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Calculate the balise group locations and the actual train position

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<summary>

Company: Siemens AG
Authors: Uwe Steinke
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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 its 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 actual 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"
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- Gist URL: ---
- Cryptography: No
- Author(s): Uwe Steinke

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

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

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

2. Software Architecture

2.1. Project Architecture

This section displays the package hierarchy of projects.

```
Project CalculateTrainPosition
  CalculateTrainPosition_Pkg
    BG_relocation_Pkg
    BG_utilities_Pkg
    gp_functions_Pkg
```

```
Project Library BasicLocationFunctions
  BasicLocationFunctions_Pkg
```

```
Project Library BG_Types
  BG_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.
- CalculateTrainPosition_Pkg::BG_relocation_Pkg::findLinkedBGs
 - 4.1.1.1.1.1.

CalculateTrainPosition_Pkg::BG_relocation_Pkg::findLinkedBG_bckwd_itr
4.1.1.1.1.2.

CalculateTrainPosition_Pkg::BG_relocation_Pkg::findLinkedBG_fwd_itr
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CalculateTrainPosition_Pkg::BG_utilities_Pkg::deleteBG_atIndex
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.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfBG_onTrack
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
4.1.3.3.1.1.4.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::insertBG_atIndex
4.1.3.3.1.1.4.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::insertBG_atIndex_itr
4.1.3.3.1.1.4.2.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::positionedBGs_ids_equal
4.1.3.3.1.1.4.2.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::nidBG_nidc_equal
4.1.3.4.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::trimSeqNoOnTrack
4.1.3.4.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::trimSeqNoOnTrack_itr
4.1.3.5. CalculateTrainPosition_Pkg::passedBG_2_positionedBG
4.1.3.5.1. BasicLocationFunctions_Pkg::add_2_Distances [3]
4.1.3.5.2. BasicLocationFunctions_Pkg::add_odo_2_Location
[2]
4.1.3.5.3.
BasicLocationFunctions_Pkg::overlapOf_2_Locations
4.1.3.5.4. BasicLocationFunctions_Pkg::sub_2_odoDistances
4.1.3.5.5.

CalculateTrainPosition_Pkg::BG_utilities_Pkg::positionLinkedBGs
4.1.3.5.5.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::positionLinkedBGs_itr
4.1.3.5.5.1.1.
BasicLocationFunctions_Pkg::add_2_Distances [3]
4.1.3.5.5.1.2.
BasicLocationFunctions_Pkg::scaledDLINK_2_dlink [2]
4.1.4. CalculateTrainPosition_Pkg::prevPassedLinkedBG
4.1.4.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfLastPassedBG
4.1.4.1.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfLastPassedBG_itr
4.1.4.2.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::nidBG_nidc_equal
4.2. CalculateTrainPosition_Pkg::calculateTrainpositionAttributes
4.2.1. BasicLocationFunctions_Pkg::add_2_Distances
4.2.2.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::nidC_nidBG_2_NIDLRBG [2]
4.3. CalculateTrainPosition_Pkg::calculateTrainPositionInfo
4.3.1. BasicLocationFunctions_Pkg::overlapOf_2_Locations
4.3.2.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfLastPassedBG [2]
4.3.2.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOfLastPassedBG_itr
4.3.3.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::positionDerivedFromPassedBG [2]
4.3.3.1. BasicLocationFunctions_Pkg::add_odo_2_Location
4.3.3.2. BasicLocationFunctions_Pkg::sub_2_odoDistances
4.4. CalculateTrainPosition_Pkg::delDispensableBGs
4.4.1. CalculateTrainPosition_Pkg::BG_utilities_Pkg::countBGs
4.4.1.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::countBGs_itr
4.4.2.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::deleteBGs_beforeIndex [2]
4.4.2.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::deleteBGs_beforeIndex_itr
4.4.3.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOf_nthPassedBG [2]
4.4.3.1.
CalculateTrainPosition_Pkg::BG_utilities_Pkg::indexOf_nthPassedBG_itr
5. CalculateTrainPosition_Pkg::memPassedBG
5.1.
CalculateTrainPosition_Pkg::BG_relocation_Pkg::improveUnlinkedBGLocation
5.1.1. BasicLocationFunctions_Pkg::odoLoc_2_refLocations
5.1.2. BasicLocationFunctions_Pkg::overlapOf_2_Locations
5.2. linear::Memory [2]

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	<p>CalculateTrainPosition</p> <ul style="list-style-type: none">- 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

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, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0} }	
cNoOfAtLeast_8_LRBGs	int	3	Comments: Covers 3.6.2.2 c): ??? The on-board equipment shall be able to accept information referring to one of at least eight LRBGONB last reported to the RBC.
cNoOfAtLeast_x_unlinkedBGs	int	2	Comments: Covers ???: Min no of unlinked BGs to be memorized

Name	Type	Value	Comments and Information
		{valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previous_versions_according_to_e_g_EEIG_SRS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1st, n_total : N_TOTAL_1_balise_in_the_group, m_dup : M_DUP_No_duplicates, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, linkedBGs : [{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}, {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_S	

Name	Type	Value	Comments and Information
		{valid : false, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked, location : {nominal : 0, d_min : 0, d_max : 0}, seqNoOnTrack : 0, infoFromLinking : {valid : false, nid_bg_fromLinkingBG : 0, nid_c_fromLinkingBG : 0, expectedLocation : {nominal : 0, d_min : 0, d_max : 0}, d_link : {nominal : 0, d_min : 0, d_max : 0}, linkingInfo : {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}}, infoFromPassing : {valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetectionInaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Downlink_telegram, m_version : M_VERSION_Previous_versions_according_to_EEIG_SRS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise,	

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

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

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

Note Name	Attribute	Value
Remark_1	Description	<p>The main function calculating the actual train position.</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.1.4.2. Interface

Table 5: Inputs of calculateBGLocations

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

Table 6: Outputs of calculateBGLocations

Name	Type	Comments and Information
BGs	TrainPosition_Types_Pkg::positionedBGs_T	Comments: The collection of currently known BGs.
errors	TrainPosition_Types_Pkg::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)

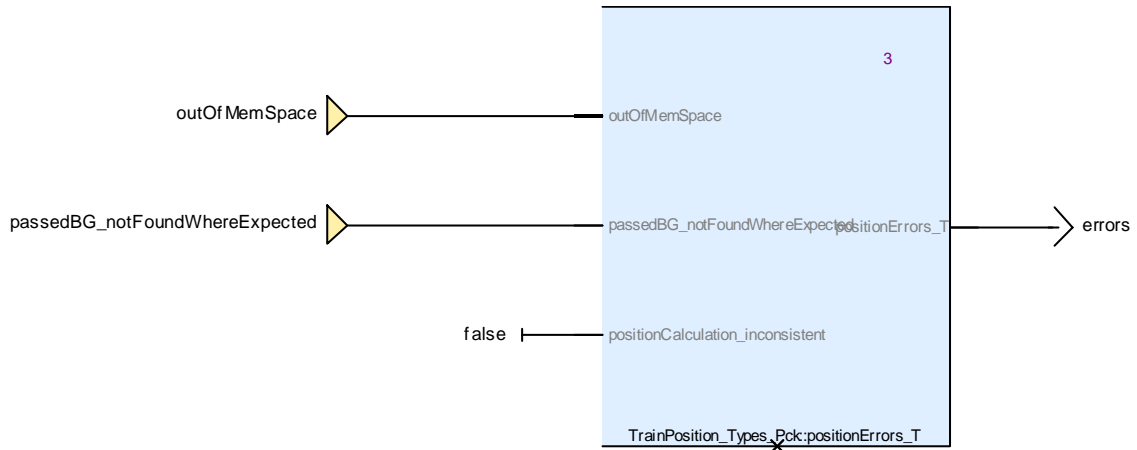


Figure 1: View of diagram_errorReporting (calculateBGLocations)

3.1.4.5.2. View of diagram_passing_a_BG (calculateBGLocations)

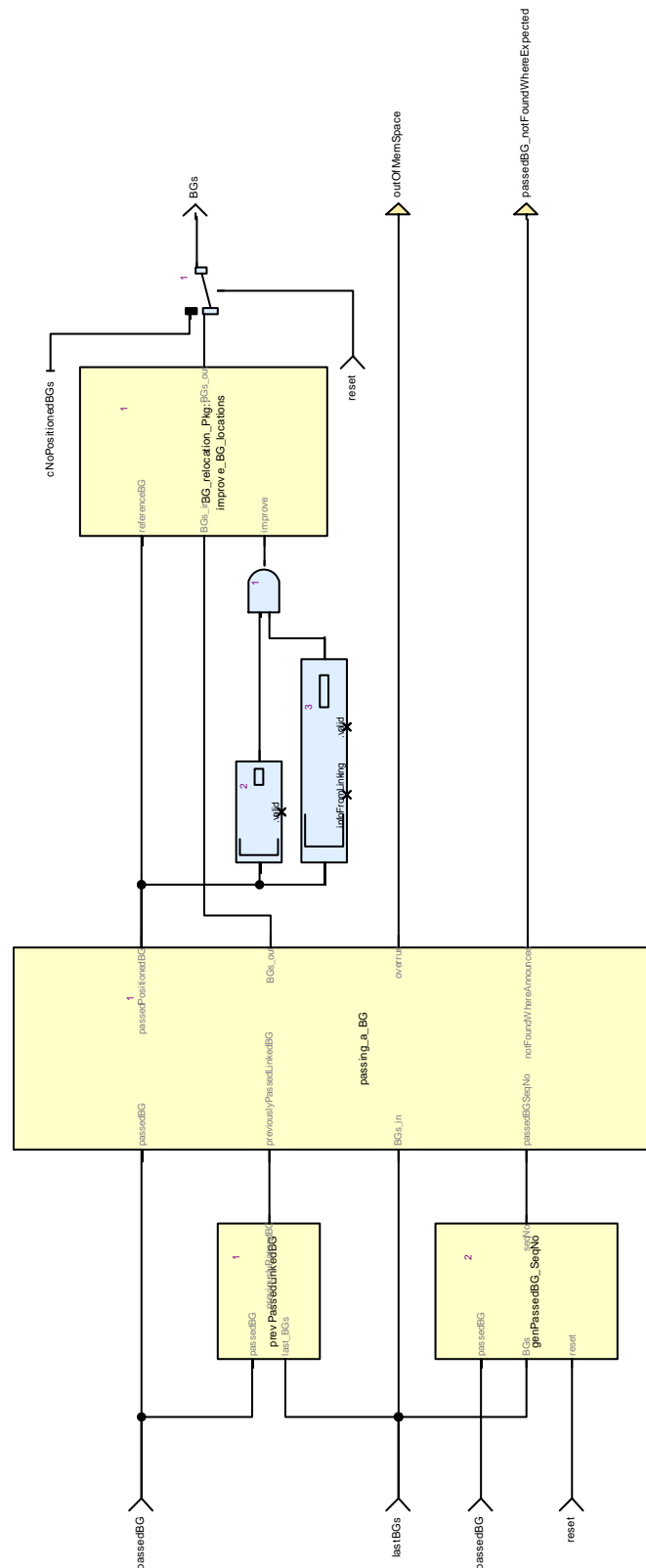


Figure 2: View of diagram_passing_a_BG (calculateBGLocations)

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	<p>The main function calculating the actual train position.</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

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.
LRBG	TrainPosition_Types_Pkg::positionedBG_T		Comments: The LRBG used for RBC communication.
prevLRBG	TrainPosition_Types_Pkg::positionedBG_T		Comments: A previously used LRBG used in RBC communication.

Name	Type	Properties	Comments and Information
reset	bool		Comments: Resets all to an initials state and deletes all stored BGs.
trainProperties	TrainPosition_Types_Pc k::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_Pc k::trainPosition_T	Comments: The resulting train position with reference to the LRBG
trainPositionInfo	TrainPosition_Types_Pc k::trainPositionInfo_T	Comments: The resulting train position with reference to the known list of balise groups.
BGs	TrainPosition_Types_Pc k::positionedBGs_T	Comments: The collection of currently known BGs.
errors	TrainPosition_Types_Pc k::positionErrors_T	Comments: Errors and inconsistencies detected by the calculation.

3.1.5.3. Locals

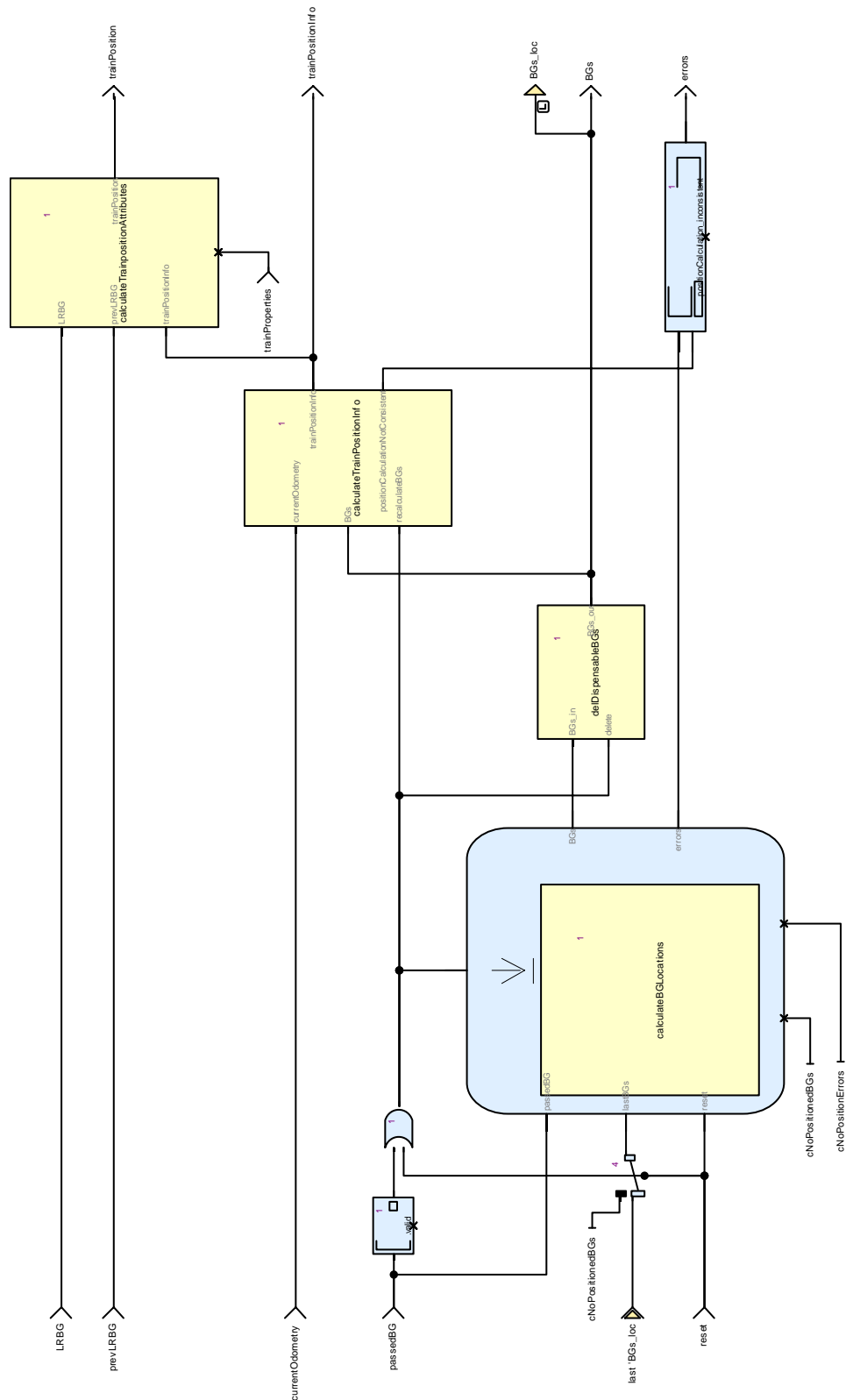
Table 11: Locals of calculateTrainPosition

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

3.1.5.4. Operator Hierarchy

diagram : diagram_calculateTrainPosition

3.1.5.5.1. View of diagram_calculateTrainPosition (calculateTrainPosition)



3.1.6. calculateTrainpositionAttributes Operator

Declared as **private function**

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	<p>The main function calculating the actual train position.</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.1.6.2. Interface

Table 13: Inputs of calculateTrainpositionAttributes

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

Name	Type	Properties	Comments and Information
trainPositionInfo	TrainPosition_Types_Pc k::trainPositionInfo_T		Comments: The resulting train position with reference to the known list of balise groups.
trainProperties	TrainPosition_Types_Pc k::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_Pc k::trainPosition_T	Comments: The resulting train position with reference to the LRBG

3.1.6.3. Operator Hierarchy

diagram : diagram_calculateTrainpositionAttributes

3.1.6.4. Graphical and Textual Diagrams

3.1.6.4.1. View of diagram_calculateTrainpositionAttributes (calculateTrainpositionAttributes)

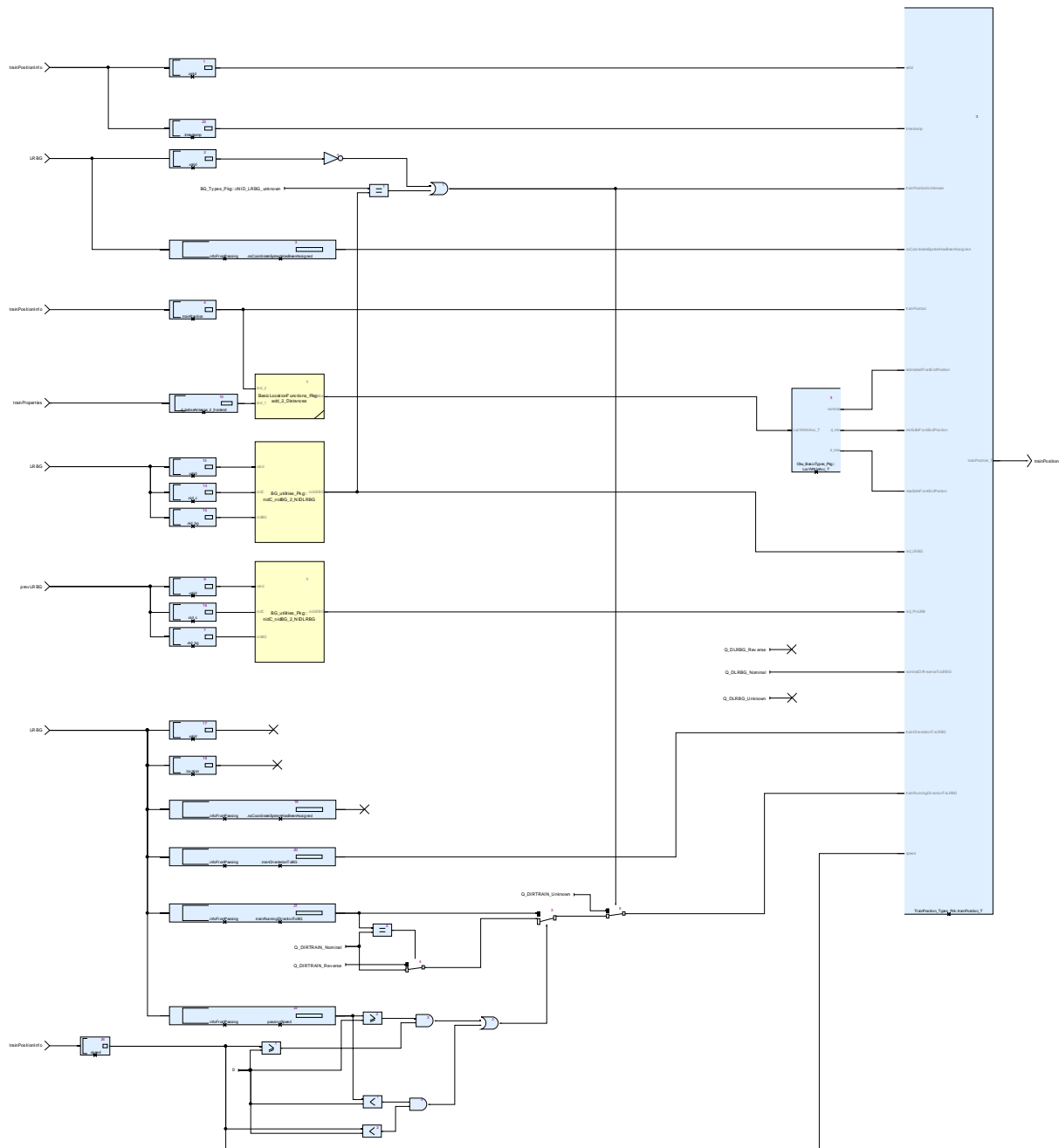


Figure 4: View of diagram_calculateTrainpositionAttributes (calculateTrainpositionAttributes)

3.1.7. calculateTrainPositionInfo Operator

Declared as **private function**

3.1.7.1. Comments and Information

calculateTrainPositionInfo Comments:

- Provides the train position information.

3.1.7.2. Interface

Table 15: Inputs of calculateTrainPositionInfo

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

Table 16: Outputs of calculateTrainPositionInfo

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

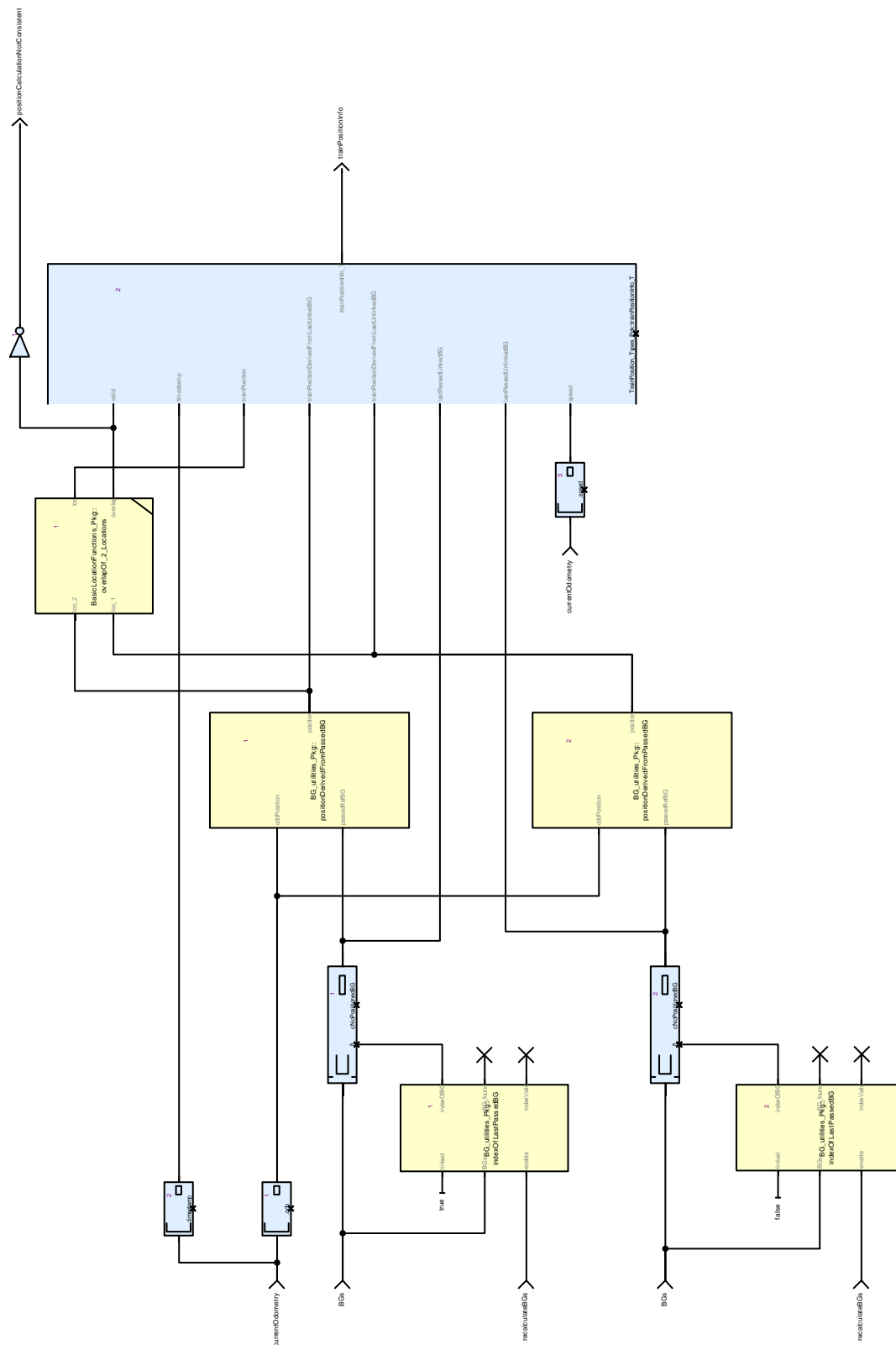


Figure 5: View of diagram_calculateTrainPositionInfo_1 (calculateTrainPositionInfo)

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 17: Inputs of delDispensableBGs

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

Table 18: Outputs of delDispensableBGs

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

3.1.8.3. Locals

Table 19: 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)

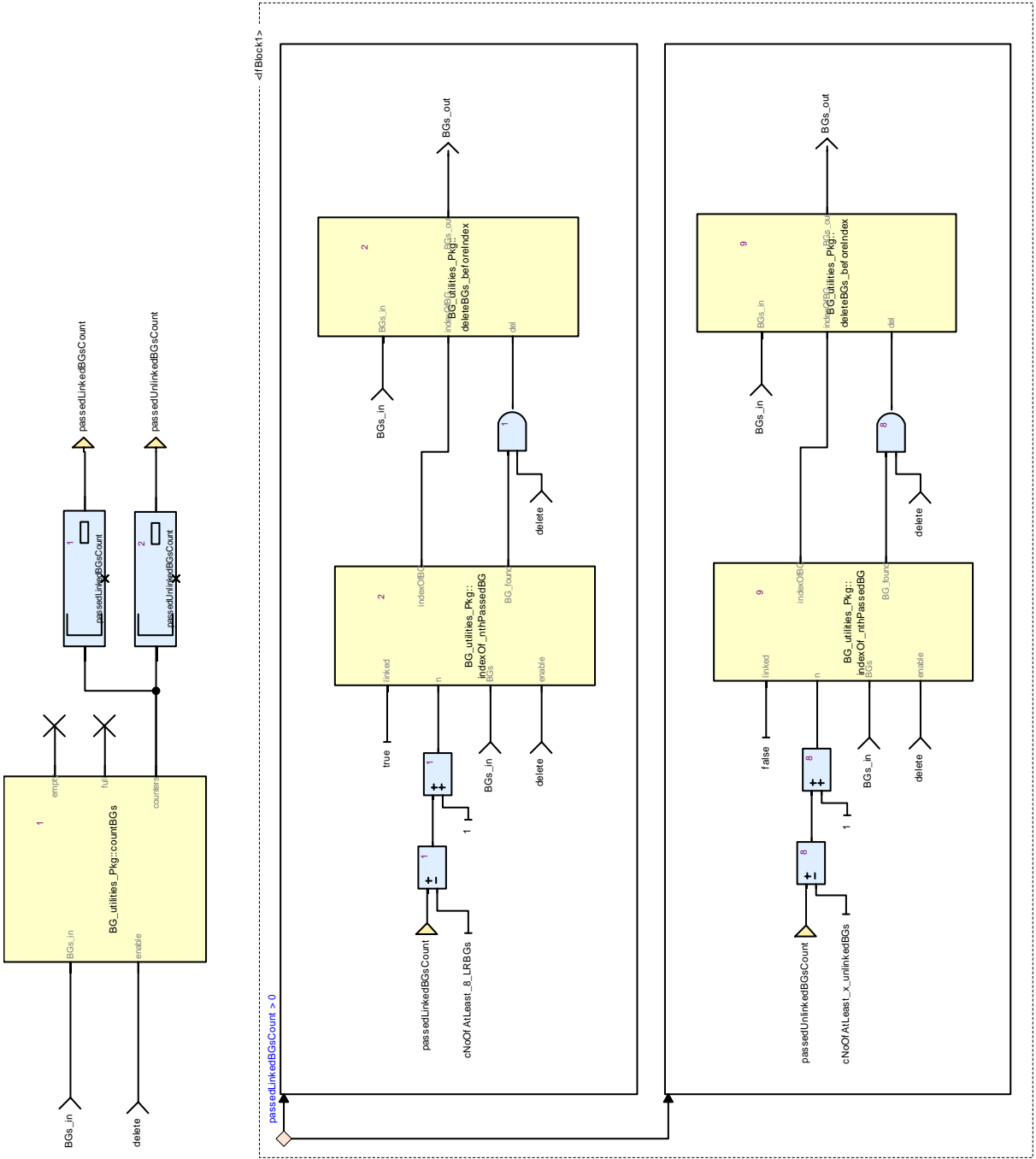


Figure 6: View of diagram_delDispensableBGs_1 (delDispensableBGs)

Table 20: Conditional Blocks of diagram_delDispensableBGs_1

Conditional Block	Comments and Information
IfBlock1	

Table 21: 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 22: 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_Pkg::positionedBGs_T	
reset	bool	Comments: Resets all to an initial state and deletes all stored BGs.

Table 23: Outputs of genPassedBG_SeqNo

Name	Type	Comments and Information
seqNo	int	

3.1.9.3. Locals

Table 24: Locals of genPassedBG_SeqNo

Name	Type	Comments and Information
incrPassedBGSeqNo	bool	
keepPassedBGSeqNo	bool	

3.1.9.4. Operator Hierarchy

diagram : diagram_genPassedBG_SeqNo_1

3.1.9.5.1. View of diagram_genPassedBG_SeqNo_1 (genPassedBG_SeqNo)

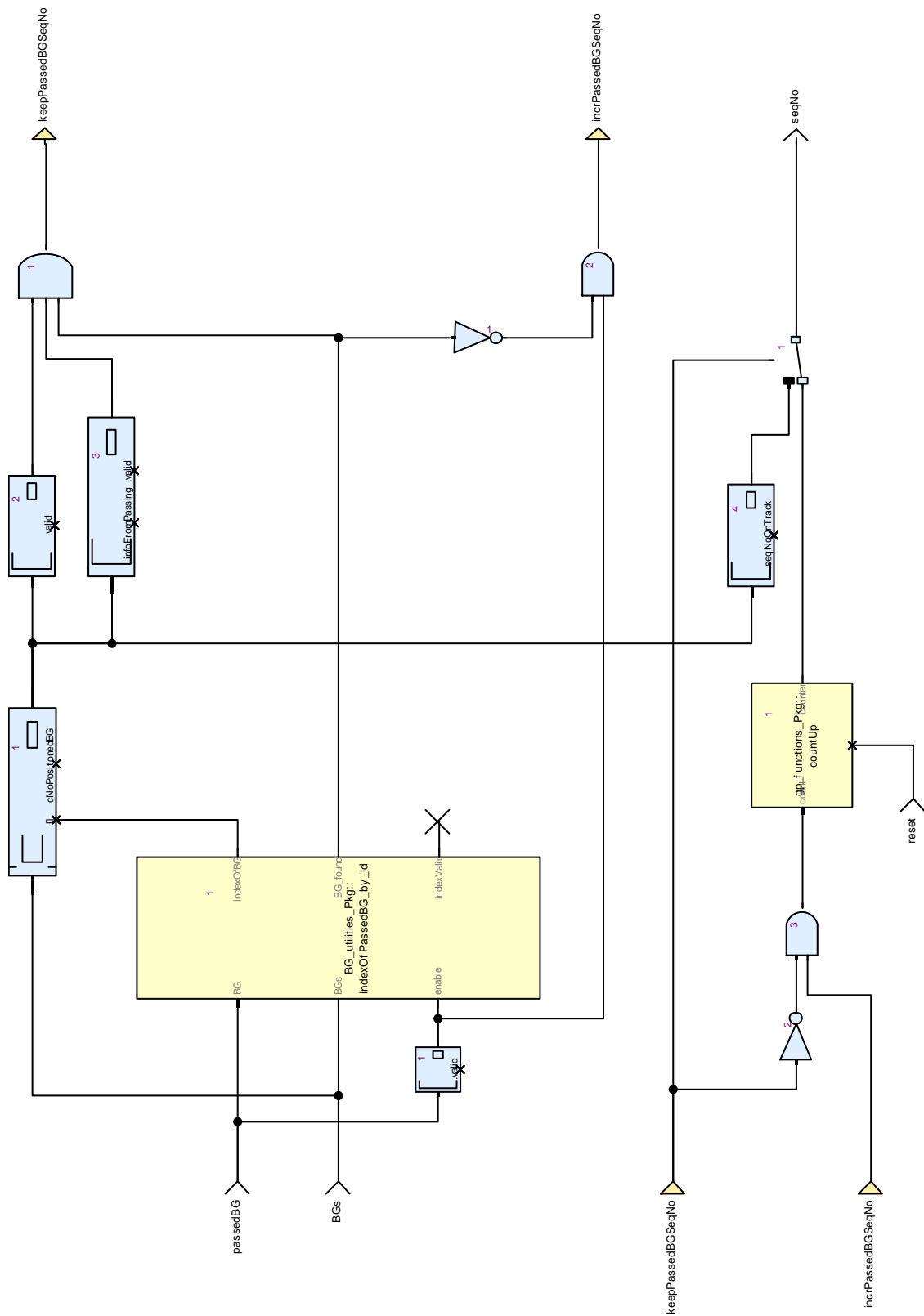


Figure 7: View of diagram_genPassedBG_SeqNo_1 (genPassedBG_SeqNo)

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 25: memPassedBG Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Memorizes the passed linked and unlinked BG</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.1.10.2. Interface

Table 26: 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 27: Outputs of memPassedBG

Name	Type	Comments and Information
passedLinkedBG	TrainPosition_Types_Pck::positionedBG_T	

Name	Type	Comments and Information
passedUnlinkedBG	TrainPosition_Types_Pc k::positionedBG_T	

3.1.10.3. Locals

Table 28: Locals of memPassedBG

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

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)

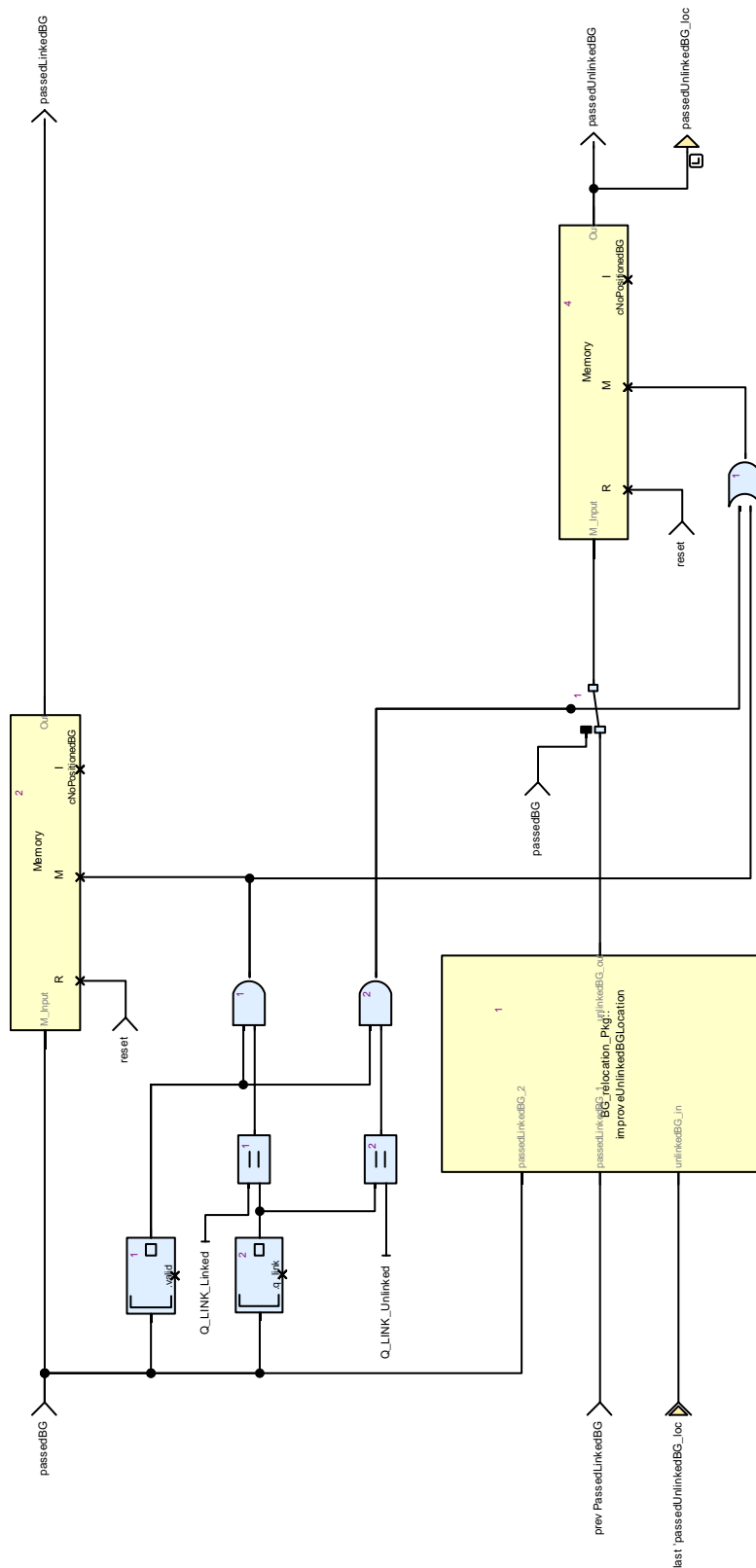


Figure 8: View of diagram_memPassedBG_1 (memPassedBG)

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 29: passedBG_2_positionedBG Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Converts a passed balise group to a positioned balise group information</p> <ul style="list-style-type: none">- 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.1.11.2. Interface

Table 30: Inputs of passedBG_2_positionedBG

Name	Type	Comments and Information
passedBG	BG_Types_Pkg::passedBG_T	Comments: The balise group as actually passed.
passedBG_asAnnounced	TrainPosition_Types_Pkg::positionedBG_T	Comments: If the passed balise group was previously announced, this is the passed BG as known before passing. If the passed balise group was not announced, this input has to be set invalid.
previouslyPassedLinkedBG	TrainPosition_Types_Pkg::positionedBG_T	Comments: The previously passed linked BG, if there is one. Serves a reference point for location calculation.

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

Table 31: 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 32: Locals of passedBG_2_positionedBG

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

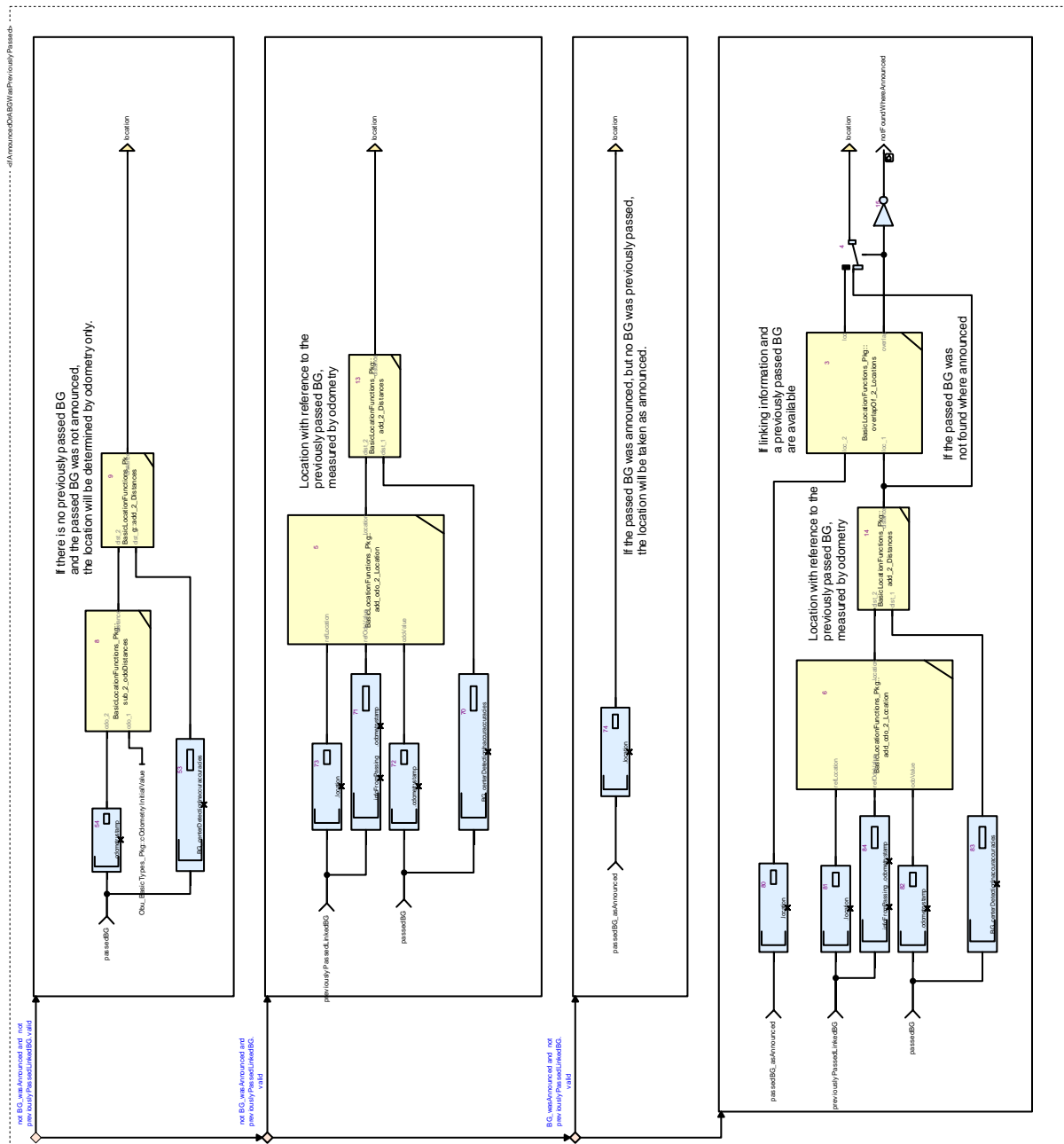


Figure 9: View of diagram_calculateDistance (passedBG_2_positionedBG)

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 33: Conditional Blocks of diagram_calculateDistance

Conditional Block	Comments and Information
ifAnnouncedOrABGWasPreviouslyPassed	

Table 34: 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)

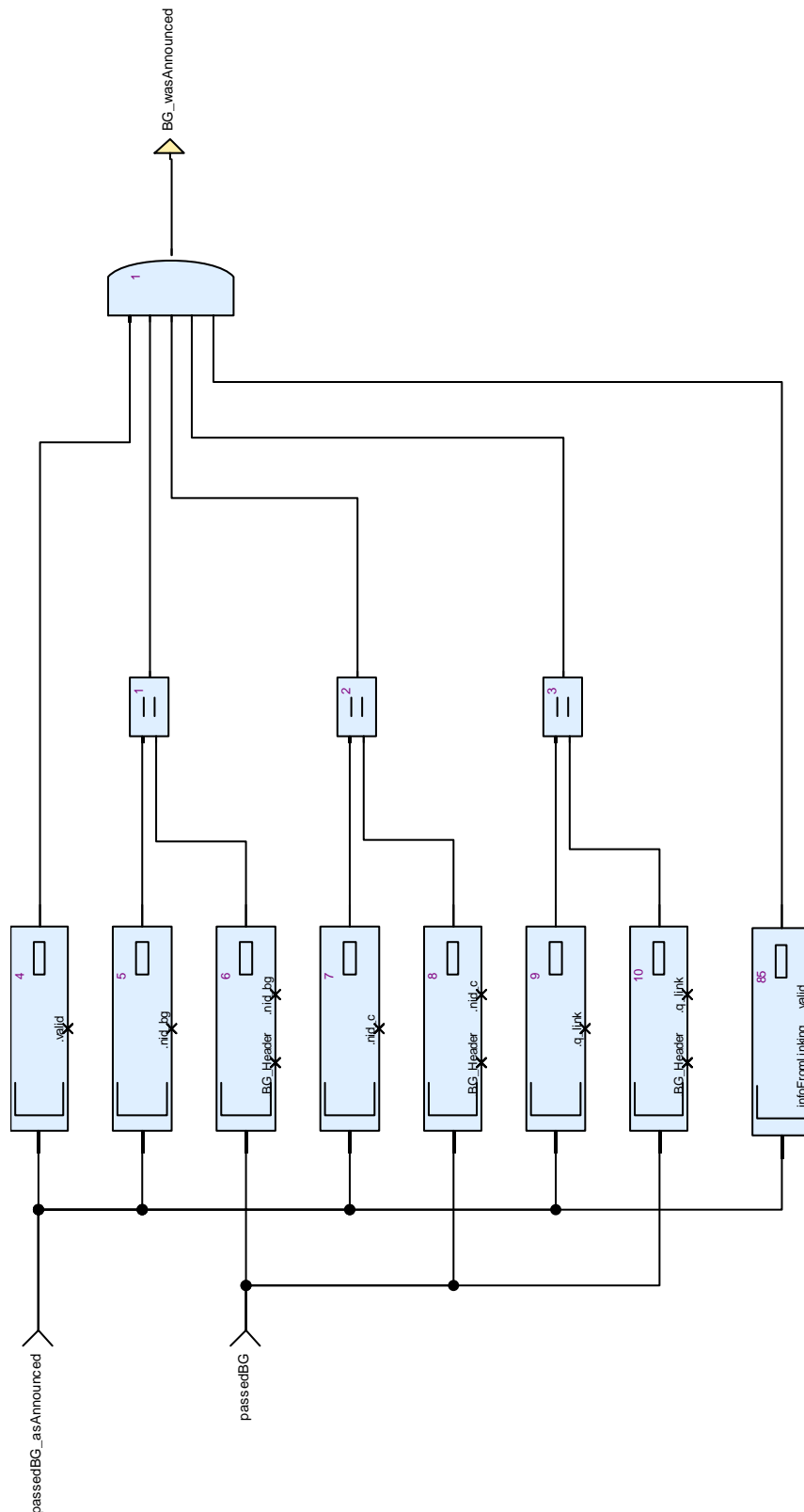


Figure 10: View of diagram_checkAnnouncedInfo (passedBG_2_positionedBG)

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)

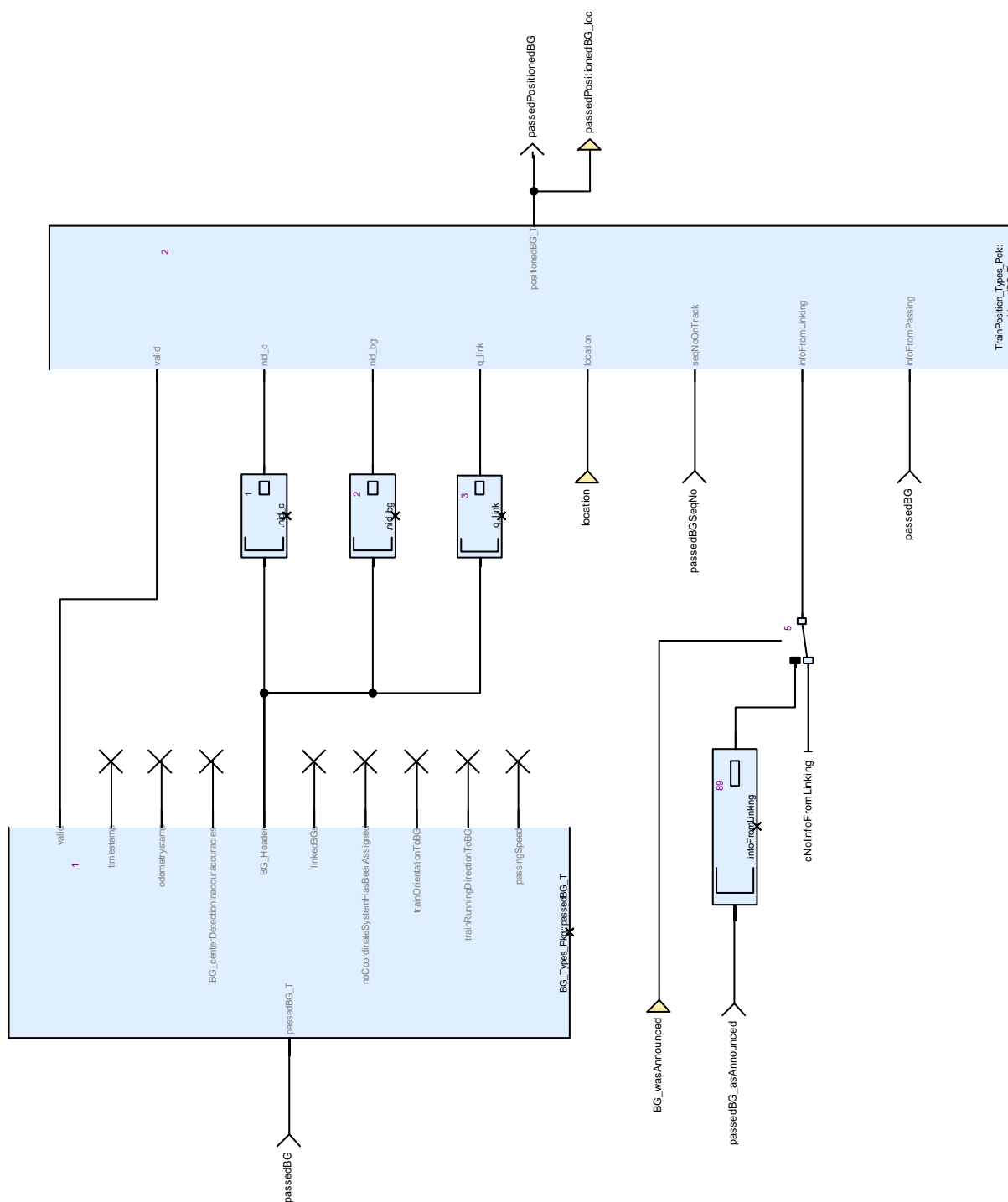


Figure 11: View of diagram_passedBG_2_positionedBG (passedBG_2_positionedBG)

3.1.11.5.4. View of diagram_positionLinkedBGs (passedBG_2_positionedBG)

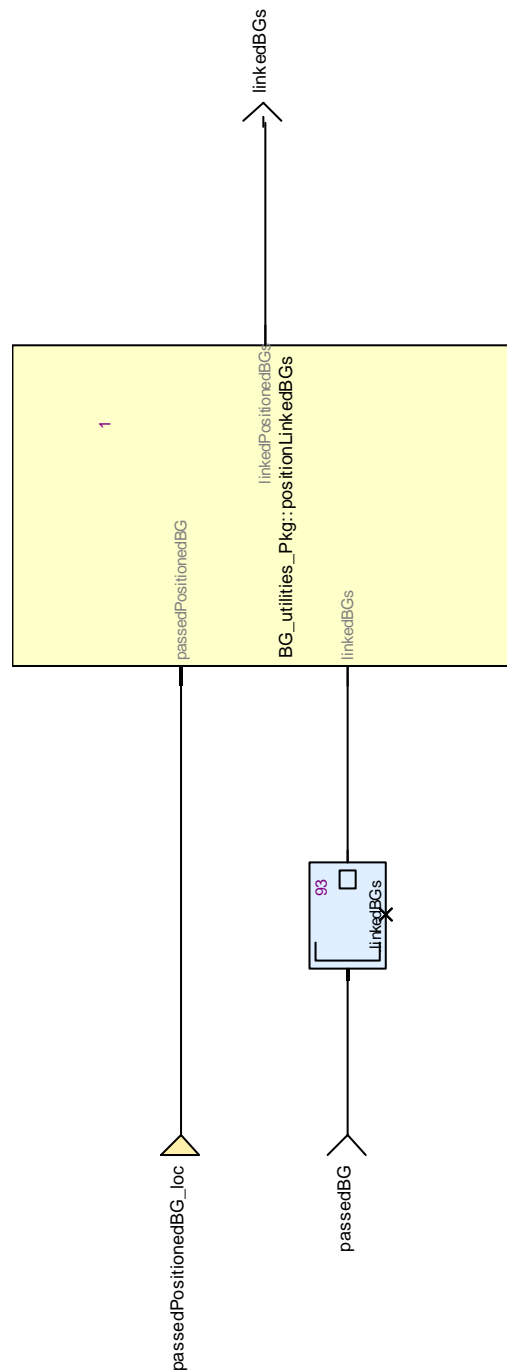


Figure 12: View of diagram_positionLinkedBGs (passedBG_2_positionedBG)

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 35: passing_a_BG Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Provides the location calculations while passing a BG</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.1.12.2. Interface

Table 36: Inputs of passing_a_BG

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

Table 37: Outputs of passing_a_BG

Name	Type	Comments and Information
passedPositionedBG	TrainPosition_Types_Pkg::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.

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::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)

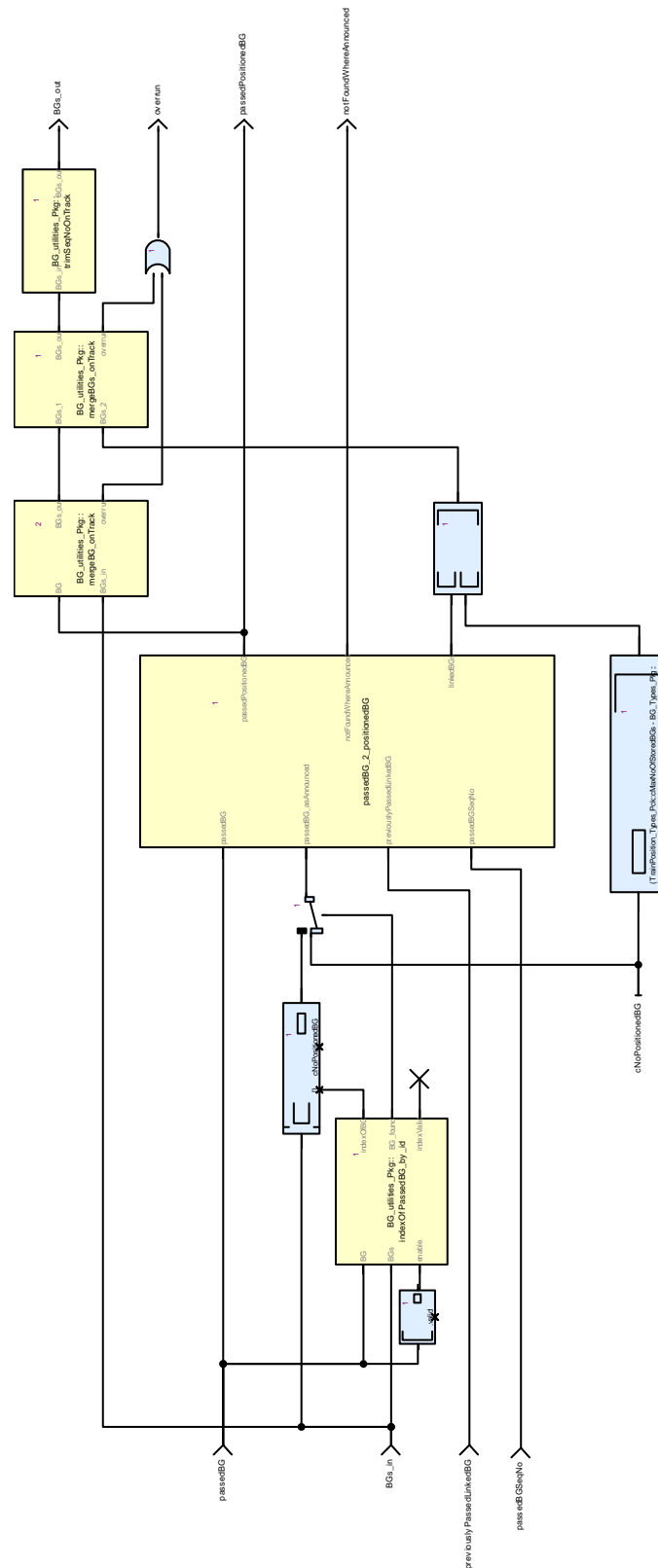


Figure 13: View of diagram_passing_a_BG_1 (passing_a_BG)

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 38: 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 39: Inputs of prevPassedLinkedBG

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

Table 40: Outputs of prevPassedLinkedBG

Name	Type	Comments and Information
previouslyPassedBG	TrainPosition_Types_Pkg::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)

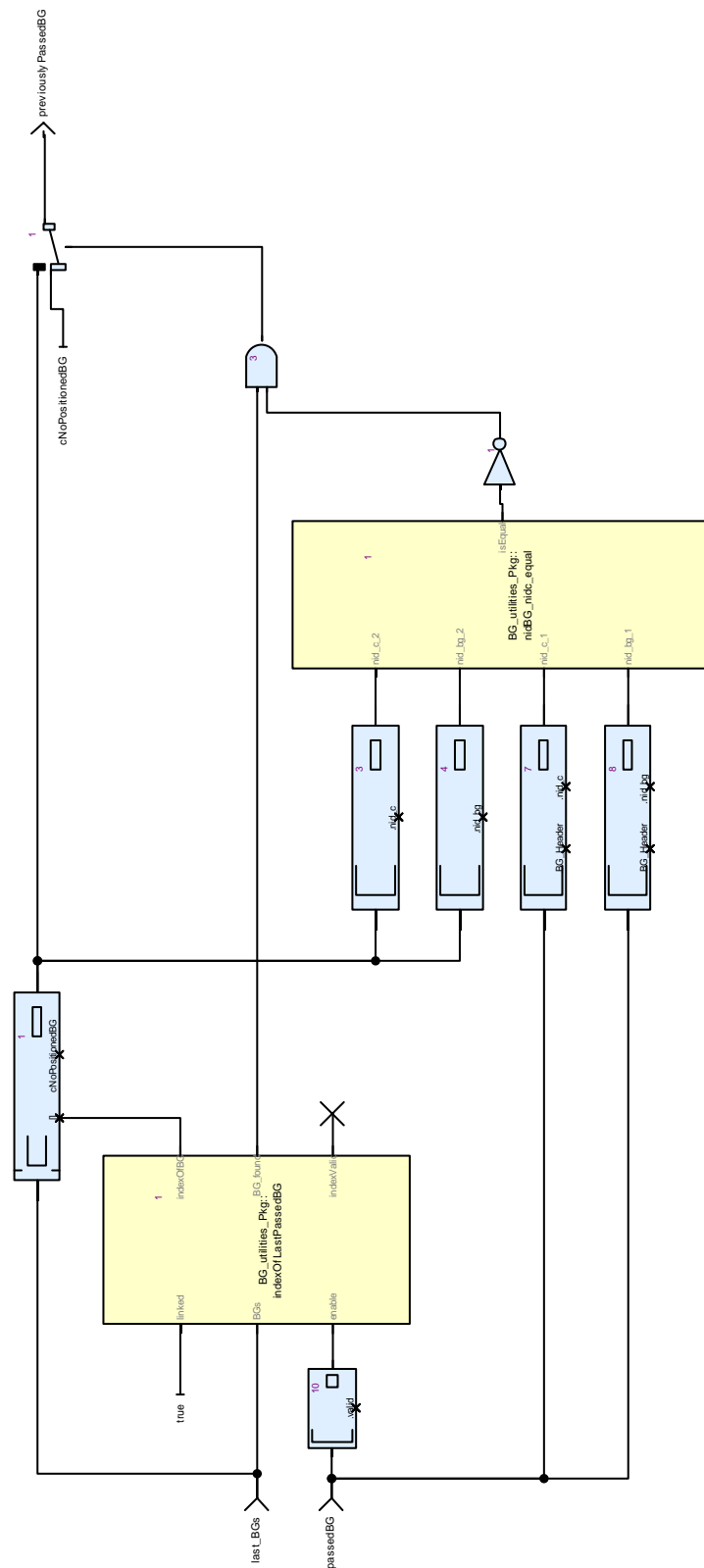


Figure 14: View of diagram_prevPassedLinkedBG_1 (prevPassedLinkedBG)

3.2. CalculateTrainPosition_Pkg::BG_relocation_Pkg Package

3.2.1. Types

Table 41: Public Types of BG_relocation_Pkg

Name	Definition	Comments and Information
BGs_forImprovement_T	{prevLinkedBG : TrainPosition_Types_Pck::positionedB G_T, unlinkedBG : TrainPosition_Types_Pck::positionedB G_T, indexOfUnlinkedBG : int}	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_reloc ation_Pkg::linkedBG_index_T ^TrainPosition_Types_Pck::cMaxNoOf StoredBGs	
refBGs_T	{refBG : TrainPosition_Types_Pck::positionedB G_T, prevLinkedBG : TrainPosition_Types_Pck::positionedB G_T, prevUnlinkedBG : TrainPosition_Types_Pck::positionedB G_T, recalculate : bool}	Comments: Serves to map and fold through the BGs refBG Comments: The reference BG for the location recalculation. prevLinkedBG Comments: The previous linked BG in the map and fold chain prevUnlinkedBG Comments: The previous unlinked BG in the map and fold chain recalculate Comments: Enables the location recalculation for all BGs subsequent to refBG

3.2.2. Constants

Table 42: Public Constants of BG_relocation_Pkg

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

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

3.2.3. findLinkedBG_bckwd_itr Operator

Declared as **private function**

3.2.3.1. Comments and Information

findLinkedBG_bckwd_itr Comments:

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

3.2.3.2. Interface

Table 43: Inputs of findLinkedBG_bckwd_itr

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

Table 44: Outputs of findLinkedBG_bckwd_itr

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

3.2.3.3. Operator Hierarchy

diagram : diagram_findLinkedBG_bckwd_itr_1

3.2.3.4. Graphical and Textual Diagrams

3.2.3.4.1. View of diagram_findLinkedBG_bckwd_itr_1 (findLinkedBG_bckwd_itr)

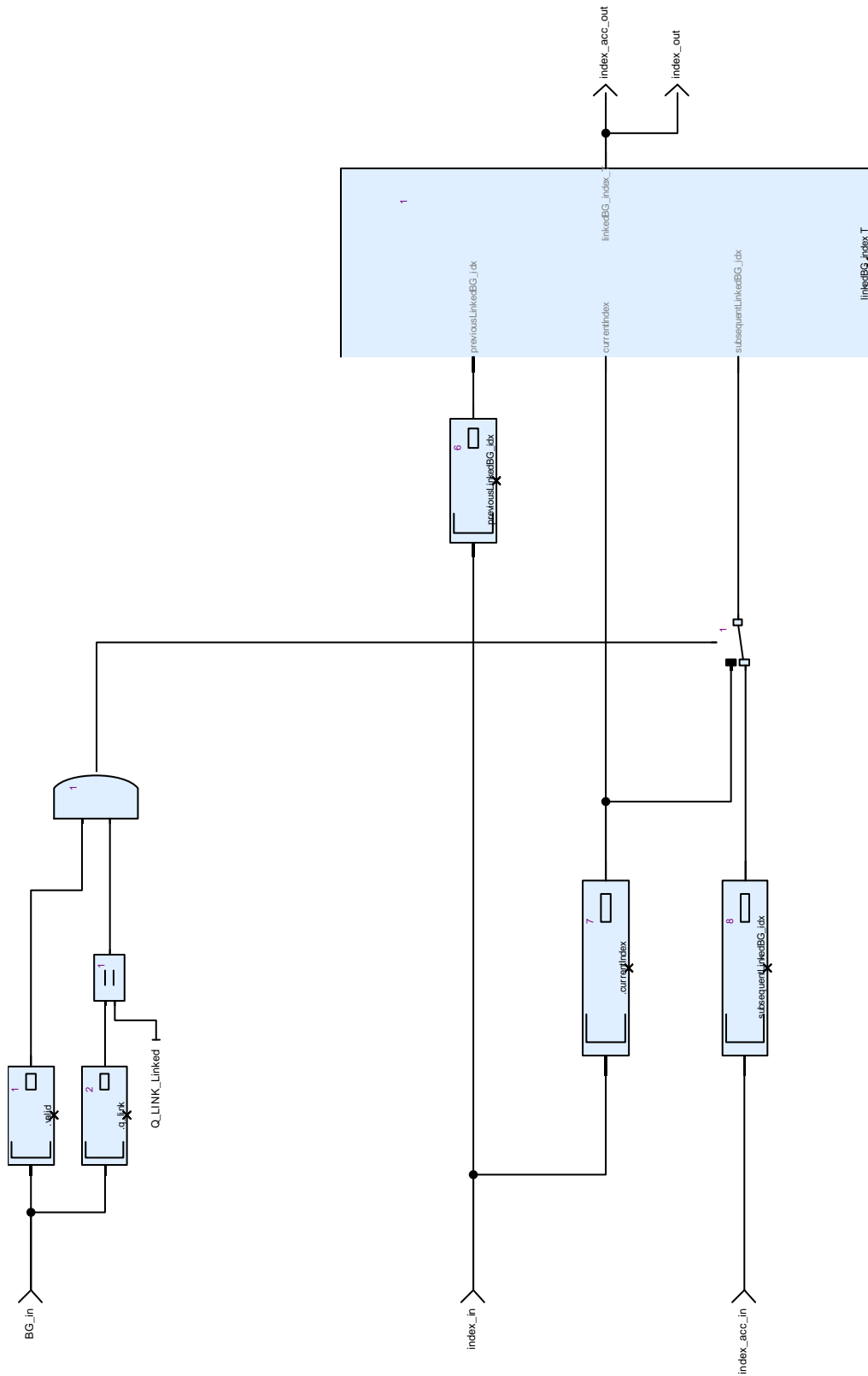


Figure 15: View of diagram_findLinkedBG_bckwd_itr_1 (findLinkedBG_bckwd_itr)

3.2.4. findLinkedBG_fwd_itr Operator

Declared as **private function**

3.2.4.1. Comments and Information

findLinkedBG_fwd_itr Comments:

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

3.2.4.2. Interface

Table 45: Inputs of findLinkedBG_fwd_itr

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

Table 46: Outputs of findLinkedBG_fwd_itr

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

3.2.4.3. Operator Hierarchy

diagram : diagram_findLinkedBG_fwd_itr_1

3.2.4.4. Graphical and Textual Diagrams

3.2.4.4.1. View of diagram_findLinkedBG_fwd_itr_1 (findLinkedBG_fwd_itr)

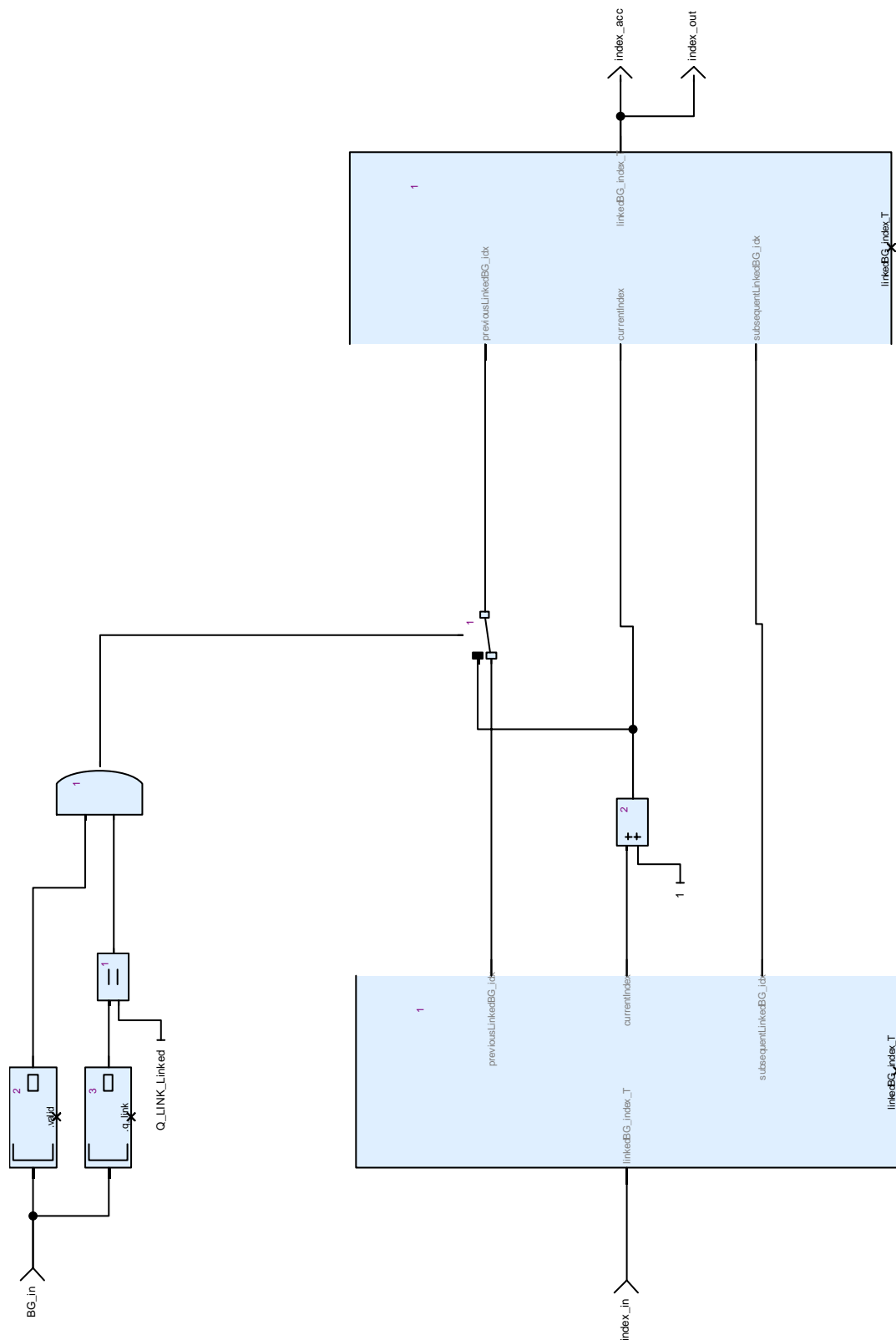


Figure 16: View of diagram_findLinkedBG_fwd_itr_1 (findLinkedBG_fwd_itr)

3.2.5. findLinkedBGs Operator

Declared as **private function**

3.2.5.1. Comments and Information

findLinkedBGs Comments:

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

3.2.5.2. Interface

Table 47: Inputs of findLinkedBGs

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

Table 48: Outputs of findLinkedBGs

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

3.2.5.3. Operator Hierarchy

diagram : diagram_findLinkedBGs_1

3.2.5.4. Graphical and Textual Diagrams

3.2.5.4.1. View of diagram_findLinkedBGs_1 (findLinkedBGs)

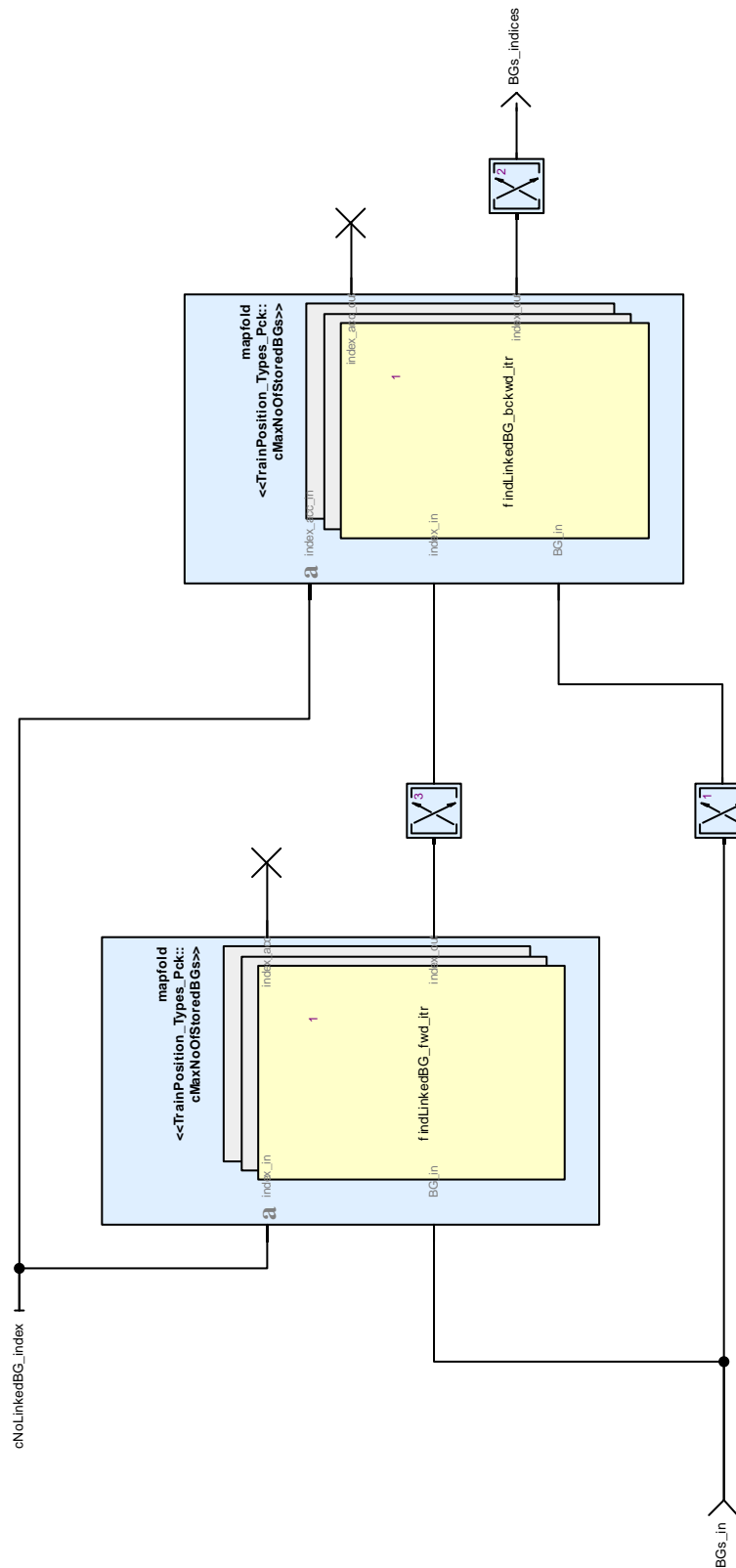


Figure 17: View of diagram_findLinkedBGs_1 (findLinkedBGs)

3.2.6. improve_BG_locations Operator

Declared as **public function**

3.2.6.1. Interface

Table 49: Inputs of improve_BG_locations

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

Table 50: Outputs of improve_BG_locations

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	

3.2.6.2. Operator Hierarchy

diagram : diagram_recalculate_refBG_location

3.2.6.3. Graphical and Textual Diagrams

3.2.6.3.1. View of diagram_recalculate_refBG_location (improve_BG_locations)

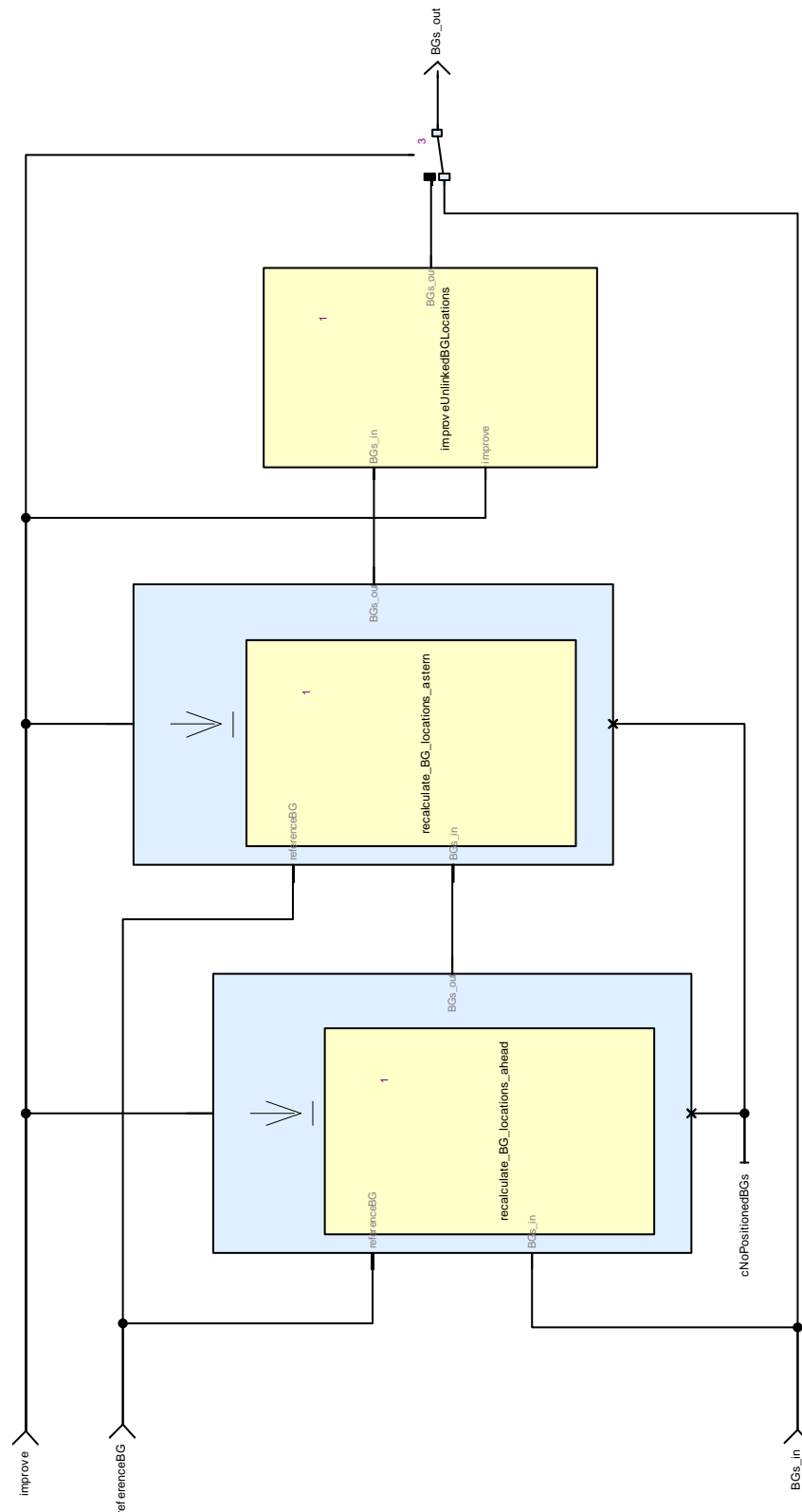


Figure 18: View of diagram_recalculate_refBG_location (improve_BG_locations)

3.2.7. improveUnlinkedBGLocation Operator

Declared as **public function**

3.2.7.1. Comments and Information

improveUnlinkedBGLocation Comments:

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

3.2.7.2. Interface

Table 51: Inputs of improveUnlinkedBGLocation

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

Table 52: Outputs of improveUnlinkedBGLocation

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

3.2.7.3. Operator Hierarchy

diagram : diagram_improveUnlinkedBGLocation_1

3.2.7.4. Graphical and Textual Diagrams

3.2.7.4.1. View of diagram_improveUnlinkedBGLocation_1 (improveUnlinkedBGLocation)

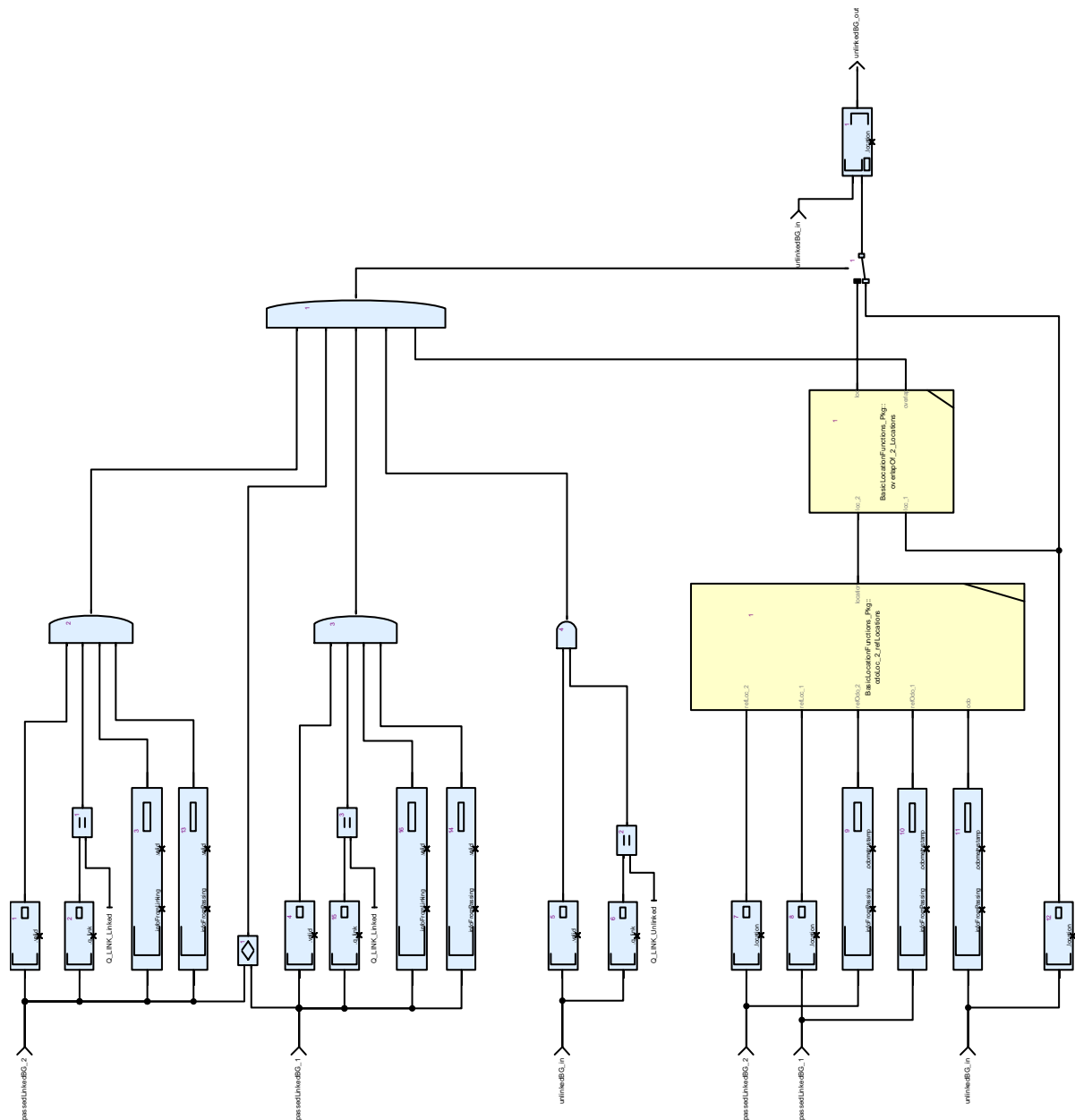


Figure 19: View of diagram_improveUnlinkedBGLocation_1 (improveUnlinkedBGLocation)

3.2.8. improveUnlinkedBGLocations Operator

Declared as **private function**

3.2.8.1. Interface

Table 53: Inputs of ImproveUnlinkedBGLocations

Name	Type	Comments and Information
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T	

Name	Type	Comments and Information
improve	bool	

Table 54: Outputs of improveUnlinkedBGLocations

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	

3.2.8.2. Operator Hierarchy

diagram : diagram_improveUnlinkedBGLocations_1

3.2.8.3. Graphical and Textual Diagrams

3.2.8.3.1. View of diagram_improveUnlinkedBGLocations_1 (improveUnlinkedBGLocations)

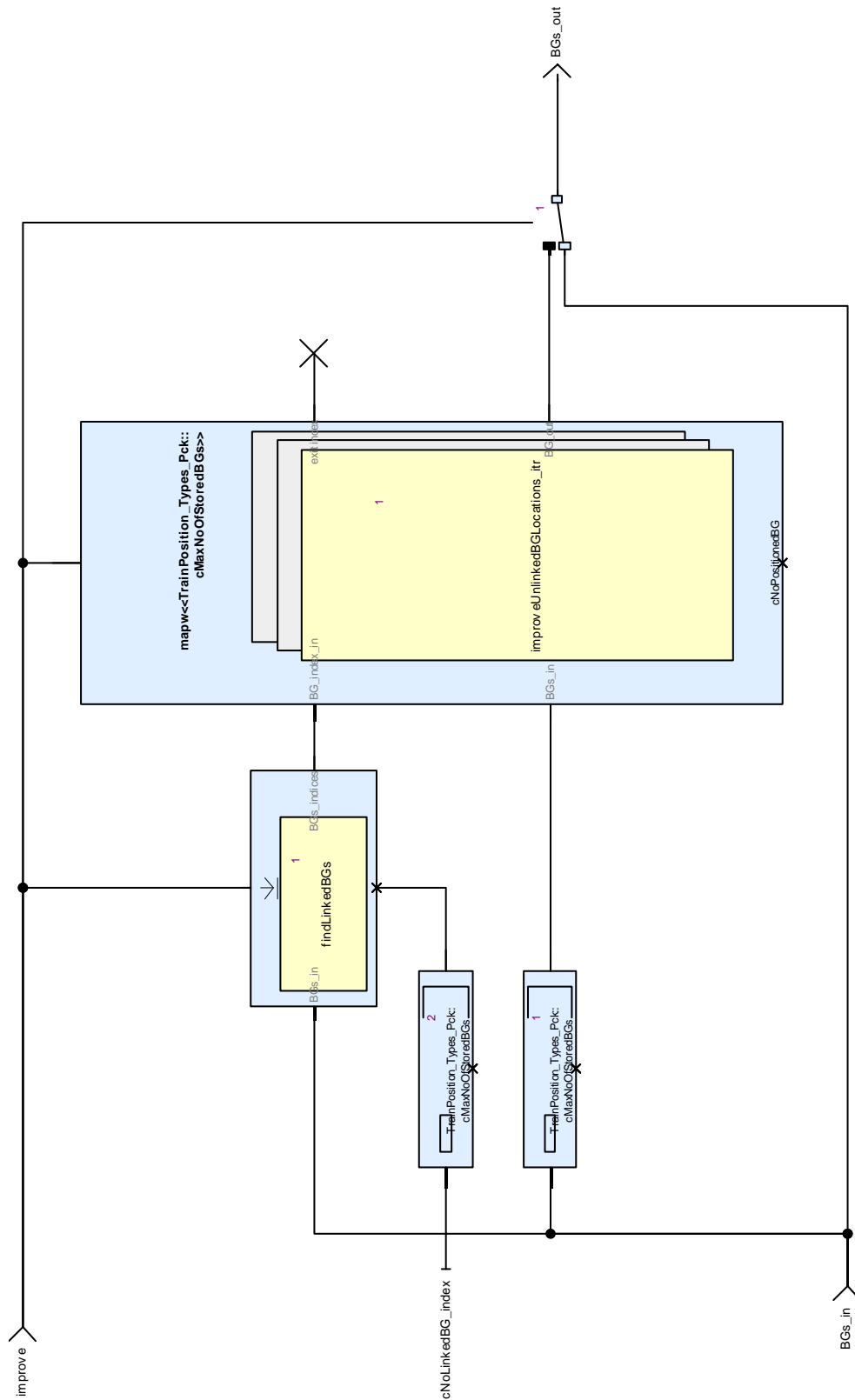


Figure 20: View of diagram_improveUnlinkedBGLocations_1 (improveUnlinkedBGLocations)

3.2.9. improveUnlinkedBGLocations_itr Operator

Declared as **private function**

3.2.9.1. Interface

Table 55: Inputs of improveUnlinkedBGLocations_itr

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

Table 56: Outputs of improveUnlinkedBGLocations_itr

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

3.2.9.2. Operator Hierarchy

diagram : diagram_improveUnlinkedBGLocations_itr_1

3.2.9.3. Graphical and Textual Diagrams

3.2.9.3.1. View of diagram_improveUnlinkedBGLocations_itr_1 (improveUnlinkedBGLocations_itr)

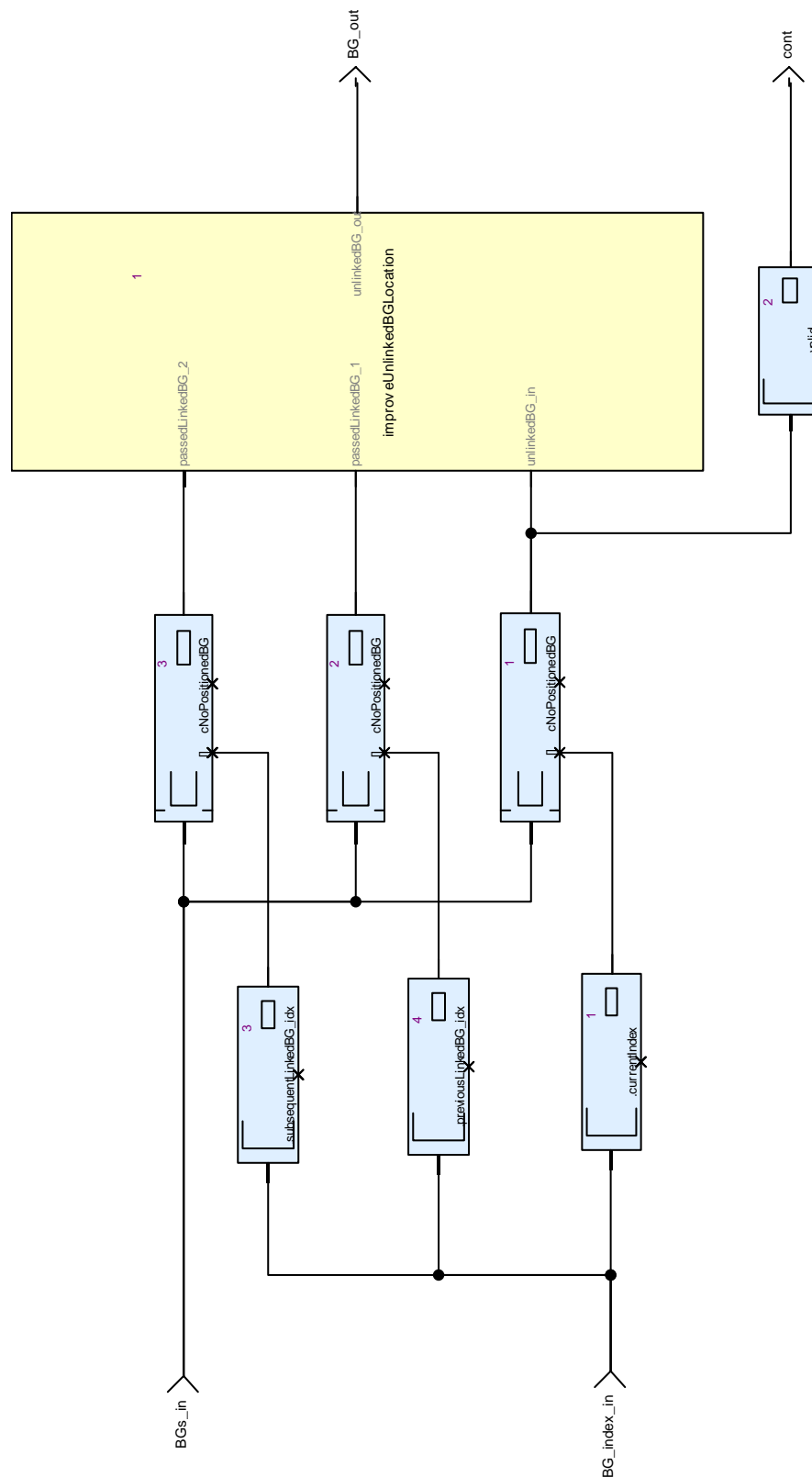


Figure 21: View of diagram_improveUnlinkedBGLocations_itr_1 (improveUnlinkedBGLocations_itr)

3.2.10. recalculate_BG_location_ahead Operator

Declared as **private function**

3.2.10.1. Comments and Information

recalculate_BG_location_ahead Comments:

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

3.2.10.2. Interface

Table 57: Inputs of recalculate_BG_location_ahead

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

Table 58: Outputs of recalculate_BG_location_ahead

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

3.2.10.3. Locals

Table 59: Locals of recalculate_BG_location_ahead

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

3.2.10.4. Operator Hierarchy

diagram : diagram_decide_linked_passed

diagram : diagram_recalculate_BG_location

3.2.10.5. Graphical and Textual Diagrams

3.2.10.5.1. View of diagram_decide_linked_passed (recalculate_BG_location_ahead)

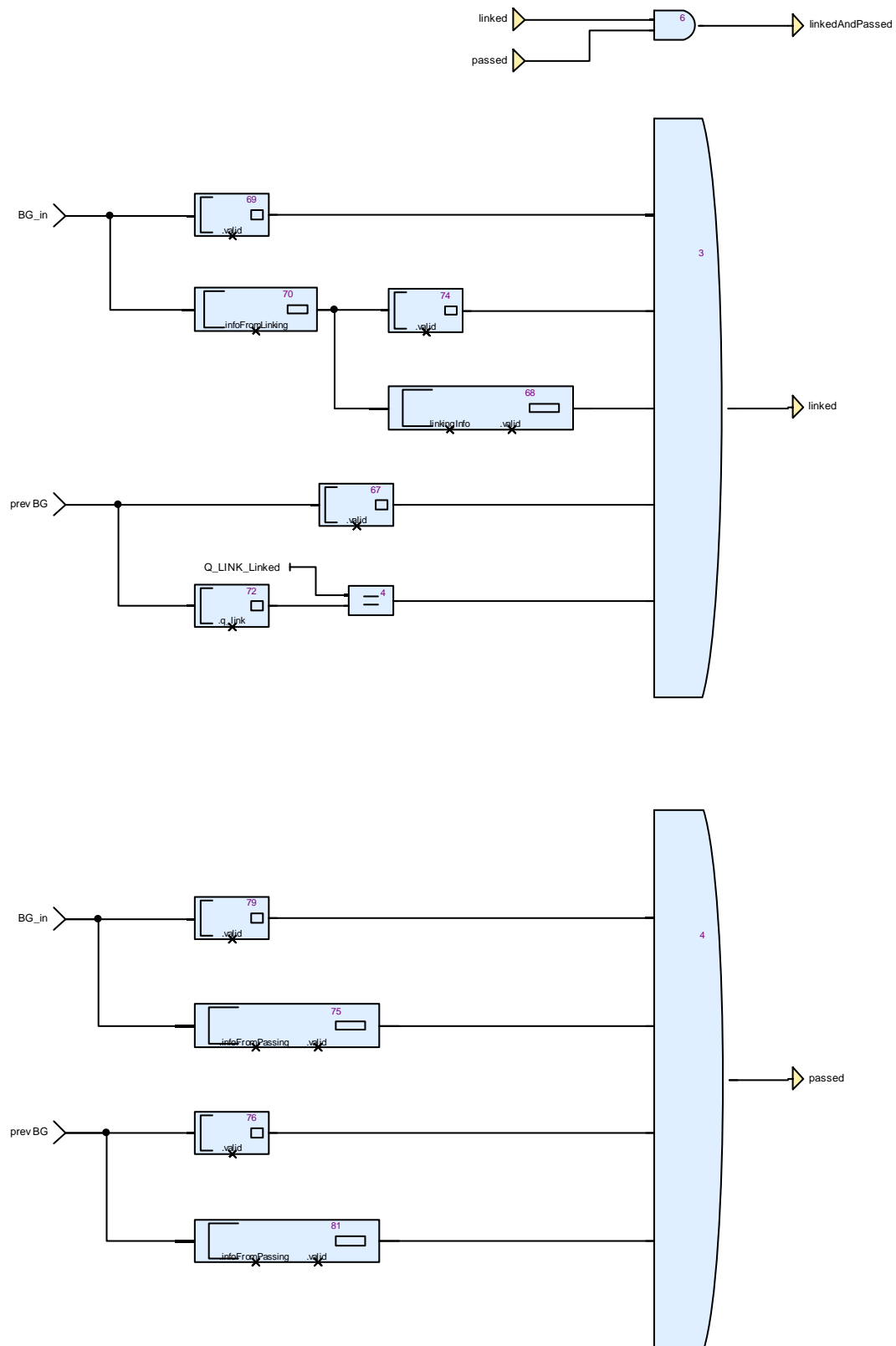


Figure 22: View of diagram_decide_linked_passed (recalculate_BG_location_ahead)

3.2.10.5.2. View of diagram_recalculate_BG_location (recalculate_BG_location_ahed)

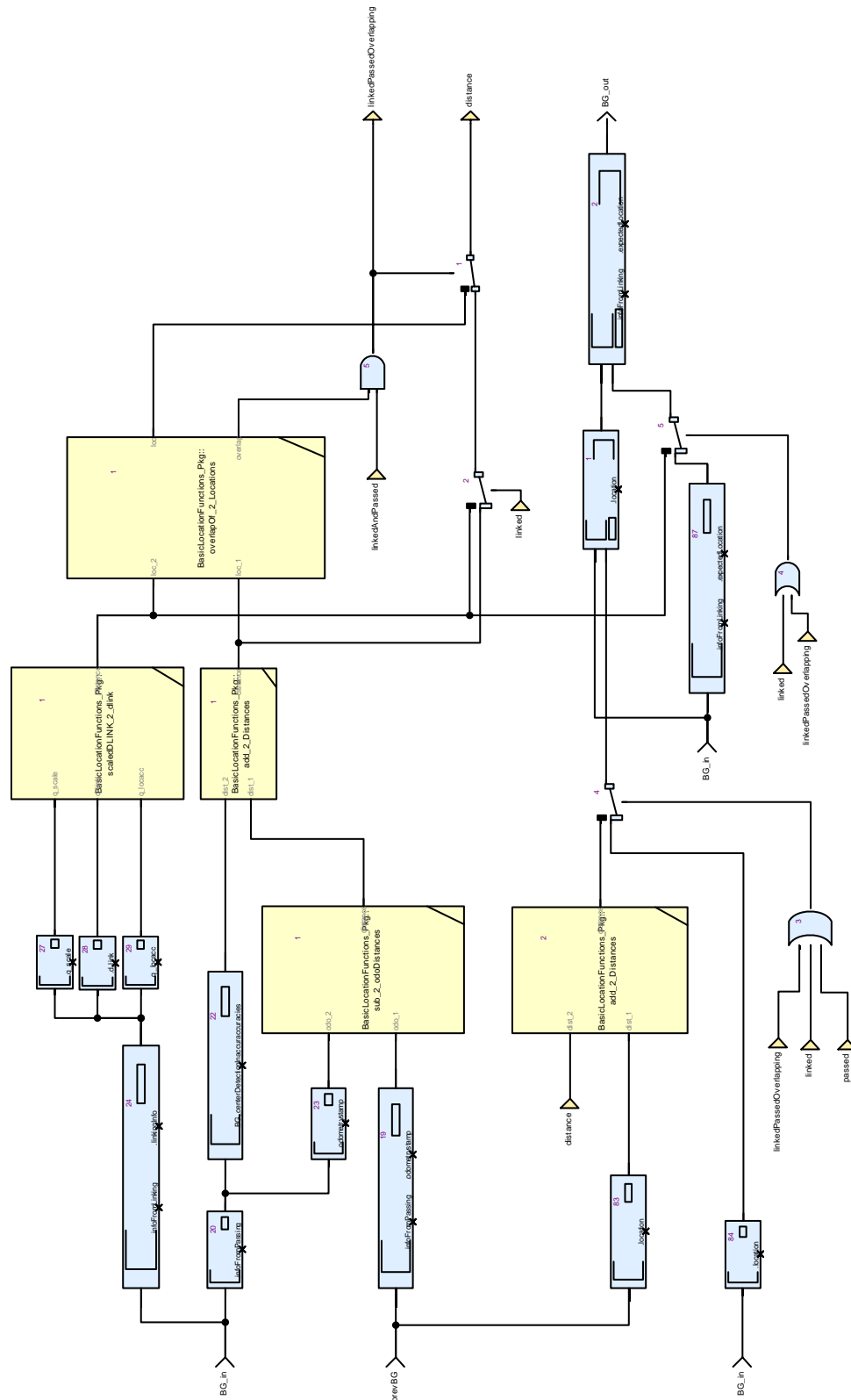


Figure 23: View of diagram_recalculate_BG_location (recalculate_BG_location_ahed)

3.2.11. recalculate_BG_location_astern Operator

Declared as **private function**

3.2.11.1. Comments and Information

recalculate_BG_location_astern Comments:

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

3.2.11.2. Interface

Table 60: Inputs of recalculate_BG_location_astern

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

Table 61: Outputs of recalculate_BG_location_astern

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

3.2.11.3. Locals

Table 62: Locals of recalculate_BG_location_astern

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

3.2.11.4. Operator Hierarchy

diagram : diagram_decide_linked_passed

diagram : diagram_recalculate_BG_location

3.2.11.5. Graphical and Textual Diagrams

3.2.11.5.1. View of diagram_decide_linked_passed (recalculate_BG_location_astern)

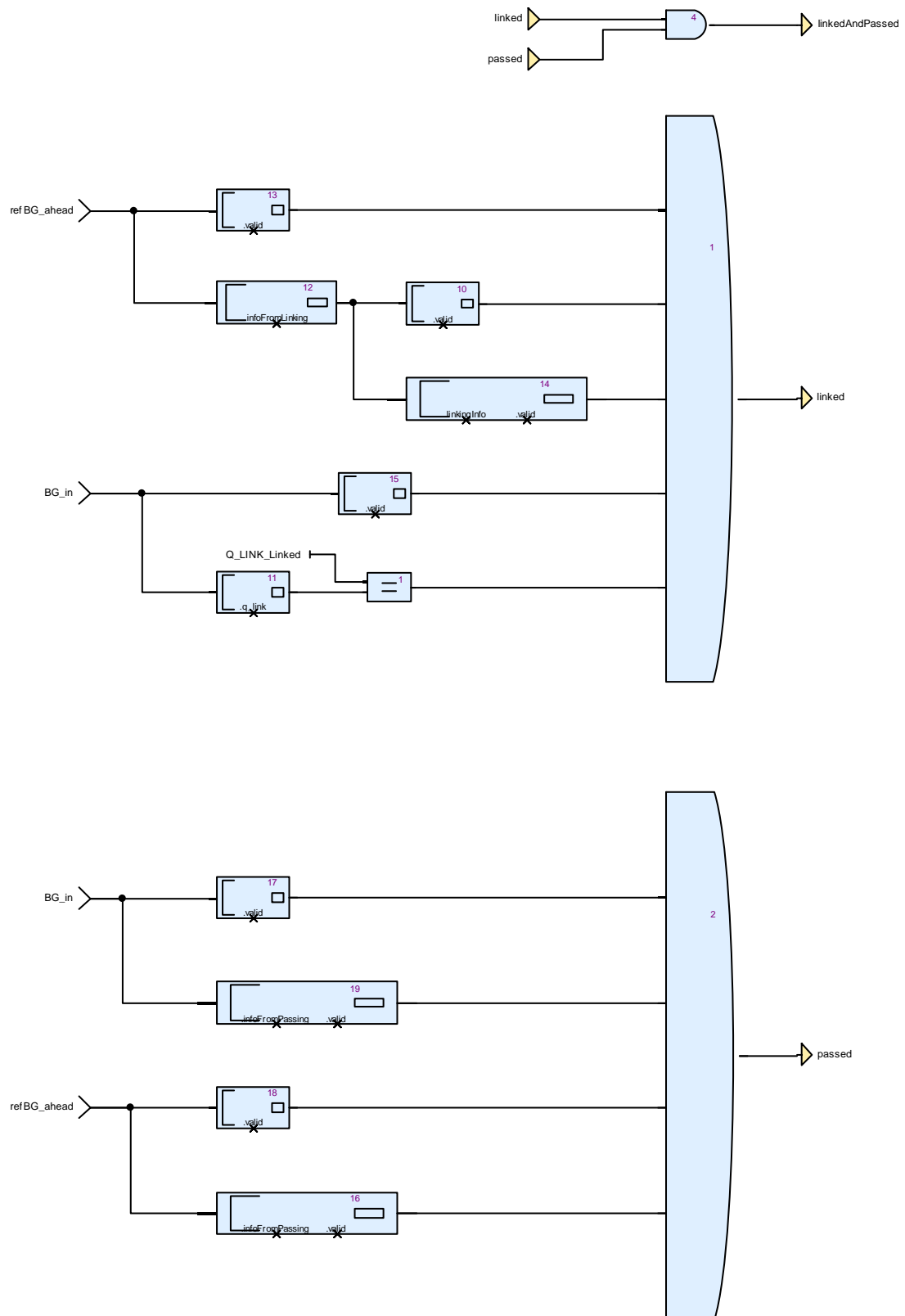


Figure 24: View of diagram_decide_linked_passed (recalculate_BG_location_astern)

3.2.11.5.2. View of diagram_recalculate_BG_location (recalculate_BG_location_astern)

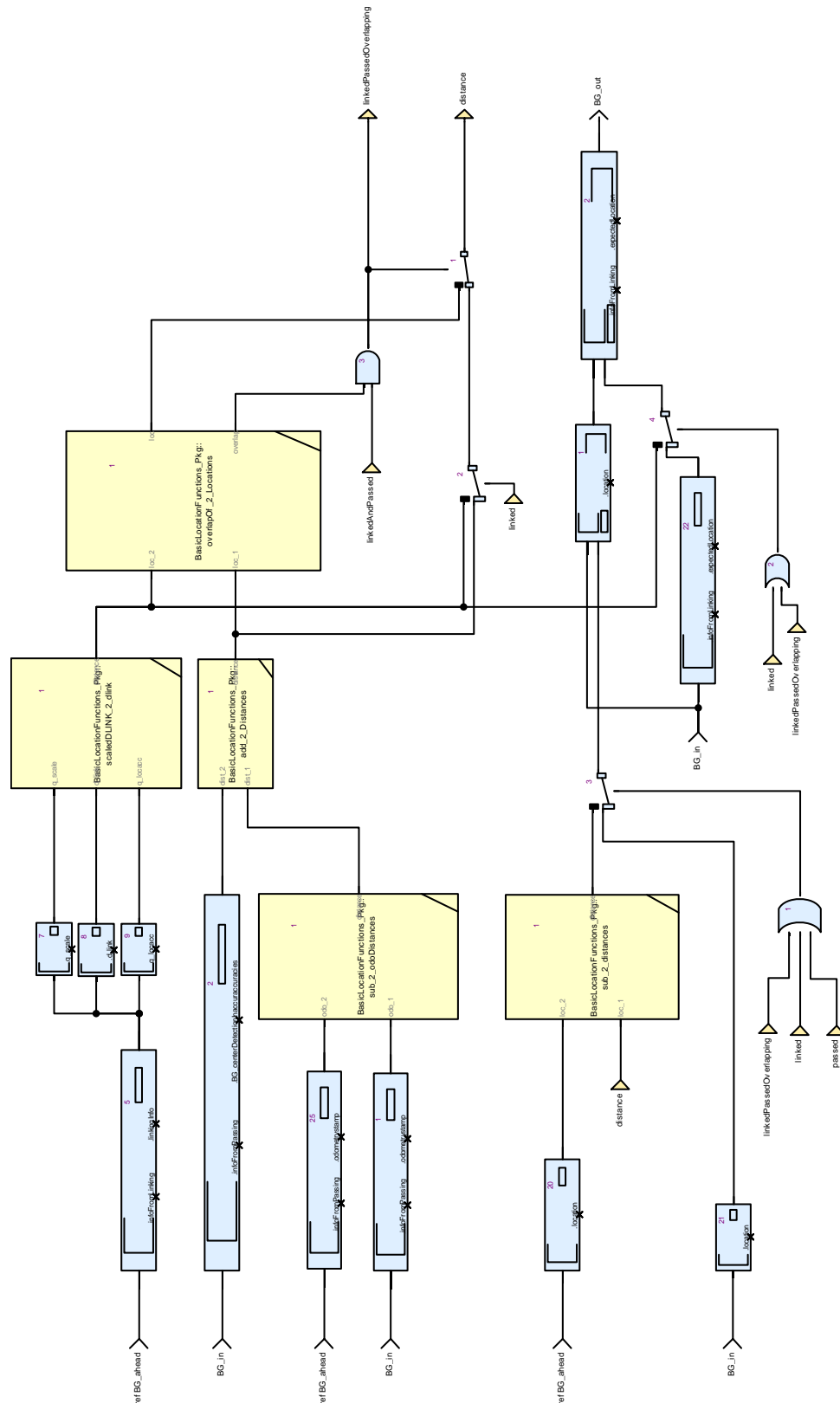


Figure 25: View of diagram_recalculate_BG_location (recalculate_BG_location_astern)

3.2.12. recalculate_BG_locations_ahead Operator

Declared as **private function**

3.2.12.1. Comments and Information

recalculate_BG_locations_ahead Comments:

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

3.2.12.2. Interface

Table 63: Inputs of recalculate_BG_locations_ahead

Name	Type	Comments and Information
referenceBG	TrainPosition_Types_Pc k::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 inaccuracies of all BGs before and after are growing in both directions.
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T	

Table 64: Outputs of recalculate_BG_locations_ahead

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	

3.2.12.3. Operator Hierarchy

diagram : diagram_recalculate_BG_locations_ahead_1

3.2.12.4. Graphical and Textual Diagrams

3.2.12.4.1. View of diagram_recalculate_BG_locations_ahead_1 (recalculate_BG_locations_ahead)

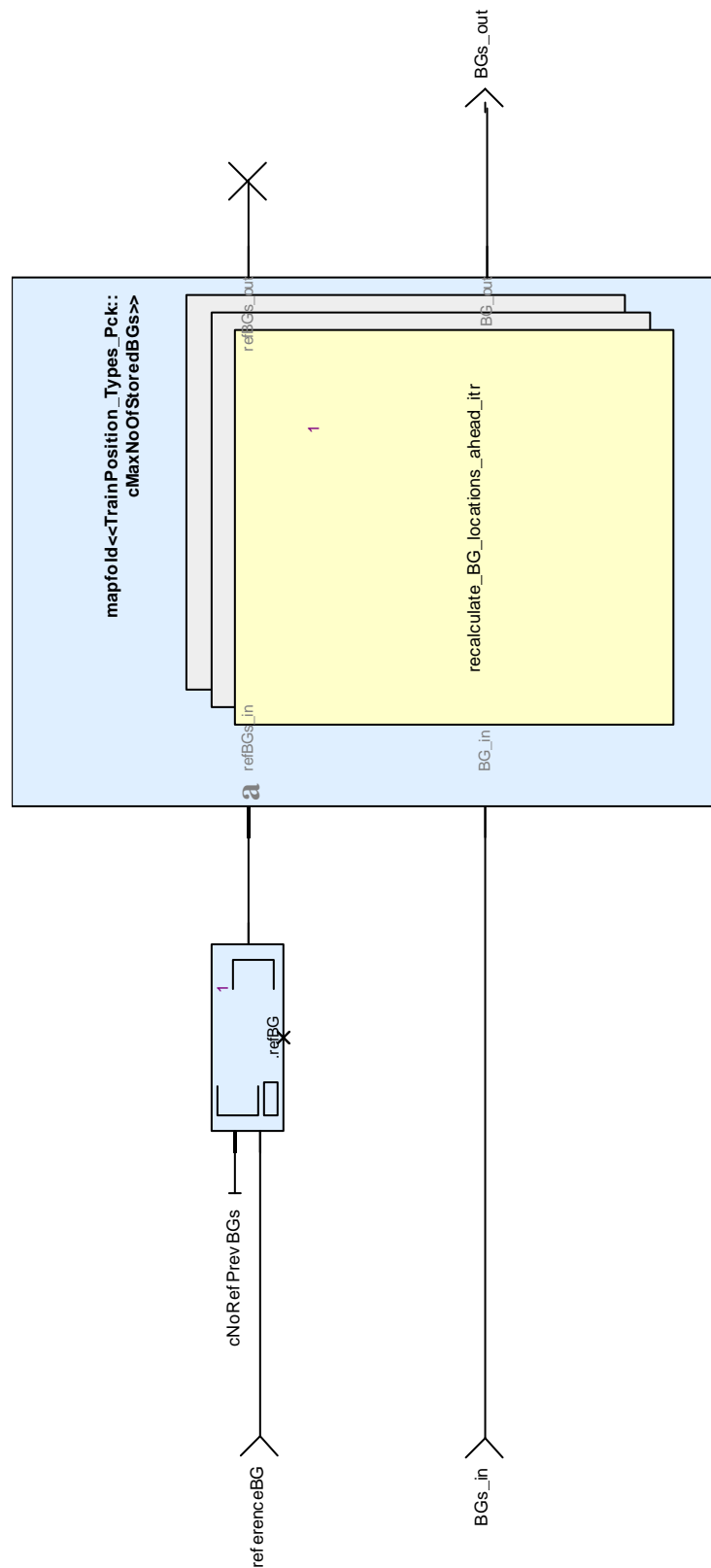


Figure 26: View of diagram_recalculate_BG_locations_ahead_1 (recalculate_BG_locations_ahead)

3.2.13. recalculate_BG_locations_ahead_itr Operator

Declared as **private function**

3.2.13.1. Comments and Information

recalculate_BG_locations_ahead_itr Comments:

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

3.2.13.2. Interface

Table 65: Inputs of recalculate_BG_locations_ahead_itr

Name	Type	Comments and Information
refBGs_in	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::refBGs_T	
BG_in	TrainPosition_Types_Pc k::positionedBG_T	Comments: The BG that's location has to be recalculated

Table 66: Outputs of recalculate_BG_locations_ahead_itr

Name	Type	Comments and Information
refBGs_out	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::refBGs_T	
BG_out	TrainPosition_Types_Pc k::positionedBG_T	Comments: The BG that's location has been recalculated.

3.2.13.3. Locals

Table 67: Locals of recalculate_BG_locations_ahead_itr

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

3.2.13.4. Operator Hierarchy

diagram : diagram_assembleResults

diagram : diagram_assign_refBG

diagram : diagram_determinePreviousLinkedBG

diagram : diagram_determinePreviousUnlinkedBG

diagram : diagram_recalculate_BG_location

diagram : diagram_recalculate_refBG_location

3.2.13.5. Graphical and Textual Diagrams

3.2.13.5.1. View of diagram_assembleResults (recalculate_BG_locations_ahead_itr)

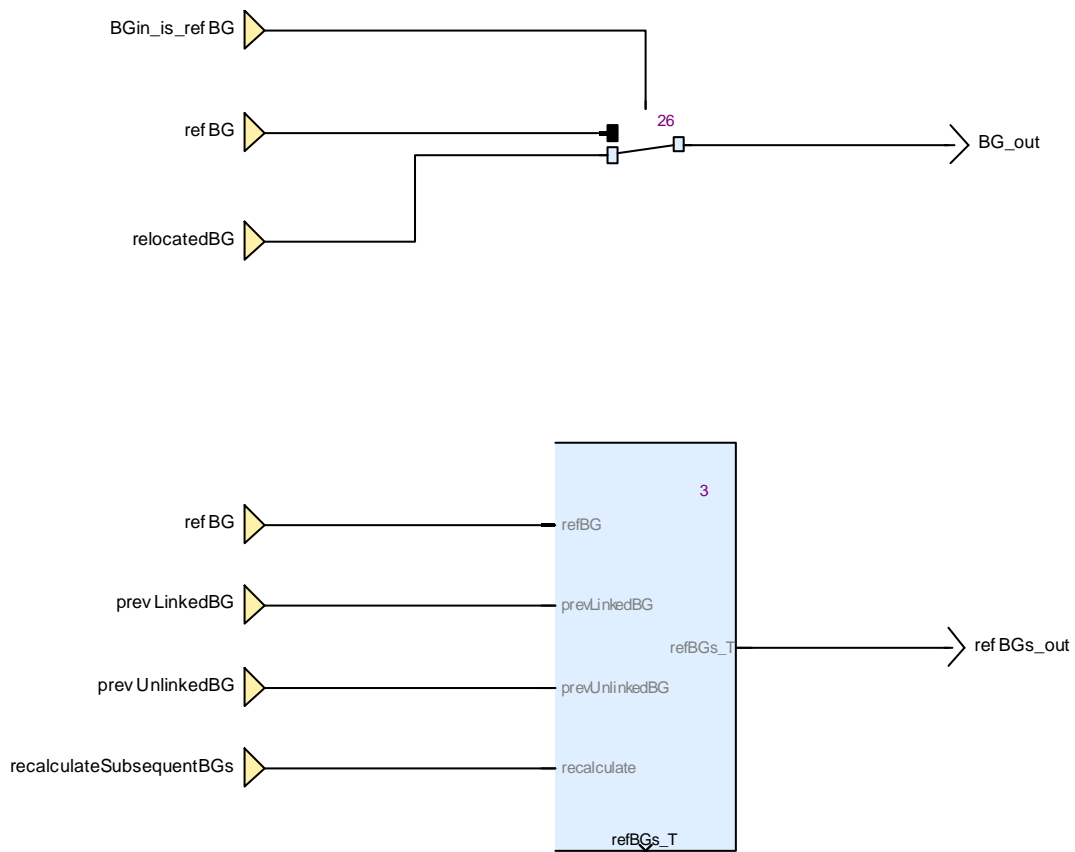


Figure 27: View of diagram_assembleResults (recalculate_BG_locations_ahead_itr)

diagram_assembleResults Comments:

- Assembles the outputs.

3.2.13.5.2. View of diagram_assign_refBG (recalculate_BG_locations_ahead_itr)

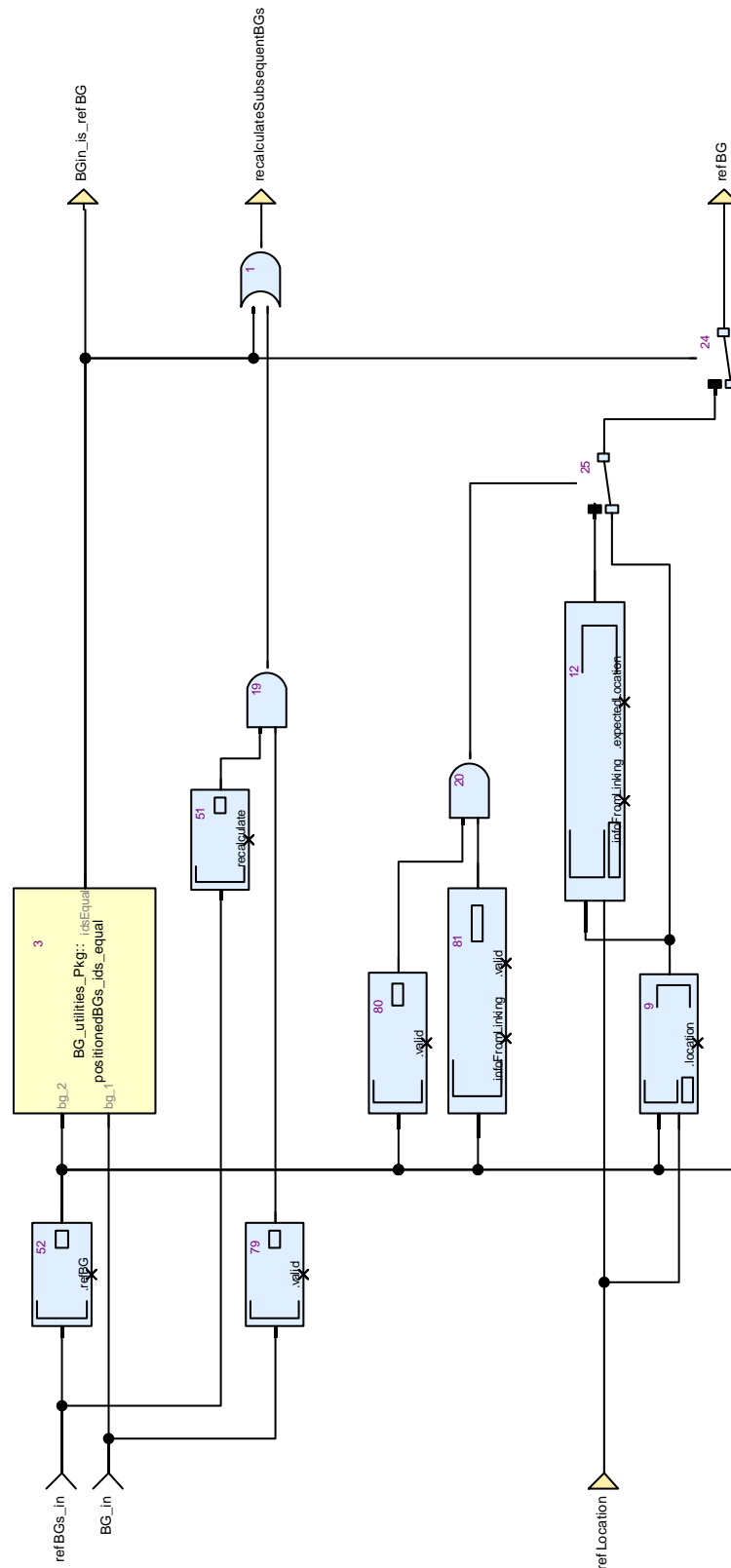


Figure 28: View of diagram_assign_refBG (recalculate_BG_locations_ahead_itr)

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

3.2.13.5.3. View of diagram_determinePreviousLinkedBG (recalculate_BG_locations_ahead_itr)

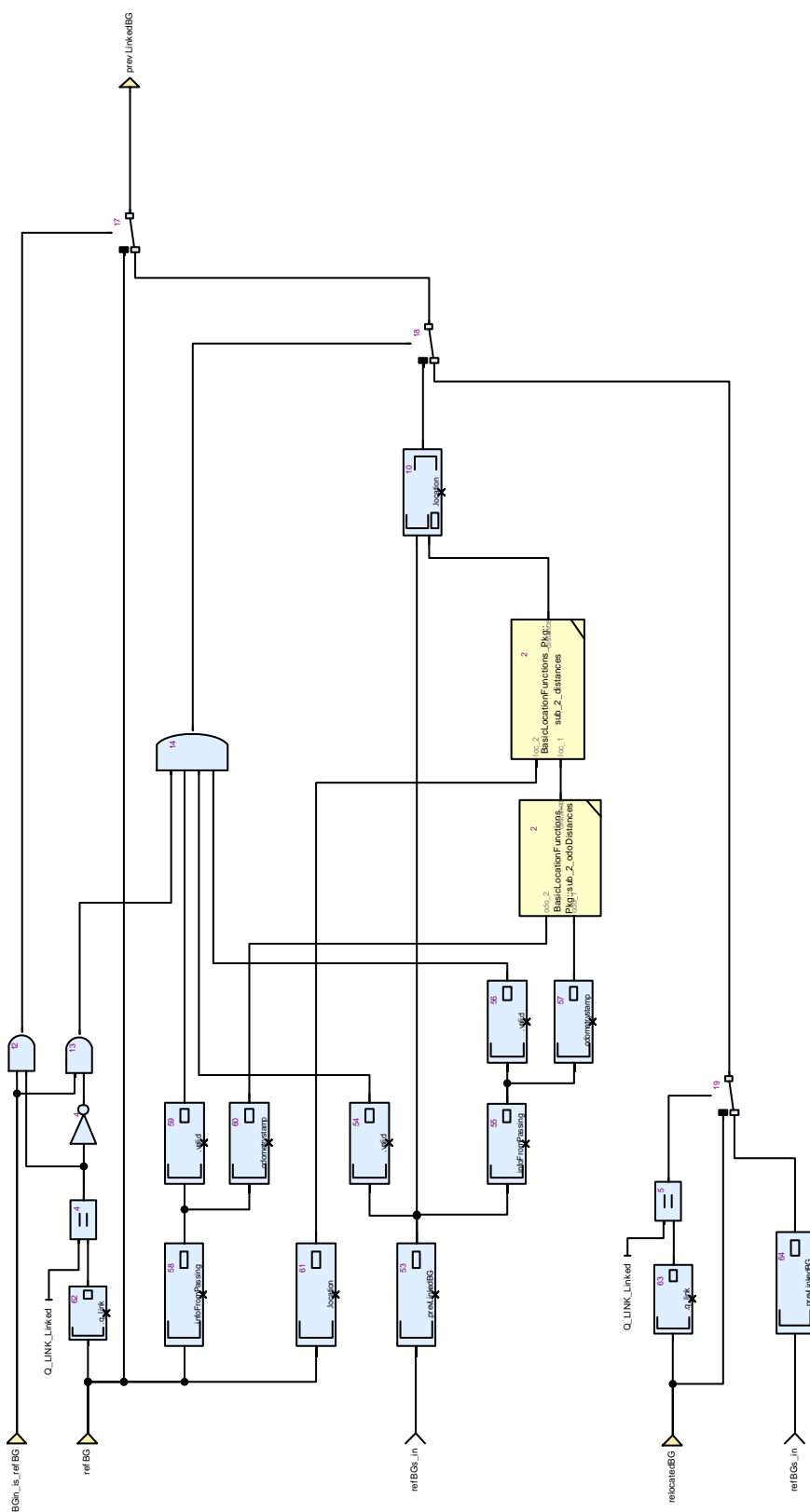


Figure 29: View of diagram_determinePreviousLinkedBG (recalculate_BG_locations_ahead_itr)

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

3.2.13.5.4. View of diagram_determinePreviousUnlinkedBG (recalculate_BG_locations_ahead_itr)

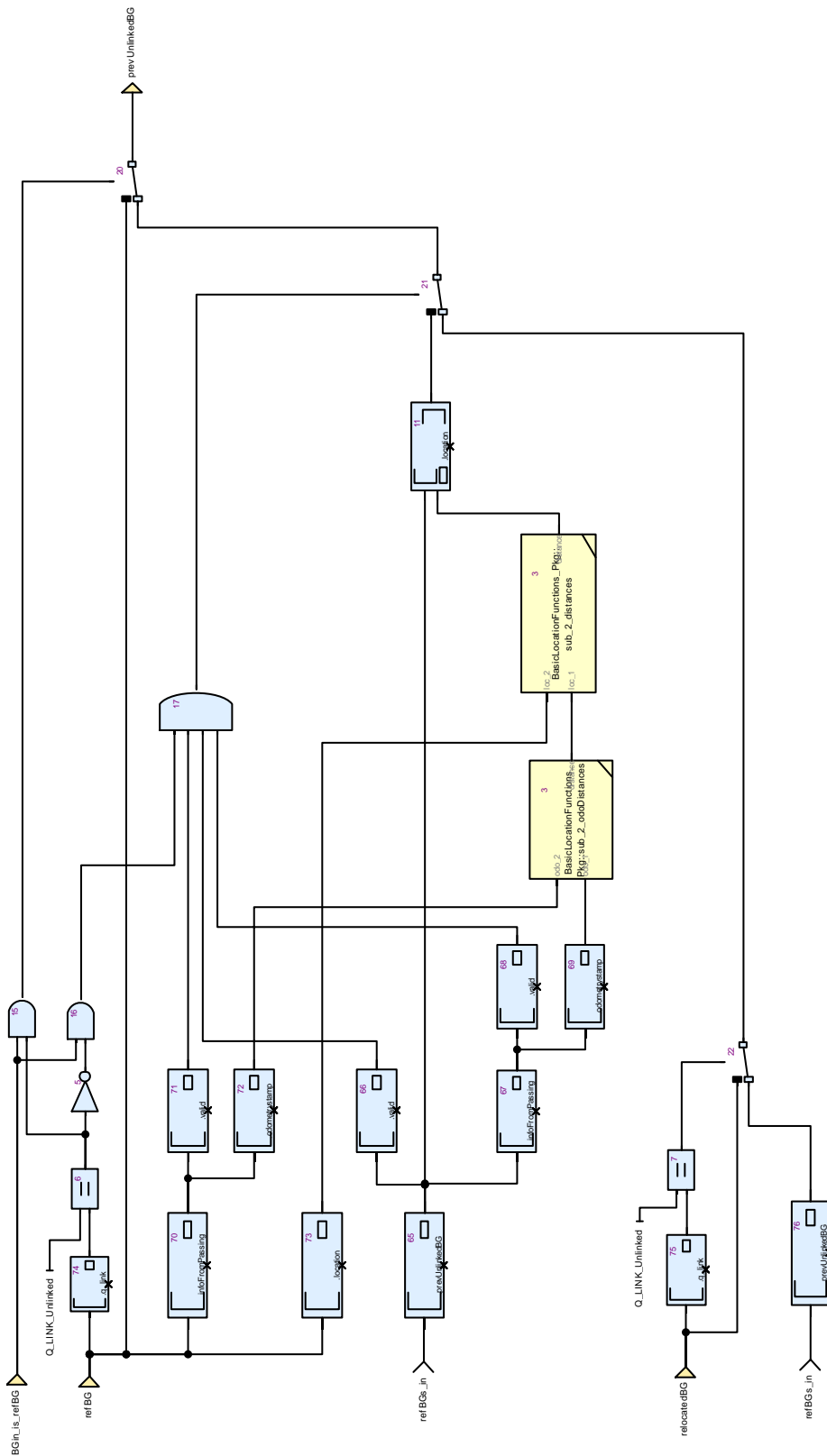


Figure 30: View of diagram_determinePreviousUnlinkedBG (recalculate_BG_locations_ahead_itr)

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.

3.2.13.5.5. View of diagram_recalculate_BG_location
(recalculate_BG_locations_ahead_itr)

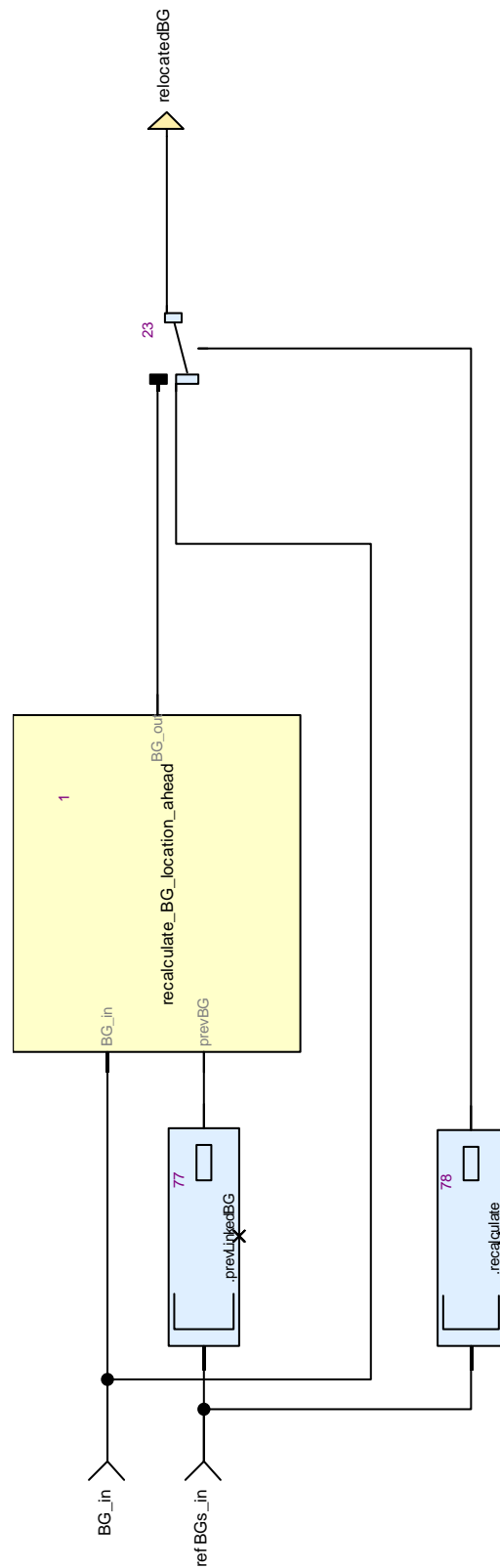


Figure 31: View of diagram_recalculate_BG_location (recalculate_BG_locations_ahead_itr)

3.2.13.5.6. View of diagram_recalculate_refBG_location (recalculate_BG_locations_ahead_itr)

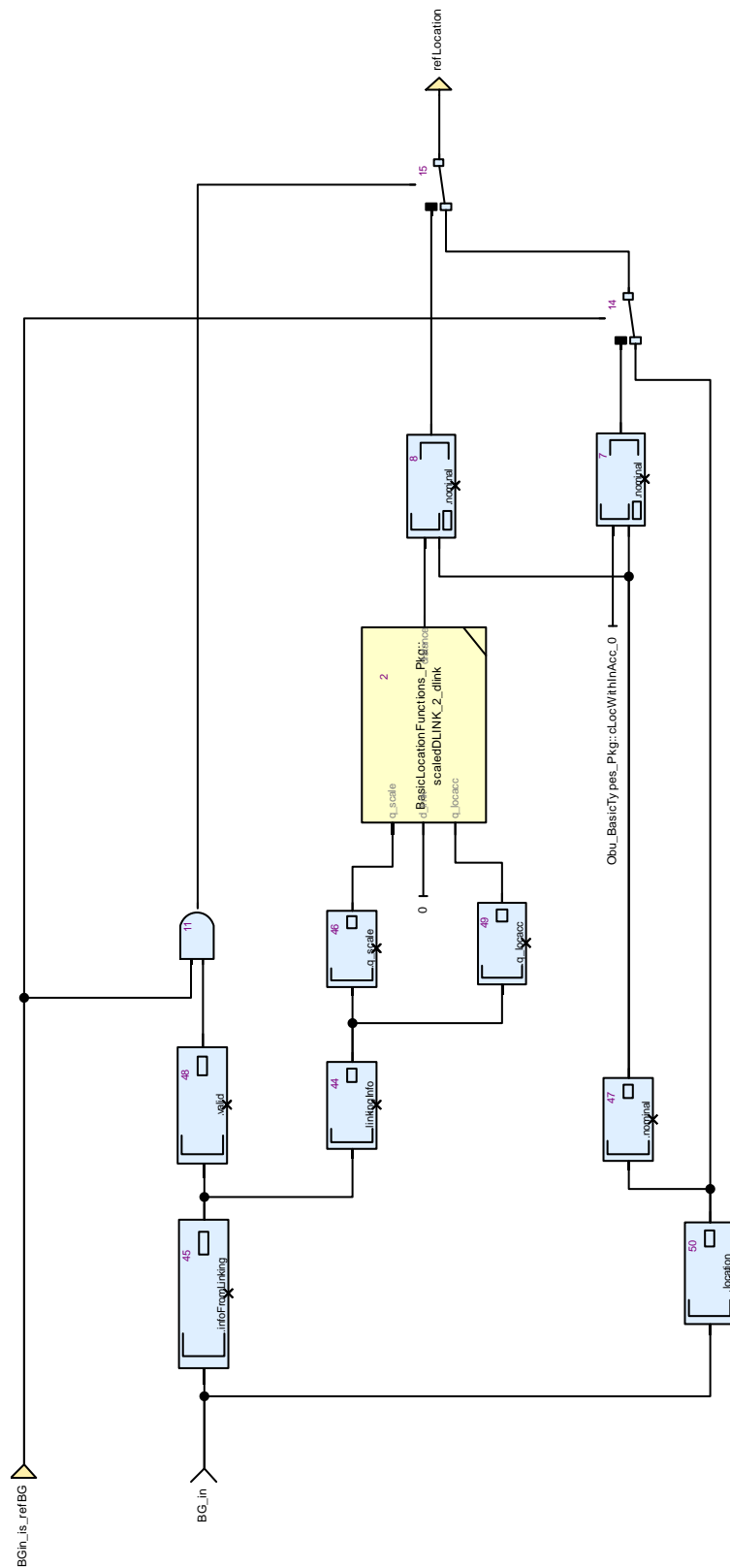


Figure 32: View of diagram_recalculate_refBG_location (recalculate_BG_locations_ahead_itr)

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

3.2.14. recalculate_BG_locations_astern Operator

Declared as **private function**

3.2.14.1. Comments and Information

recalculate_BG_locations_astern Comments:

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

3.2.14.2. Interface

Table 68: Inputs of recalculate_BG_locations_astern

Name	Type	Comments and Information
referenceBG	TrainPosition_Types_Pc k::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_Pc k::positionedBGs_T	

Table 69: Outputs of recalculate_BG_locations_astern

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::positionedBGs_T	

3.2.14.3. Operator Hierarchy

diagram : diagram_recalculate_BG_locations_astern_1

3.2.14.4. Graphical and Textual Diagrams

3.2.14.4.1. View of diagram_recalculate_BG_locations_astern_1 (recalculate_BG_locations_astern)

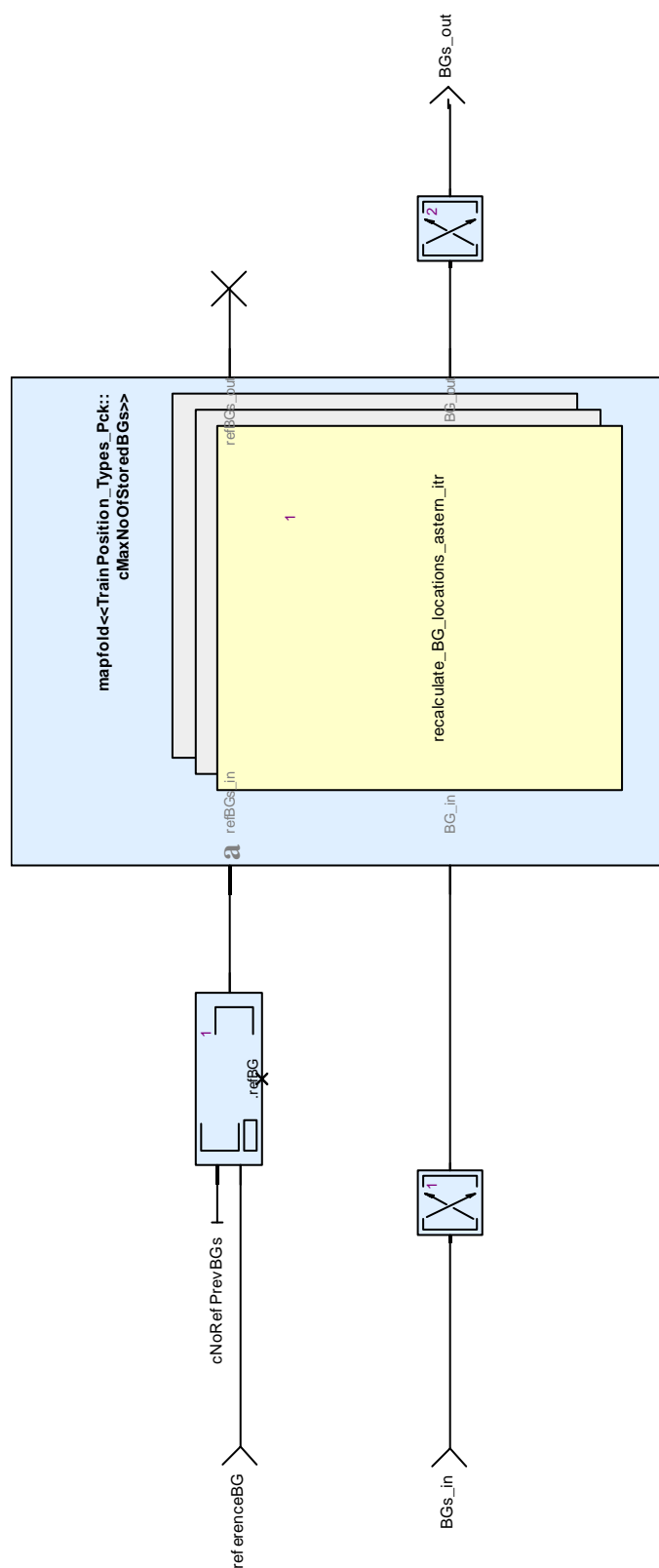


Figure 33: View of diagram_recalculate_BG_locations_astern_1 (recalculate_BG_locations_astern)

3.2.15. recalculate_BG_locations_astern_itr Operator

Declared as **private function**

3.2.15.1. Comments and Information

recalculate_BG_locations_astern_itr Comments:

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

3.2.15.2. Interface

Table 70: Inputs of recalculate_BG_locations_astern_itr

Name	Type	Comments and Information
refBGs_in	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::refBGs_T	Comments: Note: prevUnlinkedBG and prevLinkedBG are previous for the backward iteration.
BG_in	TrainPosition_Types_Pc k::positionedBG_T	Comments: The BG that's location has to be recalculated

Table 71: Outputs of recalculate_BG_locations_astern_itr

Name	Type	Comments and Information
refBGs_out	CalculateTrainPosition_ Pkg::BG_relocation_Pk g::refBGs_T	
BG_out	TrainPosition_Types_Pc k::positionedBG_T	Comments: The BG that's location has been recalculated.

3.2.15.3. Locals

Table 72: Locals of recalculate_BG_locations_astern_itr

Name	Type	Comments and Information
BGin_is_refBG	bool	
prevLinkedBG	TrainPosition_Types_Pc k::positionedBG_T	
prevUnlinkedBG	TrainPosition_Types_Pc k::positionedBG_T	
recalculateSubsequent BGs	bool	
refBG	TrainPosition_Types_Pc k::positionedBG_T	
relocatedBG	TrainPosition_Types_Pc k::positionedBG_T	

3.2.15.4. Operator Hierarchy

diagram : diagram_assembleResults

diagram : diagram_assign_refBG

diagram : diagram_determinePreviousLinkedBG

diagram : diagram_determinePreviousUnlinkedBG

diagram : diagram_recalculate_BG_location

3.2.15.5. Graphical and Textual Diagrams

3.2.15.5.1. View of diagram_assembleResults (recalculate_BG_locations_astern_itr)

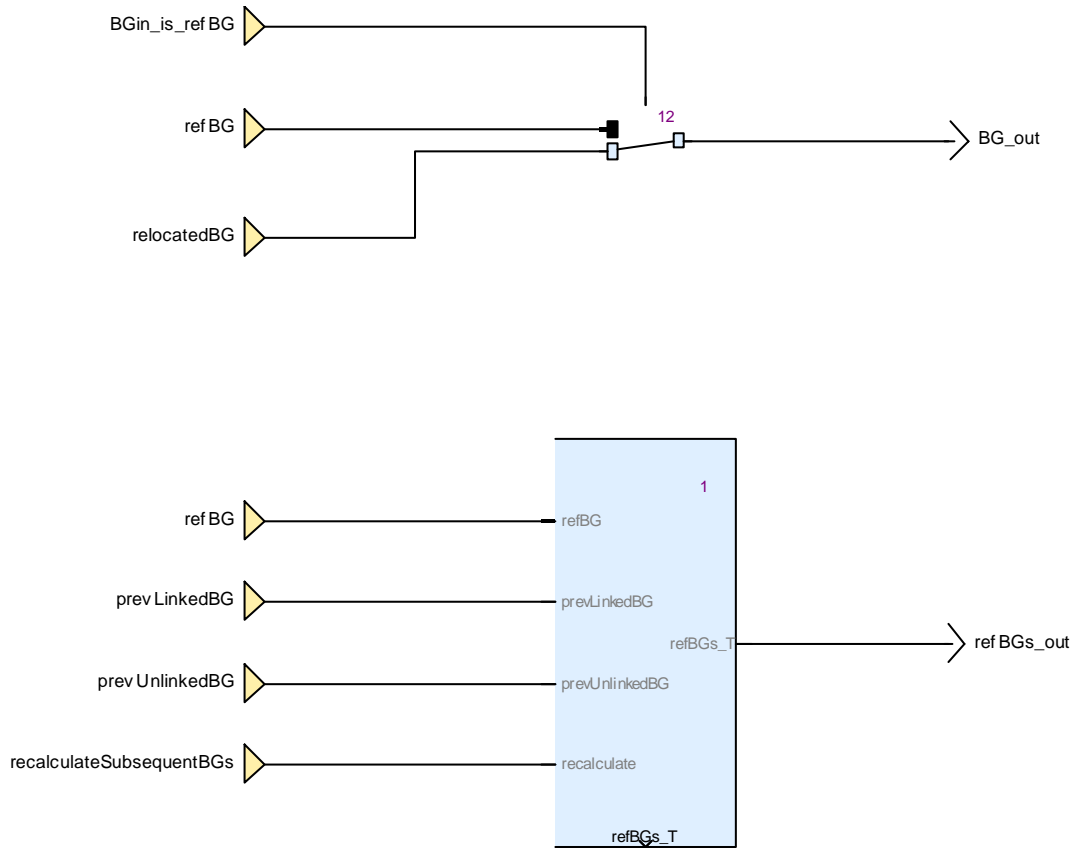


Figure 34: View of diagram_assembleResults (recalculate_BG_locations_astern_itr)

diagram_assembleResults Comments:

- Assembles the outputs.

3.2.15.5.2. View of diagram_assign_refBG (recalculate_BG_locations_astern_itr)

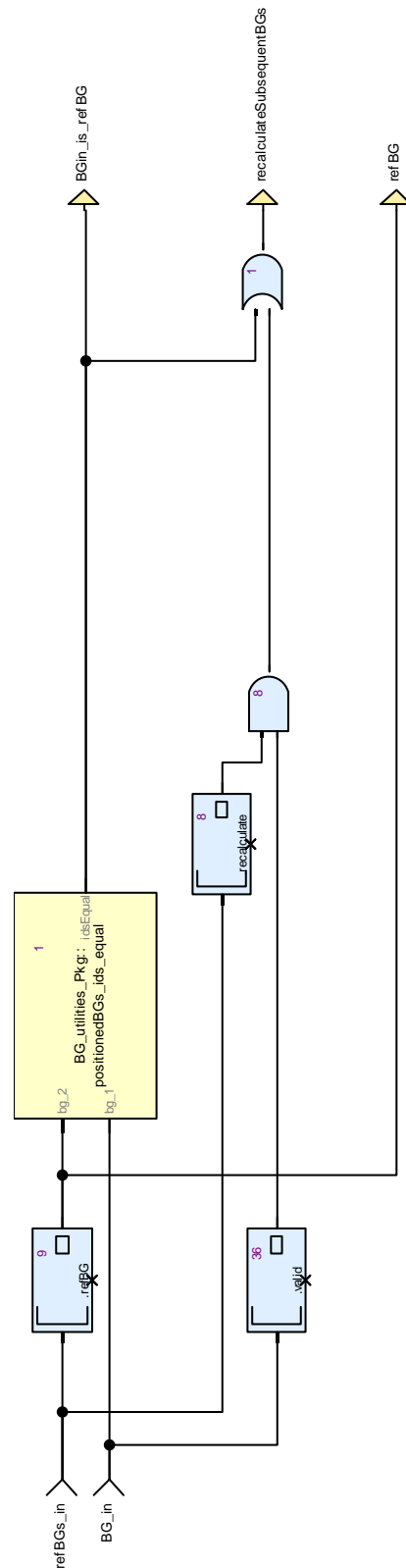


Figure 35: View of diagram_assign_refBG (recalculate_BG_locations_astern_itr)

diagram_assign_refBG Comments:

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

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

3.2.15.5.3. View of diagram_determinePreviousLinkedBG (recalculate_BG_locations_astern_itr)

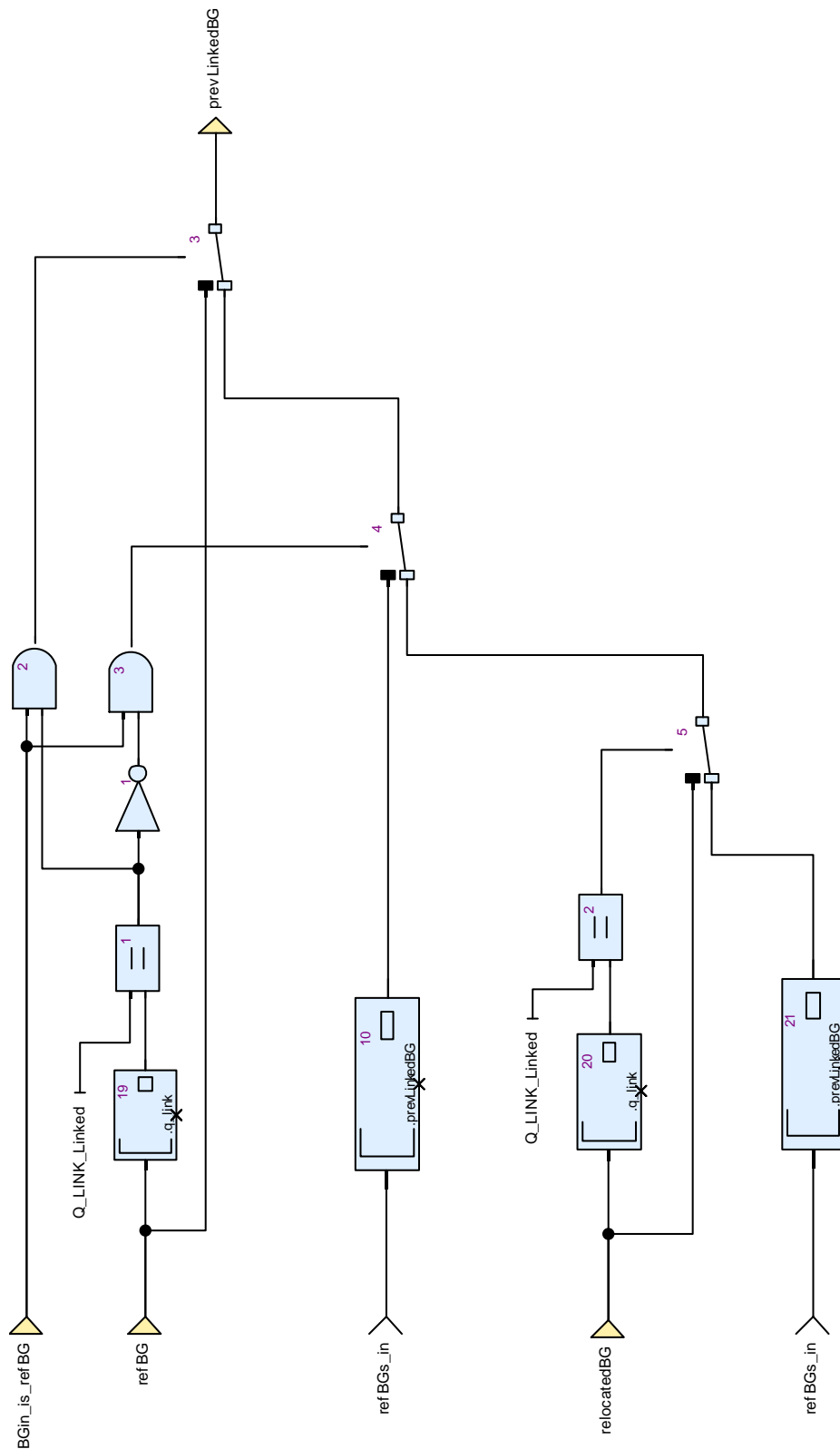


Figure 36: View of diagram_determinePreviousLinkedBG (recalculate_BG_locations_astern_itr)

diagram_determinePreviousLinkedBG Comments:

- Determines the previous linked BG.

- If BG_in is the reference BG and the reference BG is a linked BG, prevLinkedBG is set to refBG.
- If BG_in is the reference BG and is an unlinked BG, prevLinkedBG is taken from refBGs_in.prevLinkedBG
- If BG_in is not the reference BG and is a linked BG, prevLinkedBG is set to the relocated BG_in.
- If BG_in is not the reference BG and is an unlinked BG, prevLinkedBG is taken from refBGs_in.prevLinkedBG.

3.2.15.5.4. View of diagram_determinePreviousUnlinkedBG (recalculate_BG_locations_astern_itr)

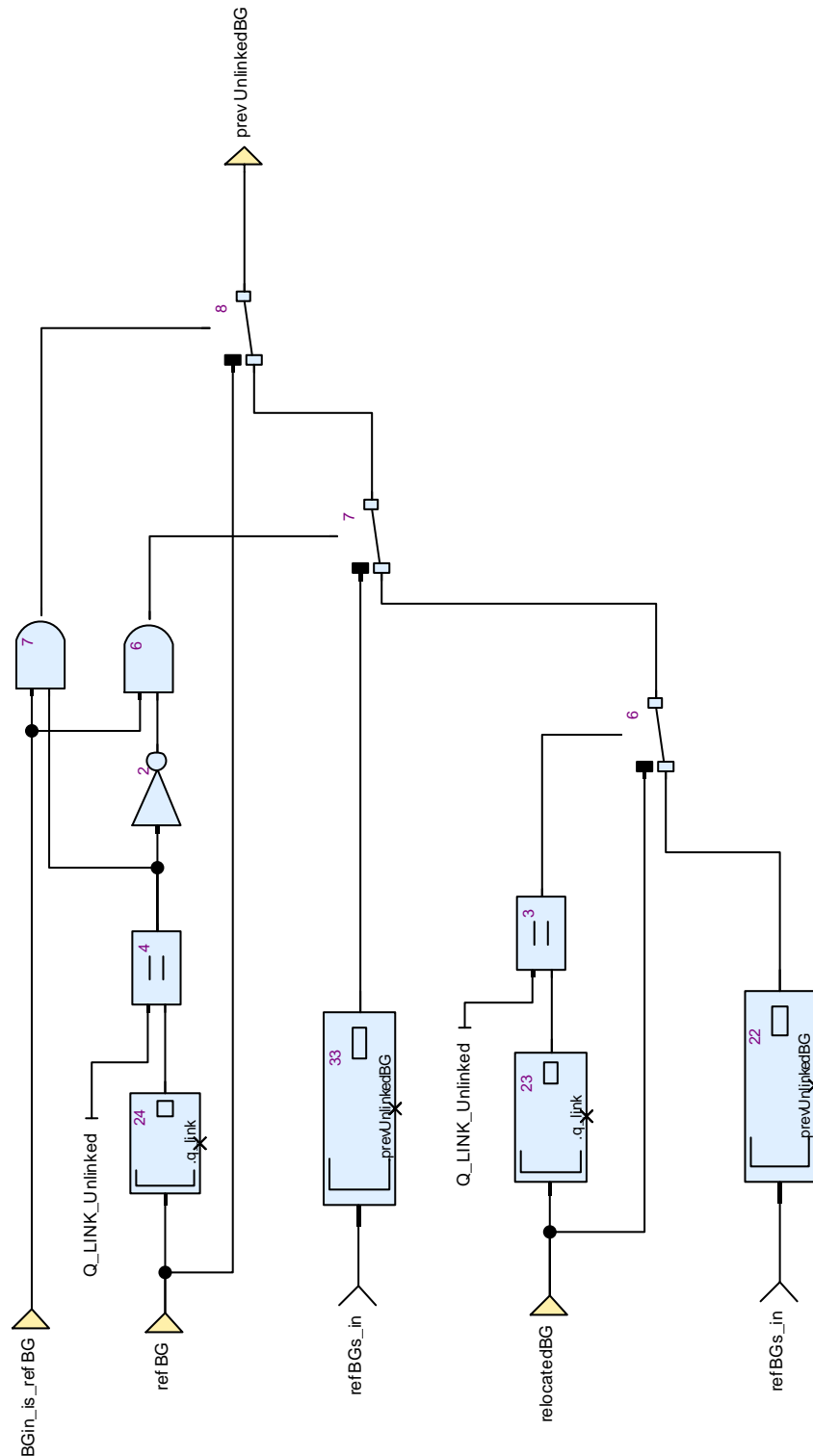


Figure 37: View of diagram_determinePreviousUnlinkedBG (recalculate_BG_locations_astern_itr)

diagram_determinePreviousUnlinkedBG Comments:

- Determines the previous unlinked BG.
- If BG_in is the reference BG and the reference BG is an unlinked BG, prevUnlinkedBG is set to refBG.

- If BG_in is the reference BG and a linked BG with or without linking information, prevUnlinkedBG is taken from refBGs_in.prevUnlinkedBG.
- If BG_in is not the reference BG and is an unlinked BG, prevLinkedBG is set to the relocated BG_in.
- If BG_in is not the reference BG and is not an unlinked BG, prevUnlinkedBG is taken from refBGs_in.prevUnlinkedBG.

3.2.15.5.5. View of diagram_recalculate_BG_location (recalculate_BG_locations_astern_itr)

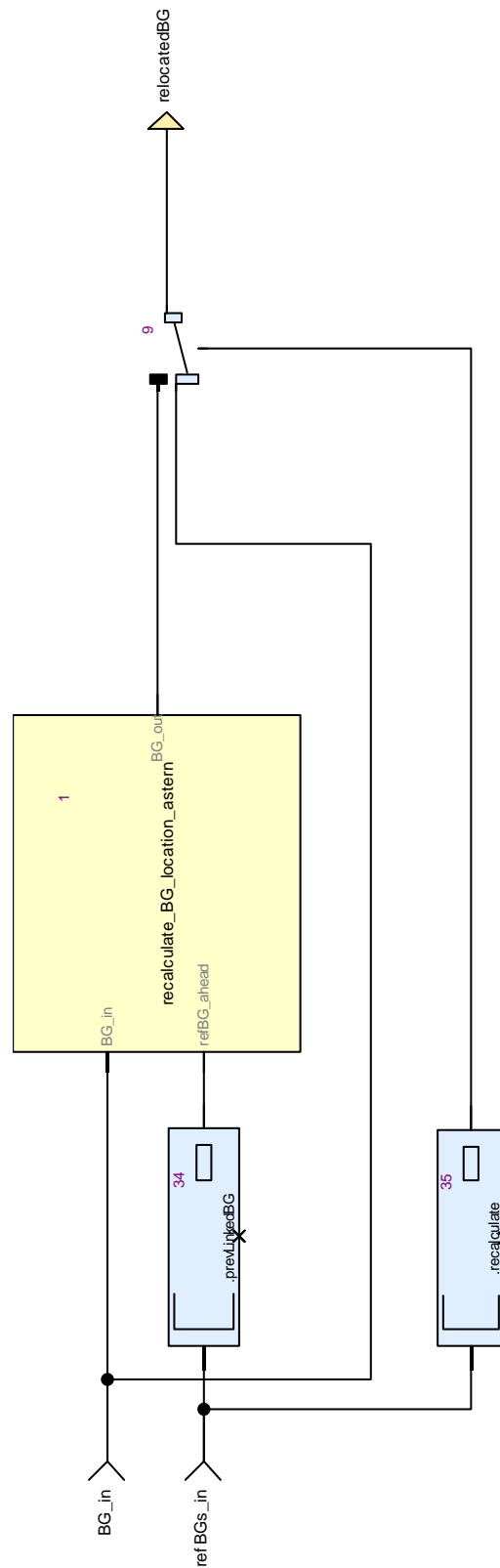


Figure 38: View of diagram_recalculate_BG_location (recalculate_BG_locations_astern_itr)

diagram_recalculate_BG_location Comments:

- Recalculates the location of BG_in.

3.3. CalculateTrainPosition_Pkg::BG_utilities_Pkg Package

3.3.1. Types

Table 73: 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 through the BGs

3.3.2. Constants

Table 74: Public Constants of BG_utilities_Pkg

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

Name	Type	Value	Comments and Information
		{valid : false, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked, location : {nominal : 0, d_min : 0, d_max : 0}, seqNoOnTrack : 0, infoFromLinking : {valid : false, nid_bg_fromLinkingBG : 0, nid_c_fromLinkingBG : 0, expectedLocation : {nominal : 0, d_min : 0, d_max : 0}, d_link : {nominal : 0, d_min : 0, d_max : 0}, linkingInfo : {valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}}, infoFromPassing : {valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetectionInaccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Downlink_telegram, m_version : M_VERSION_Previous_versions_according_to_EEIG_SRS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise,	

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 75: Inputs of countBGs

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

Table 76: 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)

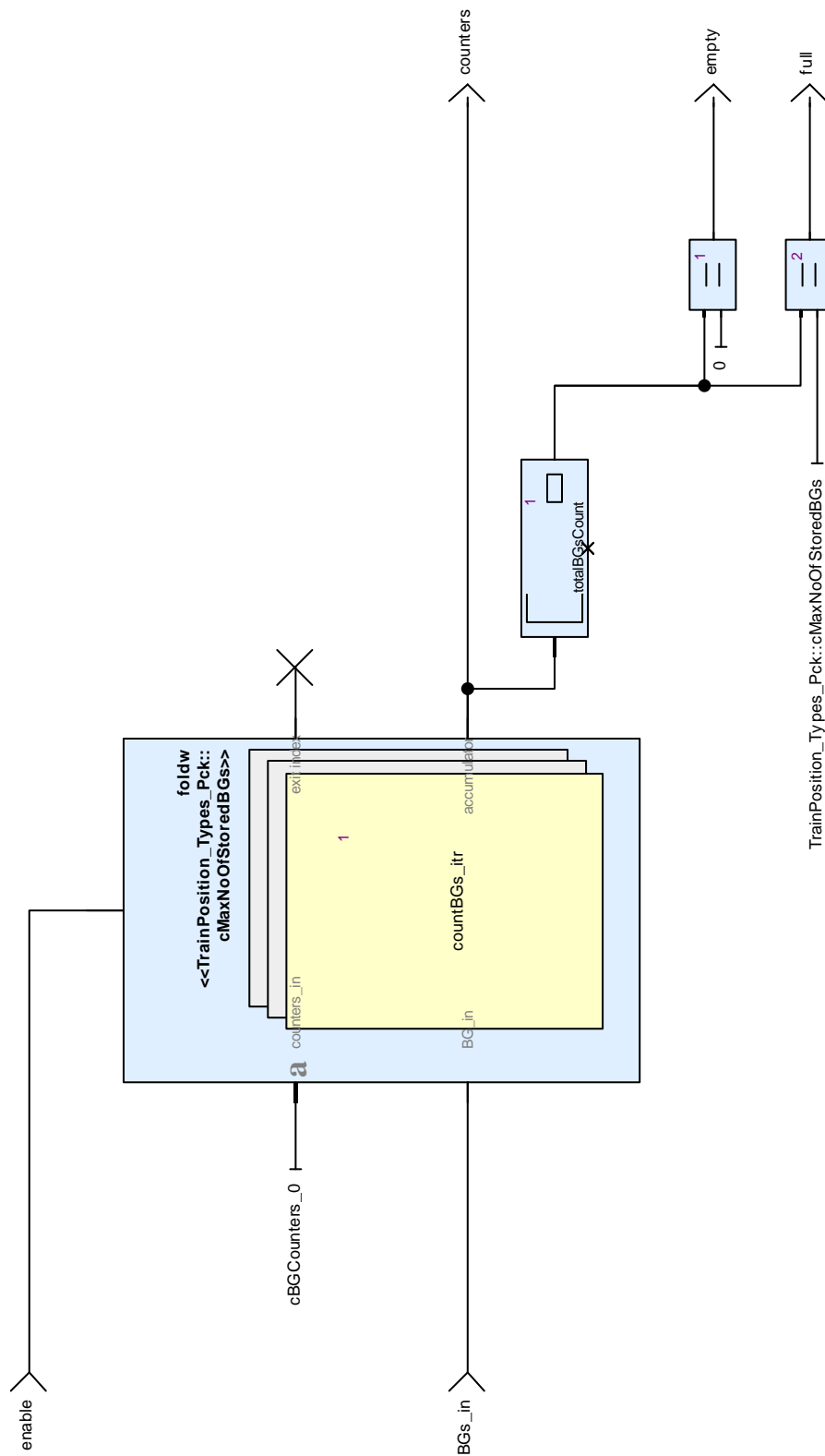


Figure 39: View of diagram_countBGs_1 (countBGs)

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 77: Inputs of countBGs_itr

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

Table 78: 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)

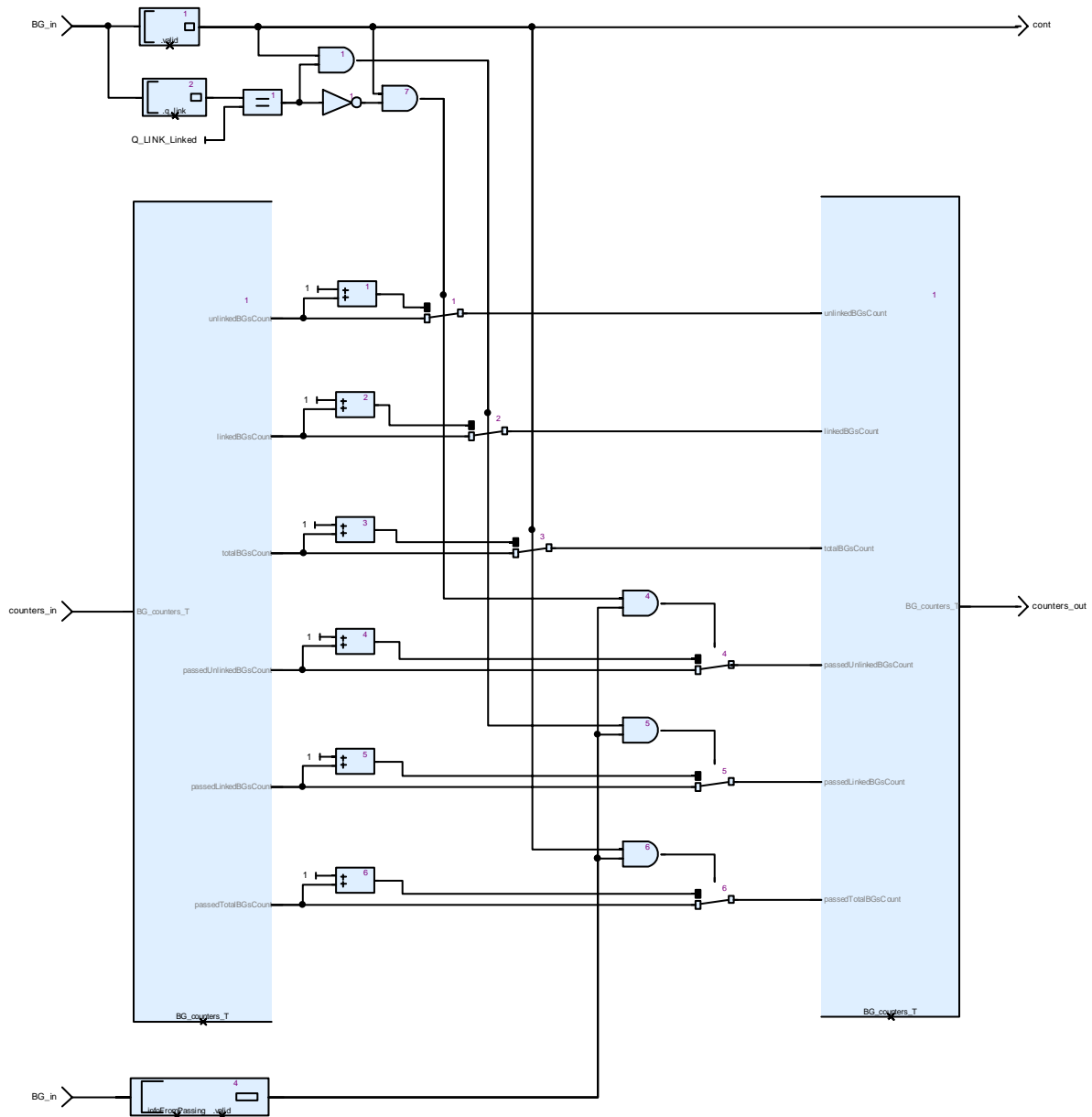


Figure 40: View of diagram_countBGs_itr_1 (countBGs_itr)

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 79: Inputs of deleteBG_atIndex

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

Table 80: Outputs of deleteBG_atIndex

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::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)

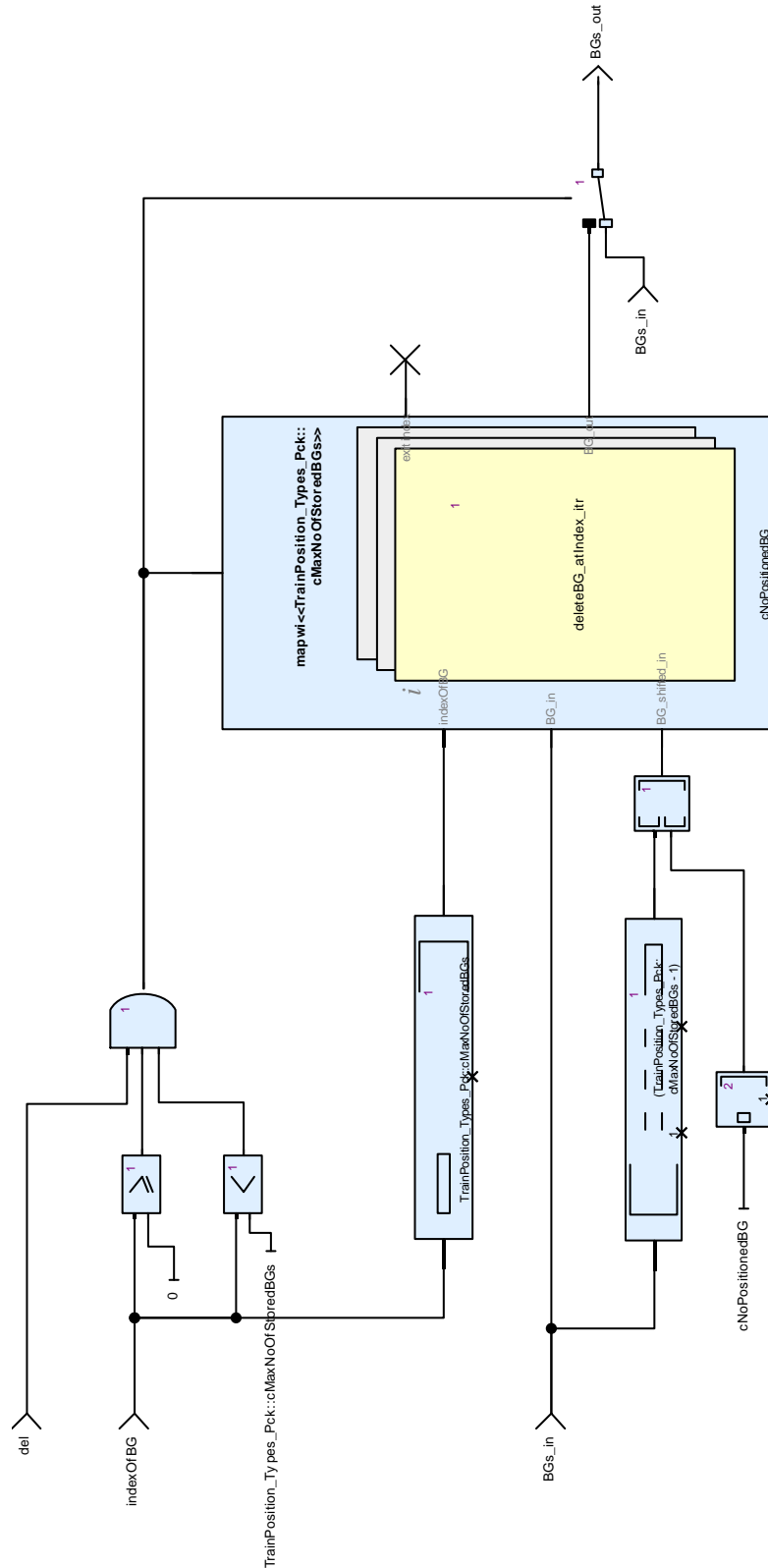


Figure 41: View of diagram_deleteBG_atIndex_1 (deleteBG_atIndex)

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 81: Inputs of deleteBG_atIndex_itr

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

Table 82: Outputs of deleteBG_atIndex_itr

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

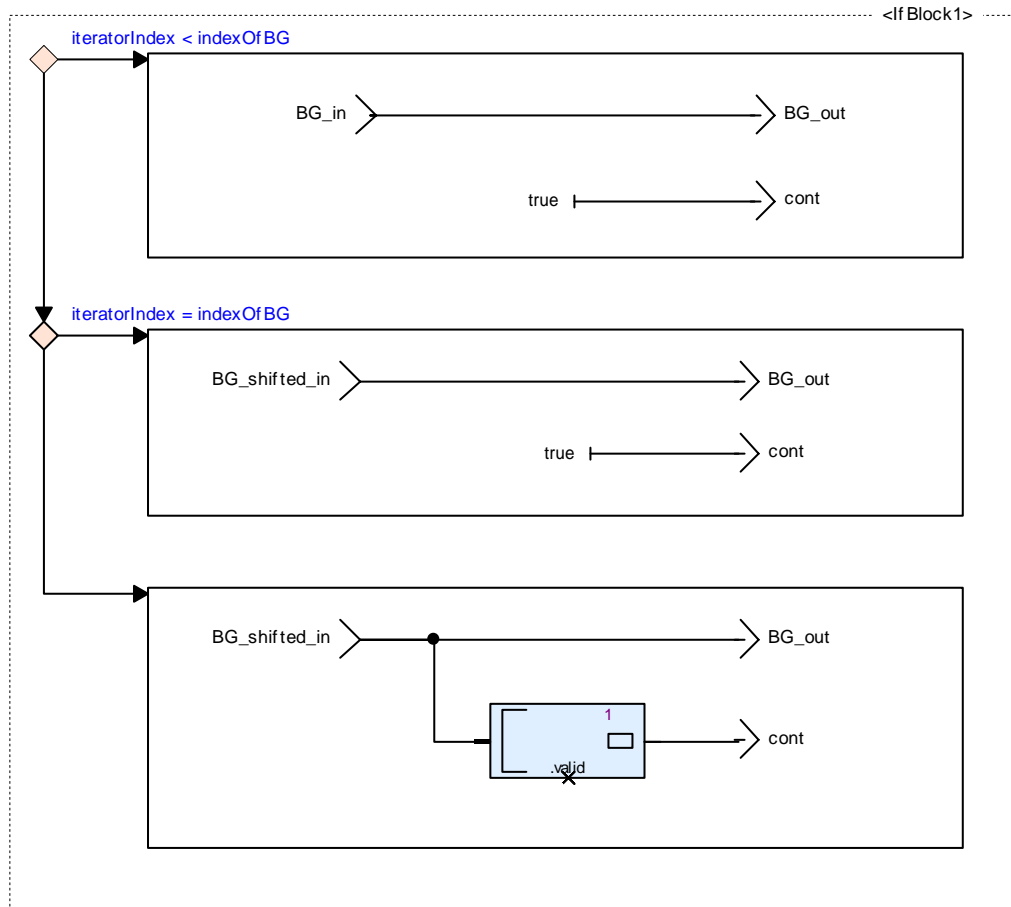


Figure 42: View of diagram_deleteBG_atIndex_itr_1 (deleteBG_atIndex_itr)

Table 83: Conditional Blocks of diagram_deleteBG_atIndex_itr_1

Conditional Block	Comments and Information
IfBlock1	

Table 84: 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 85: Inputs of deleteBGs_beforeIndex

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

Table 86: Outputs of deleteBGs_beforeIndex

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::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)

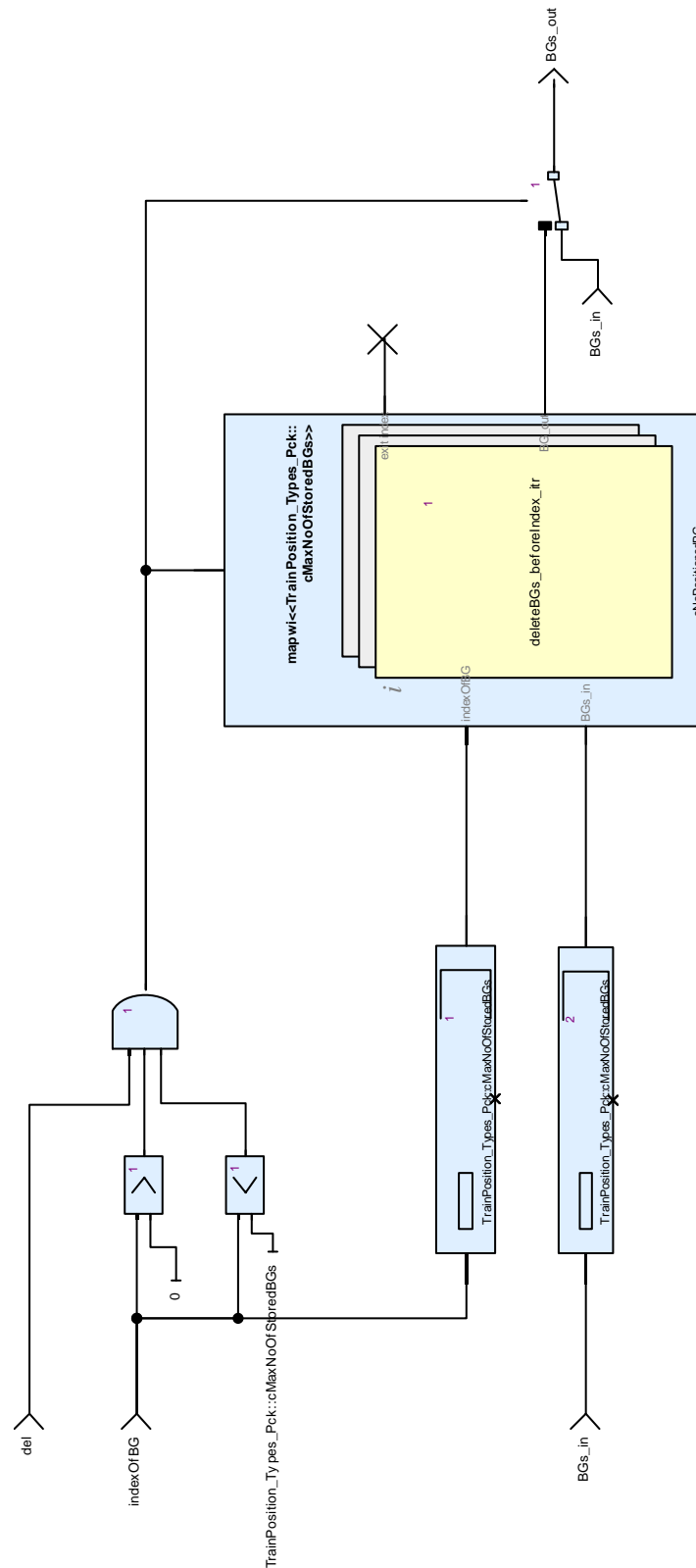


Figure 43: View of diagram_deleteBGs_beforeIndex_1 (deleteBGs_beforeIndex)

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 87: Inputs of deleteBGs_beforeIndex_itr

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

Table 88: Outputs of deleteBGs_beforeIndex_itr

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

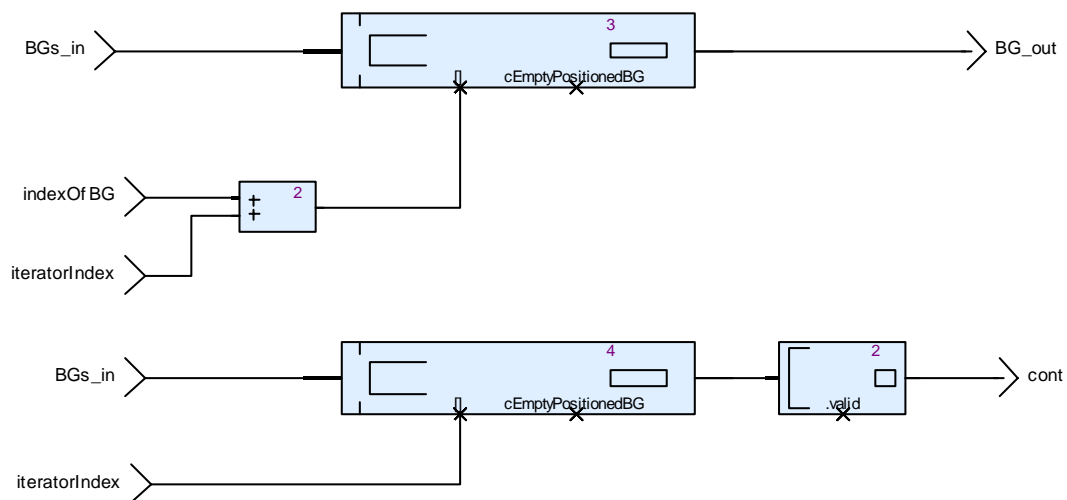


Figure 44: View of diagram_deleteBGs_beforeIndex_itr_1 (deleteBGs_beforeIndex_itr)

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 89: 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 90: 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)

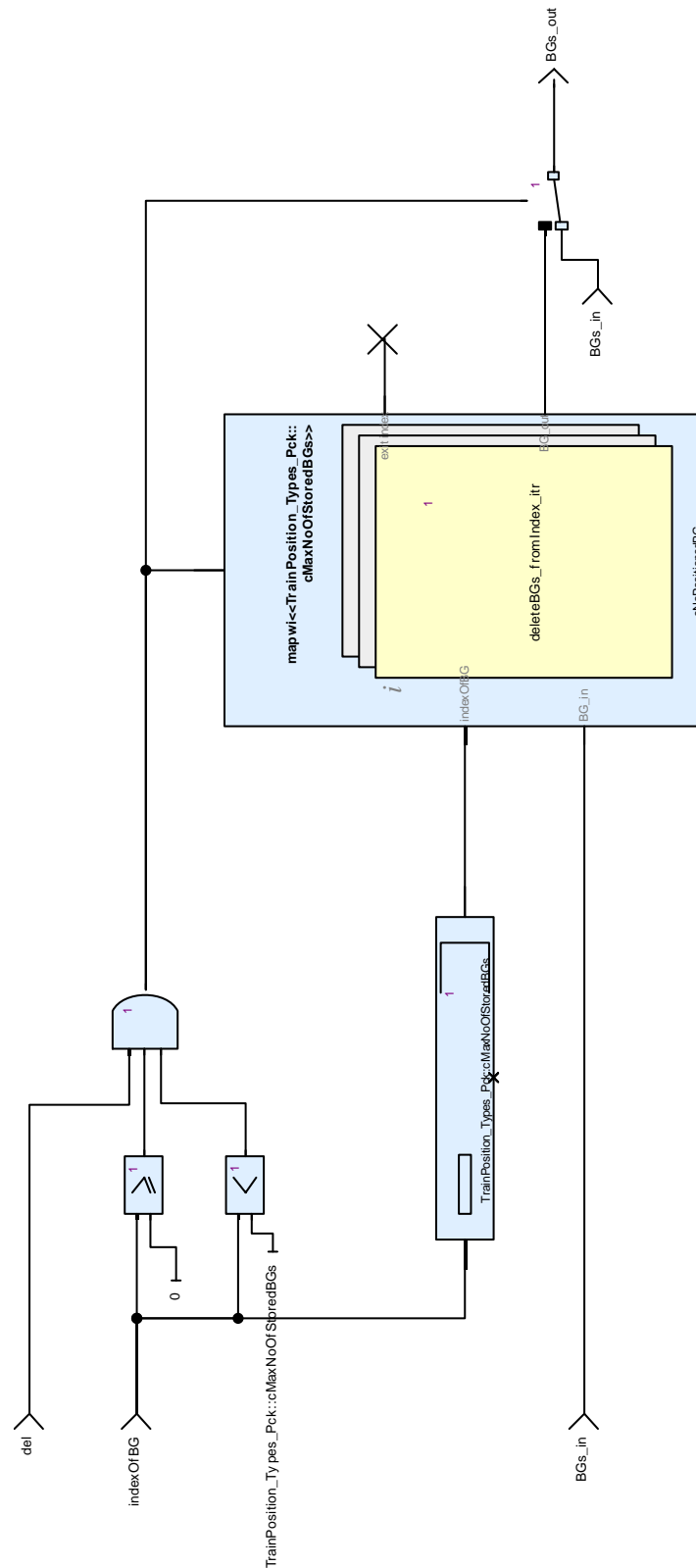


Figure 45: View of diagram_deleteBGs_fromIndex_1 (deleteBGs_fromIndex)

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 91: Inputs of deleteBGs_fromIndex_itr

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

Table 92: Outputs of deleteBGs_fromIndex_itr

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

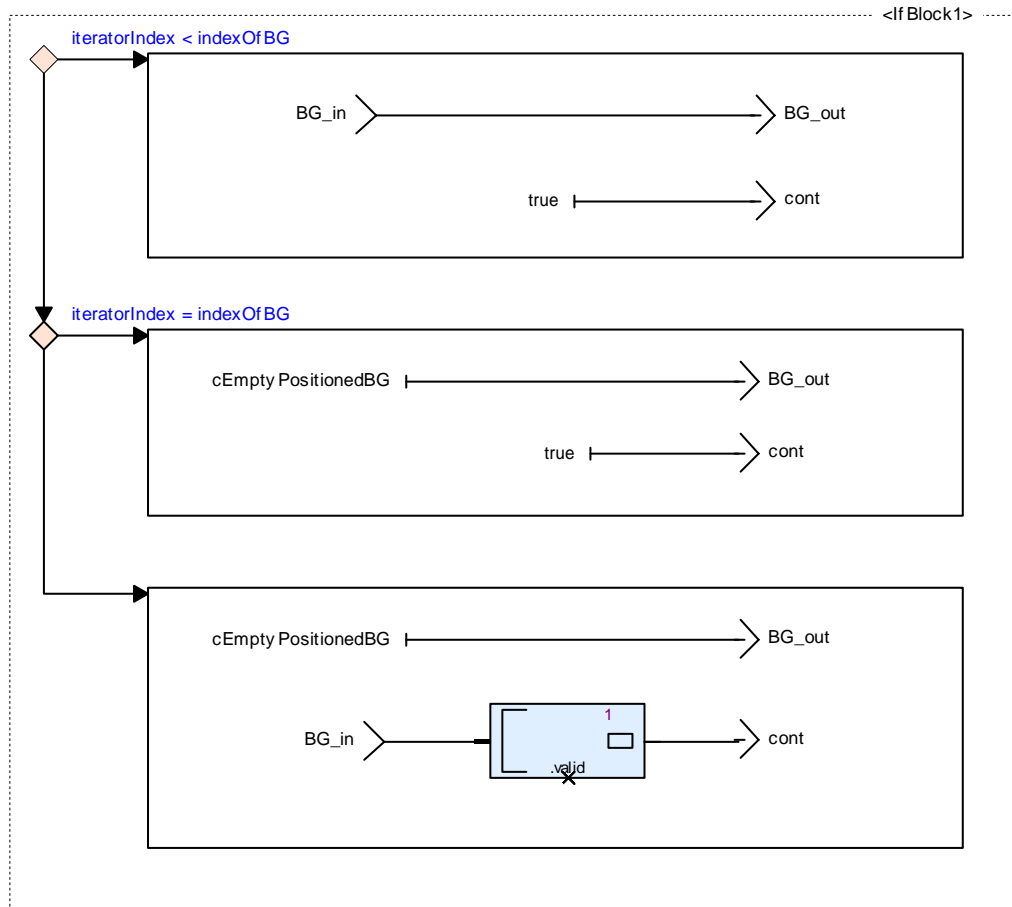


Figure 46: View of diagram_deleteBGs_fromIndex_itr_1 (deleteBGs_fromIndex_itr)

Table 93: Conditional Blocks of diagram_deleteBGs_fromIndex_itr_1

Conditional Block	Comments and Information
IfBlock1	

Table 94: 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 95: 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_Pc k::positionedBGs_T	
enable	bool	

Table 96: 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)

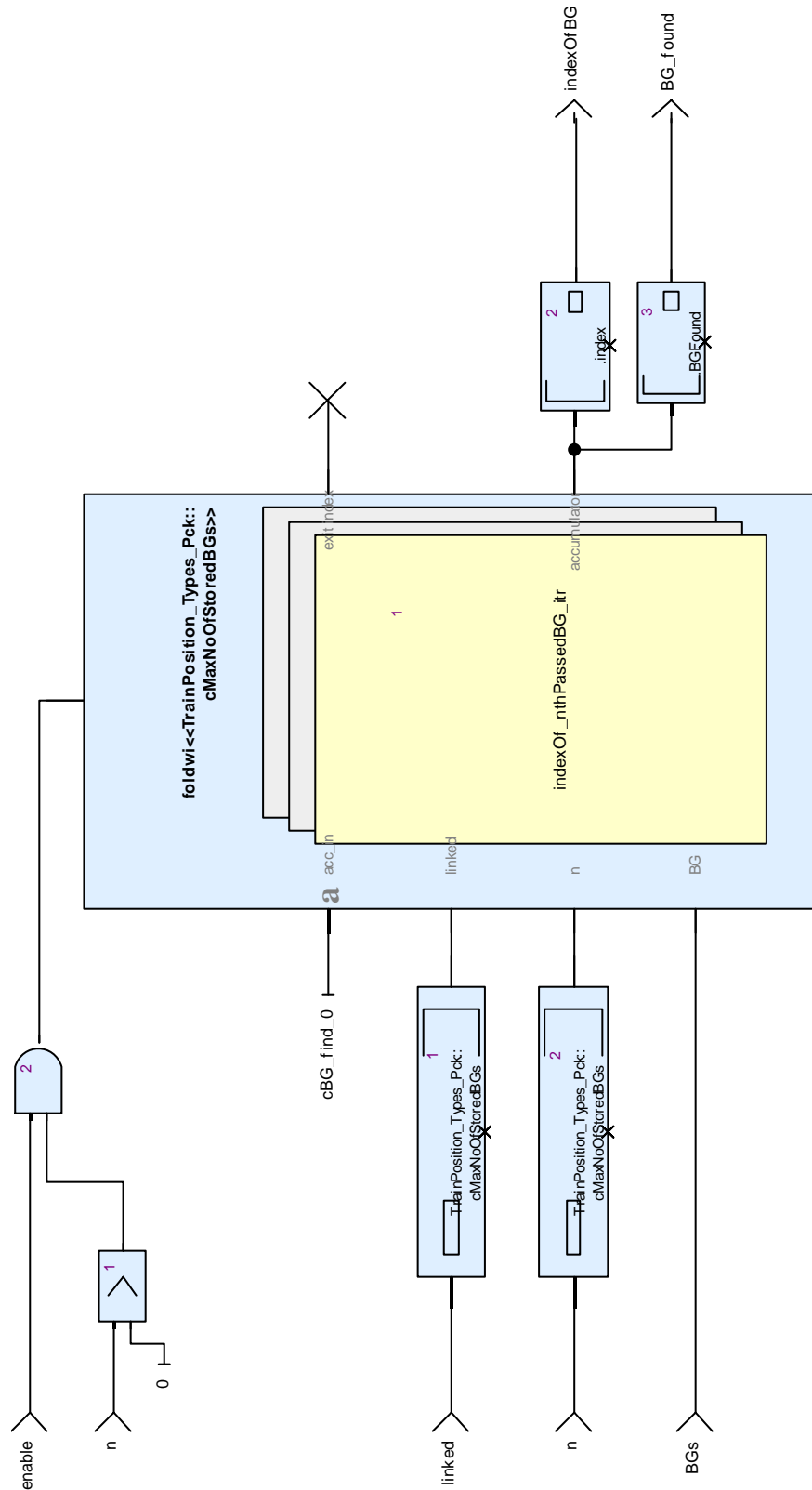


Figure 47: View of diagram_indexOf_nthPassedBG_1 (indexOf_nthPassedBG)

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 97: indexOf_nthPassedBG_itr Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	Version : 00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for determining the index of BG in BGs</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.12.2. Interface

Table 98: 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_Pc k::positionedBG_T	

Table 99: 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

3.3.12.4.1. View of diagram_indexOf_nthPassedBG_itr_1 (indexOf_nthPassedBG_itr)

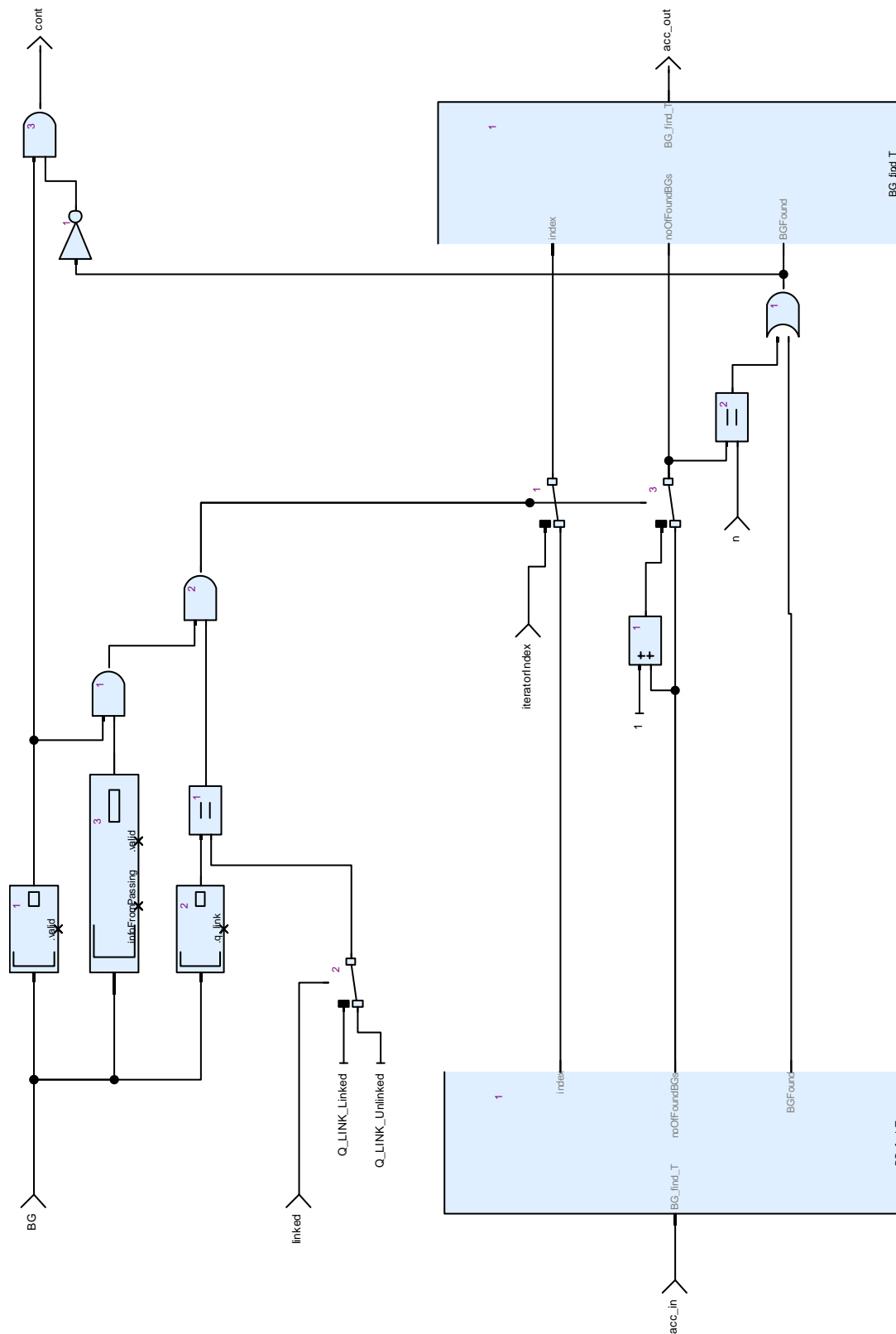


Figure 48: View of diagram_indexOf_nthPassedBG_itr_1 (indexOf_nthPassedBG_itr)

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 100: 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 101: Inputs of indexOfBG_by_id

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

Table 102: Outputs of indexOfBG_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.

3.3.13.3. 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)

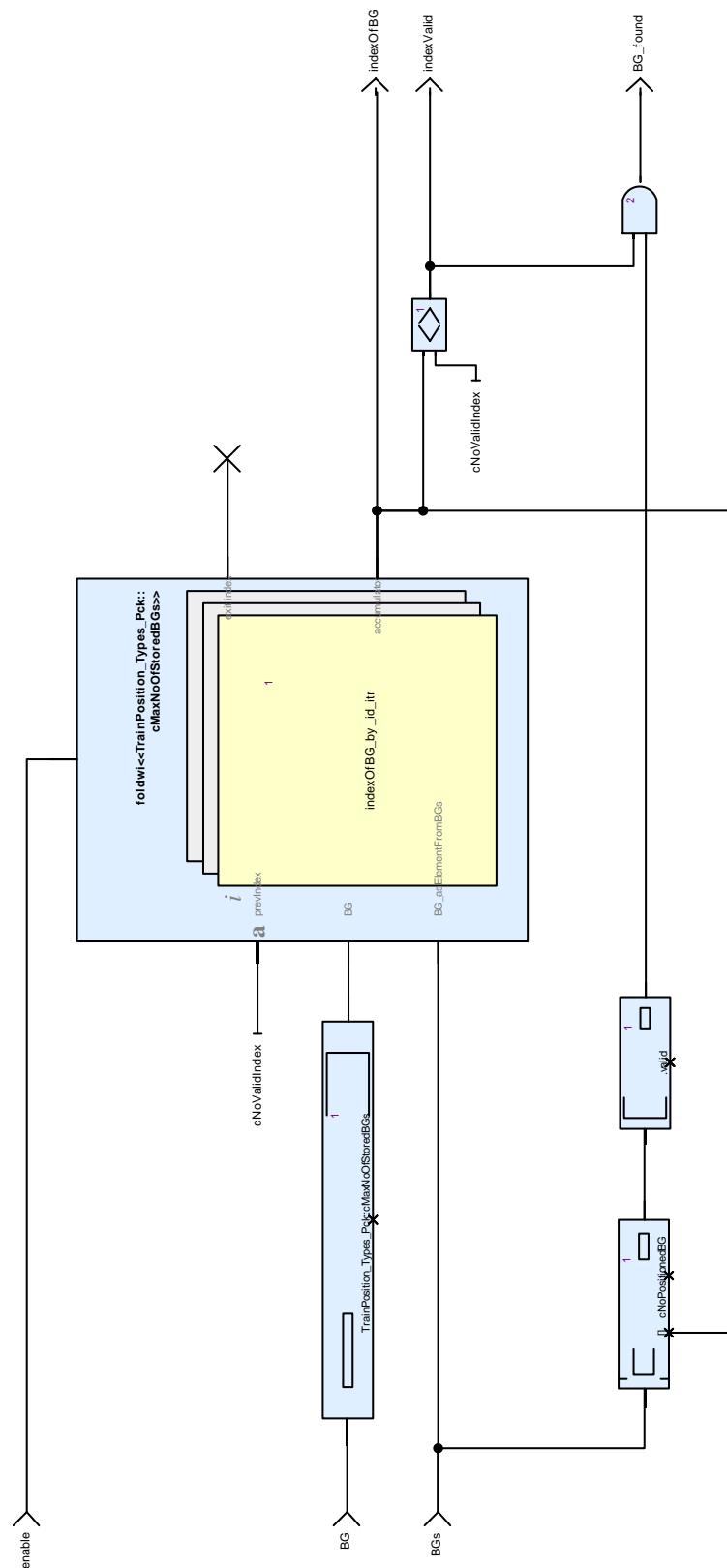


Figure 49: View of diagram_indexOfBG_by_id_1 (indexOfBG_by_id)

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 determining the index of BG in BGs

Table 103: indexOfBG_by_id_itr Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	Version : 00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for determining the index of BG in BGs</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.14.2. Interface

Table 104: 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 105: Outputs of indexOfBG_by_id_itr

Name	Type	Comments and Information
cont	bool	

Name	Type	Comments and Information
indexOfBG	int	

3.3.14.3. Operator Hierarchy

diagram : diagram_indexOfBG_by_id_itr_1

3.3.14.4.1. View of diagram_indexOfBG_by_id_itr_1 (indexOfBG_by_id_itr)

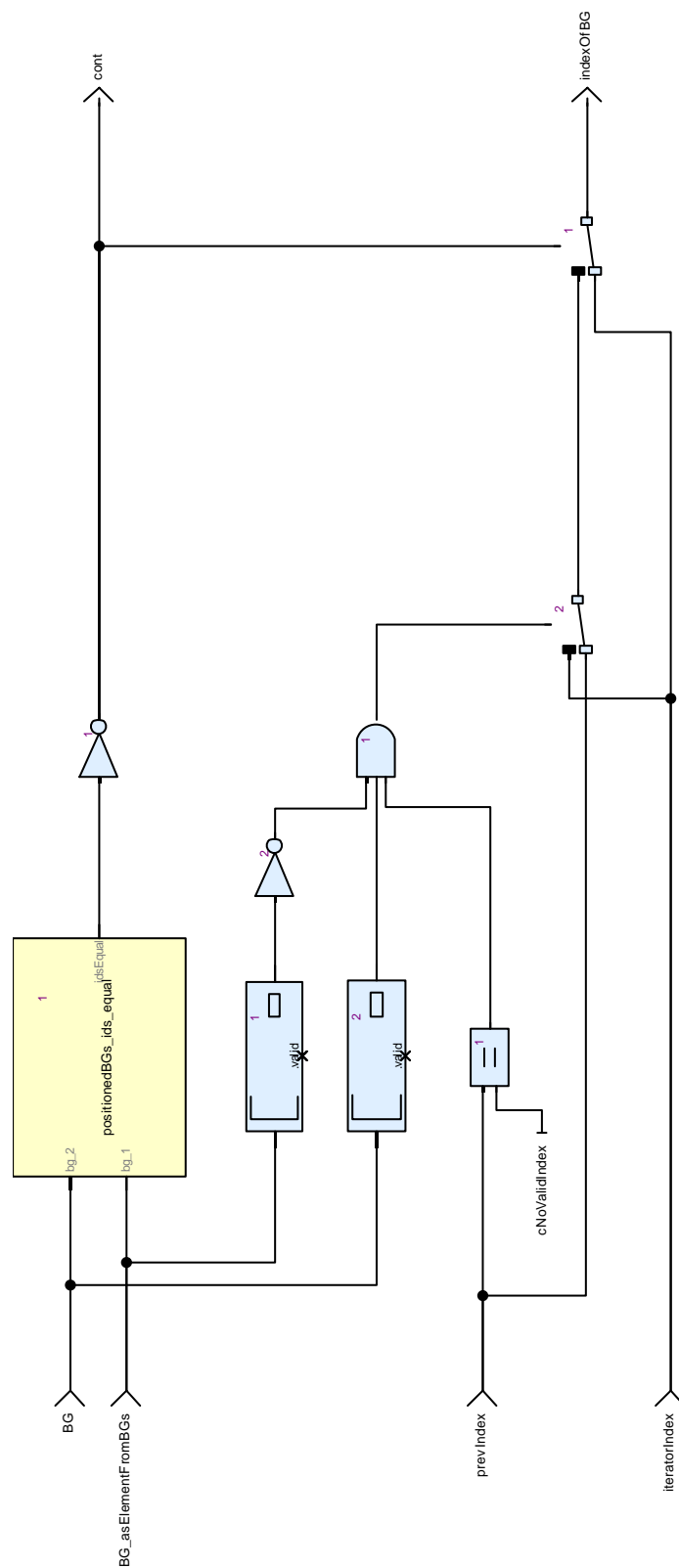


Figure 50: View of diagram_indexOfBG_by_id_itr_1 (indexOfBG_by_id_itr)

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 106: indexOfBG_onTrack Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	Version : 00.02.00
	to_c	True
Remark_1	Description	<p>Determines the index of BG in BGs</p> <ul style="list-style-type: none">- 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.15.2. Interface

Table 107: Inputs of indexOfBG_onTrack

Name	Type	Comments and Information
BG	TrainPosition_Types_Pc k::positionedBG_T	

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

Table 108: 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)

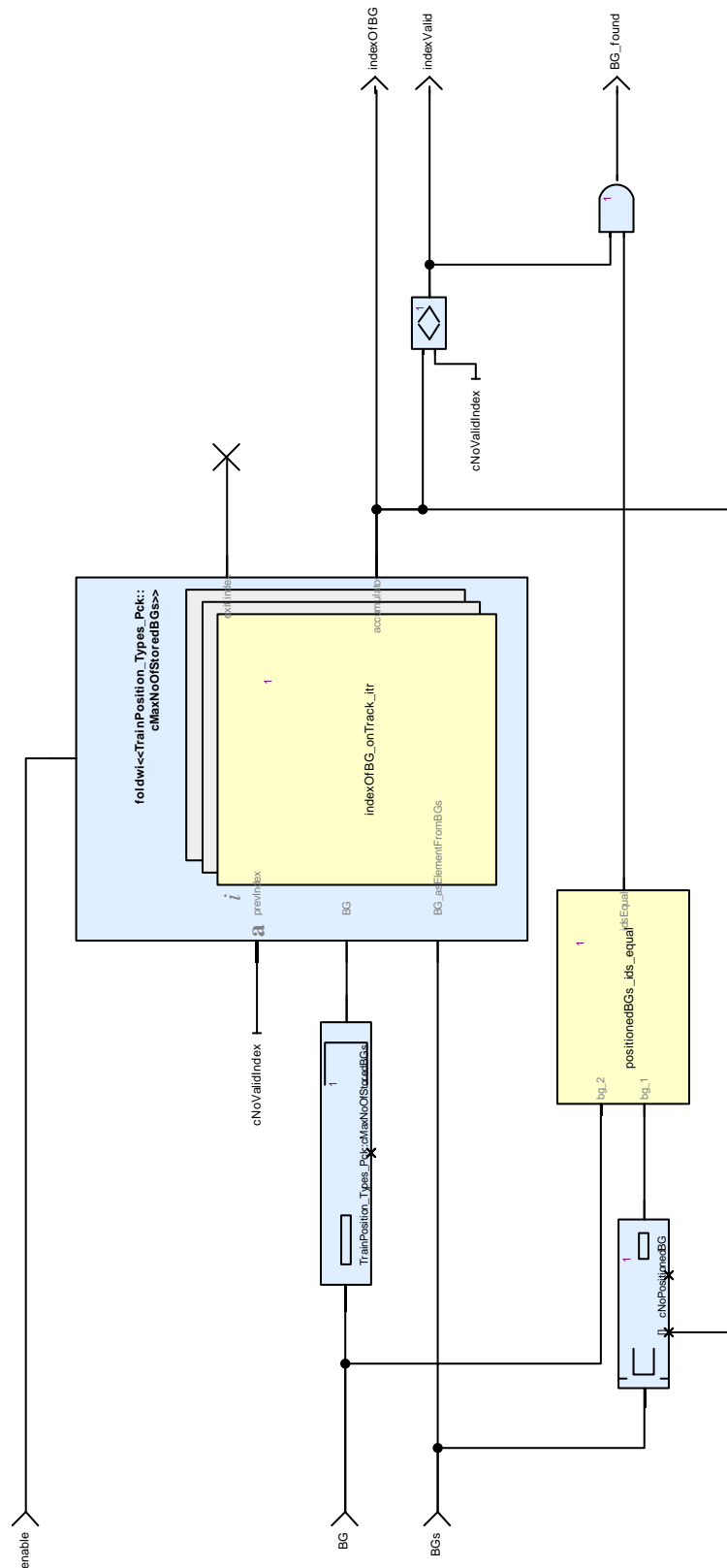


Figure 51: View of diagram_indexOfBG_onTrack_1 (indexOfBG_onTrack)

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 determining the index of BG in BGs

Table 109: indexOfBG_onTrack_itr Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	Version : 00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for determining the index of BG in BGs</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.16.2. Interface

Table 110: 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 111: Outputs of indexOfBG_onTrack_itr

Name	Type	Comments and Information
cont	bool	

Name	Type	Comments and Information
indexOfBG	int	

3.3.16.3. Locals

Table 112: 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)

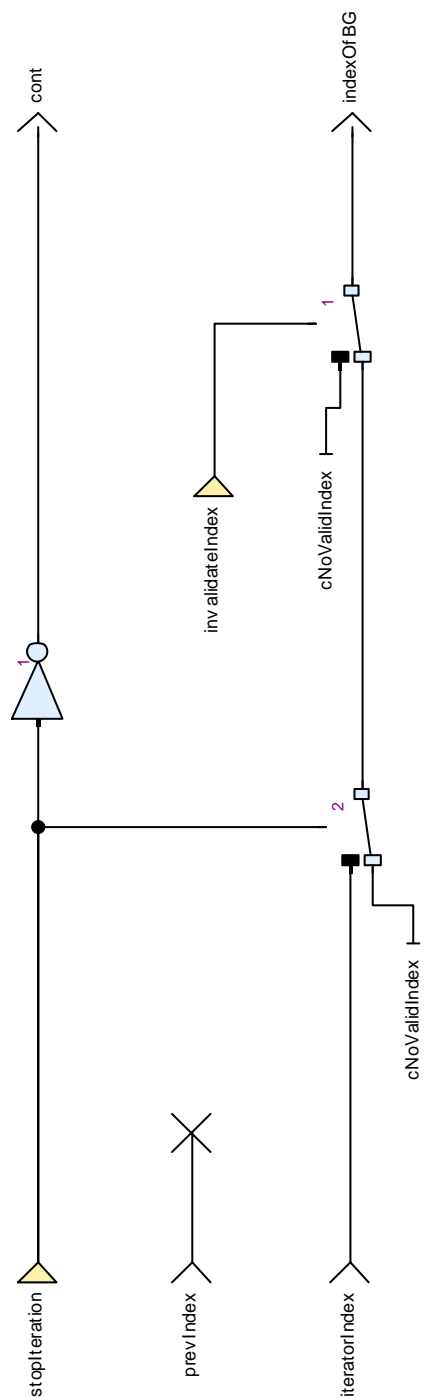


Figure 52: View of diagram_setIndex (indexOfBG_onTrack_itr)

3.3.16.5.2. View of diagram_stopIteration (indexOfBG_onTrack_itr)

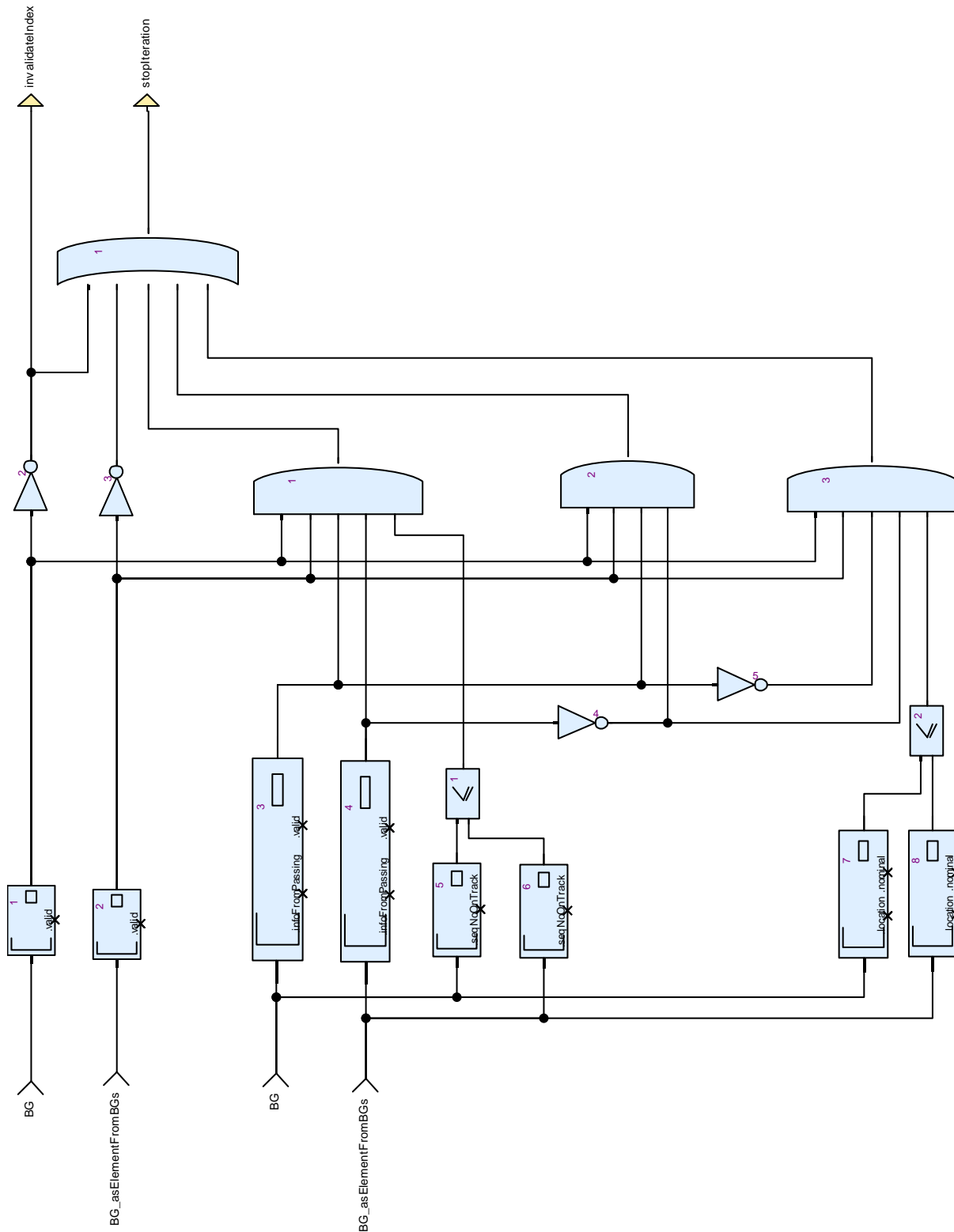


Figure 53: View of diagram_stopIteration (indexOfBG_onTrack_itr)

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 113: Inputs of indexOfLastPassedBG

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

Table 114: 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

3.3.17.4.1. View of diagram_indexOfLastPassedBG_1 (indexOfLastPassedBG)

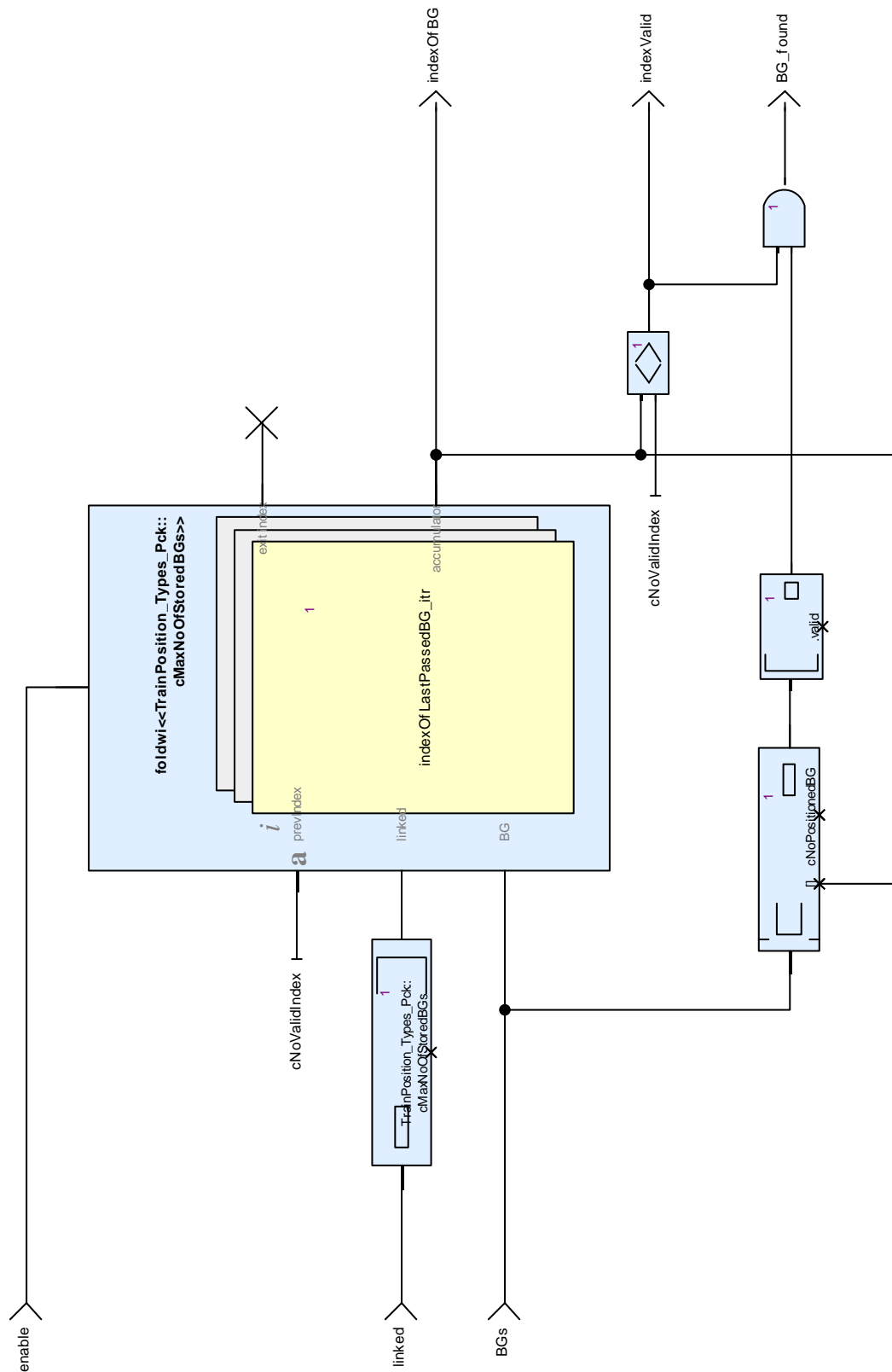


Figure 54: View of diagram_indexOfLastPassedBG_1 (indexOfLastPassedBG)

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 115: indexOfLastPassedBG_itr Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	Version : 00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for determining the index of BG in BGs</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.18.2. Interface

Table 116: 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_Pc k::positionedBG_T	

Table 117: Outputs of indexOfLastPassedBG_itr

Name	Type	Comments and Information
cont	bool	
indexOfBG	int	

3.3.18.3. Operator Hierarchy

diagram : diagram_indexOfLastPassedBG_itr_1

3.3.18.4.1. View of diagram_indexOfLastPassedBG_itr_1 (indexOfLastPassedBG_itr)

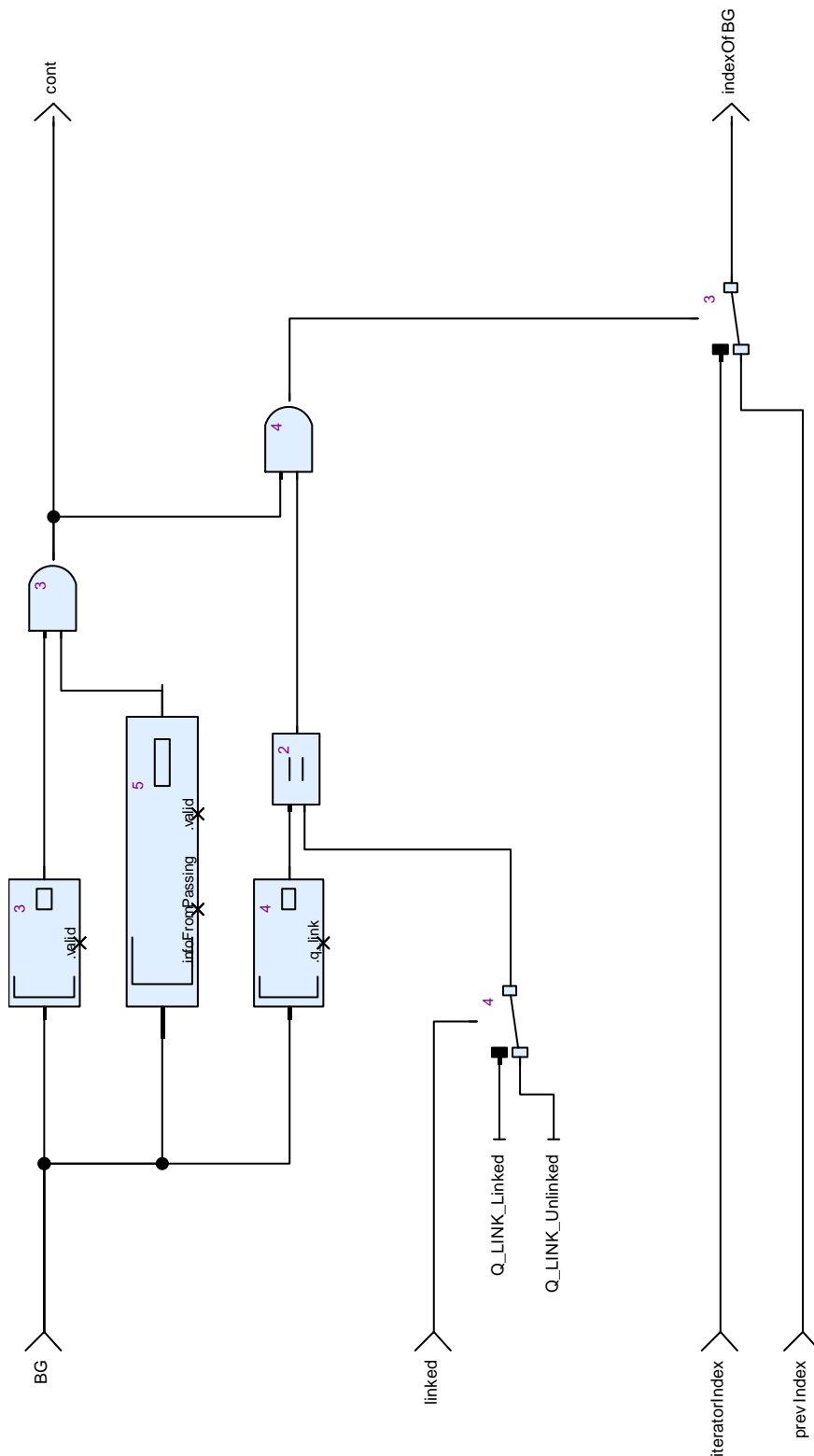


Figure 55: View of diagram_indexOfLastPassedBG_itr_1 (indexOfLastPassedBG_itr)

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 118: indexOfPassedBG_by_id Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Determines the index of a passed BG in BGs</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.19.2. Interface

Table 119: Inputs of indexOfPassedBG_by_id

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

Table 120: Outputs of indexOfPassedBG_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.

3.3.19.3. 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)

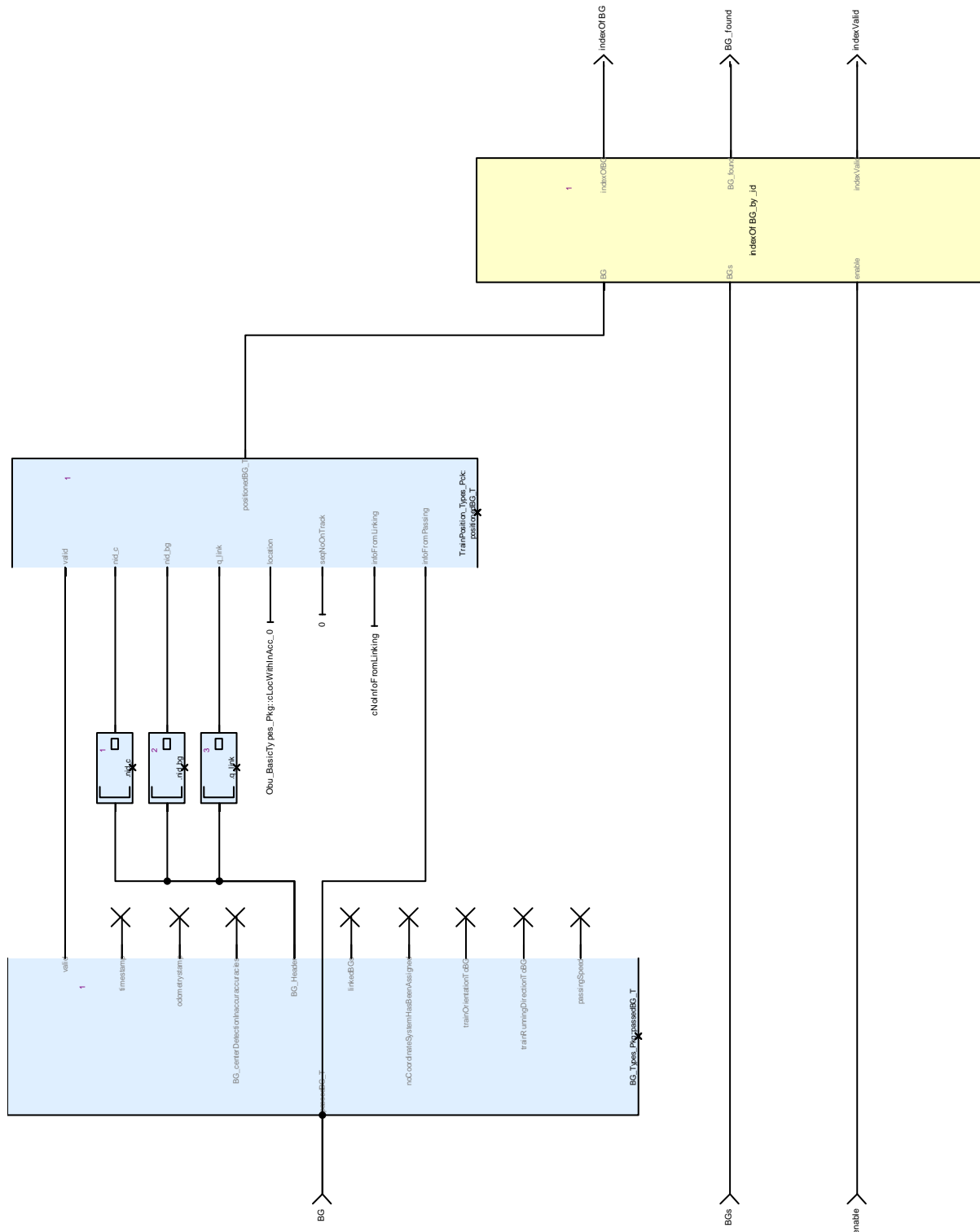


Figure 56: View of diagram_indexOfPassedBG_by_id_1 (indexOfPassedBG_by_id)

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 121: Inputs of insertBG_atIndex

Name	Type	Comments and Information
BG	TrainPosition_Types_Pc k::positionedBG_T	
BGs_in	TrainPosition_Types_Pc k::positionedBGs_T	
indexOfBG	int	
insert	bool	Comments: insert comand. Must be true to execute the insertion.

Table 122: Outputs of insertBG_atIndex

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::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

3.3.20.4.1. View of diagram_insertBG_atIndex_1 (insertBG_atIndex)

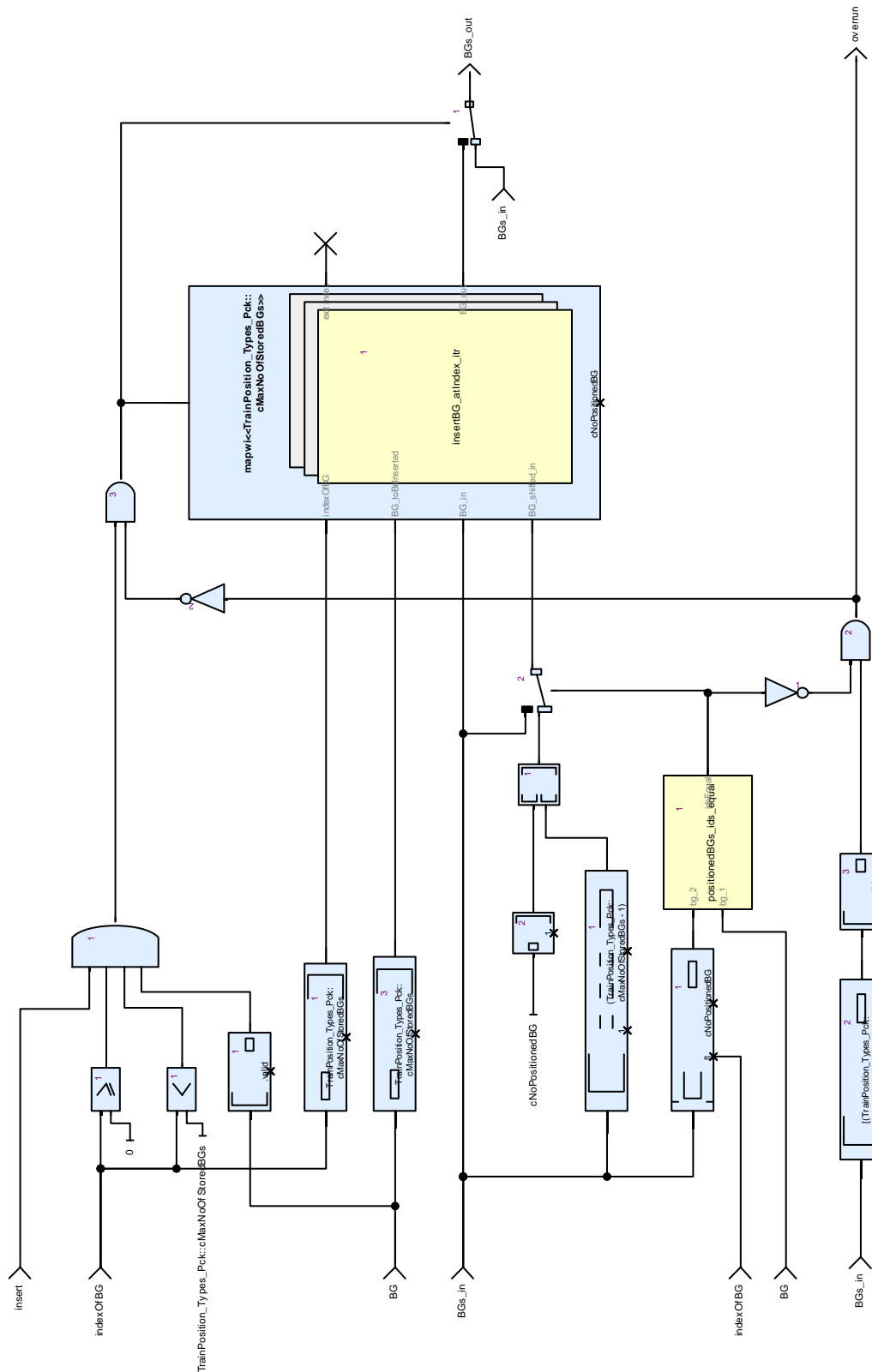


Figure 57: View of diagram_insertBG_atIndex_1 (insertBG_atIndex)

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 123: Inputs of insertBG_atIndex_itr

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

Table 124: Outputs of insertBG_atIndex_itr

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

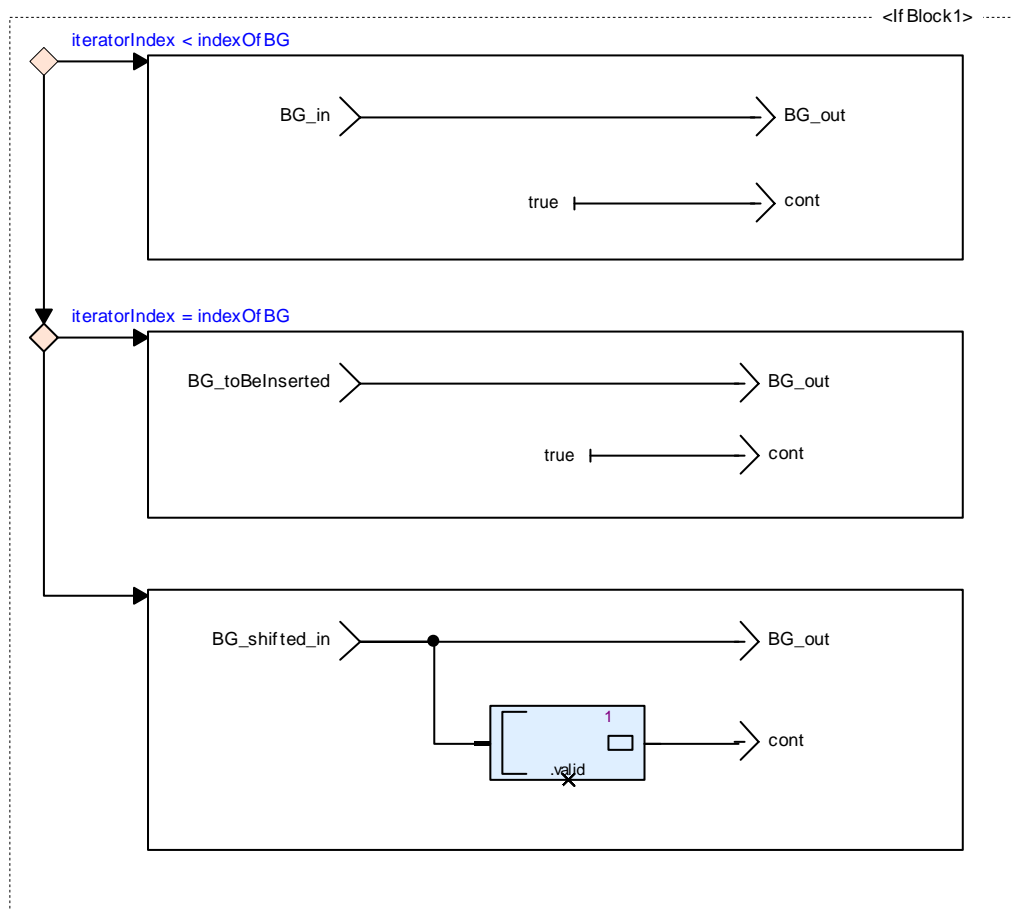


Figure 58: View of diagram_insertBG_atIndex_itr_1 (insertBG_atIndex_itr)

Table 125: Conditional Blocks of diagram_insertBG_atIndex_itr_1

Conditional Block	Comments and Information
IfBlock1	

Table 126: 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 127: mergeBG_by_id Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Merges a BG into an array of BGs</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.22.2. Interface

Table 128: 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 129: 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)

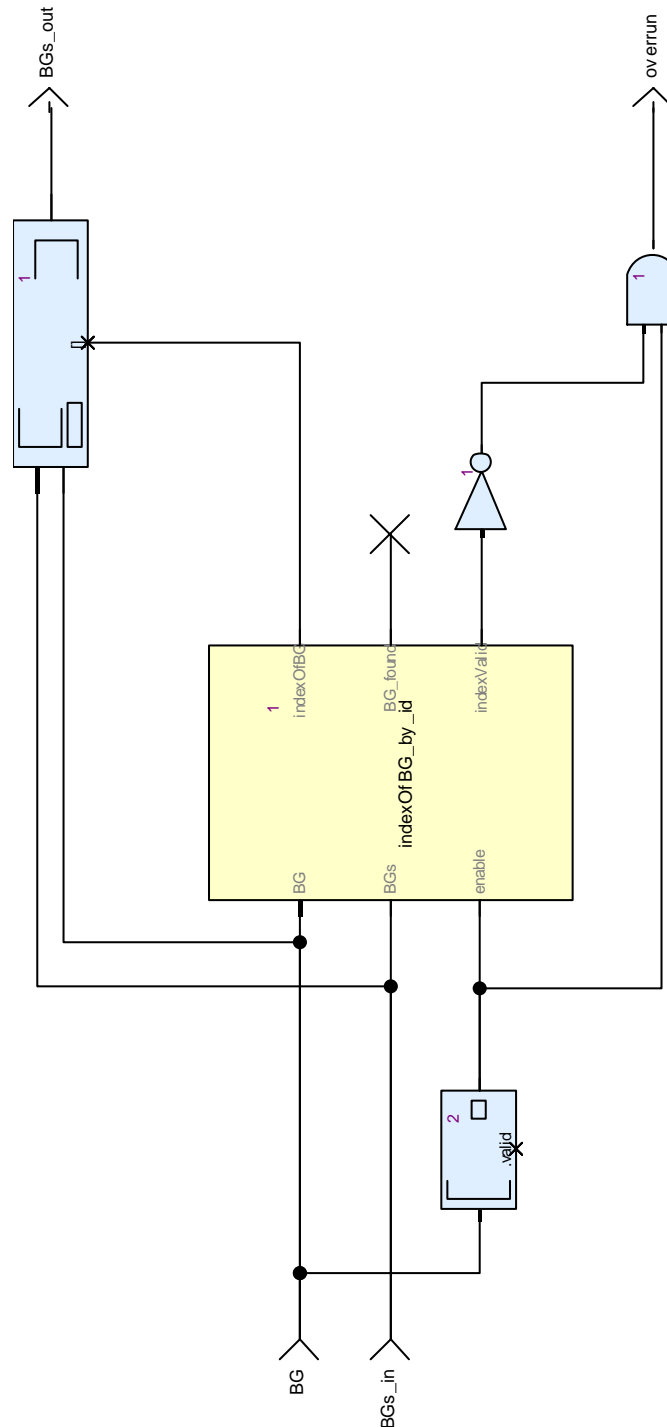


Figure 59: View of diagram_mergeBG_by_id_1 (mergeBG_by_id)

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 130: 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 131: 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

3.3.23.4.1. View of diagram_mergeBG_onTrack_1 (mergeBG_onTrack)

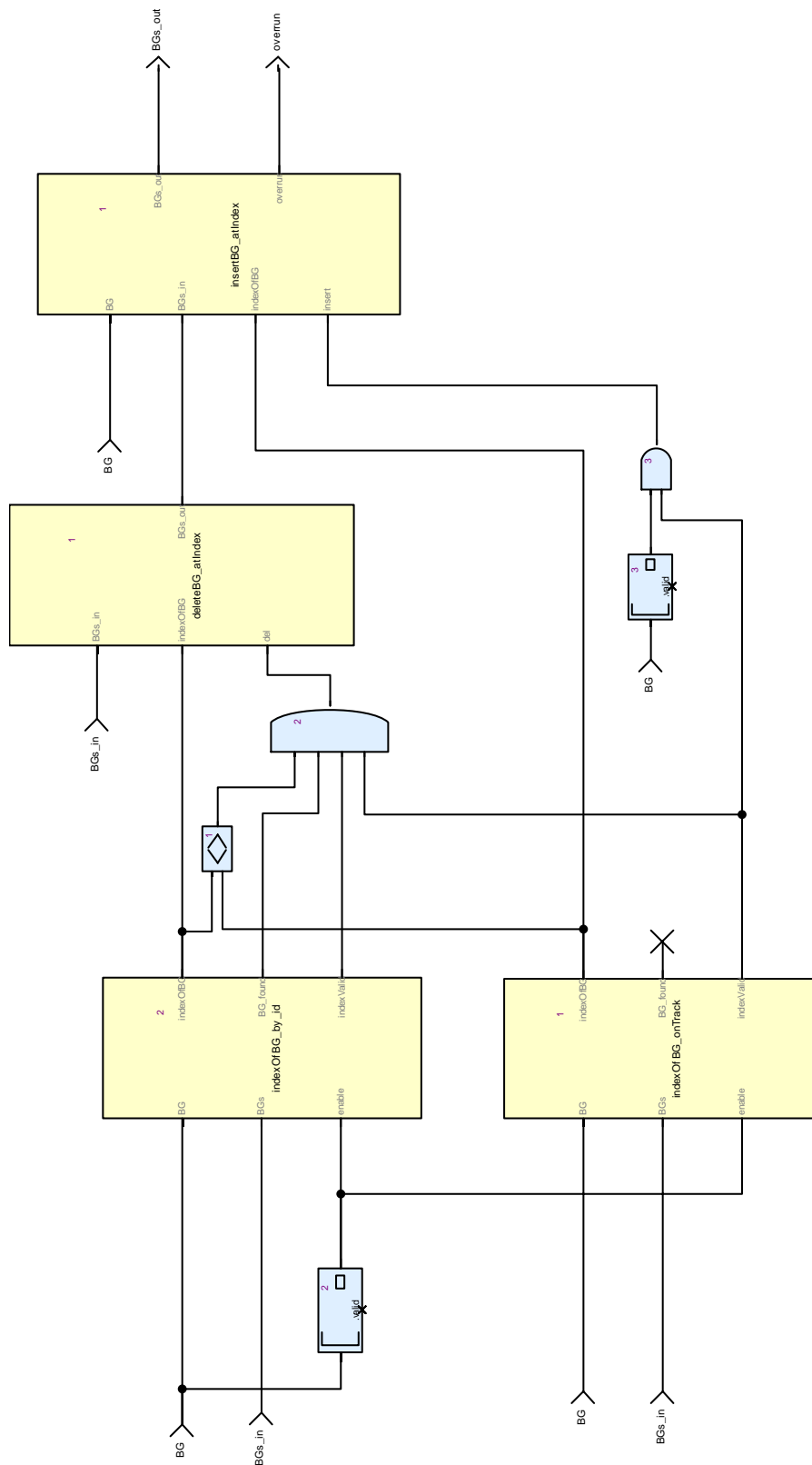


Figure 60: View of diagram_mergeBG_onTrack_1 (mergeBG_onTrack)

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 132: mergeBGs_by_id Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Merges two arrays of BGs by id.</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.24.2. Interface

Table 133: Inputs of mergeBGs_by_id

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

Table 134: Outputs of mergeBGs_by_id

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::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)

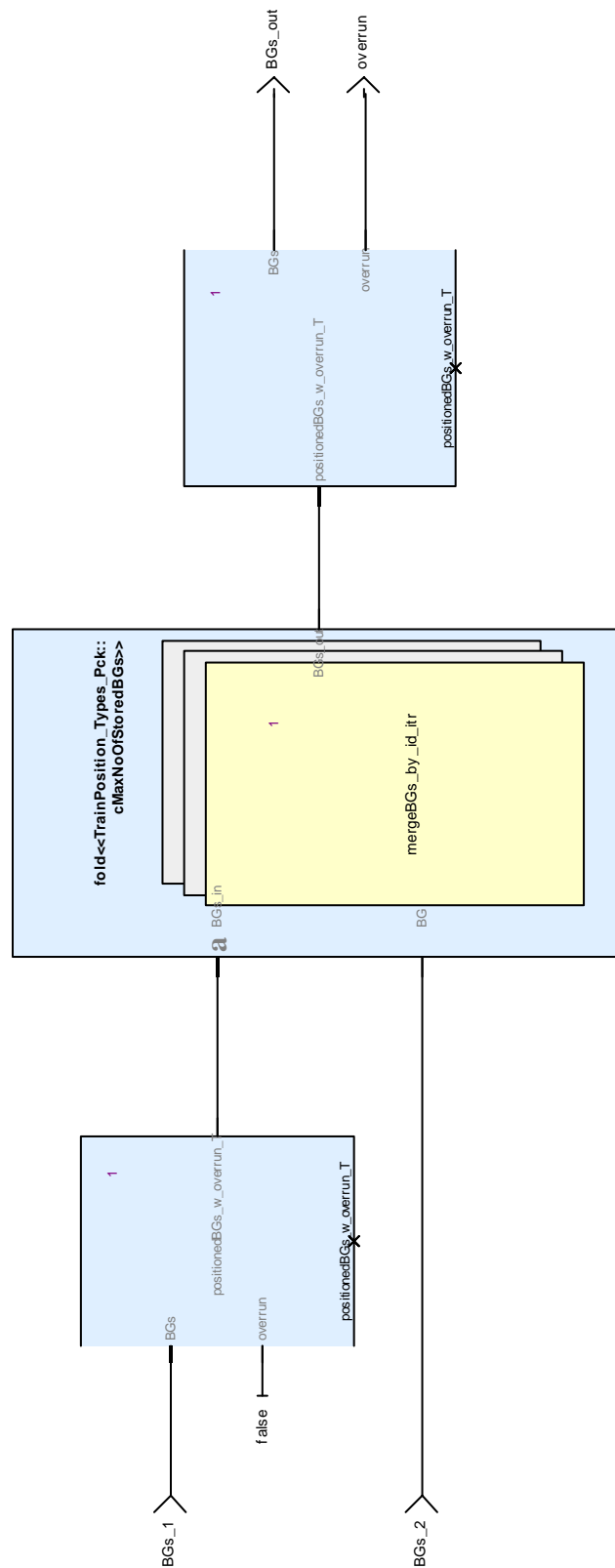


Figure 61: View of diagram_mergeBGs_by_id_1 (mergeBGs_by_id)

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 135: mergeBGs_by_id_itr Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for the merge of a BG into an array of BGs.</p> <ul style="list-style-type: none">- 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.25.2. Interface

Table 136: 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_Pc k::positionedBG_T	Comments: The BG to be merged.

Table 137: 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)

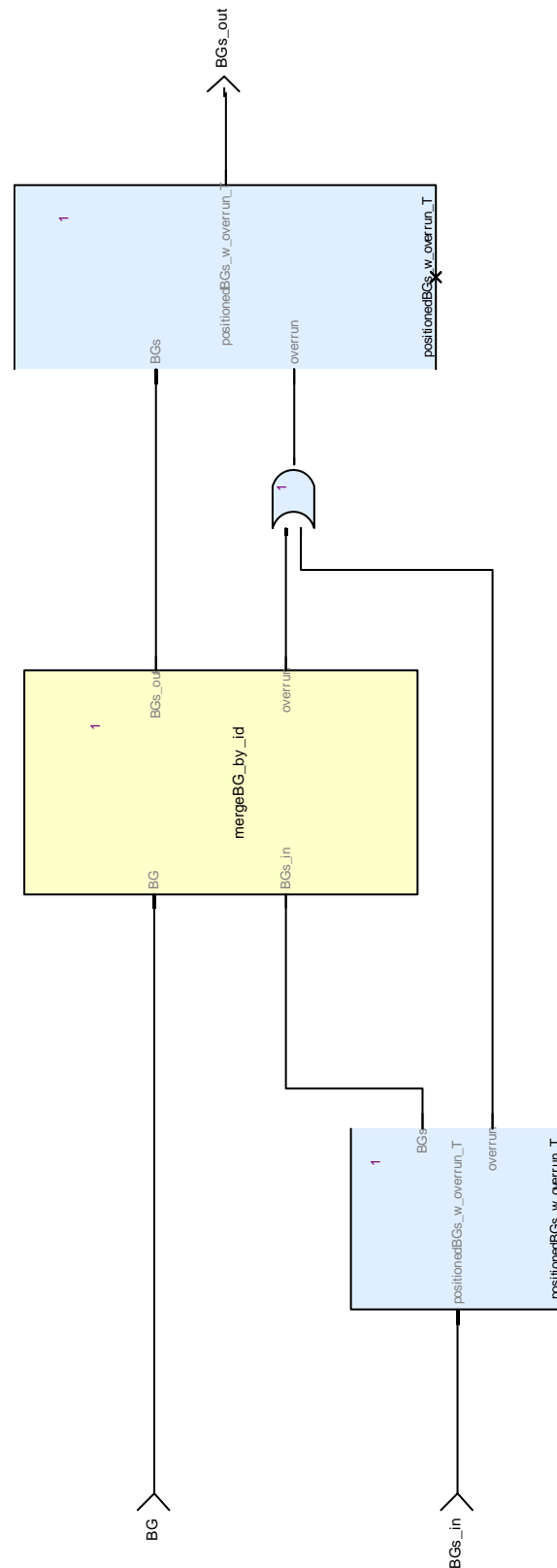


Figure 62: View of diagram_mergeBGs_by_id_itr_1 (mergeBGs_by_id_itr)

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 138: mergeBGs_onTrack Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Merges two arrays of BGs by id.</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.26.2. Interface

Table 139: 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 140: Outputs of mergeBGs_onTrack

Name	Type	Comments and Information
BGs_out	TrainPosition_Types_Pc k::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)

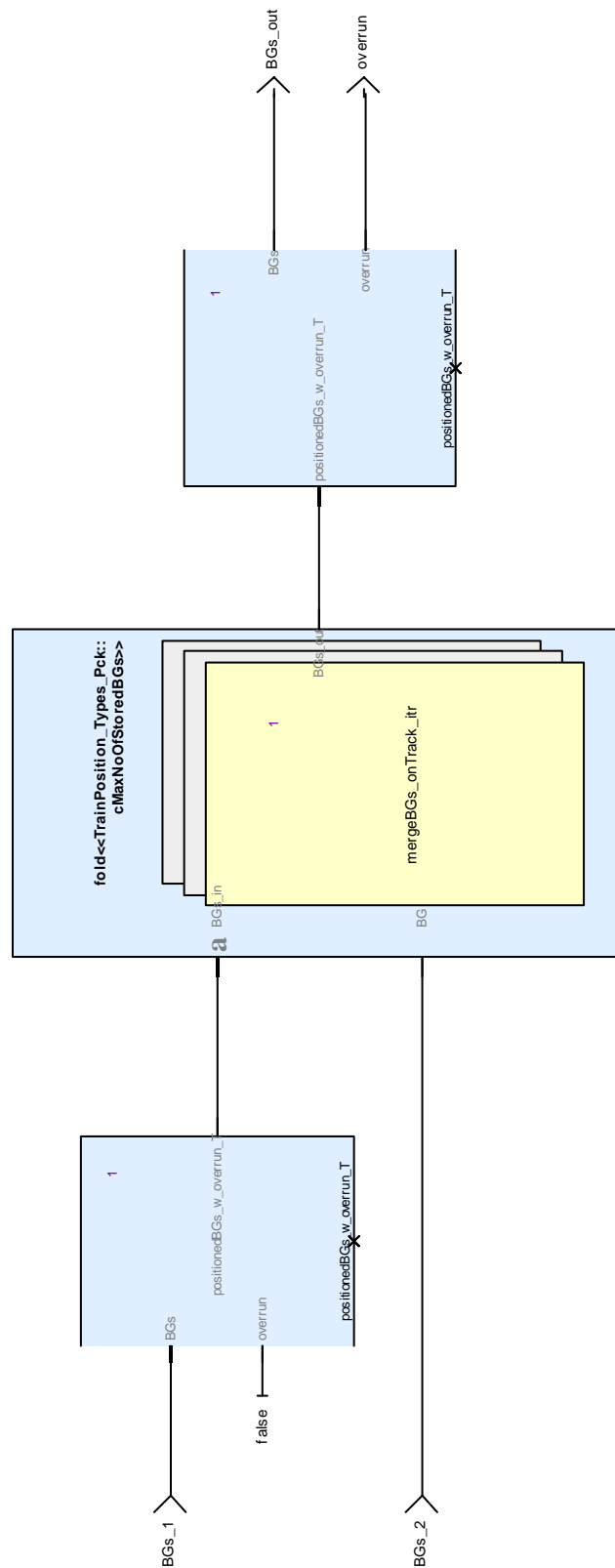


Figure 63: View of diagram_mergeBGs_onTrack_1 (mergeBGs_onTrack)

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 141: mergeBGs_onTrack_itr Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for the merge of a BG into an array of BGs.</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.27.2. Interface

Table 142: 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_Pc k::positionedBG_T	Comments: The BG to be merged.

Table 143: 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)

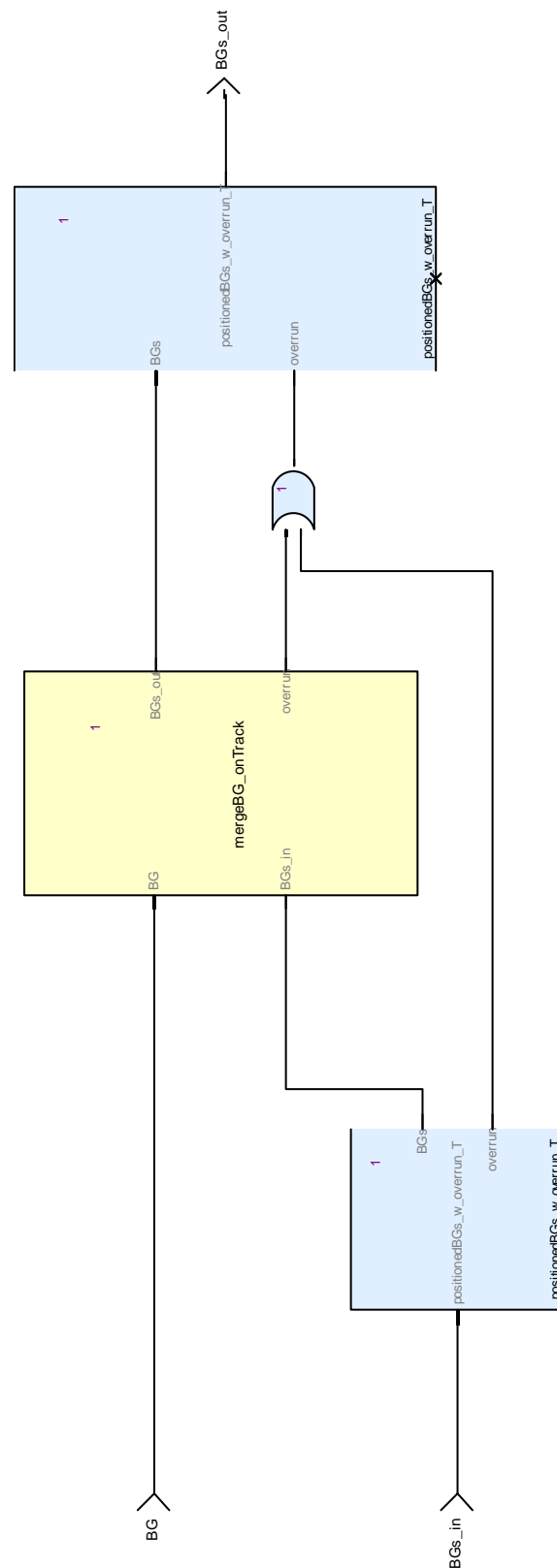


Figure 64: View of diagram_mergeBGs_onTrack_itr_1 (mergeBGs_onTrack_itr)

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 144: 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 145: 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 146: 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)

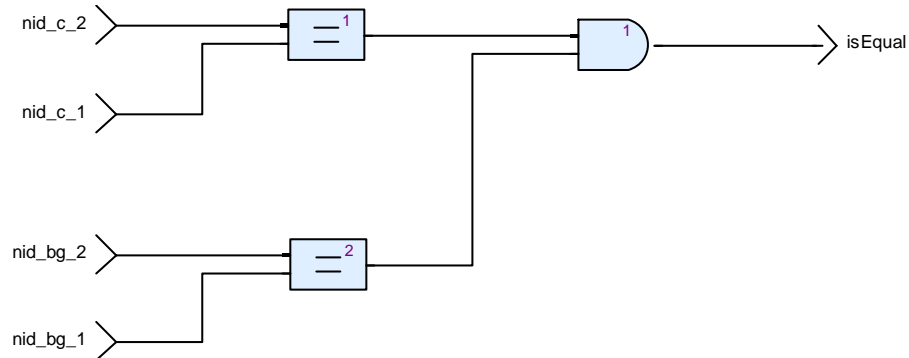


Figure 65: View of diagram_nidBG_nidc_equal_1 (nidBG_nidc_equal)

3.3.29. nidC_nidBG_2_NIDLRGB Operator

Declared as **public function**

3.3.29.1. Comments and Information

nidC_nidBG_2_NIDLRGB Comments:

- Constructs an NID_LRGB value from NID_C and NID_BG

3.3.29.2. Interface

Table 147: Inputs of nidC_nidBG_2_NIDLRGB

Name	Type	Comments and Information
valid	bool	
nidC	NID_C	
nidBG	NID_BG	

Table 148: Outputs of nidC_nidBG_2_NIDLRGB

Name	Type	Comments and Information
nidLRBG	NID_LRGB	

3.3.29.3. Operator Hierarchy

diagram : diagram_nidC_nidBG_2_NIDLRGB_1

3.3.29.4. Graphical and Textual Diagrams

3.3.29.4.1. View of diagram_nidC_nidBG_2_NIDLRGBG_1 (nidC_nidBG_2_NIDLRGBG)

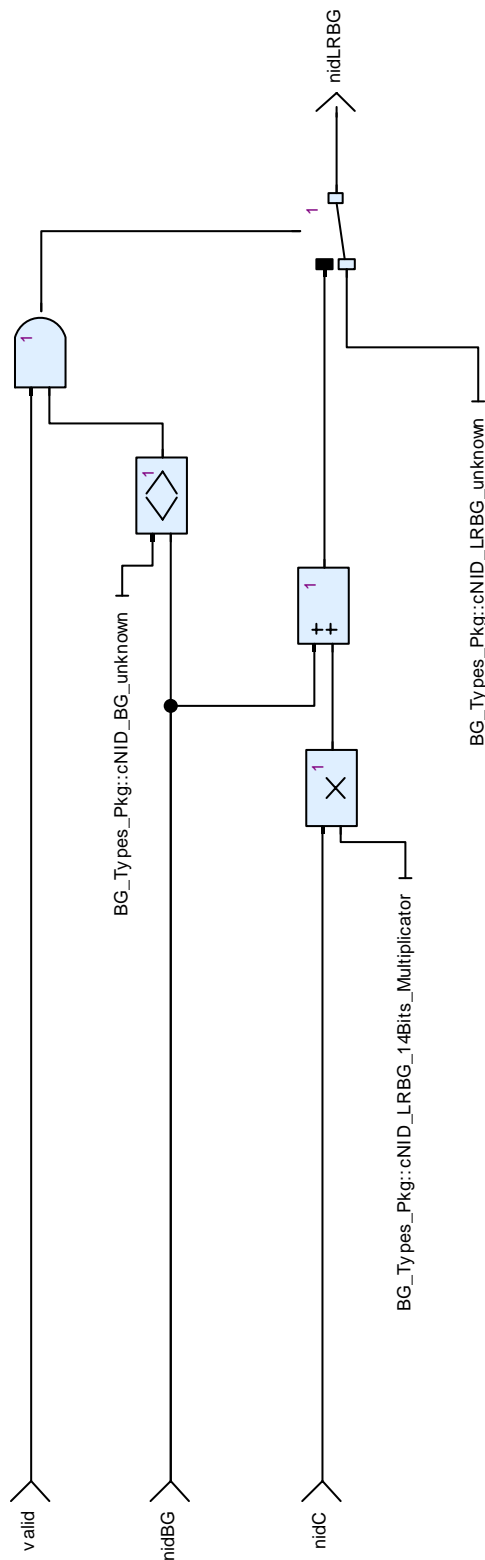


Figure 66: View of diagram_nidC_nidBG_2_NIDLRGBG_1 (nidC_nidBG_2_NIDLRGBG)

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 149: passedBGs_ids_equal Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Checks if the ids of 2 BG are equal by comparing their NID_BG and NID_C values.</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.30.2. Interface

Table 150: 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 151: 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)

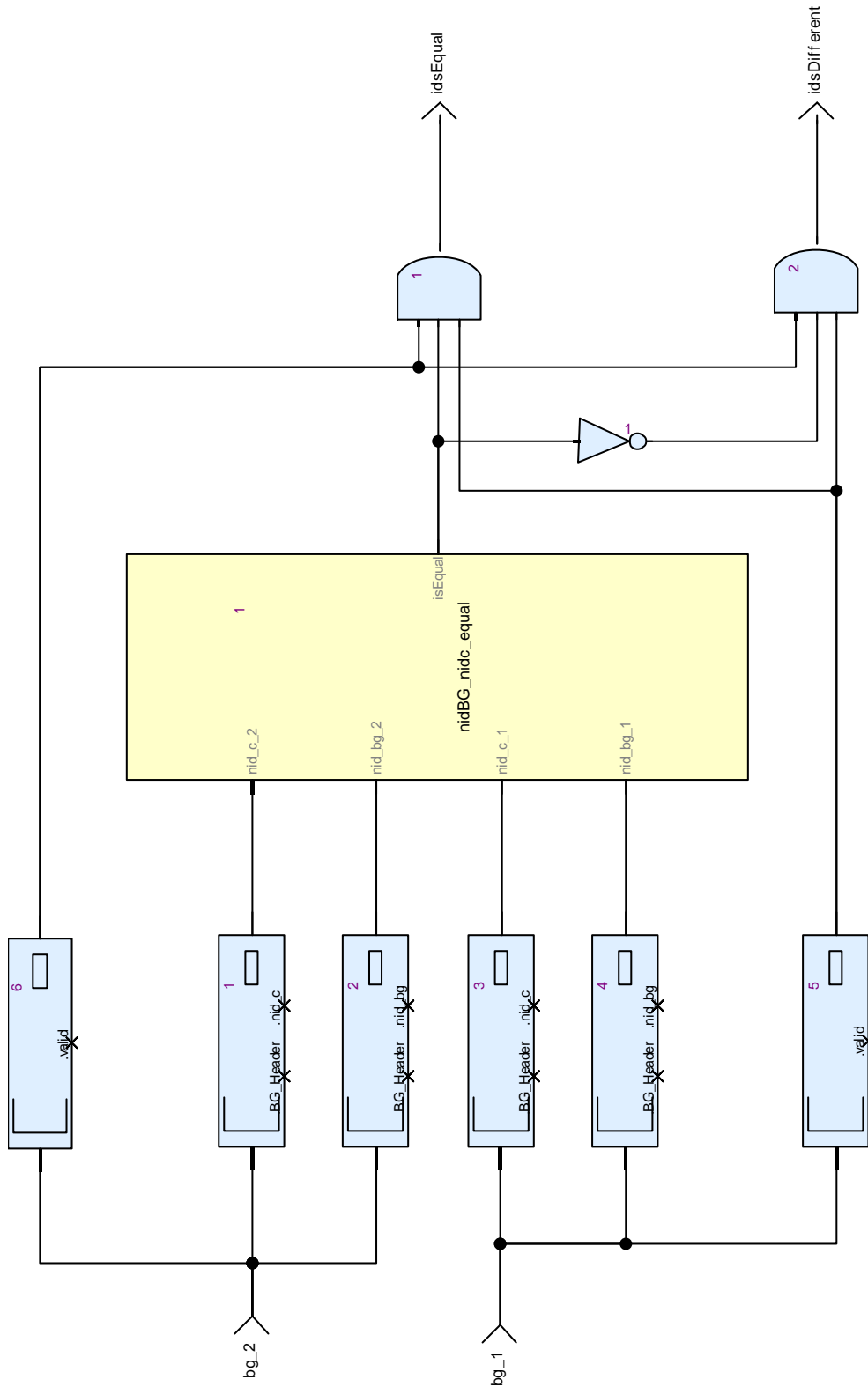


Figure 67: View of diagram_passedBGs_ids_equal_1 (passedBGs_ids_equal)

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 152: positionDerivedFromPassedBG Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the train position on the base of the odometry and a passed reference BG.</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.31.2. Interface

Table 153: Inputs of positionDerivedFromPassedBG

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

Table 154: 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)

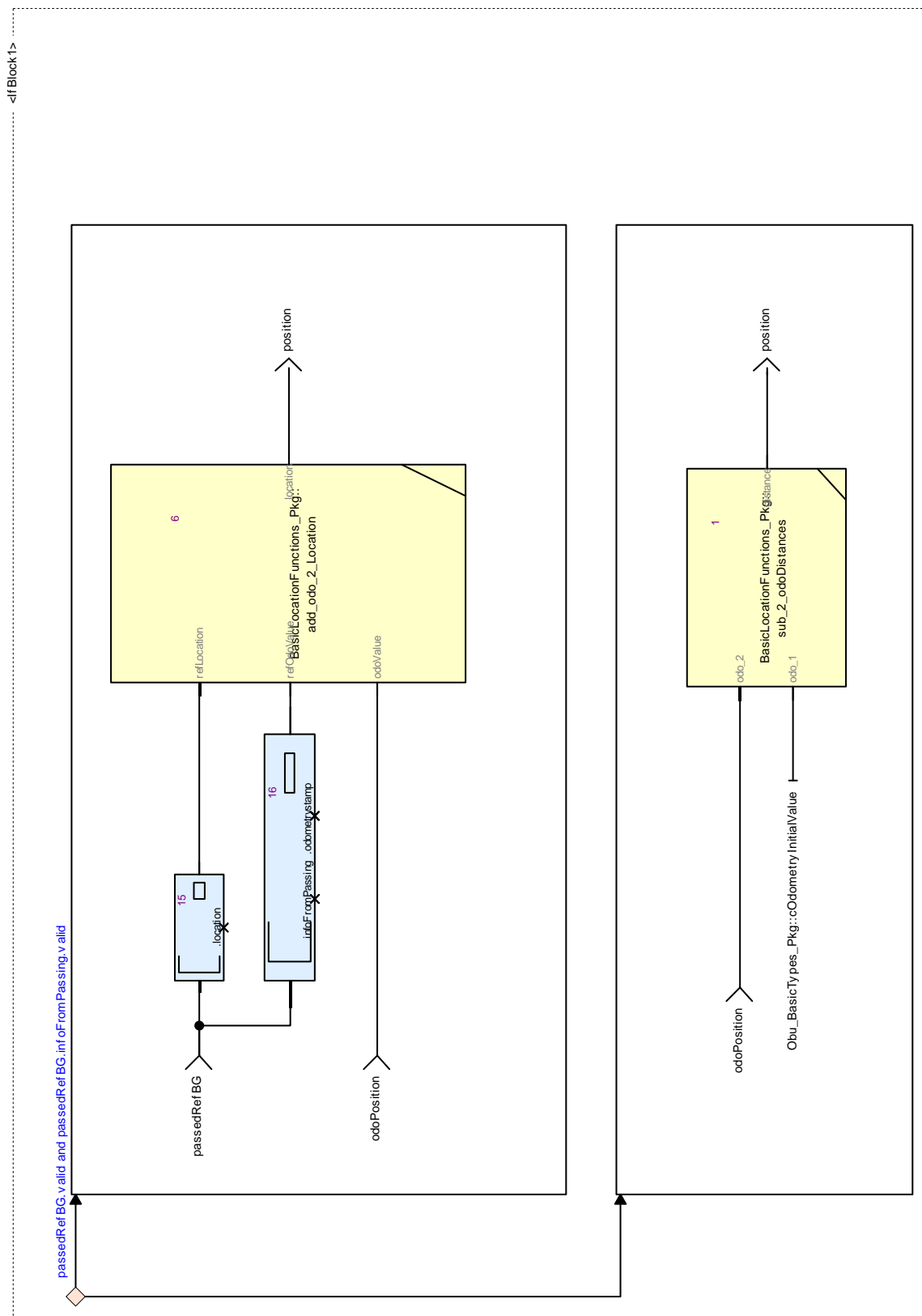


Figure 68: View of diagram_positionDerivedFromPassedBG_1 (positionDerivedFromPassedBG)

Table 155: Conditional Blocks of diagram_positionDerivedFromPassedBG_1

Conditional Block	Comments and Information
IfBlock1	

Table 156: 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 157: positionedBGs_ids_equal Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Checks if the ids of 2 BG are equal by comparing their NID_BG and NID_C values.</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.32.2. Interface

Table 158: 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 159: 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)

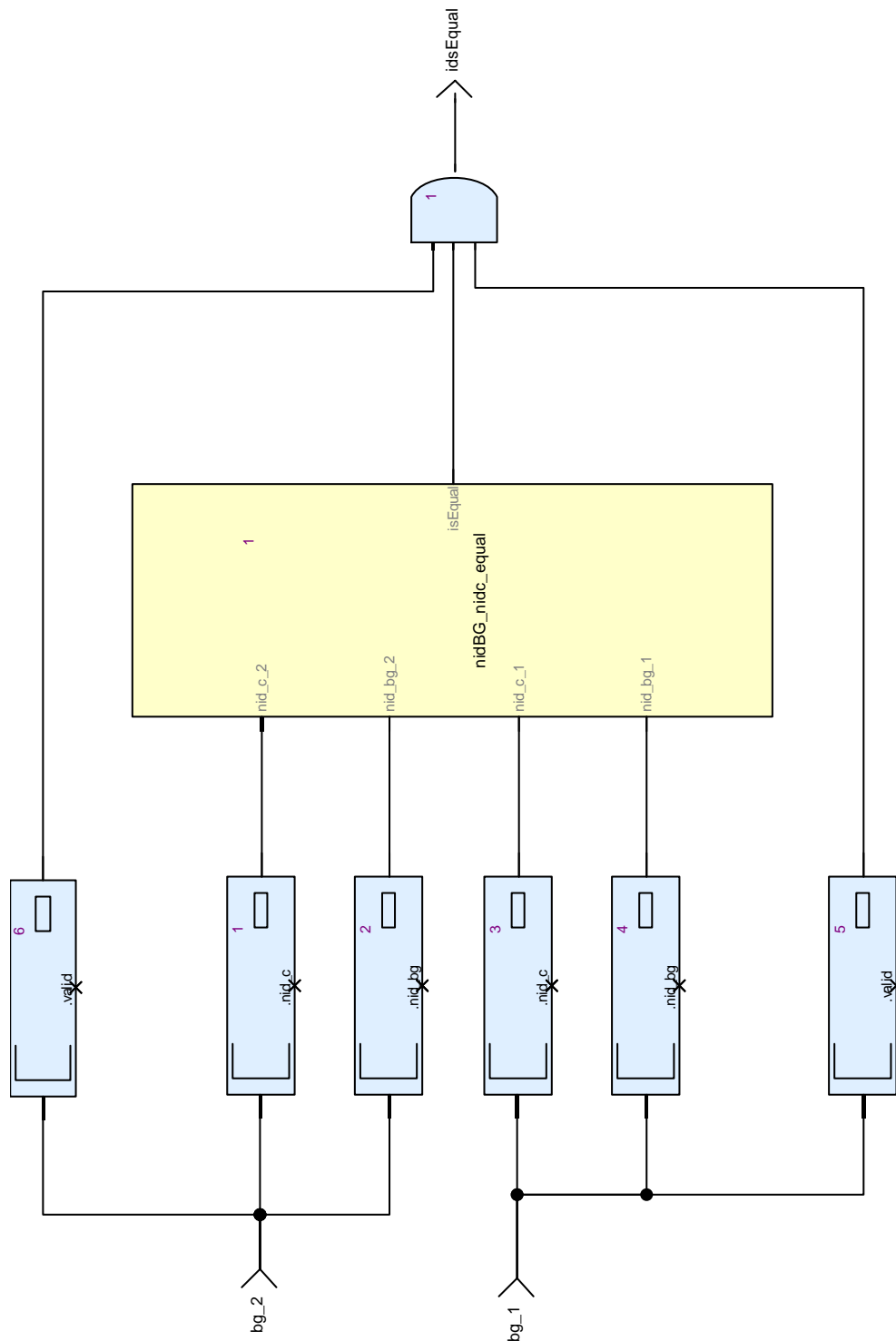


Figure 69: View of diagram_positionedBGs_ids_equal_1 (positionedBGs_ids_equal)

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 160: positionLinkedBGs Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Converts the linking information, received while passing a BG into an announced (= linked positioned) BG.</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.33.2. Interface

Table 161: Inputs of positionLinkedBGs

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

Table 162: Outputs of positionLinkedBGs

Name	Type	Comments and Information
linkedPositionedBGs	TrainPosition_Types_Pkg::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)

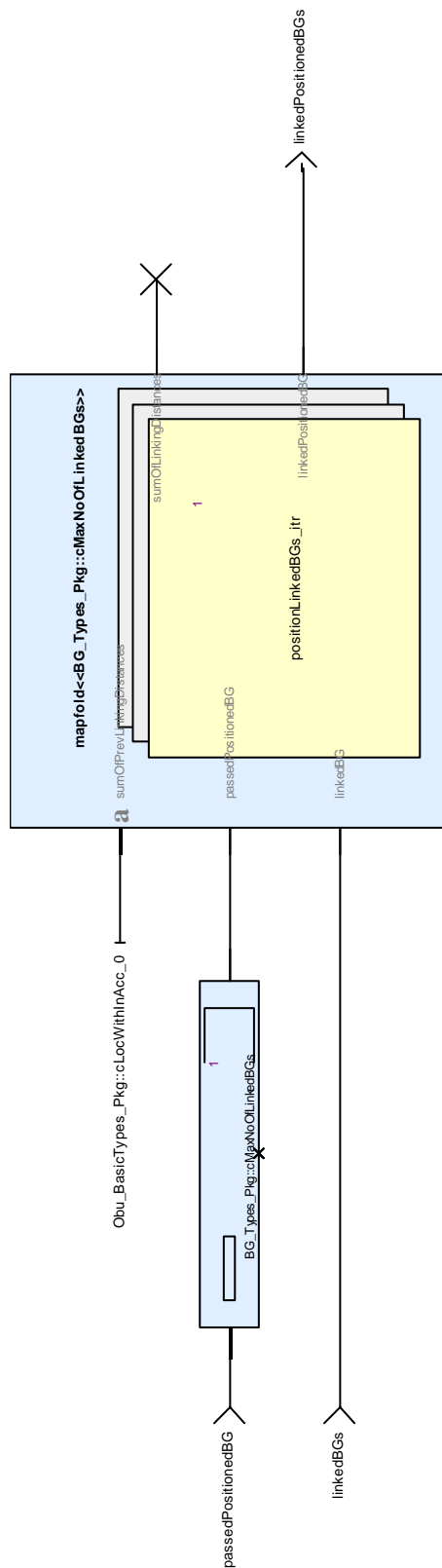


Figure 70: View of diagram_positionLinkedBGs_1 (positionLinkedBGs)

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 163: positionLinkedBGs_itr Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Iterated function for the conversion of the linking information, received while passing a BG into an announced (= linked positioned) BG.</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

3.3.34.2. Interface

Table 164: Inputs of positionLinkedBGs_itr

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

Table 165: 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_Pkg::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)

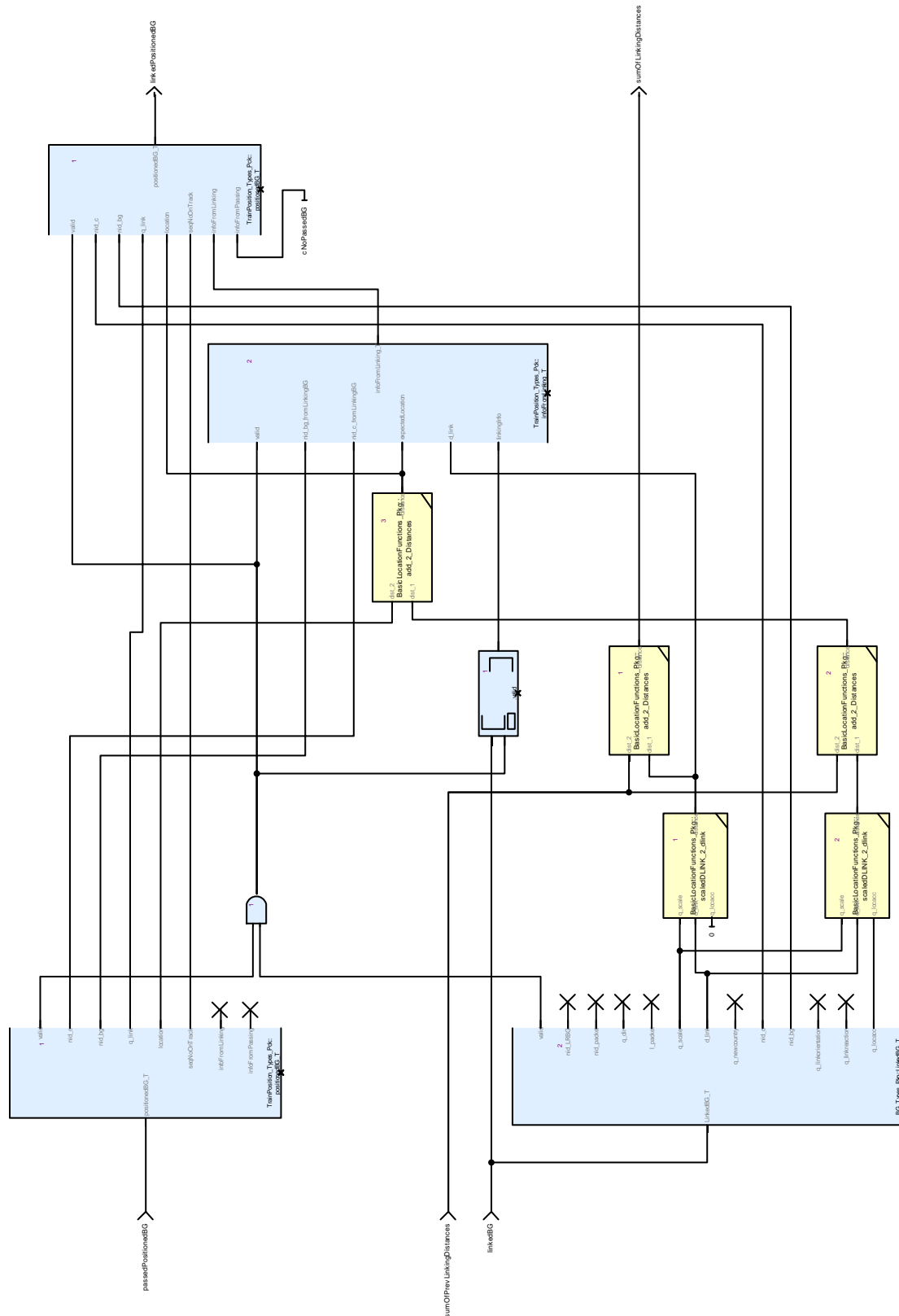


Figure 71: View of diagram_positionLinkedBGs_itr_1 (positionLinkedBGs_itr)

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 166: 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 167: 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)

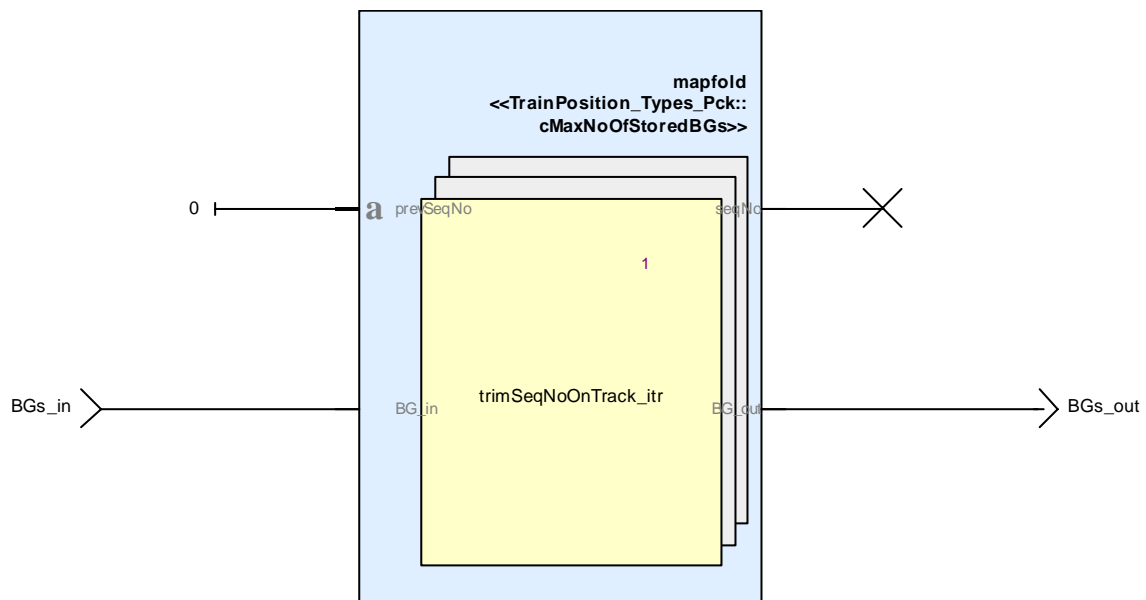


Figure 72: View of diagram_trimSeqNoOnTrack_1 (trimSeqNoOnTrack)

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 168: Inputs of trimSeqNoOnTrack_itr

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

Table 169: Outputs of trimSeqNoOnTrack_itr

Name	Type	Comments and Information
seqNo	int	
BG_out	TrainPosition_Types_Pc k::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)

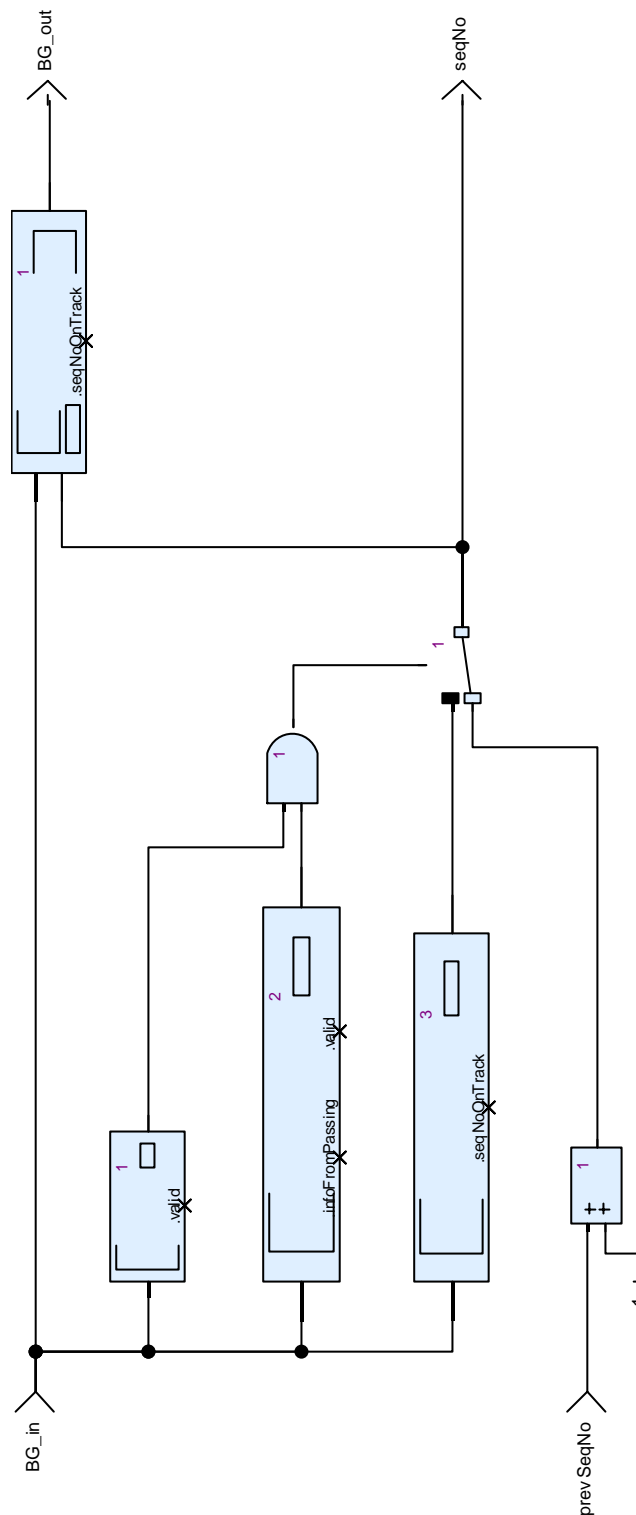


Figure 73: View of diagram_trimSeqNoOnTrack_itr_1 (trimSeqNoOnTrack_itr)

3.4. CalculateTrainPosition_Pkg::gp_functions_Pkg Package

3.4.1. Constants

Table 170: 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 171: 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 172: 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)

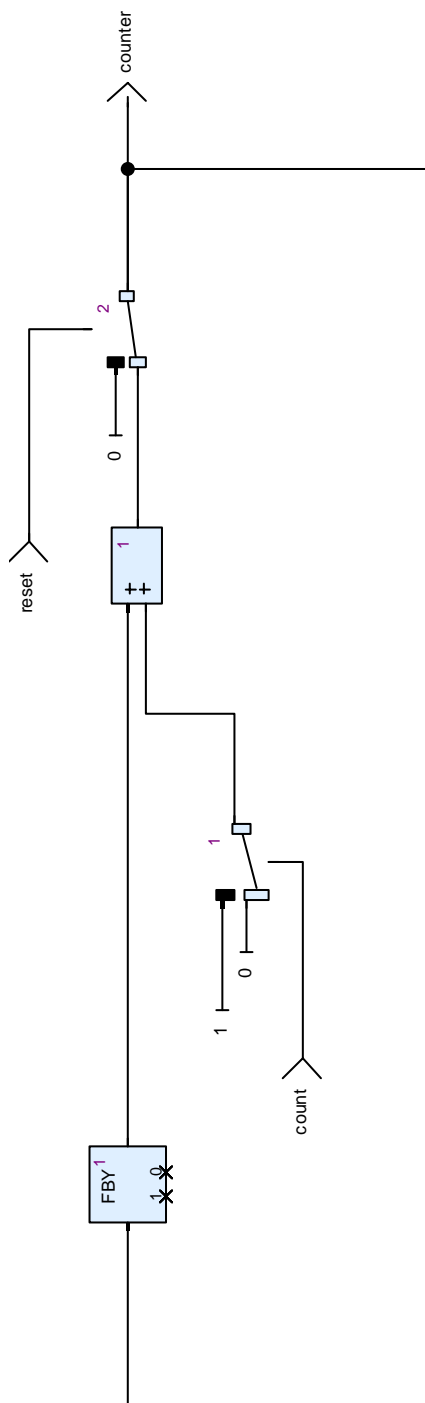


Figure 74: View of diagram_countUp_1 (countUp)

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

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

4.1.3. Constants

Table 174: 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 175: 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 176: Public Types of TrainPosition_Types_Pck

Name	Definition	Comments and Information
infoFromLinking_T	<pre>{ 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 }</pre>	<p>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.</p>
linkedBGs_asPositionedBGs_T	<pre>TrainPosition_Types_Pck::positionedB G_T ^BG_Types_Pkg::cMaxNoOfLinkedBG s</pre>	<p>Comments: Array of linked balises groups in the format of positioned BGs</p>
positionedBG_T	<pre>{ 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::infoFromLin king_T, infoFromPassing : BG_Types_Pkg::passedBG_T }</pre>	<p>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.</p>
positionedBGs_T	<pre>TrainPosition_Types_Pck::positionedB G_T ^cMaxNoOfStoredBGs</pre>	<p>Comments: All balise groups stored for train position calculation</p>

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

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

Name	Definition	Comments and Information
trainPositionInfo_T	{valid : bool, timestamp : Obu_BasicTypes_Pkg::T_internal_Type, trainPosition : Obu_BasicTypes_Pkg::LocWithInAcc_T, trainPositionDerivedFromLastLinkedBG : Obu_BasicTypes_Pkg::LocWithInAcc_T, trainPositionDerivedFromLastUnlinkedBG : Obu_BasicTypes_Pkg::LocWithInAcc_T, lastPassedLinkedBG : TrainPosition_Types_Pck::positionedBG_T, lastPassedUnlinkedBG : TrainPosition_Types_Pck::positionedBG_T, speed : Obu_BasicTypes_Pkg::Speed_T}	trainPosition Comments: The best known train position trainPositionDerivedFromLastLinkedBG Comments: The train position measured by odometry behind the position of the last passed linked BG trainPositionDerivedFromLastUnlinkedBG Comments: The train position measured by odometry behind the position of the last passed unlinked BG lastPassedLinkedBG Comments: The last passed linked BG lastPassedUnlinkedBG Comments: The last passed unlinked BG speed Comments: Actual train speed
trainProperties_T	{nid_engine : NID_ENGINE, nid_operational : NID_OPERATIONAL, l_train : L_TRAIN, d_baliseAntenna_2_frontend : Obu_BasicTypes_Pkg::LocWithInAcc_T, d_frontend_2_rearend : Obu_BasicTypes_Pkg::LocWithInAcc_T}	Comments: Static train properties necessary for train position calculation. nid_engine Comments: 7.5.1.88, Onboard ETCS identity. nid_operational Comments: 7.5.1.92, Train Running Number l_train Comments: 7.5.1.56, train length d_baliseAntenna_2_frontend Comments: Distance from the trains balise antenna to the trains front end. d_frontend_2_rearend Comments: Distance from the trains front end to rear end

5.1.3. Constants

Table 177: Public Constants of TrainPosition_Types_Pck

Name	Type	Value	Comments and Information
cMaxNoOfStoredBGs	int	2 * BG_Types_Pkg::cMaxNoOfLinkedBGs	Comments: Max. number of balise groups stored for position calculation
cQ_SCALE_10_cm_resolution	Obu_BasicTypes_Pkg::Location_T	10	Comments: 7.5.1.129: Resolution of Q_SCALE::10cm: = 10 cm (Location_Type in cm)
cQ_SCALE_10_m_resolution	Obu_BasicTypes_Pkg::Location_T	1000	Comments: 7.5.1.129: Resolution of Q_SCALE::10 m: = 1000 cm (Location_Type in cm)
cQ_SCALE_1_m_resolution	Obu_BasicTypes_Pkg::Location_T	100	Comments: 7.5.1.129: Resolution of Q_SCALE::1 m: = 100 cm (Location_Type in cm)

Name	Type	Value	Comments and Information
cQLOCACC_resolution	Obu_BasicTypes_Pkg::Location_T	100	Comments: 7.5.1.115: Resolution of Q_LOCACC is in m = 100 cm (Location_Type in cm)

6. Project Library: BG_Types

6.1. BG_Types_Pkg Package

6.1.1. Types

Table 178: Public Types of BG_Types_Pkg

Name	Definition	Comments and Information
AdditionalInformation_T	{addInfo : int, linkingPackets : BG_Types_Pkg::LinkedBGs_T}	Comments: Packets received from balises addInfo Comments: This type is not yet defined
BG_Header_T	{q_updown : Q_UPDOWN, m_version : M_VERSION, q_media : Q_MEDIA, n_pig : N_PIG, n_total : N_TOTAL, m_dup : M_DUP, m_mcount : M_MCOUNT, nid_c : NID_C, nid_bg : NID_BG, q_link : Q_LINK}	Comments: Common header of the balise group datagram
BG_Message_T	{present : bool, TelegramHeaders : BG_Types_Pkg::TelegramHeaderArray_T, AddInfo : BG_Types_Pkg::AdditionalInformation_T, numberBalises : int, centerOfBalisePosition : BG_Types_Pkg::centerOfBalisePosition_T, BGOrientation : Q_DIRTRAIN}	present Comments: indicates whether the bg-message present is. TelegramHeaders Comments: headers of all received telegrams filled up from the start of the array AddInfo Comments: For all balises of the group: Packets collected into a combined information numberBalises Comments: additional packets received with the balises centerOfBalisePosition Comments: position of the balise group BGOrientation Comments: Orientation of the balise group
centerOfBalisePosition_T	{centerOfBalisePosition : Obu_BasicTypes_Pkg::OdometryLocations_T, BG_centerDetectionInaccuracies : Obu_BasicTypes_Pkg::LocWithInAcc_T, timestamp : Obu_BasicTypes_Pkg::T_internal_Type}	Comments: Gives the information for location and accuracy of measurements centerOfBalisePosition Comments: Location BG_centerDetectionInaccuracies Comments: Location inaccuracies caused by the balise group center detection timestamp Comments: timestamp when measurement was taken
CurrentLRBG	{filteredBGMessage : BG_Types_Pkg::BG_Message_T, position : BG_Types_Pkg::Position_T}	

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

Name	Definition	Comments and Information
ListOfBG	BG_Types_Pkg::CurrentLRBG ^cMaxListBGs	
Orientation_T	enum { Single_Balise_Group, DIR_Nominal, DIR_Reverse}	
passedBG_T	{valid : bool, timestamp : Obu_BasicTypes_Pkg::T_internal_Type, odometrystamp : Obu_BasicTypes_Pkg::OdometryLocations_T, BG_centerDetectionInaccuracies : Obu_BasicTypes_Pkg::LocWithInAcc_T, BG_Header : BG_Types_Pkg::BG_Header_T, linkedBGs : BG_Types_Pkg::LinkedBGs_T, noCoordinateSystemHasBeenAssigned : bool, trainOrientationToBG : Q_DIRLRBG, trainRunningDirectionToBG : Q_DIRTRAIN, passingSpeed : Obu_BasicTypes_Pkg::Speed_T}	Comments: Information received from a BG passed odometrystamp Comments: Odometry values when the balise group was passed BG_centerDetectionInaccuracies Comments: Location inaccuracies caused by the balise group center detection BG_Header Comments: Common header of the balise group datagram linkedBGs Comments: The linked balise groups announced from this BG. 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 passingSpeed Comments: Train speed while passing the BG; its sign characterizes the passing direction based on odometry information
Position_T	int	
RBCOrientationReport_T	{assignment_of_coordinate_system : Radio_TrackToTrain::Assignment_of_ coordinate_system}	
RBCReport_T	{train_position_report : Radio_TrainToTrack::Train_Position_Report}	
Telegram_T	{present : bool, valid : bool, telegramheader : BG_Types_Pkg::TelegramHeader_T, packets : BG_Types_Pkg::AdditionalInformation_T}	present Comments: Flag indicates whether the parameter is present in the interfaces valid Comments: The element has valid data telegramheader Comments: Information received from the balise packets Comments: Packets received via the balises

Name	Definition	Comments and Information
TelegramHeader_T	{q_updown : Q_UPDOWN, m_version : M_VERSION, q_media : Q_MEDIA, n_pig : N_PIG, n_total : N_TOTAL, m_dup : M_DUP, m_mcount : M_MCOUNT, nid_c : NID_C, nid_bg : NID_BG, q_link : Q_LINK}	Comments: This structure is not "packed" to bit boundaries
TelegramHeaderArray_T	BG_Types_Pkg::TelegramHeaderFlag_T ^cMaxNoBalises	
TelegramHeaderFlag_T	{valid : bool, header : BG_Types_Pkg::TelegramHeader_T}	
TrainToTrackStatus_T	{m_mode : M_MODE, m_level : M_LEVEL, m_leveltr : M_LEVELTR, nid_ntc : NID_NTC, q_length : Q_LENGTH}	Comments: structure capturing modi, leves and train integrity

6.1.2. Constants

Table 179: Public Constants of BG_Types_Pkg

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

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

Name	Type	Value	Comments and Information
cEmpty_BaliseTlg	BG_Types_Pkg::Telegram_T	{ present : false, valid : false, telegramheader : { q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previous_versions_according_to_e_g_EEIG_SRS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1st, n_total : N_TOTAL_1_balise_in_the_group, m_dup : M_DUP_No_duplicates, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, packets : { addInfo : 0, linkingPackets : [{ valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}, { valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, l_packet : 0, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country_or_railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation :	

Name	Type	Value	Comments and Information
		<pre>{present : false, TelegramHeaders : [{valid : false, header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 st, n_total : N_TOTAL_1_balise_ in_the_group, m_dup : M_DUP_No_duplicat es, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}} , {valid : false, header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 st, n_total : N_TOTAL_1_balise_ in_the_group, m_dup : M_DUP_No_duplicat es, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}} , {valid : false, header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previo us_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 st, n_total : N_TOTAL_1_balise_ in_the_group, m_dup : M_DUP_No_duplicat es, m_mcount : 0,</pre>	

Name	Type	Value	Comments and Information
cEmptyHeader	BG_Types_Pkg::TelegramHeaderFlag_T	{ valid : false, header : { q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previous_versions_according_to_e_g_EEIG_SRS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1st, n_total : N_TOTAL_1_balise_in_the_group, m_dup : M_DUP_No_duplicates, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked} }	

Name	Type	Value	Comments and Information
		<pre>[{valid : false, header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previous_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 st, n_total : N_TOTAL_1_balise_ in_the_group, m_dup : M_DUP_No_duplicat es, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}} , {valid : false, header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previous_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 st, n_total : N_TOTAL_1_balise_ in_the_group, m_dup : M_DUP_No_duplicat es, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}} , {valid : false, header : {q_updown : Q_UPDOWN_Down_ link_telegram, m_version : M_VERSION_Previous_versions_accordi ng_to_e_g_EEIG_S RS_and_UIC_A200_ SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 st, n_total : N_TOTAL_1_balise_ in_the_group, m_dup : M_DUP_No_duplicat es, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link :</pre>	

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

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 180: BasicLocationFunctions_Pkg Annotations

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

Note Name	Attribute	Value
Remark_1	Description	<p>Basic calculation functions for position determination of train and track elements</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.</p> <p>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

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 $\text{dist}_2 + \text{dist}_1$

Table 181: add_2_Distances Annotations

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

Note Name	Attribute	Value
Remark_1	Description	<p>Calculates the sum of 2 distances</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

7.1.2.2. Interface

Table 182: 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 183: 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)

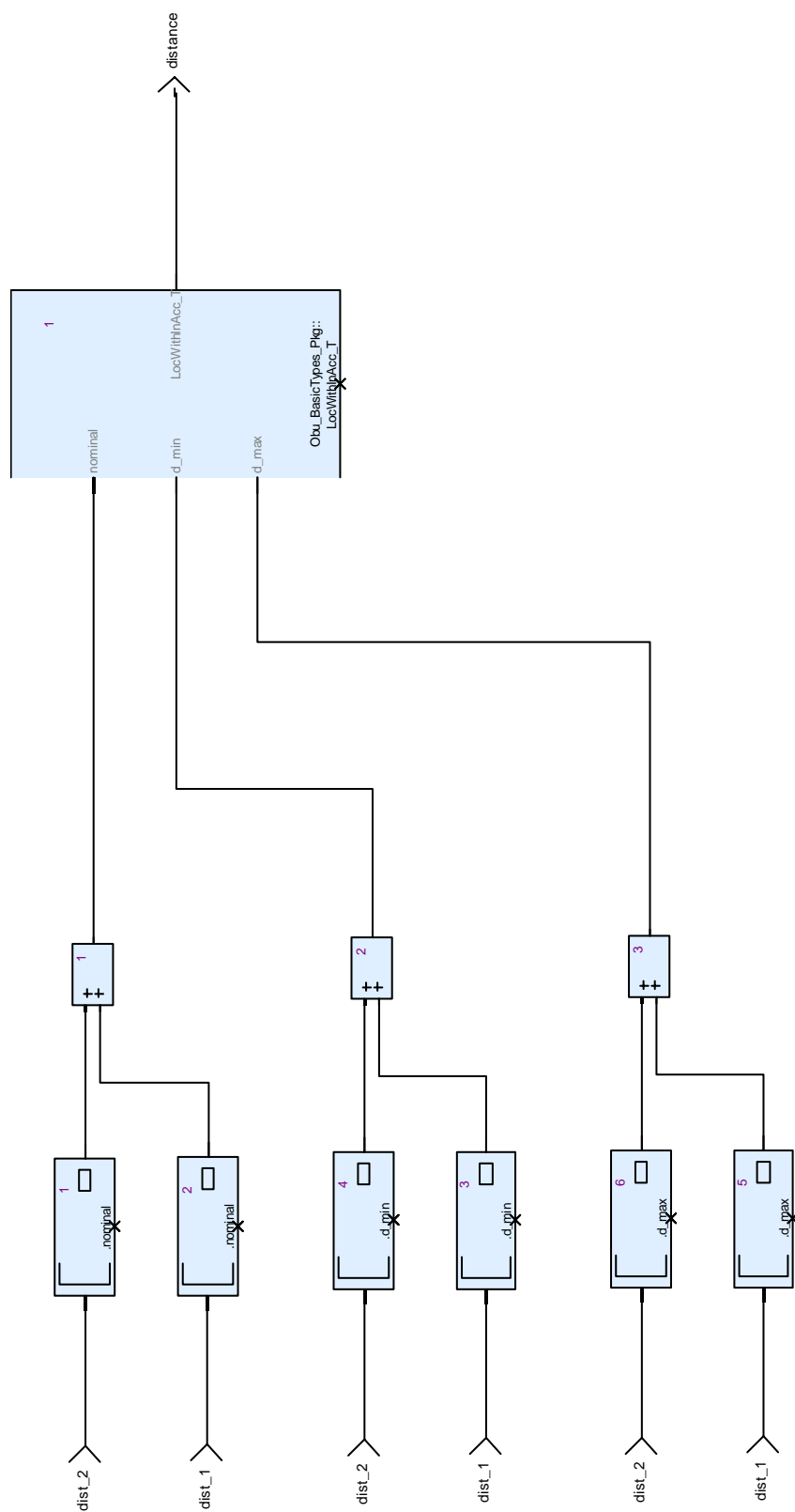


Figure 75: View of diagram_add_2_Distances_1 (add_2_Distances)

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:
- $\text{location} = \text{refLocation} + (\text{odoValue} - \text{refOdoValue})$.
- Applicable, if a reference location is given and a travel distance behind it is measured with the odometry.

Table 184: add_odo_2_Location Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the target location after a reference location measured by the odometry</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

7.1.3.2. Interface

Table 185: 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 186: 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)

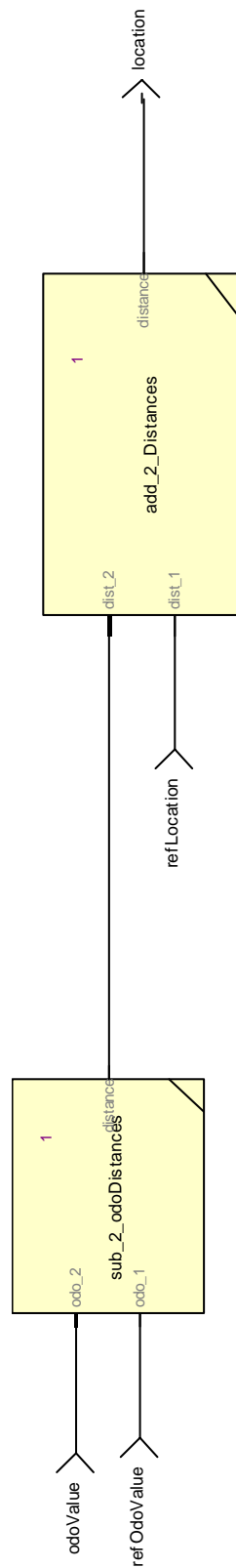


Figure 76: View of diagram_add_odo_2_Location_1 (add_odo_2_Location)

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 187: addDistances Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the sum of an array of distances</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

7.1.4.2. Interface

Table 188: Inputs of addDistances

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

Table 189: Outputs of addDistances

Name	Type	Comments and Information
sum	Obu_BasicTypes_Pkg::LocWithInAcc_T	

Table 190: 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)

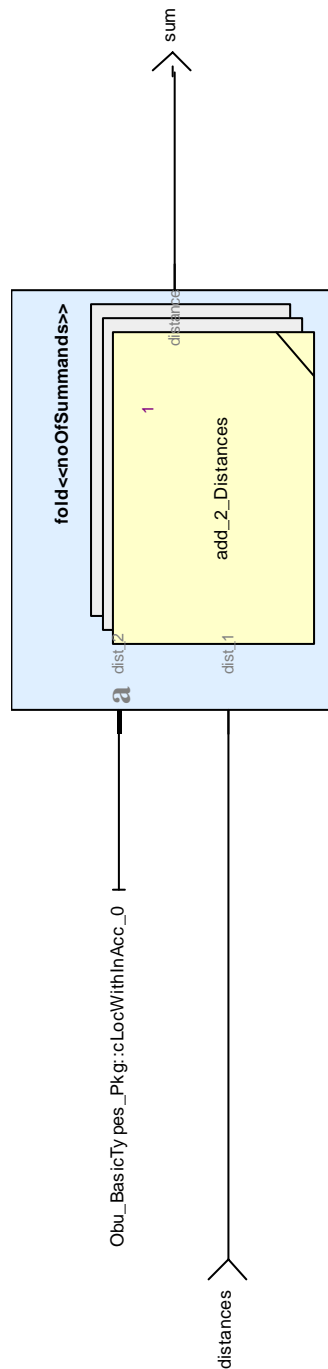


Figure 77: View of diagram_sumOfDistances_1 (addDistances)

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 191: addDistancesBetwLinkedElements Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the distance between linked elements</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

7.1.5.2. Interface

Table 192: Inputs of addDistancesBetwLinkedElements

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

Table 193: Outputs of addDistancesBetwLinkedElements

Name	Type	Comments and Information
sumOfDistances	Obu_BasicTypes_Pkg::LocWithInAcc_T	

Table 194: Size Parameters of addDistancesBetwLinkedElements

Name	Comments and Information
noOfLinkedElements	

7.1.5.3. Operator Hierarchy

diagram : diagram_distanceBetweenLinkedElements_1

7.1.5.4.1. View of diagram_distanceBetweenLinkedElements_1 (addDistancesBetwLinkedElements)

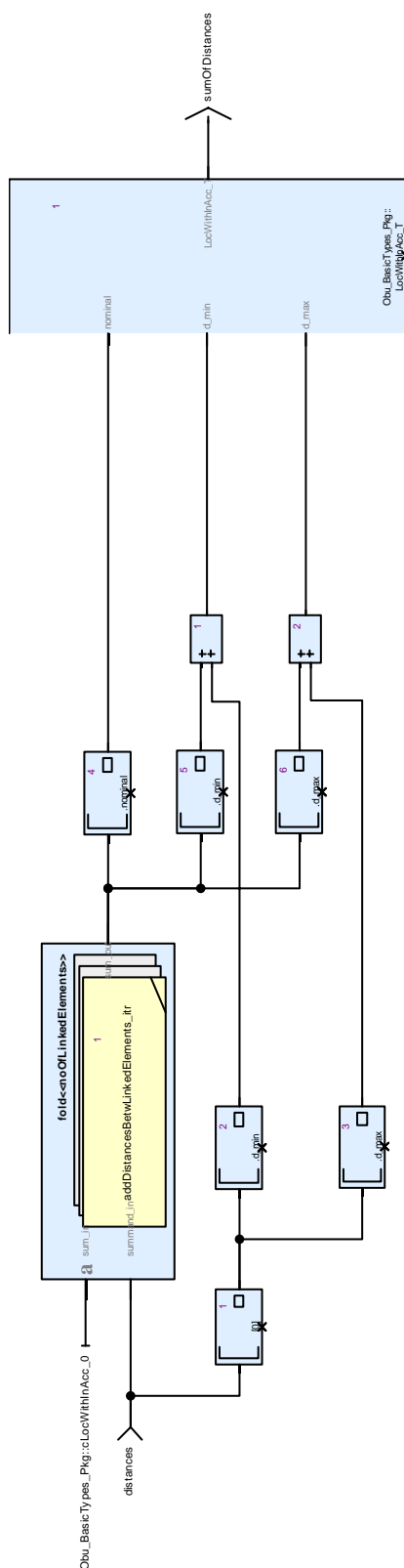


Figure 78: View of diagram_distanceBetweenLinkedElements_1 (addDistancesBetwLinkedElements)

7.1.6. addDistancesBetwLinkedElements_itr Operator

Declared as **private function**

7.1.6.1. Comments and Information

addDistancesBetwLinkedElements_itr Comments:

- distanceBetweenLinkedElements_itr is the iterated function for the distance calculation between linked elements.
- The nominal distances are added.
- d_min and d_max are taken from the summand, if it is < > 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 195: addDistancesBetwLinkedElements_itr Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>iterated function for the distance calculation between linked elements</p> <ul style="list-style-type: none">- 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

7.1.6.2. Interface

Table 196: Inputs of addDistancesBetwLinkedElements_itr

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

Table 197: 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

7.1.6.4.1. View of diagram_addDistancesBetwLinkedElements_itr_1 (addDistancesBetwLinkedElements_itr)

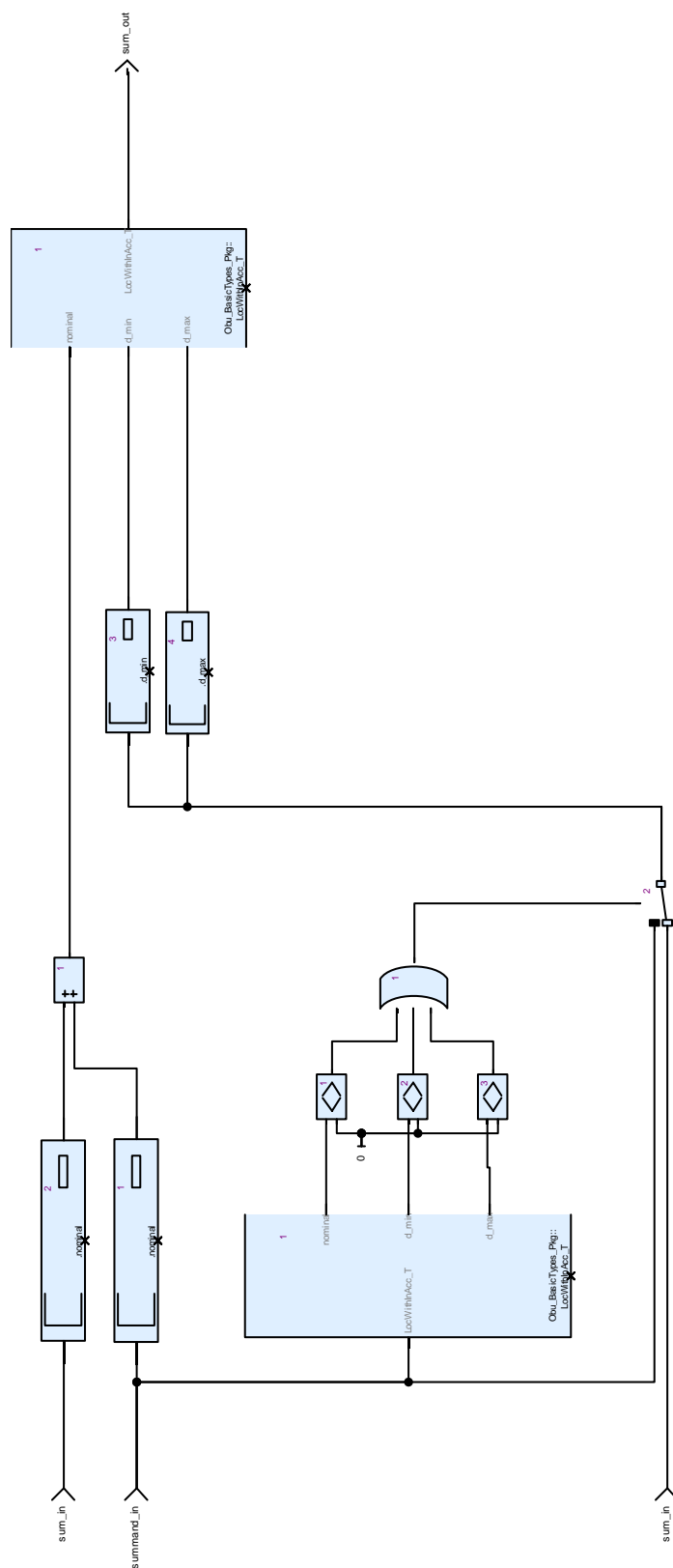


Figure 79: View of diagram_addDistancesBetwLinkedElements_itr_1
(addDistancesBetwLinkedElements_itr)

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 198: Inputs of checkMaxAbsOdoDistance

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

Table 199: Outputs of checkMaxAbsOdoDistance

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

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)

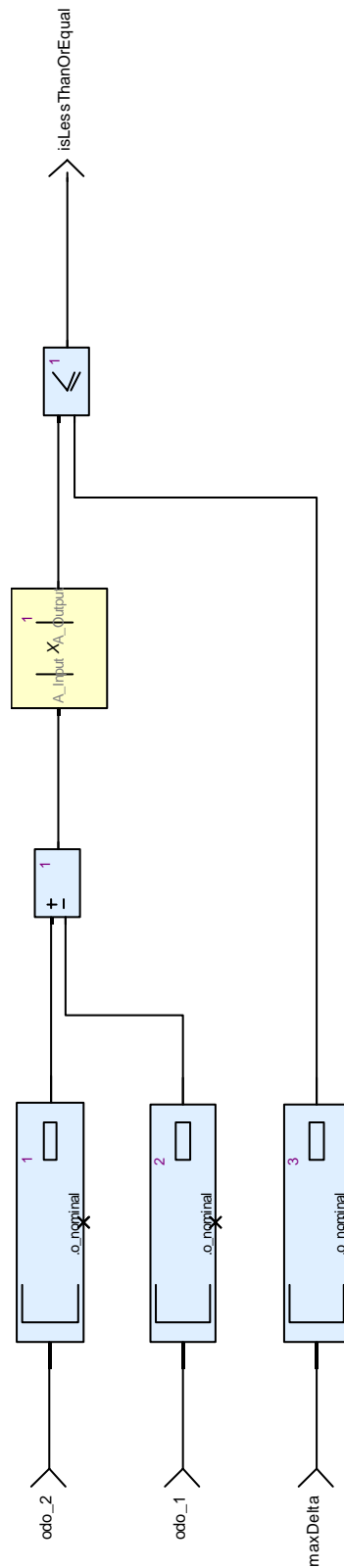


Figure 80: View of diagram_checkMaxAbsOdoDistance_1 (checkMaxAbsOdoDistance)

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 200: dTrain2Trackelem_unlinkedBG Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Distance from the actual train position to a track element</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

7.1.8.2. Interface

Table 201: 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

Name	Type	Comments and Information
loc_unlinkedBG	Obu_BasicTypes_Pkg::LocWithInAcc_T	Comments: Location of a previously passed unlinked balise group
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 202: 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)

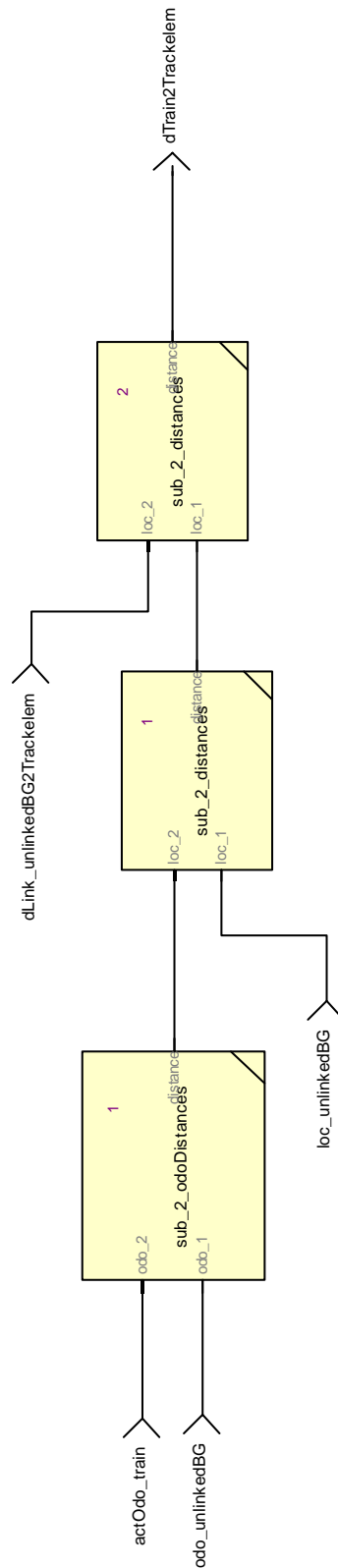


Figure 81: View of diagram_dTrain2Trackelem_unlinkedBG_1 (dTrain2Trackelem_unlinkedBG)

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 203: odoLoc_2_refLocations Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Determines the location of an element, measured by odometry, with reference to 2 different known reference locations</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

7.1.9.2. Interface

Table 204: Inputs of odoLoc_2_refLocations

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

Name	Type	Comments and Information
refLoc_1	Obu_BasicTypes_Pkg::LocWithInAcc_T	Comments: Reference location 1
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 205: 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

7.1.9.4.1. View of diagram_odoLoc_2_refLocations_1 (odoLoc_2_refLocations)

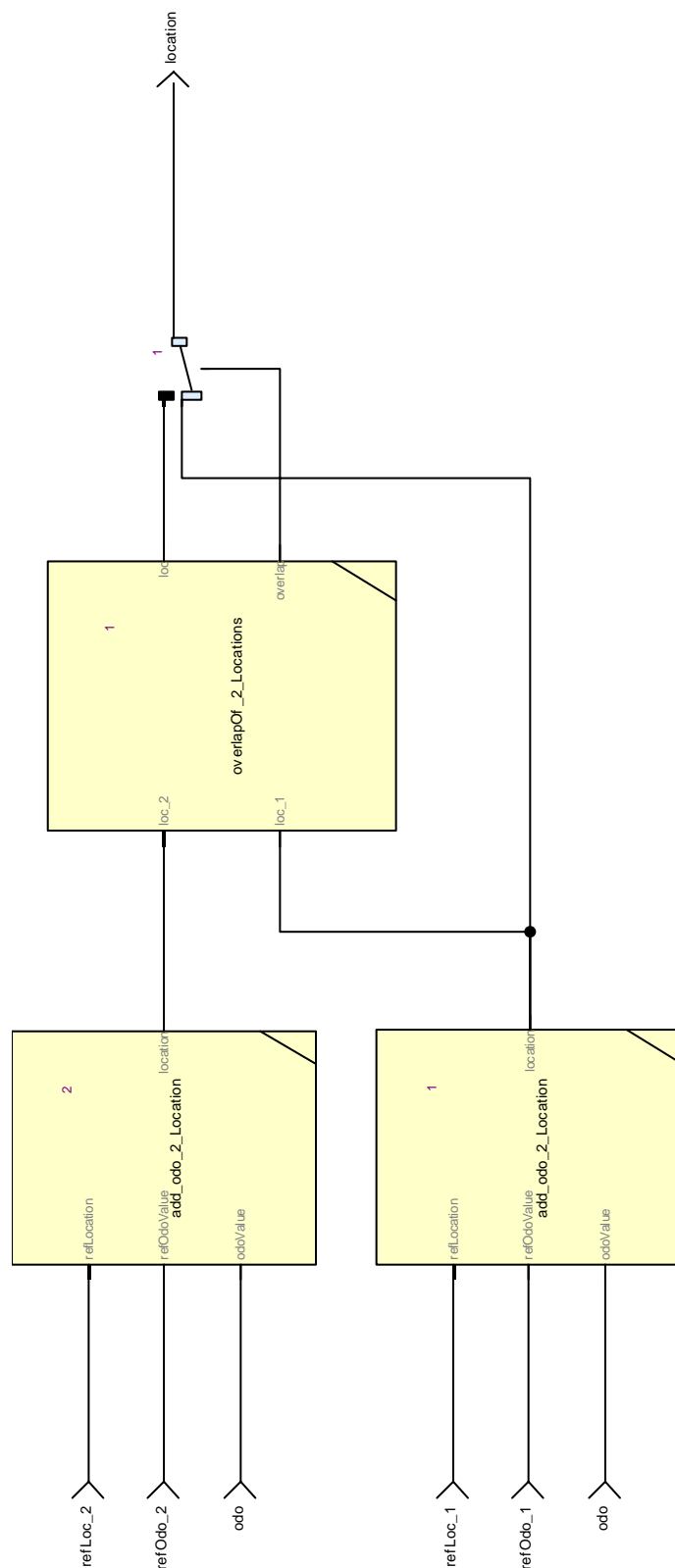


Figure 82: View of diagram_odoLoc_2_refLocations_1 (odoLoc_2_refLocations)

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

Table 206: overlapOf_2_Locations Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Determines the overlapping section of 2 locations</p> <ul style="list-style-type: none">- 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

7.1.10.2. Interface

Table 207: 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 208: 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)

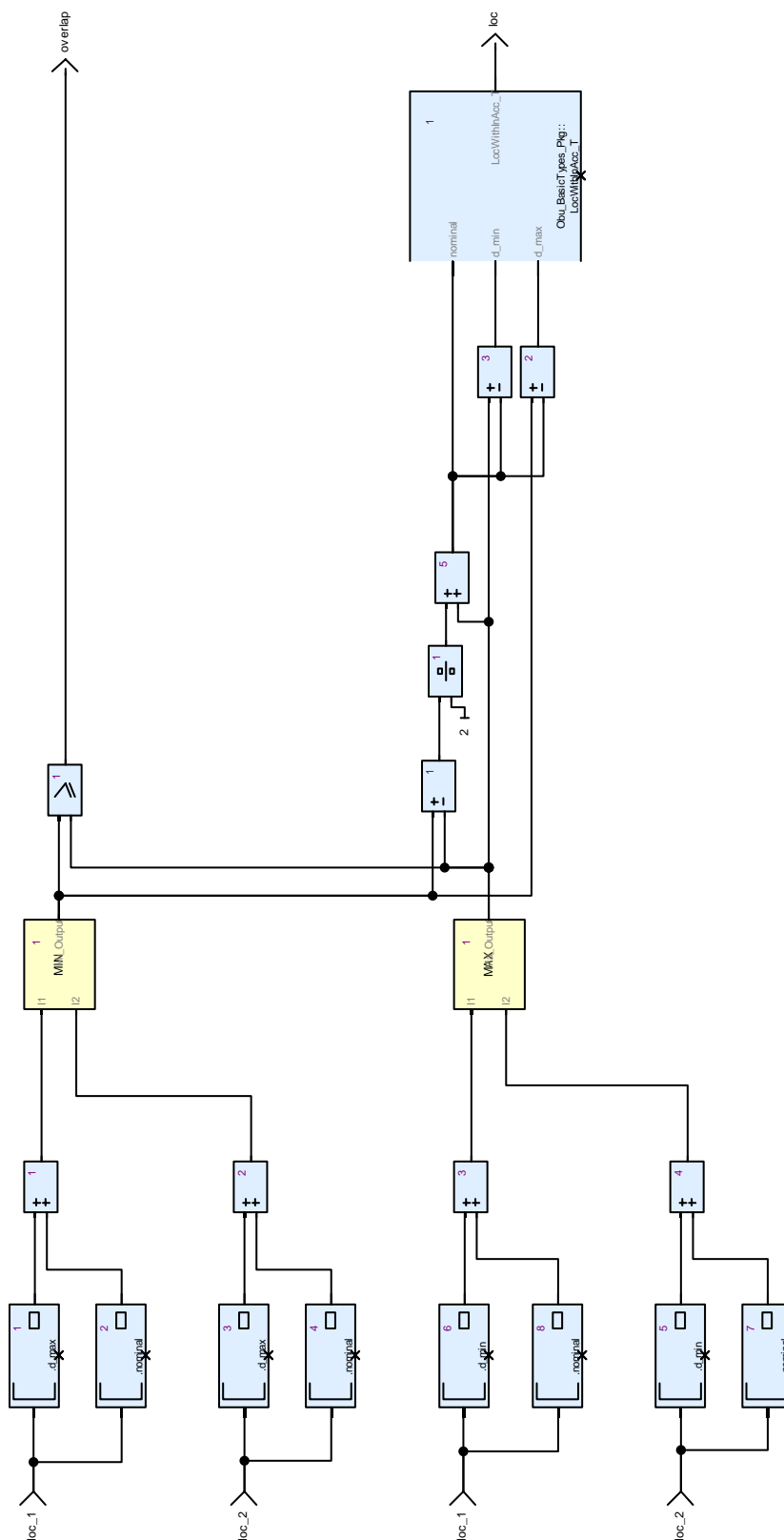


Figure 83: View of diagram_overlapOf_2_Locations_1 (overlapOf_2_Locations)

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 209: scaledDLINK_2_dlink Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Converts the linking distance variables into the uniform distance type</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

7.1.11.2. Interface

Table 210: Inputs of scaledDLINK_2_dlink

Name	Type	Comments and Information
q_scale	Q_SCALE	
d_link	D_LINK	
q_locacc	Q_LOCACC	

Table 211: 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)

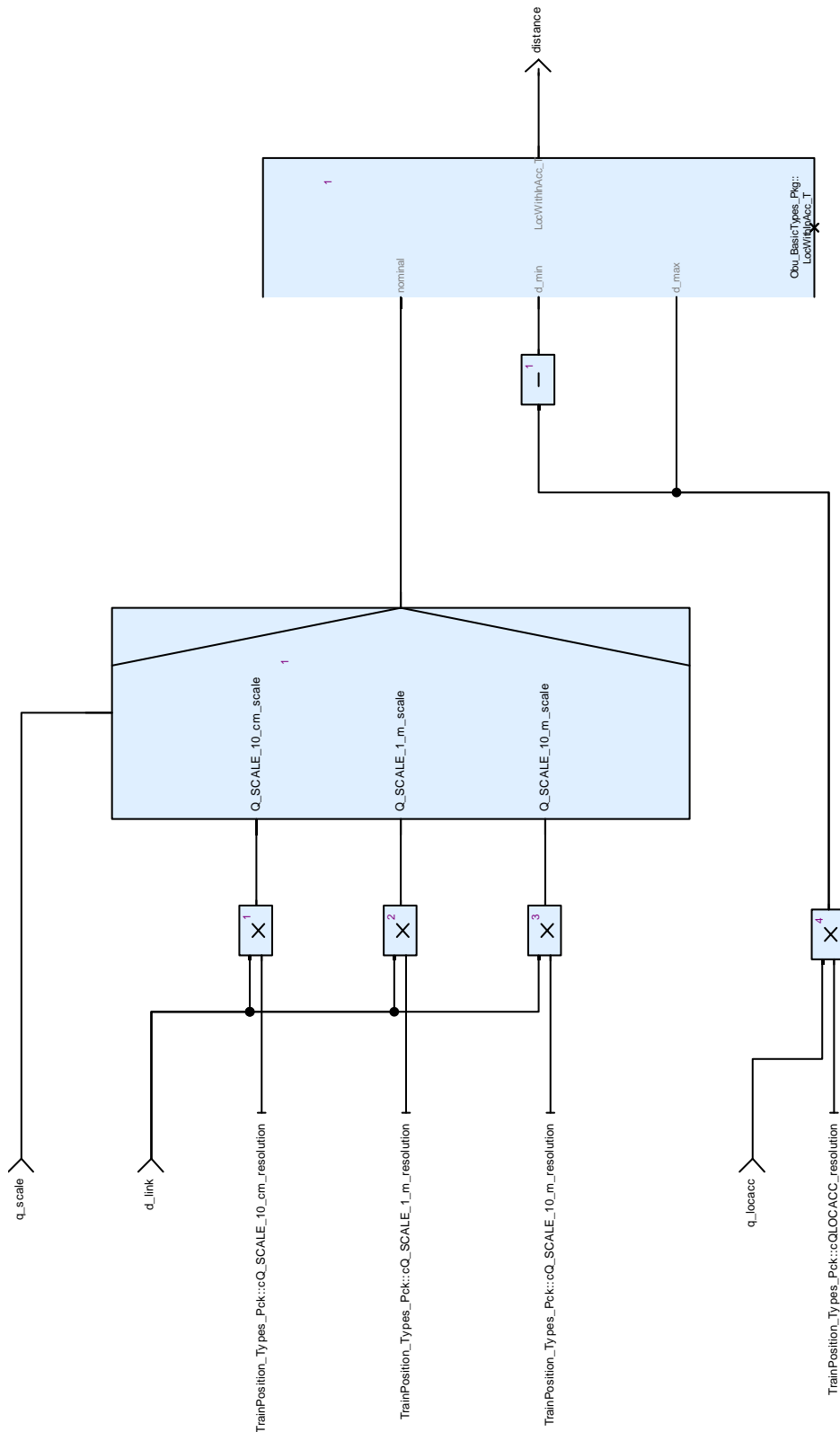


Figure 84: View of diagram_scaledDLINK_2_dlink_1 (scaledDLINK_2_dlink)

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 212: sub_2_distances Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the distance loc_2 - loc_1 between two locations</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

7.1.12.2. Interface

Table 213: 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 214: 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)

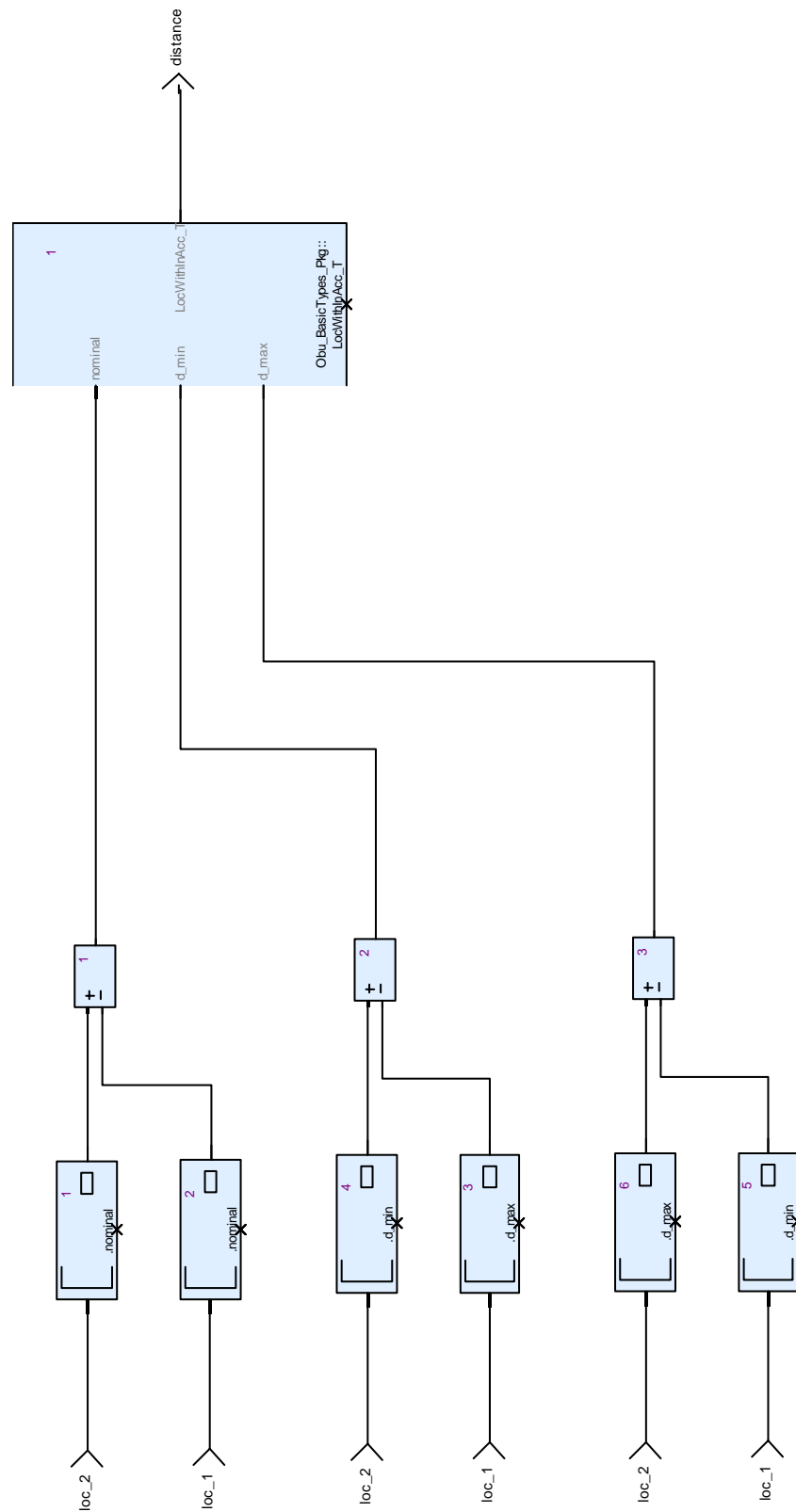


Figure 85: View of diagram_sub_2_distances_1 (sub_2_distances)

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 215: sub_2_odoDistances Annotations

Note Name	Attribute	Value
GdC_1	Author	Uwe Steinke
	DateC	Created : 2014-05-22
	DateM	Modified : 2014-05-22
	Version	00.02.00
	to_c	True
Remark_1	Description	<p>Calculates the distance o2 - o1 based on odometry data</p> <ul style="list-style-type: none"> - 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 <p>The use of this software is limited to non-vital applications. It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss. THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE.</p>
	to_c	True

7.1.13.2. Interface

Table 216: 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 217: 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)

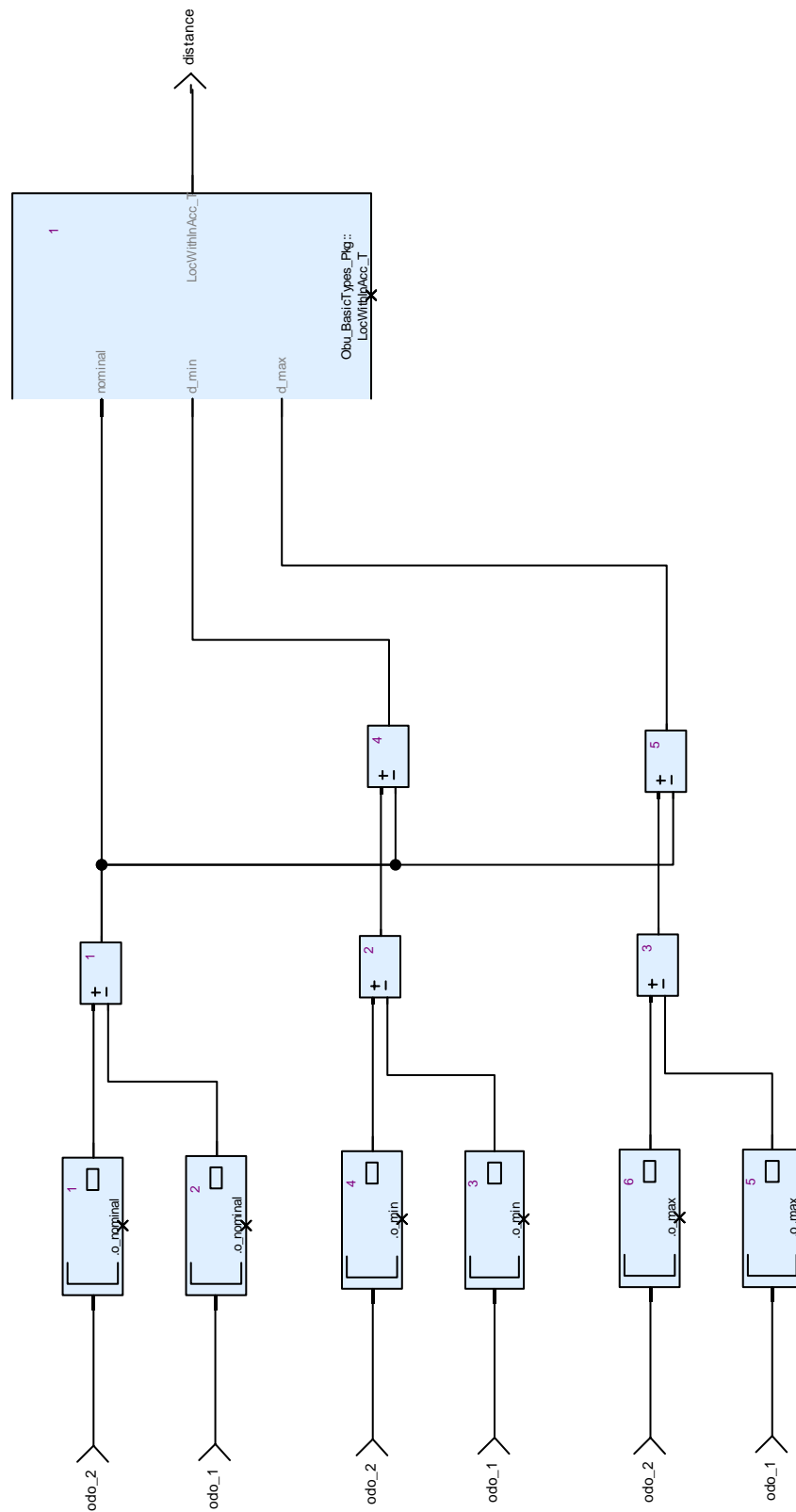


Figure 86: View of diagram_sub_2_odoDistances_1 (sub_2_odoDistances)

End of document.