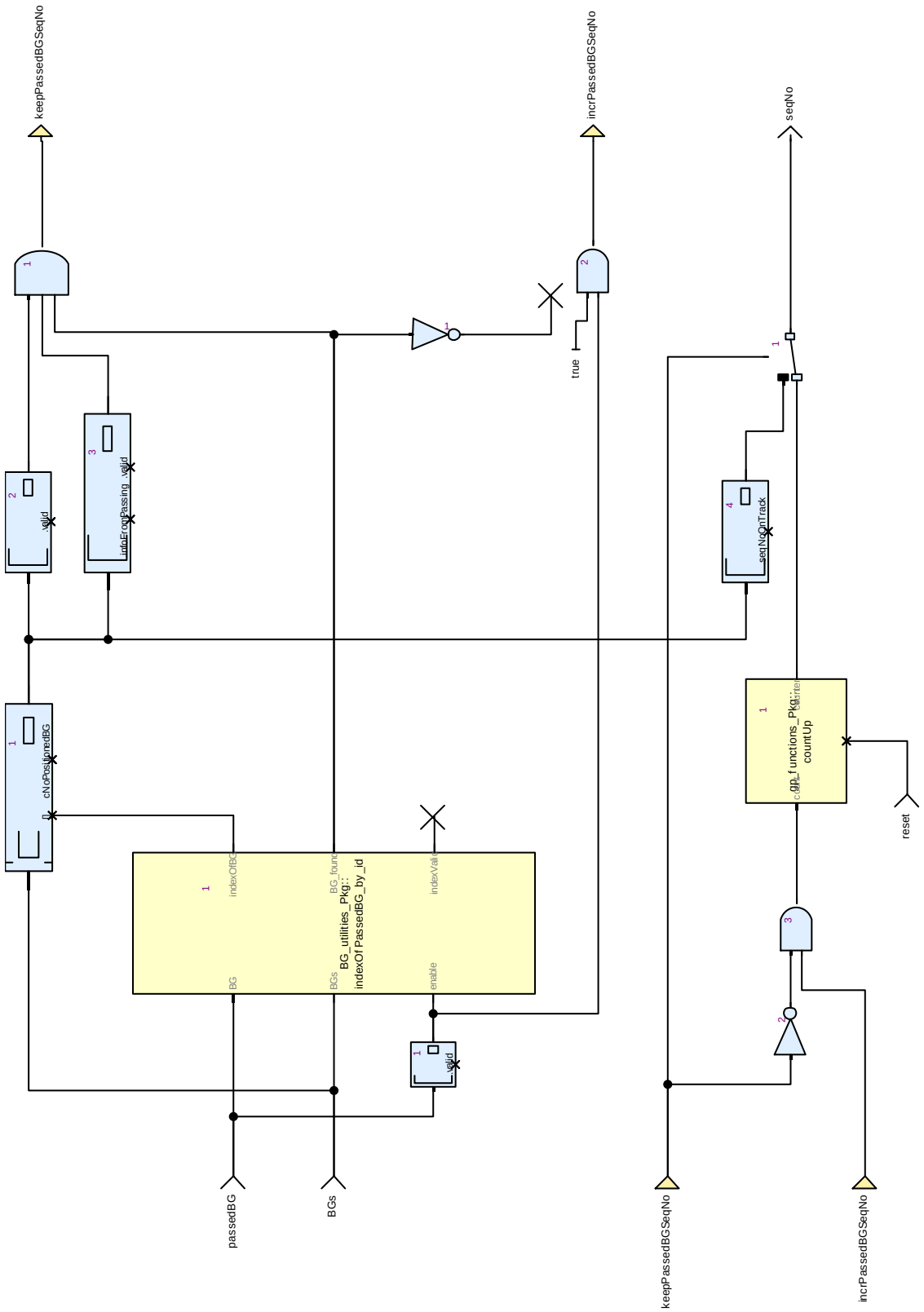

Figure 7: View of diagram_genPassedBG_SeqNo_1 (genPassedBG_SeqNo)

3.1.10. memPassedBG Operator

Declared as **`private node`**

3.1.10.1. Comments and Information

memPassedBG Comments:

- Memorizes the passed linked and unlinked BG

Table 26: 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

3.1.10.2. Interface

Table 27: 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 28: 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	

3.1.10.3. Locals

Table 29: Locals of memPassedBG

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

3.1.10.4. Operator Hierarchy

diagram : diagram_memPassedBG_1

3.1.10.5. Graphical and Textual Diagrams

3.1.10.5.1. View of diagram_memPassedBG_1 (memPassedBG)

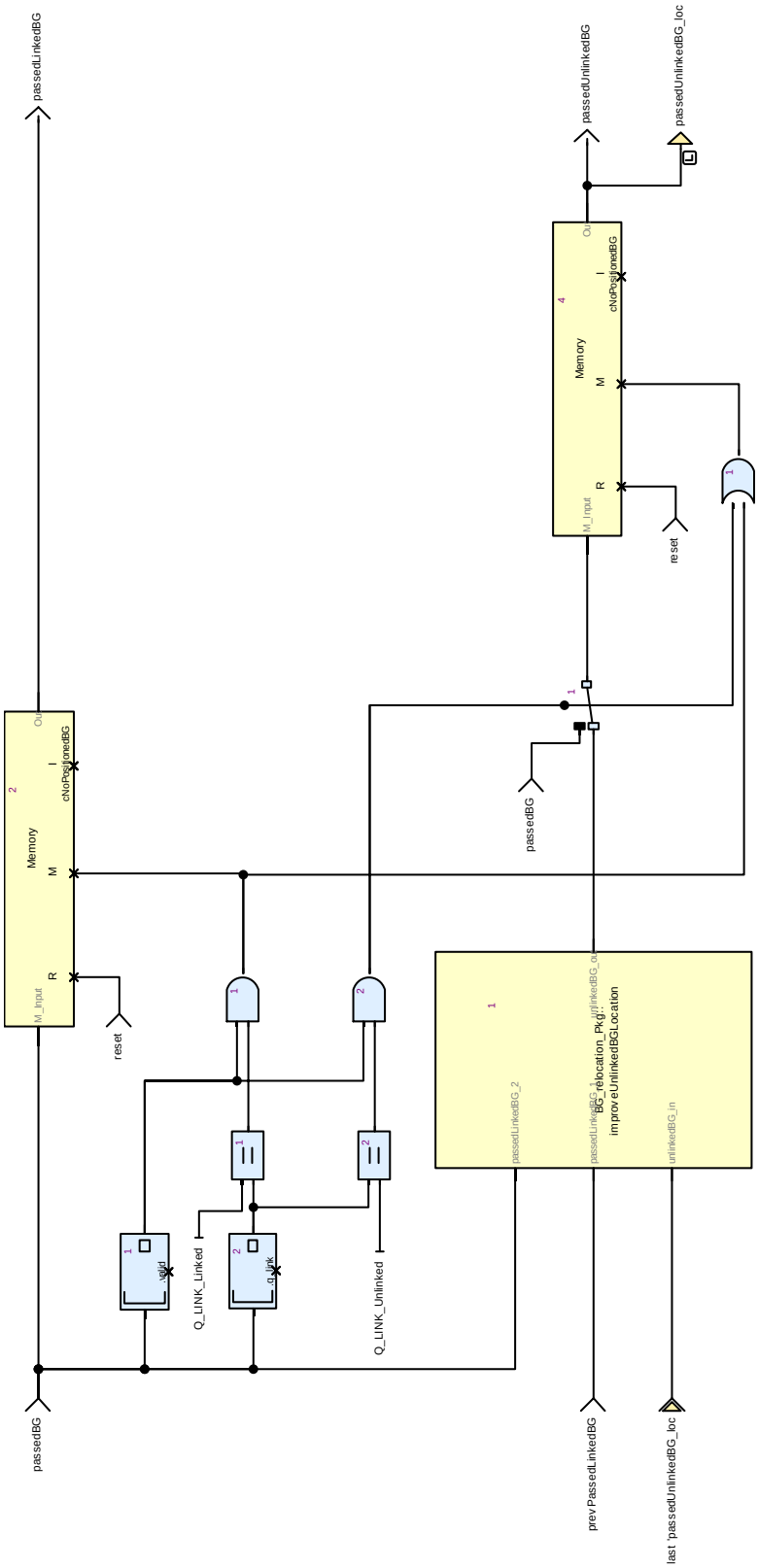

Figure 8: View of diagram_memPassedBG_1 (memPassedBG)

3.1.11. passedBG_2_positionedBG Operator

Declared as **`private function`**

3.1.11.1. 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 30: 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

3.1.11.2. Interface

Table 31: Inputs of passedBG_2_positionedBG

Name	Type	Properties	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.

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

Table 32: 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.

3.1.11.3. Locals

Table 33: Locals of passedBG_2_positionedBG

Name	Type	Properties		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			
notFoundWhereAnnounced_loc	bool	default	false	
passedPositionedBG_loc	TrainPosition_Types_Pck::positionedBG_T			

3.1.11.4. Operator Hierarchy

diagram : diagram_calculateDistance
    activate if : ifAnnouncedOrABGWasPreviouslyPassed
        branch : then
        branch : else
            branch : then
            branch : else
                branch : then
                branch : else
diagram : diagram_checkAnnouncedInfo
diagram : diagram_passedBG_2_positionedBG
diagram : diagram_positionLinkedBGs

3.1.11.5. Graphical and Textual Diagrams

3.1.11.5.1. View of diagram_calculateDistance (passedBG_2_positionedBG)

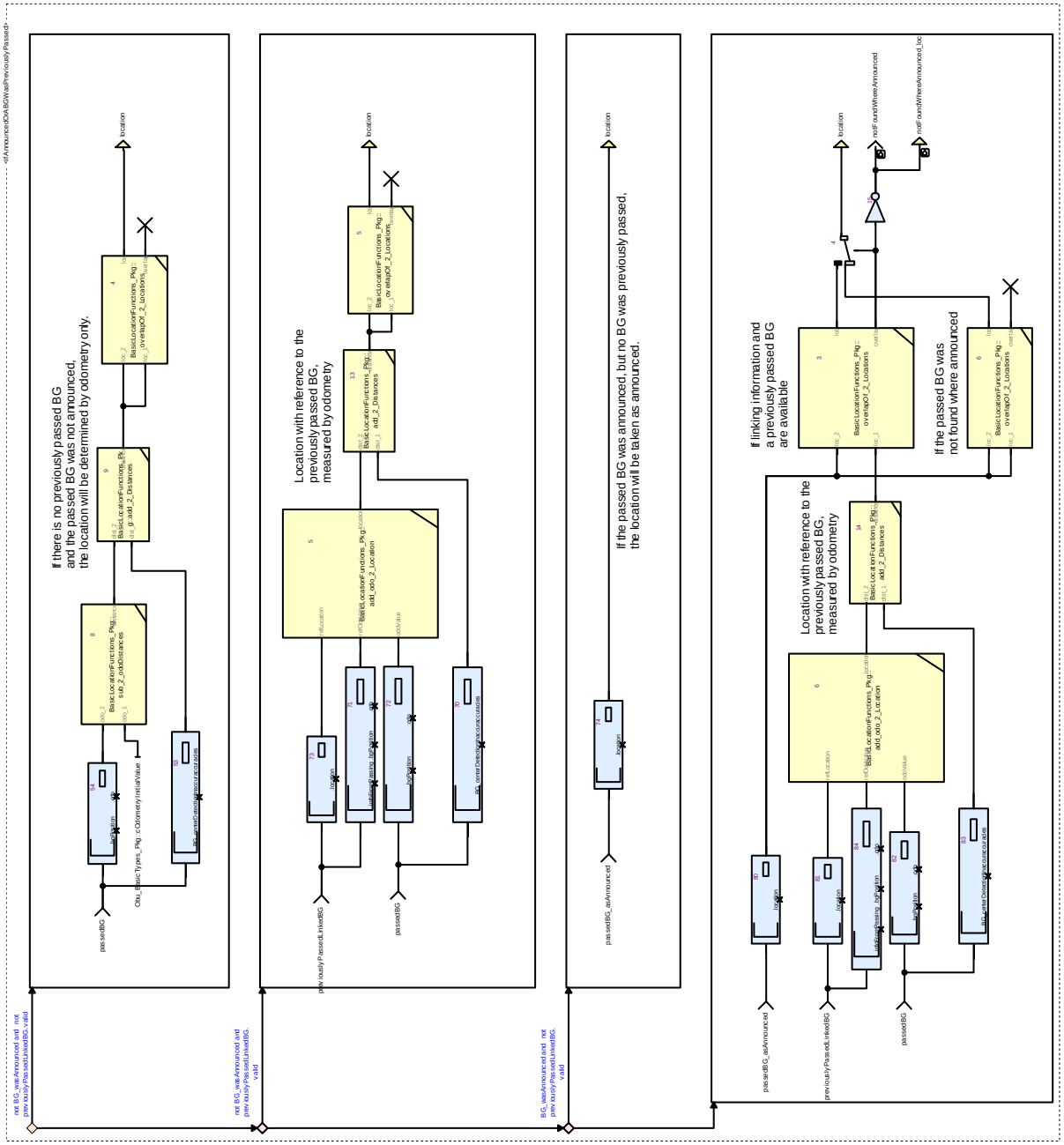

Figure 9: View of diagram_calculateDistance (passedBG_2_positionedBG)

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 34: Conditional Blocks of diagram_calculateDistance

Conditional Block	Comments and Information
ifAnnouncedOrABGWasPreviouslyPassed	

Table 35: Actions of diagram_calculateDistance

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

3.1.11.5.2. View of diagram_checkAnnouncedInfo (passedBG_2_positionedBG)

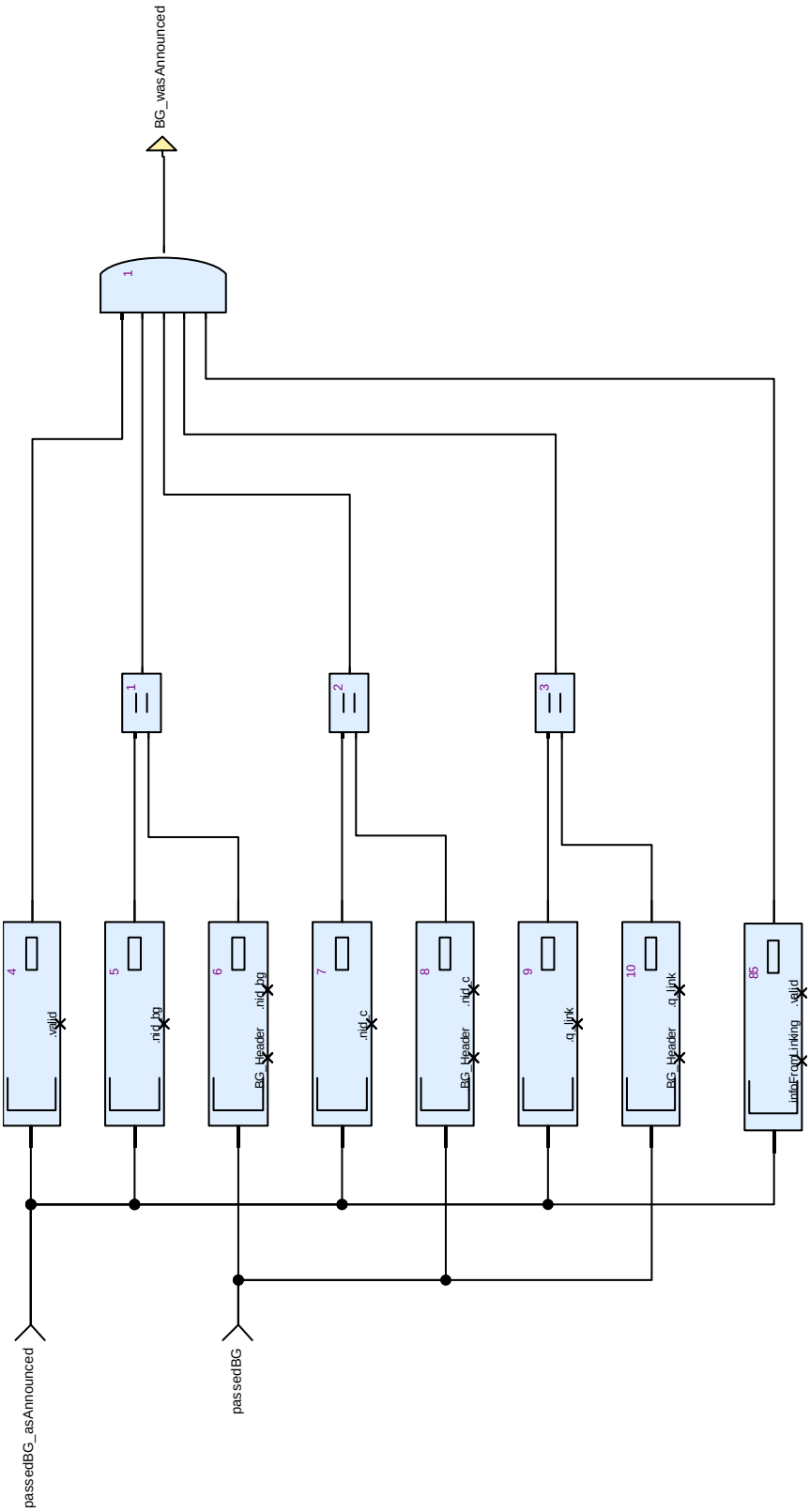

Figure 10: View of diagram_checkAnnouncedInfo (passedBG_2_positionedBG)

diagram_checkAnnouncedInfo Comments:

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

3.1.11.5.3. View of diagram_passedBG_2_positionedBG (passedBG_2_positionedBG)

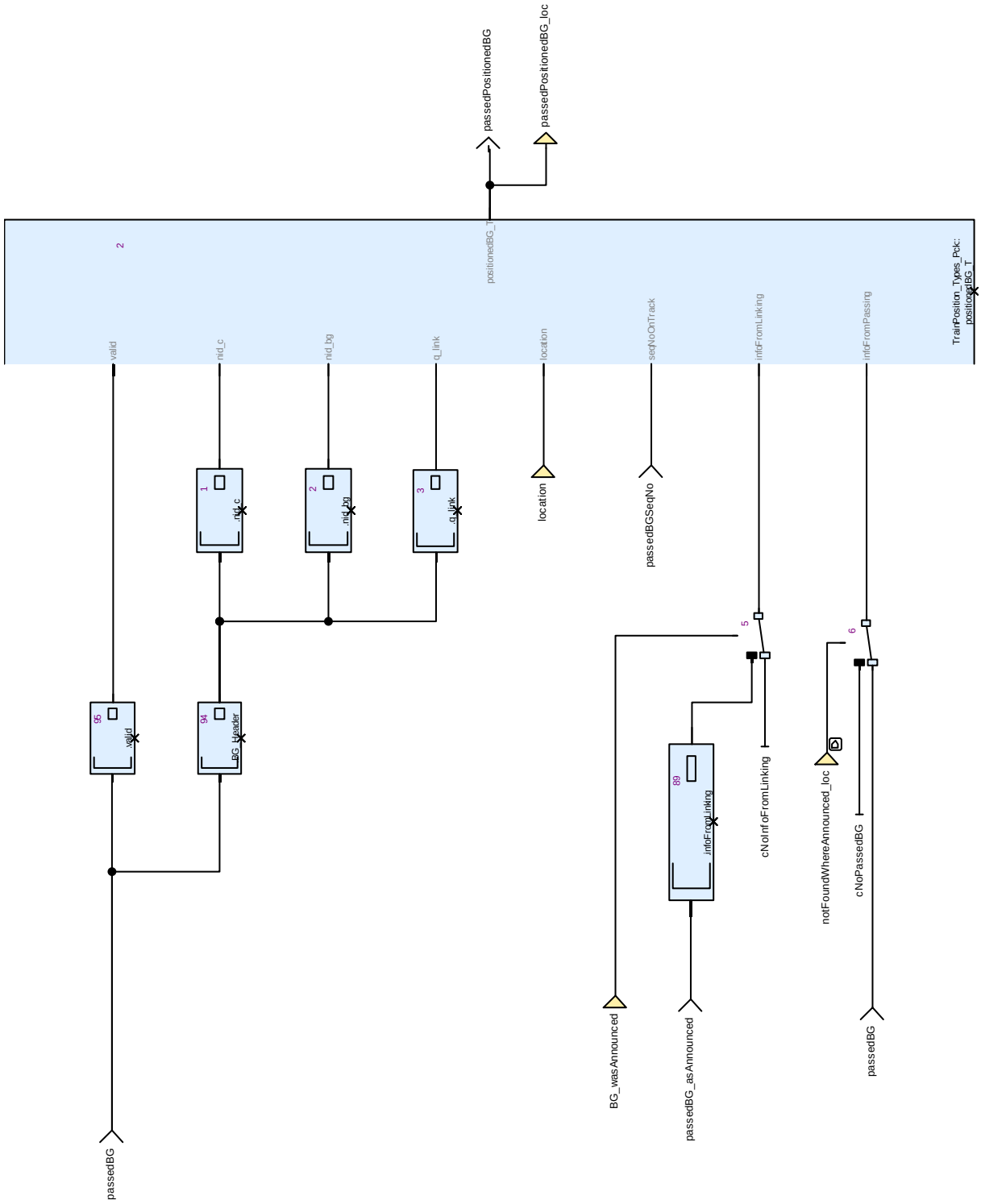

Figure 11: View of diagram_passedBG_2_positionedBG (passedBG_2_positionedBG)

3.1.11.5.4. View of diagram_positionLinkedBGs (passedBG_2_positionedBG)

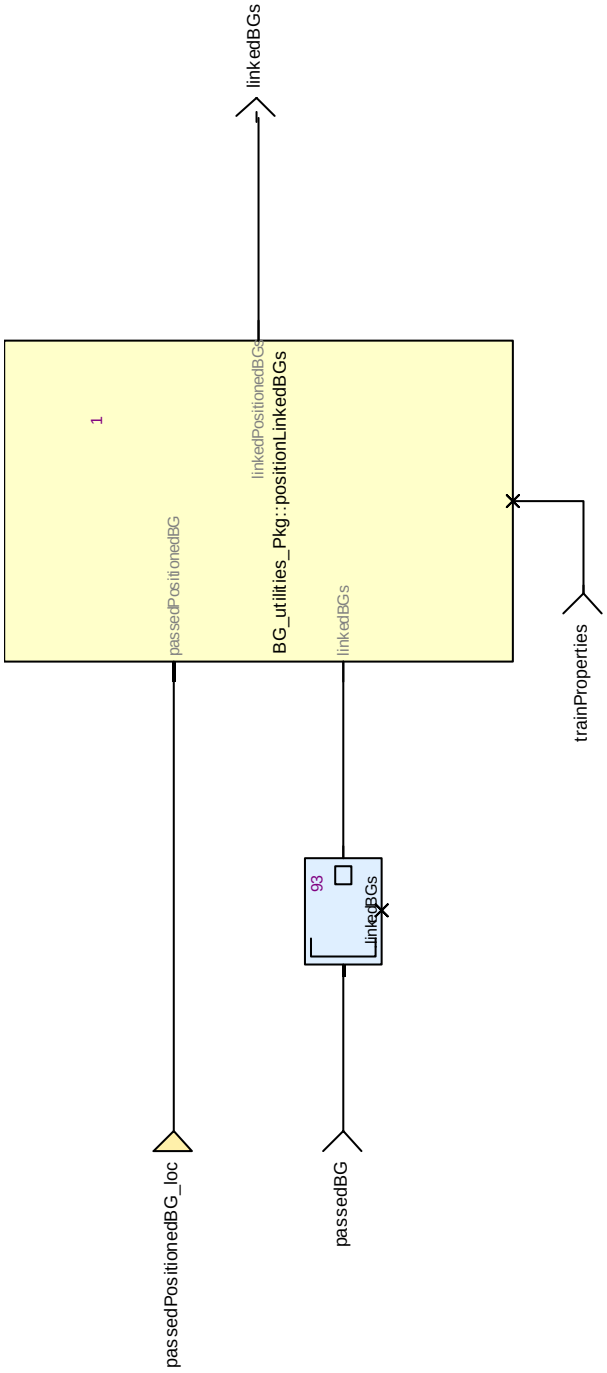

Figure 12: View of diagram_positionLinkedBGs (passedBG_2_positionedBG)

3.1.12. passing_a_BG Operator

Declared as **`private function`**

3.1.12.1. Comments and Information

passing_a_BG Comments:

- Provides the location calculations while passing a BG

Table 36: 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

3.1.12.2. Interface

Table 37: Inputs of passing_a_BG

Name	Type	Properties	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
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	Comments: The trains properties required for train position calculation.

Table 38: 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.
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.

3.1.12.3. Operator Hierarchy

diagram : diagram_passing_a_BG_1

3.1.12.4. Graphical and Textual Diagrams

3.1.12.4.1. View of diagram_passing_a_BG_1 (passing_a_BG)

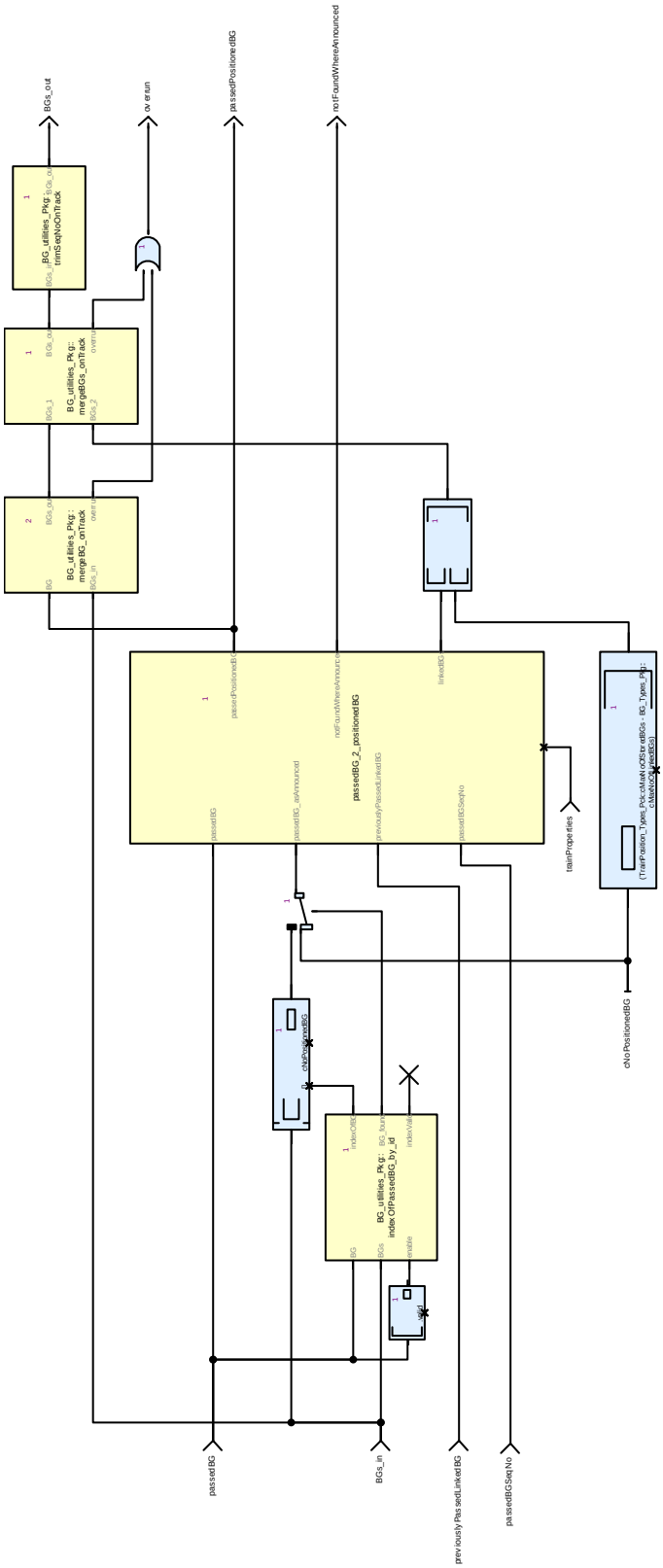

Figure 13: View of diagram_passing_a_BG_1 (passing_a_BG)

3.1.13. prevPassedLinkedBG Operator

Declared as **`private function`**

3.1.13.1. Comments and Information

prevPassedLinkedBG Comments:

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

Table 39: 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

3.1.13.2. Interface

Table 40: 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 41: Outputs of prevPassedLinkedBG

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

3.1.13.3. Operator Hierarchy

diagram : diagram_prevPassedLinkedBG_1

3.1.13.4. Graphical and Textual Diagrams

3.1.13.4.1. View of diagram_prevPassedLinkedBG_1 (prevPassedLinkedBG)

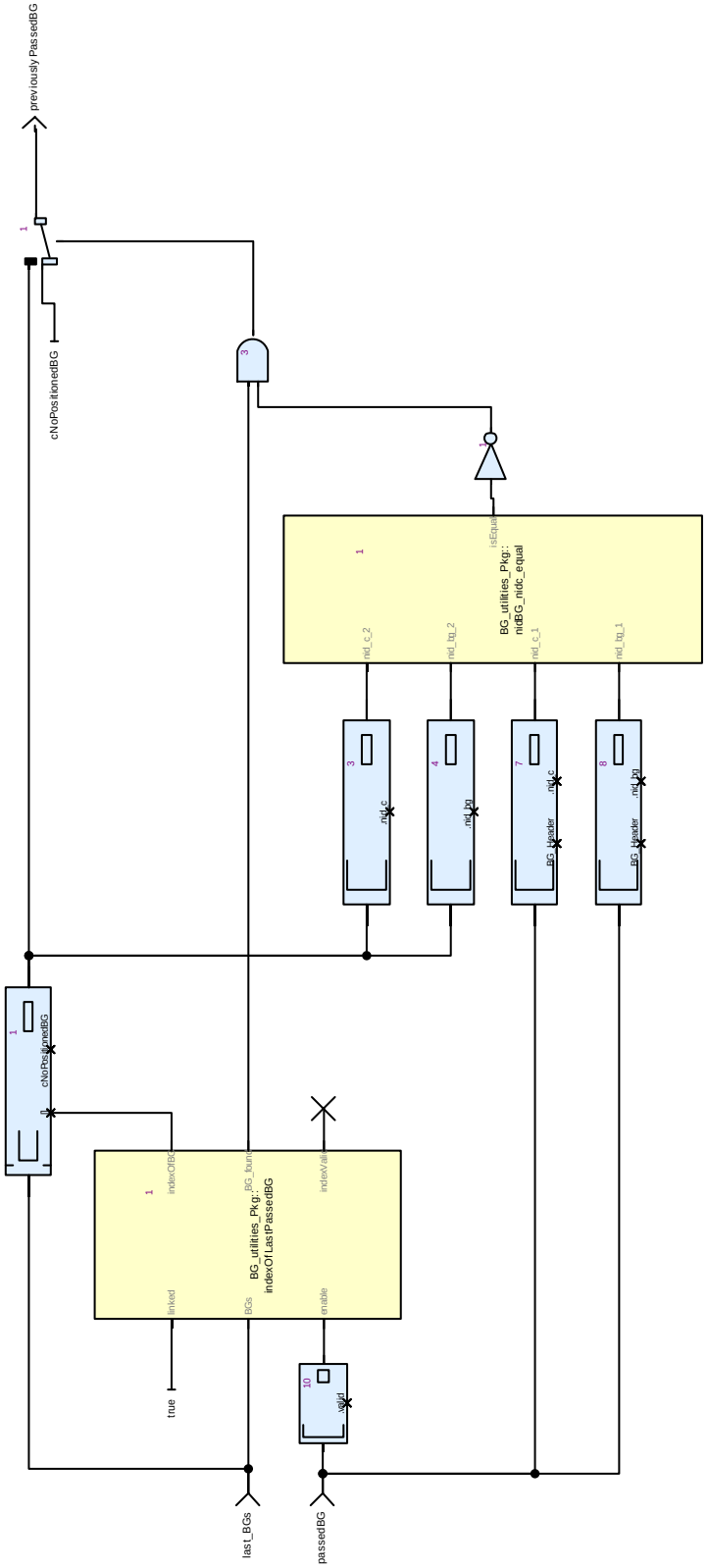

Figure 14: View of diagram_prevPassedLinkedBG_1 (prevPassedLinkedBG)

3.2. CalculateTrainPosition_Pkg::BG_relocation_Pkg Package

3.2.1. Types

Table 42: 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, sumOfBestDistances : Obu_BasicTypes_Pkg::LocWithInAcc_T}	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; the linked BG, where sumOfPrevLinkingDistances refer to. prevUnlinkedBG Comments: The previous unlinked BG in the map and fold chain recalculate Comments: Enables the location recalculation for all BGs subsequent to refBG sumOfBestDistances Comments: The sum of the linking distances and odometry (for linking holes) from the chain of previous linked BGs since refBG.

3.2.2. Constants

Table 43: 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, q_dir : Q_DIR_Reverse, 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, bgPosition : {valid : false, timestamp : 0, odo : {o_nominal : 0, o_min : 0, o_max : 0}, speed : 0, acceleration : 0, motionState : Obu_BasicTypes_Pkg::noMotion, motionDirection : Obu_BasicTypes_Pkg::unknownDirection}, BG_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, q_nvlocacc : 0, BG_Header : {q_updown : Q_UPDOWN_Down_link_telegram, m_version : M_VERSION_Previo	

3.2.3. calculateLocalBGInaccuracies Operator

Declared as **`private function`**

3.2.3.1. Comments and Information

calculateLocalBGInaccuracies Comments:

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

3.2.3.2. Interface

Table 44: Inputs of calculateLocalBGInaccuracies

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

Table 45: Outputs of calculateLocalBGInaccuracies

Name	Type	Comments and Information
localInaccuracies	Obu_BasicTypes_Pkg::LocWithInAcc_T	

3.2.3.3. Operator Hierarchy

diagram : diagram_calculateLocalBGInaccuracies_1

3.2.3.4. Graphical and Textual Diagrams

3.2.3.4.1. View of diagram_calculateLocalBGInaccuracies_1 (calculateLocalBGInaccuracies)

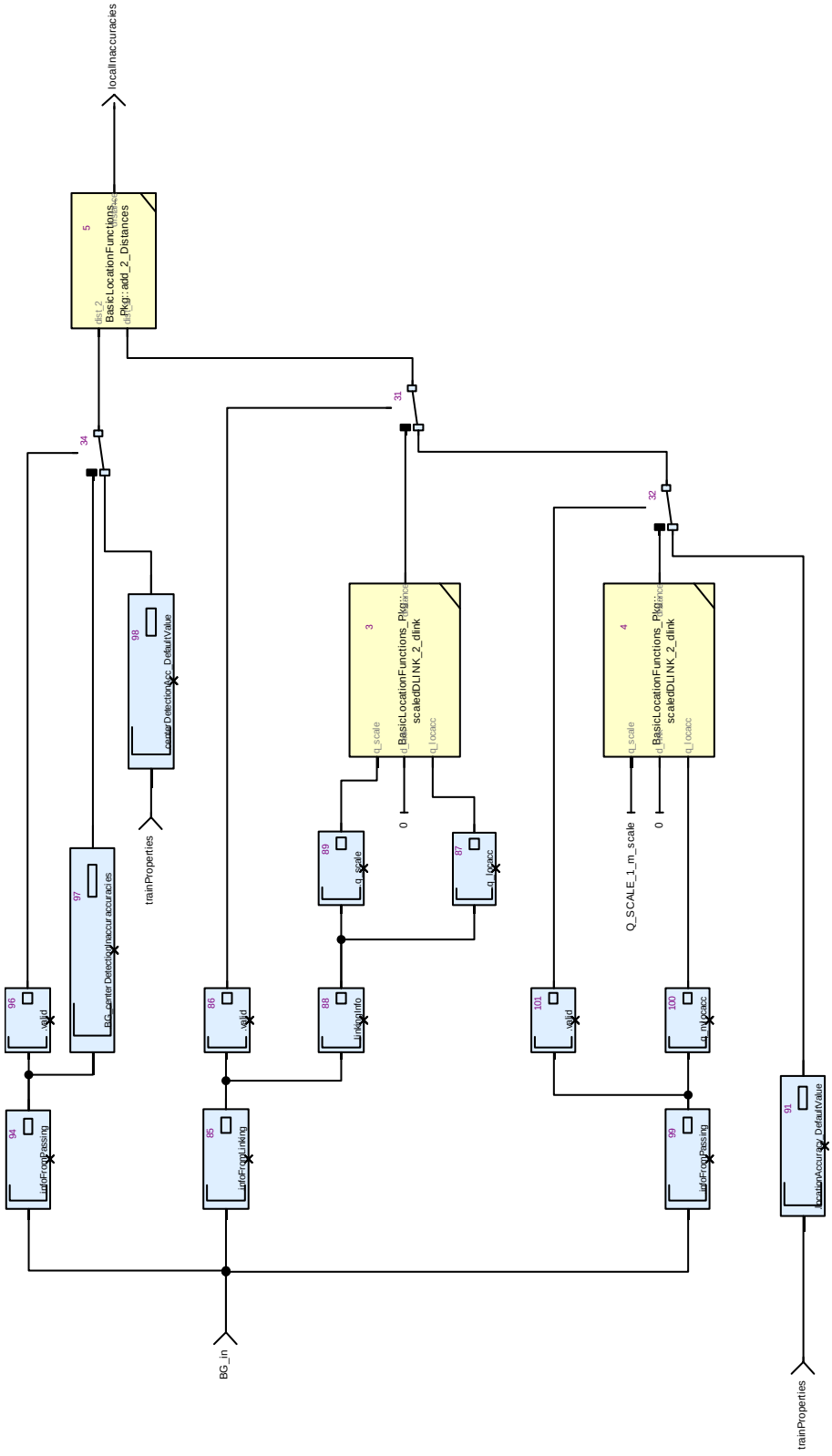

Figure 15: View of diagram_calculateLocalBGInaccuracies_1 (calculateLocalBGInaccuracies)

3.2.4. findLinkedBG_bckwd_itr Operator

Declared as **`private function`**

3.2.4.1. Comments and Information

findLinkedBG_bckwd_itr Comments:

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

3.2.4.2. Interface

Table 46: 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 47: 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	

3.2.4.3. Operator Hierarchy

diagram : diagram_findLinkedBG_bckwd_itr_1

3.2.4.4. Graphical and Textual Diagrams

3.2.4.4.1. View of diagram_findLinkedBG_bckwd_itr_1 (findLinkedBG_bckwd_itr)

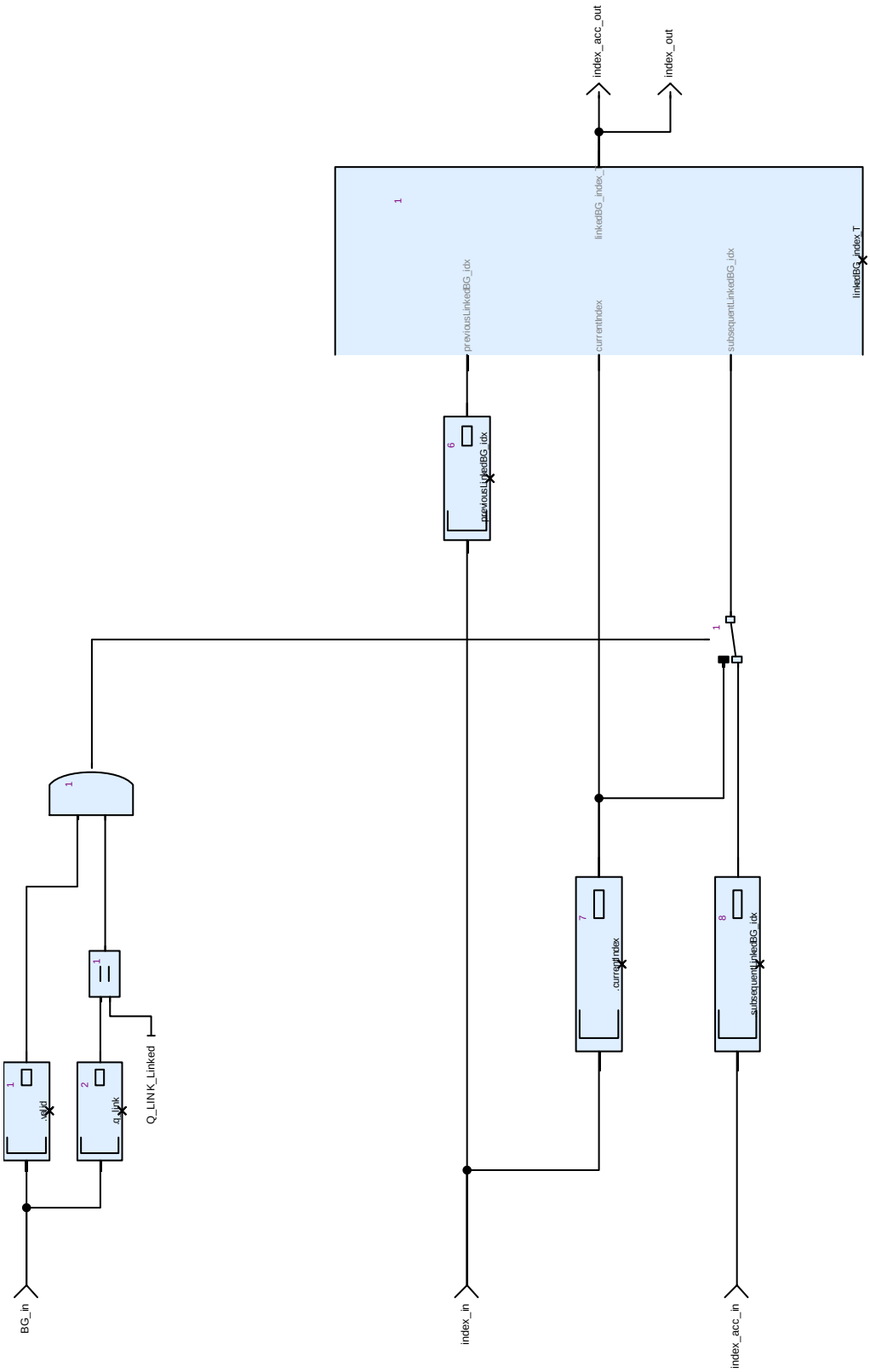

Figure 16: View of diagram_findLinkedBG_bckwd_itr_1 (findLinkedBG_bckwd_itr)

3.2.5. findLinkedBG_fwd_itr Operator

Declared as **`private function`**

3.2.5.1. Comments and Information

findLinkedBG_fwd_itr Comments:

- Function for iterating through all BGs in forward direction.
- If BG_in is a linked BG, index_out.previousLinked_BG_idx is set to the current index.
- If not, index_out.previousLinked_BG_idx is taken from the previous iteration.
- index_out.currentIndex is generated be incrementing the index from the previous iteration.
- index_out.subsequentLinkedIndex taken unchanged from index_in.

3.2.5.2. Interface

Table 48: 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 49: 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

3.2.5.3. Operator Hierarchy

diagram : diagram_findLinkedBG_fwd_itr_1

3.2.5.4. Graphical and Textual Diagrams

3.2.5.4.1. View of diagram_findLinkedBG_fwd_itr_1 (findLinkedBG_fwd_itr)

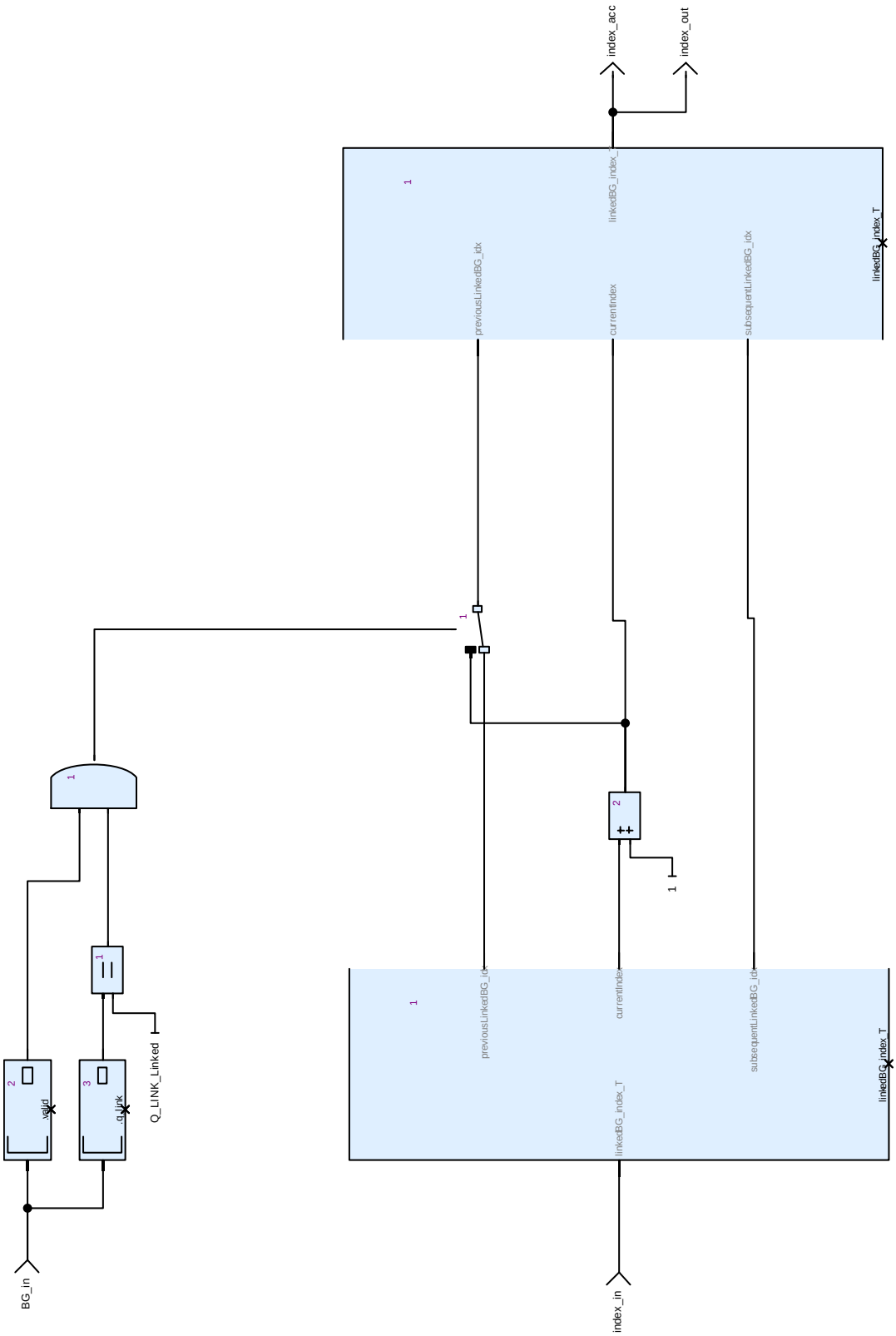

Figure 17: View of diagram_findLinkedBG_fwd_itr_1 (findLinkedBG_fwd_itr)

3.2.6. findLinkedBGs Operator

Declared as **`private function`**

3.2.6.1. Comments and Information

findLinkedBGs Comments:

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

3.2.6.2. Interface

Table 50: Inputs of findLinkedBGs

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

Table 51: Outputs of findLinkedBGs

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

3.2.6.3. Operator Hierarchy

diagram : diagram_findLinkedBGs_1

3.2.6.4. Graphical and Textual Diagrams

3.2.6.4.1. View of diagram_findLinkedBGs_1 (findLinkedBGs)

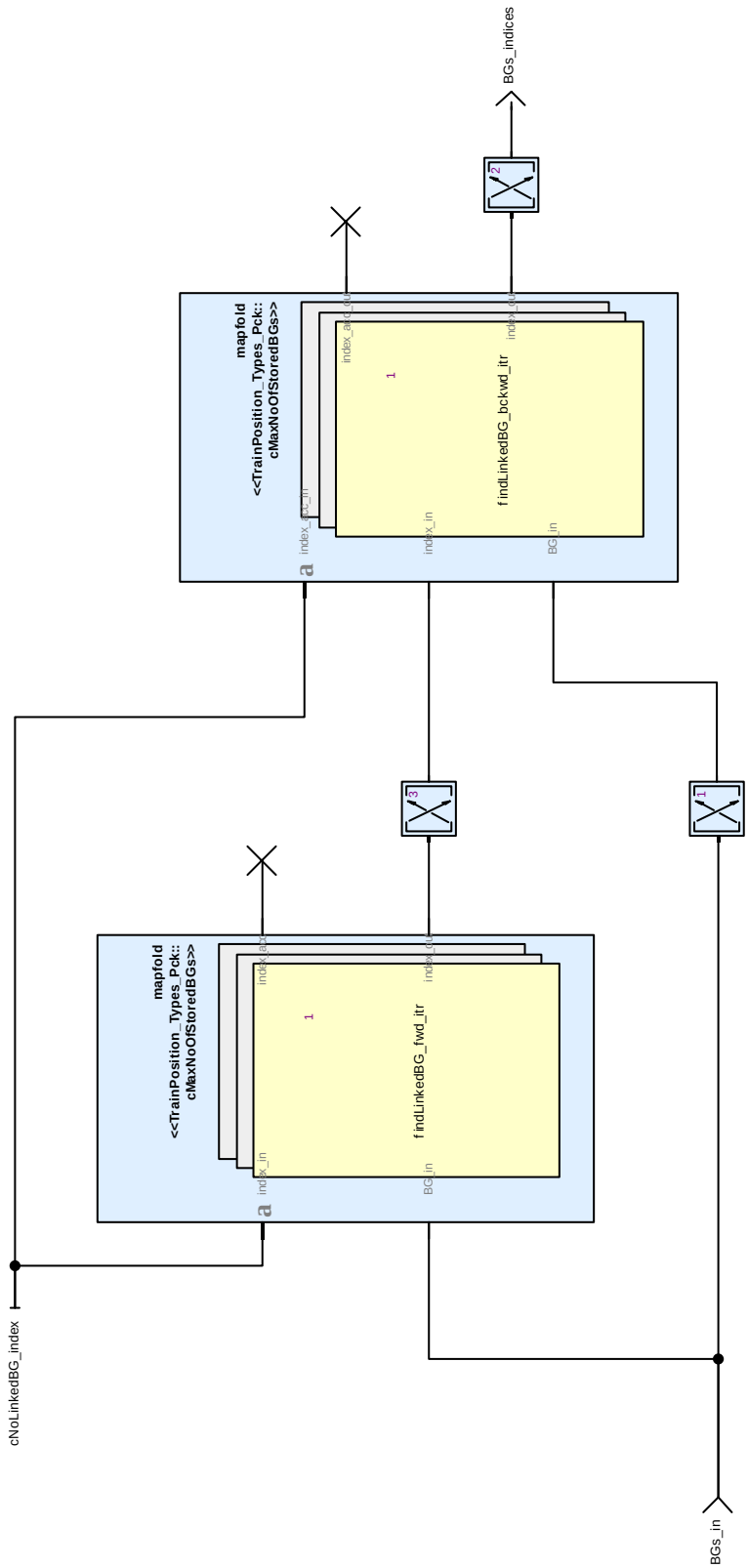

Figure 18: View of diagram_findLinkedBGs_1 (findLinkedBGs)

3.2.7. improve_BG_locations Operator

Declared as **`public function`**

3.2.7.1. Interface

Table 52: Inputs of improve_BG_locations

Name	Type	Properties	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		
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	Comments: The trains properties required for train position calculation.

Table 53: Outputs of improve_BG_locations

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

3.2.7.2. Operator Hierarchy

diagram : diagram_recalculate_refBG_location

3.2.7.3. Graphical and Textual Diagrams

3.2.7.3.1. View of diagram_recalculate_refBG_location (improve_BG_locations)

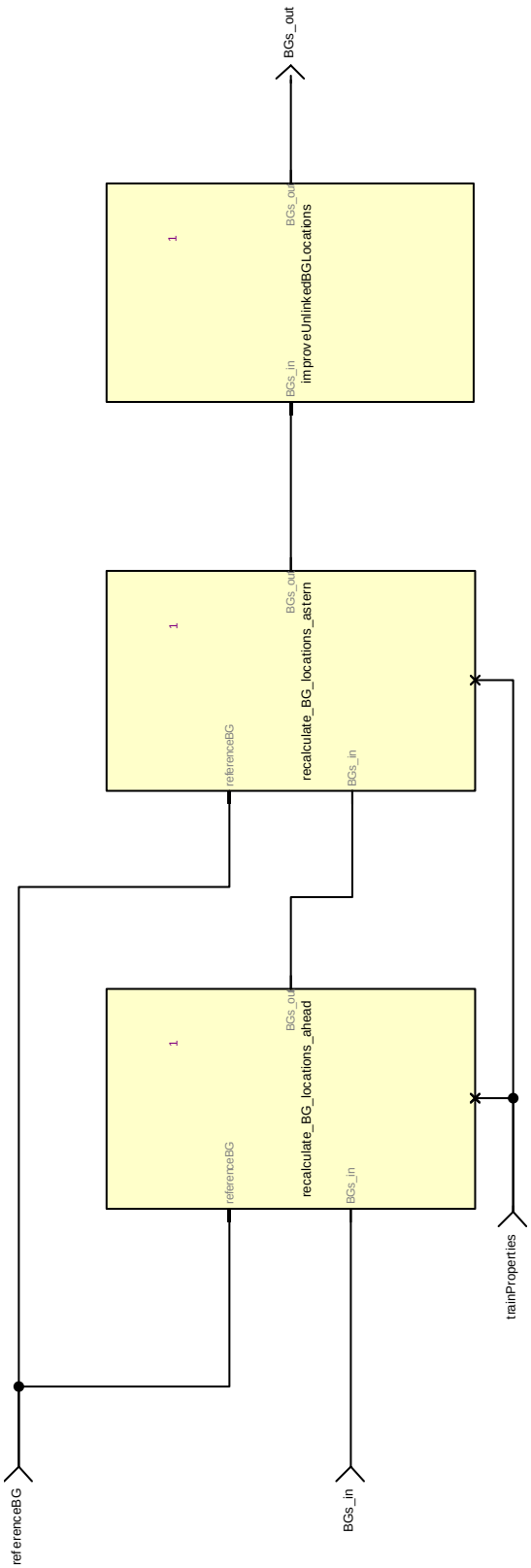

Figure 19: View of diagram_recalculate_refBG_location (improve_BG_locations)

3.2.8. improveUnlinkedBGLocation Operator

Declared as **`public function`**

3.2.8.1. Comments and Information

improveUnlinkedBGLocation Comments:

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

3.2.8.2. Interface

Table 54: 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 55: 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

3.2.8.3. Operator Hierarchy

diagram : diagram_improveUnlinkedBGLocation_1

3.2.8.4. Graphical and Textual Diagrams

3.2.8.4.1. View of diagram_improveUnlinkedBGLocation_1 (improveUnlinkedBGLocation)

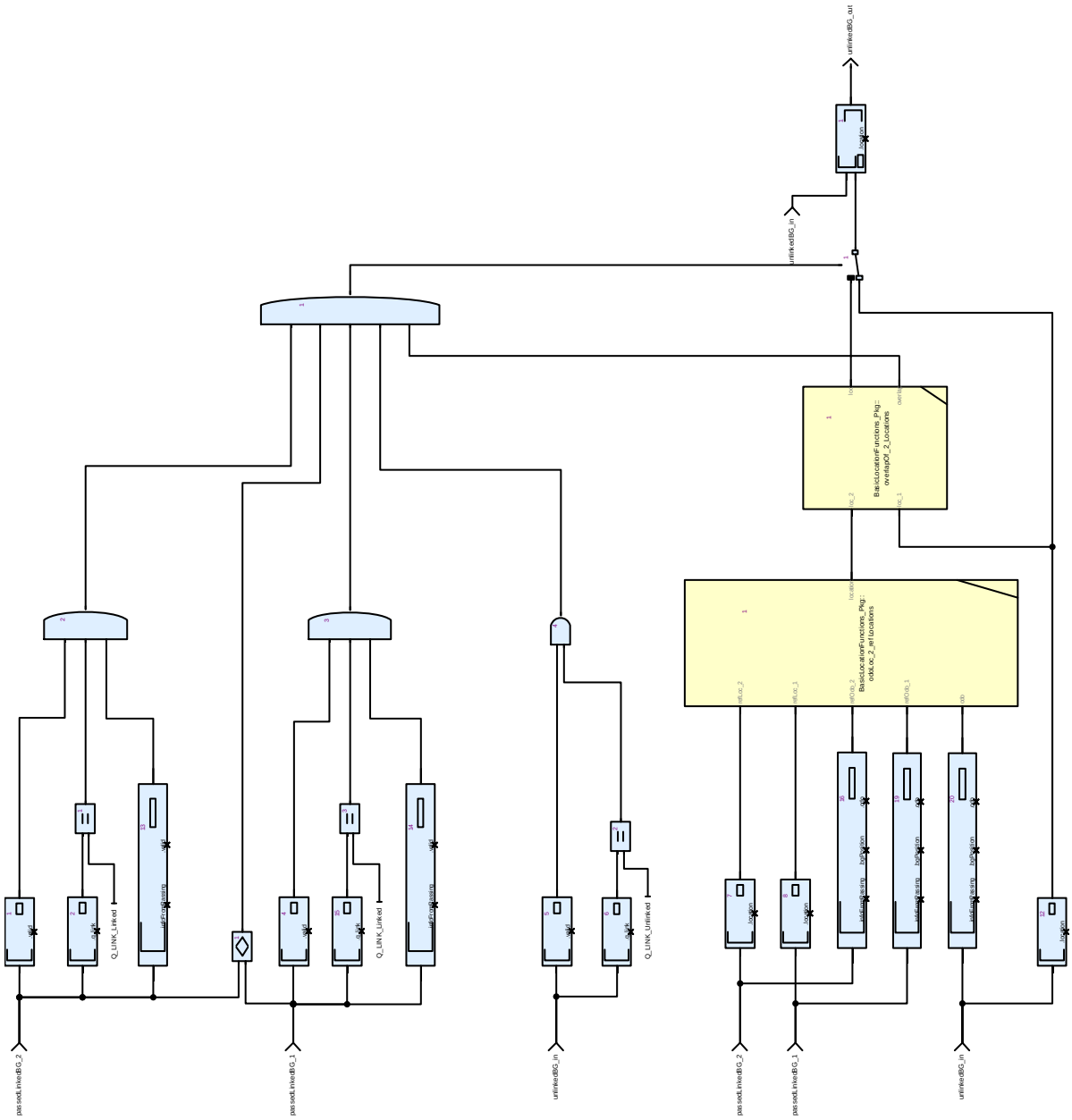

Figure 20: View of diagram_improveUnlinkedBGLocation_1 (improveUnlinkedBGLocation)

3.2.9. improveUnlinkedBGLocations Operator

Declared as **`private function`**

3.2.9.1. Interface

Table 56: Inputs of improveUnlinkedBGLocations

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pck::positionedBGs_T	

Table 57: Outputs of improveUnlinkedBGLocations

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

3.2.9.2. Operator Hierarchy

diagram : diagram_improveUnlinkedBGLocations_1

3.2.9.3. Graphical and Textual Diagrams

3.2.9.3.1. View of diagram_improveUnlinkedBGLocations_1 (improveUnlinkedBGLocations)

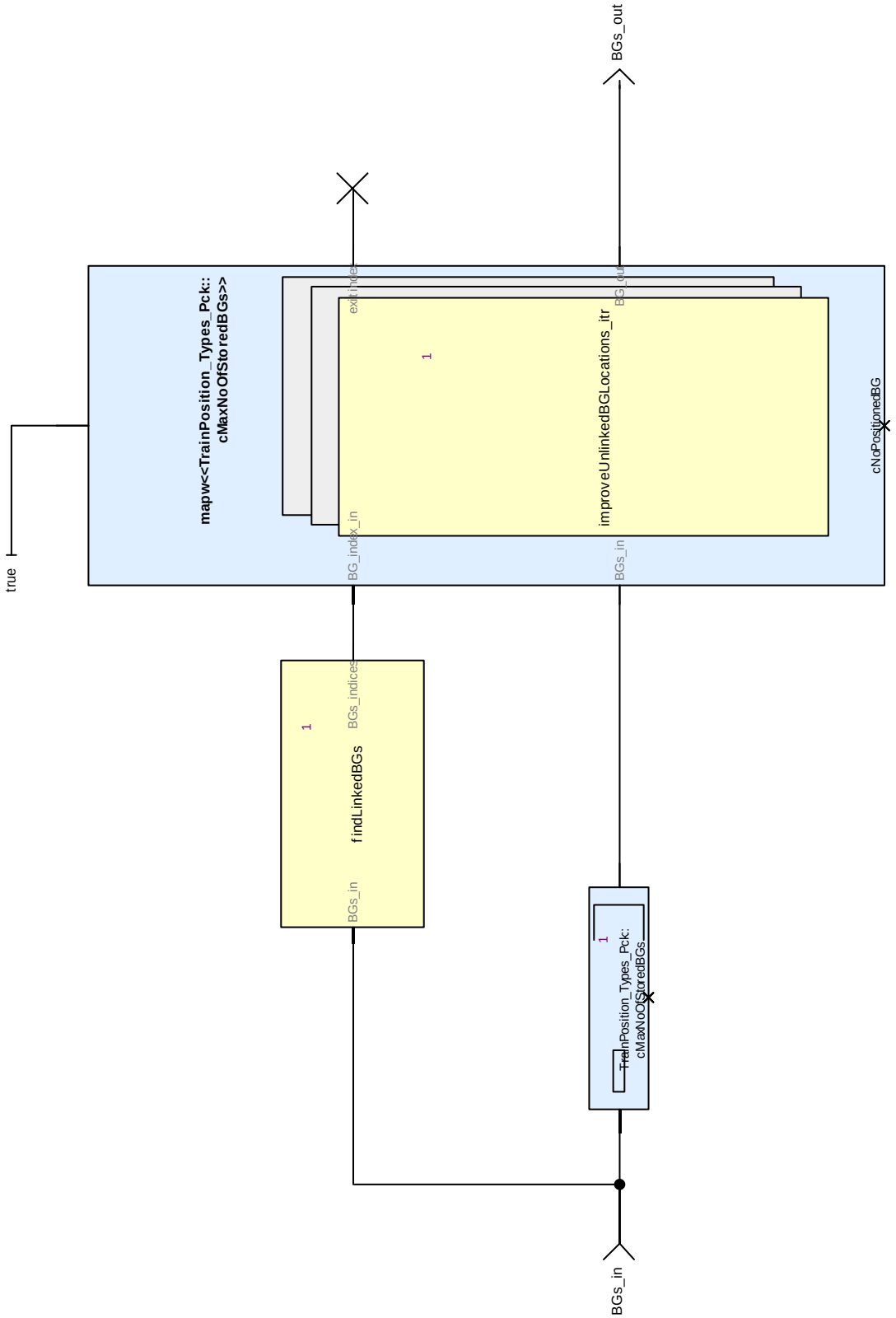

Figure 21: View of diagram_improveUnlinkedBGLocations_1 (improveUnlinkedBGLocations)

3.2.10. improveUnlinkedBGLocations_itr Operator

Declared as **`private function`**

3.2.10.1. Interface

Table 58: 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 59: 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.

3.2.10.2. Operator Hierarchy

diagram : diagram_improveUnlinkedBGLocations_itr_1

3.2.10.3. Graphical and Textual Diagrams

3.2.10.3.1. View of diagram_improveUnlinkedBGLocations_itr_1 (improveUnlinkedBGLocations_itr)

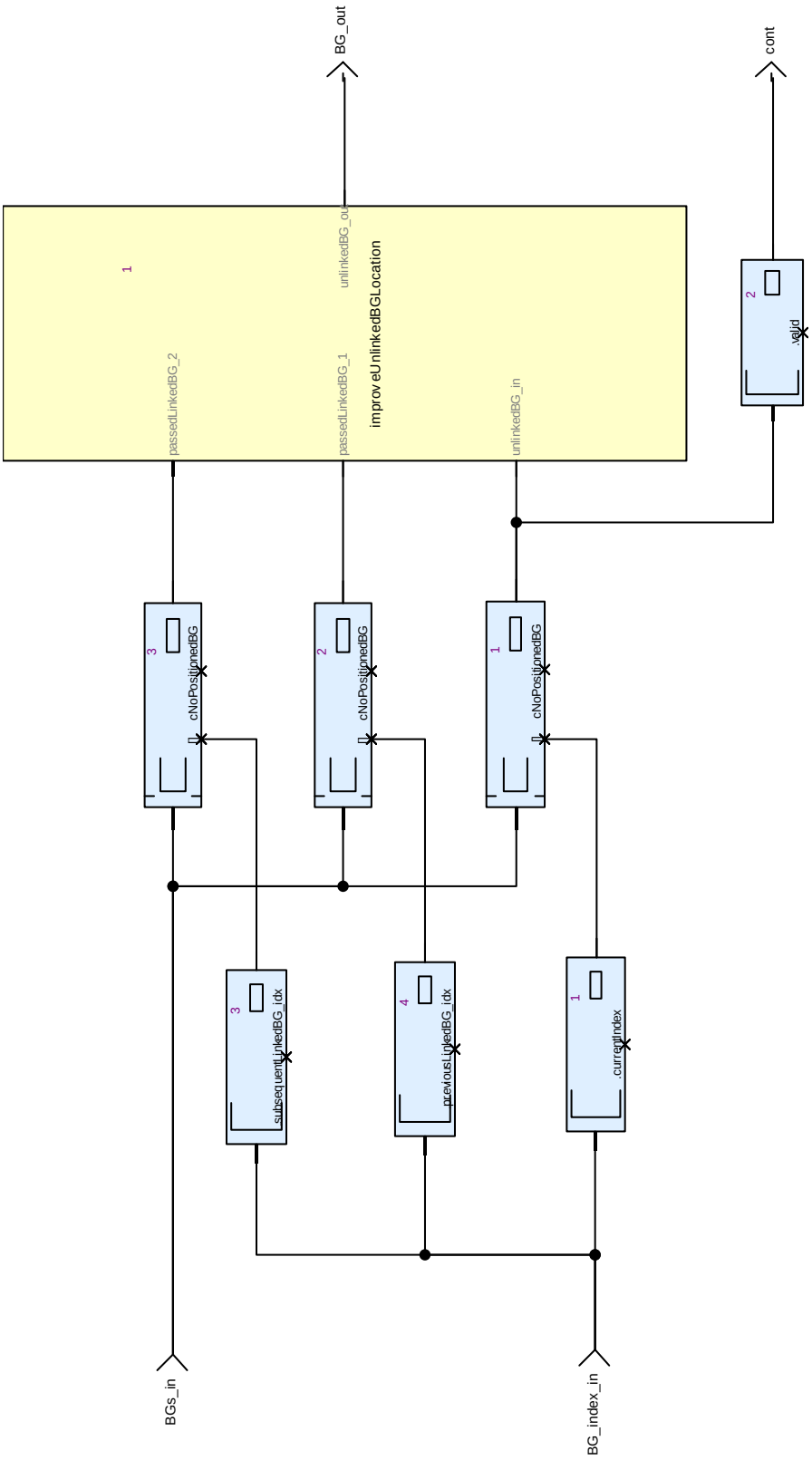

Figure 22: View of diagram_improveUnlinkedBGLocations_itr_1 (improveUnlinkedBGLocations_itr)

3.2.11. recalculate_BG_location_ahead Operator

Declared as **`private function`**

3.2.11.1. Comments and Information

recalculate_BG_location_ahead Comments:

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

3.2.11.2. Interface

Table 60: Inputs of recalculate_BG_location_ahead

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

Table 61: 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.

3.2.11.3. Operator Hierarchy

diagram : diagram_recalculate_BG_location

3.2.11.4. Graphical and Textual Diagrams

3.2.11.4.1. View of diagram_recalculate_BG_location (recalculate_BG_location_ahead)

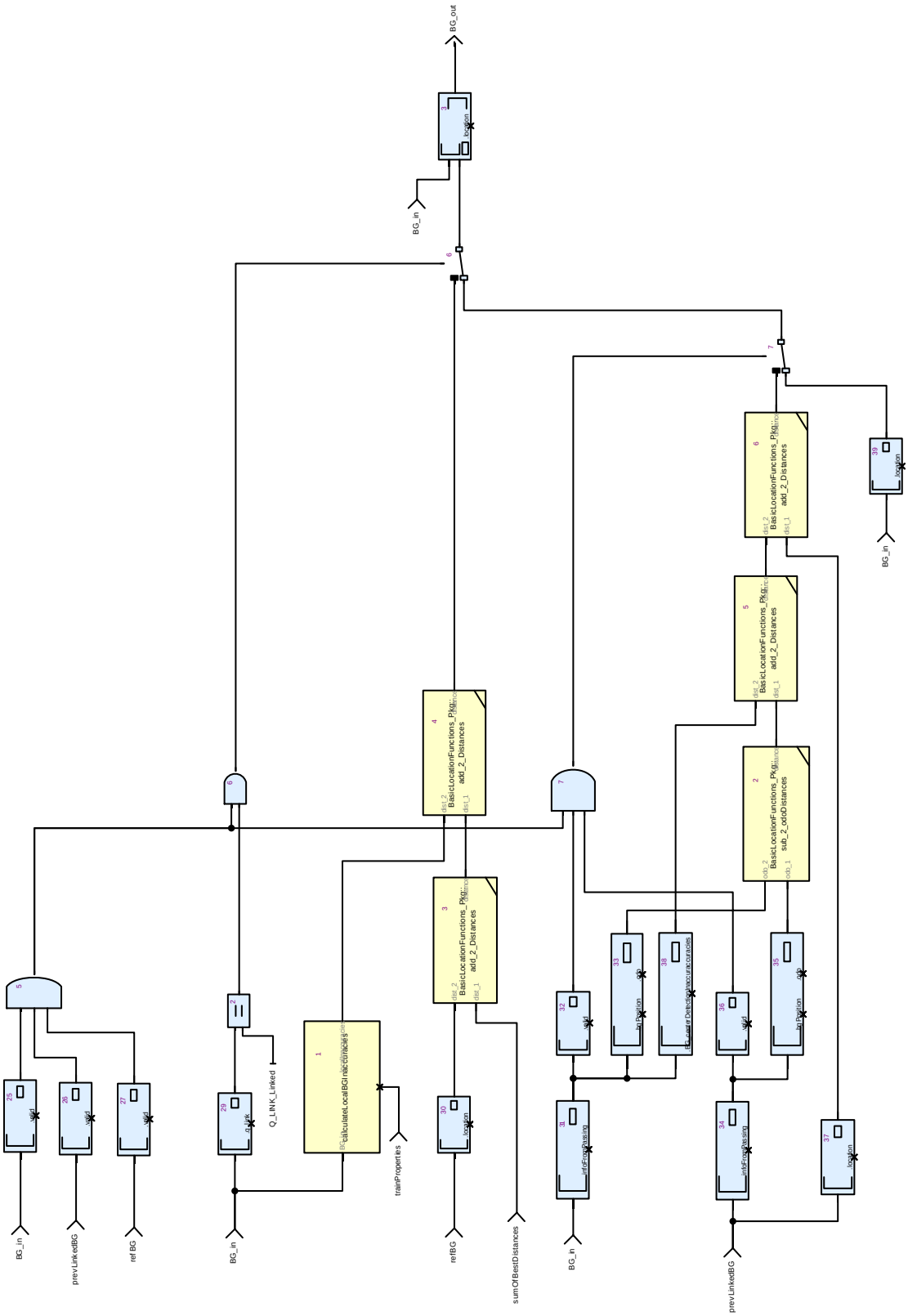

Figure 23: View of diagram_recalculate_BG_location (recalculate_BG_location_ahead)

3.2.12. recalculate_BG_location_astern Operator

Declared as **`private function`**

3.2.12.1. Comments and Information

recalculate_BG_location_astern Comments:

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

3.2.12.2. Interface

Table 62: Inputs of recalculate_BG_location_astern

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

Table 63: 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.

3.2.12.3. Operator Hierarchy

diagram : diagram_recalculate_BG_location

3.2.12.4. Graphical and Textual Diagrams

3.2.12.4.1. View of diagram_recalculate_BG_location (recalculate_BG_location_astern)

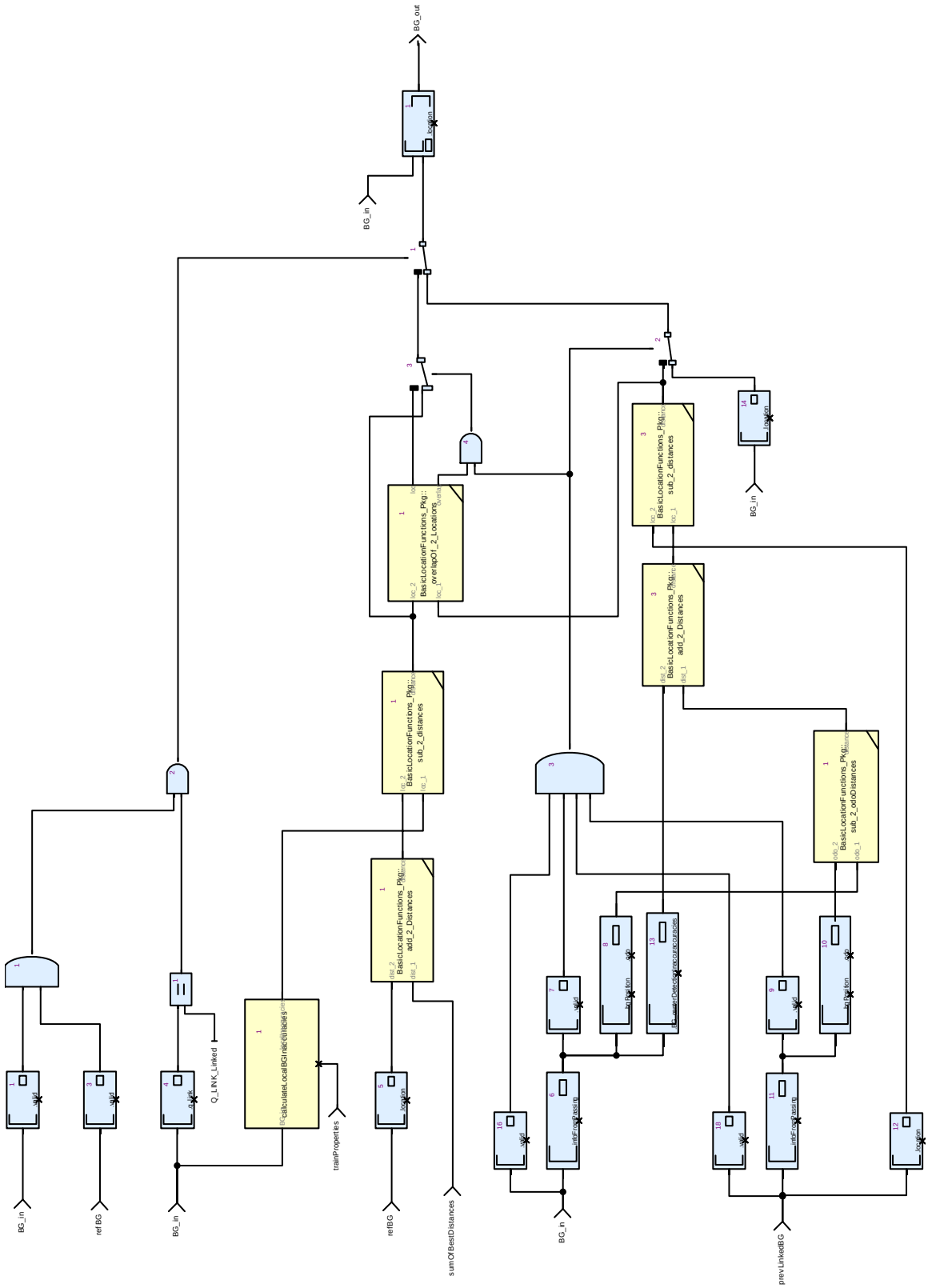

Figure 24: View of diagram_recalculate_BG_location (recalculate_BG_location_astern)

3.2.13. recalculate_BG_locations_ahead Operator

Declared as **`private function`**

3.2.13.1. Comments and Information

recalculate_BG_locations_ahead Comments:

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

3.2.13.2. Interface

Table 64: Inputs of recalculate_BG_locations_ahead

Name	Type	Properties	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		
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	Comments: The trains properties required for train position calculation.

Table 65: Outputs of recalculate_BG_locations_ahead

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

3.2.13.3. Operator Hierarchy

diagram : diagram_recalculate_BG_locations_ahead_1

3.2.13.4. Graphical and Textual Diagrams

3.2.13.4.1. View of diagram_recalculate_BG_locations_ahead_1 (recalculate_BG_locations_ahead)

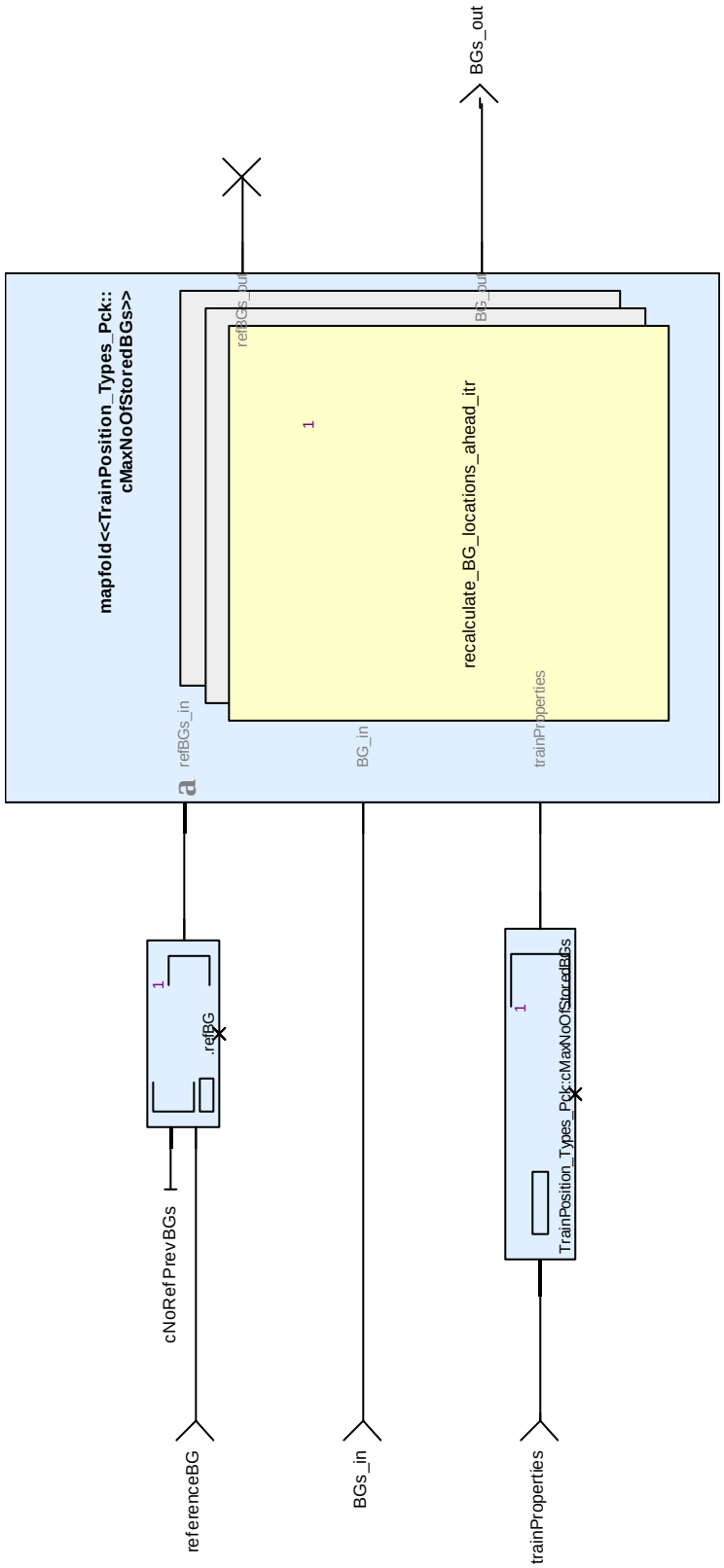

Figure 25: View of diagram_recalculate_BG_locations_ahead_1 (recalculate_BG_locations_ahead)

3.2.14. recalculate_BG_locations_ahead_itr Operator

Declared as **`private function`**

3.2.14.1. Comments and Information

recalculate_BG_locations_ahead_itr Comments:

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

3.2.14.2. Interface

Table 66: Inputs of recalculate_BG_locations_ahead_itr

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

Table 67: 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.

3.2.14.3. Locals

Table 68: Locals of recalculate_BG_locations_ahead_itr

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

Name	Type	Comments and Information
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	
sumOfBestDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T	Comments: Accumulates the distances with between refBG and a linked BG_in.

3.2.14.4. Operator Hierarchy

diagram : diagram_assembleResults
diagram : diagram_assign_refBG
diagram : diagram_calculate_BGin_inaccuracies
diagram : diagram_determinePreviousLinkedBG
diagram : diagram_determinePreviousUnlinkedBG
diagram : diagram_recalculate_BG_location
diagram : diagram_recalculate_refBG_location
diagram : diagram_sumOfPrevBestDistances

3.2.14.5. Graphical and Textual Diagrams

3.2.14.5.1. View of diagram_assembleResults (recalculate_BG_locations_ahead_itr)

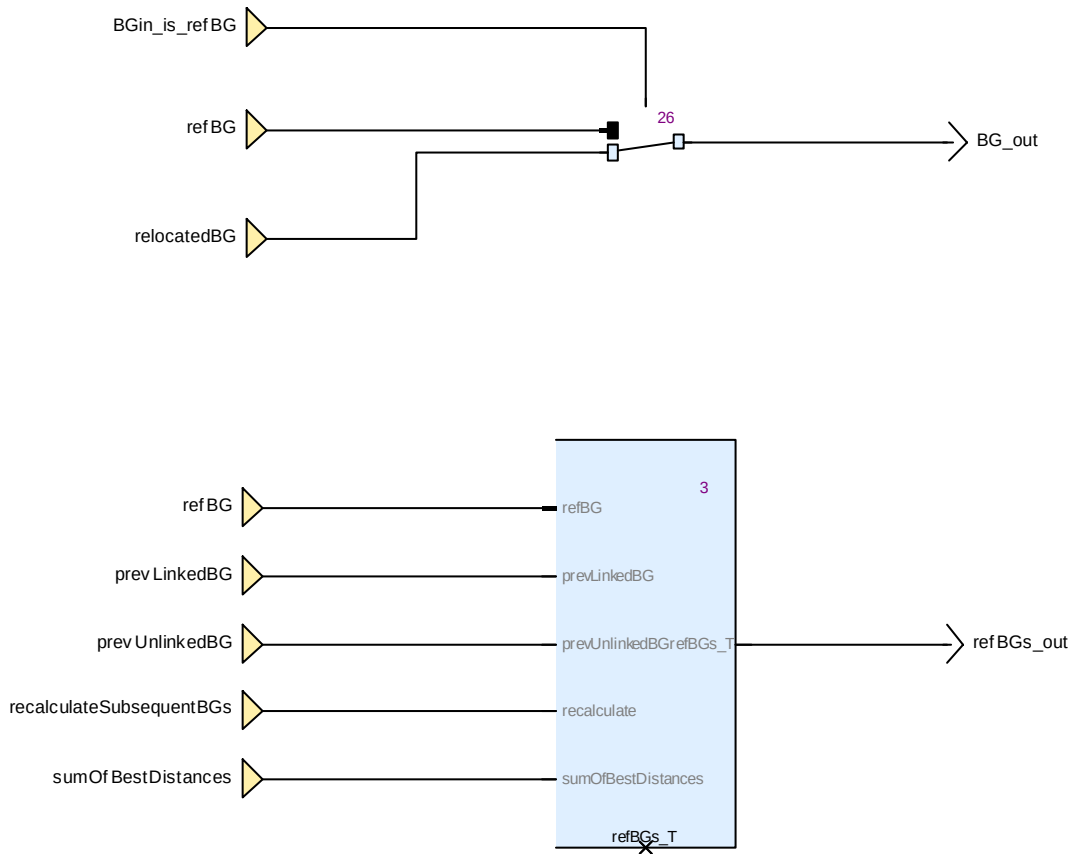

Figure 26: View of diagram_assembleResults (recalculate_BG_locations_ahead_itr)

diagram_assembleResults Comments:

- Assembles the outputs.

3.2.14.5.2. View of diagram_assign_refBG (recalculate_BG_locations_ahead_itr)

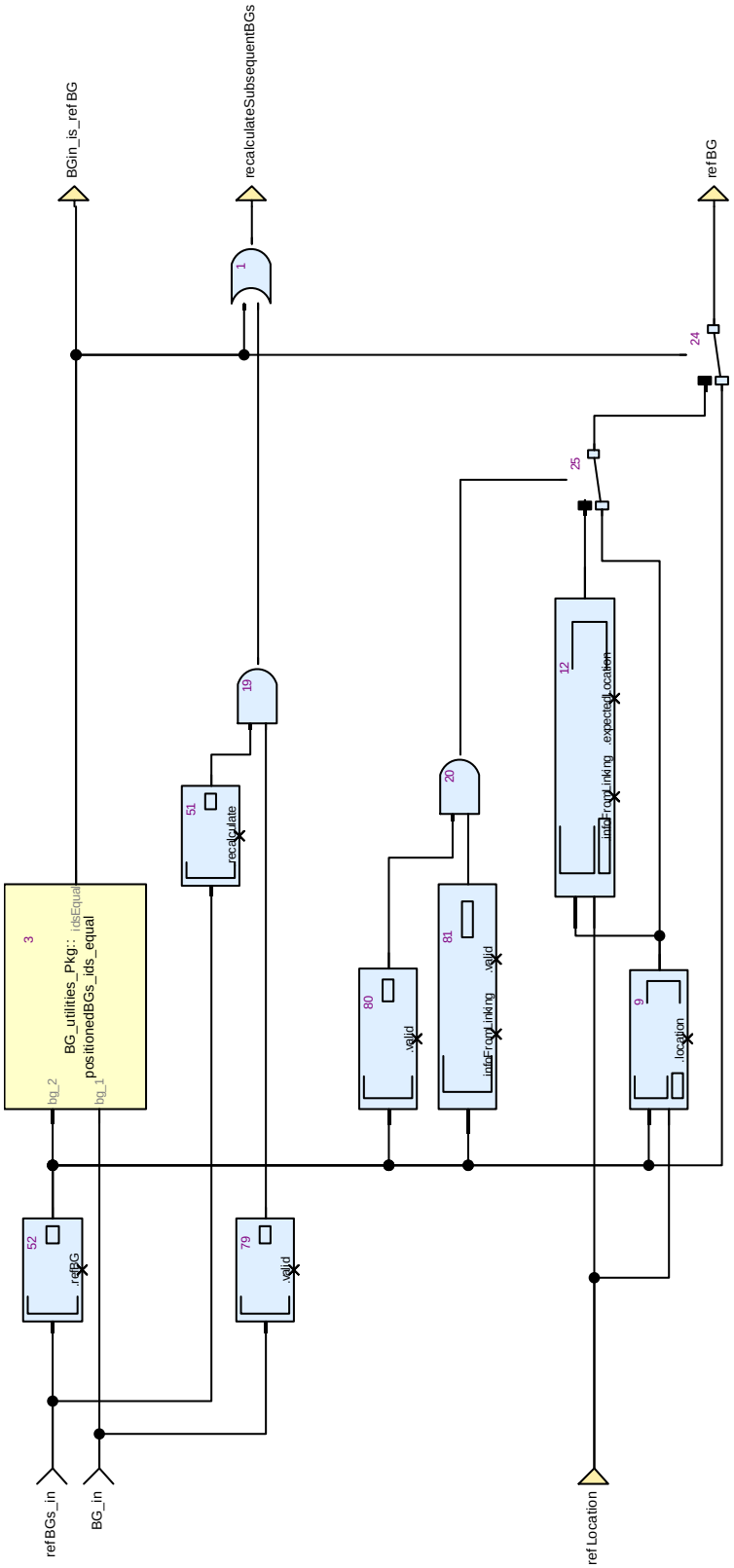

Figure 27: View of diagram_assign_refBG (recalculate_BG_locations_ahead_itr)

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.

3.2.14.5.3. View of diagram_calculate_BGin_inaccuracies (recalculate_BG_locations_ahead_itr)

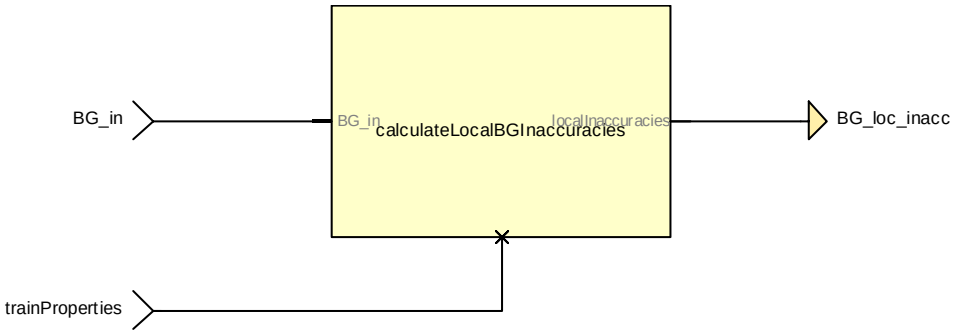

Figure 28: View of diagram_calculate_BGin_inaccuracies (recalculate_BG_locations_ahead_itr)

diagram_calculate_BGin_inaccuracies Comments:

- Calculates the local inaccuraccies of BG_in, i. e. the inaccuracies caused
- - by linking Q_LOCACC or
- - by the national value Q_NVLOCACC or
- - by the default location inaccuracy
- and the centerDetectionInaccuracies.

3.2.14.5.4. View of diagram_determinePreviousLinkedBG (recalculate_BG_locations_ahead_itr)

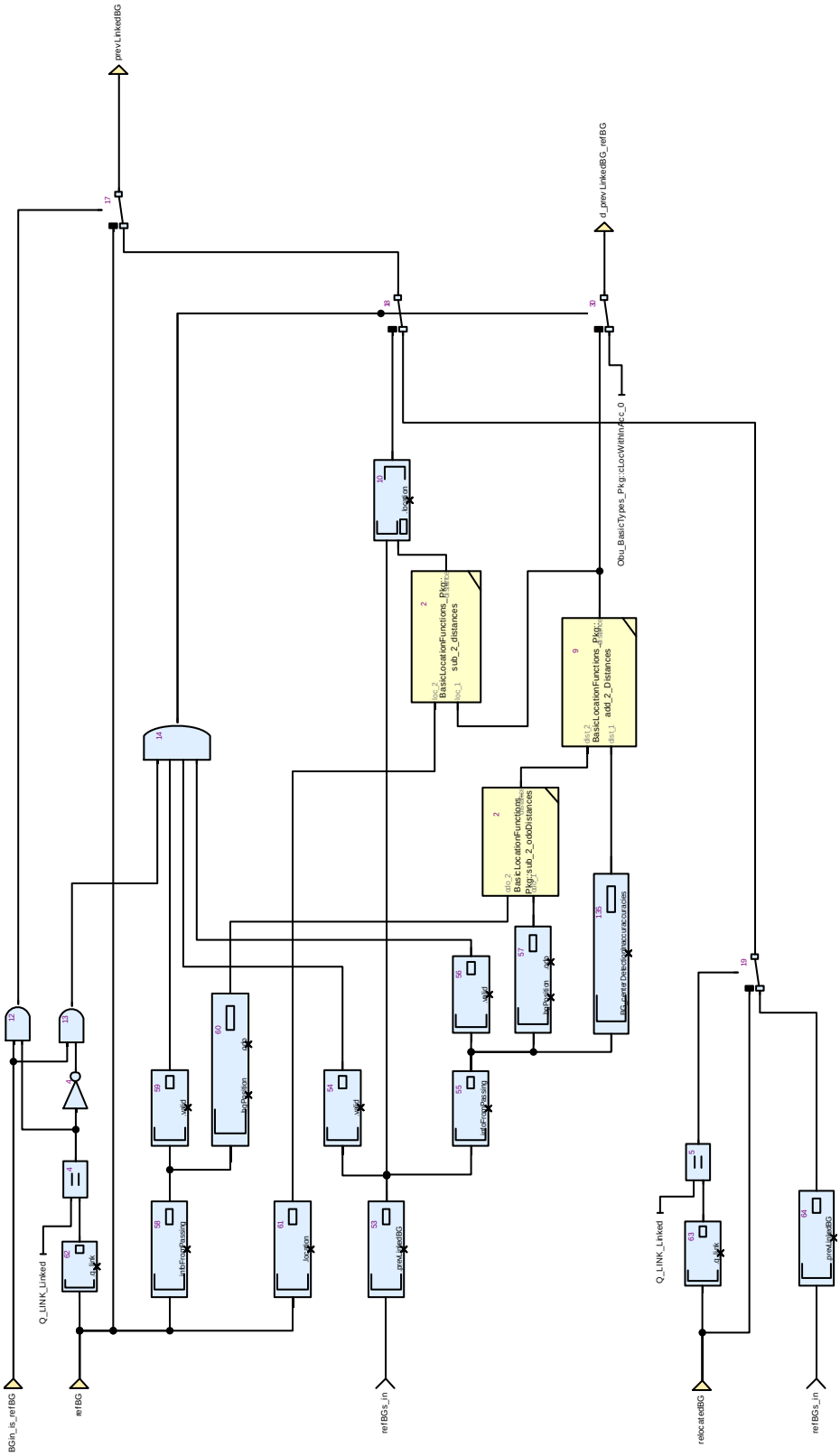

Figure 29: View of diagram_determinePreviousLinkedBG (recalculate_BG_locations_ahead_itr)

diagram_determinePreviousLinkedBG Comments:

- Determines the previous linked BG.

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

3.2.14.5.5. View of diagram_determinePreviousUnlinkedBG (recalculate_BG_locations_ahead_itr)

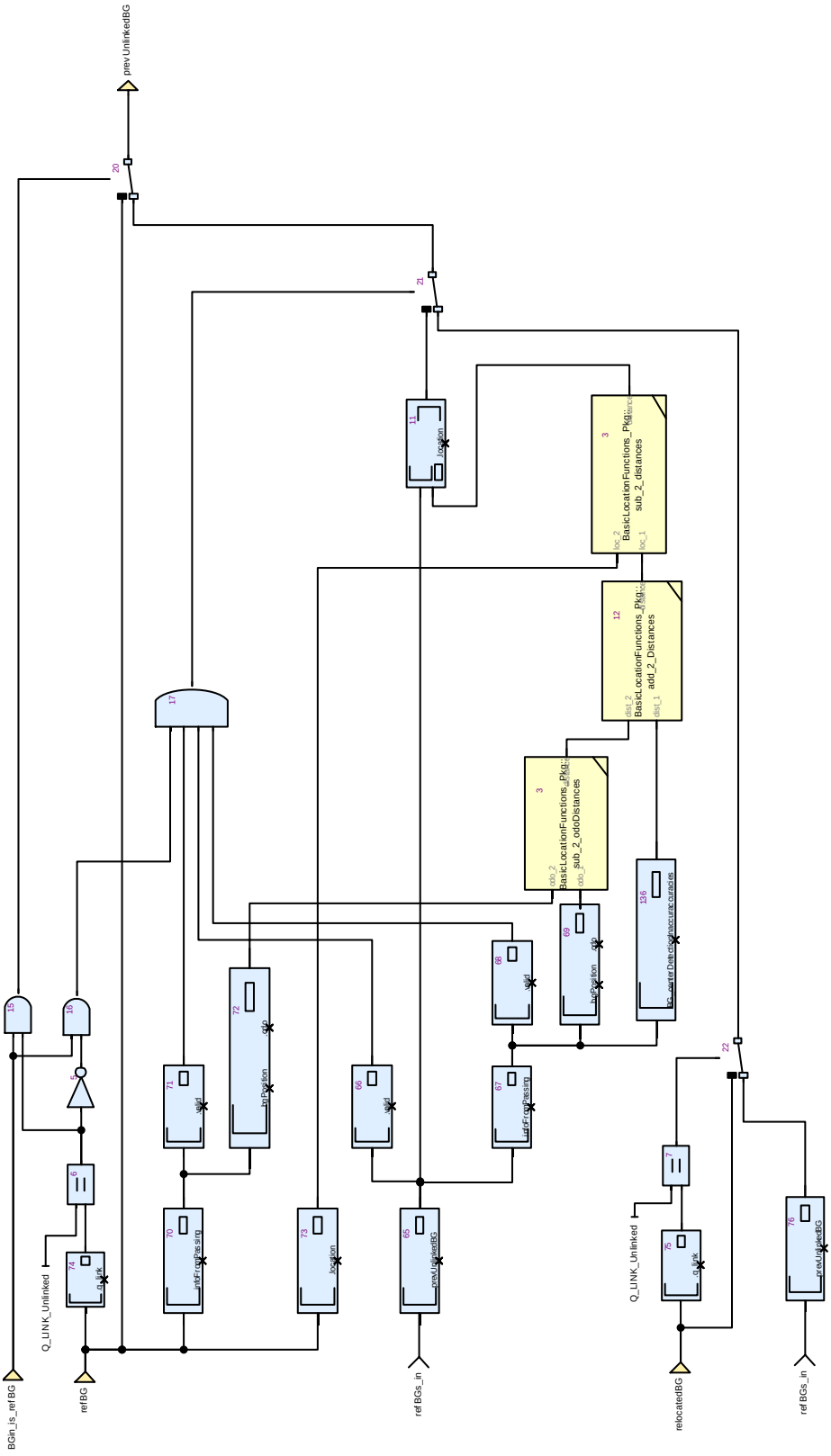

Figure 30: View of diagram_determinePreviousUnlinkedBG (recalculate_BG_locations_ahead_itr)

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.

3.2.14.5.6. View of diagram_recalculate_BG_location (recalculate_BG_locations_ahead_itr)

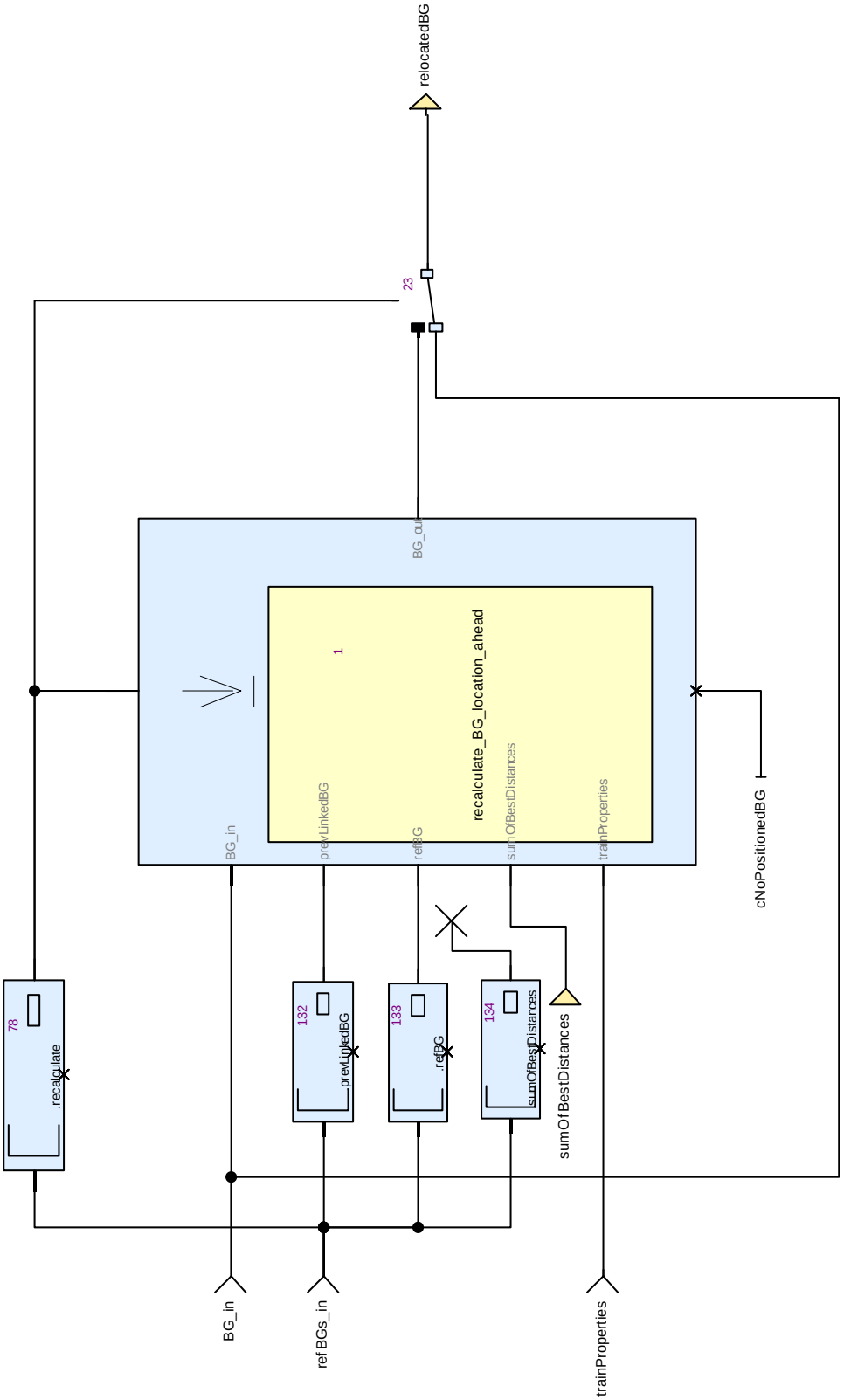

Figure 31: View of diagram_recalculate_BG_location (recalculate_BG_locations_ahead_itr)

3.2.14.5.7. View of diagram_recalculate_refBG_location (recalculate_BG_locations_ahead_itr)

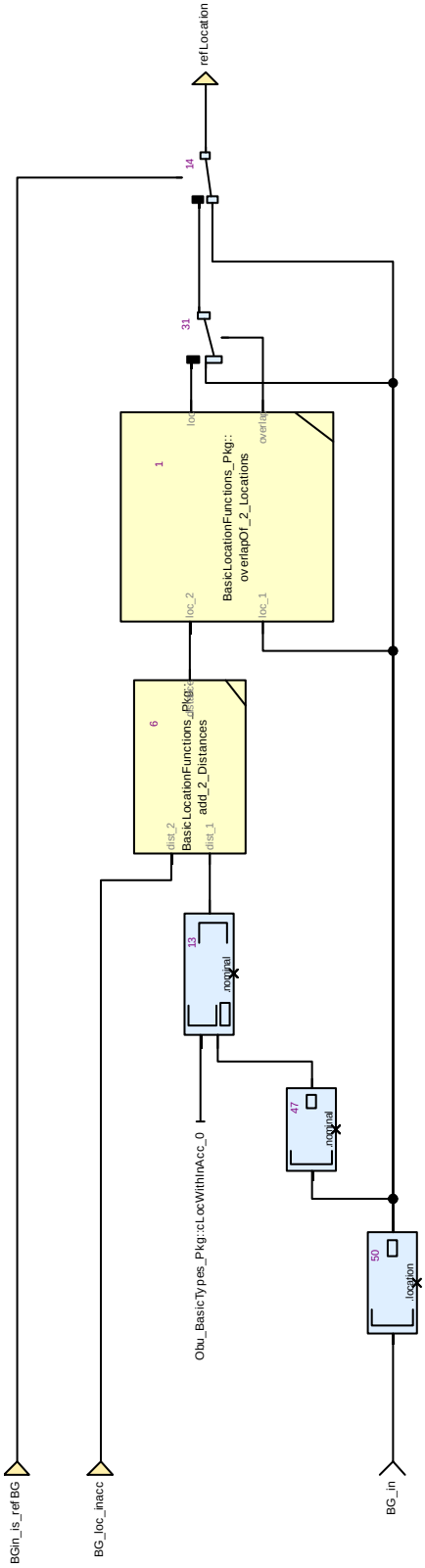

Figure 32: View of diagram_recalculate_refBG_location (recalculate_BG_locations_ahead_itr)

diagram_recalculate_refBG_location Comments:

- Recalculate the location of the reference BG.

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

3.2.14.5.8. View of diagram_sumOfPrevBestDistances (recalculate_BG_locations_ahead_itr)

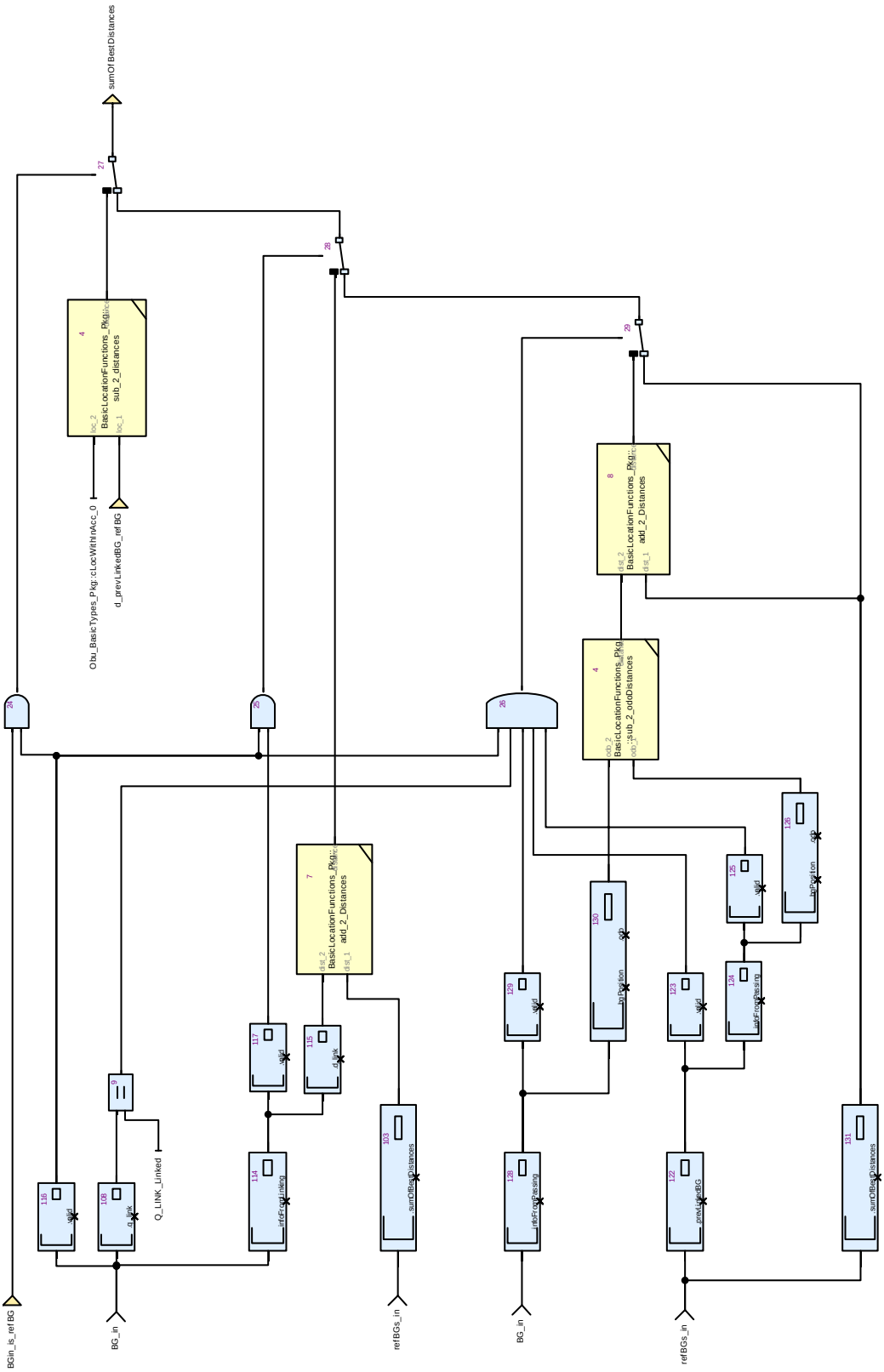

Figure 33: View of diagram_sumOfPrevBestDistances (recalculate_BG_locations_ahead_itr)

diagram_sumOfPrevBestDistances Comments:

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

3.2.15. recalculate_BG_locations_astern Operator

Declared as **`private function`**

3.2.15.1. Comments and Information

recalculate_BG_locations_astern Comments:

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

3.2.15.2. Interface

Table 69: Inputs of recalculate_BG_locations_astern

Name	Type	Properties	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		
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	Comments: The trains properties required for train position calculation.

Table 70: Outputs of recalculate_BG_locations_astern

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

3.2.15.3. Operator Hierarchy

diagram : diagram_recalculate_BG_locations_astern_1

3.2.15.4. Graphical and Textual Diagrams

3.2.15.4.1. View of diagram_recalculate_BG_locations_astern_1 (recalculate_BG_locations_astern)

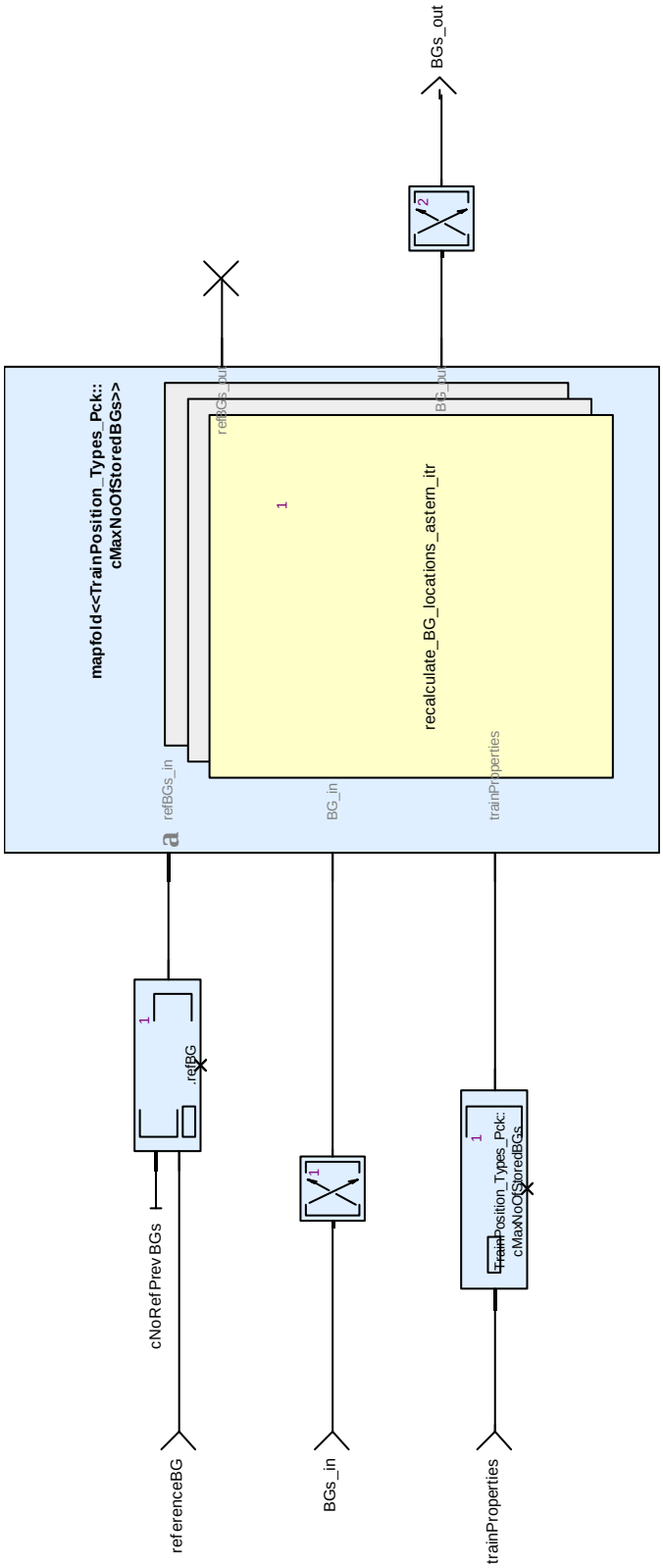

Figure 34: View of diagram_recalculate_BG_locations_astern_1 (recalculate_BG_locations_astern)

3.2.16. recalculate_BG_locations_astern_itr Operator

Declared as **`private function`**

3.2.16.1. Comments and Information

recalculate_BG_locations_astern_itr Comments:

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

3.2.16.2. Interface

Table 71: Inputs of recalculate_BG_locations_astern_itr

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

Table 72: 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.

3.2.16.3. Locals

Table 73: 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	

Name	Type	Comments and Information
refBG	TrainPosition_Types_Pck::positionedBG_T	
relocatedBG	TrainPosition_Types_Pck::positionedBG_T	
sumOfBestDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T	Comments: Accumulates the distances with between refBG and a linked BG_in.

3.2.16.4. Operator Hierarchy

diagram : diagram_assembleResults
diagram : diagram_assign_refBG
diagram : diagram_determinePreviousLinkedBG
diagram : diagram_determinePreviousUnlinkedBG
diagram : diagram_recalculate_BG_location
diagram : diagram_sumOfPrevBestDistances

3.2.16.5. Graphical and Textual Diagrams

3.2.16.5.1. View of diagram_assembleResults (recalculate_BG_locations_astern_itr)

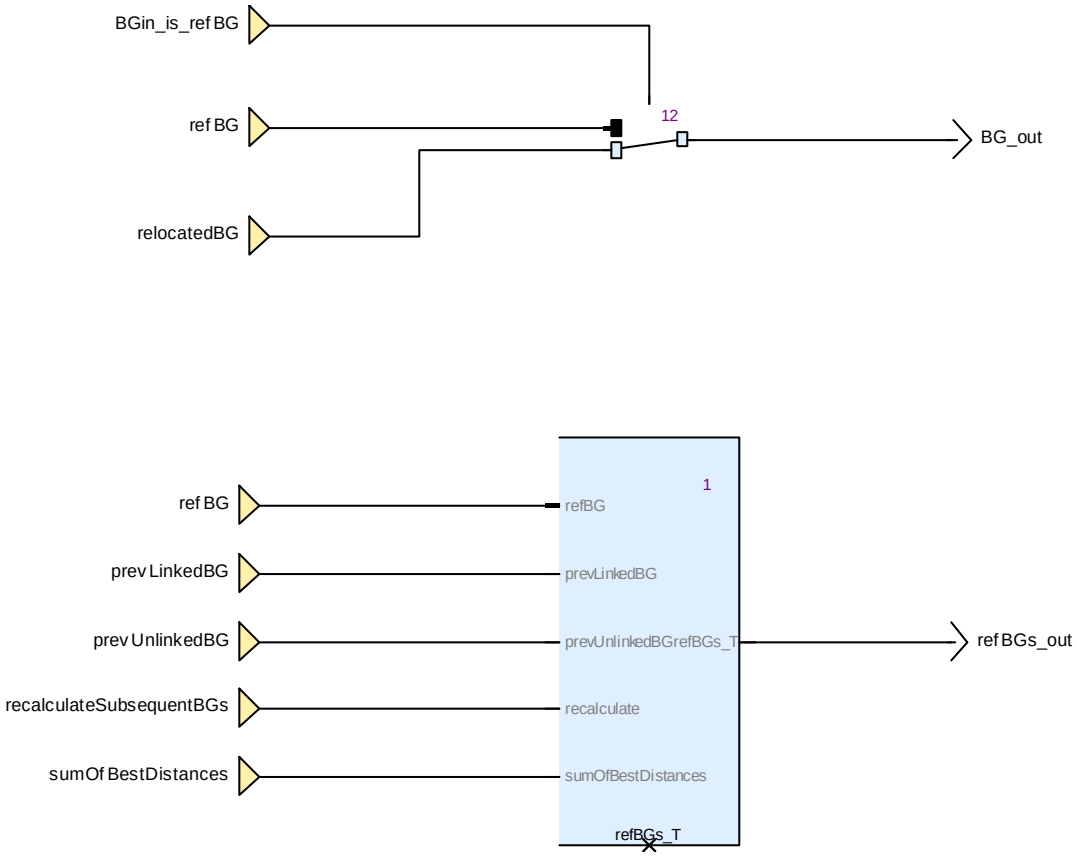

Figure 35: View of diagram_assembleResults (recalculate_BG_locations_astern_itr)

diagram_assembleResults Comments:

- Assembles the outputs.

3.2.16.5.2. View of diagram_assign_refBG (recalculate_BG_locations_astern_itr)

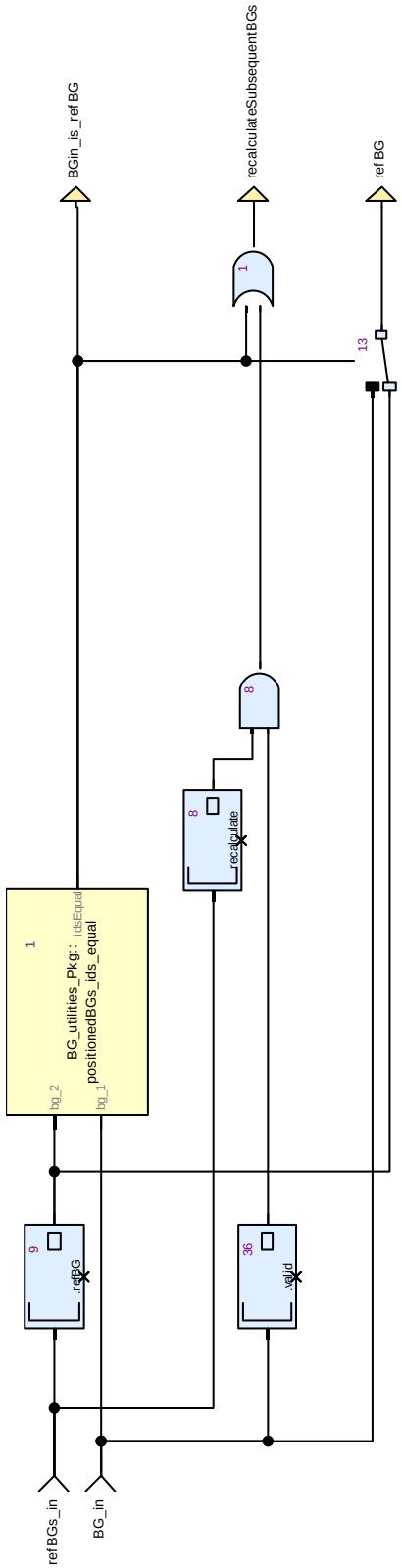

Figure 36: View of diagram_assign_refBG (recalculate_BG_locations_astern_itr)

diagram_assign_refBG Comments:

- Determines if BG_in is the reference BG.

- If yes, the location of the reference BG has to be taken from BG_in instead of refBGs_in, since the location of the reference BG was recalculated in the previous “recalculate_BG_locations_ahead” function.
- For all subsequent BGs in the iteration, the locations have to recalculated.
- For all BGs in the iteration before the reference BGs, the locations are kept unchanged.

3.2.16.5.3. View of diagram_determinePreviousLinkedBG (recalculate_BG_locations_astern_itr)

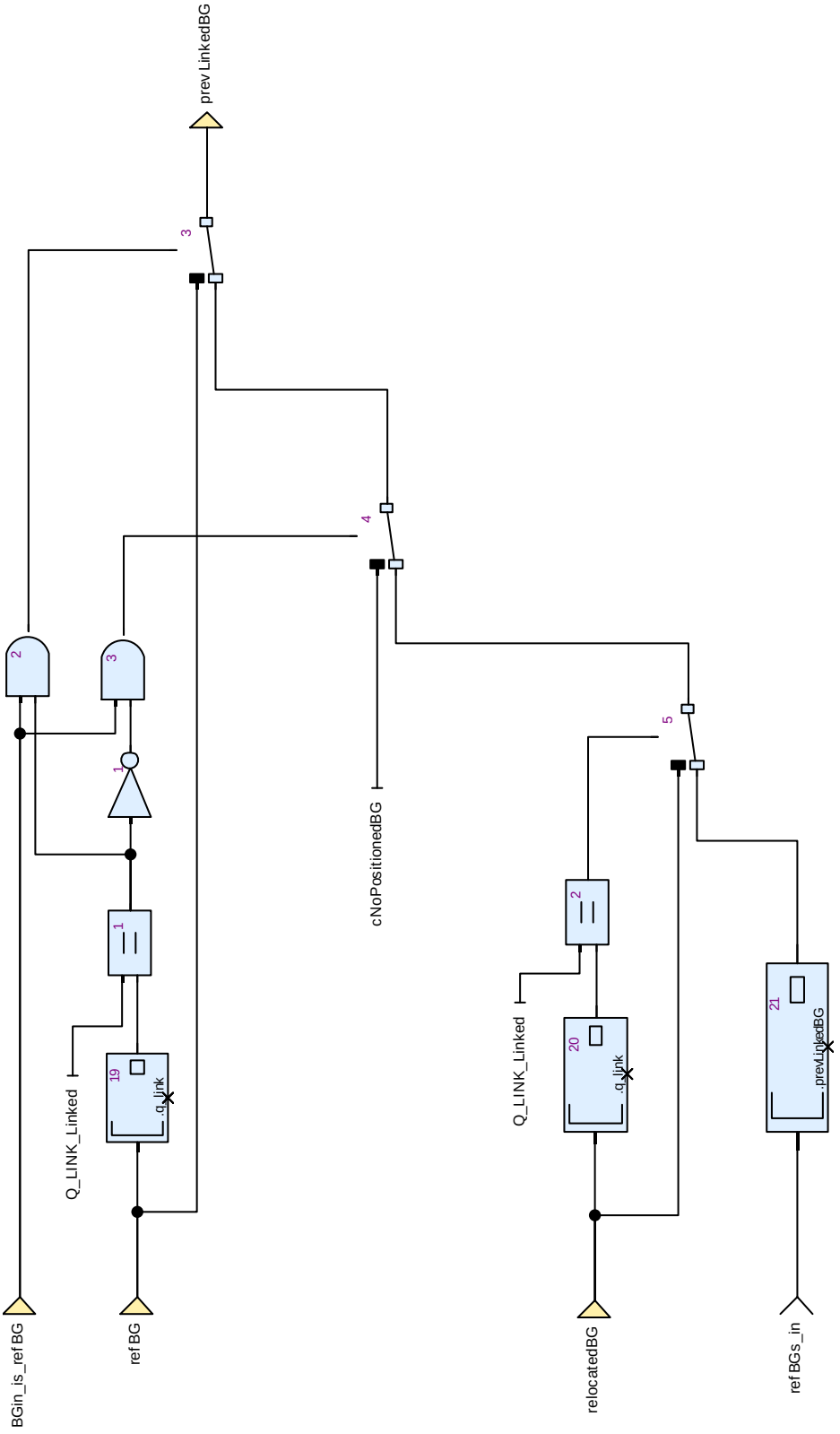

Figure 37: View of diagram_determinePreviousLinkedBG (recalculate_BG_locations_astern_itr)

diagram_determinePreviousLinkedBG Comments:

- Determines the previous linked BG.

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

3.2.16.5.4. View of diagram_determinePreviousUnlinkedBG (recalculate_BG_locations_astern_itr)

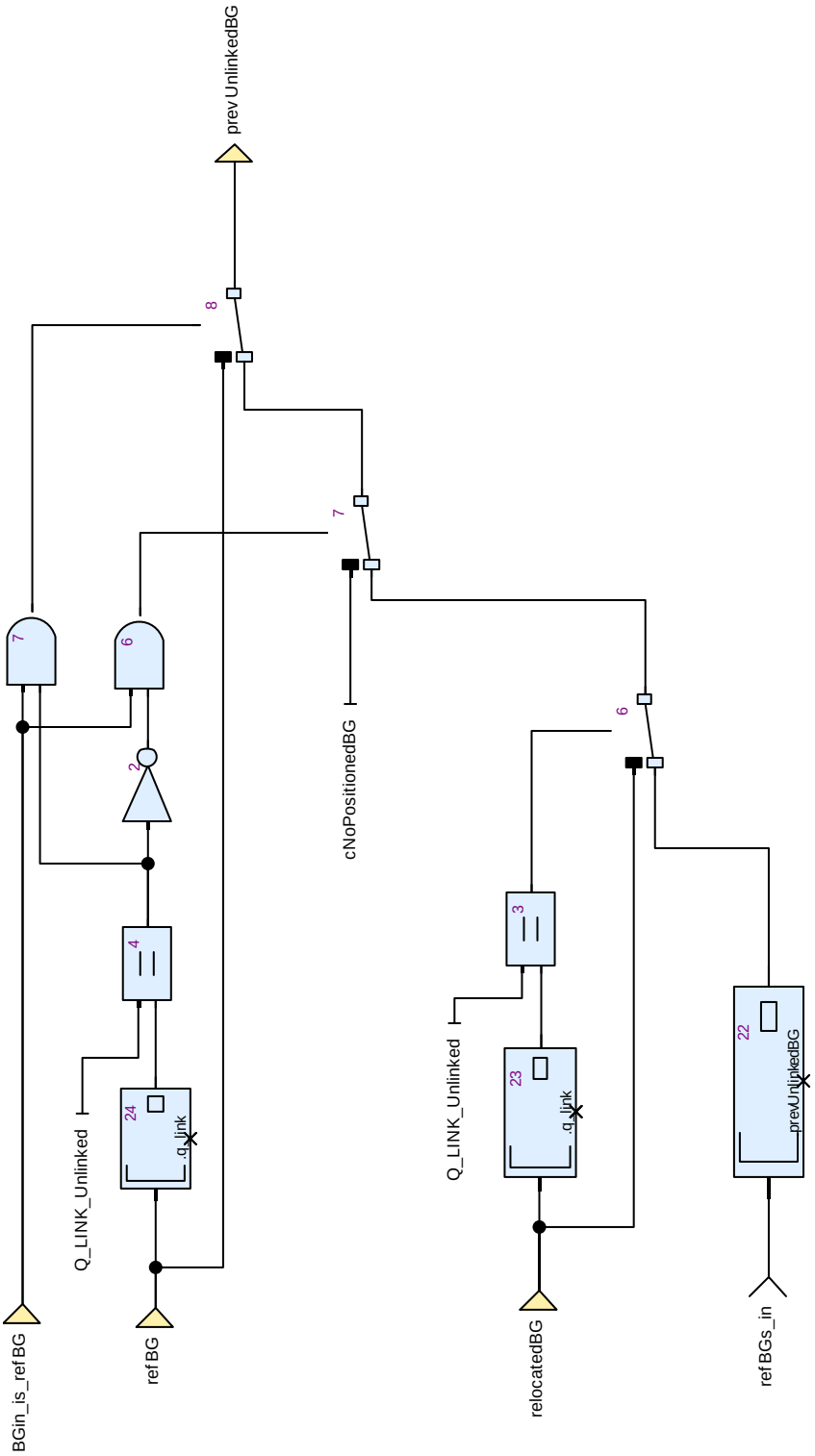

Figure 38: View of diagram_determinePreviousUnlinkedBG (recalculate_BG_locations_astern_itr)

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 set to no BG (cNoPositionedBG).
- If BG_in is not the reference BG and is an unlinked BG, prevLinkedBG is set to the relocated BG_in.
- If BG_in is not the reference BG and is not an unlinked BG, prevUnlinkedBG is taken from refBGs_in.prevUnlinkedBG.

3.2.16.5.5. View of diagram_recalculate_BG_location (recalculate_BG_locations_astern_itr)

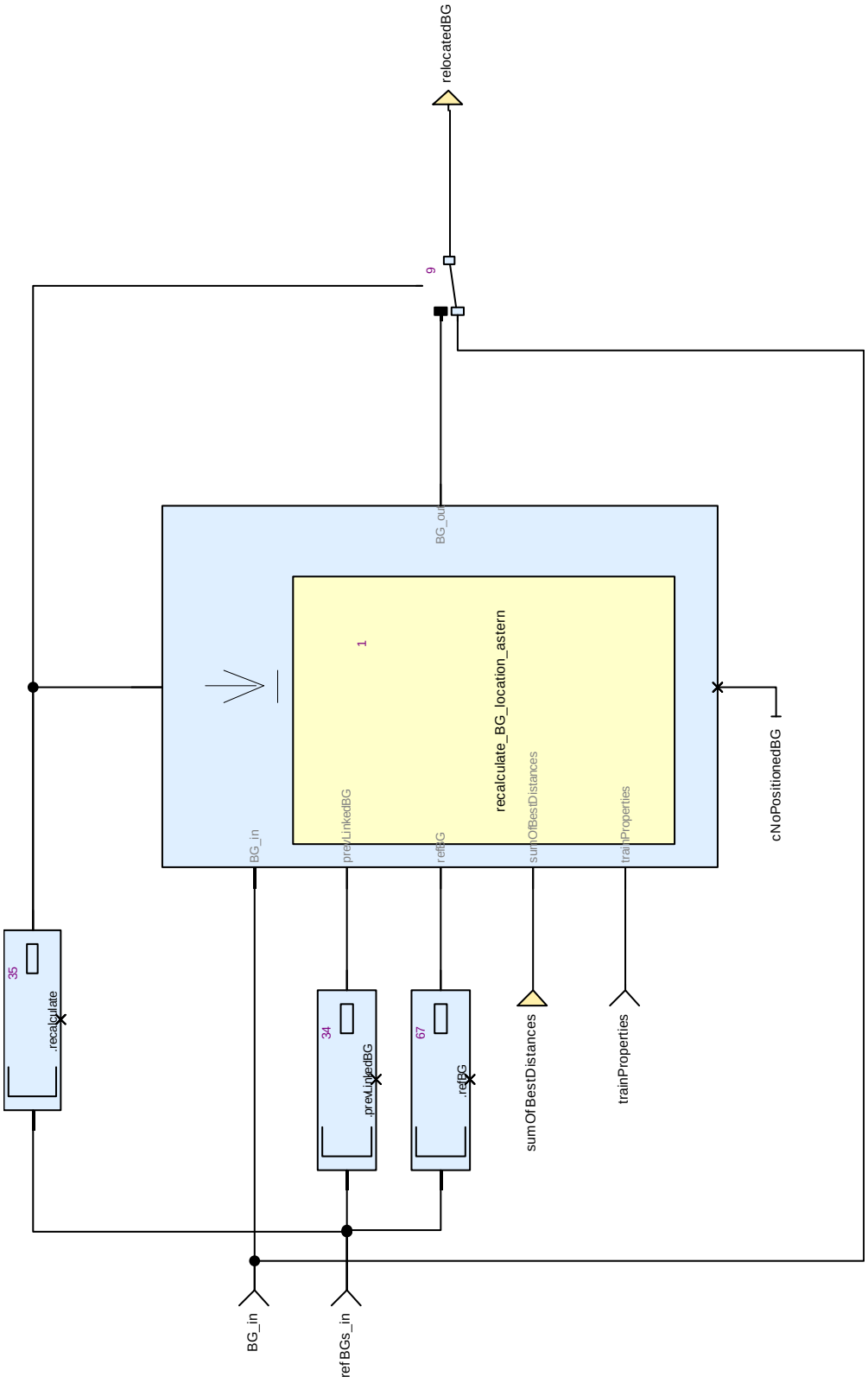

Figure 39: View of diagram_recalculate_BG_location (recalculate_BG_locations_astern_itr)

diagram_recalculate_BG_location Comments:

- Recalculates the location of BG_in.

3.2.16.5.6. View of diagram_sumOfPrevBestDistances (recalculate_BG_locations_astern_itr)

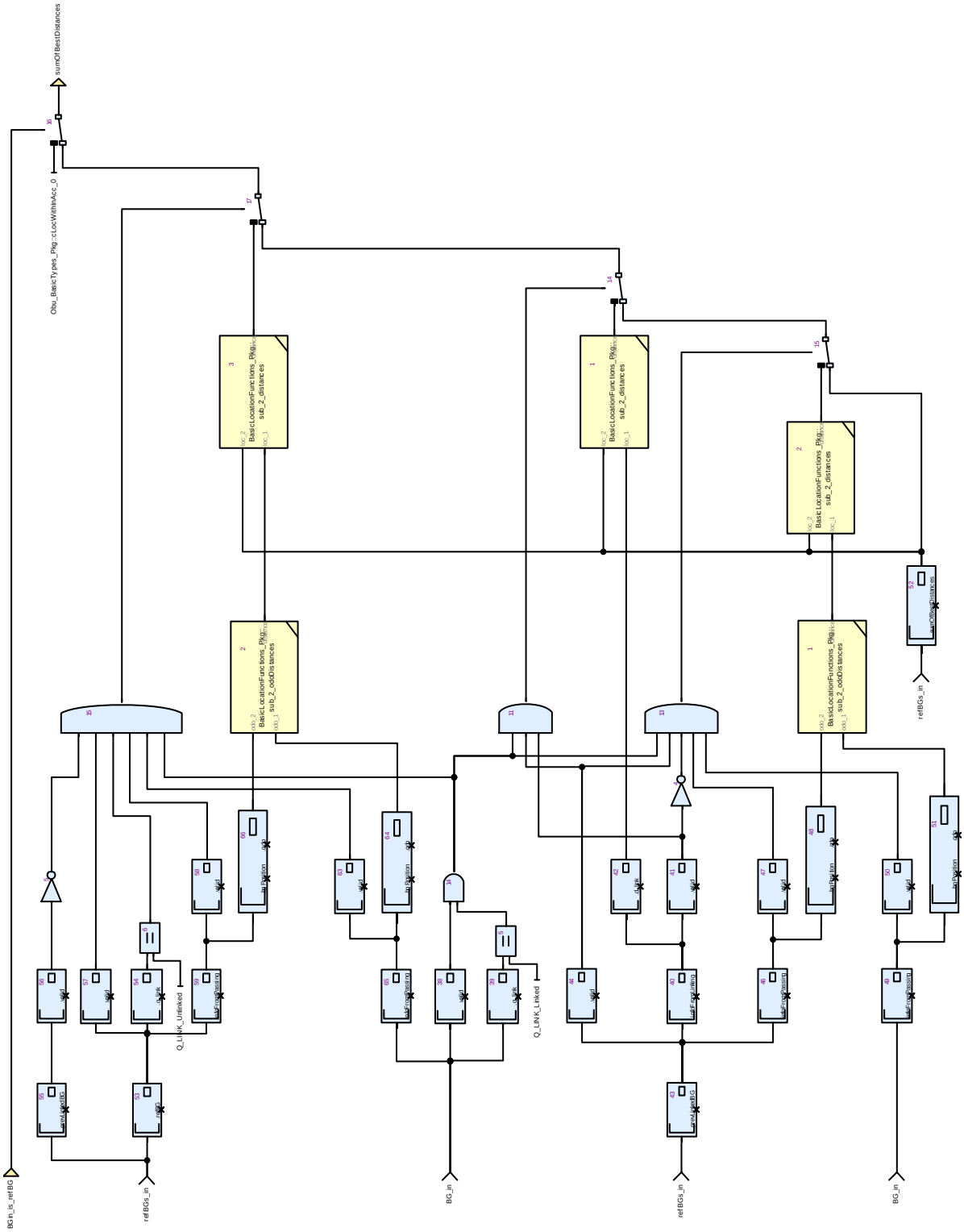

Figure 40: View of diagram_sumOfPrevBestDistances (recalculate_BG_locations_astern_itr)

diagram_sumOfPrevBestDistances Comments:

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

3.3. CalculateTrainPosition_Pkg::BG_utilities_Pkg Package

3.3.1. Types

Table 74: 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

3.3.2. Constants

Table 75: 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, q_dir : Q_DIR_Reverse, 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, bgPosition : {valid : false, timestamp : 0, odo : {o_nominal : 0, o_min : 0, o_max : 0}, speed : 0, acceleration : 0, motionState : Obu_BasicTypes_Pkg::noMotion, motionDirection : Obu_BasicTypes_Pkg::unknownDirection}, BG_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, q_nvlocacc : 0, BG_Header : {q_updown : Q_UPDOWN_Down_link_telegram, m_version : M_VERSION_Previo	

3.3.3. countBGs Operator

Declared as **`public function`**

3.3.3.1. Comments and Information

countBGs Comments:

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

3.3.3.2. Interface

Table 76: Inputs of countBGs

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

Table 77: 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	

3.3.3.3. Operator Hierarchy

diagram : diagram_countBGs_1

3.3.3.4. Graphical and Textual Diagrams

3.3.3.4.1. View of diagram_countBGs_1 (countBGs)

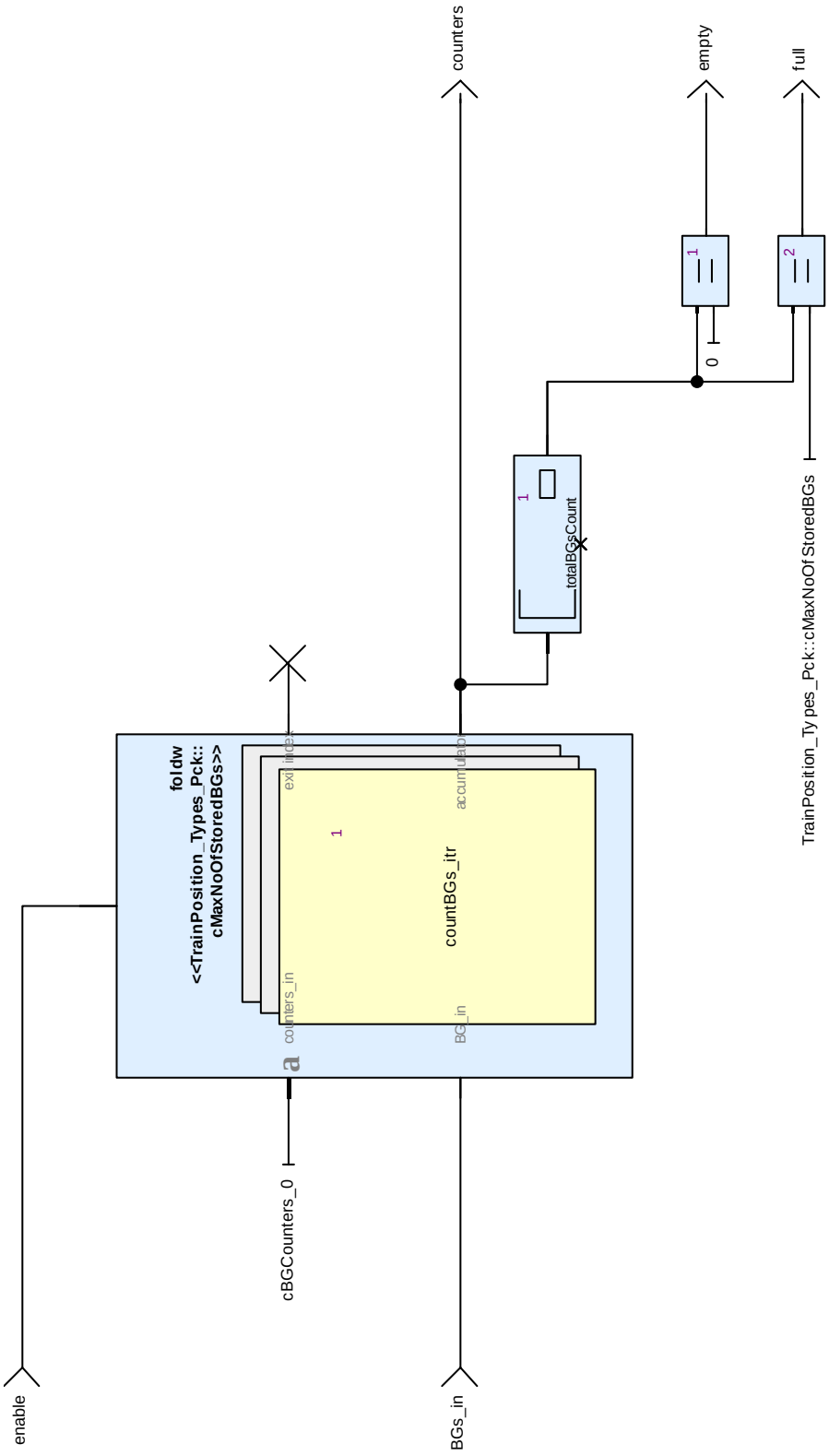

Figure 41: View of diagram_countBGs_1 (countBGs)

3.3.4. countBGs_itr Operator

Declared as **`private function`**

3.3.4.1. Comments and Information

countBGs_itr Comments:

- Iterated function for countBGs

3.3.4.2. Interface

Table 78: 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 79: Outputs of countBGs_itr

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

3.3.4.3. Operator Hierarchy

diagram : diagram_countBGs_itr_1

3.3.4.4. Graphical and Textual Diagrams

3.3.4.4.1. View of diagram_countBGs_itr_1 (countBGs_itr)

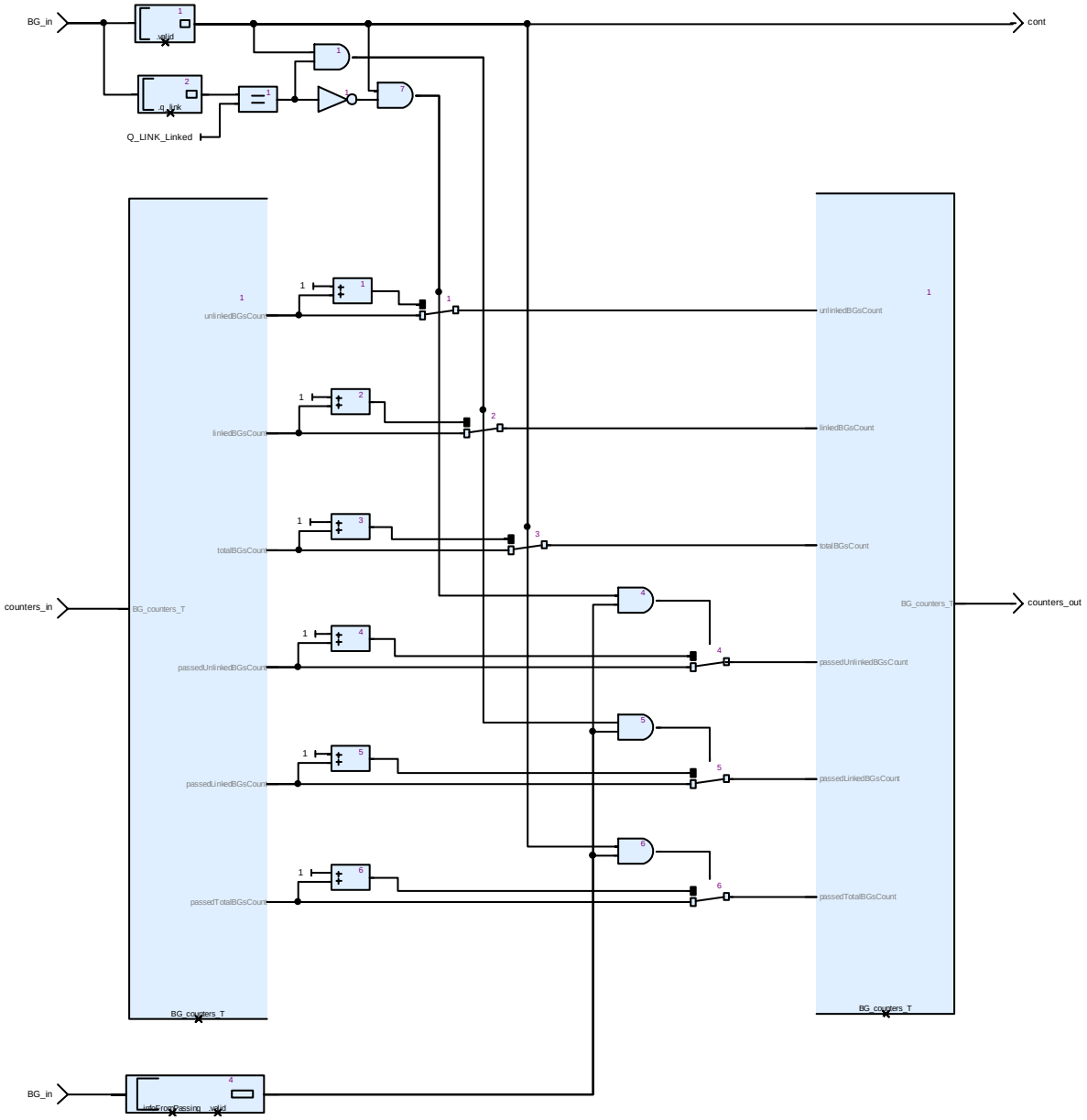

Figure 42: View of diagram_countBGs_itr_1 (countBGs_itr)

3.3.5. deleteBG_atIndex Operator

Declared as **`public function`**

3.3.5.1. 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.

3.3.5.2. Interface

Table 80: 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 81: Outputs of deleteBG_atIndex

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

3.3.5.3. Operator Hierarchy

diagram : diagram_deleteBG_atIndex_1

3.3.5.4. Graphical and Textual Diagrams

3.3.5.4.1. View of diagram_deleteBG_atIndex_1 (deleteBG_atIndex)

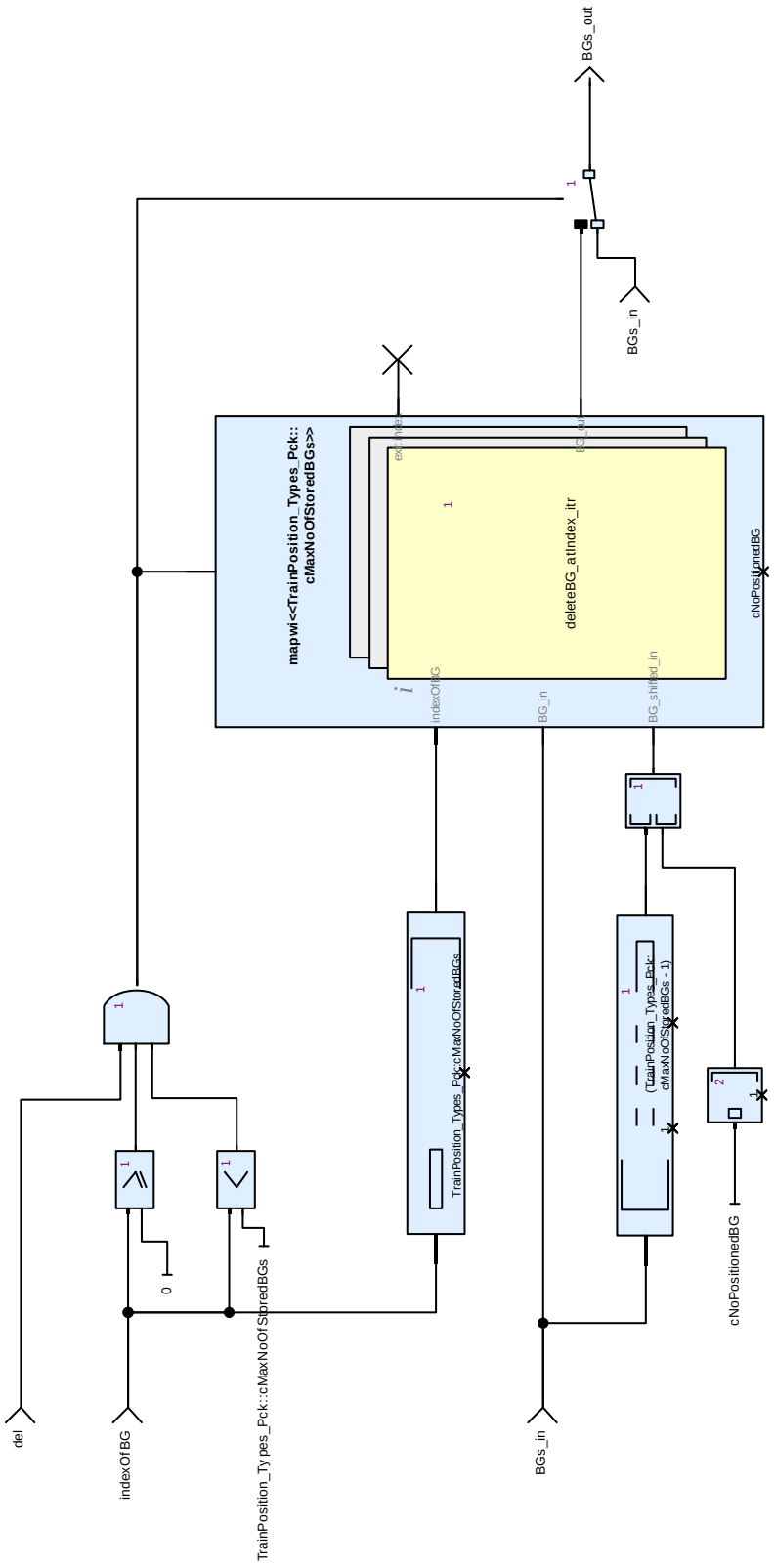

Figure 43: View of diagram_deleteBG_atIndex_1 (deleteBG_atIndex)

3.3.6. deleteBG_atIndex_itr Operator

Declared as **`private function`**

3.3.6.1. Comments and Information

deleteBG_atIndex_itr Comments:

- Iterated function used by deleteBG_atIndex

3.3.6.2. Interface

Table 82: 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 83: Outputs of deleteBG_atIndex_itr

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

3.3.6.3. Operator Hierarchy

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

3.3.6.4. Graphical and Textual Diagrams

3.3.6.4.1. View of diagram_deleteBG_atIndex_itr_1 (deleteBG_atIndex_itr)

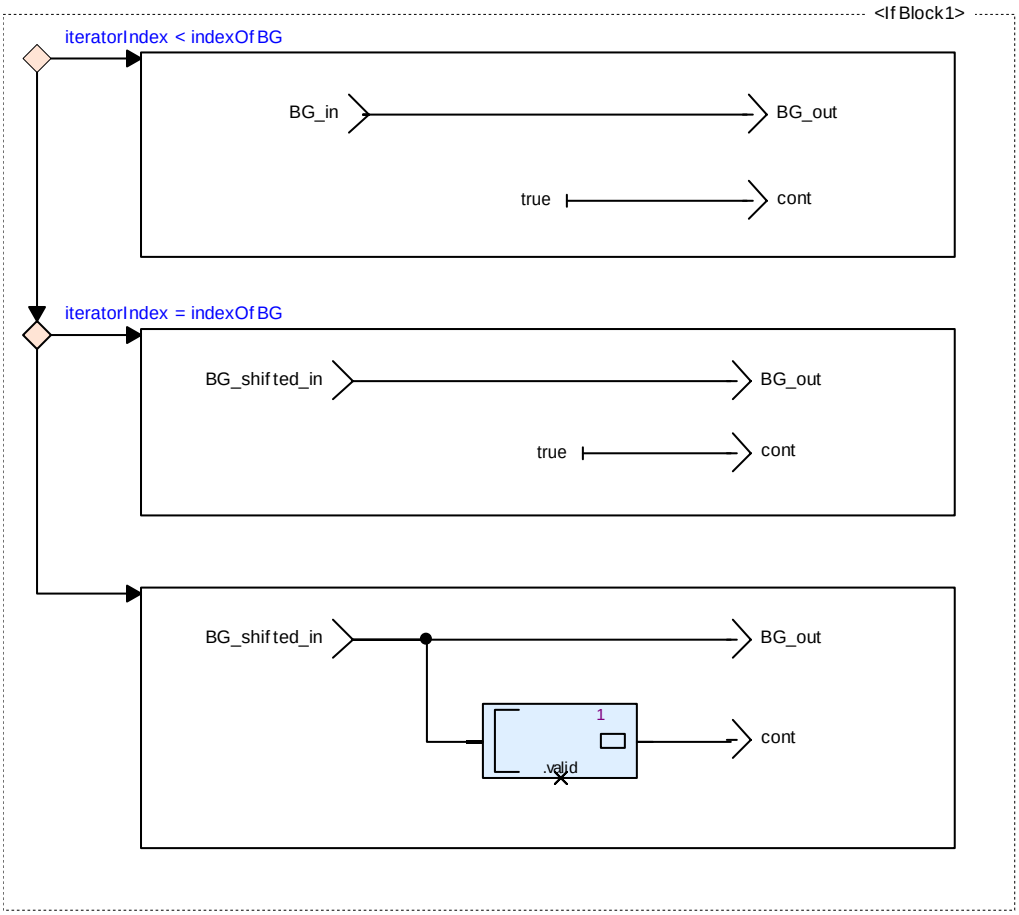

Figure 44: View of diagram_deleteBG_atIndex_itr_1 (deleteBG_atIndex_itr)

Table 84: Conditional Blocks of diagram_deleteBG_atIndex_itr_1

Conditional Block	Comments and Information
IfBlock1	

Table 85: Actions of diagram_deleteBG_atIndex_itr_1

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

3.3.7. deleteBGs_beforeIndex Operator

Declared as **`public function`**

3.3.7.1. Comments and Information

deleteBGs_beforeIndex Comments:

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

3.3.7.2. Interface

Table 86: 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 87: Outputs of deleteBGs_beforeIndex

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

3.3.7.3. Operator Hierarchy

diagram : diagram_deleteBGs_beforeIndex_1

3.3.7.4. Graphical and Textual Diagrams

3.3.7.4.1. View of diagram_deleteBGs_beforeIndex_1 (deleteBGs_beforeIndex)

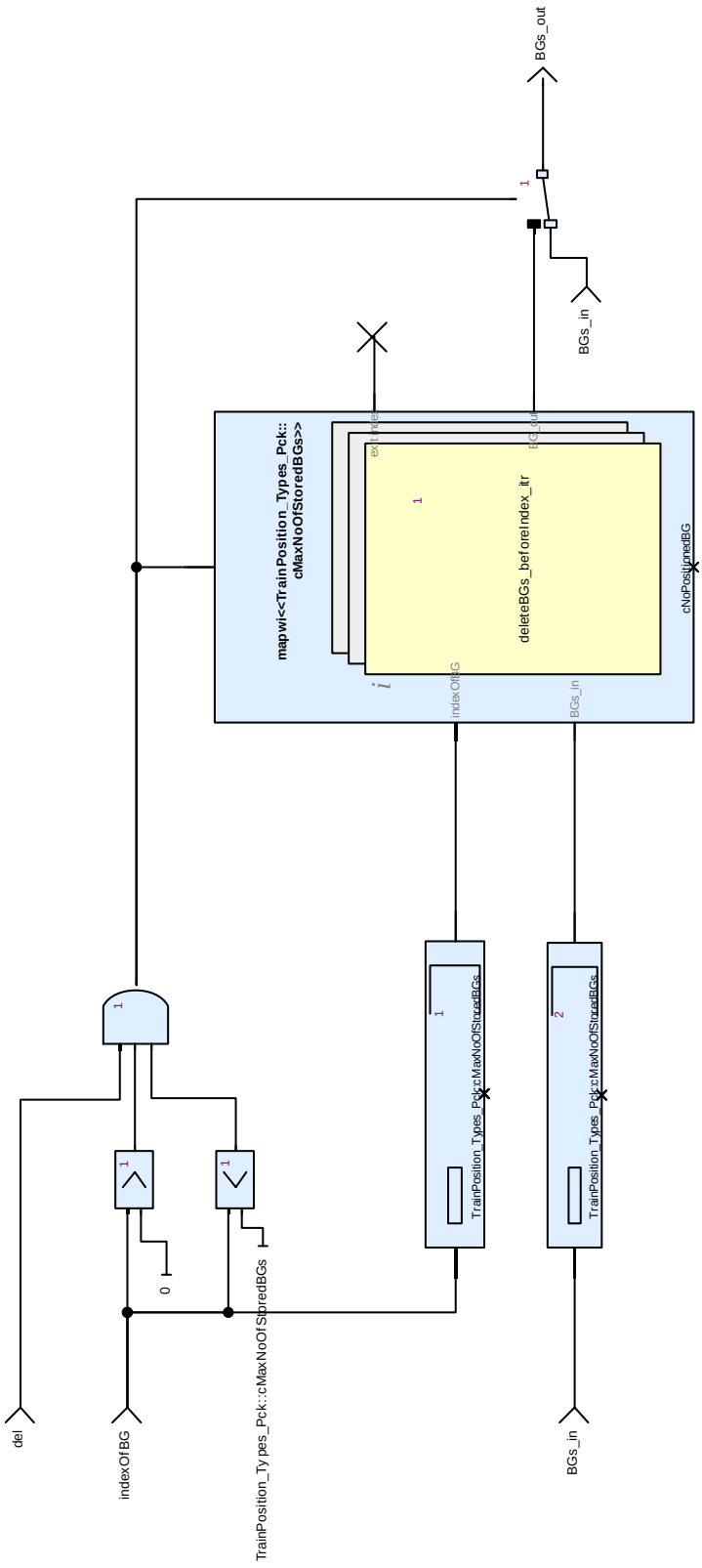

Figure 45: View of diagram_deleteBGs_beforeIndex_1 (deleteBGs_beforeIndex)

3.3.8. deleteBGs_beforeIndex_itr Operator

Declared as **`private function`**

3.3.8.1. Comments and Information

deleteBGs_beforeIndex_itr Comments:

- Iterated function used by deleteBGs_beforeIndex

3.3.8.2. Interface

Table 88: Inputs of deleteBGs_beforeIndex_itr

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

Table 89: Outputs of deleteBGs_beforeIndex_itr

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

3.3.8.3. Operator Hierarchy

diagram : diagram_deleteBGs_beforeIndex_itr_1

3.3.8.4. Graphical and Textual Diagrams

3.3.8.4.1. View of diagram_deleteBGs_beforeIndex_itr_1 (deleteBGs_beforeIndex_itr)

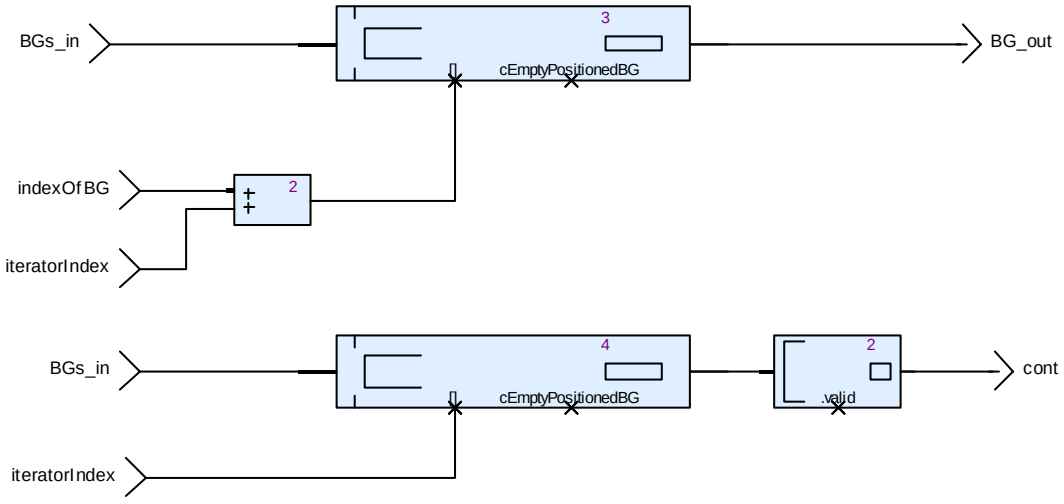

Figure 46: View of diagram_deleteBGs_beforeIndex_itr_1 (deleteBGs_beforeIndex_itr)

3.3.9. deleteBGs_fromIndex Operator

Declared as **`public function`**

3.3.9.1. Comments and Information

deleteBGs_fromIndex Comments:

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

3.3.9.2. Interface

Table 90: 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 91: Outputs of deleteBGs_fromIndex

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pck::positionedBGs_T	

3.3.9.3. Operator Hierarchy

diagram : diagram_deleteBGs_fromIndex_1

3.3.9.4. Graphical and Textual Diagrams

3.3.9.4.1. View of diagram_deleteBGs_fromIndex_1 (deleteBGs_fromIndex)

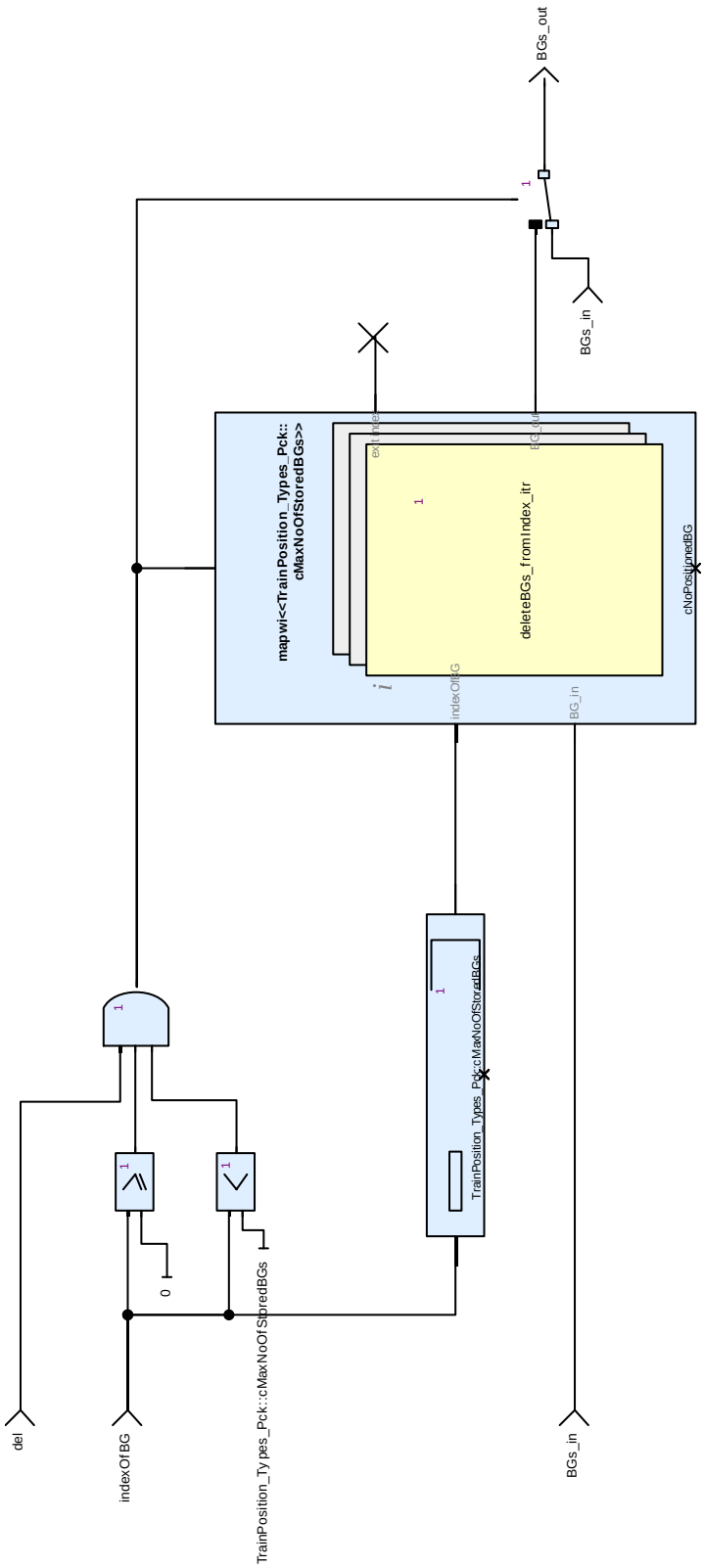

Figure 47: View of diagram_deleteBGs_fromIndex_1 (deleteBGs_fromIndex)

3.3.10. deleteBGs_fromIndex_itr Operator

Declared as **`private function`**

3.3.10.1. Comments and Information

deleteBGs_fromIndex_itr Comments:

- Iterated function used by deleteBGs_fromIndex

3.3.10.2. Interface

Table 92: Inputs of deleteBGs_fromIndex_itr

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

Table 93: Outputs of deleteBGs_fromIndex_itr

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

3.3.10.3. Operator Hierarchy

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

3.3.10.4. Graphical and Textual Diagrams

3.3.10.4.1. View of diagram_deleteBGs_fromIndex_itr_1 (deleteBGs_fromIndex_itr)

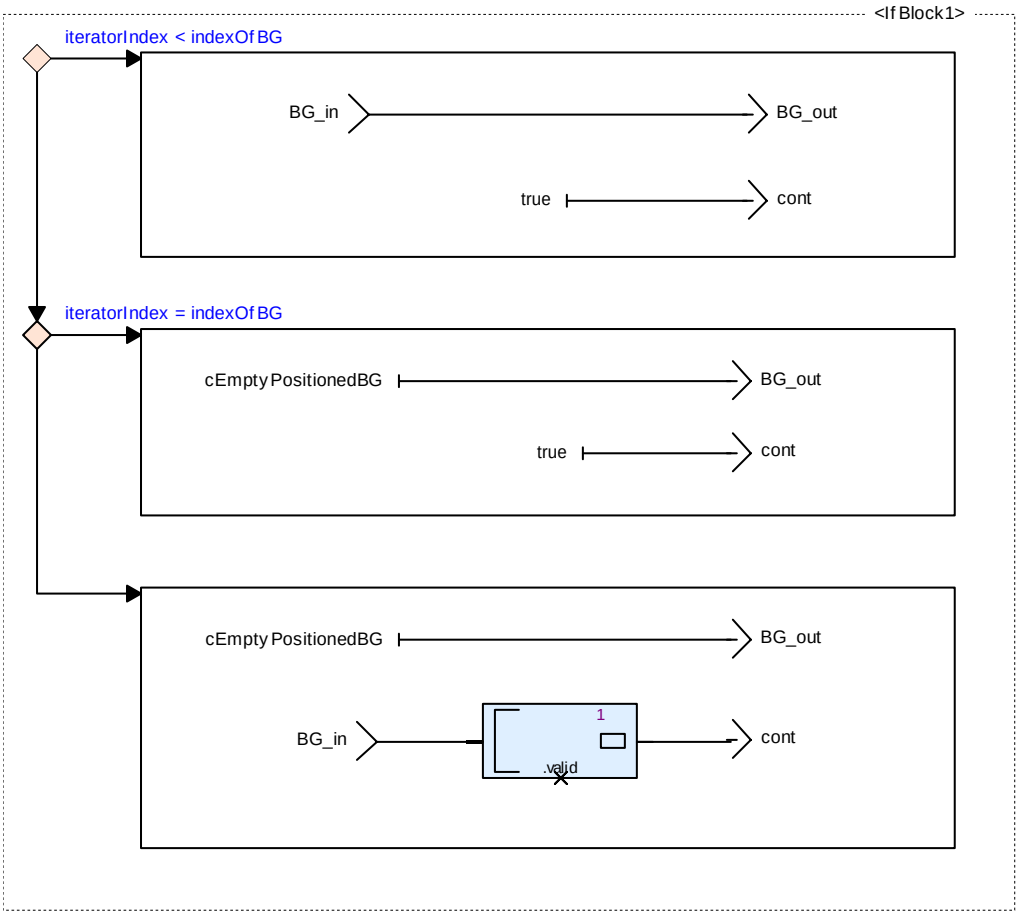

Figure 48: View of diagram_deleteBGs_fromIndex_itr_1 (deleteBGs_fromIndex_itr)

Table 94: Conditional Blocks of diagram_deleteBGs_fromIndex_itr_1

Conditional Block	Comments and Information
IfBlock1	

Table 95: Actions of diagram_deleteBGs_fromIndex_itr_1

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

3.3.11. indexOf_nthPassedBG Operator

Declared as **`public function`**

3.3.11.1. Comments and Information

indexOf_nthPassedBG Comments:

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

3.3.11.2. Interface

Table 96: 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 97: Outputs of indexOf_nthPassedBG

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

3.3.11.3. Operator Hierarchy

diagram : diagram_indexOf_nthPassedBG_1

3.3.11.4. Graphical and Textual Diagrams

3.3.11.4.1. View of diagram_indexOf_nthPassedBG_1 (indexOf_nthPassedBG)

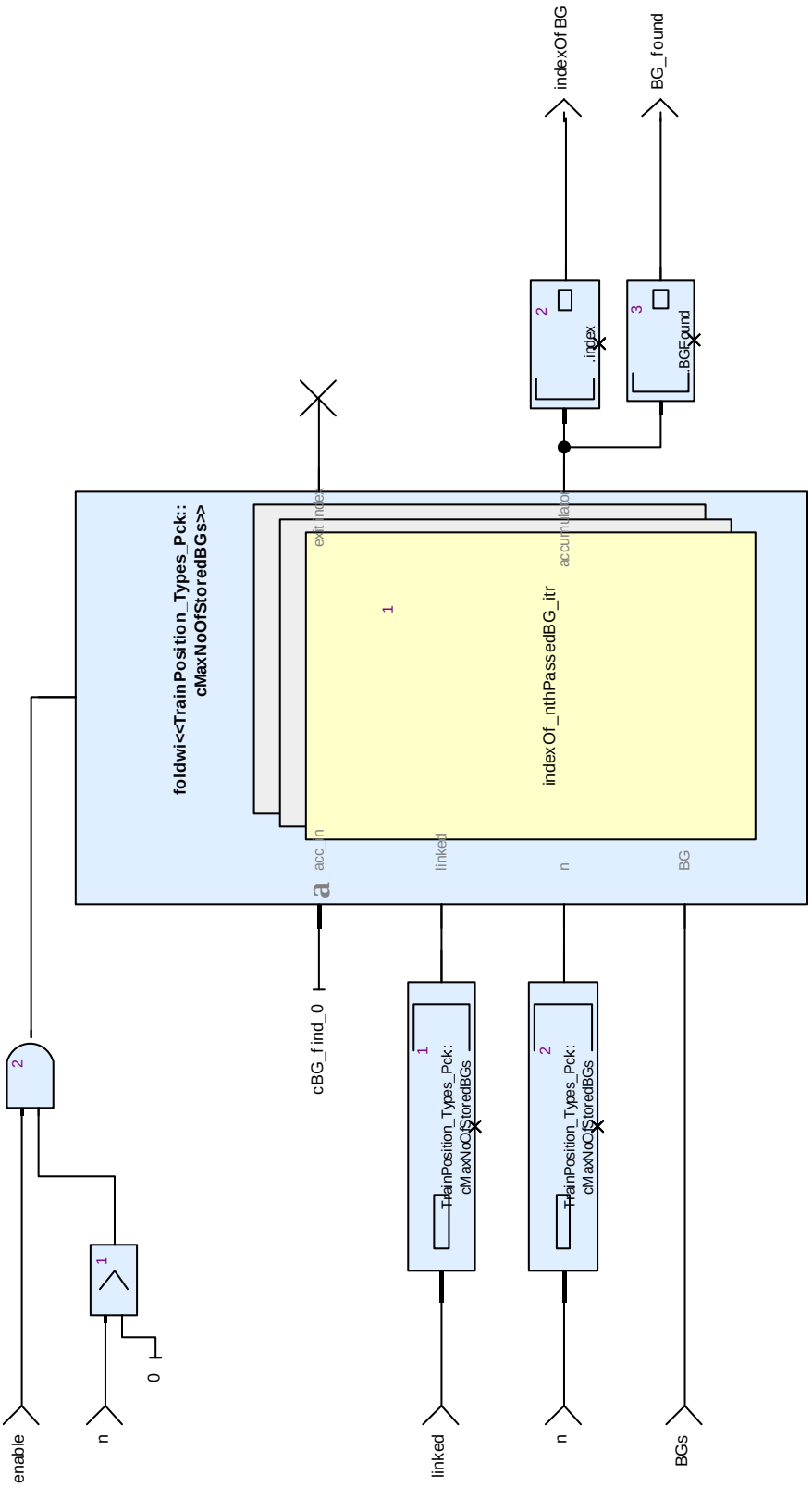

Figure 49: View of diagram_indexOf_nthPassedBG_1 (indexOf_nthPassedBG)

3.3.12. indexOf_nthPassedBG_itr Operator

Declared as **`private function`**

3.3.12.1. Comments and Information

indexOf_nthPassedBG_itr Comments:

- Iterated function for indexOf_nthPassedBG

Table 98: 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

3.3.12.2. Interface

Table 99: 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 100: Outputs of indexOf_nthPassedBG_itr

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

3.3.12.3. Operator Hierarchy

diagram : diagram_indexOf_nthPassedBG_itr_1

3.3.12.4. Graphical and Textual Diagrams

3.3.12.4.1. View of diagram_indexOf_nthPassedBG_itr_1 (indexOf_nthPassedBG_itr)

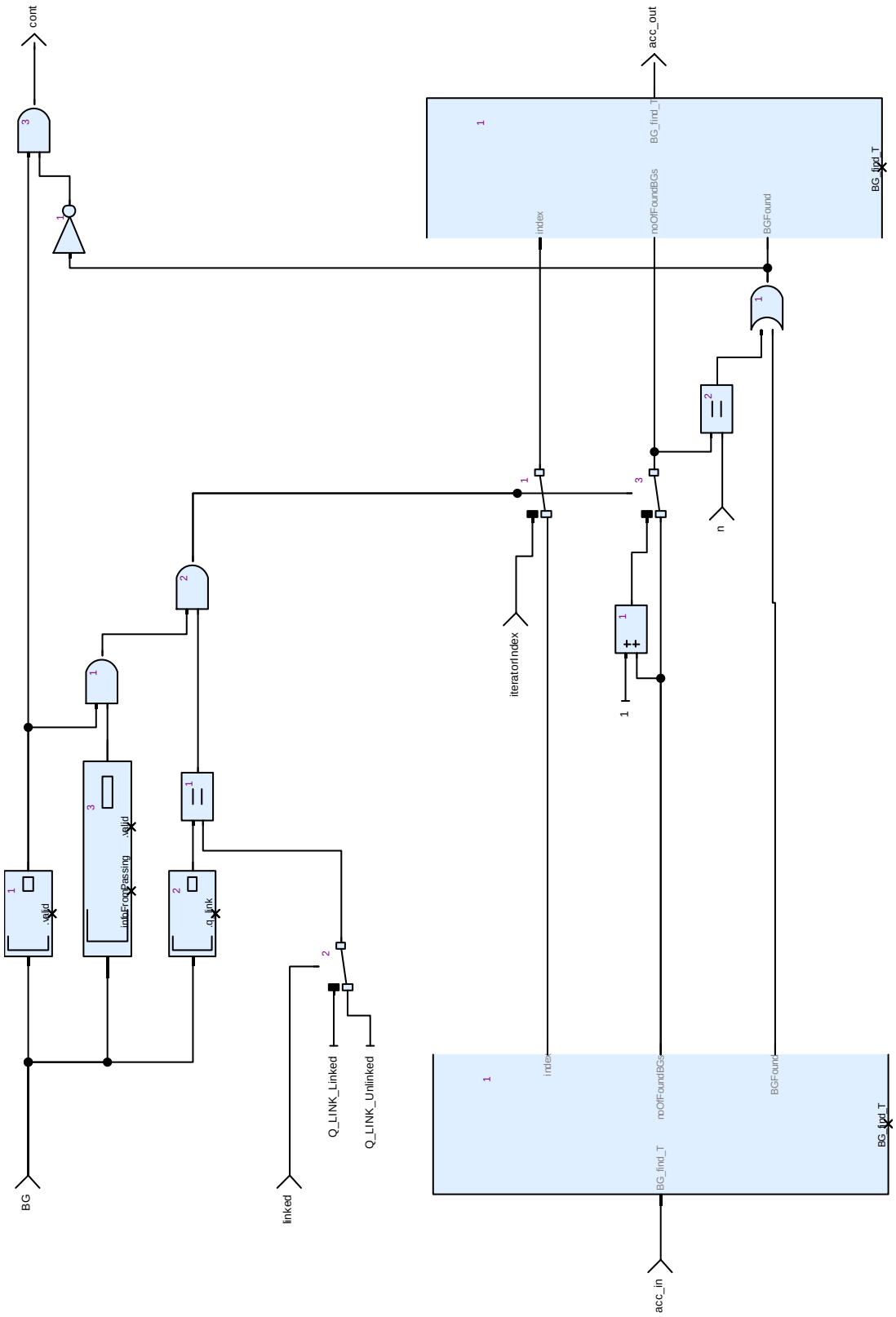

Figure 50: View of diagram_indexOf_nthPassedBG_itr_1 (indexOf_nthPassedBG_itr)

3.3.13. indexOfBG_by_id Operator

Declared as **`public function`**

3.3.13.1. 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 101: 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

3.3.13.2. Interface

Table 102: 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 103: 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.

3.3.13.3. Operator Hierarchy

diagram : diagram_indexOfBG_by_id_1

3.3.13.4. Graphical and Textual Diagrams

3.3.13.4.1. View of diagram_indexOfBG_by_id_1 (indexOfBG_by_id)

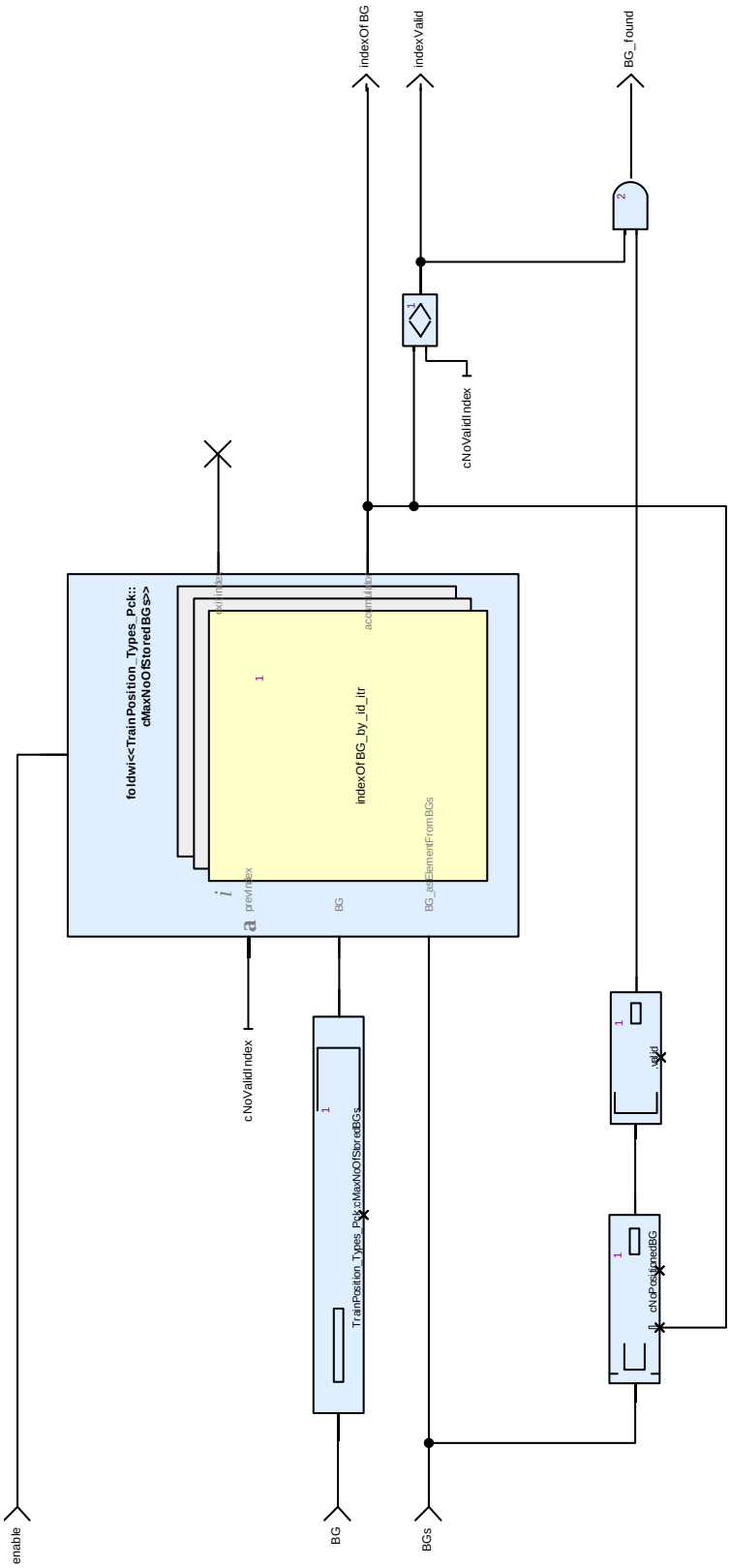

Figure 51: View of diagram_indexOfBG_by_id_1 (indexOfBG_by_id)

3.3.14. indexOfBG_by_id_itr Operator

Declared as **`private function`**

3.3.14.1. Comments and Information

indexOfBG_by_id_itr Comments:

- Iterated function for determing the index of BG in BGs

Table 104: 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

3.3.14.2. Interface

Table 105: 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 106: Outputs of indexOfBG_by_id_itr

Name	Type	Comments and Information
cont	bool	
indexOfBG	int	

3.3.14.3. Operator Hierarchy

diagram : diagram_indexOfBG_by_id_itr_1

3.3.14.4. Graphical and Textual Diagrams

3.3.14.4.1. View of diagram_indexOfBG_by_id_itr_1 (indexOfBG_by_id_itr)

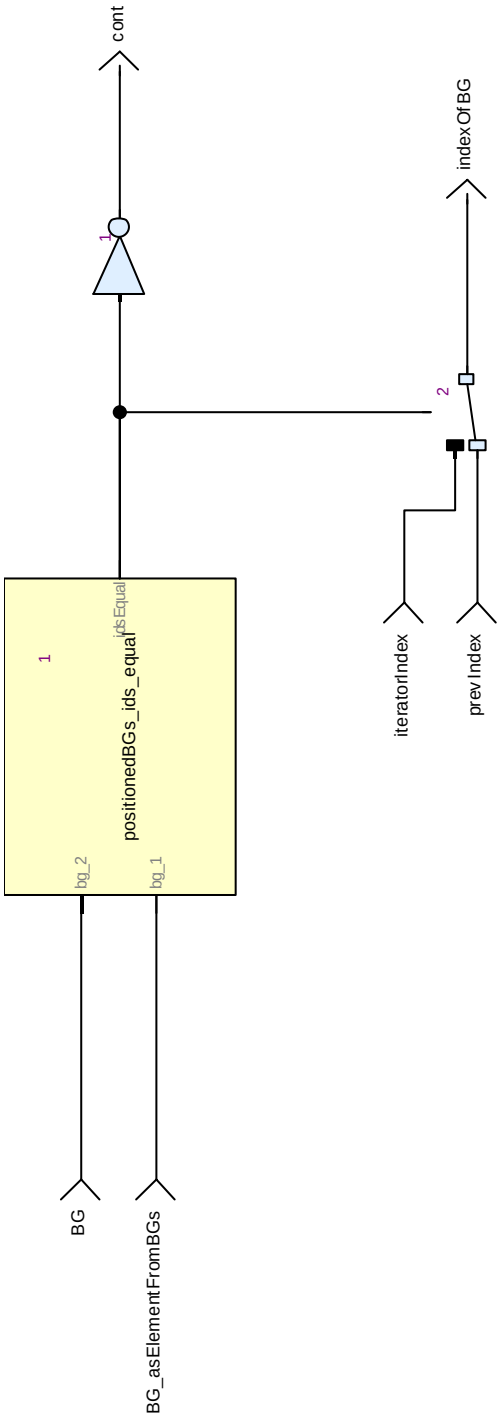

Figure 52: View of diagram_indexOfBG_by_id_itr_1 (indexOfBG_by_id_itr)

3.3.15. indexOfBG_onTrack Operator

Declared as **`public function`**

3.3.15.1. 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 107: 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

3.3.15.2. Interface

Table 108: Inputs of indexOfBG_onTrack

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

Table 109: 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.

3.3.15.3. Operator Hierarchy

diagram : diagram_indexOfBG_onTrack_1

3.3.15.4. Graphical and Textual Diagrams

3.3.15.4.1. View of diagram_indexOfBG_onTrack_1 (indexOfBG_onTrack)

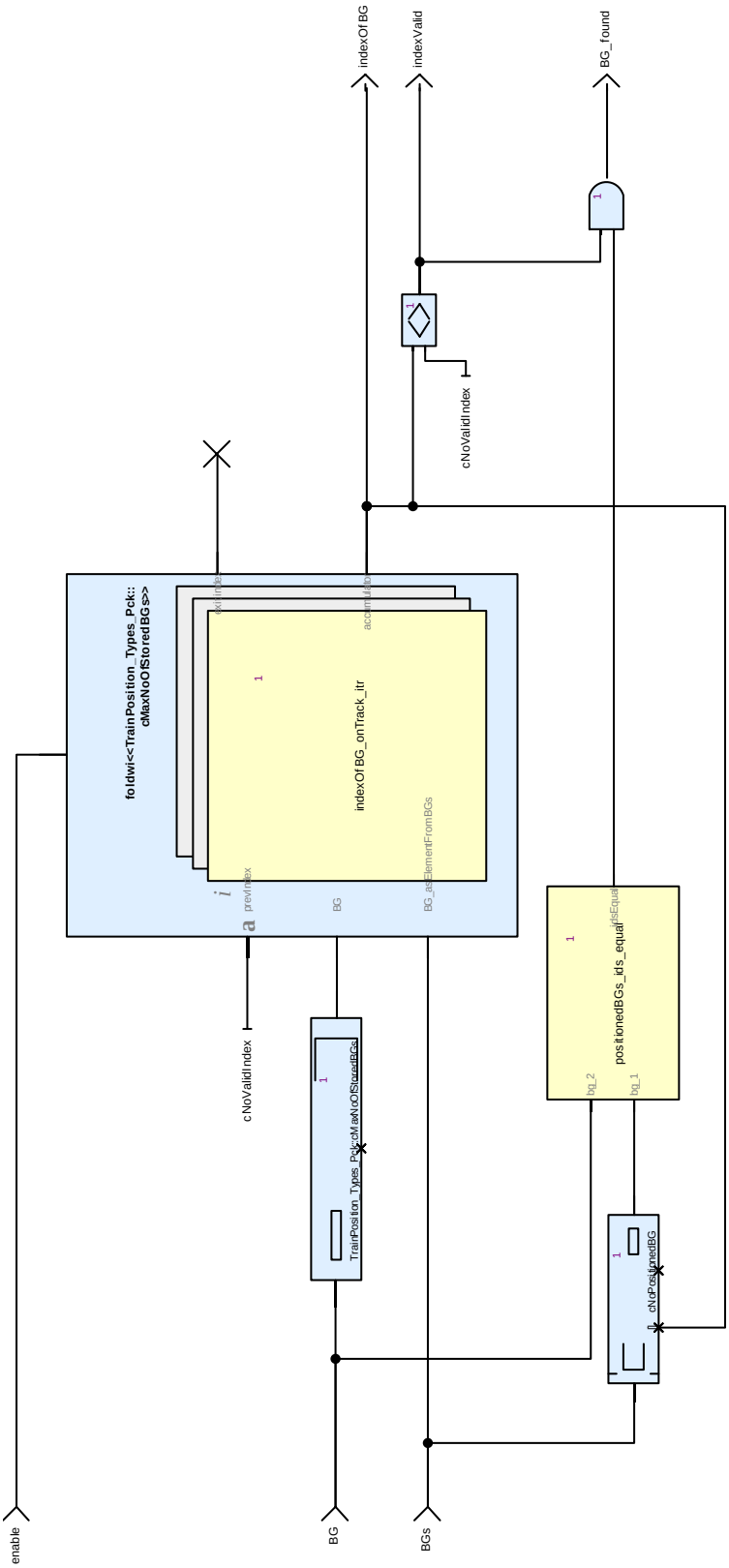

Figure 53: View of diagram_indexOfBG_onTrack_1 (indexOfBG_onTrack)

3.3.16. indexOfBG_onTrack_itr Operator

Declared as **`private function`**

3.3.16.1. Comments and Information

indexOfBG_onTrack_itr Comments:

- Iterated function for determing the index of BG in BGs

Table 110: 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/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

3.3.16.2. Interface

Table 111: 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 112: Outputs of indexOfBG_onTrack_itr

Name	Type	Comments and Information
cont	bool	
indexOfBG	int	

3.3.16.3. Locals

Table 113: Locals of indexOfBG_onTrack_itr

Name	Type	Comments and Information
invalidateIndex	bool	
stopIteration	bool	

3.3.16.4. Operator Hierarchy

diagram : diagram_setIndex
diagram : diagram_stopIteration

3.3.16.5. Graphical and Textual Diagrams

3.3.16.5.1. View of diagram_setIndex (indexOfBG_onTrack_itr)

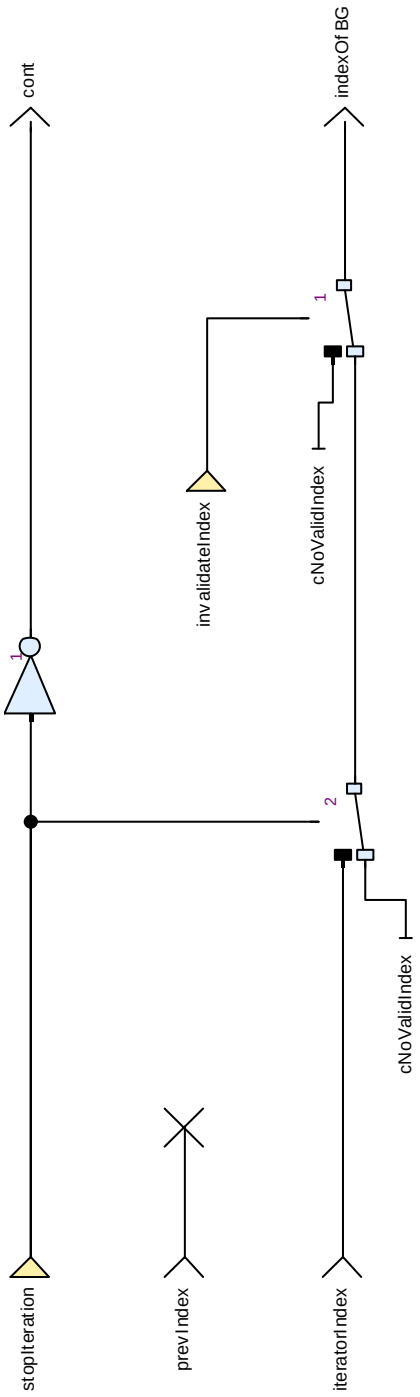

Figure 54: View of diagram_setIndex (indexOfBG_onTrack_itr)

3.3.16.5.2. View of diagram_stopIteration (indexOfBG_onTrack_itr)

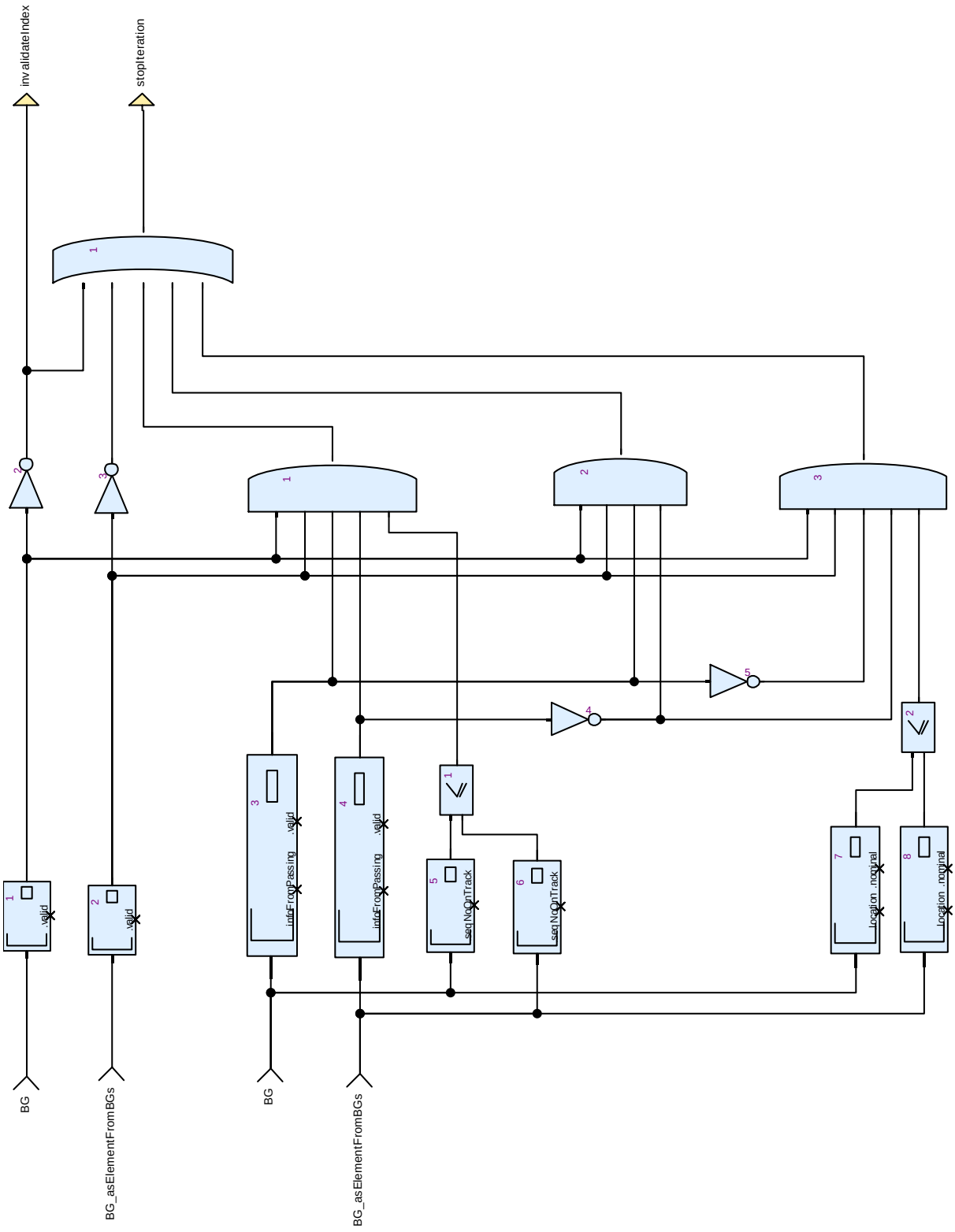

Figure 55: View of diagram_stopIteration (indexOfBG_onTrack_itr)

3.3.17. indexOfLastPassedBG Operator

Declared as **`public function`**

3.3.17.1. Comments and Information

indexOfLastPassedBG Comments:

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

3.3.17.2. Interface

Table 114: 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 115: 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.

3.3.17.3. Operator Hierarchy

diagram : diagram_indexOfLastPassedBG_1

3.3.17.4. Graphical and Textual Diagrams

3.3.17.4.1. View of diagram_indexOfLastPassedBG_1 (indexOfLastPassedBG)

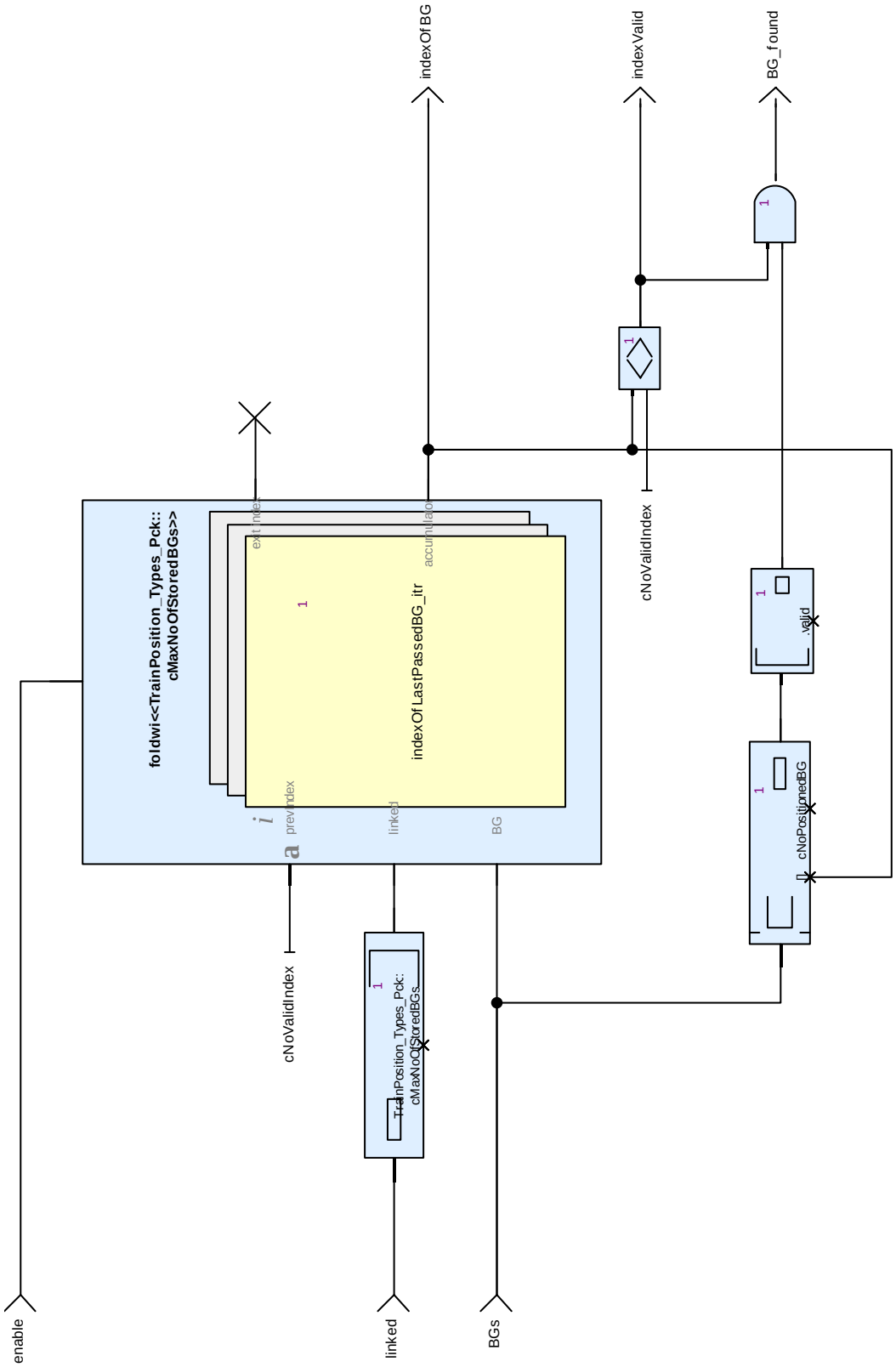

Figure 56: View of diagram_indexOfLastPassedBG_1 (indexOfLastPassedBG)

3.3.18. indexOfLastPassedBG_itr Operator

Declared as **`private function`**

3.3.18.1. Comments and Information

indexOfLastPassedBG_itr Comments:

- Iterated function for indexOfLastPassedBG

Table 116: 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/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

3.3.18.2. Interface

Table 117: 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 118: Outputs of indexOfLastPassedBG_itr

Name	Type	Comments and Information
cont	bool	

Name	Type	Comments and Information
indexOfBG	int	

3.3.18.3. Operator Hierarchy

diagram : diagram_indexOfLastPassedBG_itr_1

3.3.18.4. Graphical and Textual Diagrams

3.3.18.4.1. View of diagram_indexOfLastPassedBG_itr_1 (indexOfLastPassedBG_itr)

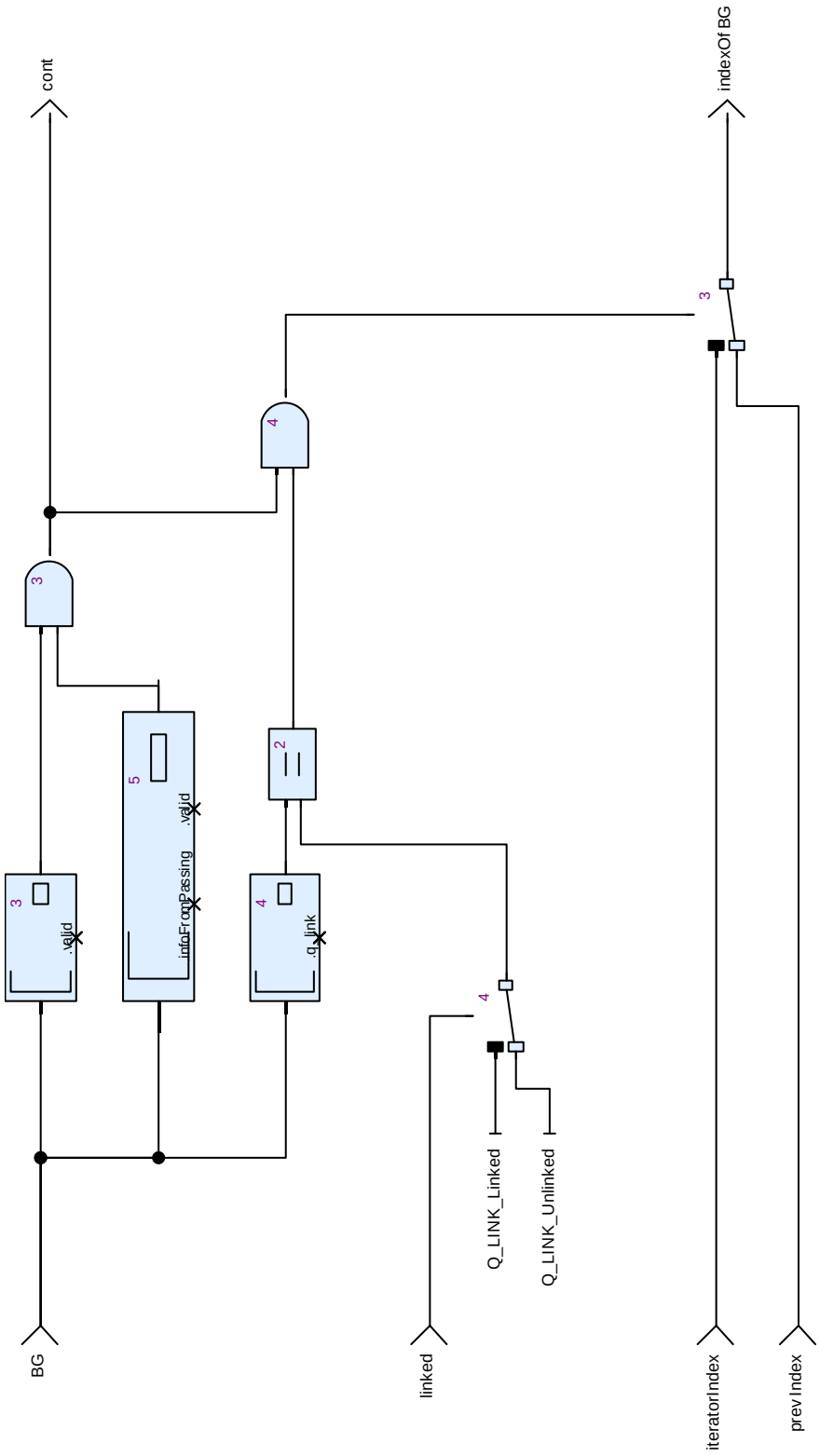

Figure 57: View of diagram_indexOfLastPassedBG_itr_1 (indexOfLastPassedBG_itr)

3.3.19. indexOfPassedBG_by_id Operator

Declared as **`public function`**

3.3.19.1. Comments and Information

indexOfPassedBG_by_id Comments:

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

Table 119: 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

3.3.19.2. Interface

Table 120: 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 121: 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.

3.3.19.3. Operator Hierarchy

diagram : diagram_indexOfPassedBG_by_id_1

3.3.19.4. Graphical and Textual Diagrams

3.3.19.4.1. View of diagram_indexOfPassedBG_by_id_1 (indexOfPassedBG_by_id)

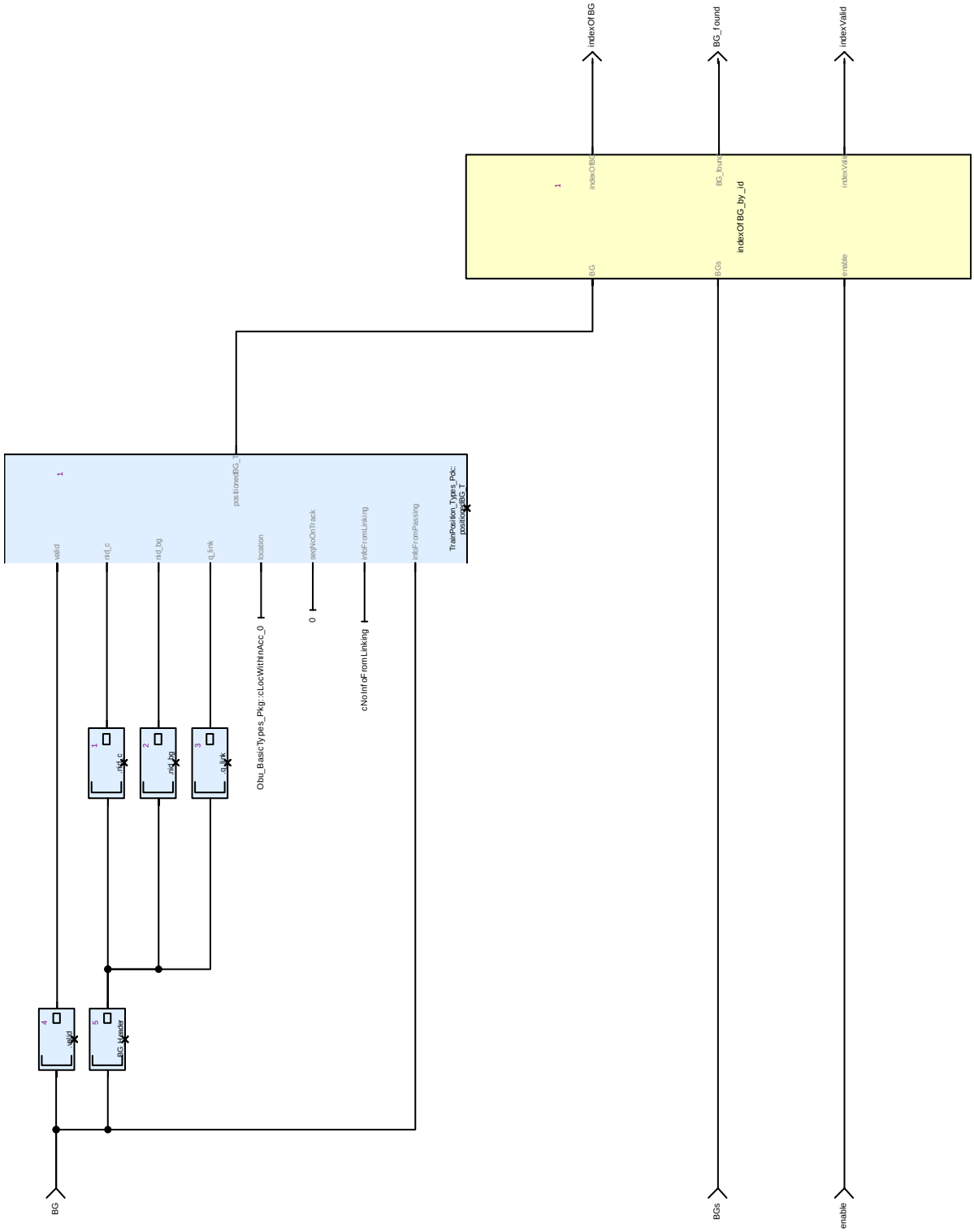

Figure 58: View of diagram_indexOfPassedBG_by_id_1 (indexOfPassedBG_by_id)

3.3.20. insertBG_atIndex Operator

Declared as **`public function`**

3.3.20.1. 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.

3.3.20.2. Interface

Table 122: 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 123: 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.

3.3.20.3. Operator Hierarchy

diagram : diagram_insertBG_atIndex_1

3.3.20.4. Graphical and Textual Diagrams

3.3.20.4.1. View of diagram_insertBG_atIndex_1 (insertBG_atIndex)

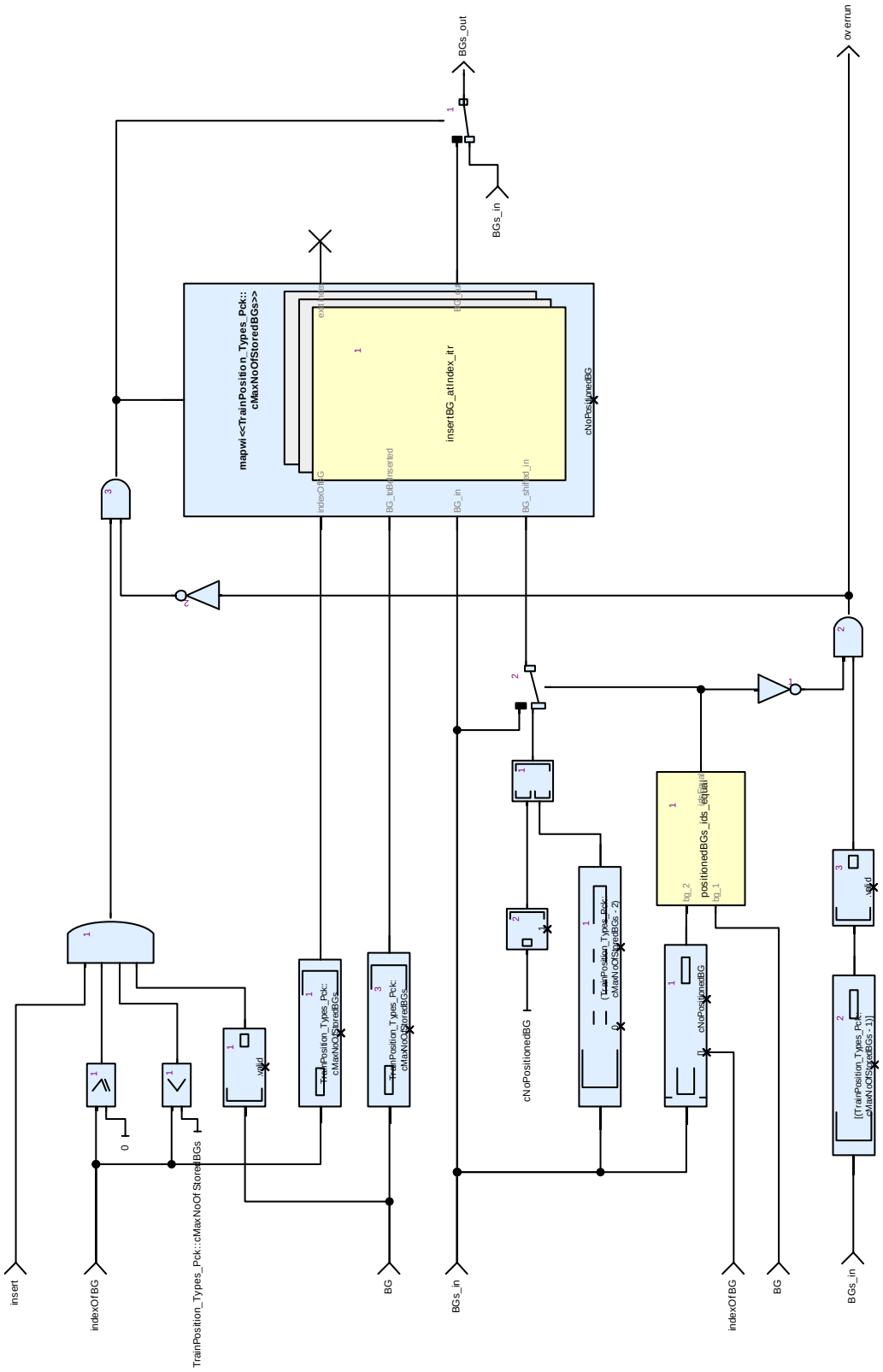

Figure 59: View of diagram_insertBG_atIndex_1 (insertBG_atIndex)

3.3.21. insertBG_atIndex_itr Operator

Declared as **`private function`**

3.3.21.1. Comments and Information

insertBG_atIndex_itr Comments:

- Iterated function for insertBG_atIndex.

3.3.21.2. Interface

Table 124: 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 125: Outputs of insertBG_atIndex_itr

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

3.3.21.3. Operator Hierarchy

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

3.3.21.4. Graphical and Textual Diagrams

3.3.21.4.1. View of diagram_insertBG_atIndex_itr_1 (insertBG_atIndex_itr)

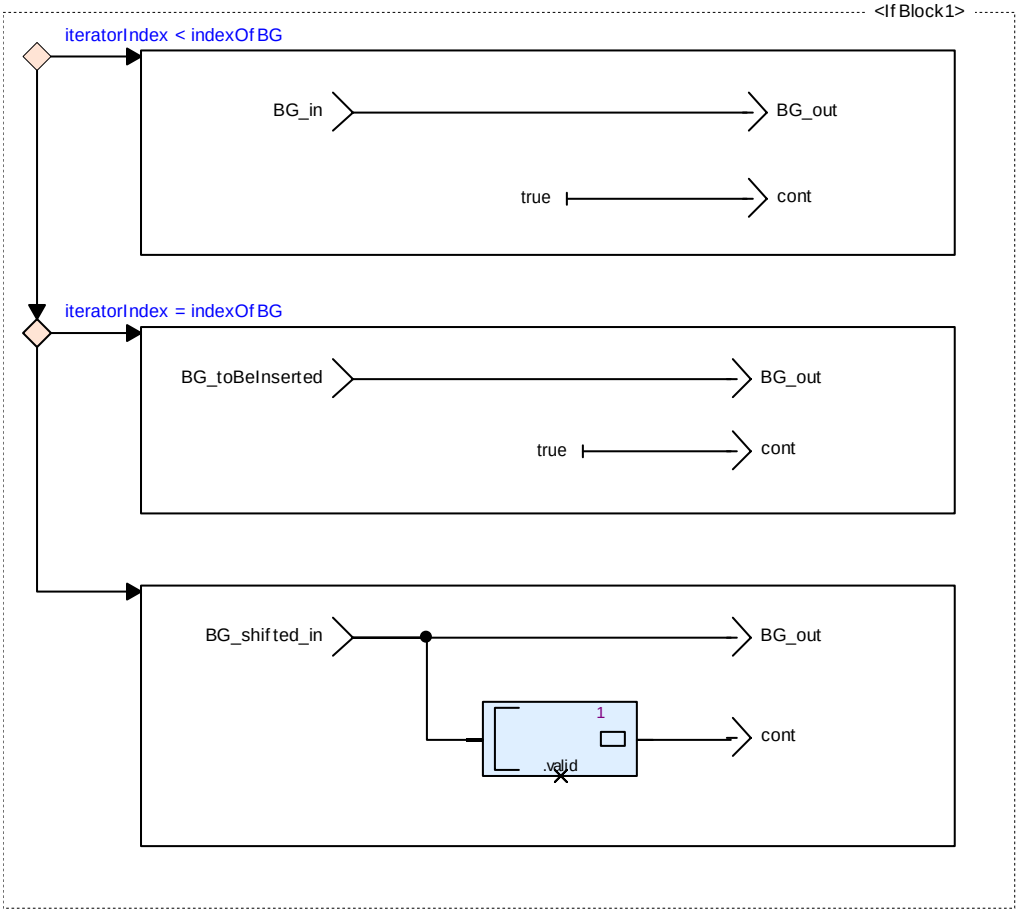

Figure 60: View of diagram_insertBG_atIndex_itr_1 (insertBG_atIndex_itr)

Table 126: Conditional Blocks of diagram_insertBG_atIndex_itr_1

Conditional Block	Comments and Information
IfBlock1	

Table 127: Actions of diagram_insertBG_atIndex_itr_1

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

3.3.22. mergeBG_by_id Operator

Declared as **`private function`**

3.3.22.1. 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 128: 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/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

3.3.22.2. Interface

Table 129: 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 130: 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.

3.3.22.3. Operator Hierarchy

diagram : diagram_mergeBG_by_id_1

3.3.22.4. Graphical and Textual Diagrams

3.3.22.4.1. View of diagram_mergeBG_by_id_1 (mergeBG_by_id)

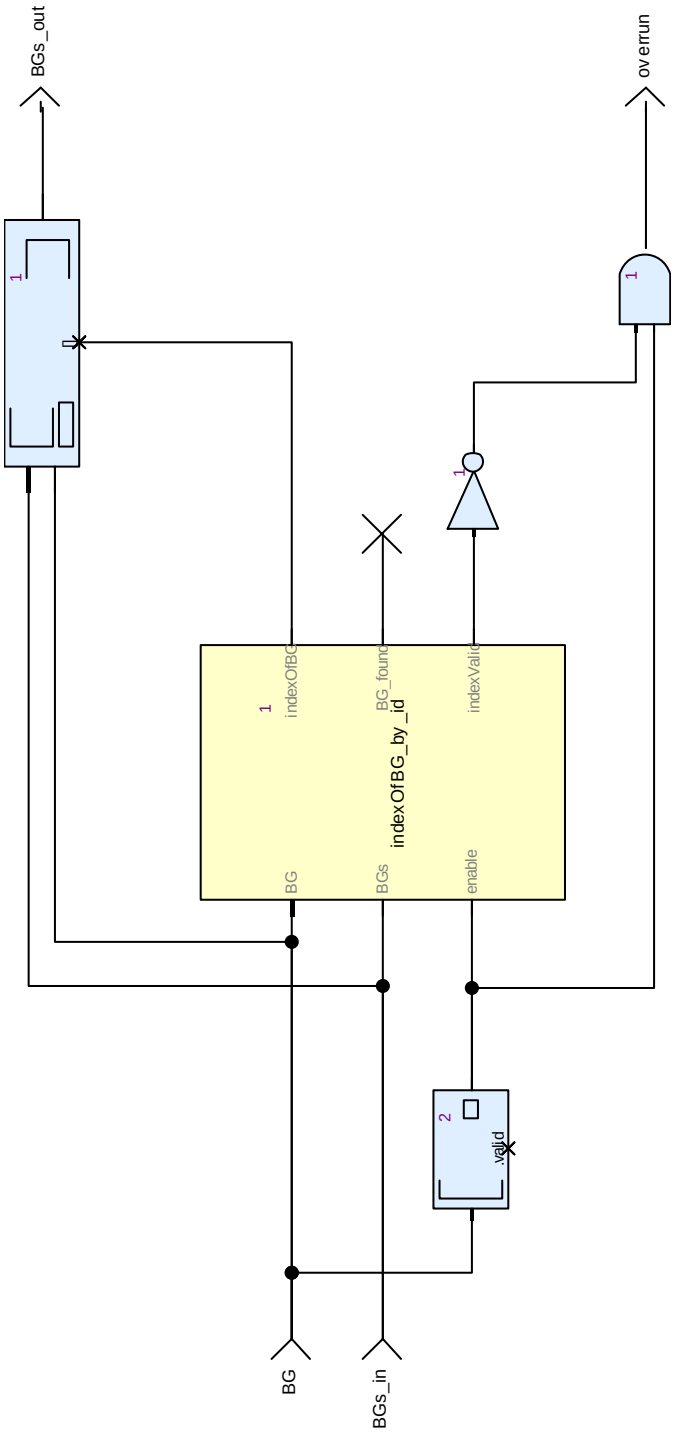

Figure 61: View of diagram_mergeBG_by_id_1 (mergeBG_by_id)

3.3.23. mergeBG_onTrack Operator

Declared as **`public function`**

3.3.23.1. 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.

3.3.23.2. Interface

Table 131: 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 132: 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.

3.3.23.3. Operator Hierarchy

diagram : diagram_mergeBG_onTrack_1

3.3.23.4. Graphical and Textual Diagrams

3.3.23.4.1. View of diagram_mergeBG_onTrack_1 (mergeBG_onTrack)

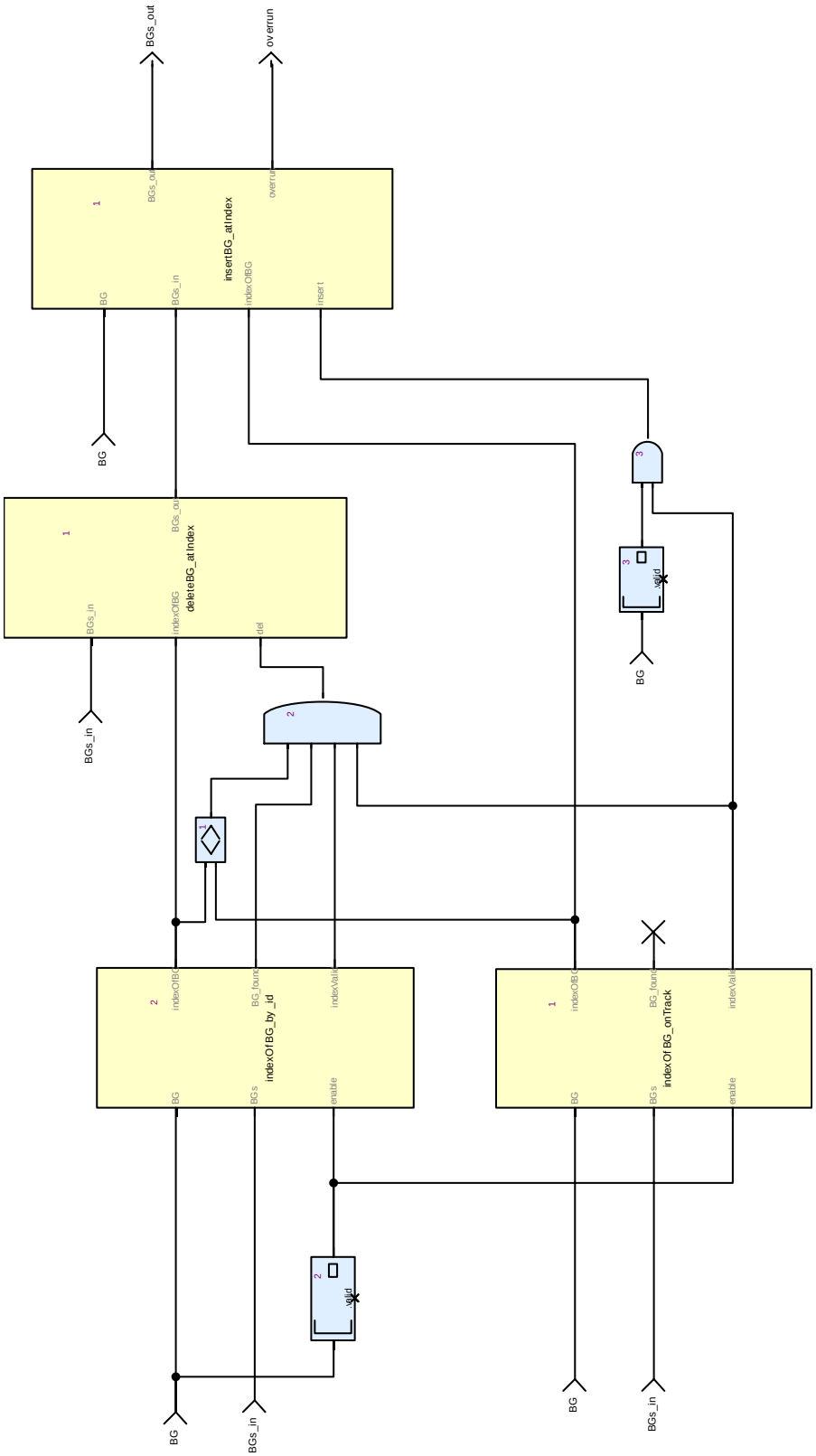

Figure 62: View of diagram_mergeBG_onTrack_1 (mergeBG_onTrack)

3.3.24. mergeBGs_by_id Operator

Declared as **`public function`**

3.3.24.1. 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 133: 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/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

3.3.24.2. Interface

Table 134: 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 135: 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.

3.3.24.3. Operator Hierarchy

diagram : diagram_mergeBGs_by_id_1

3.3.24.4. Graphical and Textual Diagrams

3.3.24.4.1. View of diagram_mergeBGs_by_id_1 (mergeBGs_by_id)

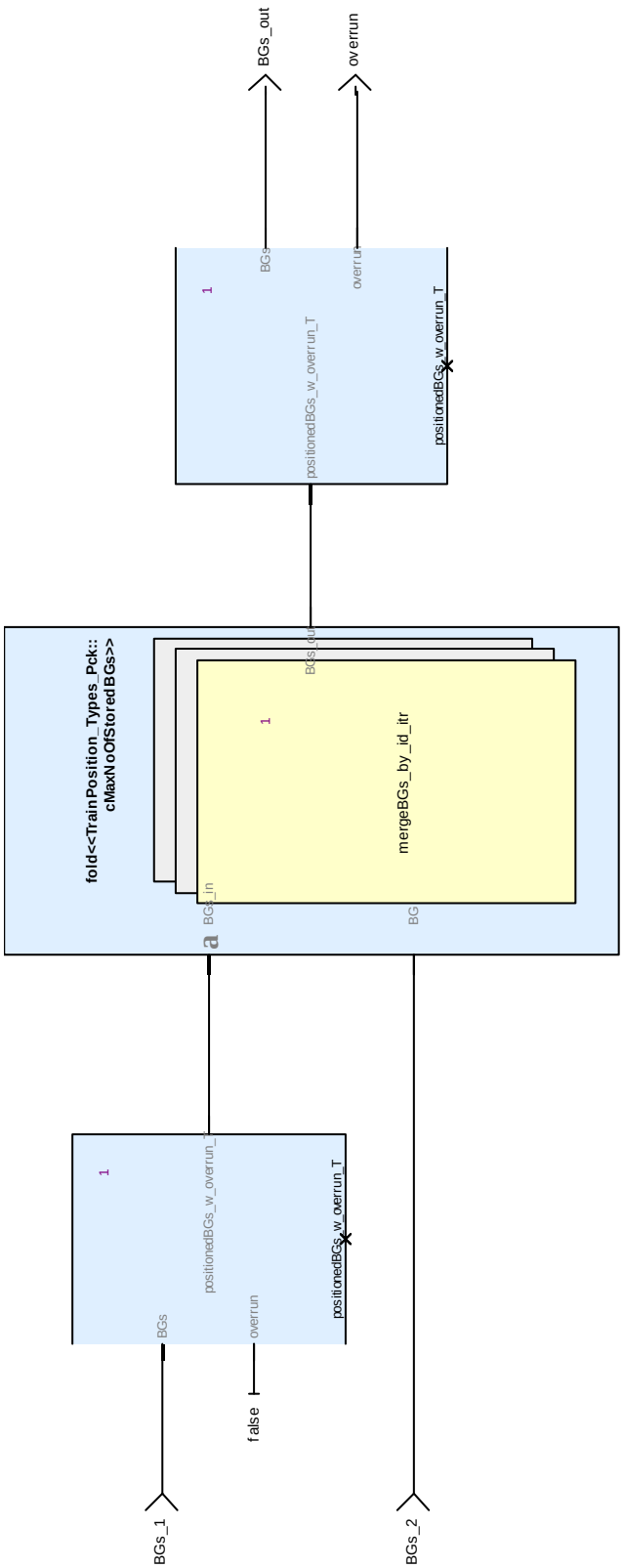

Figure 63: View of diagram_mergeBGs_by_id_1 (mergeBGs_by_id)

3.3.25. mergeBGs_by_id_itr Operator

Declared as **`private function`**

3.3.25.1. Comments and Information

mergeBGs_by_id_itr Comments:

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

Table 136: 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/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

3.3.25.2. Interface

Table 137: 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 138: 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.

3.3.25.3. Operator Hierarchy

diagram : diagram_mergeBGs_by_id_itr_1

3.3.25.4. Graphical and Textual Diagrams

3.3.25.4.1. View of diagram_mergeBGs_by_id_itr_1 (mergeBGs_by_id_itr)

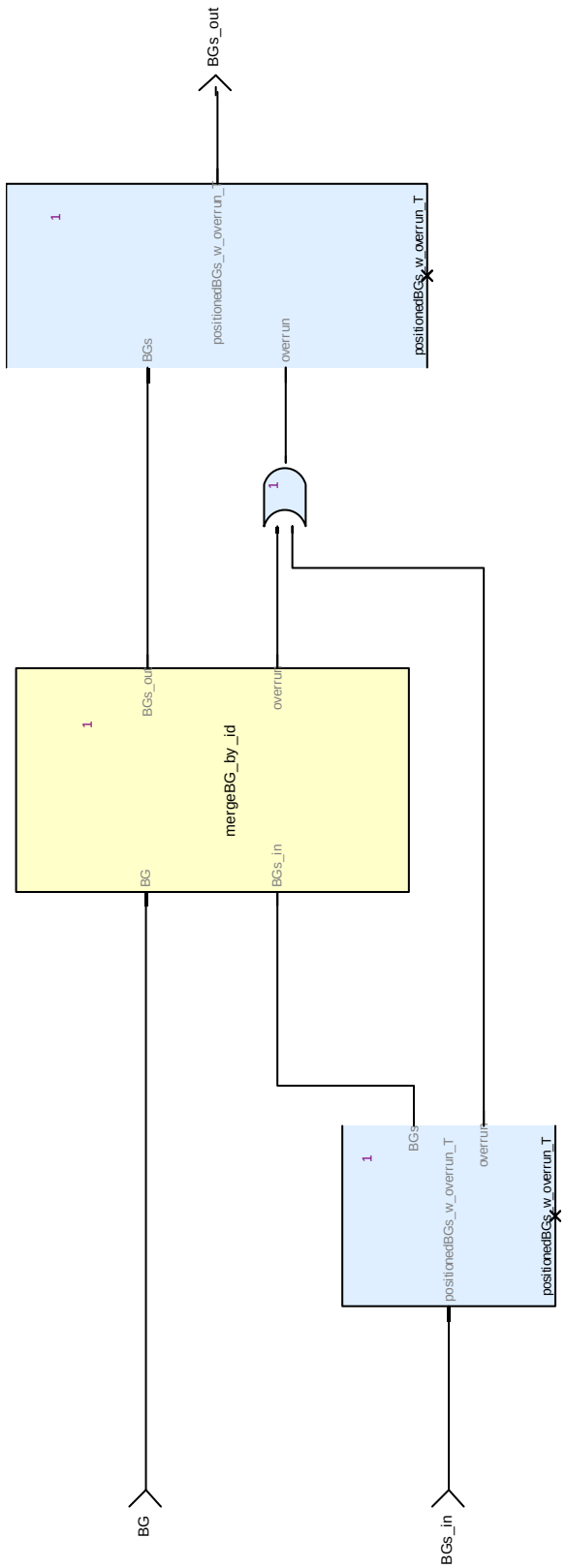

Figure 64: View of diagram_mergeBGs_by_id_itr_1 (mergeBGs_by_id_itr)

3.3.26. mergeBGs_onTrack Operator

Declared as **`public function`**

3.3.26.1. 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 139: 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

3.3.26.2. Interface

Table 140: 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 141: 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.

3.3.26.3. Operator Hierarchy

diagram : diagram_mergeBGs_onTrack_1

3.3.26.4. Graphical and Textual Diagrams

3.3.26.4.1. View of diagram_mergeBGs_onTrack_1 (mergeBGs_onTrack)

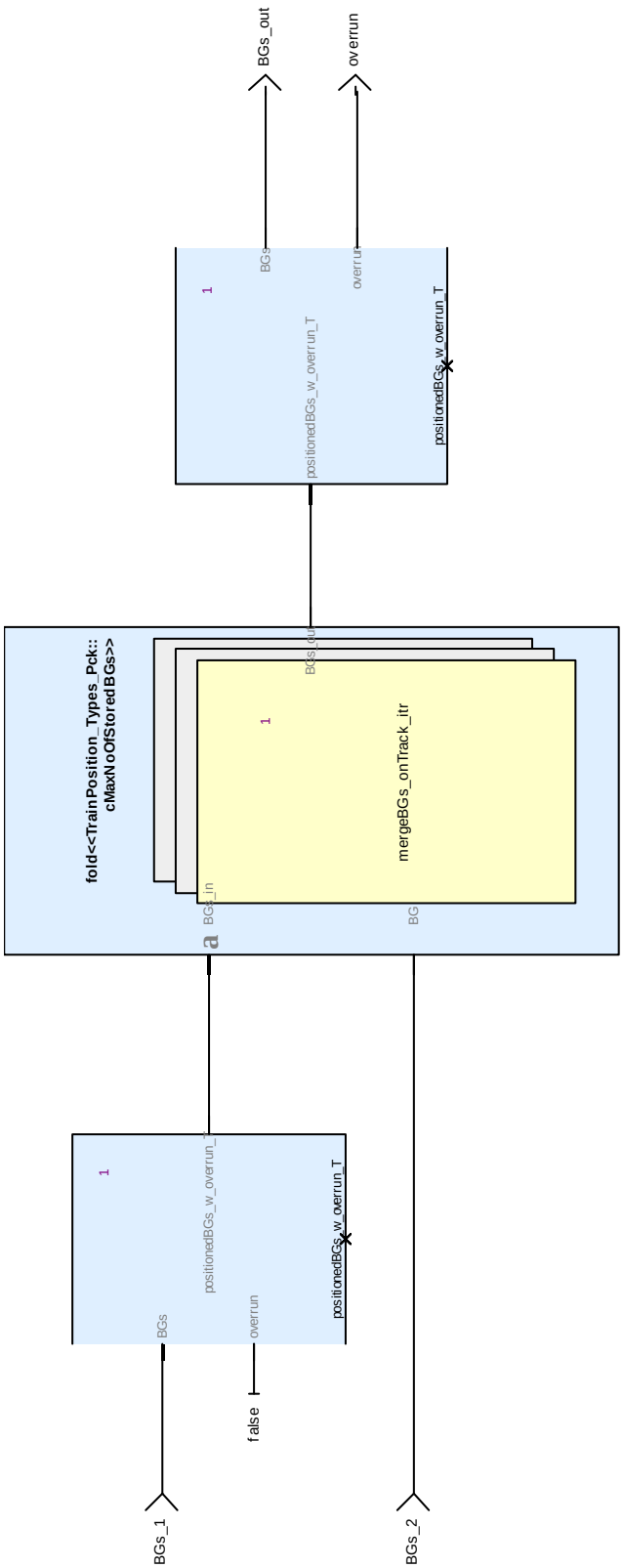

Figure 65: View of diagram_mergeBGs_onTrack_1 (mergeBGs_onTrack)

3.3.27. mergeBGs_onTrack_itr Operator

Declared as **`private function`**

3.3.27.1. Comments and Information

mergeBGs_onTrack_itr Comments:

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

Table 142: 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

3.3.27.2. Interface

Table 143: 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 144: 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.

3.3.27.3. Operator Hierarchy

diagram : diagram_mergeBGs_onTrack_itr_1

3.3.27.4. Graphical and Textual Diagrams

3.3.27.4.1. View of diagram_mergeBGs_onTrack_itr_1 (mergeBGs_onTrack_itr)

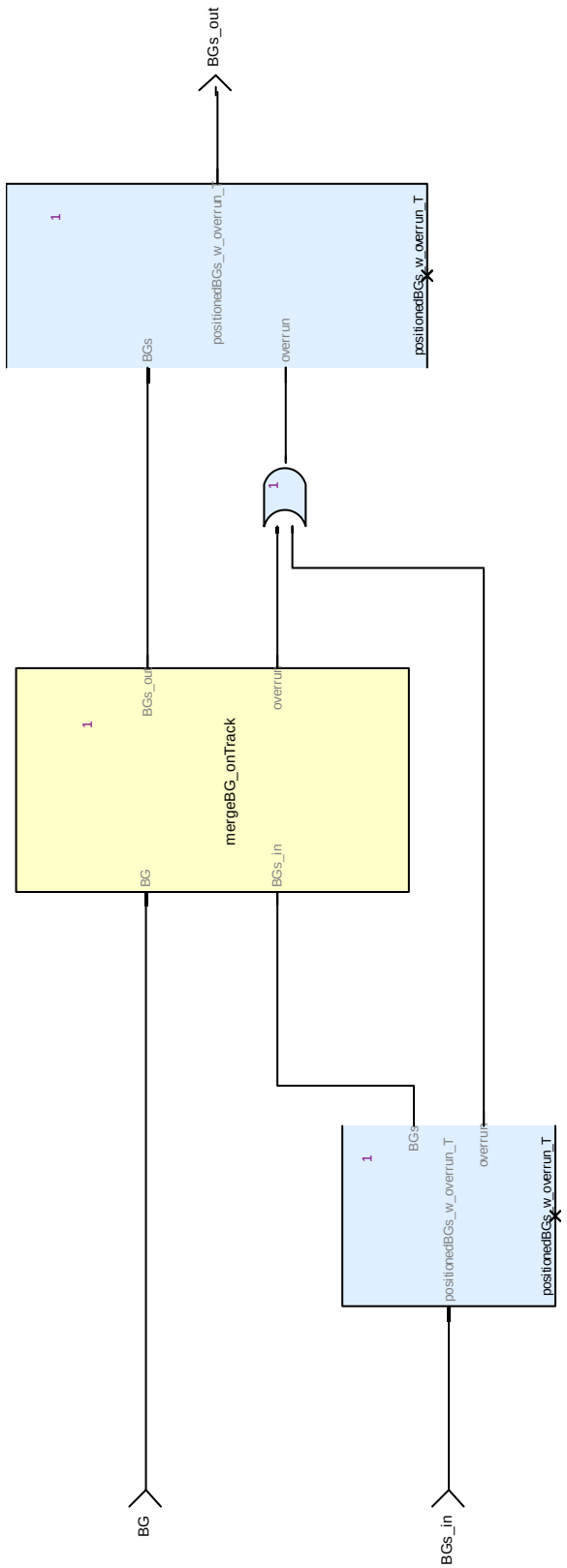

Figure 66: View of diagram_mergeBGs_onTrack_itr_1 (mergeBGs_onTrack_itr)

3.3.28. nidBG_nidc_equal Operator

Declared as **`public function`**

3.3.28.1. 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 145: 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

3.3.28.2. Interface

Table 146: 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 147: Outputs of nidBG_nidc_equal

Name	Type	Comments and Information
isEqual	bool	

3.3.28.3. Operator Hierarchy

diagram : diagram_nidBG_nidc_equal_1

3.3.28.4. Graphical and Textual Diagrams

3.3.28.4.1. View of diagram_nidBG_nidc_equal_1 (nidBG_nidc_equal)

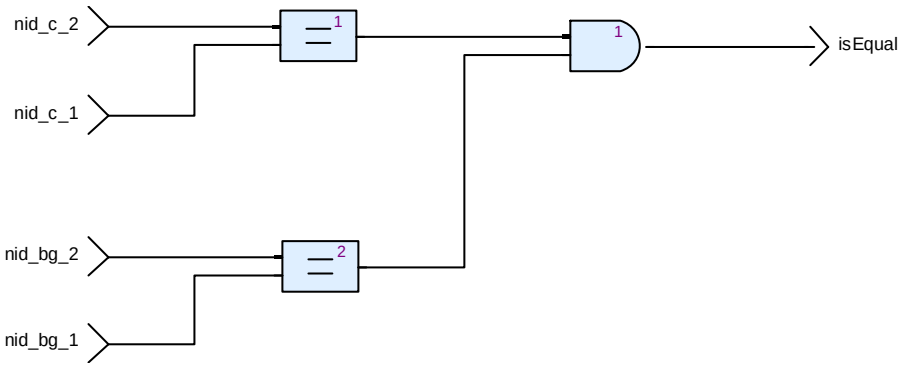

Figure 67: View of diagram_nidBG_nidc_equal_1 (nidBG_nidc_equal)

3.3.29. nidC_nidBG_2_NIDLRBG Operator

Declared as **`public function`**

3.3.29.1. Comments and Information

nidC_nidBG_2_NIDLRBG Comments:

- Constructs an NID_LRBG value from NID_C and NID_BG

3.3.29.2. Interface

Table 148: Inputs of nidC_nidBG_2_NIDLRBG

Name	Type	Comments and Information
valid	bool	
nidC	NID_C	
nidBG	NID_BG	

Table 149: Outputs of nidC_nidBG_2_NIDLRBG

Name	Type	Comments and Information
nidLRBG	NID_LRBG	

3.3.29.3. Operator Hierarchy

diagram : diagram_nidC_nidBG_2_NIDLRBG_1

3.3.29.4. Graphical and Textual Diagrams

3.3.29.4.1. View of diagram_nidC_nidBG_2_NIDLRBG_1 (nidC_nidBG_2_NIDLRBG)

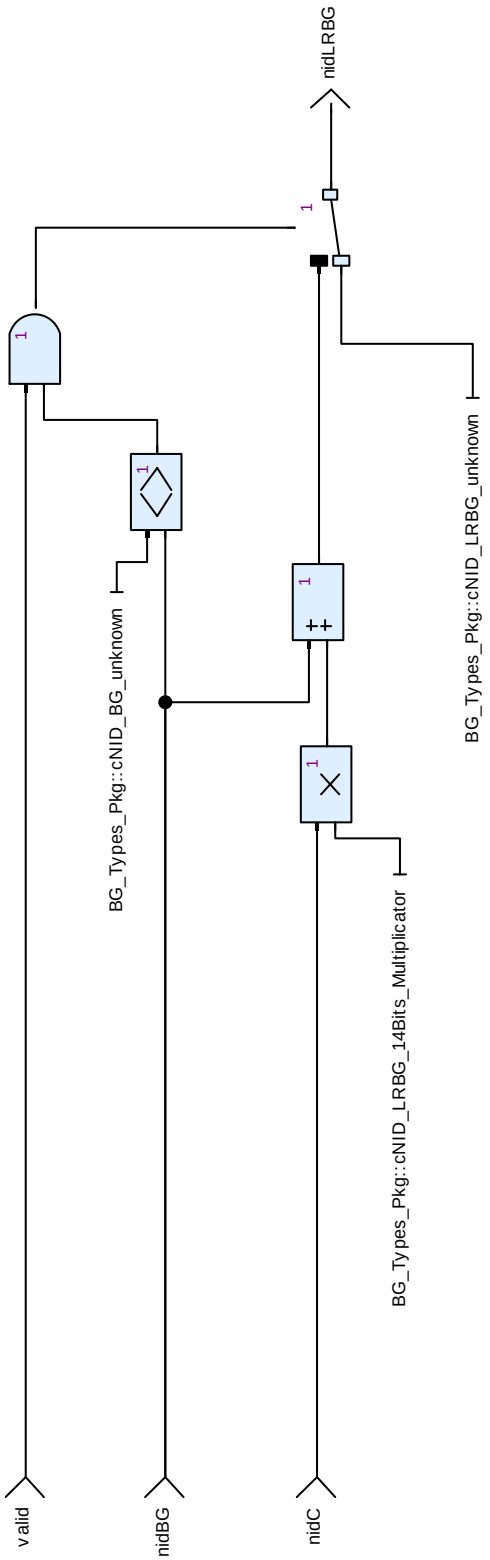

Figure 68: View of diagram_nidC_nidBG_2_NIDLRBG_1 (nidC_nidBG_2_NIDLRBG)

3.3.30. passedBGs_ids_equal Operator

Declared as **`public function`**

3.3.30.1. 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 150: 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

3.3.30.2. Interface

Table 151: 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 152: Outputs of passedBGs_ids_equal

Name	Type	Comments and Information
idsEqual	bool	
idsDifferent	bool	

3.3.30.3. Operator Hierarchy

diagram : diagram_passedBGs_ids_equal_1

3.3.30.4. Graphical and Textual Diagrams

3.3.30.4.1. View of diagram_passedBGs_ids_equal_1 (passedBGs_ids_equal)

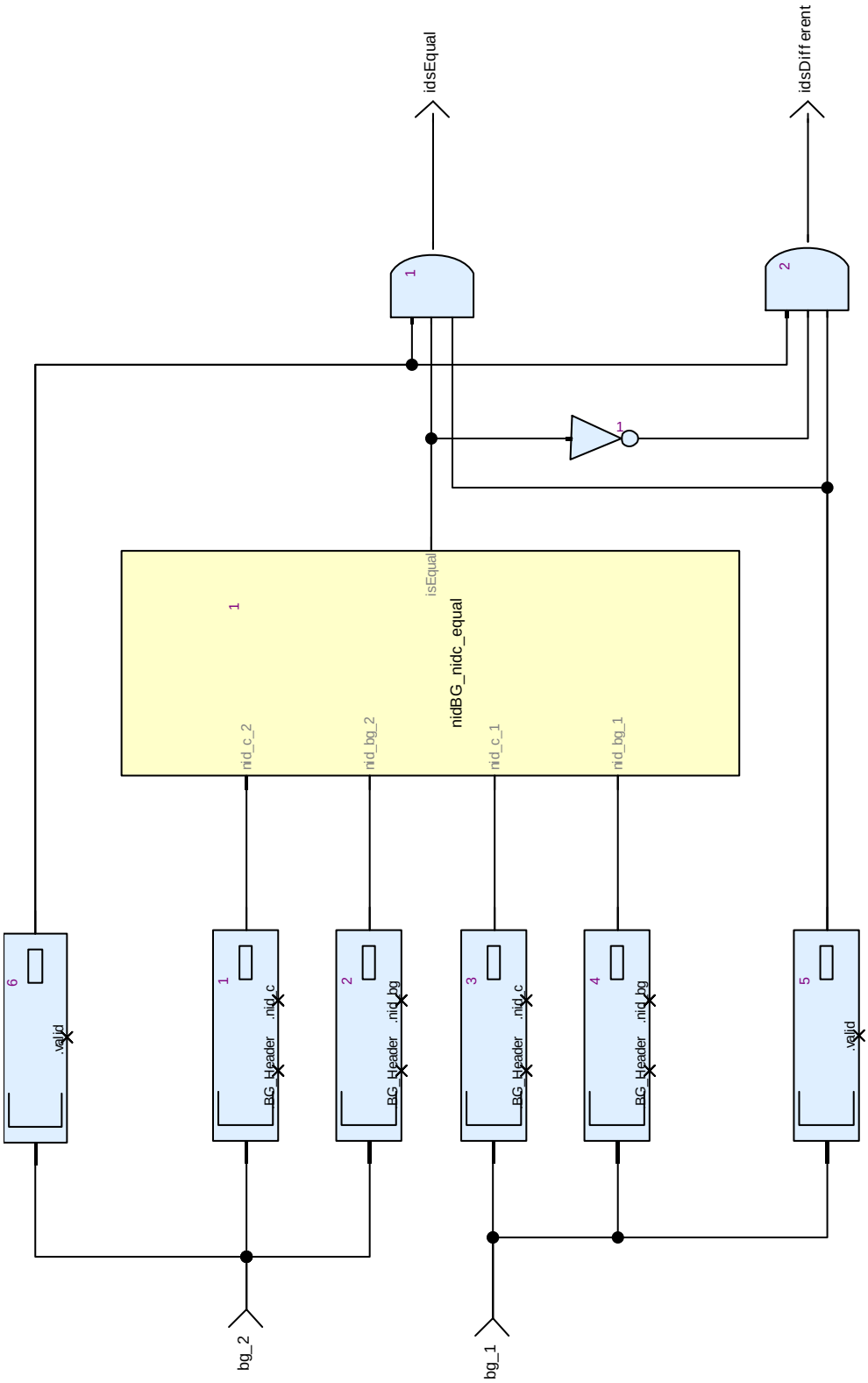

Figure 69: View of diagram_passedBGs_ids_equal_1 (passedBGs_ids_equal)

3.3.31. positionDerivedFromPassedBG Operator

Declared as **`public function`**

3.3.31.1. 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 153: 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

3.3.31.2. Interface

Table 154: 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 155: Outputs of positionDerivedFromPassedBG

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

3.3.31.3. Operator Hierarchy

diagram : diagram_positionDerivedFromPassedBG_1
activate if : IfBlock1
branch : then
branch : else

3.3.31.4. Graphical and Textual Diagrams

3.3.31.4.1. View of diagram_positionDerivedFromPassedBG_1 (positionDerivedFromPassedBG)

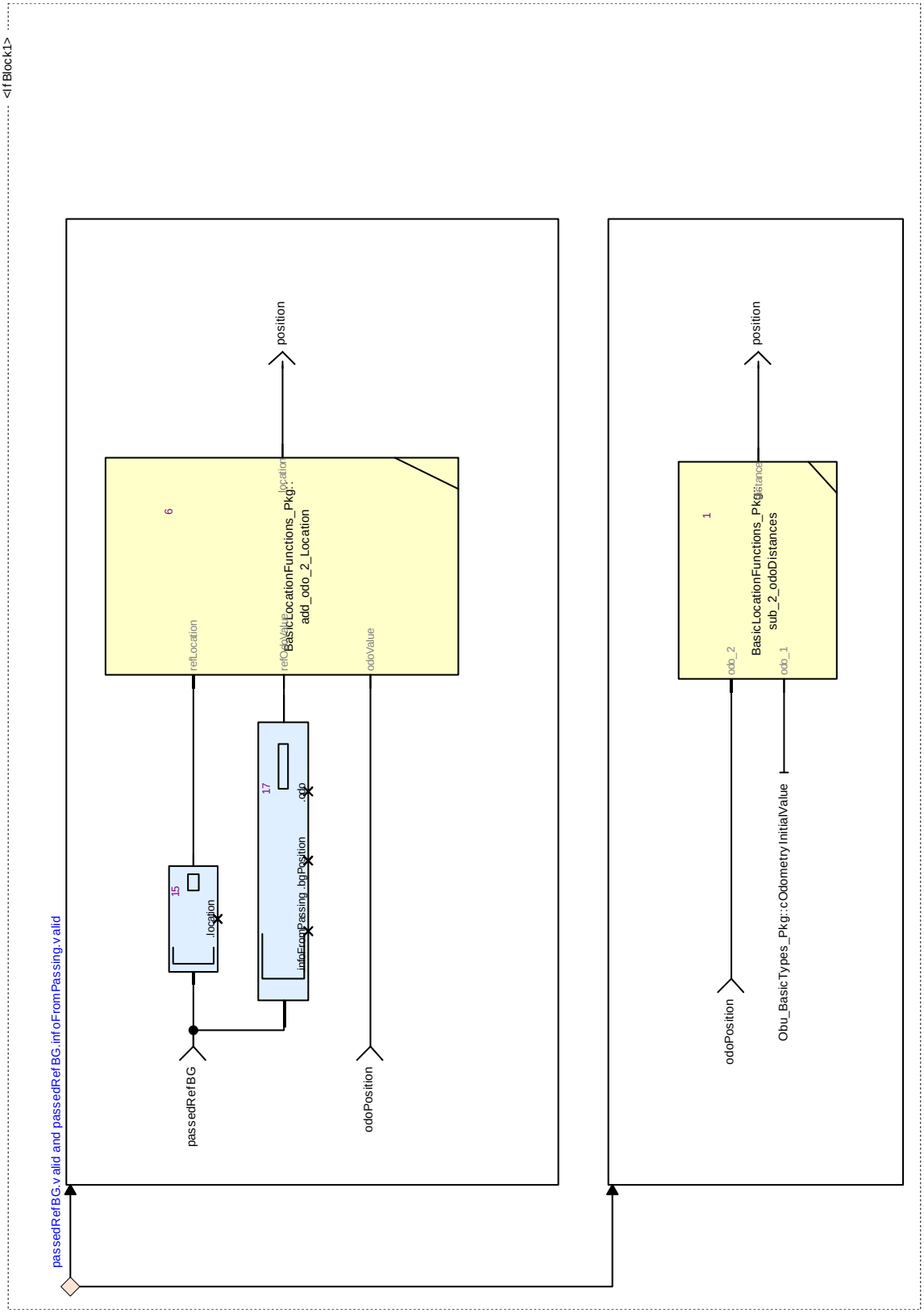

Figure 70: View of diagram_positionDerivedFromPassedBG_1 (positionDerivedFromPassedBG)

Table 156: Conditional Blocks of diagram_positionDerivedFromPassedBG_1

Conditional Block	Comments and Information
IfBlock1	

Table 157: Actions of diagram_positionDerivedFromPassedBG_1

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

3.3.32. positionedBGs_ids_equal Operator

Declared as **`public function`**

3.3.32.1. 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 158: 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

3.3.32.2. Interface

Table 159: 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 160: Outputs of positionedBGs_ids_equal

Name	Type	Comments and Information
idsEqual	bool	

3.3.32.3. Operator Hierarchy

diagram : diagram_positionedBGs_ids_equal_1

3.3.32.4. Graphical and Textual Diagrams

3.3.32.4.1. View of diagram_positionedBGs_ids_equal_1 (positionedBGs_ids_equal)

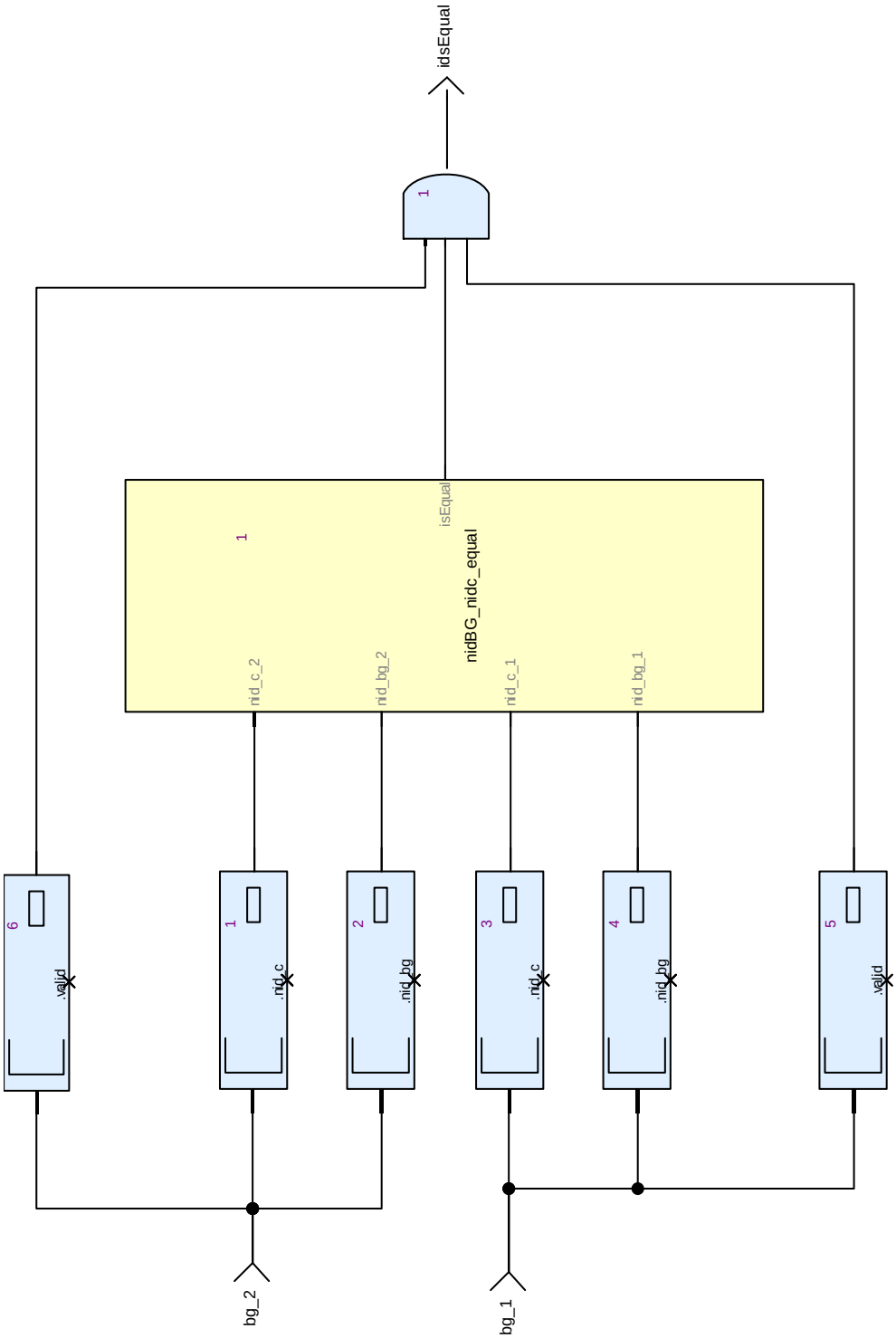

Figure 71: View of diagram_positionedBGs_ids_equal_1 (positionedBGs_ids_equal)

3.3.33. positionLinkedBGs Operator

Declared as **`public function`**

3.3.33.1. Comments and Information

positionLinkedBGs Comments:

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

Table 161: 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

3.3.33.2. Interface

Table 162: Inputs of positionLinkedBGs

Name	Type	Properties	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		
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	Comments: The trains properties required for train position calculation.

Table 163: Outputs of positionLinkedBGs

Name	Type	Comments and Information
linkedPositionedBGs	TrainPosition_Types_Pck::linkedBGs_asPositionedBGs_T	

3.3.33.3. Operator Hierarchy

diagram : diagram_positionLinkedBGs_1

3.3.33.4. Graphical and Textual Diagrams

3.3.33.4.1. View of diagram_positionLinkedBGs_1 (positionLinkedBGs)

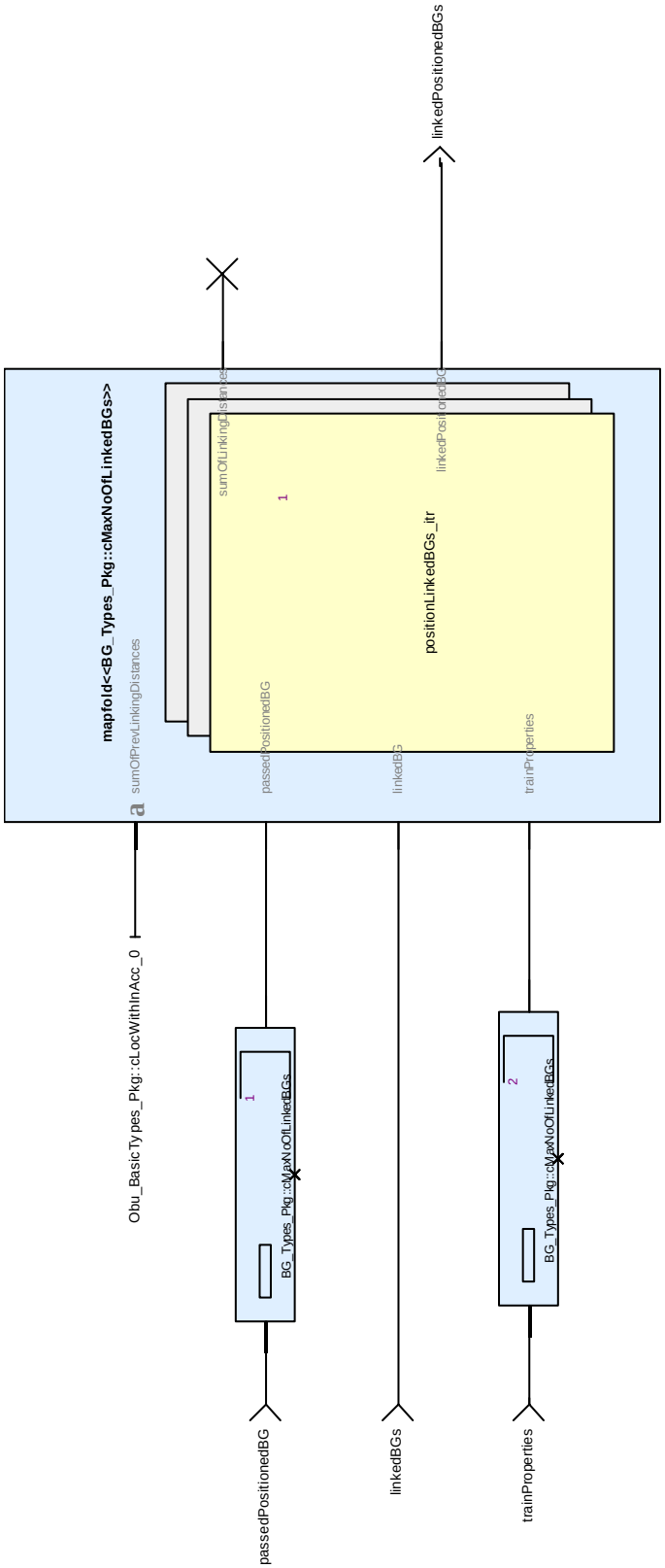

Figure 72: View of diagram_positionLinkedBGs_1 (positionLinkedBGs)

3.3.34. positionLinkedBGs_itr Operator

Declared as **`private function`**

3.3.34.1. 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 164: 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

3.3.34.2. Interface

Table 165: Inputs of positionLinkedBGs_itr

Name	Type	Properties	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.

Name	Type	Properties	Comments and Information
linkedBG	BG_Types_Pkg::LinkedBG_T		Comments: One of the linked BG, announced by the passed BG.
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	Comments: The trains properties required for train position calculation.

Table 166: 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	

3.3.34.3. Operator Hierarchy

diagram : diagram_positionLinkedBGs_itr_1

3.3.34.4. Graphical and Textual Diagrams

3.3.34.4.1. View of diagram_positionLinkedBGs_itr_1 (positionLinkedBGs_itr)

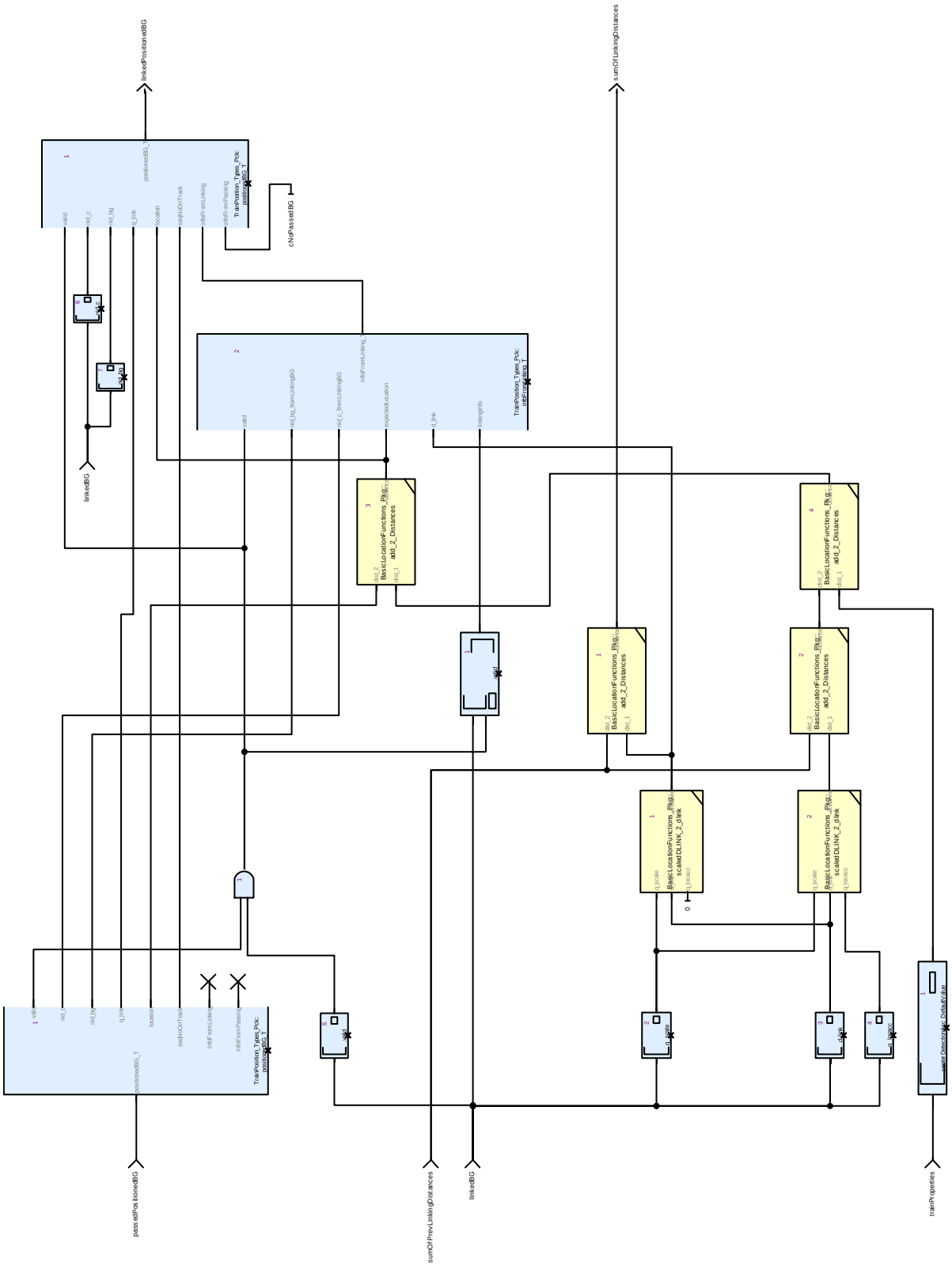

Figure 73: View of diagram_positionLinkedBGs_itr_1 (positionLinkedBGs_itr)

3.3.35. trimSeqNoOnTrack Operator

Declared as **`public function`**

3.3.35.1. Comments and Information

trimSeqNoOnTrack Comments:

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

3.3.35.2. Interface

Table 167: 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 168: Outputs of trimSeqNoOnTrack

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

3.3.35.3. Operator Hierarchy

diagram : diagram_trimSeqNoOnTrack_1

3.3.35.4. Graphical and Textual Diagrams

3.3.35.4.1. View of diagram_trimSeqNoOnTrack_1 (trimSeqNoOnTrack)

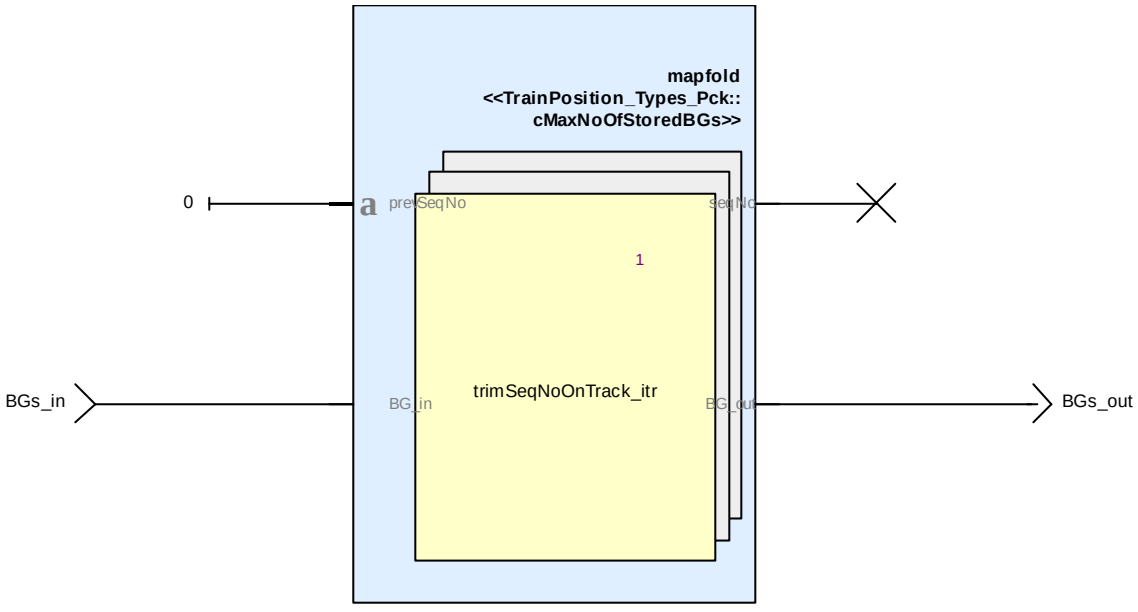

Figure 74: View of diagram_trimSeqNoOnTrack_1 (trimSeqNoOnTrack)

3.3.36. trimSeqNoOnTrack_itr Operator

Declared as **`private function`**

3.3.36.1. Comments and Information

trimSeqNoOnTrack_itr Comments:

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

3.3.36.2. Interface

Table 169: 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 170: Outputs of trimSeqNoOnTrack_itr

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

3.3.36.3. Operator Hierarchy

diagram : diagram_trimSeqNoOnTrack_itr_1

3.3.36.4. Graphical and Textual Diagrams

3.3.36.4.1. View of diagram_trimSeqNoOnTrack_itr_1 (trimSeqNoOnTrack_itr)

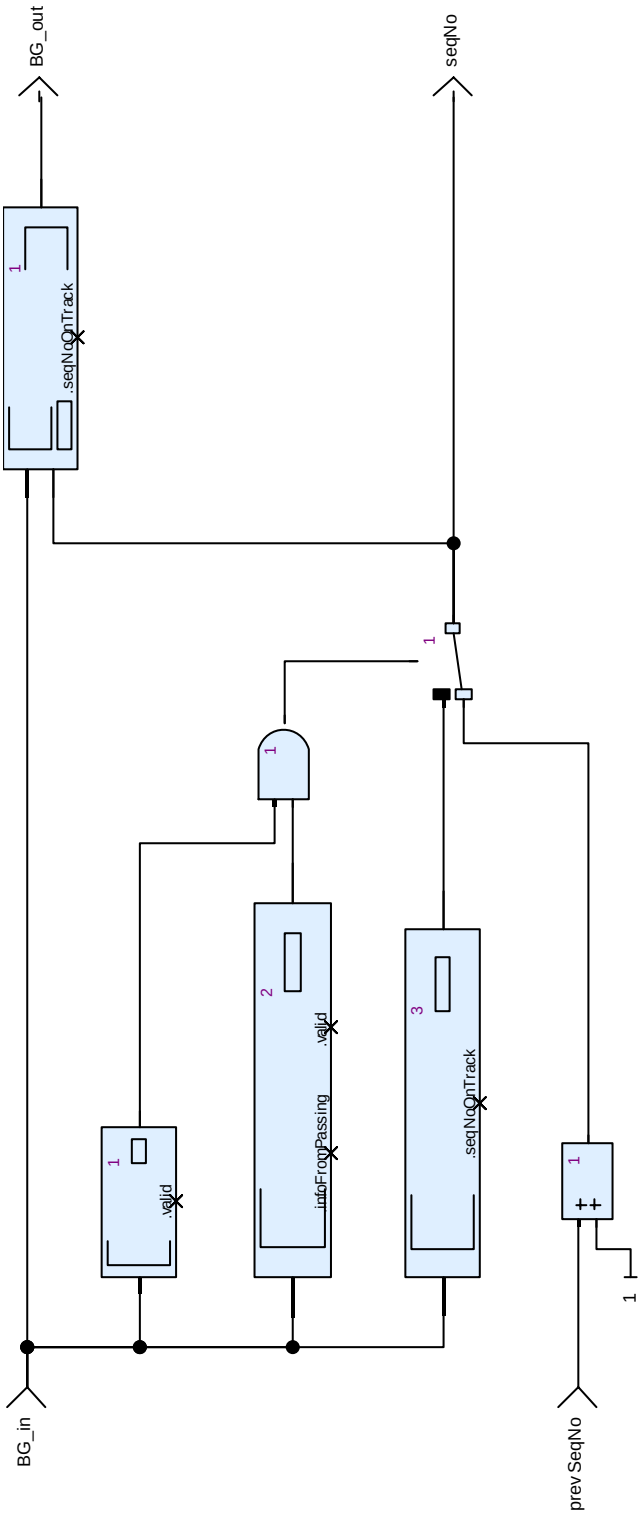

Figure 75: View of diagram_trimSeqNoOnTrack_itr_1 (trimSeqNoOnTrack_itr)

3.4. CalculateTrainPosition_Pkg::gp_functions_Pkg Package

3.4.1. Constants

Table 171: Public Constants of gp_functions_Pkg

Name	Type	Value	Comments and Information
noValidIndex	int	-1	

3.4.2. countUp Operator

Declared as **public node**

3.4.2.1. Comments and Information

countUp Comments:

- Counter counting upwards by one.

3.4.2.2. Interface

Table 172: 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 173: Outputs of countUp

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

3.4.2.3. Operator Hierarchy

diagram : diagram_countUp_1

3.4.2.4. Graphical and Textual Diagrams

3.4.2.4.1. View of diagram_countUp_1 (countUp)

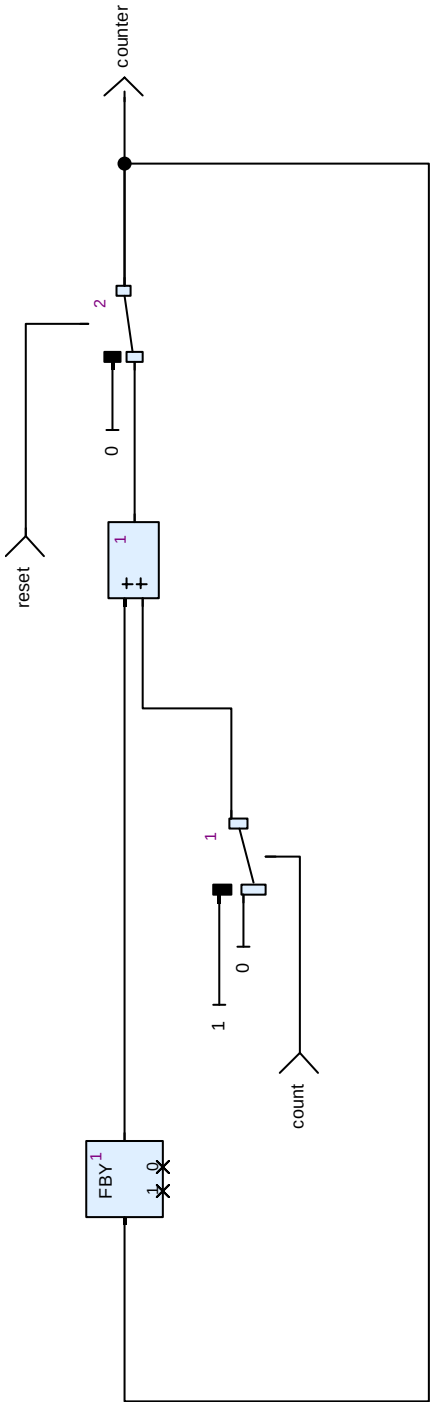

Figure 76: View of diagram_countUp_1 (countUp)

3.5. CalculateTrainPosition_Pkg::Pos_Pkg Package

3.5.1. Types

Table 174: Public Types of Pos_Pkg

Name	Definition	Comments and Information
trainMovementDir_T	enum {trm_unknown, trm_standstill, trm_increasing, trm_decreasing}	Comments: Train direction related to the OBU coordinate system trm_unknown Comments: Direction unknown trm_standstill Comments: No movement: train stands still trm_increasing Comments: Train moves towards increasing locations of the OBU coordinate system trm_decreasing Comments: Train moves towards decreasing locations of the OBU coordinate system

3.5.2. Constants

Table 175: Public Constants of Pos_Pkg

Name	Type	Value	Comments and Information
cOdometryStartVal	Obu_BasicTypes_Pkg::odometry_T	{valid : false, timestamp : 0, odo : {o_nominal : 0, o_min : 0, o_max : 0}, speed : 0, acceleration : 0, motionState : Obu_BasicTypes_Pkg::noMotion, motionDirection : Obu_BasicTypes_Pkg::unknownDirection}	
cSpeed_0	Obu_BasicTypes_Pkg::Speed_T	0	

3.5.3. frontendToLRBG Operator

Declared as **`public function`**

3.5.3.1. Comments and Information

frontendToLRBG Comments:

- Calculates on which side of the LRBG the estimated front end is

3.5.3.2. Interface

Table 176: Inputs of frontendToLRBG

Name	Type	Properties	Comments and Information
LRBG	TrainPosition_Types_Pck::positionedBG_T		Comments: The LRBG

Name	Type	Properties	Comments and Information
trainPositionInfo	TrainPosition_Types_Pck::trainPositionInfo_T		Comments: The resulting train position with reference to the known list of balise groups.
trainProperties	TrainPosition_Types_Pck::trainProperties_T	hidden	Comments: The trains properties required for train position calculation.

Table 177: Outputs of frontendToLRBG

Name	Type	Comments and Information
nominalOrReverseToLRBG	Q_DLRBG	

3.5.3.3. Locals

Table 178: Locals of frontendToLRBG

Name	Type	Comments and Information
estimated_d_LRBGToFrontend	Obu_BasicTypes_Pkg::L_internal_Type	Comments: Estimated (nominal) distance from train front end to LRBG (typically astern to the front end)
trainOrientationToLRBG	Q_DIRLRBG	

3.5.3.4. Operator Hierarchy

diagram : diagram_frontendToLRBG_1
    activate if : IfBlock1
        branch : then
        branch : else
            branch : then
            branch : else

3.5.3.5. Graphical and Textual Diagrams

3.5.3.5.1. View of diagram_frontendToLRBG_1 (frontendToLRBG)

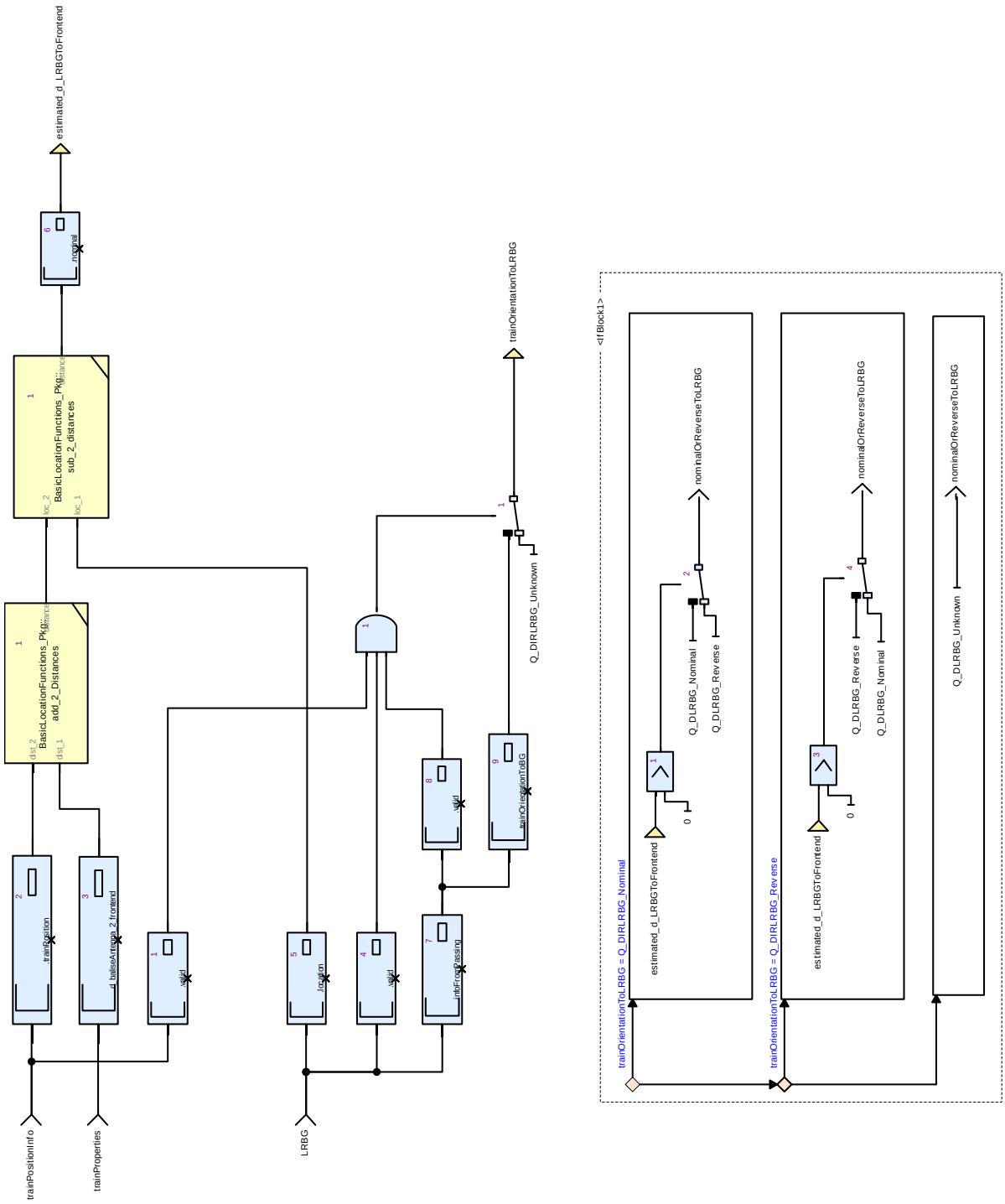

Figure 77: View of diagram_frontendToLRBG_1 (frontendToLRBG)

Table 179: Conditional Blocks of diagram_frontendToLRBG_1

Conditional Block	Comments and Information
IfBlock1	

Table 180: Actions of diagram_frontendToLRBG_1

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

3.5.4. runningDirectionVsRef Operator

Declared as **`public node`**

3.5.4.1. Comments and Information

runningDirectionVsRef Comments:

- Determines the current train running direction compared to a known reference running direction and speed.

3.5.4.2. Interface

Table 181: Inputs of runningDirectionVsRef

Name	Type	Comments and Information
refTrainRunningDirection	Q_DIRTRAIN	Comments: Train running direction at the reference location
refSpeed	Obu_BasicTypes_Pkg::Speed_T	Comments: Speed at the reference location
currentOdometry	Obu_BasicTypes_Pkg::odometry_T	Comments: The current odometry with the current speed

Table 182: Outputs of runningDirectionVsRef

Name	Type	Comments and Information
trainRunningDirection	Q_DIRTRAIN	Comments: The current train running direction

3.5.4.3. Locals

Table 183: Locals of runningDirectionVsRef

Name	Type	Comments and Information
currentDir	CalculateTrainPosition_Pkg::Pos_Pkg::trainMovementDir_T	
refDir	CalculateTrainPosition_Pkg::Pos_Pkg::trainMovementDir_T	

3.5.4.4. Operator Hierarchy

diagram : diagram_runningDirectionVsRef_1
    activate if : IfBlock1
        branch : then
        branch : else
            branch : then
            branch : else
    activate if : IfBlock2
        branch : then

branch : else
branch : then
branch : else

3.5.4.5. Graphical and Textual Diagrams

3.5.4.5.1. View of diagram_runningDirectionVsRef_1 (runningDirectionVsRef)

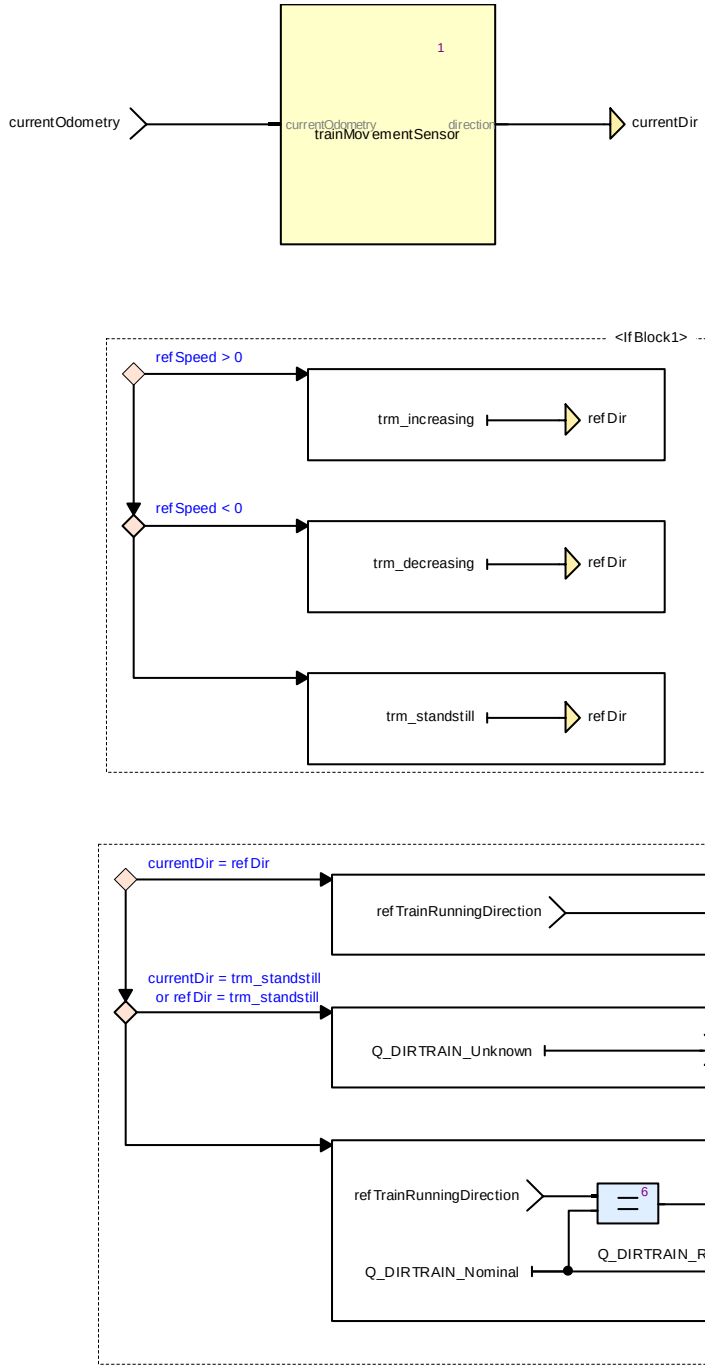

Figure 78: View of diagram_runningDirectionVsRef_1 (runningDirectionVsRef)

Table 184: Conditional Blocks of diagram_runningDirectionVsRef_1

Conditional Block	Comments and Information
IfBlock1	
IfBlock2	

Table 185: Actions of diagram_runningDirectionVsRef_1

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

3.5.5. trainMovementSensor Operator

Declared as **`private node`**

3.5.5.1. Comments and Information

trainMovementSensor Comments:

- Determines the movement direction of the train based on odometry.

3.5.5.2. Interface

Table 186: Inputs of trainMovementSensor

Name	Type	Properties		Comments and Information
currentOdometry	Obu_BasicTypes_Pkg::odometry_T	last	cOdometryStartVal	Comments: The current odometry values

Table 187: Outputs of trainMovementSensor

Name	Type	Comments and Information
direction	CalculateTrainPosition_Pkg::Pos_Pkg::trainMovementDir_T	Comments: The movement related to the OBU coordination system.

3.5.5.3. Locals

Table 188: Locals of trainMovementSensor

Name	Type	Comments and Information
direction_loc	CalculateTrainPosition_Pkg::Pos_Pkg::trainMovementDir_T	
standstillDetected	bool	

3.5.5.4. Operator Hierarchy

diagram : diagram_trainMovementSensor_1
    state-machine : SM1
        state : Decreasing
        state : Increasing
        state : Standstill
        state : Unknown

3.5.5.5. Graphical and Textual Diagrams

3.5.5.5.1. View of diagram_trainMovementSensor_1 (trainMovementSensor)

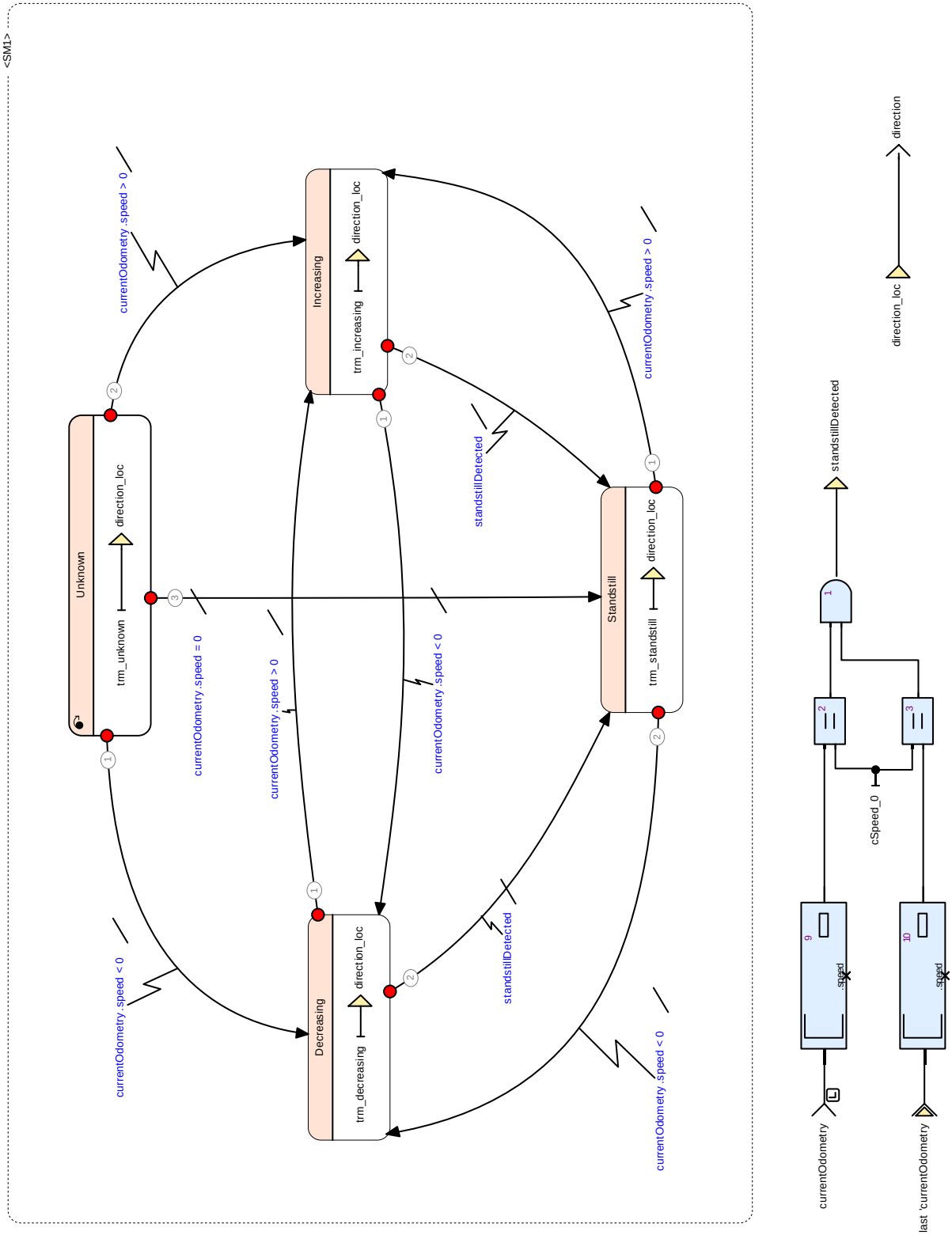

Figure 79: View of diagram_trainMovementSensor_1 (trainMovementSensor)

Table 189: State Machines of diagram_trainMovementSensor_1

State Machine	Comments and Information
SM1	

Table 190: States of diagram_trainMovementSensor_1

State	Comments and Information
SM1:Decreasing	
SM1:Increasing	
SM1:Standstill	
SM1:Unknown	

Table 191: Transitions of diagram_trainMovementSensor_1

Source/Target	#	Conditions/Actions	Comments and Information
Source: SM1:Decreasing Target: SM1:Increasing	1	Condition: currentOdometry.speed > 0	
Source: SM1:Decreasing Target: SM1:Standstill	2	Condition: standstillDetected	
Source: SM1:Increasing Target: SM1:Decreasing	1	Condition: currentOdometry.speed < 0	
Source: SM1:Increasing Target: SM1:Standstill	2	Condition: standstillDetected	
Source: SM1:Standstill Target: SM1:Increasing	1	Condition: currentOdometry.speed > 0	
Source: SM1:Standstill Target: SM1:Decreasing	2	Condition: currentOdometry.speed < 0	
Source: SM1:Unknown Target: SM1:Decreasing	1	Condition: currentOdometry.speed < 0	
Source: SM1:Unknown Target: SM1:Increasing	2	Condition: currentOdometry.speed > 0	
Source: SM1:Unknown Target: SM1:Standstill	3	Condition: currentOdometry.speed = 0	

4. Project Library: Obu_BasicTypes

4.1. Obu_BasicTypes_Pkg Package

4.1.1. Comments and Information

Obu_BasicTypes_Pkg Comments:

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

4.1.2. Types

Table 192: 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, acceleration : Obu_BasicTypes_Pkg::A_internal_Type, motionState : Obu_BasicTypes_Pkg::odoMotionState_T, motionDirection : Obu_BasicTypes_Pkg::odoMotionDirection_T}	Comments: Odometry values with time stamp timestamp Comments: time of the odometry stamp [ms] odo Comments: Odometry values speed Comments: speed given by the sensors of the odometer [km/h] acceleration Comments: acceleration provided by the odometer [0.01m/s2] motionState Comments: “Train is in Motion” State motionDirection Comments: “Direction the train is moving”

Name	Definition	Comments and Information
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
odoMotionDirection_T	enum {unknownDirection, cabAFirst, cabBFirst}	Comments: Indicates the direction the train is moving. Based on the sensors of the Odometer.
odoMotionState_T	enum {noMotion, Motion}	Comments: Indicates whether from a Train point of View the train is in motion. Based on the sensors of the Odometer.
Speed_T	Obu_BasicTypes_Pkg::V_internal_Type	Comments: General speed type: in km/h.
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

4.1.3. Constants

Table 193: 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

5. Project Library: TrainPosition_Types

5.1. TrainPosition_Types_Pck Package

5.1.1. Comments and Information

TrainPosition_Types_Pck Comments:

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

Table 194: 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

5.1.2. Types

Table 195: 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_asPositionedBGs_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

Name	Definition	Comments and Information
positionErrors_T	{outOfMemSpace : bool, passedBG_notFoundWhereExpected : bool, positionCalculation_inconsistent : bool, BG_LinkingConsistencyError : bool, DoubleLinkingError : bool, DoubleRepositioningError : 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 BG_LinkingConsistencyError Comments: Balise group: linking consistency error (ref. 3.16.2.3) DoubleLinkingError Comments: Double linking error (3.16.2.7.1) DoubleRepositioningError Comments: Double repositioning error (3.16.2.7.2)

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, LRBG : TrainPosition_Types_Pck::positionedBG_T, prvLRBG : TrainPosition_Types_Pck::positionedBG_T, nominalOrReverseToLRBG : Q_DLRBG, trainOrientationToLRBG : Q_DIRLRBG, trainRunningDirectionToLRBG : Q_DIRTRAIN, linkingIsUsedOnboard : bool}	Comments: 3.6.1.3 trainPositionIsUnknown Comments: 3.6.3.1.3.1 noCoordinateSystemHasBeen Assigned 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 LRBG Comments: LRBG = last passed linked balise group prvLRBG Comments: BG passed previously to LRBG 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 linkingIsUsedOnboard Comments: Designates, if at least one announced linked BG is ahead

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, locationAccuracy_DefaultValue : Obu_BasicTypes_Pkg::LocWithInAcc_T, centerDetectionAcc_DefaultValue : 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 locationAccuracy_DefaultValue Comments: 3.6.4.3.2 centerDetectionAcc_DefaultValue Comments: Will be applied, if centerDetectionInaccuracy from BTM is not available, especially for announced and not yet passed BGs

5.1.3. Constants

Table 196: 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)

Name	Type	Value	Comments and Information
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)
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)

6. Project Library: BG_Types

6.1. BG_Types_Pkg Package

6.1.1. Types

Table 197: Public Types of BG_Types_Pkg

Name	Definition	Comments and Information
AdditionalInformation_T	{linkingPackets : BG_Types_Pkg::LinkedBGs_T}	Comments: Packets received from balises
BG_Header_T	{q_updown : Q_UPDOWN, m_version : M_VERSION, q_media : Q_MEDIA, n_total : N_TOTAL, m_mcount : M_MCOUNT, nid_c : NID_C, nid_bg : NID_BG, q_link : Q_LINK}	Comments: Common header of the balise group datagram
BG_Message_T	{present : bool, Telegrams : BG_Types_Pkg::TelegramArray_T, numberBalises : int, centerOfBalisePosition : BG_Types_Pkg::centerOfBalisePosition_T}	present Comments: indicates whether the bg-message present is. Telegrams Comments: headers of all received telegrams filled up from the start of the array numberBalises Comments: additional packets received with the balises centerOfBalisePosition Comments: position of the balise group as given by the Odometer
BG_Orientation_T	enum {BG_Orientation_Reverse, BG_Orientation_Nominal, BG_Orientation_Unknown}	Comments: gives the orientation of a balise group
centerOfBalisePosition_T	{odometerOfBaliseDetection : Obu_BasicTypes_Pkg::odometry_T, BG_centerDetectionInaccuraccuracies : Obu_BasicTypes_Pkg::LocWithInAcc_T}	Comments: Gives the information for location and accuracy of measurements odometerOfBaliseDetection Comments: Location BG_centerDetectionInaccuraccuracies Comments: Location inaccuries caused by the balise group center detection

Name	Definition	Comments and Information
LinkedBG_T	{valid : bool, nid_LRBG : NID_LRBG, q_dir : Q_DIR, 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) 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 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: 7.5.1.86: Identity number of the country or region nid_bg Comments: 7.5.1.85: Identity number of the balise group Identity number of a balise group or loop within the country or region defined by NID_C 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)

Name	Definition	Comments and Information
passedBG_T	{valid : bool, bgPosition : Obu_BasicTypes_Pkg::odometry_T, BG_centerDetectionInaccuraccuracies : Obu_BasicTypes_Pkg::LocWithInAcc_T, q_nvlocacc : Q_NVLOCACC, BG_Header : BG_Types_Pkg::BG_Header_T, linkedBGs : BG_Types_Pkg::LinkedBGs_T, noCoordinateSystemHasBeenAssigned : bool, trainOrientationToBG : Q_DIRLRBG, trainRunningDirectionToBG : Q_DIRTRAIN}	Comments: Information reveived from a BG passede BG_centerDetectionInaccuraccuracies Comments: Location inaccuries caused by the balise group center detection q_nvlocacc Comments: 3.6.4.3.2: Default accuracy of the balise location, specific to each balise and taken from the national values BG_Header Comments: Common header of the balise group datagram linkedBGs Comments: The linked balise groups announced from this BG. noCoordinateSystemHasBeenAssigned 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
RBCOrientationReport_T	{assignment_of_coordinate_system : Radio_TrackToTrain::Assignment_of_coordinate_system}	Comments: !! Check: Usecase
RBCReport_T	{train_position_report : Radio_TrainToTrack::Train_Position_Report}	Comments: !! Check: Usecase
Telegram_T	{valid : bool, checkResult : bool, telegramheader : BG_Types_Pkg::TelegramHeader_T, packets : BG_Types_Pkg::AdditionalInformation_T}	Comments: 8.4.2: Structure of a telegram in the balise group channel. valid Comments: The element has valid data checkResult Comments: Result generated by the API on the success of the decoding of the telegram. True: teegram decoded without errors False errors recognised when decoding the telegram. The decoding routine performs checks on bit level on all relevant parameters. telegramheader Comments: Information received from the balise packets Comments: Packets received via the balises

Name	Definition	Comments and Information
TelegramArray_T	BG_Types_Pkg::Telegram_T ^cMaxNoBalises	Comments: Array of Telegrams making a Balise Group (for check)
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: 8.4.2.1: The Balise Telegram Header This structure is not “packed” to bit boundaries q_updown Comments: 7.5.1.142: Balise telegram transmission direction m_version Comments: 7.5.1.79: Version of ETCS system q_media Comments: 7.5.1.119: Qualifier to indicate the type of media, i.e., 0 Balise 1 Loop n_pig Comments: 7.5.1.81: Defines the relative position in a balise group n_total Comments: 7.5.1.82: Total number of balise(s) in the group, i.e., 0 --> 1 balise in the group 7 --> 8 balises in the group m_dup Comments: 7.5.1.63: Duplicate balise, Flags to tell whether the balise is a duplicate of one of the adjacent balises. m_mcount Comments: 7.5.1.71: Message counter, The purpose of this counter is to make it possible for the ERTMS/ETCS on-board to detect which balise group message the telegram belongs to. nid_c Comments: 7.5.1.86: Identity number of the country or region nid_bg Comments: 7.5.1.85: Identity number of the balise group Identity number of a balise group or loop within the country or region defined by NID_C q_link Comments: 7.5.1.114: Link Qualifier This qualifier is used to mark a balise group as linked or unlinked.

Name	Definition	Comments and Information
TrainToTrackStatus_T	{m_mode : M_MODE, m_level : M_LEVEL, m_leveltr : M_LEVELTR, nid_ntc : NID_NTC, q_length : Q_LENGTH}	Comments: !! Change Name and Type name (Christian) m_mode Comments: Mode of train m_level Comments: Level of train m_leveltr Comments: level transition nid_ntc Comments: national system id : where does the type result from q_length Comments: qualifier for train integrity status: woher?

6.1.2. Constants

Table 198: Public Constants of BG_Types_Pkg

Name	Type	Value	Comments and Information

Name	Type	Value	Comments and Information
cAddInfo	BG_Types_Pkg::AdditionalInformation_T	{linkingPackets : [{valid : false, nid_LRBG : 0, q_dir : Q_DIR_Reverse, 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, q_dir : Q_DIR_Reverse, 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, q_dir : Q_DIR_Reverse, 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,	Comments: empty structure for additional information

Name	Type	Value	Comments and Information
cEmpty_BaliseTlg	BG_Types_Pkg::Telegram_T	{valid : false, checkResult : 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 : {linkingPackets : [{valid : false, nid_LRBG : 0, q_dir : Q_DIR_Reverse, 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, q_dir : Q_DIR_Reverse, 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 :	Comments: empty telegram

Name	Type	Value	Comments and Information
		{present : false, Telegrams : [{valid : false, checkResult : 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 : {linkingPackets : [{valid : false, nid_LRBG : 0, q_dir : Q_DIR_Reverse, 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, q_dir : Q_DIR_Reverse, 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_dir	

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

Name	Type	Value	Comments and Information
		[{valid : false, checkResult : 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 : {linkingPackets : [{valid : false, nid_LRBG : 0, q_dir : Q_DIR_Reverse, 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, q_dir : Q_DIR_Reverse, 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 :	

Name	Type	Value	Comments and Information
		{valid : false, bgPosition : {valid : false, timestamp : 0, odo : {o_nominal : 0, o_min : 0, o_max : 0}, speed : 0, acceleration : 0, motionState : Obu_BasicTypes_Pkg::noMotion, motionDirection : Obu_BasicTypes_Pkg::unknownDirection}, BG_centerDetection Inaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, q_nvlocacc : 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_total : N_TOTAL_1_balise_in_the_group, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, linkedBGs : [{valid : false, nid_LRBG : 0, q_dir : Q_DIR_Reverse, 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, q_dir : Q_DIR_Reverse, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S	Comments:

Name	Type	Value	Comments and Information
cemptyPosition	BG_Types_Pkg::centerOfBalisePosition_T	{odometerOfBaliseDetection : {valid : false, timestamp : 0, odo : {o_nominal : 0, o_min : 0, o_max : 0}, speed : 0, acceleration : 0, motionState : Obu_BasicTypes_Pkg::noMotion, motionDirection : Obu_BasicTypes_Pkg::unknownDirection}, BG_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}}	Comments: empty Balise Position
cInitOrientation	Q_DIRTRAIN	Q_DIRTRAIN_Unknown	Comments: Default Orientation
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	Comments: Maximum Number of Balises
cMaxNoBalises	int	8	Comments: Max. number of balises in a balise group
cMaxNoOfLevelTransitionOrders	int	4	Comments: Max. number = 31
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

6.2. Packet_Types_Pkg Package

6.2.1. Types

Table 199: Public Types of Packet_Types_Pkg

Name	Definition	Comments and Information
axleload_T	{valid : bool, m_axleloadcat : M_AXLELOADCAT, v_axleload : V_AXLELOAD}	
axleloadArray_T	Packet_Types_Pkg::axleload_T ^N_IterMax	
axleloadSpeedProfile_T	{valid : bool, d_axleload : D_AXLELOAD, l_axleload : L_AXLELOAD, q_front : Q_FRONT, axleloadArray : Packet_Types_Pkg::axleloadArray_T}	
axleloadSpeedProfileArray_T	Packet_Types_Pkg::axleloadSpeedProfile_T ^N_IterMax	
Diff_T	{valid : bool, q_diff : Q_DIFF, nc_cddiff : NC_CDDIFF, nc_diff : NC_DIFF, v_diff : V_DIFF}	
DiffArray_T	Packet_Types_Pkg::Diff_T ^N_IterMax	
geographicalPositionInformation_T	{valid : bool, q_newcountry : Q_NEWCOUNTRY, nid_c : NID_C, nid_bg : NID_BG, d_posoff : D_POSOFF, q_mposition : Q_MPOSITION, m_position : M_POSITION}	
geographicalPositionInformationArray_T	Packet_Types_Pkg::geographicalPositionInformation_T ^N_IterMax	
GradientProfileData_T	{valid : bool, d_gradient : D_GRADIENT, q_gdir : Q_GDIR, g_a : G_A}	
GradientProfileDataArray_T	Packet_Types_Pkg::GradientProfileData_T ^N_IterMax	
leveltr_T	{valid : bool, m_leveltr : M_LEVELTR, nid_ntc : NID_NTC}	
leveltrAck_T	{valid : bool, m_leveltr : M_LEVELTR, nid_ntc : NID_NTC, l_ackleveltr : L_ACKLEVELTR}	
leveltrAckArray_T	Packet_Types_Pkg::leveltrAck_T ^N_IterMax	
leveltrArray_T	Packet_Types_Pkg::leveltr_T ^N_IterMax	
linking_T	{valid : bool, 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}	
linkingArray_T	Packet_Types_Pkg::linking_T ^N_IterMax	
loc_T	{valid : bool, d_loc : D_LOC, q_lgtloc : Q_LGTLOC}	
locArray_T	Packet_Types_Pkg::loc_T ^N_IterMax	

Name	Definition	Comments and Information
modeProfile_T	{valid : bool, d_mamode : D_MAMODE, m_mamode : M_MAMODE, v_mamode : V_MAMODE, l_mamode : L_MAMODE, l_ackmamode : L_ACKMAMODE, q_mamode : Q_MAMODE}	
modeProfileArray_T	Packet_Types_Pkg::modeProfile_T ^N_IterMax	
newCountry_T	{valid : bool, q_newcountry : Q_NEWCOUNTRY, nid_c : NID_C, nid_bg : NID_BG}	
newCountryArray_T	Packet_Types_Pkg::newCountry_T ^N_IterMax	
nidC_T	{valid : bool, nid_c : NID_C}	
nidCArray_T	Packet_Types_Pkg::nidC_T ^N_IterMax	
nvkrint_T	{valid : bool, l_nvkrint : L_NVKRINT, m_nvkrint : M_NVKRINT}	
nvkrintArray_T	Packet_Types_Pkg::nvkrint_T ^N_IterMax	
nvkvint_T	{valid : bool, v_nvkvint : V_NVKVINT, m_nvkvint12 : M_NVKVINT, m_nvkvint23 : M_NVKVINT}	m_nvkvint12 Comments: Valid between V_NVKVINT(n) and V_NVKVINT(n+1) If Q_NVKVINTSET = 1, gives the correction factor if maximum emergency brake deceleration is lower than A_NVP12 m_nvkvint23 Comments: Only if Q_NVKVINTSET = 1 Valid between V_NVKVINT(n) and V_NVKVINT(n+1) Gives the correction factor if maximum emergency brake deceleration is higher than A_NVP23
nvkvintArray_T	Packet_Types_Pkg::nvkvint_T ^N_IterMax	
nvkvintset_T	{valid : bool, q_nvkvintset : bool, a_nvp12 : bool, a_nvp23 : bool, nvkintArray : Packet_Types_Pkg::nvkvintArray_T}	q_nvkvintset Comments: ??? a_nvp12 Comments: ??? a_nvp23 Comments: ??? nvkintArray Comments: Only if Q_NVKVINTSET = 1 Valid between V_NVKVINT(n) and V_NVKVINT(n+1) Gives the correction factor if maximum emergency brake deceleration is higher than A_NVP23
nvkvintsetArray_T	Packet_Types_Pkg::nvkvintset_T ^N_IterMax	
P131_RBC_transition_order	{nid_packet : NID_PACKET, q_dir : Q_DIR, d_rbctr : D_RBCTR, nid_c : NID_C, nid_rbc : NID_RBC, nid_radio : NID_RADIO, q_sleepsession : Q_SLEEPSESSION}	

Name	Definition	Comments and Information
P137_Stop_if_in_Staff_Responsible	{nid_packet : NID_PACKET, q_dir : Q_DIR, q_srstop : Q_SRSTOP}	
P138_Reversing_area_information	{nid_packet : NID_PACKET, q_dir : Q_DIR, d_startreverse : D_STARTREVERSE, l_reversearea : L_REVERSEAREA}	
P139_Reversing_supervision_information	{nid_packet : NID_PACKET, q_dir : Q_DIR, d_reverse : D_REVERSE, v_reverse : V_REVERSE}	
P140_Train_running_number_from_RBC	{nid_packet : NID_PACKET, q_dir : Q_DIR, nid_operational : NID_OPERATIONAL}	
P21_Gradient_Profile	{nid_packet : NID_PACKET, q_dir : Q_DIR, gradientProfileData : Packet_Types_Pkg::GradientProfileDataArray_T}	
P255_End_of_Information	{nid_packet : NID_PACKET}	
P27_International_Static_Speed_Profile	{nid_packet : NID_PACKET, q_dir : Q_DIR, d_static : D_STATIC, v_static : V_STATIC, q_front : Q_FRONT, diffArray : Packet_Types_Pkg::DiffArray_T, SSPArray : Packet_Types_Pkg::SSPArray_T}	
P39_Track_Condition_Change_of_traction_system	{nid_packet : NID_PACKET, q_dir : Q_DIR, d_traction : D_TRACTION, m_voltage : M_VOLTAGE, nid_ctraction : NID_CTRACTION}	

Name	Definition	Comments and Information
P3_National_Values	{nid_packet : NID_PACKET, q_dir : Q_DIR, d_validnv : D_VALIDNV, nid_cArray : Packet_Types_Pkg::nidCArray_T, v_nvshunt : V_NVSHUNT, v_nvstff : V_NVSTFF, v_nvonsight : V_NVONSIGHT, v_nvlimsuperv : V_NVLIMSUPERV, v_nvunfit : V_NVUNFIT, v_nvrel : V_NVREL, d_nvroll : D_NVROLL, q_nvsbtsmperm : Q_NVSBTSMPERM, q_nvemrrls : Q_NVEMRRLS, q_nvguiperm : Q_NVGUIPERM, q_nvsbfbperm : Q_NVSBFBPERM, q_nvinhsmicperm : Q_NVINHSMICPERM, v_nvallowovtrp : V_NVALLOWOVTRP, v_nvsupovtrp : V_NVSUPOVTRP, d_nvovtrp : D_NVOVTRP, t_nvovtrp : T_NVOVTRP, d_nvpotrp : D_NVPOTRP, m_nvcontact : M_NVCONTACT, t_nvcontact : T_NVCONTACT, m_nvderun : M_NVDERUN, d_nvstff : D_NVSTFF, q_nvdriver_adhes : Q_NVDRIVER_ADHES, a_nvmaxredadh1 : A_NVMAXREDADH1, a_nvmaxredadh2 : A_NVMAXREDADH2, a_nvmaxredadh3 : A_NVMAXREDADH3, q_nvlocacc : Q_NVLOCACC, m_nvavadh : M_NVAVADH, m_nvebcl : M_NVEBCL, q_nvkint : Q_NVKINT, nvkvintsetArray : Packet_Types_Pkg::nvkvintsetArray_T, nvkrintArray : Packet_Types_Pkg::nvkrintArray_T, m_nvktint : M_NVKTINT}	
P40_Track_Condition_Change_of_allowed_current_consumption	{nid_packet : NID_PACKET, q_dir : Q_DIR, d_current : D_CURRENT, m_current : M_CURRENT}	
P41_Level_Transition_Order	{nid_packet : NID_PACKET, q_dir : Q_DIR, d_leveltr : D_LEVELTR, leveltrArray : Packet_Types_Pkg::leveltrAckArray_T}	
P42_Session_Management	{nid_packet : NID_PACKET, q_dir : Q_DIR, q_rbc : Q_RBC, nid_c : NID_C, nid_rbc : NID_RBC, nid_radio : NID_RADIO, q_sleepsession : Q_SLEEPSESSION}	
P44_Data_used_by_applications_outside_the_ERTMSETCS_system	{nid_packet : NID_PACKET, q_dir : Q_DIR, nid_xuser : NID_XUSER, nid_ntc : NID_NTC, Other_data_depending_on__NID_XUSER : int}	Other_data_depending_on__NID_XUSER Comments: TODO
P45_Radio_Network_registration	{nid_packet : NID_PACKET, q_dir : Q_DIR, nid_mn : NID_MN}	
P46_Conditional_Level_Transition_Order	{nid_packet : NID_PACKET, q_dir : Q_DIR, leveltrArray : Packet_Types_Pkg::leveltrArray_T}	

Name	Definition	Comments and Information
P49_List_of_balises_for_SH_Area	{nid_packet : NID_PACKET, q_dir : Q_DIR, newCountryArray : Packet_Types_Pkg::newCountryArray_T}	
P51_Axle_Load_Speed_Profile	{nid_packet : NID_PACKET, q_dir : Q_DIR, q_trackinit : Q_TRACKINIT, d_trackinit : D_TRACKINIT, axleloadSpeedProfileArray : Packet_Types_Pkg::axleloadSpeedProfileArray_T}	
P52_Permitted_Braking_Distance_Information	{nid_packet : NID_PACKET, q_dir : Q_DIR, q_trackinit : Q_TRACKINIT, d_trackinit : D_TRACKINIT, permittedBrakingDistanceInformationArray : Packet_Types_Pkg::permittedBrakingDistanceInformationArray_T}	
P57_Movement_Authority_Request_Parameters	{nid_packet : NID_PACKET, q_dir : Q_DIR, t_mar : T_MAR, t_timeoutrqst : T_TIMEOUTRQST, t_cycrqst : T_CYCRQST}	
P58_Position_Report_Parameters	{nid_packet : NID_PACKET, q_dir : Q_DIR, t_cycloc : T_CYCLOC, d_cycloc : D_CYCLOC, m_loc : M_LOC, locArray : Packet_Types_Pkg::locArray_T}	
P5_Linking	{nid_packet : NID_PACKET, q_dir : Q_DIR, linkingArray : Packet_Types_Pkg::linkingArray_T}	
P64_Inhibition_of_revocable_TSRs_from_balises_in_L23	{nid_packet : NID_PACKET, q_dir : Q_DIR}	
P65_Temporary_Speed_Restriction	{nid_packet : NID_PACKET, q_dir : Q_DIR, nid_tsr : NID_TSR, d_tsr : D_TSR, l_tsr : L_TSR, q_front : Q_FRONT, v_tsr : V_TSR}	
P66_Temporary_Speed_Restriction_Revocation	{nid_packet : NID_PACKET, q_dir : Q_DIR, nid_tsr : NID_TSR}	
P68_Track_Condition	{nid_packet : NID_PACKET, q_dir : Q_DIR, q_trackinit : Q_TRACKINIT, d_trackinit : D_TRACKINIT, trackConditionArray : Packet_Types_Pkg::trackConditionArray_T}	
P69_Track_Condition_Station_Platforms	{nid_packet : NID_PACKET, q_dir : Q_DIR, q_trackinit : Q_TRACKINIT, d_trackinit : D_TRACKINIT, trackConditionStationPlatformsArray : Packet_Types_Pkg::trackConditionStationPlatformsArray_T}	
P70_Route_Suitability_Data	{nid_packet : NID_PACKET, q_dir : Q_DIR, q_trackinit : Q_TRACKINIT, d_trackinit : D_TRACKINIT, routeSuitabilityDataArray : Packet_Types_Pkg::routeSuitabilityDataArray_T}	

Name	Definition	Comments and Information
P71_Adhesion_factor	{nid_packet : NID_PACKET, q_dir : Q_DIR, d_adhesion : D_ADHESION, l_adhesion : L_ADHESION, m_adhesion : M_ADHESION}	
P72_Packet_for_sending_plain_text_messages	{nid_packet : NID_PACKET, q_dir : Q_DIR, q_textclass : Q_TEXTCLASS, q_textdisplay : Q_TEXTDISPLAY, d_textdisplay : D_TEXTDISPLAY, m_modetextdisplay_start : M_MODETEXTDISPLAY, m_leveltextdisplay_start : M_LEVELTEXTDISPLAY, nid_ntc_start : NID_NTC, l_textdisplay : L_TEXTDISPLAY, t_textdisplay : T_TEXTDISPLAY, m_modetextdisplay_end : M_MODETEXTDISPLAY, m_leveltextdisplay_end : M_LEVELTEXTDISPLAY, nid_ntc_end : NID_NTC, q_textconfirm : Q_TEXTCONFIRM, q_conftextdisplay : Q_CONFTEXTDISPLAY, q_textreport : Q_TEXTREPORT, nid_textmessage : NID_TEXTMESSAGE, nid_c : NID_C, nid_rbc : NID_RBC, l_text : L_TEXT, x_text : Packet_Types_Pkg::xTextArray_T}	
P76_Packet_for_sending_fixed_text_messages	{nid_packet : NID_PACKET, q_dir : Q_DIR, q_textclass : Q_TEXTCLASS, q_textdisplay : Q_TEXTDISPLAY, d_textdisplay : D_TEXTDISPLAY, m_modetextdisplay_start : M_MODETEXTDISPLAY, m_leveltextdisplay_start : M_LEVELTEXTDISPLAY, nid_ntc_start : NID_NTC, l_textdisplay : L_TEXTDISPLAY, t_textdisplay : T_TEXTDISPLAY, m_modetextdisplay_end : M_MODETEXTDISPLAY, m_leveltextdisplay_end : M_LEVELTEXTDISPLAY, nid_ntc_end : NID_NTC, q_textconfirm : Q_TEXTCONFIRM, q_conftextdisplay : Q_CONFTEXTDISPLAY, q_textreport : Q_TEXTREPORT, nid_textmessage : NID_TEXTMESSAGE, nid_c : NID_C, nid_rbc : NID_RBC, q_text : Q_TEXT}	
P79_Geographical_Position_Information	{nid_packet : NID_PACKET, q_dir : Q_DIR, geographicalPositionInformationArray : Packet_Types_Pkg::geographicalPositionInformationArray_T}	
P80_Mode_profile	{nid_packet : NID_PACKET, q_dir : Q_DIR, modeProfileArray : Packet_Types_Pkg::modeProfileArray_T}	

Name	Definition	Comments and Information
P88_Level_Crossing_information	{nid_packet : NID_PACKET, q_dir : Q_DIR, nid_lx : NID_LX, d_lx : D_LX, l_lx : L_LX, q_lxstatus : Q_LXSTATUS, v_lx : V_LX, q_stoplx : Q_STOPLX, l_stoplx : L_STOPLX}	
permittedBrakingDistanceInformation_T	{valid : bool, d_pbd : D_PBD, q_gdir : Q_GDIR, g_pbdsr : G_PBDSR, q_pbdsr : Q_PBDSR, d_pbdsr : D_PBDSR, l_pbdsr : L_PBDSR}	
permittedBrakingDistanceInformationArray_T	Packet_Types_Pkg::permittedBrakingDistanceInformation_T ^N_IterMax	
routeSuitabilityData_T	{valid : bool, d_suitability : D_SUITABILITY, q_suitability : Q_SUITABILITY, m_linegauge : M_LINEGAUGE, m_axleloadcat : M_AXLELOADCAT, m_voltage : M_VOLTAGE, nid_ctraction : NID_CTRACTION}	
routeSuitabilityDataArray_T	Packet_Types_Pkg::routeSuitabilityData_T ^N_IterMax	
SSP_T	{valid : bool, d_static : D_STATIC, v_static : V_STATIC, q_front : Q_FRONT, diffArray : Packet_Types_Pkg::DiffArray_T}	
SSPArray_T	Packet_Types_Pkg::SSP_T ^N_IterMax	
trackCondition_T	{valid : bool, d_trackcond : D_TRACKCOND, l_trackcond : L_TRACKCOND, m_trackcond : M_TRACKCOND}	
trackConditionArray_T	Packet_Types_Pkg::trackCondition_T ^N_IterMax	
trackConditionStationPlatforms_T	{valid : bool, d_trackcond : D_TRACKCOND, l_trackcond : L_TRACKCOND, m_platform : M_PLATFORM, q_platform : Q_PLATFORM}	
trackConditionStationPlatformsArray_T	Packet_Types_Pkg::trackConditionStationPlatforms_T ^N_IterMax	
xText_T	{valid : bool, x_text : X_TEXT}	
xTextArray_T	Packet_Types_Pkg::xText_T ^255	

6.2.2. Constants

Table 200: Public Constants of Packet_Types_Pkg

Name	Type	Value	Comments and Information
N_IterMax	int	32	Comments: N_ITER max value is 31. One element added for the first element, since the SRS does not include it in the array.

6.3. Radio_Types_Pkg Package

6.3.1. Types

Table 201: Public Types of Radio_Types_Pkg

Name	Definition	Comments and Information
Radio_TrackTrain_Header_T	{nid_message : NID_MESSAGE, t_train : T_TRAIN, m_ack : M_ACK, nid_lrbg : NID_LRBG, level_23_movement_authority : TrackToTrain::Level_23_Movement_Authority, sh_request_t_train : T_TRAIN, q_scale : Q_SCALE}	nid_message Comments: Message Identifier / From: General header t_train Comments: Time, according to trainborne clock, at which message is sent / From: General header m_ack Comments: Indicates whether the telegram must be acknowledged or not / From: General header nid_lrbg Comments: Identity of last relevant balise group / From: General header level_23_movement_authority Comments: Packet 15: Movement authority / From: Message 3: MA / Message 9: Request to Shorten MA // TODO: maybe move to separate packet. sh_request_t_train Comments: Time stamp of the shunting request / From: Message 28: SH Authorised q_scale Comments: Qualifier for the distance scale / From: Message 33: MA with Shifted Location Reference

7. Project Library: BasicLocationFunctions

7.1. BasicLocationFunctions_Pkg Package

7.1.1. 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 202: 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

7.1.2. add_2_Distances Operator

Declared as **`public function`**

7.1.2.1. Comments and Information

add_2_Distances Comments:

- Calculates the sum of 2 distances dist_2 + dist_1

Table 203: 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

7.1.2.2. Interface

Table 204: 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 205: Outputs of add_2_Distances

Name	Type	Comments and Information
distance	Obu_BasicTypes_Pkg::LocWithInAcc_T	

7.1.2.3. Operator Hierarchy

diagram : diagram_add_2_Distances_1

7.1.2.4. Graphical and Textual Diagrams

7.1.2.4.1. View of diagram_add_2_Distances_1 (add_2_Distances)

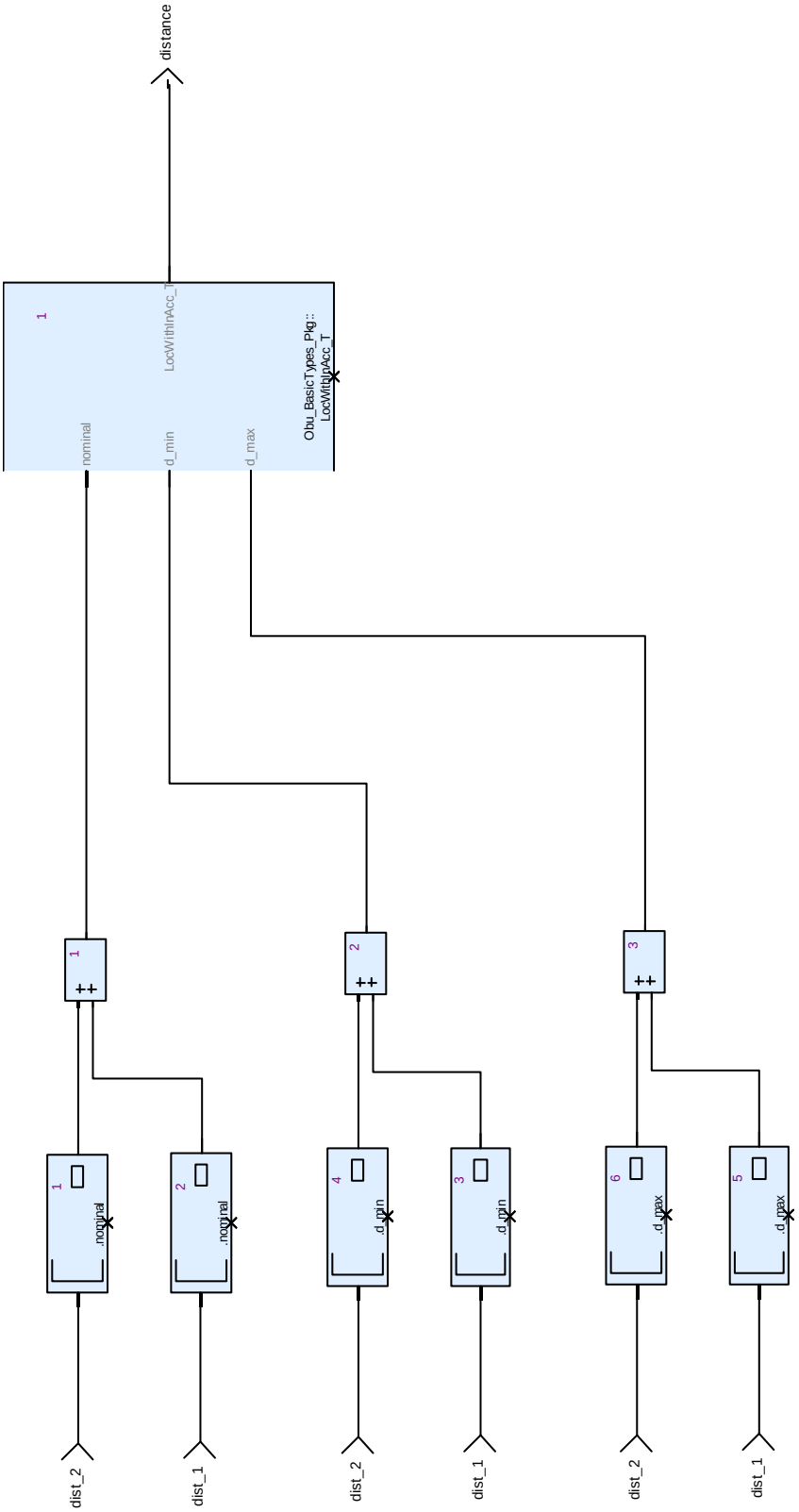

Figure 80: View of diagram_add_2_Distances_1 (add_2_Distances)

7.1.3. add_odo_2_Location Operator

Declared as **`public function`**

7.1.3.1. 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 206: 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

7.1.3.2. Interface

Table 207: 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 208: Outputs of add_odo_2_Location

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

7.1.3.3. Operator Hierarchy

diagram : diagram_add_odo_2_Location_1

7.1.3.4. Graphical and Textual Diagrams

7.1.3.4.1. View of diagram_add_odo_2_Location_1 (add_odo_2_Location)

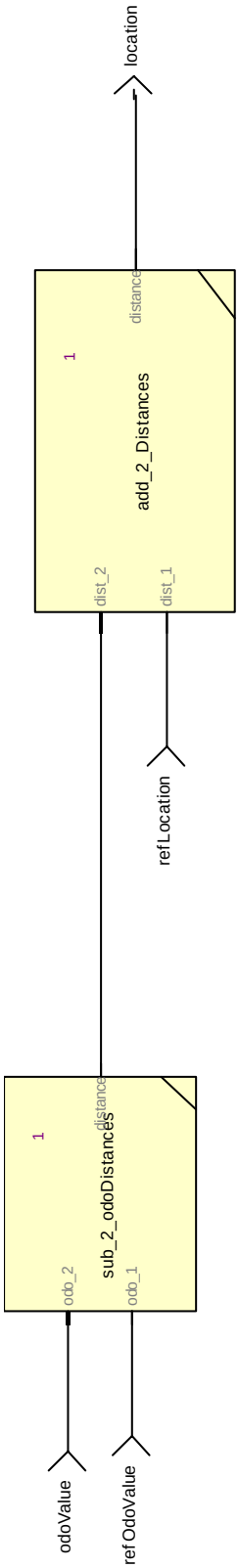

Figure 81: View of diagram_add_odo_2_Location_1 (add_odo_2_Location)

7.1.4. addDistances Operator

Declared as **`public function`**

7.1.4.1. Comments and Information

addDistances Comments:

- Calculates the sum of an array of distances

Table 209: 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/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

7.1.4.2. Interface

Table 210: Inputs of addDistances

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

Table 211: Outputs of addDistances

Name	Type	Comments and Information
sum	Obu_BasicTypes_Pkg::LocWithInAcc_T	

Table 212: Size Parameters of addDistances

Name	Comments and Information
noOfSummands	Comments: Number of summands

7.1.4.3. Operator Hierarchy

diagram : diagram_sumOfDistances_1

7.1.4.4. Graphical and Textual Diagrams

7.1.4.4.1. View of diagram_sumOfDistances_1 (addDistances)

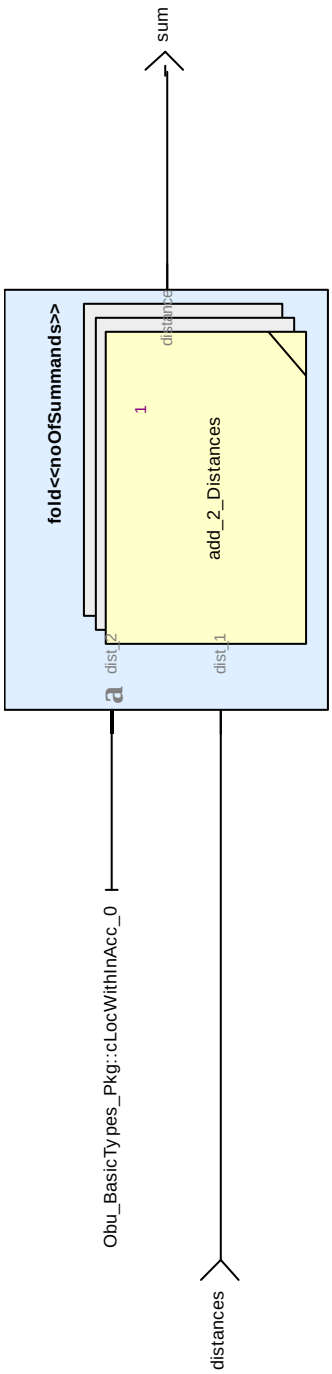

Figure 82: View of diagram_sumOfDistances_1 (addDistances)

7.1.5. addDistancesBetwLinkedElements Operator

Declared as **`public function`**

7.1.5.1. 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 213: 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

7.1.5.2. Interface

Table 214: Inputs of addDistancesBetwLinkedElements

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

Table 215: Outputs of addDistancesBetwLinkedElements

Name	Type	Comments and Information
sumOfDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T	

Table 216: Size Parameters of addDistancesBetwLinkedElements

Name	Comments and Information
noOfLinkedElements	

7.1.5.3. Operator Hierarchy

diagram : diagram_distanceBetweenLinkedElements_1

7.1.5.4. Graphical and Textual Diagrams

7.1.5.4.1. View of diagram_distanceBetweenLinkedElements_1 (addDistancesBetwLinkedElements)

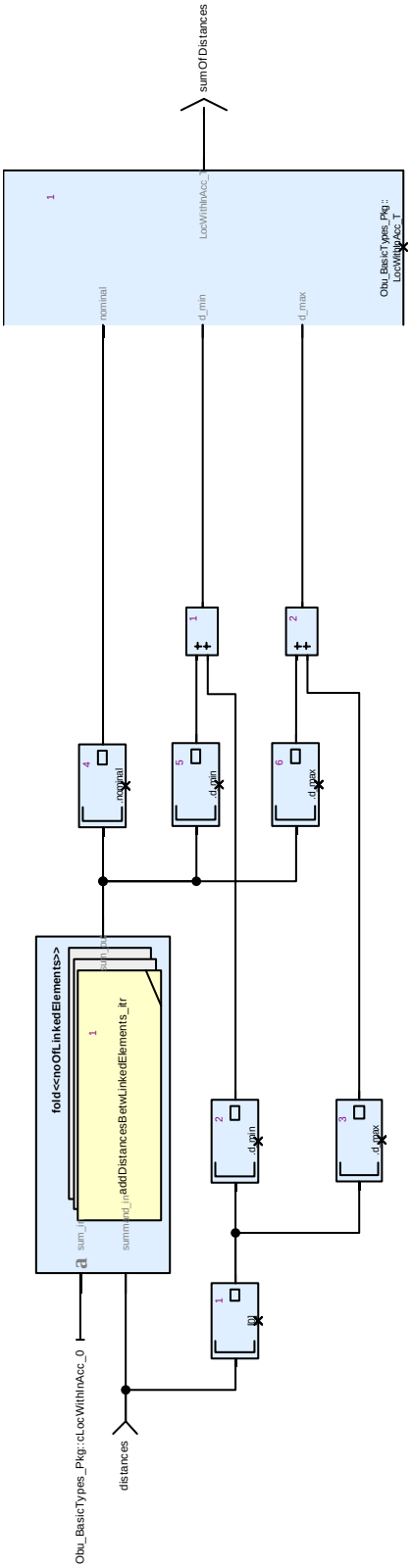

Figure 83: View of diagram_distanceBetweenLinkedElements_1 (addDistancesBetwLinkedElements)

7.1.6. addDistancesBetwLinkedElements_itr Operator

Declared as **`private function`**

7.1.6.1. 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 217: 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

7.1.6.2. Interface

Table 218: Inputs of addDistancesBetwLinkedElements_itr

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

Table 219: Outputs of addDistancesBetwLinkedElements_itr

Name	Type	Comments and Information
sum_out	Obu_BasicTypes_Pkg::LocWithInAcc_T	

7.1.6.3. Operator Hierarchy

diagram : diagram_addDistancesBetwLinkedElements_itr_1

7.1.6.4. Graphical and Textual Diagrams

7.1.6.4.1. View of diagram_addDistancesBetwLinkedElements_itr_1 (addDistancesBetwLinkedElements_itr)

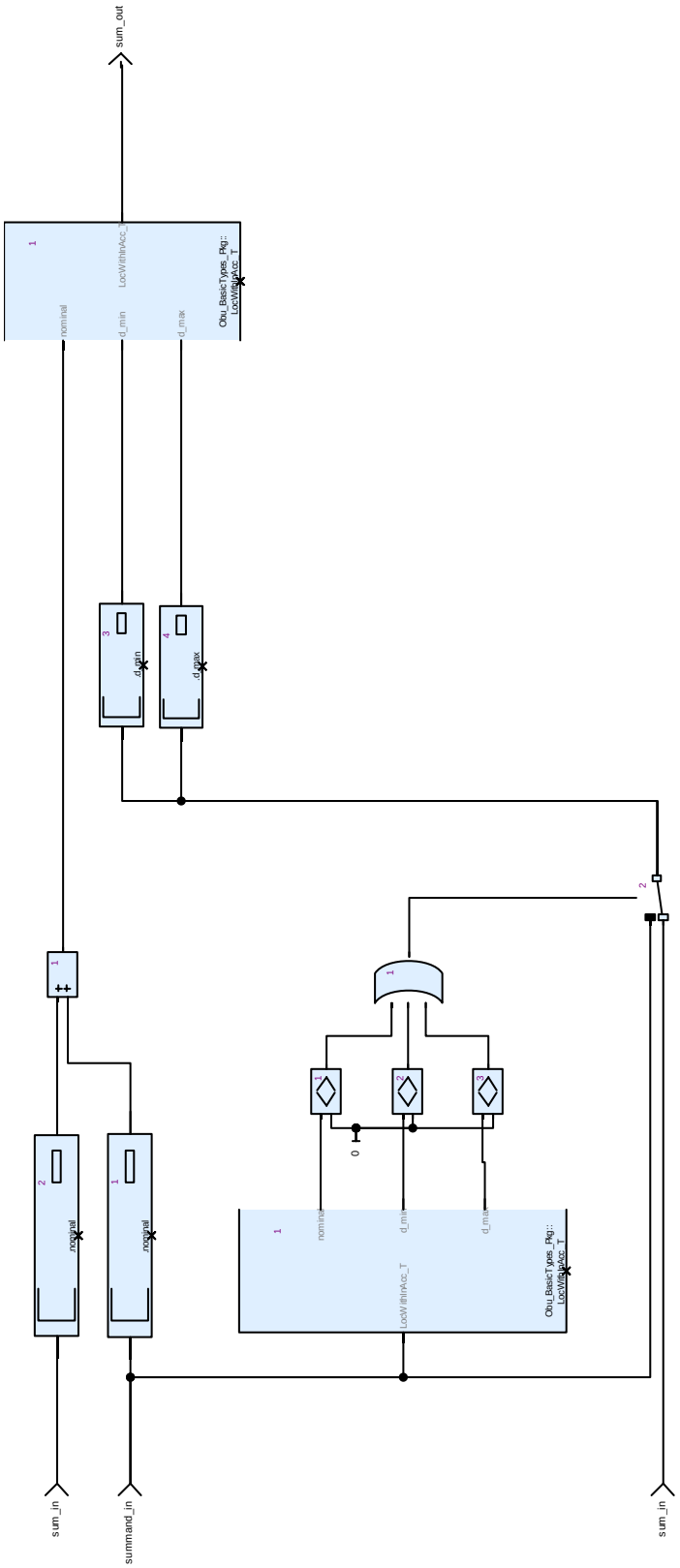

Figure 84: View of diagram_addDistancesBetwLinkedElements_itr_1 (addDistancesBetwLinkedElements_itr)

7.1.7. checkMaxAbsOdoDistance Operator

Declared as **`public function`**

7.1.7.1. 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!

7.1.7.2. Interface

Table 220: 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 221: Outputs of checkMaxAbsOdoDistance

Name	Type	Comments and Information
isLessThanOrEqual	bool	

7.1.7.3. Operator Hierarchy

diagram : diagram_checkMaxAbsOdoDistance_1

7.1.7.4. Graphical and Textual Diagrams

7.1.7.4.1. View of diagram_checkMaxAbsOdoDistance_1 (checkMaxAbsOdoDistance)

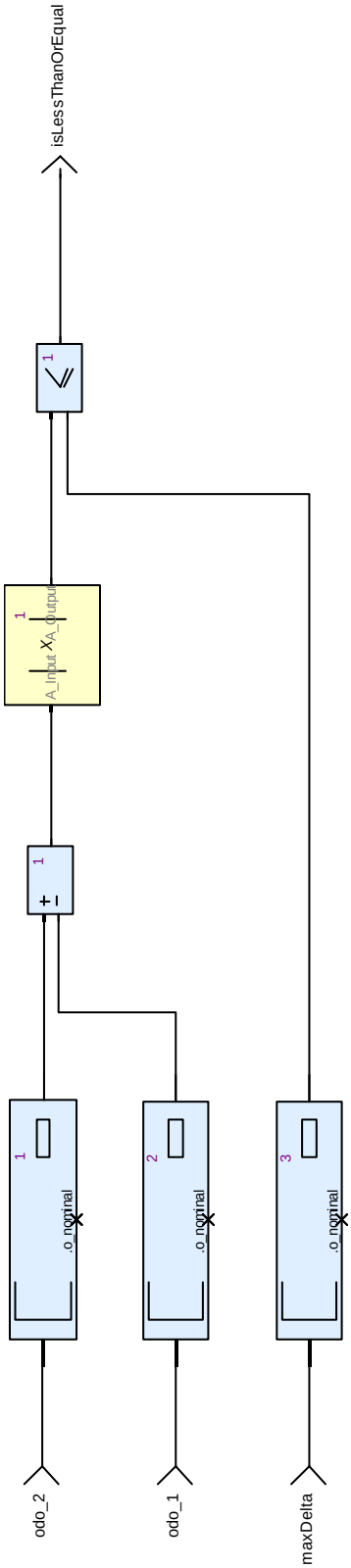

Figure 85: View of diagram_checkMaxAbsOdoDistance_1 (checkMaxAbsOdoDistance)

7.1.8. dTrain2Trackelem_unlinkedBG Operator

Declared as **`public function`**

7.1.8.1. 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 222: 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

7.1.8.2. Interface

Table 223: 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 224: 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

7.1.8.3. Operator Hierarchy

diagram : diagram_dTrain2Trackelem_unlinkedBG_1

7.1.8.4. Graphical and Textual Diagrams

7.1.8.4.1. View of diagram_dTrain2Trackelem_unlinkedBG_1 (dTrain2Trackelem_unlinkedBG)

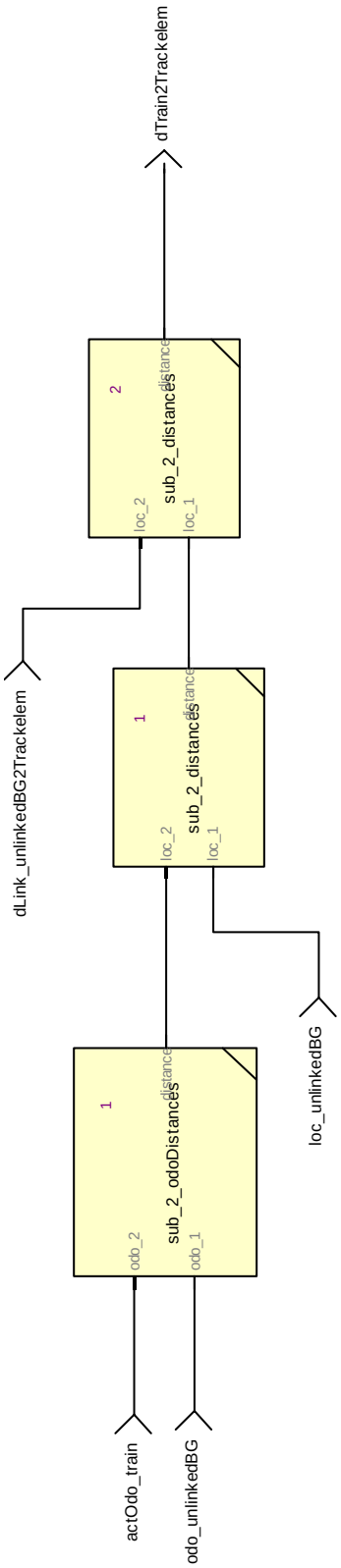

Figure 86: View of diagram_dTrain2Trackelem_unlinkedBG_1 (dTrain2Trackelem_unlinkedBG)

7.1.9. odoLoc_2_refLocations Operator

Declared as **`public function`**

7.1.9.1. 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 225: 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/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

7.1.9.2. Interface

Table 226: 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 227: Outputs of odoLoc_2_refLocations

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

7.1.9.3. Operator Hierarchy

diagram : diagram_odoLoc_2_refLocations_1

7.1.9.4. Graphical and Textual Diagrams

7.1.9.4.1. View of diagram_odoLoc_2_refLocations_1 (odoLoc_2_refLocations)

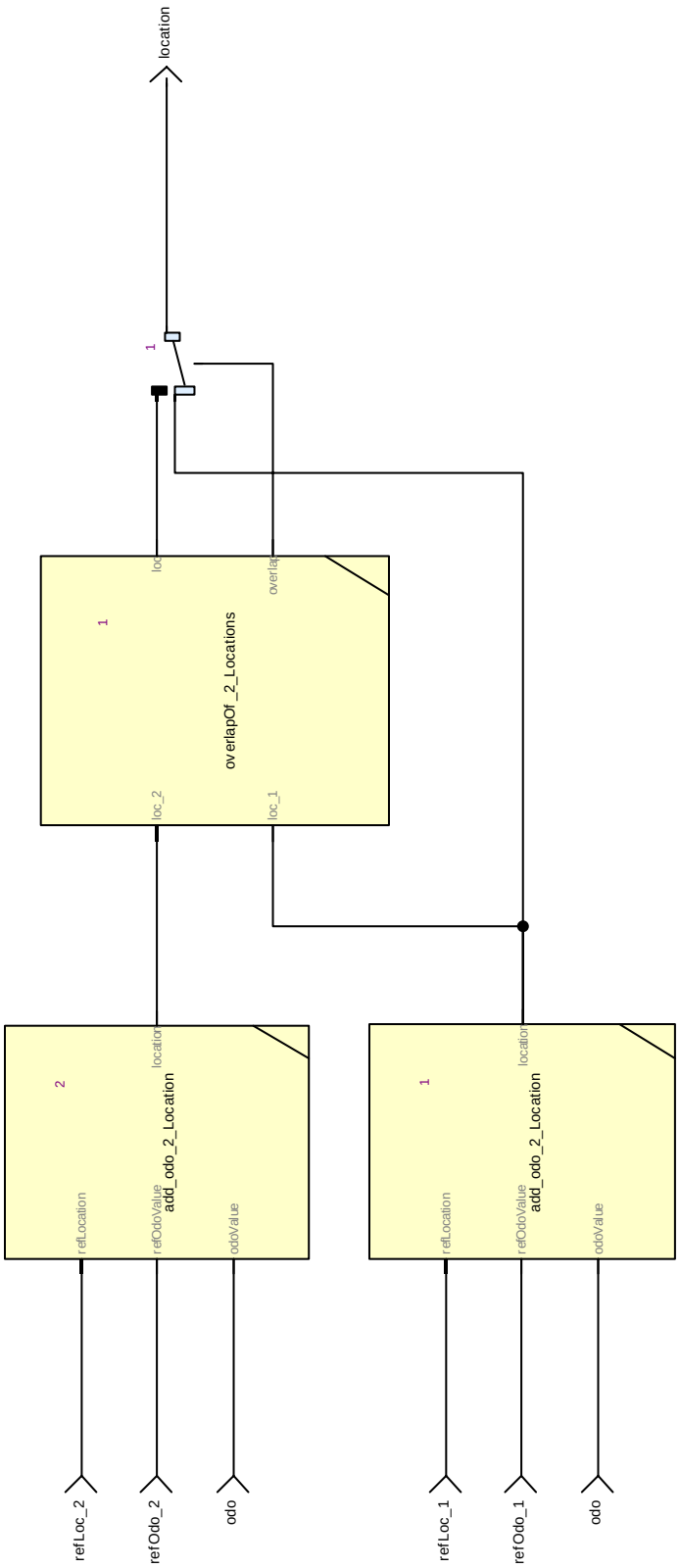

Figure 87: View of diagram_odoLoc_2_refLocations_1 (odoLoc_2_refLocations)

7.1.10. overlapOf_2_Locations Operator

Declared as **`public function`**

7.1.10.1. 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 228: 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

7.1.10.2. Interface

Table 229: 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 230: Outputs of overlapOf_2_Locations

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

7.1.10.3. Operator Hierarchy

diagram : diagram_overlapOf_2_Locations_1

7.1.10.4. Graphical and Textual Diagrams

7.1.10.4.1. View of diagram_overlapOf_2_Locations_1 (overlapOf_2_Locations)

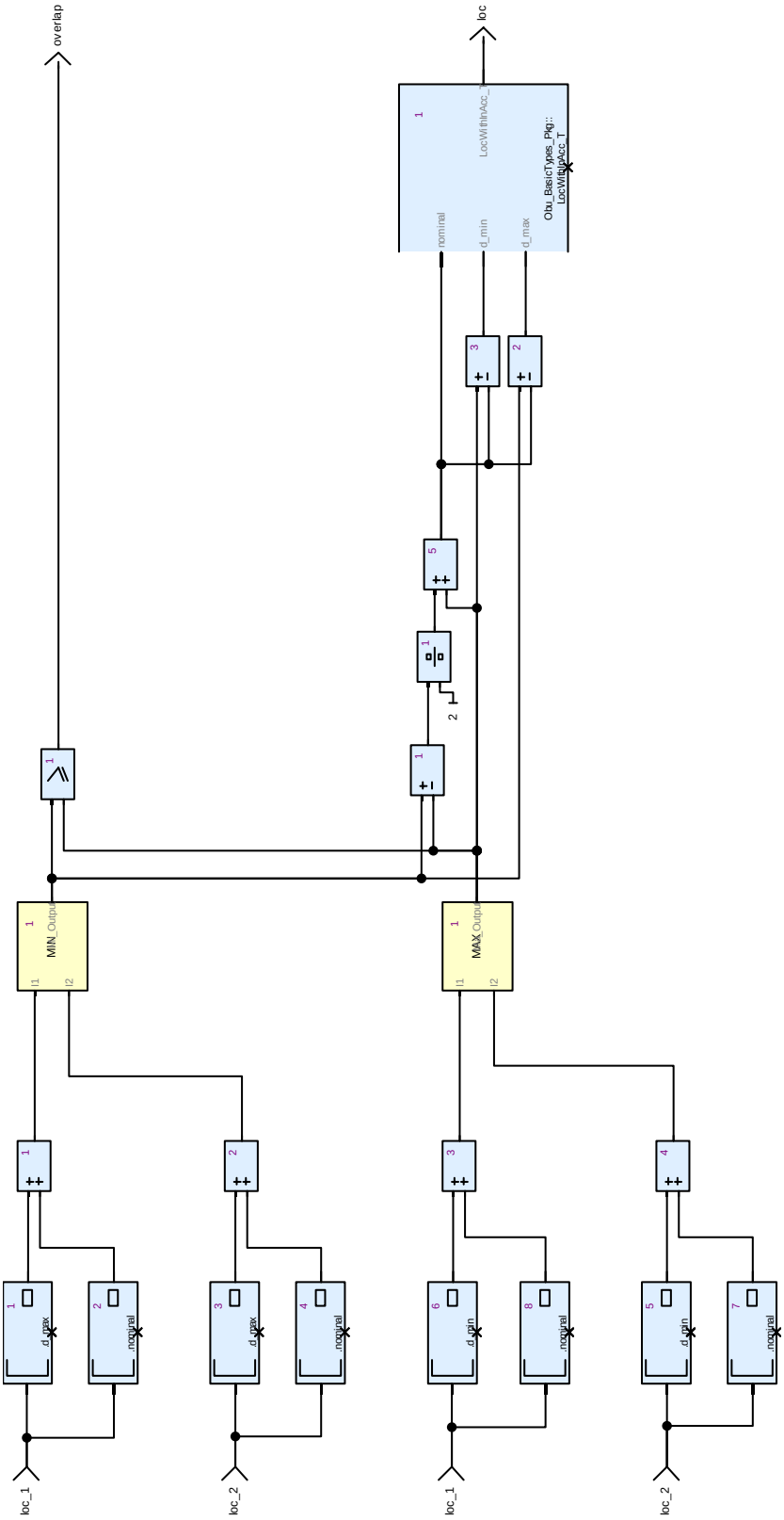

Figure 88: View of diagram_overlapOf_2_Locations_1 (overlapOf_2_Locations)

7.1.11. scaledDLINK_2_dlink Operator

Declared as **`public function`**

7.1.11.1. Comments and Information

scaledDLINK_2_dlink Comments:

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

Table 231: 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/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

7.1.11.2. Interface

Table 232: Inputs of scaledDLINK_2_dlink

Name	Type	Comments and Information
q_scale	Q_SCALE	
d_link	D_LINK	
q_locacc	Q_LOCACC	

Table 233: Outputs of scaledDLINK_2_dlink

Name	Type	Comments and Information
distance	Obu_BasicTypes_Pkg::LocWithInAcc_T	

7.1.11.3. Operator Hierarchy

diagram : diagram_scaledDLINK_2_dlink_1

7.1.11.4. Graphical and Textual Diagrams

7.1.11.4.1. View of diagram_scaledDLINK_2_dlink_1 (scaledDLINK_2_dlink)

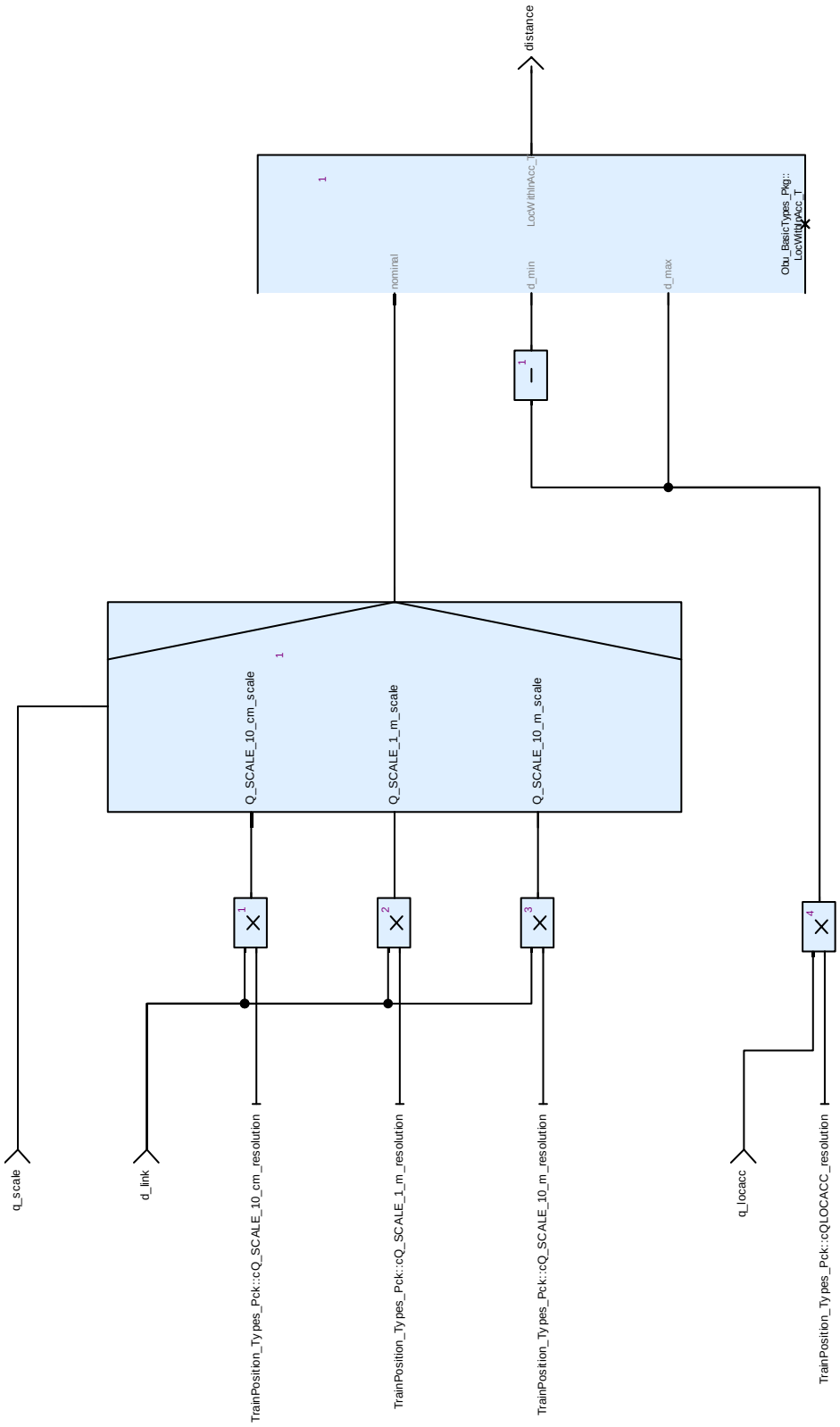

Figure 89: View of diagram_scaledDLINK_2_dlink_1 (scaledDLINK_2_dlink)

7.1.12. sub_2_distances Operator

Declared as **public function**

7.1.12.1. Comments and Information

sub_2_distances Comments:

- Calculates the distance loc_2 - loc_1 between two locations

Table 234: 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/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

7.1.12.2. Interface

Table 235: 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 236: Outputs of sub_2_distances

Name	Type	Comments and Information
distance	Obu_BasicTypes_Pkg::LocWithInAcc_T	

7.1.12.3. Operator Hierarchy

diagram : diagram_sub_2_distances_1

7.1.12.4. Graphical and Textual Diagrams

7.1.12.4.1. View of diagram_sub_2_distances_1 (sub_2_distances)

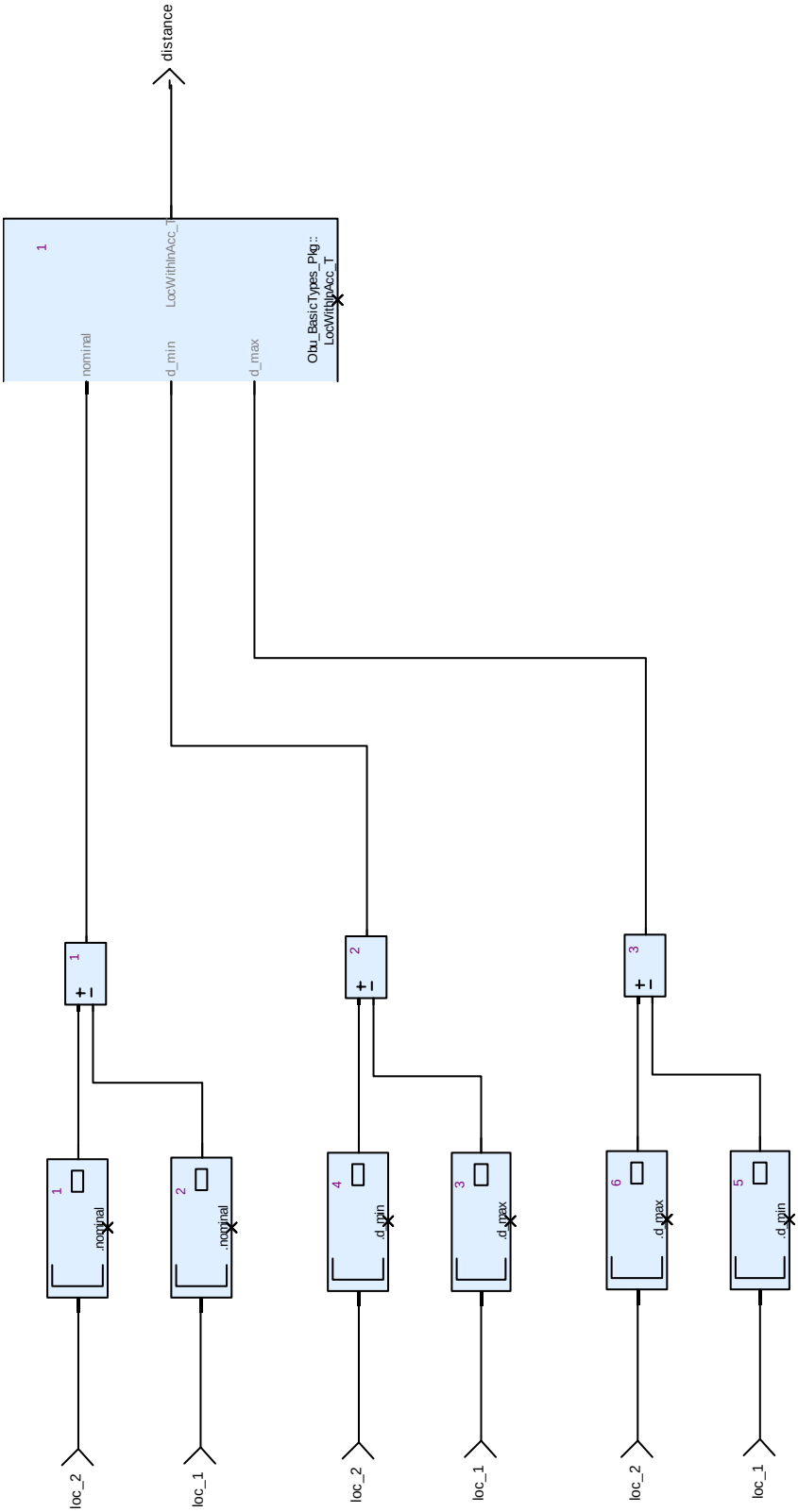

Figure 90: View of diagram_sub_2_distances_1 (sub_2_distances)

7.1.13. sub_2_odoDistances Operator

Declared as **`public function`**

7.1.13.1. Comments and Information

sub_2_odoDistances Comments:

- Calculates the distance o2 - o1 based on odometry data

Table 237: 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

7.1.13.2. Interface

Table 238: 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 239: Outputs of sub_2_odoDistances

Name	Type	Comments and Information
distance	Obu_BasicTypes_Pkg::LocWithInAcc_T	

7.1.13.3. Operator Hierarchy

diagram : diagram_sub_2_odoDistances_1

7.1.13.4. Graphical and Textual Diagrams

7.1.13.4.1. View of diagram_sub_2_odoDistances_1 (sub_2_odoDistances)

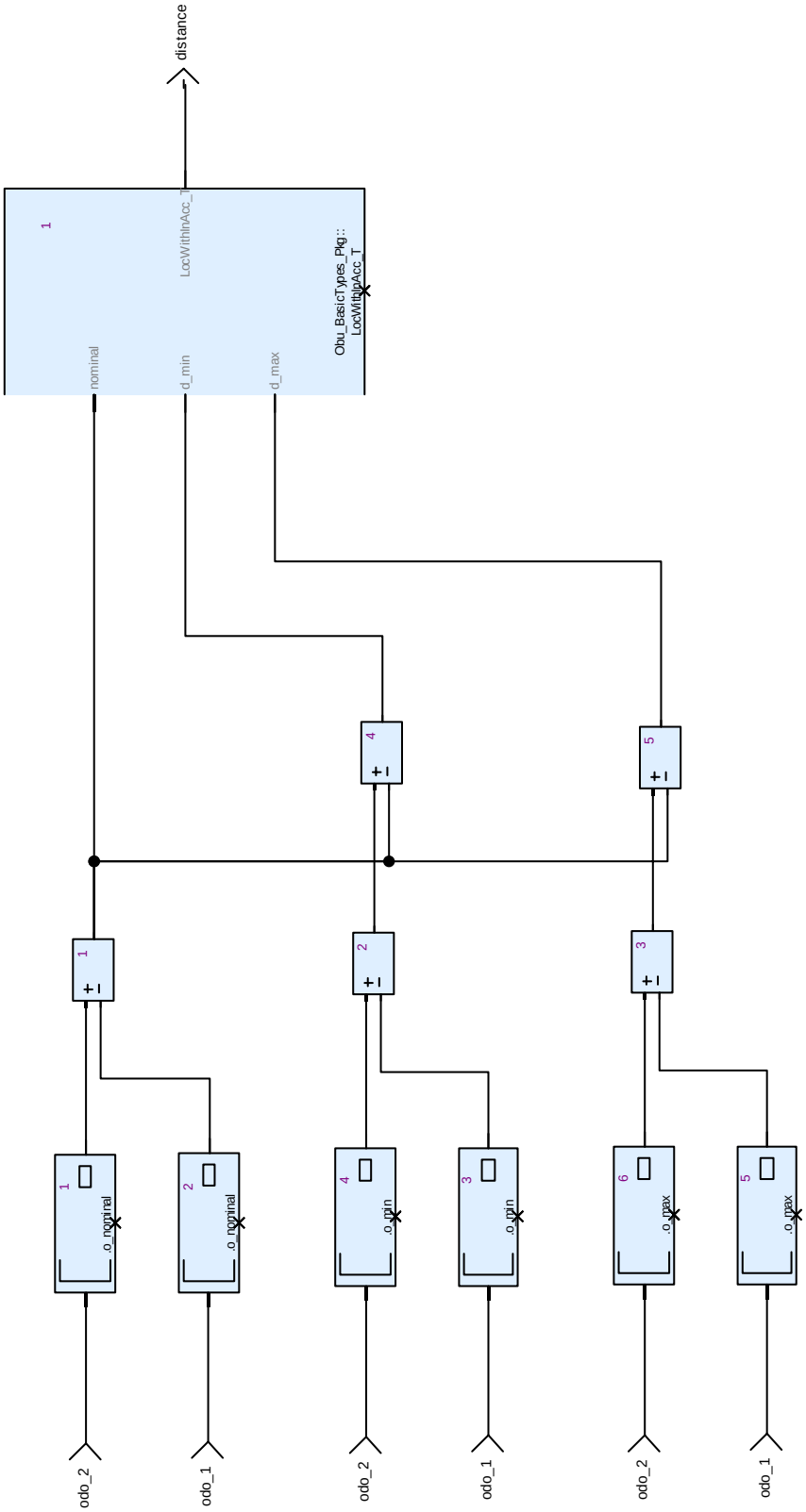

Figure 91: View of diagram_sub_2_odoDistances_1 (sub_2_odoDistances)

End of document.