<document classification>

# openETCS / UNISIG Subset-026-3.6

## *Calculate the actual train position*

Summary:
<summary>

Company: Siemens AG
Authors: Uwe Steinke
Reference: UNISIG Subset026-3.6 “Location principles, train position and train orientation”
Index: Version No 00.02.00
Date: 2014-05-22

Distribution List: <distribution list>

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# 1. General Project Description

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

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

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

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

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

- Gist URL: ---
- Cryptography: No
- Author(s): Uwe Steinke

The use of this software is limited to non-vital applications.
It has not been developed for vital operation purposes and must not be used for applications which may cause harm to people, physical accidents or financial loss.

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

# 2. Software Architecture

## 2.1. Project Architecture

This section displays the package hierarchy of projects.

Project CalculateTrainPosition
    CalculateTrainPosition_Pkg

Project Library BasicLocationFunctions
    BasicLocationFunctions_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.

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        1.1.2. CalculateTrainPosition_Pkg::memPassedBG
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                                    1.1.3.3.1.1.1.1.1.1. CalculateTrainPosition_Pkg::nidBG_nidc_equal

CalculateTrainPosition_Pkg::positionedBGs_ids_equal
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1.1.3.4.5. CalculateTrainPosition_Pkg::positionLinkedBGs
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1.1.5. CalculateTrainPosition_Pkg::prevPassedLinkedBG
1.1.5.1. CalculateTrainPosition_Pkg::nidBG_nidc_equal
1.1.5.2. digital::RisingEdge
1.1.5.3. linear::Memory
1.2. CalculateTrainPosition_Pkg::calculateTrainpositionAttributes
1.2.1. BasicLocationFunctions_Pkg::add_2_Distances
1.2.2. CalculateTrainPosition_Pkg::nidC_nidBG_2_NIDLRBG [2]
2. CalculateTrainPosition_Pkg::passedBGs_ids_equal
2.1. CalculateTrainPosition_Pkg::nidBG_nidc_equal

# 3. CalculateTrainPosition Project

## 3.1. CalculateTrainPosition_Pkg Package

### 3.1.1. Comments and Information

CalculateTrainPosition_Pkg Comments:

- Incorporates the functions to calculate the actual train position.

Table 1: CalculateTrainPosition_Pkg Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.0 |
| | to_c | True |
| Remark_1 | Description | CalculateTrainPosition<br>- Description: Calculates the actual train position based on passed balise groups<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

### 3.1.2. Types

Table 2: Public Types of CalculateTrainPosition_Pkg

| Name | Definition | Comments and Information |
|---|---|---|
| error_T | {outOfMemSpace : bool, passedBG_notFoundWhereExpected : bool, positionCalculation_inconsistent : bool} | outOfMemSpace Comments:<br>Memory overrun: a passed or announced BG could not be stored<br>passedBG_notFoundWhereExpected Comments:<br>The currently passed linked BG location does not match the expected location<br>positionCalculation_inconsistent Comments:<br>A consistency problem arised during position calculation |

| 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, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country__or__railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}} | |

| Name | Type | Value | Comments and Information |
|---|---|---|---|
| | | {valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetection Inaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_link_telegram, m_version : M_VERSION_Previous_versions_according_to_e_g_EEIG_SRS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1st, n_total : N_TOTAL_1_balise_in_the_group, m_dup : M_DUP_No_duplicates, m_mcount : 0, nid_c : 0, nid_bg : 0, q_link : Q_LINK_Unlinked}, linkedBGs : [{valid : false, nid_LRBG : 0, nid_packet : 0, q_dir : Q_DIR_Reverse, 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, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country__or__railway_administrati | |

| 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}, 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, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country__or__railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}}, infoFromPassing : {valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_link_telegram, m_version : M_VERSION_Previous_versions_according_to_e_g_EEIG_SRS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 | |

| 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}, 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, q_scale : Q_SCALE_10_cm_scale, d_link : 0, q_newcountry : Q_NEWCOUNTRY_Same_country__or__railway_administration_no_NID_C_follows, nid_c : 0, nid_bg : 0, q_linkorientation : Q_LINKORIENTATION_The_balise_group_is_seen_by_the_train_in_reverse_direction, q_linkreaction : Q_LINKREACTION_Train_trip, q_locacc : 0}}, infoFromPassing : {valid : false, timestamp : 0, odometrystamp : {o_nominal : 0, o_min : 0, o_max : 0}, BG_centerDetectionInaccuraccuracies : {nominal : 0, d_min : 0, d_max : 0}, BG_Header : {q_updown : Q_UPDOWN_Down_link_telegram, m_version : M_VERSION_Previous_versions_according_to_e_g_EEIG_SRS_and_UIC_A200_SRS, q_media : Q_MEDIA_Balise, n_pig : N_PIG_I_am_the_1 | |

| Name | Type | Value | Comments and Information |
|---|---|---|---|
| cNoValidIndex | int | -1 | Comments:<br>An invalid index. |
| cTrainPosition_0 | TrainPosition_Types_Pck::trainPosition_T | {valid : false, trainPositionIsUnknown : false, noCoordinateSystemHasBeenAssigned : false, trainPosition : {nominal : 0, d_min : 0, d_max : 0}, estimatedFrontEndPosition : 0, minSafeFrontEndPosition : 0, maxSafeFrontEndPostion : 0, nid_LRBG : 0, nid_PrvLRB : 0, nominalOrReverseToLRBG : Q_DLRBG_Reverse, trainOrientationToLRBG : Q_DIRLRBG_Reverse, trainRunningDirectionToLRBG : Q_DIRTRAIN_Reverse, speed : 0} | |

### 3.1.4. calculateBG_and_trainLocation Operator

Declared as **`private node`**

#### 3.1.4.1. Comments and Information

calculateBG_and_trainLocation Comments:

- Calculation of the location of passed and announced BGs and the actual train position

Table 4: calculateBG_and_trainLocation Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Author : Uwe Steinke |
| | DateC | Created : 2014-15-22 |
| | DateM | Modified : 2014-15-22 |
| | Version | No 00.02.00 |
| | to_c | True |

| Note Name | Attribute | Value |
|---|---|---|
| Remark_1 | Description | The main function calculating the actual train position.<br>- Description: Calculates the actual train position based on passed balise groups<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

### 3.1.4.2. Interface

Table 5: Inputs of calculateBG_and_trainLocation

| Name | Type | Comments and Information |
|---|---|---|
| currentOdometry | TrainPosition_Types_Pck::OdometryLocations_Type | Comments:<br>The current odometry values |
| passedBG | TrainPosition_Types_Pck::passedBG_T | Comments:<br>Input event reporting a balise group during its passage, if there is one. |
| reset | bool | Comments:<br>Resets all to an initials state and deletes all stored BGs. |

Table 6: Outputs of calculateBG_and_trainLocation

| Name | Type | Comments and Information |
|---|---|---|
| trainPositionInfo | TrainPosition_Types_Pck::trainPositionInfo_T | Comments:<br>The resulting train position with reference to the known list of balise groups. |
| BGs | TrainPosition_Types_Pck::positionedBGs_T | Comments:<br>The collection of currently known BGs. |
| errors | CalculateTrainPosition_Pkg::error_T | |

### 3.1.4.3. Locals

Table 7: Locals of calculateBG_and_trainLocation

| Name | Type | Properties | | Comments and Information |
|---|---|---|---|---|
| BGs_loc | TrainPosition_Types_Pck::positionedBGs_T | last | cNoPositionedBGs | |
| outOfMemSpace | bool | | | |

| Name | Type | Properties | | Comments and Information |
|---|---|---|---|---|
| passedBG_notFoundWhereExpected | bool | | | |
| passedLinkedBG | TrainPosition_Types_Pck::positionedBG_T | last | cNoPositionedBG | |
| passedUnlinkedBG | TrainPosition_Types_Pck::positionedBG_T | | | |
| positionCalculationNotConsistent | bool | | | |

#### 3.1.4.4. Operator Hierarchy

diagram : diagram_calculateBG_and_trainLocation
diagram : diagram_errorReporting
diagram : diagram_passing_a_BG

### 3.1.4.5. Graphical and Textual Diagrams

#### 3.1.4.5.1. View of diagram_calculateBG_and_trainLocation (calculateBG_and_trainLocation)

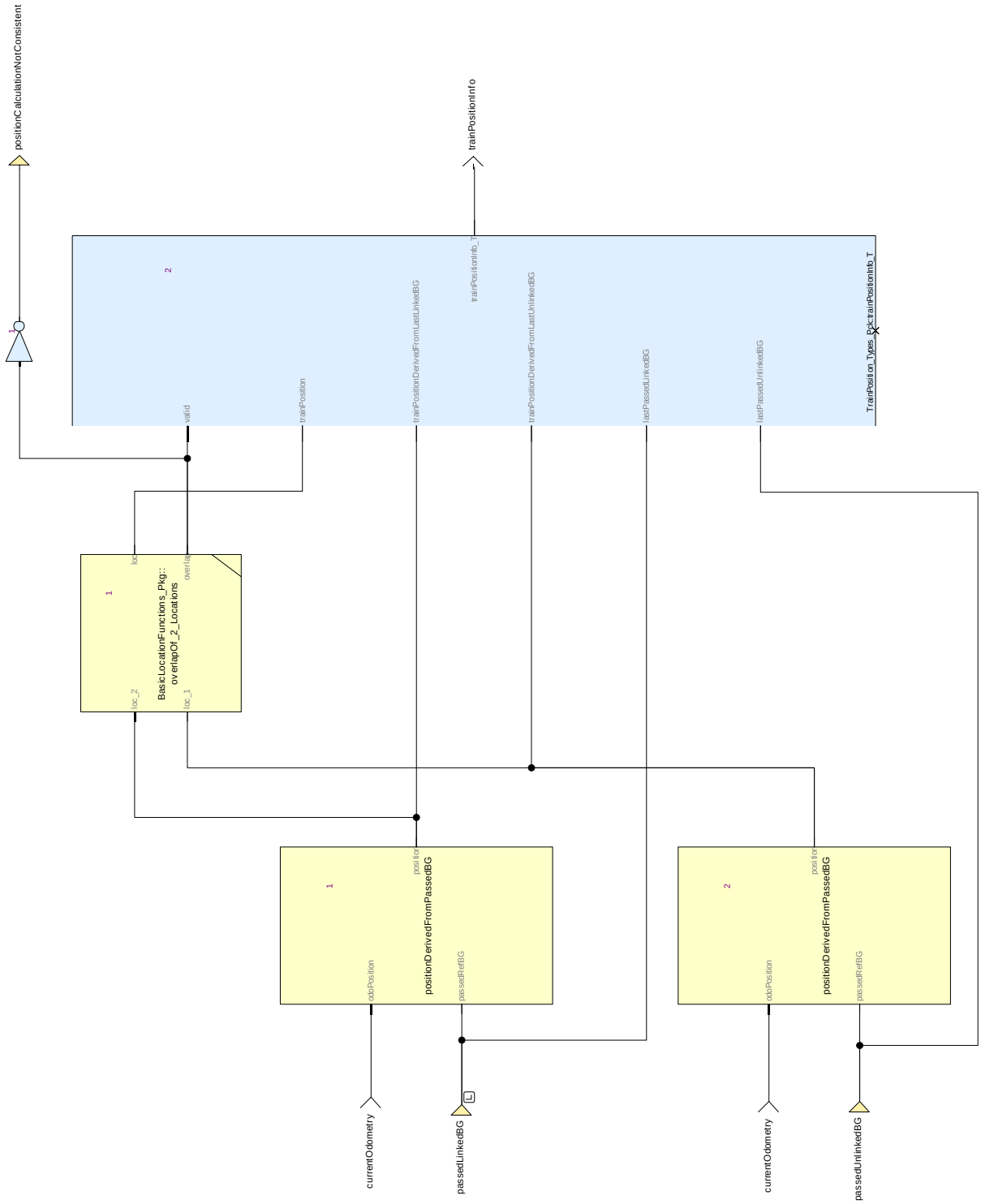


Figure 1: View of diagram_calculateBG_and_trainLocation (calculateBG_and_trainLocation)

### 3.1.4.5.2. View of diagram_errorReporting (calculateBG_and_trainLocation)

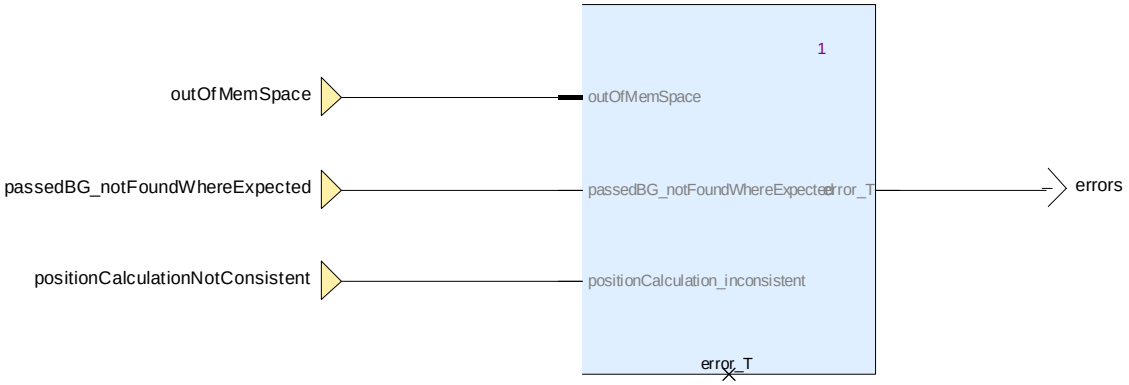


Figure 2: View of diagram_errorReporting (calculateBG_and_trainLocation)

#### 3.1.4.5.3. View of diagram_passing_a_BG (calculateBG_and_trainLocation)

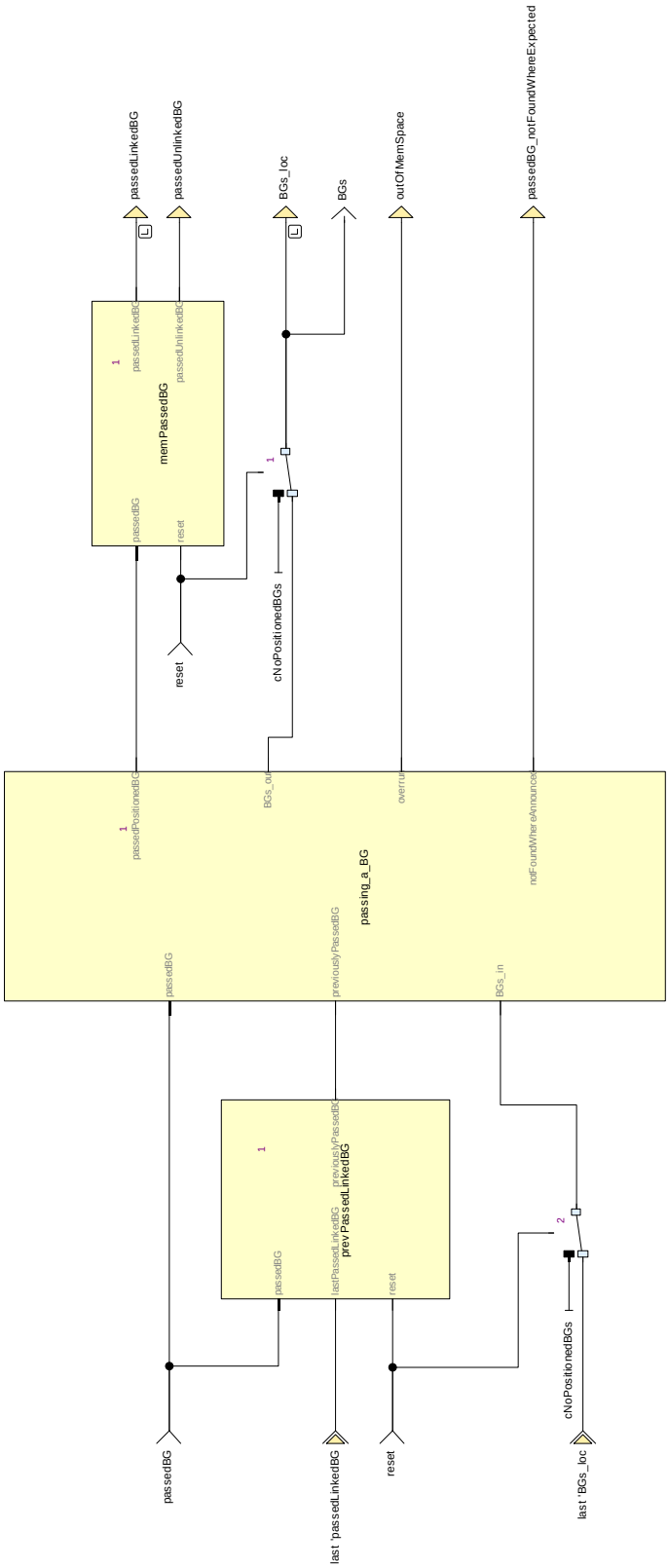


Figure 3: View of diagram_passing_a_BG (calculateBG_and_trainLocation)

## 3.1.5. calculateTrainPosition Operator

Declared as **`public node`**

#### 3.1.5.1. Comments and Information

calculateTrainPosition Comments:

- The main function calculating 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 : 2014-15-22 |
| | Version | No 00.02.00 |
| | to_c | True |
| Remark_1 | Description | The main function calculating the actual train position.<br>- Description: Calculates the actual train position based on passed balise groups<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.5.2. Interface

Table 9: Inputs of calculateTrainPosition

| Name | Type | Properties | Comments and Information |
|---|---|---|---|
| currentSpeed | TrainPosition_Types_Pck::Speed_Type1 | | Comments:<br>The current train speed |
| currentOdometry | TrainPosition_Types_Pck::OdometryLocations_Type | | Comments:<br>The current odometry values |
| passedBG | TrainPosition_Types_Pck::passedBG_T | | Comments:<br>Input event reporting a balise group during its passage, if there is one. |
| LRBG | TrainPosition_Types_Pck::positionedBG_T | | Comments:<br>The LRBG used for RBC communication. |
| prevLRBG | TrainPosition_Types_Pck::positionedBG_T | | Comments:<br>A previously used LRBG used in RBC communication. |

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

Table 10: Outputs of calculateTrainPosition

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

#### 3.1.5.3. Operator Hierarchy

diagram : diagram_calculateTrainPosition

### 3.1.5.4. Graphical and Textual Diagrams

#### 3.1.5.4.1. View of diagram_calculateTrainPosition (calculateTrainPosition)

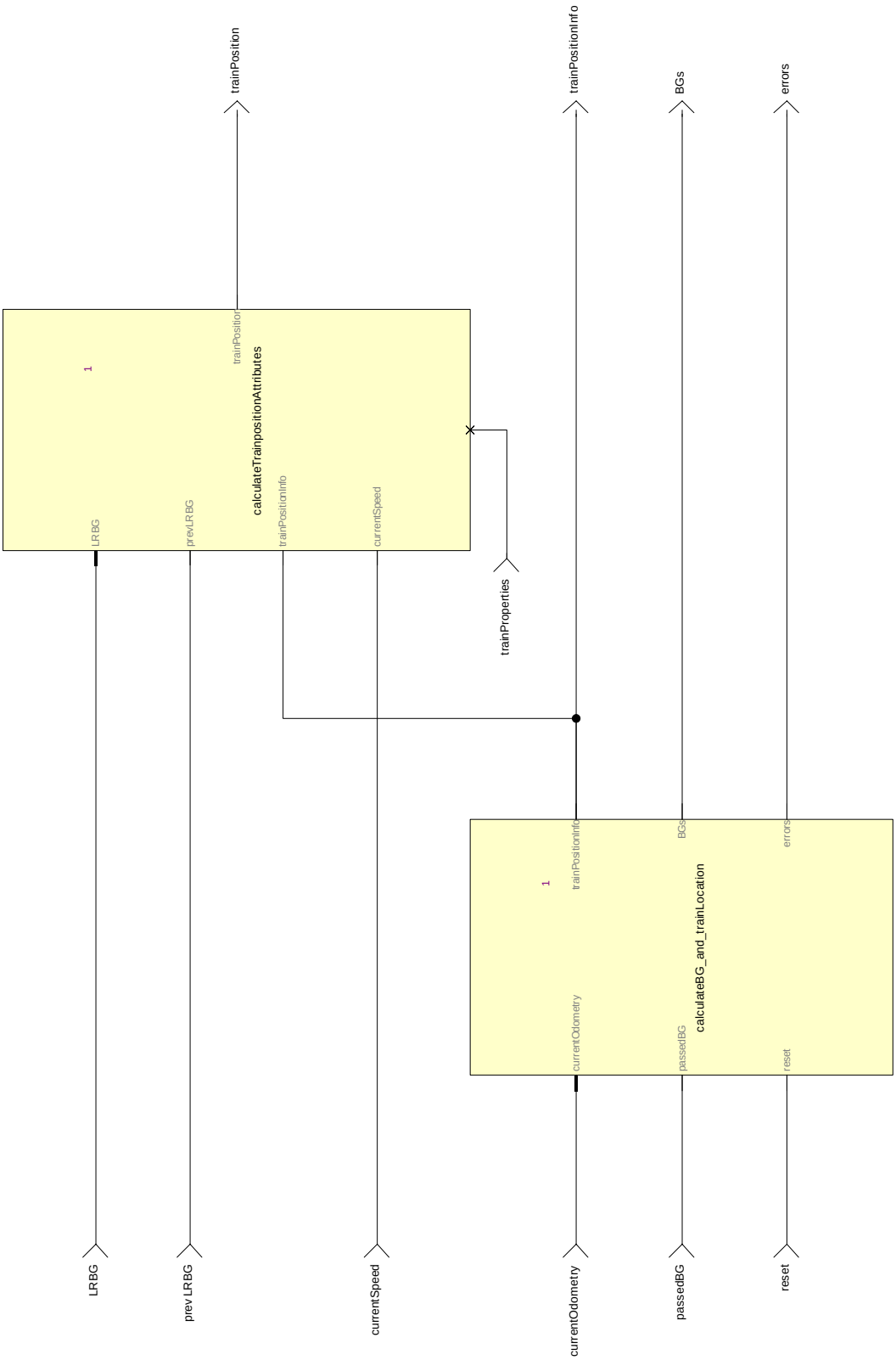


Figure 4: View of diagram_calculateTrainPosition (calculateTrainPosition)

### 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 11: calculateTrainpositionAttributes Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Author : Uwe Steinke |
| | DateC | Created : 2014-15-22 |
| | DateM | Modified : 2014-15-22 |
| | Version | No 00.02.00 |
| | to_c | True |
| Remark_1 | Description | The main function calculating the actual train position.<br>- Description: Calculates the actual train position based on passed balise groups<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.6.2. Interface

Table 12: Inputs of calculateTrainpositionAttributes

| Name | Type | Properties | Comments and Information |
|---|---|---|---|
| LRBG | TrainPosition_Types_Pck::positionedBG_T | | Comments:<br>The LRBG used for RBC communication. |
| prevLRBG | TrainPosition_Types_Pck::positionedBG_T | | Comments:<br>A previously used LRBG used in RBC communication. |
| trainPositionInfo | TrainPosition_Types_Pck::trainPositionInfo_T | | Comments:<br>The resulting train position with reference to the known list of balise groups. |

| Name | Type | Properties | Comments and Information |
|---|---|---|---|
| currentSpeed | TrainPosition_Types_Pck::Speed_Type1 | | |
| trainProperties | TrainPosition_Types_Pck::trainProperties_T | hidden | Comments:<br>The trains properties required for train position calculation. |

Table 13: Outputs of calculateTrainpositionAttributes

| Name | Type | Comments and Information |
|---|---|---|
| trainPosition | TrainPosition_Types_Pck::trainPosition_T | Comments:<br>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)

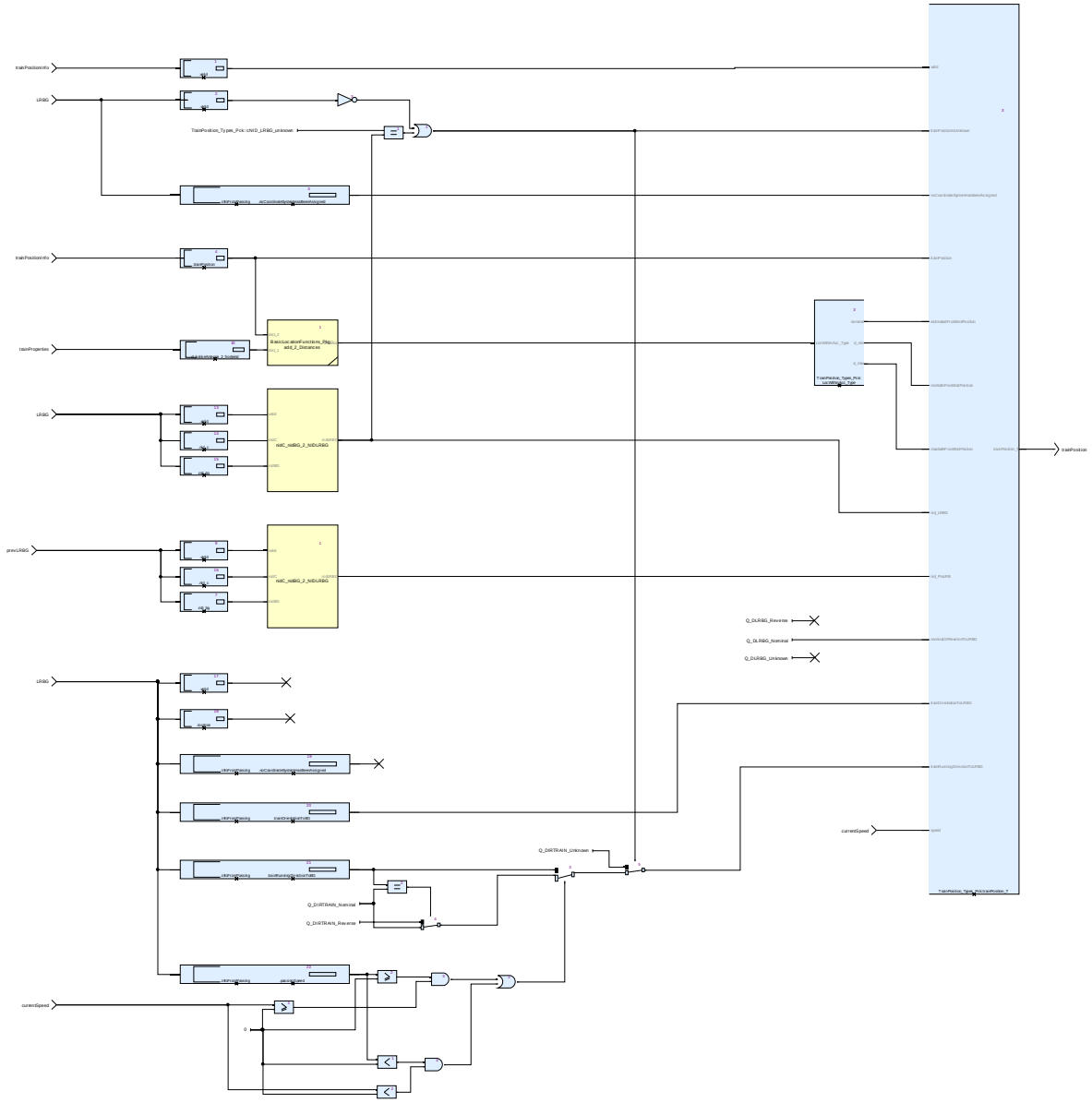

Figure 5: View of diagram_calculateTrainpositionAttributes (calculateTrainpositionAttributes)

## 3.1.7. indexOfBG_by_id Operator

Declared as **`private function`**

### 3.1.7.1. 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 14: 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<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

### 3.1.7.2. Interface

Table 15: Inputs of indexOfBG_by_id

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

Table 16: Outputs of indexOfBG_by_id

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

### 3.1.7.3. Operator Hierarchy

diagram : diagram_indexOfBG_by_id_1

### 3.1.7.4. Graphical and Textual Diagrams

#### 3.1.7.4.1. View of diagram_indexOfBG_by_id_1 (indexOfBG_by_id)

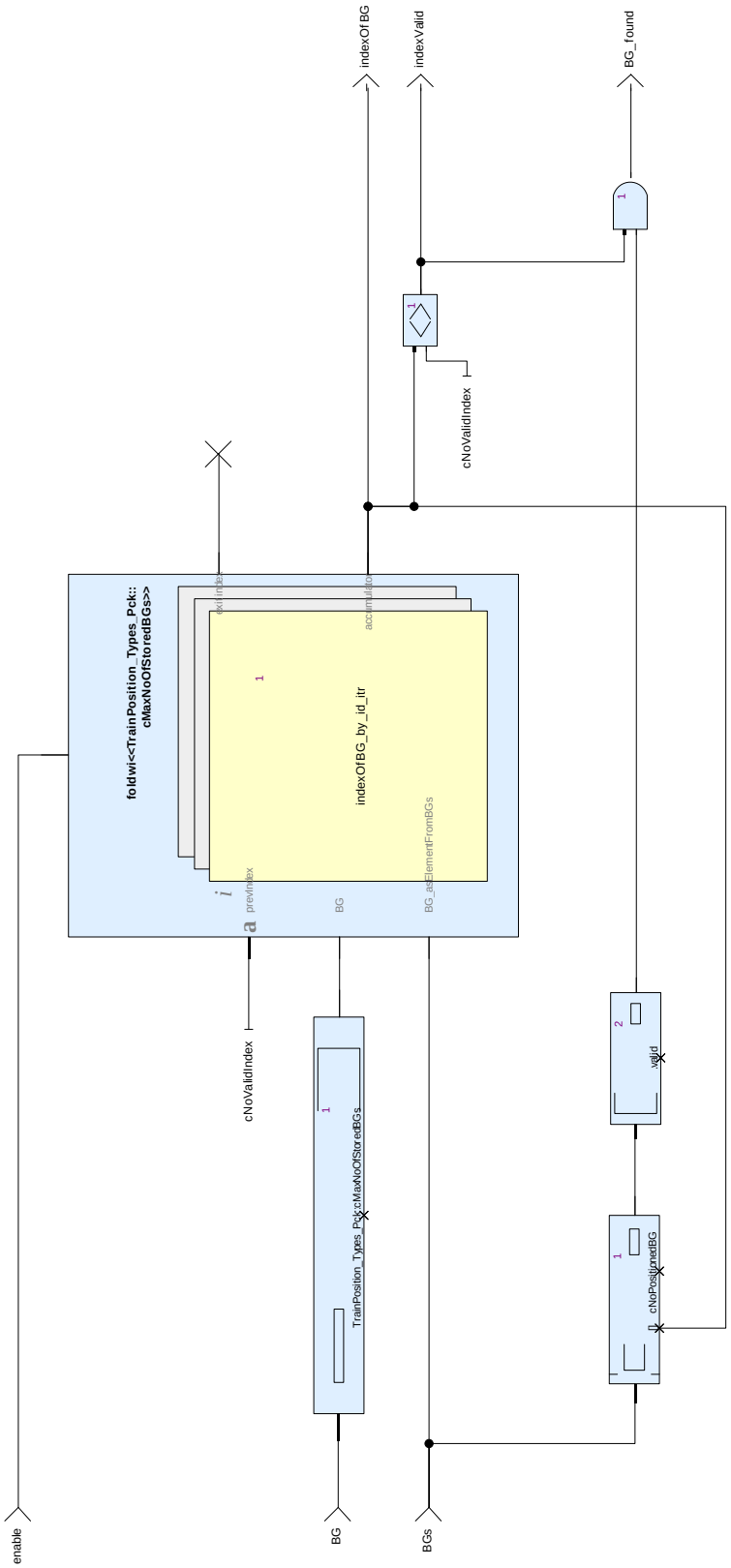


Figure 6: View of diagram_indexOfBG_by_id_1 (indexOfBG_by_id)

### 3.1.8. indexOfBG_by_id_itr Operator

Declared as **`private function`**

#### 3.1.8.1. Comments and Information

indexOfBG_by_id_itr Comments:

- Iterated function for determing the index of BG in BGs

Table 17: indexOfBG_by_id_itr Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | Version : 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Iterated function for determing the index of BG in BGs<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.8.2. Interface

Table 18: 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 19: Outputs of indexOfBG_by_id_itr

| Name | Type | Comments and Information |
|---|---|---|
| cont | bool | |
| indexOfBG | int | |

#### 3.1.8.3. Operator Hierarchy

diagram : diagram_indexOfBG_by_id_itr_1

### 3.1.8.4. Graphical and Textual Diagrams

#### 3.1.8.4.1. View of diagram_indexOfBG_by_id_itr_1 (indexOfBG_by_id_itr)

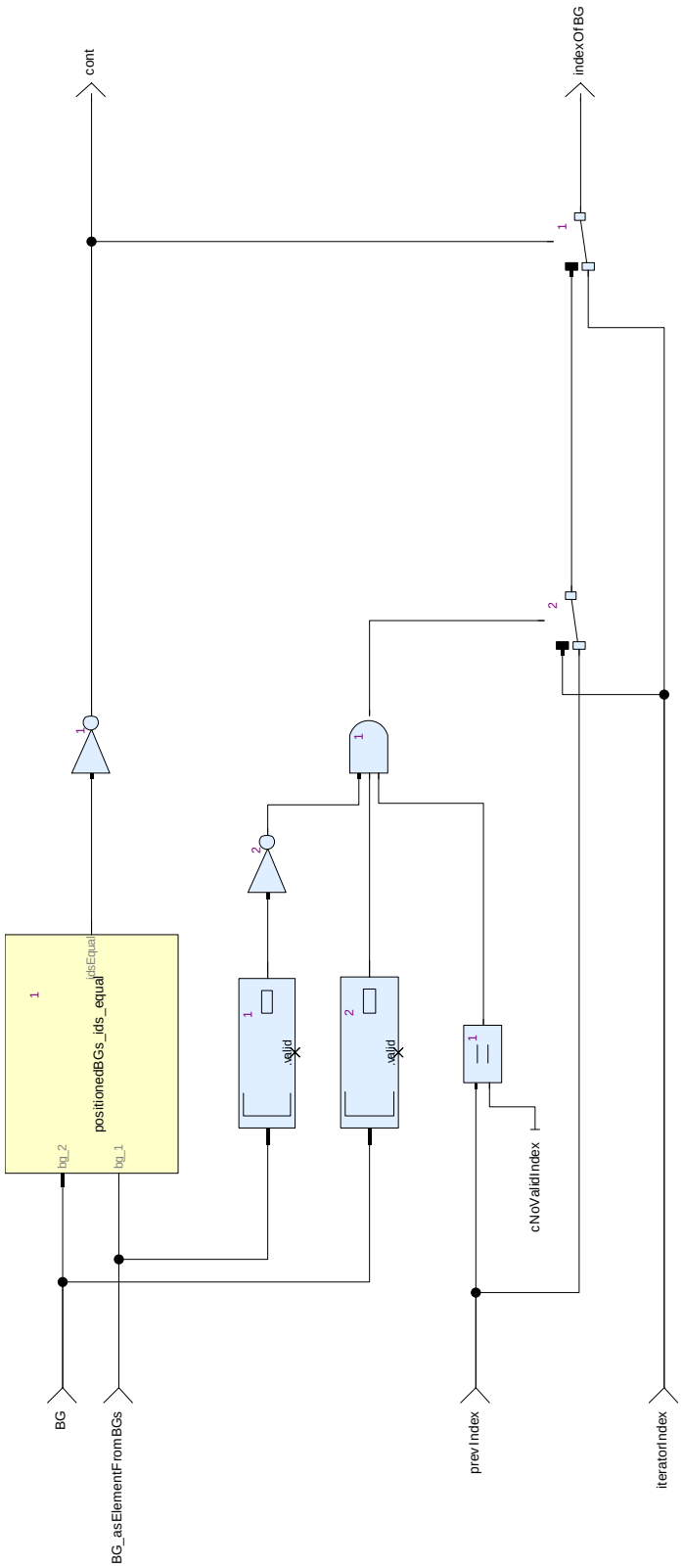


Figure 7: View of diagram_indexOfBG_by_id_itr_1 (indexOfBG_by_id_itr)

### 3.1.9. indexOfPassedBG_by_id Operator

Declared as **`private function`**

#### 3.1.9.1. Comments and Information

indexOfPassedBG_by_id Comments:

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

Table 20: indexOfPassedBG_by_id Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Determines the index of a passed BG in BGs<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.9.2. Interface

Table 21: Inputs of indexOfPassedBG_by_id

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

Table 22: Outputs of indexOfPassedBG_by_id

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

| Name | Type | Comments and Information |
|---|---|---|
| indexValid | bool | Comments:<br>Indicates, that no valid index could be assigned to BG.<br>Practically, this means that there could no place be assigned to BG in BGs. |

#### 3.1.9.3. Operator Hierarchy

diagram : diagram_indexOfPassedBG_by_id_1

### 3.1.9.4. Graphical and Textual Diagrams

#### 3.1.9.4.1. View of diagram_indexOfPassedBG_by_id_1 (indexOfPassedBG_by_id)

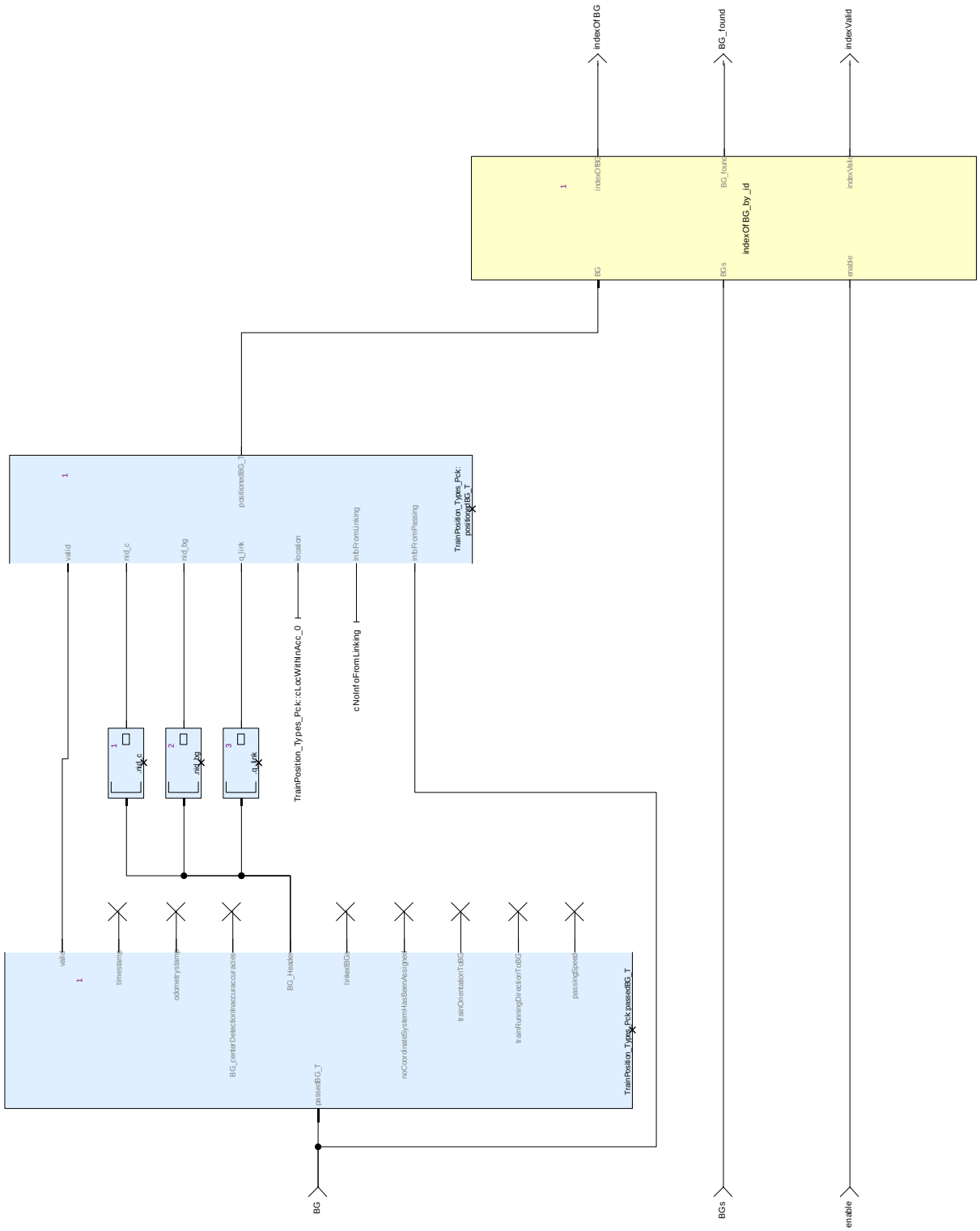


Figure 8: View of diagram_indexOfPassedBG_by_id_1 (indexOfPassedBG_by_id)

## 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 23: memPassedBG Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Memorizes the passed linked and unlinked BG<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

### 3.1.10.2. Interface

Table 24: Inputs of memPassedBG

| Name | Type | Comments and Information |
|---|---|---|
| passedBG | TrainPosition_Types_Pck::positionedBG_T | |
| reset | bool | |

Table 25: Outputs of memPassedBG

| Name | Type | Comments and Information |
|---|---|---|
| passedLinkedBG | TrainPosition_Types_Pck::positionedBG_T | |
| passedUnlinkedBG | TrainPosition_Types_Pck::positionedBG_T | |

### 3.1.10.3. Operator Hierarchy

diagram : diagram_memPassedBG_1

### 3.1.10.4. Graphical and Textual Diagrams

#### 3.1.10.4.1. View of diagram_memPassedBG_1 (memPassedBG)

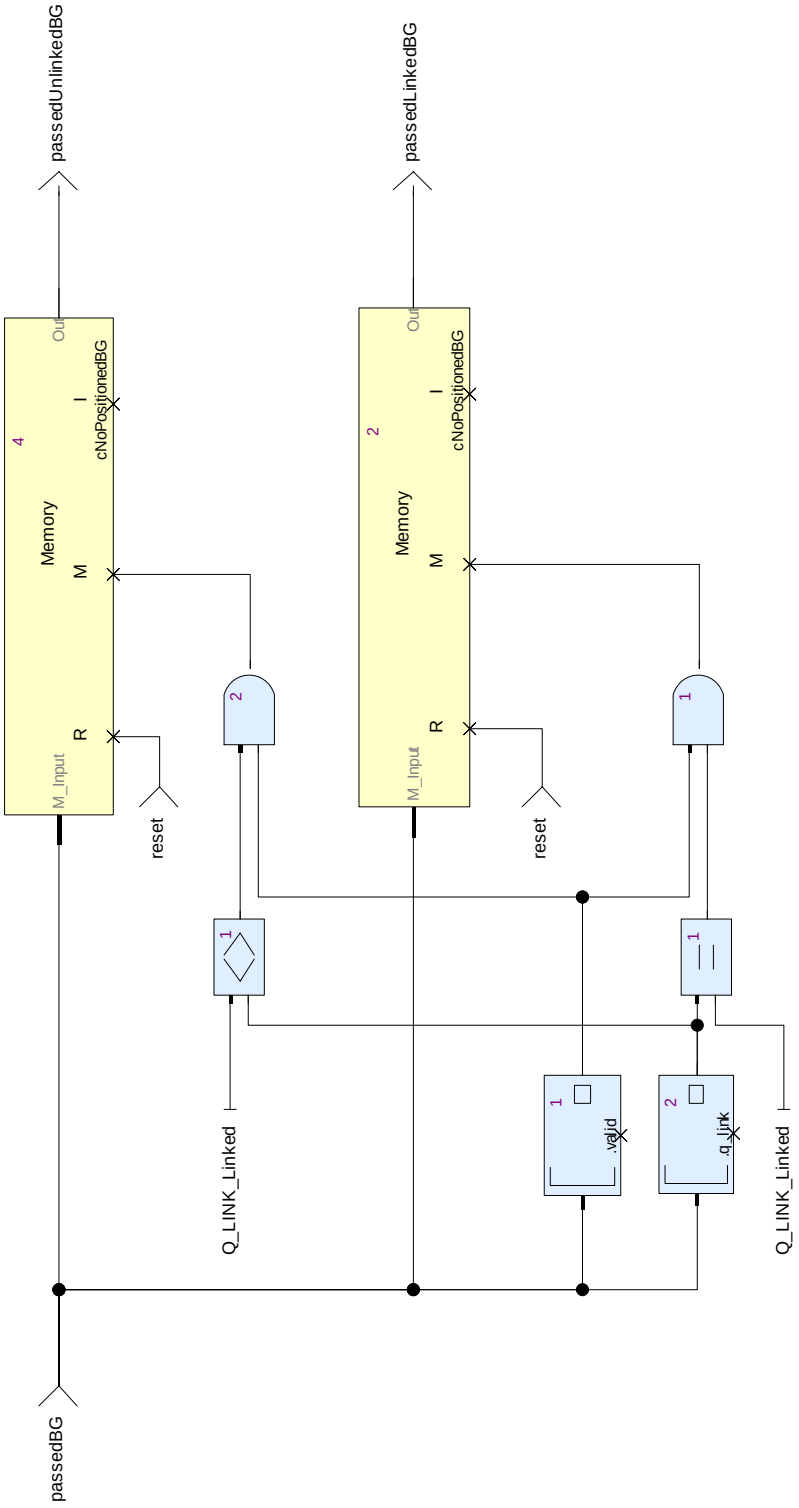


Figure 9: View of diagram_memPassedBG_1 (memPassedBG)

## 3.1.11. mergeBG_by_id Operator

Declared as **`private function`**

#### 3.1.11.1. 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 26: mergeBG_by_id Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Merges a BG into an array of BGs<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.11.2. Interface

Table 27: Inputs of mergeBG_by_id

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

Table 28: Outputs of mergeBG_by_id

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

### 3.1.11.3. Operator Hierarchy

diagram : diagram_mergeBG_by_id_1

### 3.1.11.4. Graphical and Textual Diagrams

#### 3.1.11.4.1. View of diagram_mergeBG_by_id_1 (mergeBG_by_id)

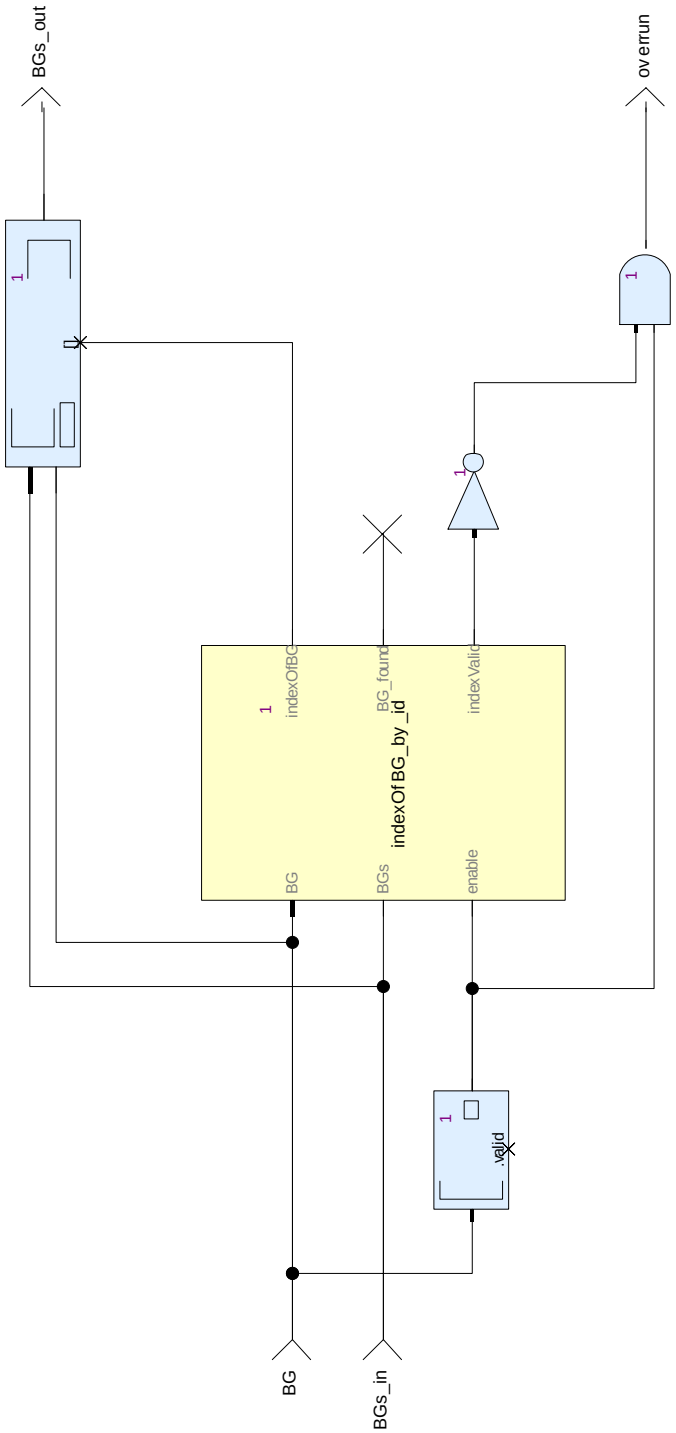


Figure 10: View of diagram_mergeBG_by_id_1 (mergeBG_by_id)

## 3.1.12. mergeBGs_by_id Operator

Declared as **`private function`**

#### 3.1.12.1. 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 29: mergeBGs_by_id Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Merges two arrays of BGs by id.<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.12.2. Interface

Table 30: Inputs of mergeBGs_by_id

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

Table 31: Outputs of mergeBGs_by_id

| Name | Type | Comments and Information |
|---|---|---|
| BGs_out | TrainPosition_Types_Pck::positionedBGs_T | Comments:<br>The resulting array of merged BGs. |

| Name | Type | Comments and Information |
|---|---|---|
| overrun | bool | Comments:<br>Indicates, that not all of the elements of BGs_2 could be merged into BGs_out, due to not enough space in BGs_out. |

#### 3.1.12.3. Operator Hierarchy

diagram : diagram_mergeBGs_by_id_1

### 3.1.12.4. Graphical and Textual Diagrams

#### 3.1.12.4.1. View of diagram_mergeBGs_by_id_1 (mergeBGs_by_id)

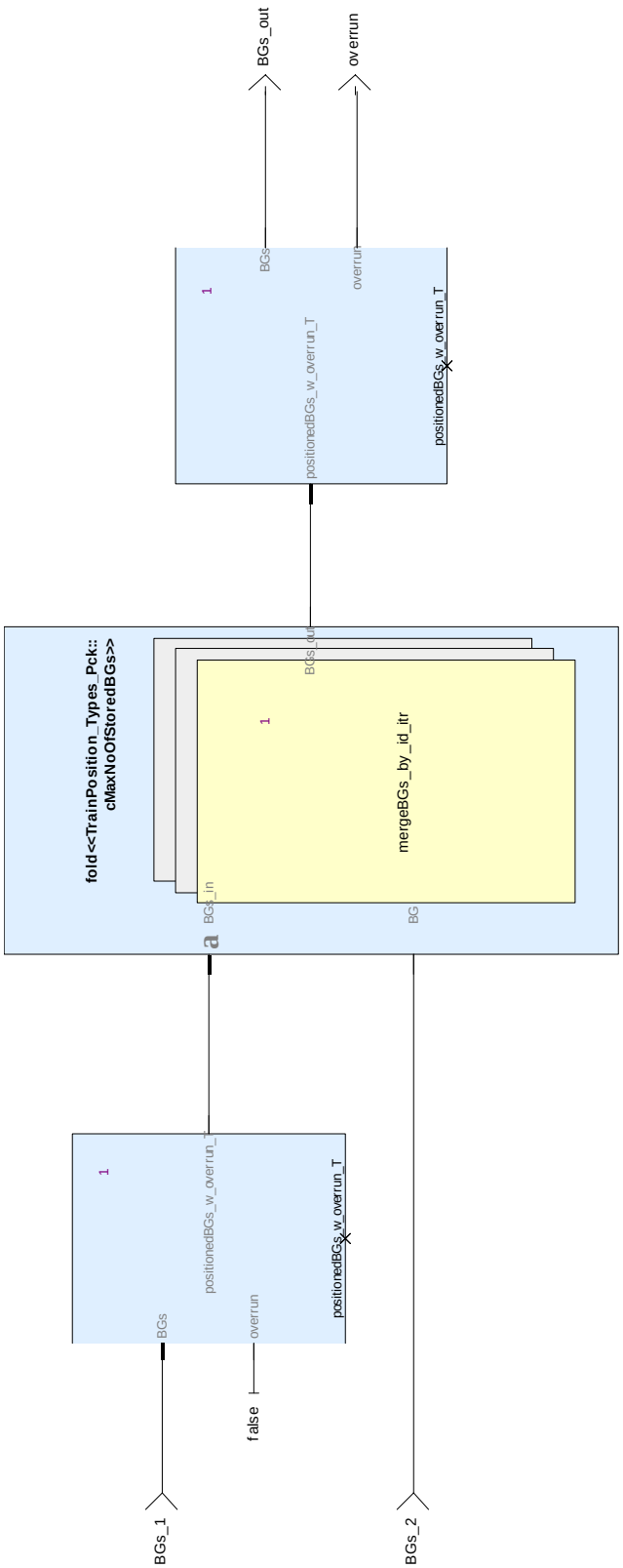


Figure 11: View of diagram_mergeBGs_by_id_1 (mergeBGs_by_id)

### 3.1.13. mergeBGs_by_id_itr Operator

Declared as **`private function`**

#### 3.1.13.1. Comments and Information

mergeBGs_by_id_itr Comments:

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

Table 32: mergeBGs_by_id_itr Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Iterated function for the merge of a BG into an array of BGs.<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.13.2. Interface

Table 33: Inputs of mergeBGs_by_id_itr

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

Table 34: Outputs of mergeBGs_by_id_itr

| Name | Type | Comments and Information |
|---|---|---|
| BGs_out | CalculateTrainPosition_Pkg::positionedBGs_w_overrun_T | Comments:<br>The resulting array of merged BGs. |

#### 3.1.13.3. Operator Hierarchy

diagram : diagram_mergeBGs_by_id_itr_1

### 3.1.13.4. Graphical and Textual Diagrams

#### 3.1.13.4.1. View of diagram_mergeBGs_by_id_itr_1 (mergeBGs_by_id_itr)

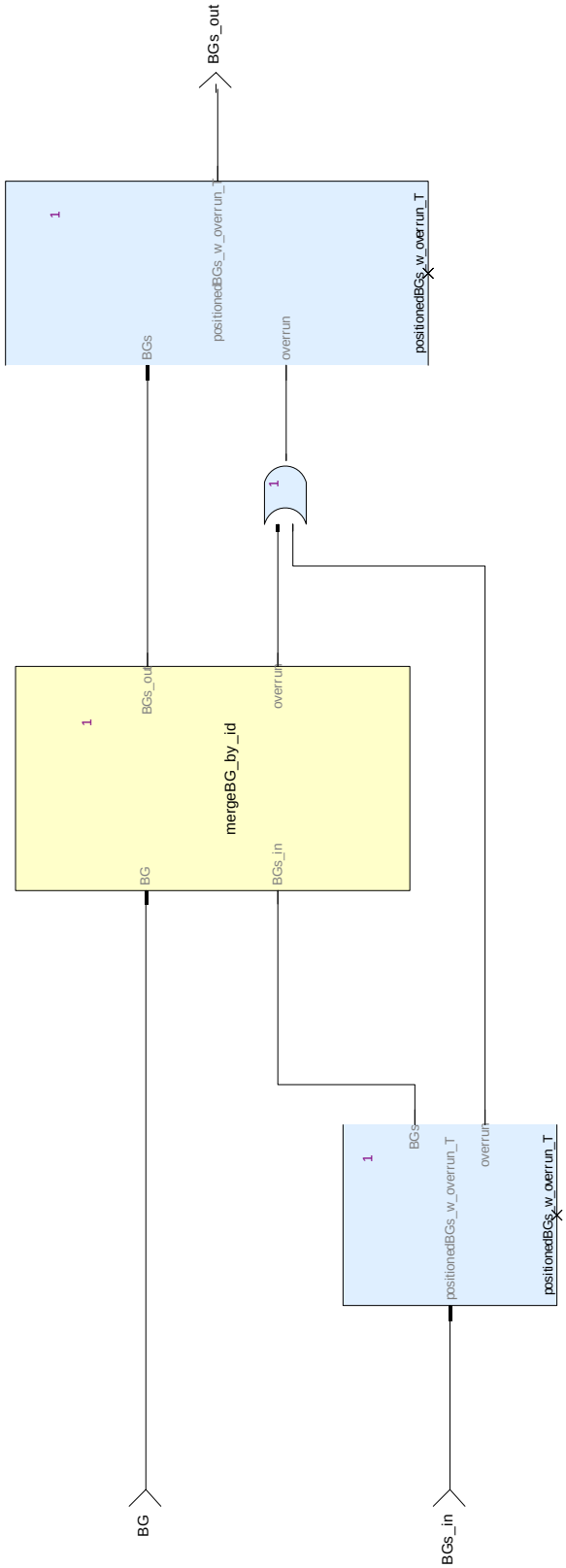


Figure 12: View of diagram_mergeBGs_by_id_itr_1 (mergeBGs_by_id_itr)

### 3.1.14. nidBG_nidc_equal Operator

Declared as **`private function`**

#### 3.1.14.1. 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 35: 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<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.14.2. Interface

Table 36: 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 37: Outputs of nidBG_nidc_equal

| Name | Type | Comments and Information |
|---|---|---|
| isEqual | bool | |

#### 3.1.14.3. Operator Hierarchy

diagram : diagram_nidBG_nidc_equal_1

#### 3.1.14.4. Graphical and Textual Diagrams

##### 3.1.14.4.1. View of diagram_nidBG_nidc_equal_1 (nidBG_nidc_equal)

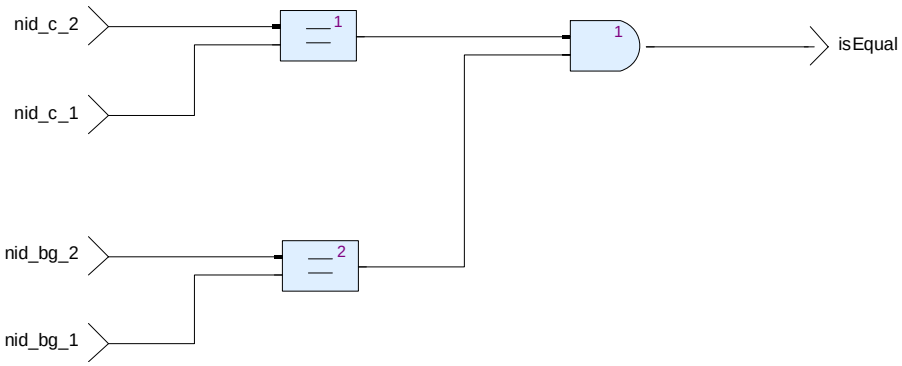


Figure 13: View of diagram_nidBG_nidc_equal_1 (nidBG_nidc_equal)

### 3.1.15. nidC_nidBG_2_NIDLRBG Operator

Declared as **`private function`**

#### 3.1.15.1. Comments and Information

nidC_nidBG_2_NIDLRBG Comments:

- Constructs an NID_LRBG value from NID_C and NID_BG

#### 3.1.15.2. Interface

Table 38: Inputs of nidC_nidBG_2_NIDLRBG

| Name | Type | Comments and Information |
|---|---|---|
| valid | bool | |
| nidC | NID_C | |
| nidBG | NID_BG | |

Table 39: Outputs of nidC_nidBG_2_NIDLRBG

| Name | Type | Comments and Information |
|---|---|---|
| nidLRBG | NID_LRBG | |

#### 3.1.15.3. Operator Hierarchy

diagram : diagram_nidC_nidBG_2_NIDLRBG_1

### 3.1.15.4. Graphical and Textual Diagrams

#### 3.1.15.4.1. View of diagram_nidC_nidBG_2_NIDLRBG_1 (nidC_nidBG_2_NIDLRBG)

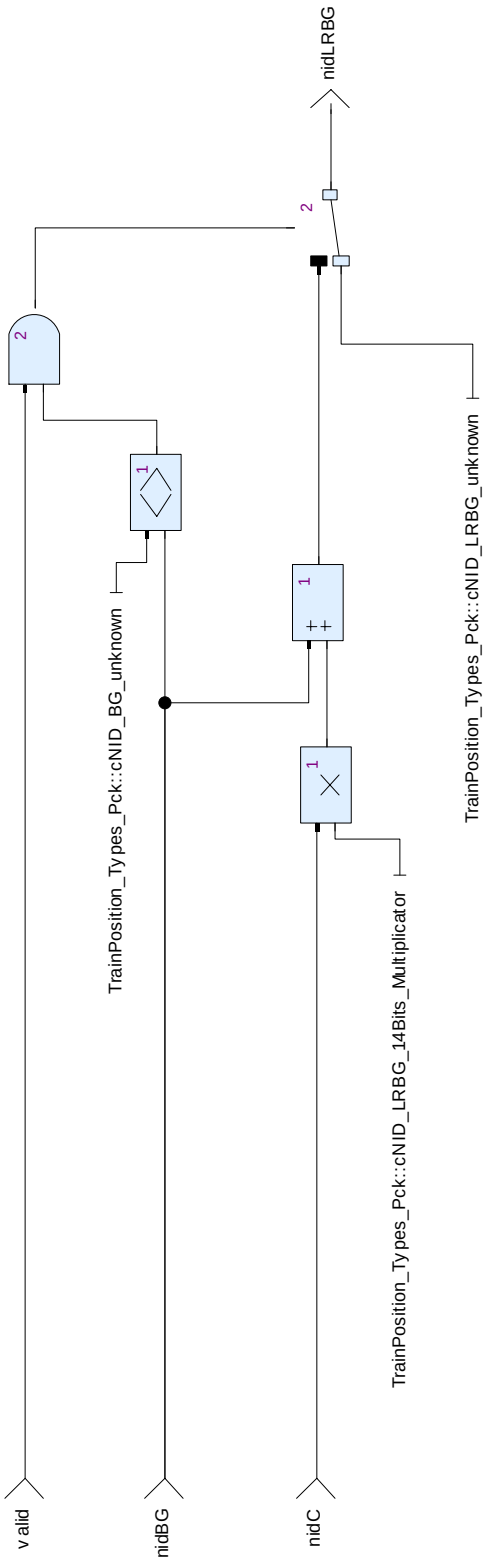


Figure 14: View of diagram_nidC_nidBG_2_NIDLRBG_1 (nidC_nidBG_2_NIDLRBG)

## 3.1.16. passedBG_2_positionedBG Operator

Declared as **`private function`**

### 3.1.16.1. 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 40: passedBG_2_positionedBG Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Converts a passed balise group to a positioned balise group information<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

### 3.1.16.2. Interface

Table 41: Inputs of passedBG_2_positionedBG

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

Table 42: Outputs of passedBG_2_positionedBG

| Name | Type | Properties | | Comments and Information |
|---|---|---|---|---|
| passedPositionedBG | TrainPosition_Types_Pck::positionedBG_T | | | Comments:<br>The passed and positioned balise group.<br>If the BG was announced by linking information previously, the linking and the passing information are merged together.<br>If the BG was not announced before, only the passing information is evaluated. |
| notFoundWhereAnnounced | bool | default | false | Comments:<br>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:<br>The balise groups linked with the passed BG. |

### 3.1.16.3. Locals

Table 43: Locals of passedBG_2_positionedBG

| Name | Type | Comments and Information |
|---|---|---|
| BG_wasAnnounced | bool | Comments:<br>Indicates, that the BG was previously announced with linking information and the signature is consistent. |
| location | TrainPosition_Types_Pck::LocWithInAcc_Type | |
| passedPositionedBG_loc | TrainPosition_Types_Pck::positionedBG_T | |

### 3.1.16.4. 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

### 3.1.16.5. Graphical and Textual Diagrams

#### 3.1.16.5.1. View of diagram_calculateDistance (passedBG_2_positionedBG)

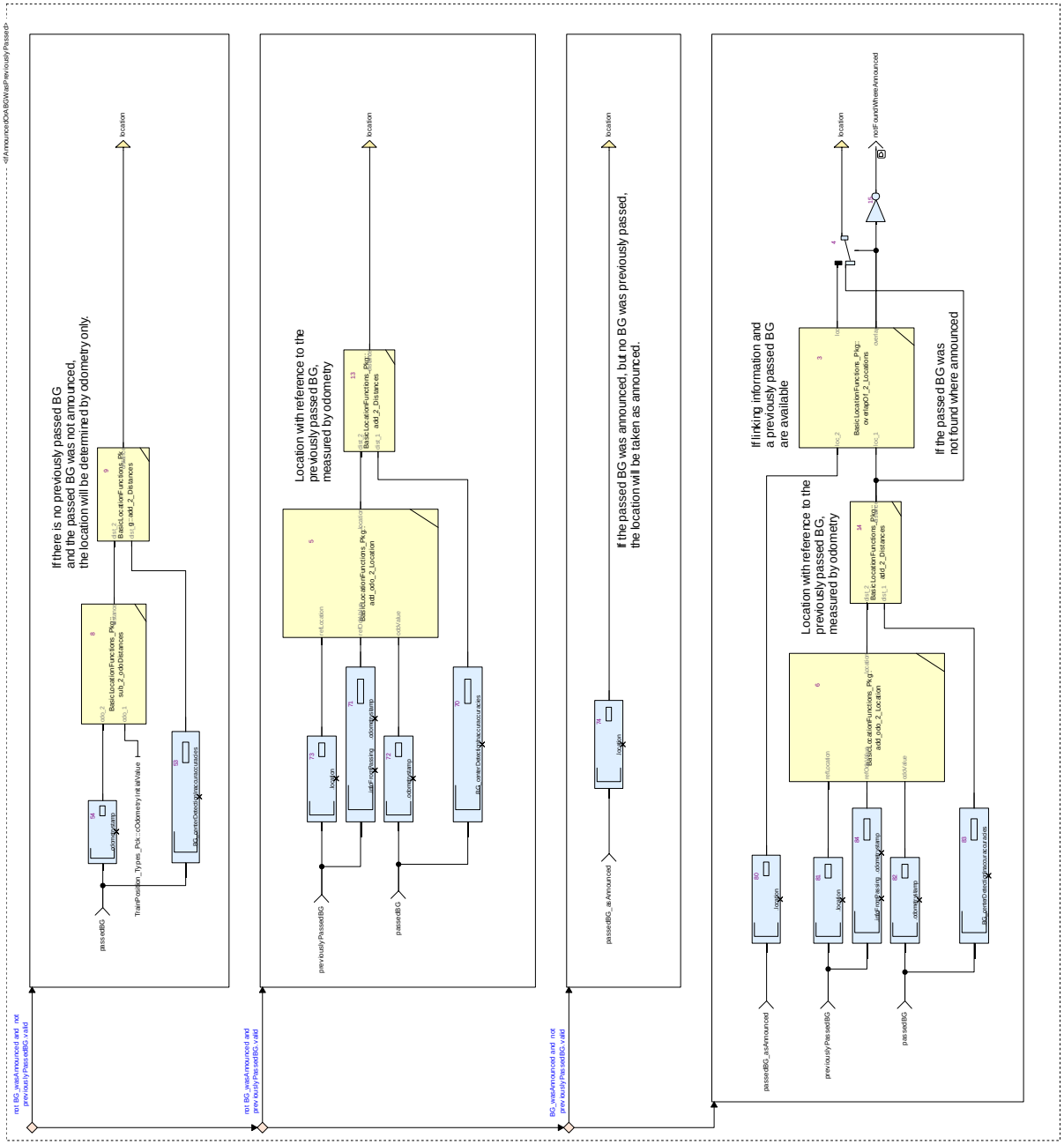


Figure 15: View of diagram_calculateDistance (passedBG_2_positionedBG)

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 44: Conditional Blocks of diagram_calculateDistance

| Conditional Block | Comments and Information |
|---|---|
| ifAnnouncedOrABGWasPreviouslyPassed | |

Table 45: Actions of diagram_calculateDistance

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

### 3.1.16.5.2. View of diagram_checkAnnouncedInfo (passedBG_2_positionedBG)

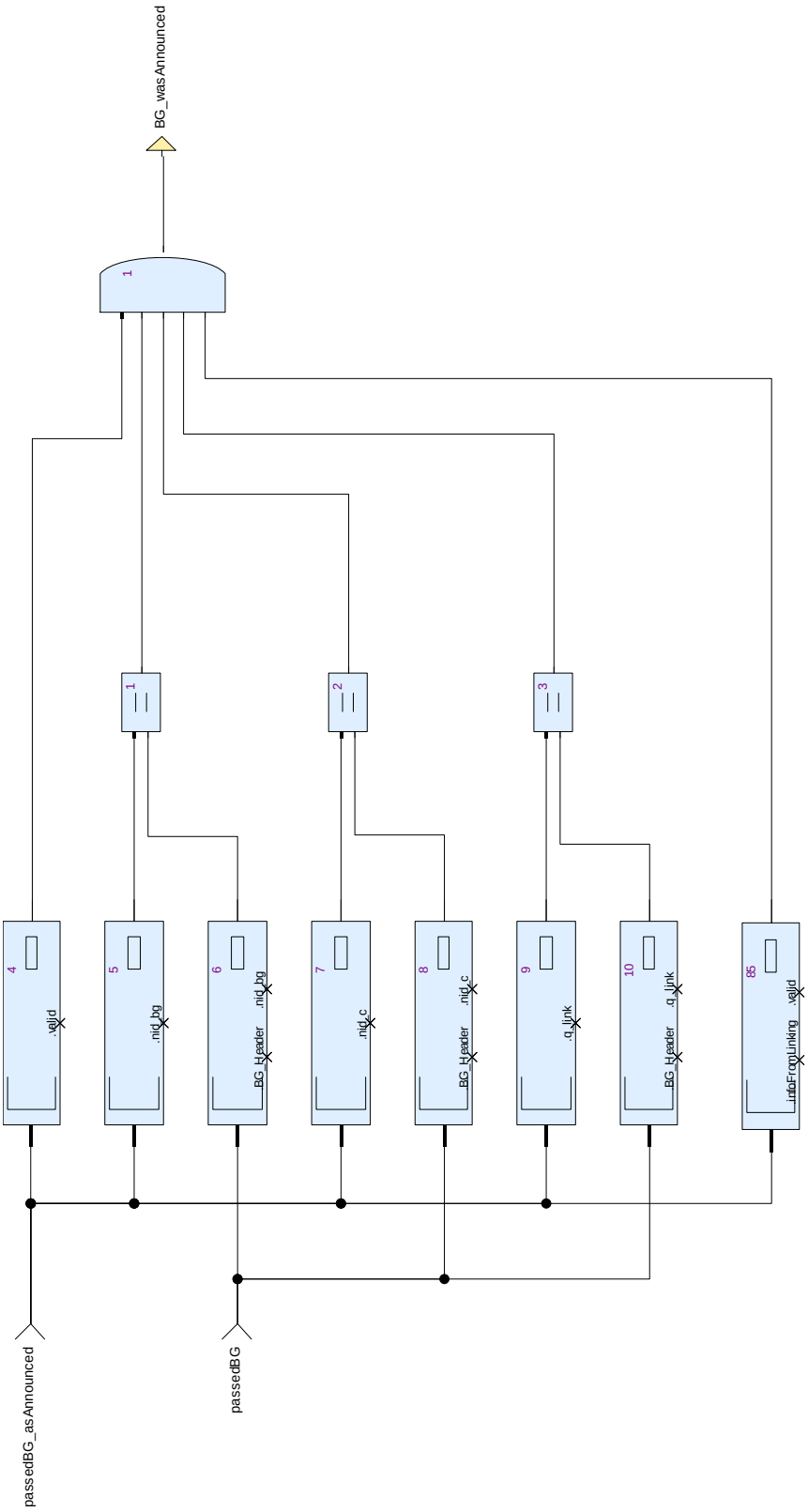


Figure 16: View of diagram_checkAnnouncedInfo (passedBG_2_positionedBG)

diagram_checkAnnouncedInfo Comments:

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

### 3.1.16.5.3. View of diagram_passedBG_2_positionedBG (passedBG_2_positionedBG)

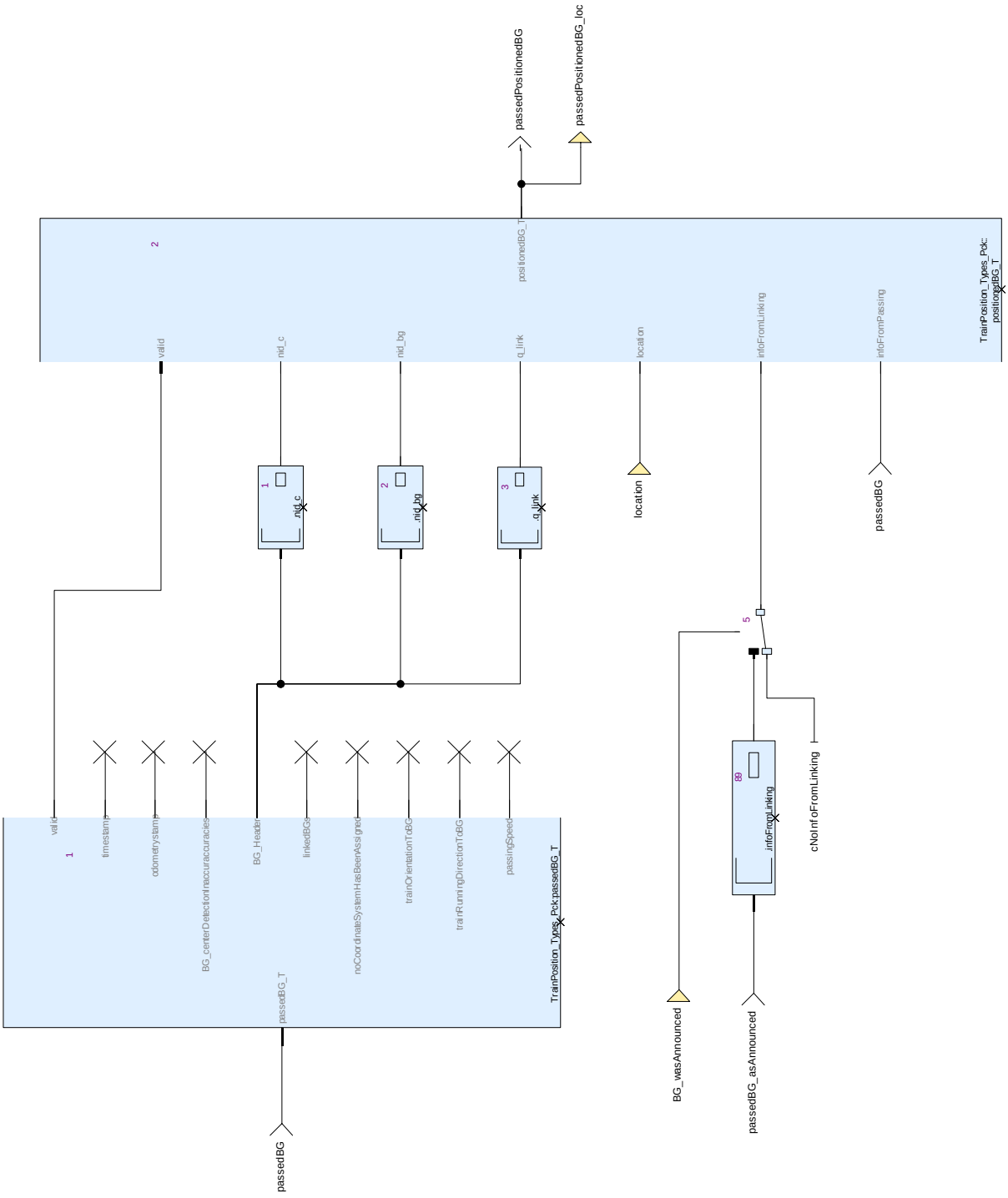


Figure 17: View of diagram_passedBG_2_positionedBG (passedBG_2_positionedBG)

#### 3.1.16.5.4. View of diagram_positionLinkedBGs (passedBG_2_positionedBG)

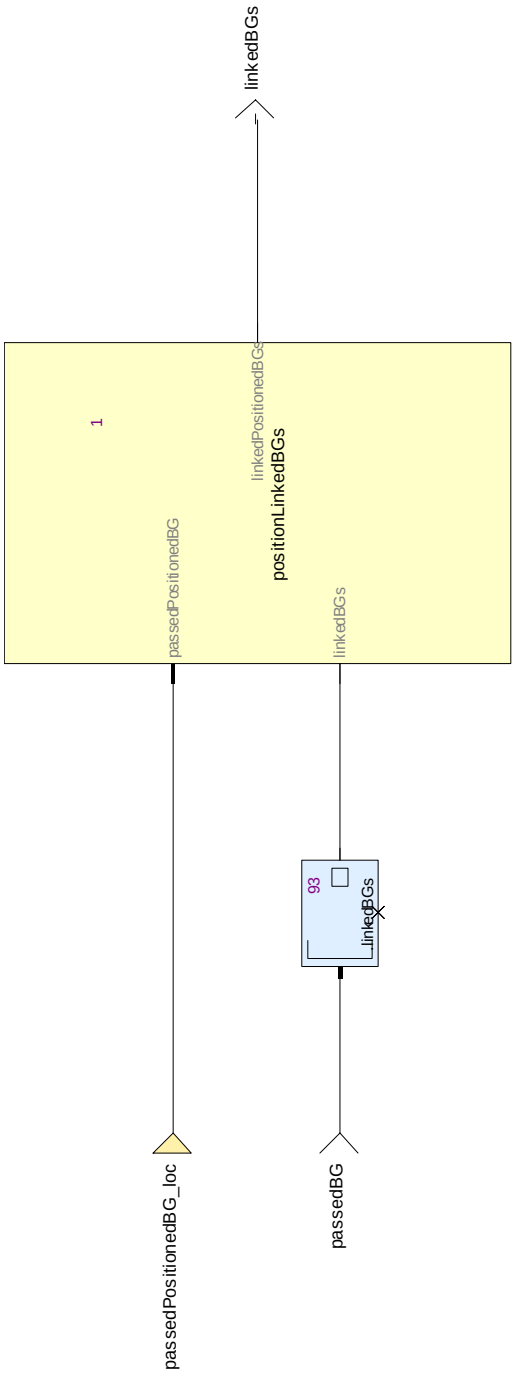


Figure 18: View of diagram_positionLinkedBGs (passedBG_2_positionedBG)

### 3.1.17. passedBGs_ids_equal Operator

Declared as **`private function`**

#### 3.1.17.1. 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 46: passedBGs_ids_equal Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Checks if the ids of 2 BG are equal by comparing their NID_BG and NID_C values.<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

### 3.1.17.2. Interface

Table 47: Inputs of passedBGs_ids_equal

| Name | Type | Comments and Information |
|---|---|---|
| bg_2 | TrainPosition_Types_Pck::passedBG_T | |
| bg_1 | TrainPosition_Types_Pck::passedBG_T | |

Table 48: Outputs of passedBGs_ids_equal

| Name | Type | Comments and Information |
|---|---|---|
| idsEqual | bool | |
| idsDifferent | bool | |

### 3.1.17.3. Operator Hierarchy

diagram : diagram_passedBGs_ids_equal_1

### 3.1.17.4. Graphical and Textual Diagrams

#### 3.1.17.4.1. View of diagram_passedBGs_ids_equal_1 (passedBGs_ids_equal)

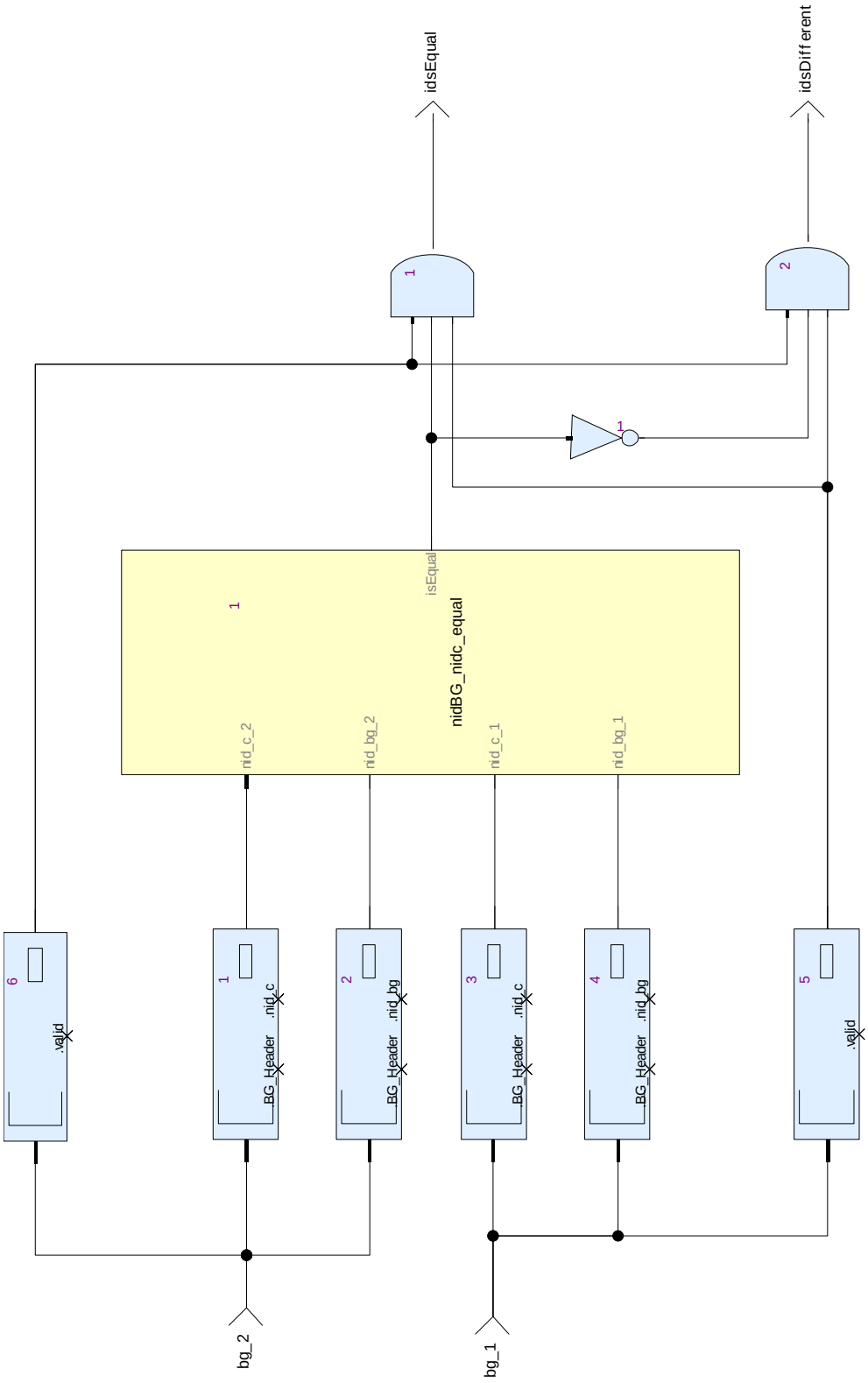


Figure 19: View of diagram_passedBGs_ids_equal_1 (passedBGs_ids_equal)

## 3.1.18. passing_a_BG Operator

Declared as **`private function`**

### 3.1.18.1. Comments and Information

passing_a_BG Comments:

- Provides the location calculations while passing a BG

Table 49: passing_a_BG Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Provides the location calculations while passing a BG<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

### 3.1.18.2. Interface

Table 50: Inputs of passing_a_BG

| Name | Type | Comments and Information |
|---|---|---|
| passedBG | TrainPosition_Types_Pck::passedBG_T | |
| previouslyPassedBG | TrainPosition_Types_Pck::positionedBG_T | Comments:<br>The previously passed BG, if there is one.<br>Serves a reference point for location calculation. |
| BGs_in | TrainPosition_Types_Pck::positionedBGs_T | Comments:<br>The collection of BGs as known before passedBG was passed. |

Table 51: Outputs of passing_a_BG

| Name | Type | Comments and Information |
|---|---|---|
| passedPositionedBG | TrainPosition_Types_Pck::positionedBG_T | Comments:<br>The passed and positioned balise group.<br>If the BG was announced by linking information previously, the linking and the passing information are merged together.<br>If the BG was not announced before, only the passing information is evaluated. |
| BGs_out | TrainPosition_Types_Pck::positionedBGs_T | Comments:<br>The collection of BGs as known when passedBG was passed. |
| overrun | bool | Comments:<br>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:<br>Indicates that the location of the passed BG does not fit into the range, where it was expected by the linking information. |

### 3.1.18.3. Operator Hierarchy

diagram : diagram_passing_a_BG_1

### 3.1.18.4. Graphical and Textual Diagrams

#### 3.1.18.4.1. View of diagram_passing_a_BG_1 (passing_a_BG)

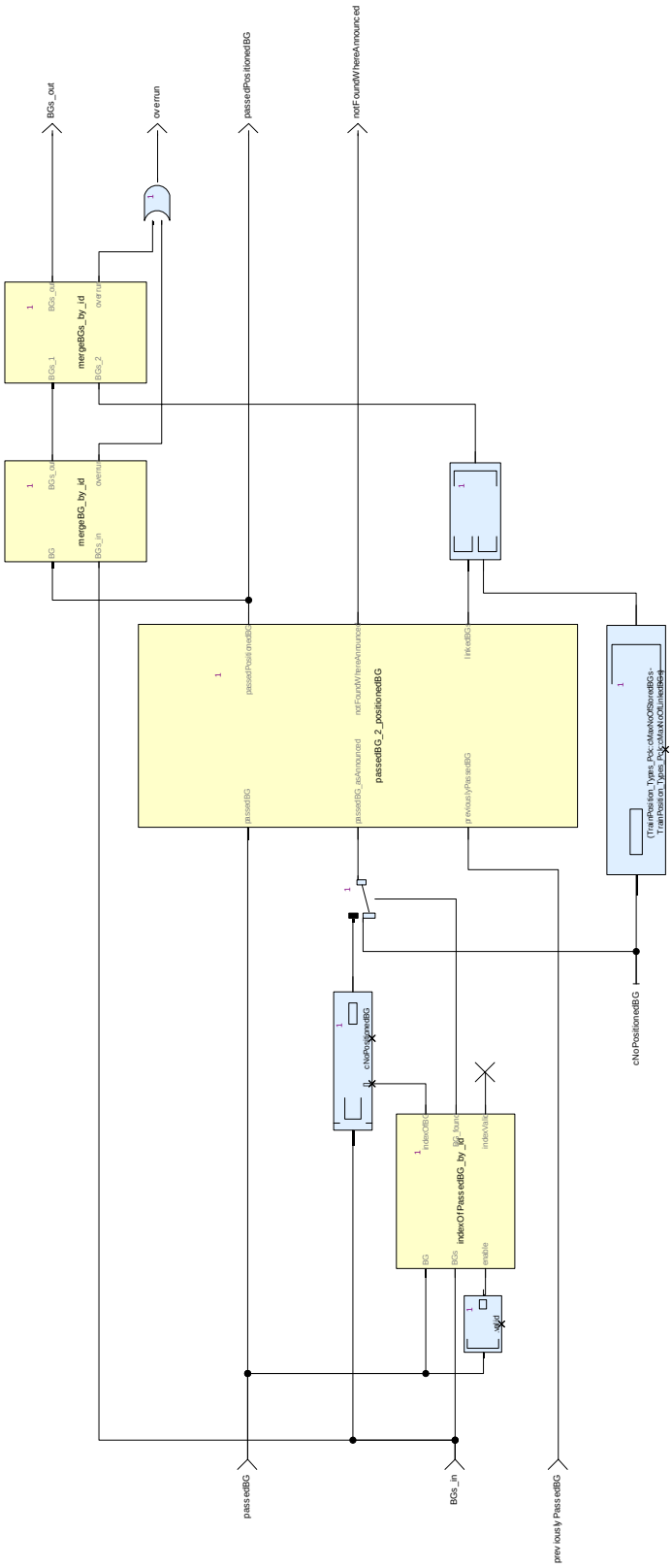


Figure 20: View of diagram_passing_a_BG_1 (passing_a_BG)

### 3.1.19. positionDerivedFromPassedBG Operator

Declared as **`private function`**

#### 3.1.19.1. 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 52: positionDerivedFromPassedBG Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Calculates the train position on the base of the odometry and a passed reference BG.<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.19.2. Interface

Table 53: Inputs of positionDerivedFromPassedBG

| Name | Type | Comments and Information |
|---|---|---|
| odoPosition | TrainPosition_Types_Pck::OdometryLocations_Type | Comments:<br>The position measured by odometry |
| passedRefBG | TrainPosition_Types_Pck::positionedBG_T | Comments:<br>The passed reference BG.<br>Important: this BG must have been passed already, since its odometry values must be known. |

Table 54: Outputs of positionDerivedFromPassedBG

| Name | Type | Comments and Information |
|---|---|---|
| position | TrainPosition_Types_Pck::LocWithInAcc_Type | Comments:<br>The resulting position. |

### 3.1.19.3. Operator Hierarchy

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

### 3.1.19.4. Graphical and Textual Diagrams

#### 3.1.19.4.1. View of diagram_positionDerivedFromPassedBG_1 (positionDerivedFromPassedBG)

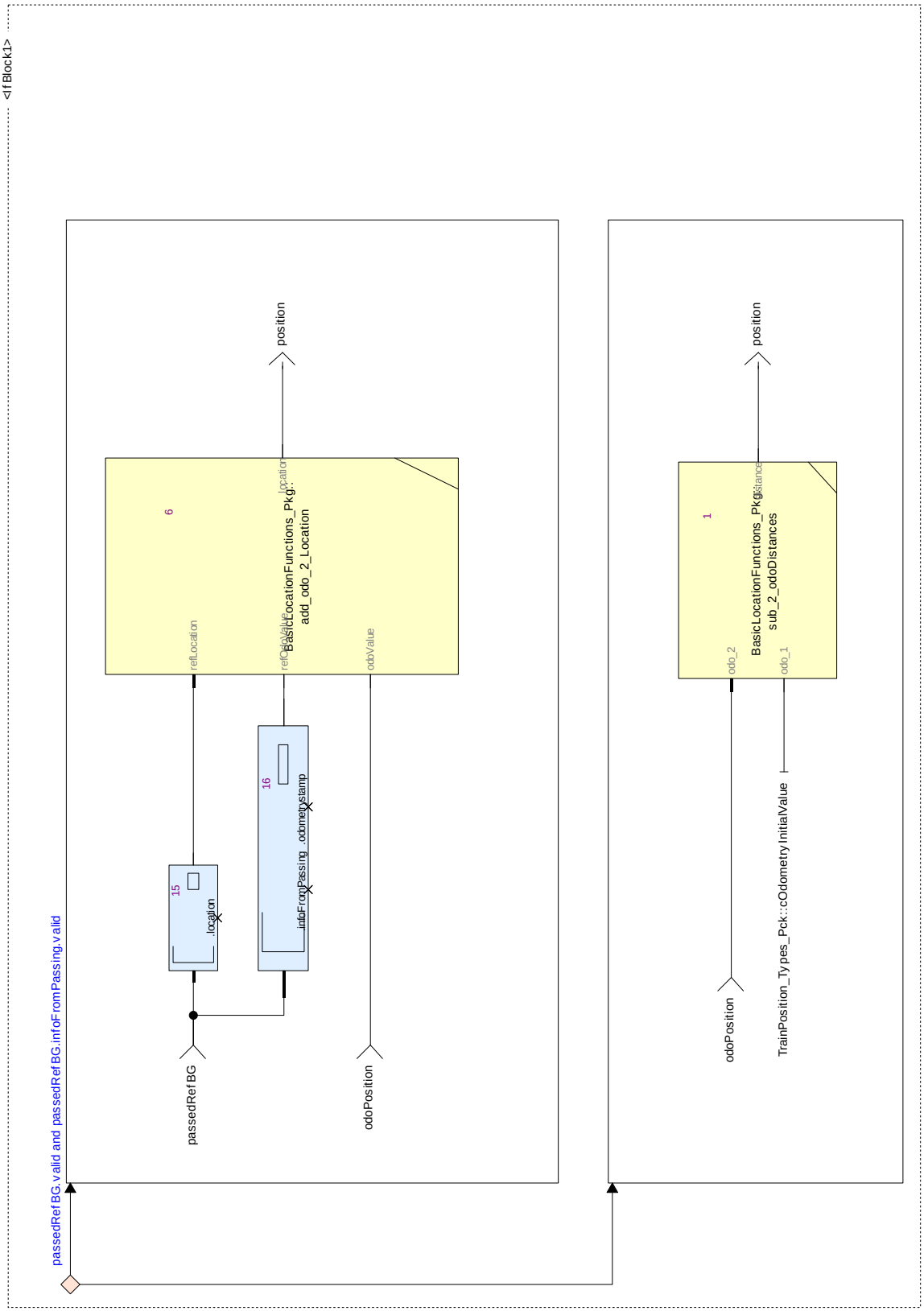


Figure 21: View of diagram_positionDerivedFromPassedBG_1 (positionDerivedFromPassedBG)

Table 55: Conditional Blocks of diagram_positionDerivedFromPassedBG_1

| Conditional Block | Comments and Information |
|---|---|
| IfBlock1 | |

Table 56: Actions of diagram_positionDerivedFromPassedBG_1

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

### 3.1.20. positionedBGs_ids_equal Operator

Declared as **`private function`**

#### 3.1.20.1. 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 57: positionedBGs_ids_equal Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Checks if the ids of 2 BG are equal by comparing their NID_BG and NID_C values.<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

### 3.1.20.2. Interface

Table 58: 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 59: Outputs of positionedBGs_ids_equal

| Name | Type | Comments and Information |
|---|---|---|
| idsEqual | bool | |

### 3.1.20.3. Operator Hierarchy

diagram : diagram_positionedBGs_ids_equal_1

### 3.1.20.4. Graphical and Textual Diagrams

#### 3.1.20.4.1. View of diagram_positionedBGs_ids_equal_1 (positionedBGs_ids_equal)

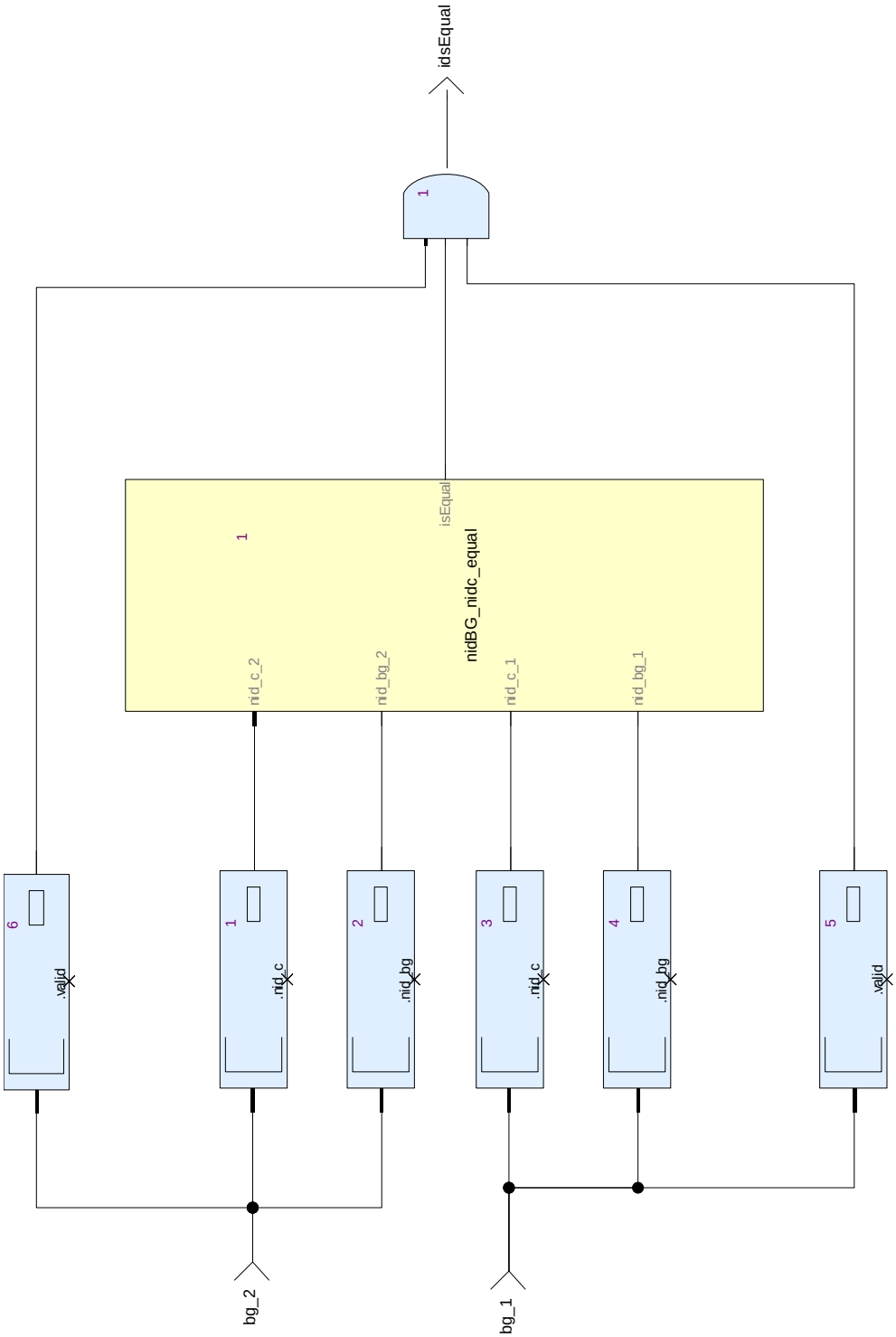


Figure 22: View of diagram_positionedBGs_ids_equal_1 (positionedBGs_ids_equal)

## 3.1.21. positionLinkedBG_itr Operator

Declared as **`private function`**

#### 3.1.21.1. Comments and Information

positionLinkedBG_itr Comments:

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

Table 60: positionLinkedBG_itr Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Iterated function for the conversion of the linking information, received while passing a BG into an announced (= linked positioned) BG.<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.21.2. Interface

Table 61: Inputs of positionLinkedBG_itr

| Name | Type | Comments and Information |
|---|---|---|
| prevLinkedBGLocation | TrainPosition_Types_Pck::LocWithInAcc_Type | Comments:<br>Location of the previous linked BG in the chain of linked BGs. |
| passedPositionedBG | TrainPosition_Types_Pck::positionedBG_T | Comments:<br>The actually passed BG, where the linking information originates from. |
| linkedBG | TrainPosition_Types_Pck::LinkedBG_T | Comments:<br>One of the linked BG, announced by the passed BG. |

Table 62: Outputs of positionLinkedBG_itr

| Name | Type | Comments and Information |
|---|---|---|
| location | TrainPosition_Types_Pck::LocWithInAcc_Type | |

| Name | Type | Comments and Information |
|---|---|---|
| linkedPositionedBG | TrainPosition_Types_Pck::positionedBG_T | |

#### 3.1.21.3. Operator Hierarchy

diagram : diagram_positionLinkedBG_itr_1

### 3.1.21.4. Graphical and Textual Diagrams

#### 3.1.21.4.1. View of diagram_positionLinkedBG_itr_1 (positionLinkedBG_itr)

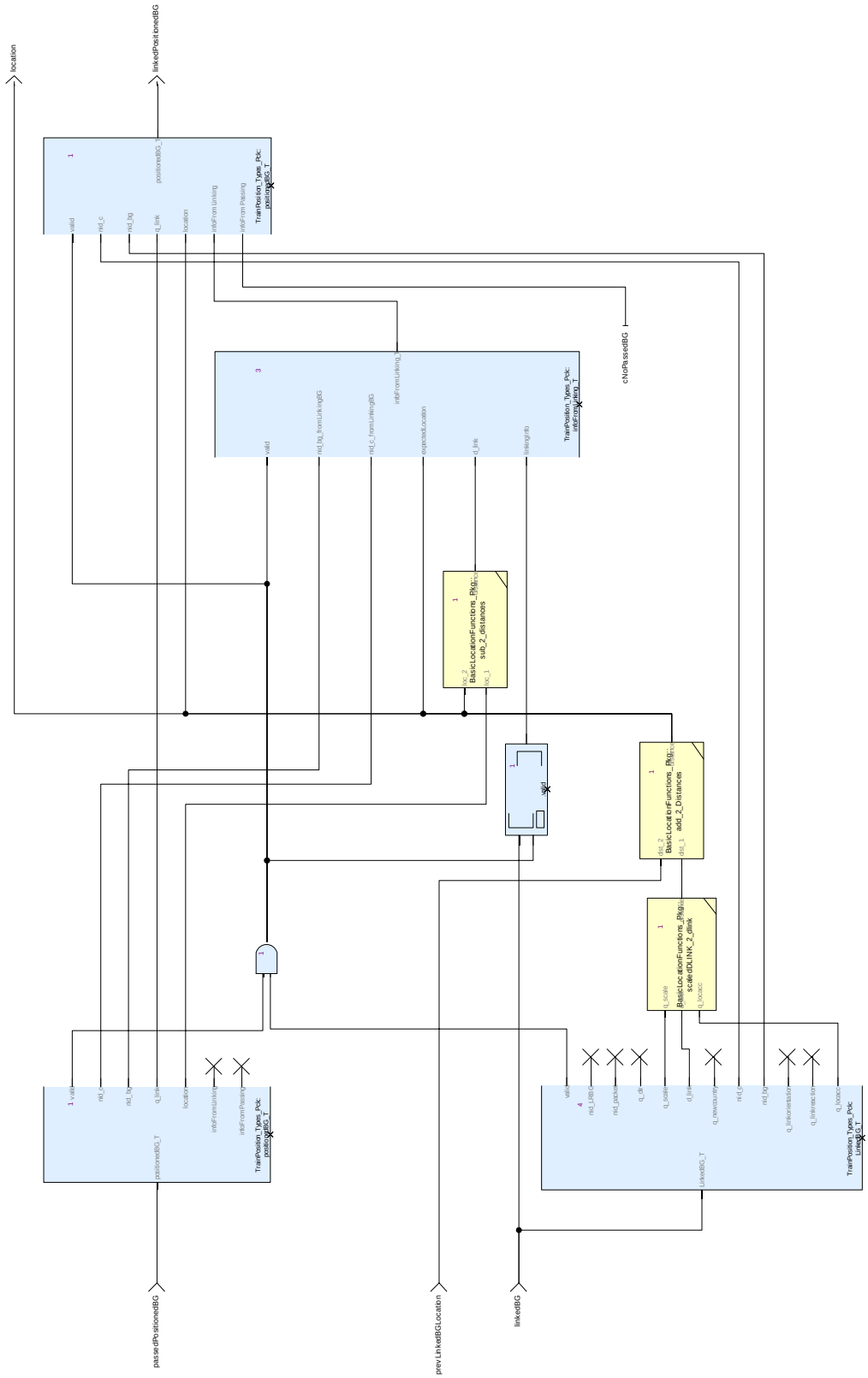


Figure 23: View of diagram_positionLinkedBG_itr_1 (positionLinkedBG_itr)

### 3.1.22. positionLinkedBGs Operator

Declared as **`private function`**

#### 3.1.22.1. Comments and Information

positionLinkedBGs Comments:

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

Table 63: positionLinkedBGs Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Converts the linking information, received while passing a BG into an announced (= linked positioned) BG.<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.22.2. Interface

Table 64: Inputs of positionLinkedBGs

| Name | Type | Comments and Information |
|---|---|---|
| passedPositionedBG | TrainPosition_Types_Pck::positionedBG_T | Comments:<br>The actually passed BG, where the linking information originates from. |
| linkedBGs | TrainPosition_Types_Pck::LinkedBGs_T | |

Table 65: Outputs of positionLinkedBGs

| Name | Type | Comments and Information |
|---|---|---|
| linkedPositionedBGs | TrainPosition_Types_Pck::linkedBGs_asPositionedBGs_T | |

### 3.1.22.3. Operator Hierarchy

diagram : diagram_positionLinkedBGs_1

### 3.1.22.4. Graphical and Textual Diagrams

#### 3.1.22.4.1. View of diagram_positionLinkedBGs_1 (positionLinkedBGs)

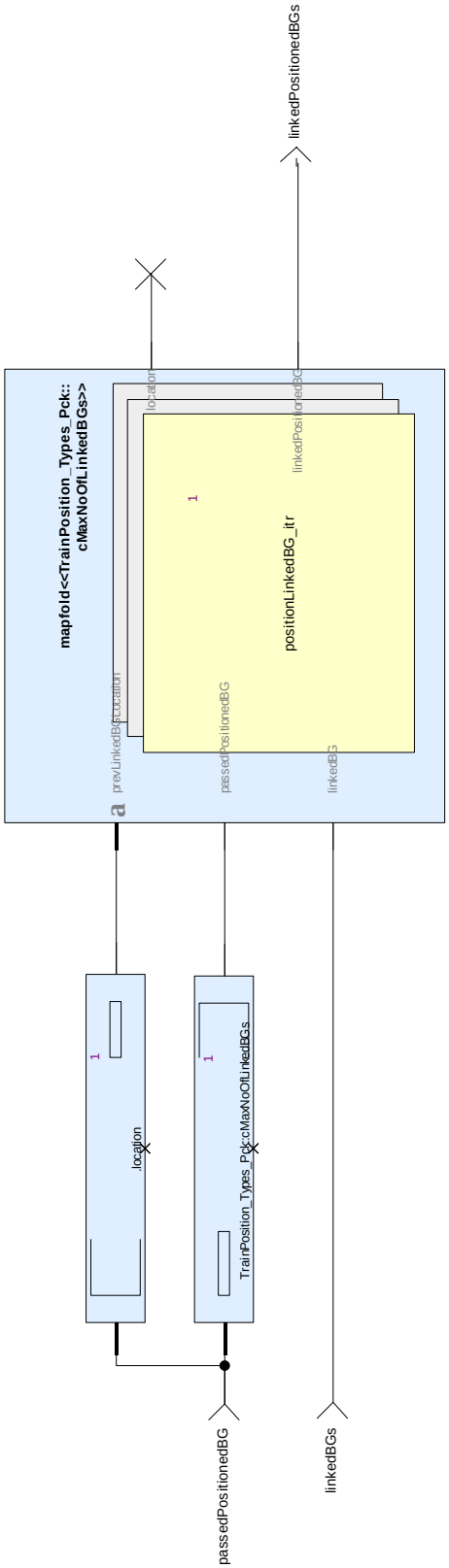


Figure 24: View of diagram_positionLinkedBGs_1 (positionLinkedBGs)

### 3.1.23. prevPassedLinkedBG Operator

Declared as **`private node`**

#### 3.1.23.1. Comments and Information

prevPassedLinkedBG Comments:

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

Table 66: 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.<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 3.1.23.2. Interface

Table 67: Inputs of prevPassedLinkedBG

| Name | Type | Comments and Information |
|---|---|---|
| passedBG | TrainPosition_Types_Pck::passedBG_T | Comments:<br>The currently passed BG |
| lastPassedLinkedBG | TrainPosition_Types_Pck::positionedBG_T | Comments:<br>The linked BG passed before the currently passed BG.<br>Becomes the previously passed linked BG while passing a new BG. |
| reset | bool | Comments:<br>Deletes the memorized previously passed BG. |

Table 68: Outputs of prevPassedLinkedBG

| Name | Type | Comments and Information |
|---|---|---|
| previouslyPassedBG | TrainPosition_Types_Pck::positionedBG_T | Comments:<br>The previously passed linked BG |

### 3.1.23.3. Operator Hierarchy

diagram : diagram_prevPassedLinkedBG_1

### 3.1.23.4. Graphical and Textual Diagrams

#### 3.1.23.4.1. View of diagram_prevPassedLinkedBG_1 (prevPassedLinkedBG)

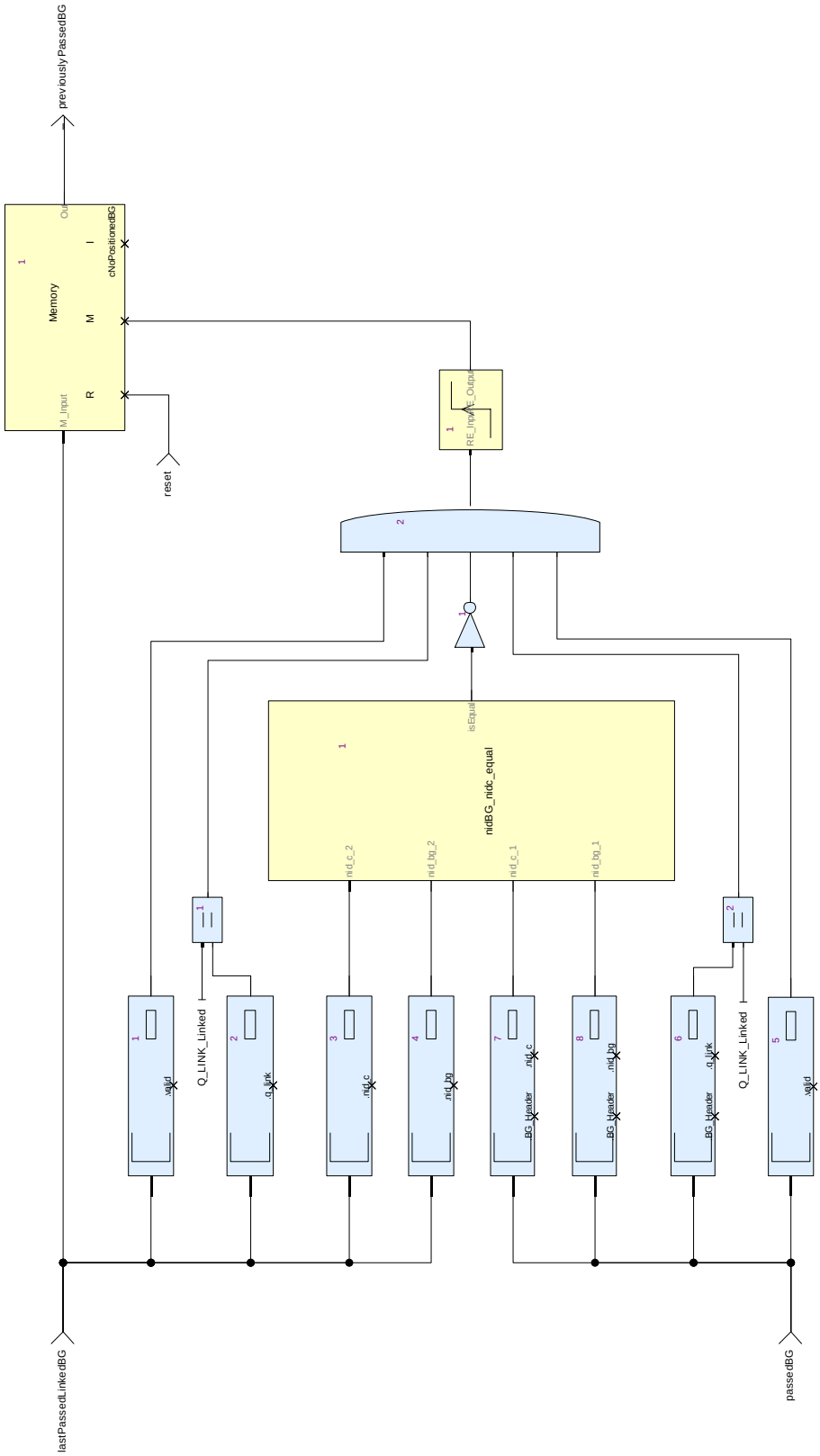


Figure 25: View of diagram_prevPassedLinkedBG_1 (prevPassedLinkedBG)

# 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 69: Public Types of Obu_BasicTypes_Pkg

| Name | Definition | Comments and Information |
|---|---|---|
| A_internal_Type | int | Comments:<br>Standardized acceleration type for all internal calculations: in 0.01 m/s2 |
| G_internal_Type | int | Comments:<br>Standardized gradient type for all internal gradient calculations: in per 0.1 mill |
| L_internal_Type | int | Comments:<br>Standardized length type for all internal length, distance and location calculations: in cm |
| T_internal_Type | int | Comments:<br>Standardized system time type used for all internal time calculations: in ms |
| V_internal_Type | int | Comments:<br>Standardized speed type used for all internal speed calculations: in km/h |

# 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 70: TrainPosition_Types_Pck 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 | Description : Determines the index of BG in BGs<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

### 5.1.2. Types

Table 71: Public Types of TrainPosition_Types_Pck

| Name | Definition | Comments and Information |
|---|---|---|
| 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:<br>Common header of the balise group datagram |

| Name | Definition | Comments and Information |
|---|---|---|
| infoFromLinking_T | {valid : bool, nid_bg_fromLinkingBG : NID_BG, nid_c_fromLinkingBG : NID_C, expectedLocation : TrainPosition_Types_Pck::LocWithInAcc_Type, d_link : TrainPosition_Types_Pck::LocWithInAcc_Type, linkingInfo : TrainPosition_Types_Pck::LinkedBG_T } | Comments:<br>Describes a linked BG as announced from the linking BG. Mainly, this information is taken from the linking packet.<br>nid_bg_fromLinkingBG Comments:<br>ID of the BG, where the linking information originates from<br>expectedLocation Comments:<br>Location, where the BG is expected to be found, calculated from announced linking distance.<br>d_link Comments:<br>Linking distance with inaccuracies, converted from Q_SCALE, D_LINK, Q_LOCACC of the linking packet.<br>linkingInfo Comments:<br>Linking info as announced from the linking BG, where this BG. |

| Name | Definition | Comments and Information |
|---|---|---|
| LinkedBG_T | {valid : bool, nid_LRBG : NID_LRBG, nid_packet : NID_PACKET, q_dir : Q_DIR, q_scale : Q_SCALE, d_link : D_LINK, q_newcountry : Q_NEWCOUNTRY, nid_c : NID_C, nid_bg : NID_BG, q_linkorientation : Q_LINKORIENTATION, q_linkreaction : Q_LINKREACTION, q_locacc : Q_LOCACC} | Comments:<br>7.4.2.2: Single, but complete, element from LinkingPacket_Type<br>valid Comments:<br>This element has valid data<br>nid_LRBG Comments:<br>8.4.4.61: ID of the reference LRBG<br>nid_packet Comments:<br>Packet identifier: probably not needed here: Packet 5 = constant<br>q_dir Comments:<br>Validity direction of transmitted data with reference to directionality of the balise group sending the information or to directionality of the LRBG<br>q_scale Comments:<br>7.5.1.129: Qualifier for the distance scale: 10 cm, 1 m, 10 m<br>d_link Comments:<br>7.5.1.10: Incremental linking distance to next linked balise group<br>q_newcountry Comments:<br>7.5.1.121: New Country Qualifier<br>nid_c Comments:<br>Identity number of the country or region<br>nid_bg Comments:<br>Identity number of the balise group<br>q_linkorientation Comments:<br>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.<br>q_linkreaction Comments:<br>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<br>q_locacc Comments:<br>7.5.1.115: defines the absolute value of the accuracy of the Balise location (max +/- 63 m) |
| linkedBGs_asPositionedBGs_T | TrainPosition_Types_Pck::positionedBG_T ^cMaxNoOfLinkedBGs | Comments:<br>Array of linked balises groups in the format of positioned BGs |
| LinkedBGs_T | TrainPosition_Types_Pck::LinkedBG_T ^cMaxNoOfLinkedBGs | Comments:<br>Array of linked balise groups. This array replaces the linking packet (TrackToTrain::Linking ) |
| Location_Type | Obu_BasicTypes_Pkg::L_internal_Type | Comments:<br>Generic for all length, distance and location calculation: in cm |

| Name | Definition | Comments and Information |
|---|---|---|
| LocWithInAcc_Type | {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<br>nominal Comments: Nominal location<br>d_min Comments: Min Location = nominal + d_min (typically < 0)<br>d_max Comments: Max Location = nominal + d_max |
| OdometryLocations_Type | {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<br>o_nominal Comments: Nominal odometry value<br>o_min Comments: Min. distance = o_min2 - o_min1<br>o_max Comments: Max distance = o_max2 - o_max1 |
| passedBG_T | {valid : bool, timestamp : Obu_BasicTypes_Pkg::T_internal_Type, odometrystamp : TrainPosition_Types_Pck::OdometryLocations_Type, BG_centerDetectionInaccuraccuracies : TrainPosition_Types_Pck::LocWithInAcc_Type, BG_Header : TrainPosition_Types_Pck::BG_Header_T, linkedBGs : TrainPosition_Types_Pck::LinkedBGs_T, noCoordinateSystemHasBeenAssigned : bool, trainOrientationToBG : Q_DIRLRBG, trainRunningDirectionToBG : Q_DIRTRAIN, passingSpeed : TrainPosition_Types_Pck::Speed_Type1} | Comments: Information reveived from a BG passede<br>odometrystamp Comments: Odometry values when the balise group was passed<br>BG_centerDetectionInaccuraccuracies Comments: Location inaccuries caused by the balise group center detection<br>BG_Header Comments: Common header of the balise group datagram<br>linkedBGs Comments: The linked balise groups announced from this BG.<br>noCoordinateSystemHasBeenAssigned Comments: 3.4.2, 3.6.3.1.4: Every balise group has its own co-ordinate system<br>trainOrientationToBG Comments: 3.6.1.3: Orientation of the train in relation to the direction of the BG<br>trainRunningDirectionToBG Comments: 3.6.1.3: Direction of train movement in relation to the BG orientation<br>passingSpeed Comments: Train speed while passing the BG; its sign characterizes the passing direction based on odometry information |

| Name | Definition | Comments and Information |
|---|---|---|
| positionedBG_T | {valid : bool, nid_c : NID_C, nid_bg : NID_BG, q_link : Q_LINK, location : TrainPosition_Types_Pck::LocWithInAcc_Type, infoFromLinking : TrainPosition_Types_Pck::infoFromLinking_T, infoFromPassing : TrainPosition_Types_Pck::passedBG_T} | location Comments:<br>The best known location calculated from linking and from passing information<br>infoFromLinking Comments:<br>If linked, this is the BG info as announced from a linked BG. Most of the data is taken from the linking information.<br>infoFromPassing Comments:<br>If the balise group was passed, this is the relevant information received from the BG. |
| positionedBGs_T | TrainPosition_Types_Pck::positionedBG_T ^cMaxNoOfStoredBGs | Comments:<br>All balise groups stored for train position calculation |
| Speed_Type1 | Obu_BasicTypes_Pkg::V_internal_Type | Comments:<br>General speed type: in km/h. |

| Name | Definition | Comments and Information |
|---|---|---|
| trainPosition_T | {valid : bool, trainPositionIsUnknown : bool, noCoordinateSystemHasBeenAssigned : bool, trainPosition : TrainPosition_Types_Pck::LocWithInAcc_Type, estimatedFrontEndPosition : TrainPosition_Types_Pck::Location_Type, minSafeFrontEndPosition : TrainPosition_Types_Pck::Location_Type, maxSafeFrontEndPostion : TrainPosition_Types_Pck::Location_Type, nid_LRBG : NID_BG, nid_PrvLRB : NID_PRVLRBG, nominalOrReverseToLRBG : Q_DLRBG, trainOrientationToLRBG : Q_DIRLRBG, trainRunningDirectionToLRBG : Q_DIRTRAIN, speed : TrainPosition_Types_Pck::Speed_Type1} | Comments:<br>3.6.1.3<br>trainPositionIsUnknown Comments:<br>3.6.3.1.3.1<br>noCoordinateSystemHasBeen Assigned Comments:<br>3.4.2, 3.6.3.1.4: Every balise group has its own co-ordinate system<br>trainPosition Comments:<br>The calculated train position with inaccuracies.#<br>estimatedFrontEndPosition Comments:<br>3.6.4.4 a): Absolute train front end position since system start<br>minSafeFrontEndPosition Comments:<br>3.6.4.4 c) :Minimum safe front end position<br>maxSafeFrontEndPostion Comments:<br>3.6.4.4.b) :Maximum safe front end position<br>nid_LRBG Comments:<br>Identity of last relevant balise group<br>nid_PrvLRB Comments:<br>Identity of previous LRBG (7.4.3.2, 7.5.1.94), for position report based on 2 balise groups<br>nominalOrReverseToLRBG Comments:<br>7.5.1.106: Q_DLRBG: Qualifier telling on which side of the LRBG the estimated front end is<br>trainOrientationToLRBG Comments:<br>3.6.1.3: Orientation of the train in relation to the direction of the LRBG<br>trainRunningDirectionToLRBG Comments:<br>3.6.1.3: Direction of train movement in relation to the LRBG orientation<br>speed Comments:<br>Actual train speed |

| Name | Definition | Comments and Information |
|---|---|---|
| trainPositionInfo_T | {valid : bool, trainPosition : TrainPosition_Types_Pck::LocWithInAcc_Type, trainPositionDerivedFromLastLinkedBG : TrainPosition_Types_Pck::LocWithInAcc_Type, trainPositionDerivedFromLastUnlinkedBG : TrainPosition_Types_Pck::LocWithInAcc_Type, lastPassedLinkedBG : TrainPosition_Types_Pck::positionedBG_T, lastPassedUnlinkedBG : TrainPosition_Types_Pck::positionedBG_T} | trainPosition Comments:<br>The best known train position<br>trainPositionDerivedFromLastLinkedBG Comments:<br>The train position measured by odometry behind the positon of the last passed linked BG<br>trainPositionDerivedFromLastUnlinkedBG Comments:<br>The train position measured by odometry behind the positon of the last passed unlinked BG<br>lastPassedLinkedBG Comments:<br>The last passed linked BG<br>lastPassedUnlinkedBG Comments:<br>The last passed unlinked BG |
| trainProperties_T | {d_baliseAntenna_2_frontend : TrainPosition_Types_Pck::LocWithInAcc_Type, d_frontend_2_rearend : TrainPosition_Types_Pck::LocWithInAcc_Type} | Comments:<br>The trains properties required for train position calculation.<br>d_baliseAntenna_2_frontend Comments:<br>Distance from the trains balise antenna to the trains front end.<br>d_frontend_2_rearend Comments:<br>Distance from the trains front end to rear end |

### 5.1.3. Constants

Table 72: Public Constants of TrainPosition_Types_Pck

| Name | Type | Value | Comments and Information |
|---|---|---|---|
| cLocWithInAcc_0 | TrainPosition_Types_Pck::LocWithInAcc_Type | {nominal : 0, d_min : 0, d_max : 0} | |
| cMaxNoOfLinkedBGs | int | 10 | Comments:<br>Max. number of linked balise groups announced by a BG (arbitrarily value) |
| cMaxNoOfStoredBGs | int | 30 | Comments:<br>Max. number of balise groups stored for position calculation |
| cNID_BG_unknown | NID_BG | 16383 | Comments:<br>type NID_BG = int /* MinVal = 0, MaxVal = 16382 */ -- 16383 = Identity_is_unknown_(only_to_be_used_for_Linking_information) |
| cNID_LRBG_14Bits_Multiplicator | int | 16384 | Comments:<br>16384: Serves to calculate NID_LRBG = 16384 * NID_C + NID_BG |
| cNID_LRBG_unknown | NID_LRBG | 16777215 | Comments:<br>type NID_LRBG = int -- 16777215 = Unknown |

| Name | Type | Value | Comments and Information |
|---|---|---|---|
| cOdometryInitialValue | TrainPosition_Types_Pck::OdometryLocations_Type | {o_nominal : 0, o_min : 0, o_max : 0} | Comments:<br>Initial odometry values |
| cQ_SCALE_10_cm_resolution | TrainPosition_Types_Pck::Location_Type | 10 | Comments:<br>7.5.1.129: Resolution of Q_SCALE::10cm: = 10 cm (Location_Type in cm) |
| cQ_SCALE_10_m_resolution | TrainPosition_Types_Pck::Location_Type | 1000 | Comments:<br>7.5.1.129: Resolution of Q_SCALE::10 m: = 1000 cm (Location_Type in cm) |
| cQ_SCALE_1_m_resolution | TrainPosition_Types_Pck::Location_Type | 100 | Comments:<br>7.5.1.129: Resolution of Q_SCALE::1 m: = 100 cm (Location_Type in cm) |
| cQLOCACC_resolution | TrainPosition_Types_Pck::Location_Type | 100 | Comments:<br>7.5.1.115: Resolution of Q_LOCACC is in m = 100 cm (Location_Type in cm) |

# 6. Project Library: BasicLocationFunctions

## 6.1. BasicLocationFunctions_Pkg Package

### 6.1.1. 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 73: BasicLocationFunctions_Pkg Annotations

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

| Note Name | Attribute | Value |
|---|---|---|
| Remark_1 | Description | Basic calculation functions for position determination of train and track elements<br><br>- Name: BasicLocationFunctions.etp<br>- Description: Basic calculation functions for position determination of train and track elements<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br><br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

### 6.1.2. add_2_Distances Operator

Declared as **`public function`**

#### 6.1.2.1. Comments and Information

add_2_Distances Comments:

- Calculates the sum of 2 distances dist_2 + dist_1

Table 74: add_2_Distances Annotations

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

| Note Name | Attribute | Value |
|---|---|---|
| Remark_1 | Description | Calculates the sum of 2 distances<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

### 6.1.2.2. Interface

Table 75: Inputs of add_2_Distances

| Name | Type | Comments and Information |
|---|---|---|
| dist_2 | TrainPosition_Types_Pck::LocWithInAcc_Type | |
| dist_1 | TrainPosition_Types_Pck::LocWithInAcc_Type | |

Table 76: Outputs of add_2_Distances

| Name | Type | Comments and Information |
|---|---|---|
| distance | TrainPosition_Types_Pck::LocWithInAcc_Type | |

### 6.1.2.3. Operator Hierarchy

diagram : diagram_add_2_Distances_1

### 6.1.2.4. Graphical and Textual Diagrams

#### 6.1.2.4.1. View of diagram_add_2_Distances_1 (add_2_Distances)

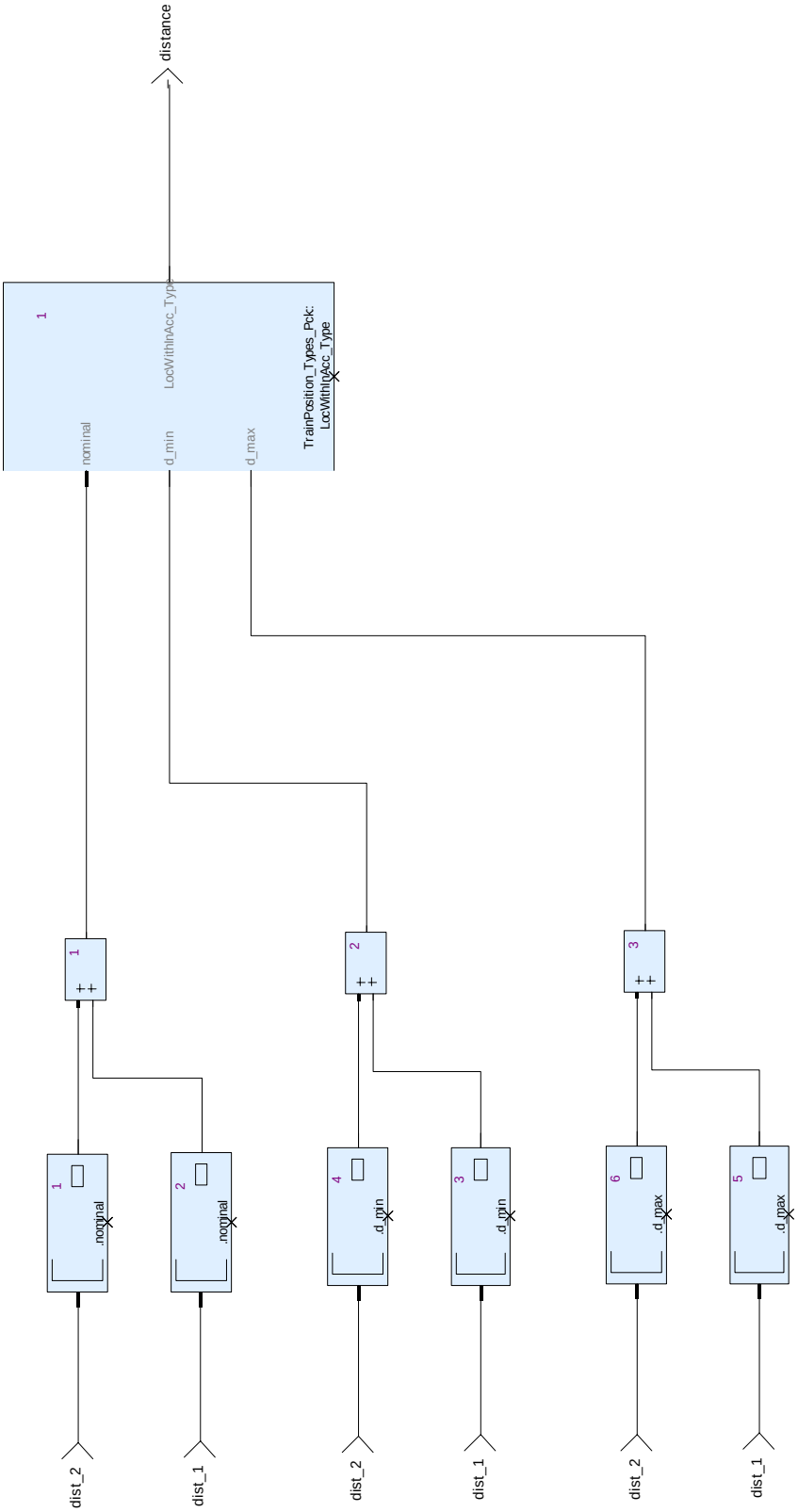


Figure 26: View of diagram_add_2_Distances_1 (add_2_Distances)

### 6.1.3. add_odo_2_Location Operator

Declared as **`public function`**

#### 6.1.3.1. Comments and Information

add_odo_2_Location Comments:

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

Table 77: add_odo_2_Location Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Calculates the target location after a reference location measured by the odometry<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 6.1.3.2. Interface

Table 78: Inputs of add_odo_2_Location

| Name | Type | Comments and Information |
|---|---|---|
| refLocation | TrainPosition_Types_Pck::LocWithInAcc_Type | Comments:<br>The reference location |
| refOdoValue | TrainPosition_Types_Pck::OdometryLocations_Type | Comments:<br>The odometry value at refLocation |
| odoValue | TrainPosition_Types_Pck::OdometryLocations_Type | Comments:<br>The odometry value at the target location “location” |

Table 79: Outputs of add_odo_2_Location

| Name | Type | Comments and Information |
|---|---|---|
| location | TrainPosition_Types_Pck::LocWithInAcc_Type | Comments:<br>The target location |

#### 6.1.3.3. Operator Hierarchy

diagram : diagram_add_odo_2_Location_1

### 6.1.3.4. Graphical and Textual Diagrams

#### 6.1.3.4.1. View of diagram_add_odo_2_Location_1 (add_odo_2_Location)

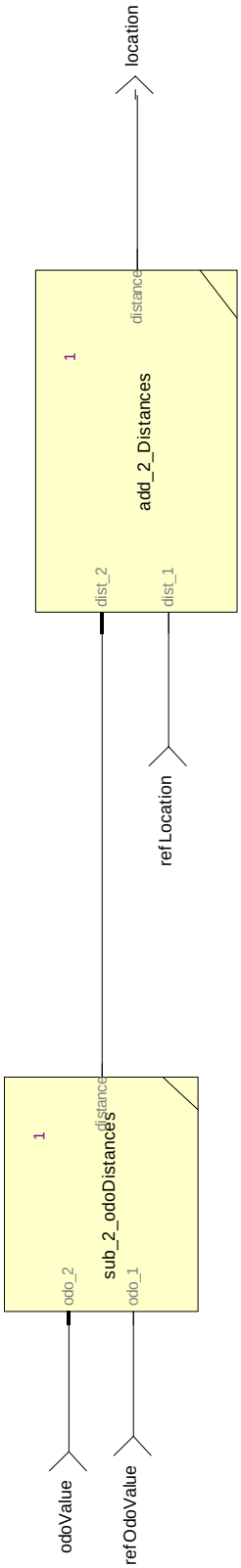


Figure 27: View of diagram_add_odo_2_Location_1 (add_odo_2_Location)

### 6.1.4. addDistances Operator

Declared as **`public function`**

#### 6.1.4.1. Comments and Information

addDistances Comments:

- Calculates the sum of an array of distances

Table 80: addDistances Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Calculates the sum of an array of distances<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 6.1.4.2. Interface

Table 81: Inputs of addDistances

| Name | Type | Comments and Information |
|---|---|---|
| distances | TrainPosition_Types_Pck::LocWithInAcc_Type ^noOfSummands | |

Table 82: Outputs of addDistances

| Name | Type | Comments and Information |
|---|---|---|
| sum | TrainPosition_Types_Pck::LocWithInAcc_Type | |

Table 83: Size Parameters of addDistances

| Name | Comments and Information |
|---|---|
| noOfSummands | Comments:<br>Number of summands |

#### 6.1.4.3. Operator Hierarchy

diagram : diagram_sumOfDistances_1

#### 6.1.4.4. Graphical and Textual Diagrams

##### 6.1.4.4.1. View of diagram_sumOfDistances_1 (addDistances)

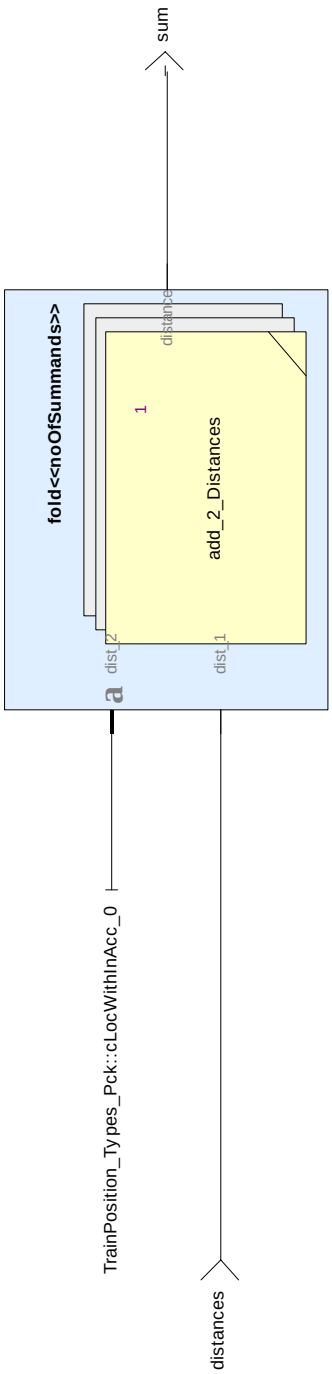


Figure 28: View of diagram_sumOfDistances_1 (addDistances)

### 6.1.5. addDistancesBetwLinkedElements Operator

Declared as **`public function`**

#### 6.1.5.1. 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 84: addDistancesBetwLinkedElements Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Calculates the distance between linked elements<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 6.1.5.2. Interface

Table 85: Inputs of addDistancesBetwLinkedElements

| Name | Type | Comments and Information |
|---|---|---|
| distances | TrainPosition_Types_Pck::LocWithInAcc_Type ^noOfLinkedElements | |

Table 86: Outputs of addDistancesBetwLinkedElements

| Name | Type | Comments and Information |
|---|---|---|
| sumOfDistances | TrainPosition_Types_Pck::LocWithInAcc_Type | |

Table 87: Size Parameters of addDistancesBetwLinkedElements

| Name | Comments and Information |
|---|---|
| noOfLinkedElements | |

#### 6.1.5.3. Operator Hierarchy

diagram : diagram_distanceBetweenLinkedElements_1

### 6.1.5.4. Graphical and Textual Diagrams

#### 6.1.5.4.1. View of diagram_distanceBetweenLinkedElements_1 (addDistancesBetwLinkedElements)

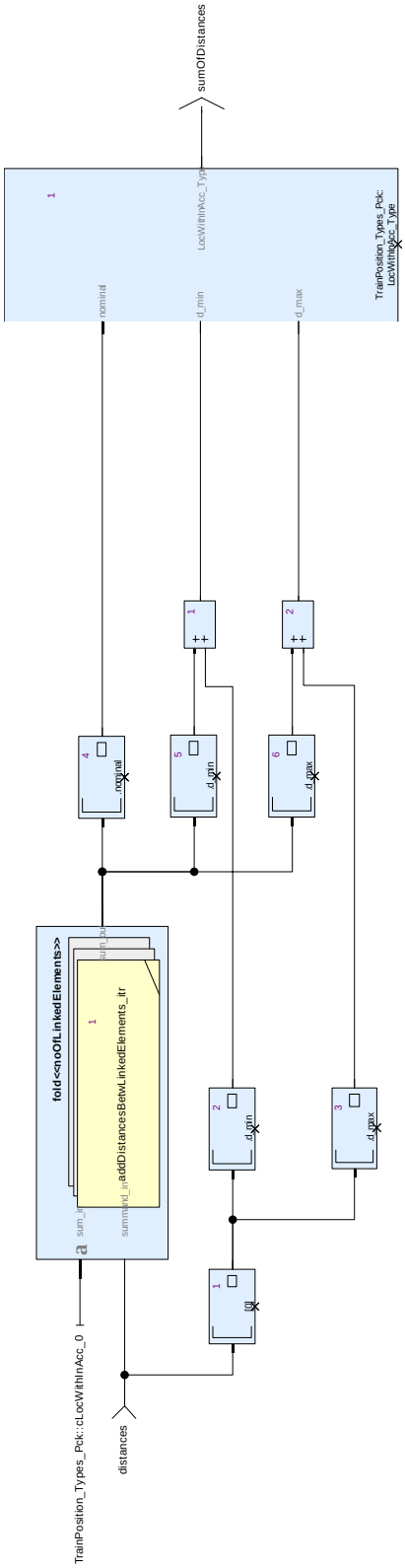


Figure 29: View of diagram_distanceBetweenLinkedElements_1 (addDistancesBetwLinkedElements)

### 6.1.6. addDistancesBetwLinkedElements_itr Operator

Declared as **`private function`**

#### 6.1.6.1. Comments and Information

addDistancesBetwLinkedElements_itr Comments:

- distanceBetweenLinkedElements_itr is the íterated function for the distance calculation between linked elements.
- The nominal distances are added.
- d_min and d_max are taken from the summand, if it is <> 0 and from the previous sum_in, if == 0.
- This assures that the inaccuracies from the last element in the iteration <> 0 are forward even if not all iterations are filled with valid data.

Table 88: addDistancesBetwLinkedElements_itr Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | íterated function for the distance calculation between linked elements<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 6.1.6.2. Interface

Table 89: Inputs of addDistancesBetwLinkedElements_itr

| Name | Type | Comments and Information |
|---|---|---|
| sum_in | TrainPosition_Types_Pck::LocWithInAcc_Type | |
| summand_in | TrainPosition_Types_Pck::LocWithInAcc_Type | |

Table 90: Outputs of addDistancesBetwLinkedElements_itr

| Name | Type | Comments and Information |
|---|---|---|
| sum_out | TrainPosition_Types_Pck::LocWithInAcc_Type | |

#### 6.1.6.3. Operator Hierarchy

diagram : diagram_addDistancesBetwLinkedElements_itr_1

## 6.1.6.4. Graphical and Textual Diagrams

### 6.1.6.4.1. View of diagram_addDistancesBetwLinkedElements_itr_1 (addDistancesBetwLinkedElements_itr)

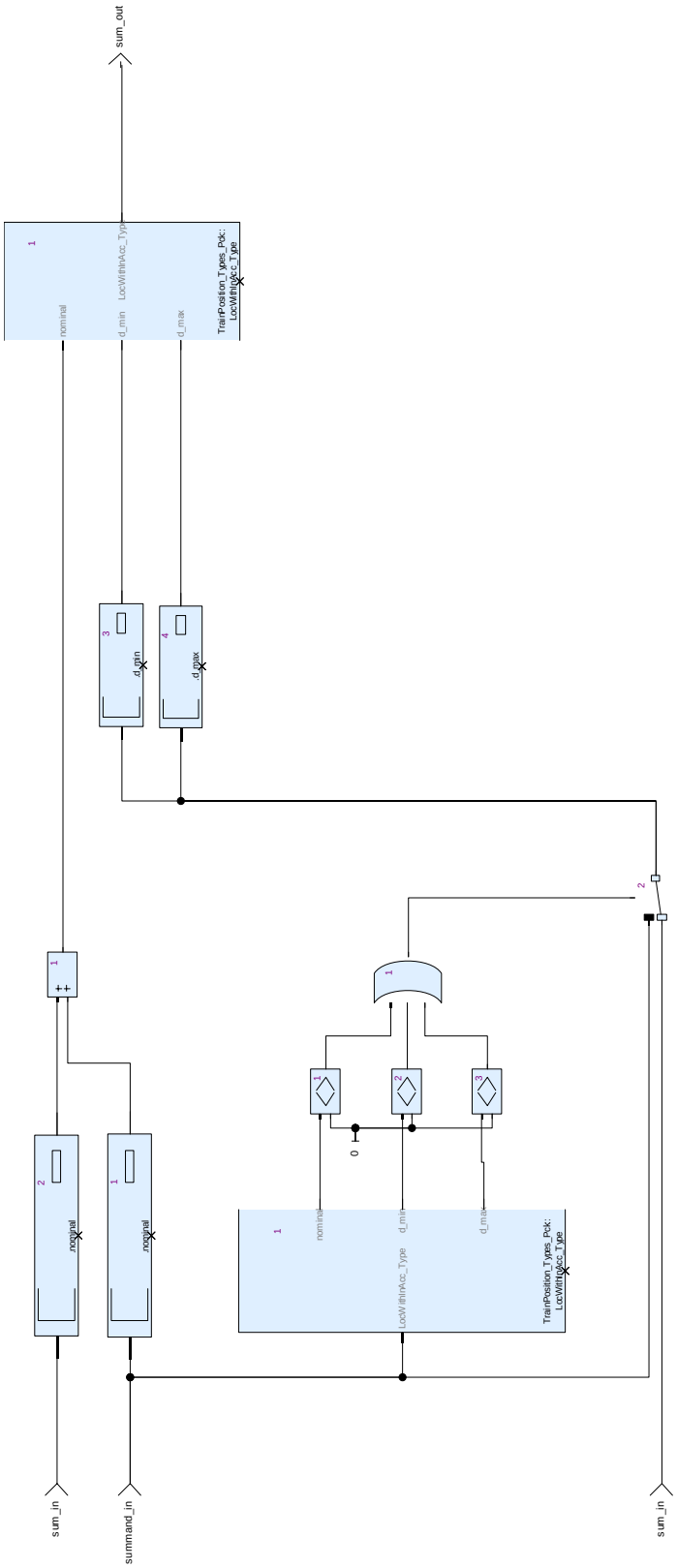


Figure 30: View of diagram_addDistancesBetwLinkedElements_itr_1 (addDistancesBetwLinkedElements_itr)

### 6.1.7. dTrain2Trackelem_unlinkedBG Operator

Declared as **`public function`**

#### 6.1.7.1. Comments and Information

dTrain2Trackelem_unlinkedBG Comments:

- Calculates the distance from the actual train position to a track element, that is linked with a previously passed unlinked BG.
- Remark:
- There is no need to determine the distance via a second calculation with reference to the following linked balise group.
- Instead, the input loc_unlinkedBG should be fed via the odoLoc_2_refLocations function, based on two different reference calculations.

Table 91: dTrain2Trackelem_unlinkedBG Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Distance from the actual train position to a track element<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 6.1.7.2. Interface

Table 92: Inputs of dTrain2Trackelem_unlinkedBG

| Name | Type | Comments and Information |
|---|---|---|
| dLink_unlinkedBG2Trackelem | TrainPosition_Types_Pck::LocWithInAcc_Type | Comments:<br>Linking distance from a previously passed unlinked balise group to the track element |
| loc_unlinkedBG | TrainPosition_Types_Pck::LocWithInAcc_Type | Comments:<br>Location of a previously passed unlinked balise group |

| Name | Type | Comments and Information |
|---|---|---|
| odo_unlinkedBG | TrainPosition_Types_Pck::OdometryLocations_Type | Comments:<br>Odometry value at the previously passed unlinked balise group |
| actOdo_train | TrainPosition_Types_Pck::OdometryLocations_Type | Comments:<br>Odometry value at the actual train position |

Table 93: Outputs of dTrain2Trackelem_unlinkedBG

| Name | Type | Comments and Information |
|---|---|---|
| dTrain2Trackelem | TrainPosition_Types_Pck::LocWithInAcc_Type | Comments:<br>Distance from the actual train position to the track element in front |

#### 6.1.7.3. Operator Hierarchy

diagram : diagram_dTrain2Trackelem_unlinkedBG_1

### 6.1.7.4. Graphical and Textual Diagrams

#### 6.1.7.4.1. View of diagram_dTrain2Trackelem_unlinkedBG_1 (dTrain2Trackelem_unlinkedBG)

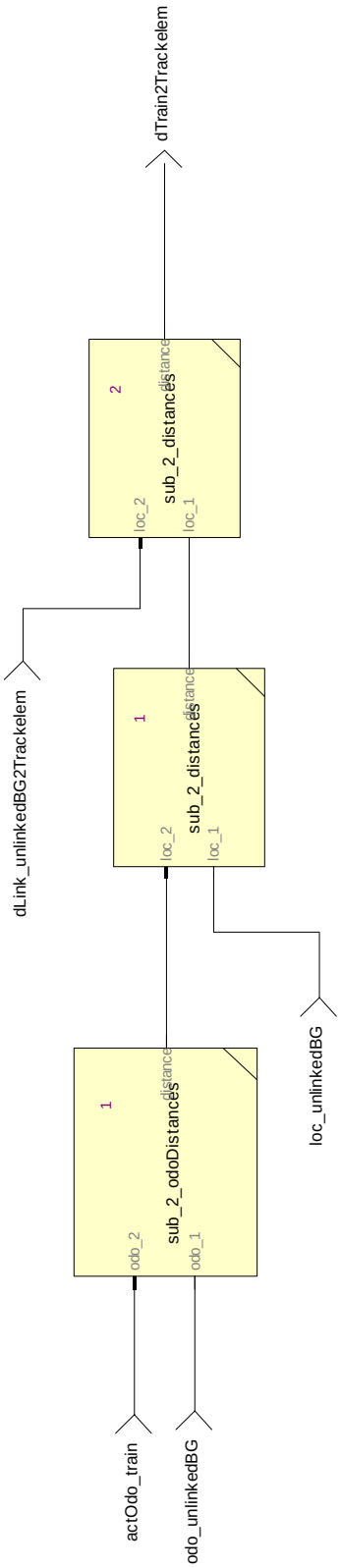


Figure 31: View of diagram_dTrain2Trackelem_unlinkedBG_1 (dTrain2Trackelem_unlinkedBG)

### 6.1.8. odoLoc_2_refLocations Operator

Declared as **`public function`**

#### 6.1.8.1. Comments and Information

odoLoc_2_refLocations Comments:

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

Table 94: odoLoc_2_refLocations Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Determines the location of an element, measured by odometry, with reference to 2 different known reference locations<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 6.1.8.2. Interface

Table 95: Inputs of odoLoc_2_refLocations

| Name | Type | Comments and Information |
|---|---|---|
| refLoc_2 | TrainPosition_Types_Pck::LocWithInAcc_Type | Comments:<br>Reference location 2 |
| refLoc_1 | TrainPosition_Types_Pck::LocWithInAcc_Type | Comments:<br>Reference location 1 |

| Name | Type | Comments and Information |
|---|---|---|
| refOdo_2 | TrainPosition_Types_Pck::OdometryLocations_Type | Comments:<br>Odometry value at reference location 2 |
| refOdo_1 | TrainPosition_Types_Pck::OdometryLocations_Type | Comments:<br>Odometry value at reference location 1 |
| odo | TrainPosition_Types_Pck::OdometryLocations_Type | Comments:<br>Odometry value at the location to be determined |

Table 96: Outputs of odoLoc_2_refLocations

| Name | Type | Comments and Information |
|---|---|---|
| location | TrainPosition_Types_Pck::LocWithInAcc_Type | Comments:<br>The resulting location to be determined |

#### 6.1.8.3. Operator Hierarchy

diagram : diagram_odoLoc_2_refLocations_1

### 6.1.8.4. Graphical and Textual Diagrams

#### 6.1.8.4.1. View of diagram_odoLoc_2_refLocations_1 (odoLoc_2_refLocations)

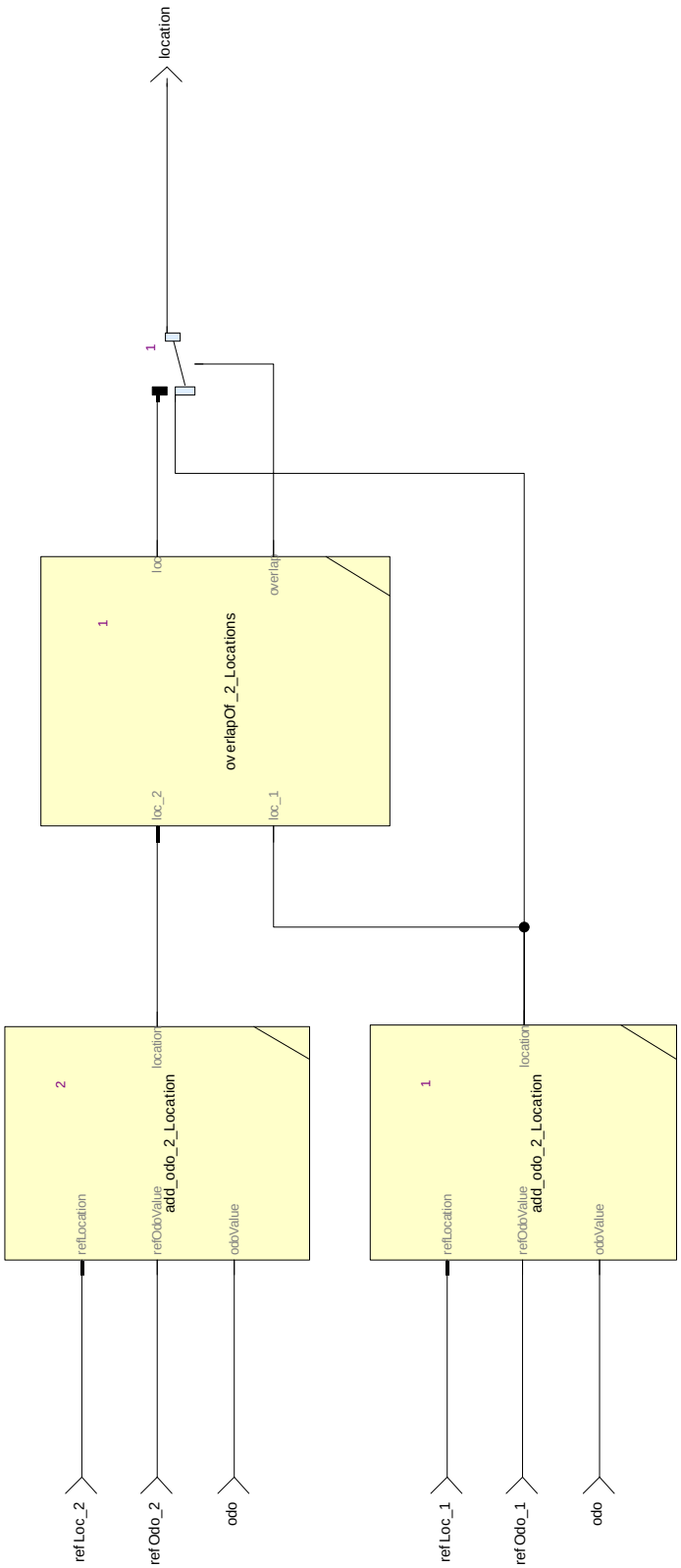


Figure 32: View of diagram_odoLoc_2_refLocations_1 (odoLoc_2_refLocations)

### 6.1.9. overlapOf_2_Locations Operator

Declared as **`public function`**

#### 6.1.9.1. Comments and Information

overlapOf_2_Locations Comments:

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

Table 97: overlapOf_2_Locations Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Determines the overlapping section of 2 locations<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 6.1.9.2. Interface

Table 98: Inputs of overlapOf_2_Locations

| Name | Type | Comments and Information |
|---|---|---|
| loc_2 | TrainPosition_Types_Pck::LocWithInAcc_Type | |
| loc_1 | TrainPosition_Types_Pck::LocWithInAcc_Type | |

Table 99: Outputs of overlapOf_2_Locations

| Name | Type | Comments and Information |
|---|---|---|
| loc | TrainPosition_Types_Pck::LocWithInAcc_Type | |
| overlap | bool | |

#### 6.1.9.3. Operator Hierarchy

diagram : diagram_overlapOf_2_Locations_1

### 6.1.9.4. Graphical and Textual Diagrams

#### 6.1.9.4.1. View of diagram_overlapOf_2_Locations_1 (overlapOf_2_Locations)

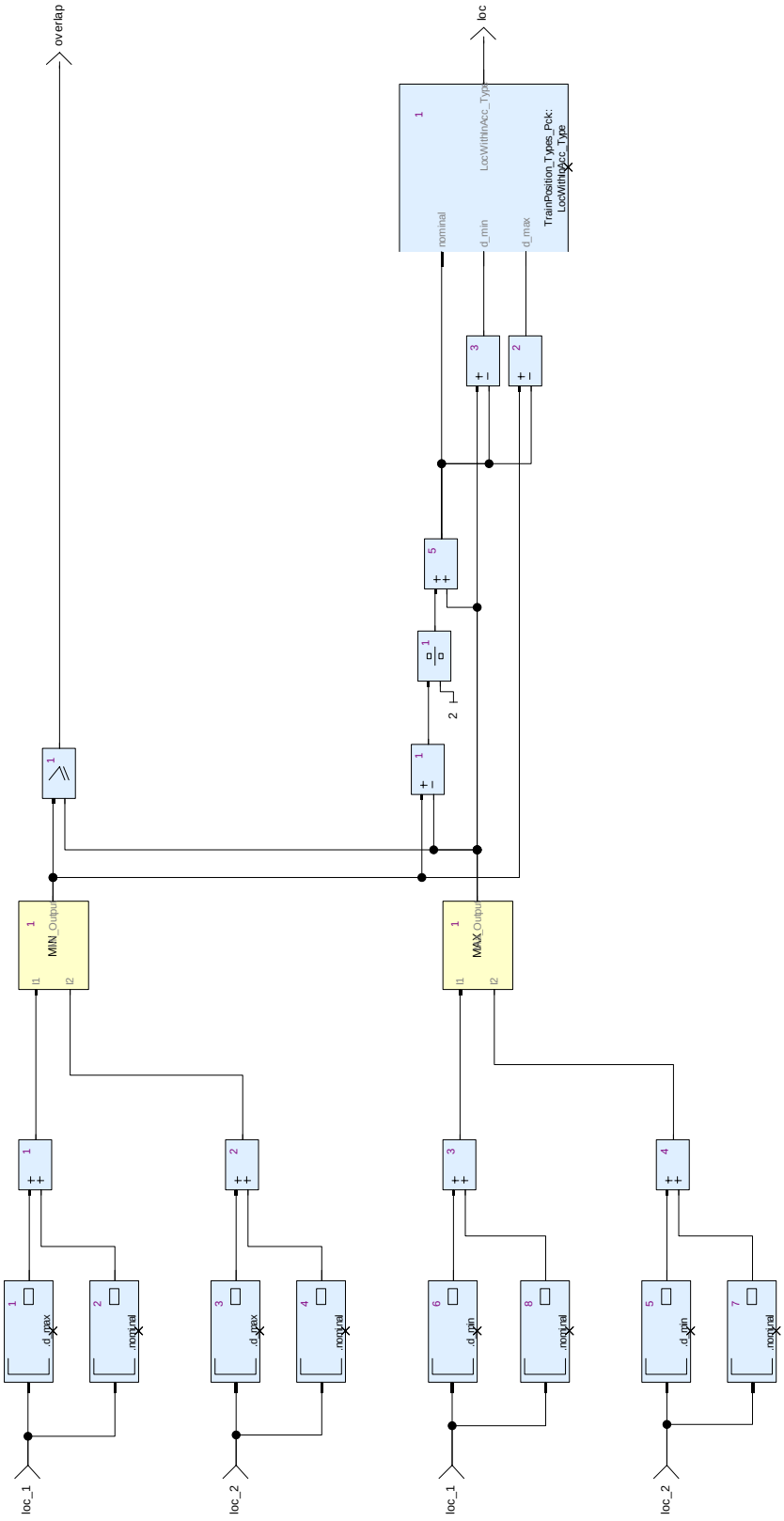


Figure 33: View of diagram_overlapOf_2_Locations_1 (overlapOf_2_Locations)

### 6.1.10. scaledDLINK_2_dlink Operator

Declared as **`public function`**

#### 6.1.10.1. Comments and Information

scaledDLINK_2_dlink Comments:

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

Table 100: scaledDLINK_2_dlink Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Converts the linking distance variables into the uniform distance type<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 6.1.10.2. Interface

Table 101: Inputs of scaledDLINK_2_dlink

| Name | Type | Comments and Information |
|---|---|---|
| q_scale | Q_SCALE | |
| d_link | D_LINK | |
| q_locacc | Q_LOCACC | |

Table 102: Outputs of scaledDLINK_2_dlink

| Name | Type | Comments and Information |
|---|---|---|
| distance | TrainPosition_Types_Pck::LocWithInAcc_Type | |

### 6.1.10.3. Operator Hierarchy

diagram : diagram_scaledDLINK_2_dlink_1

### 6.1.10.4. Graphical and Textual Diagrams

#### 6.1.10.4.1. View of diagram_scaledDLINK_2_dlink_1 (scaledDLINK_2_dlink)

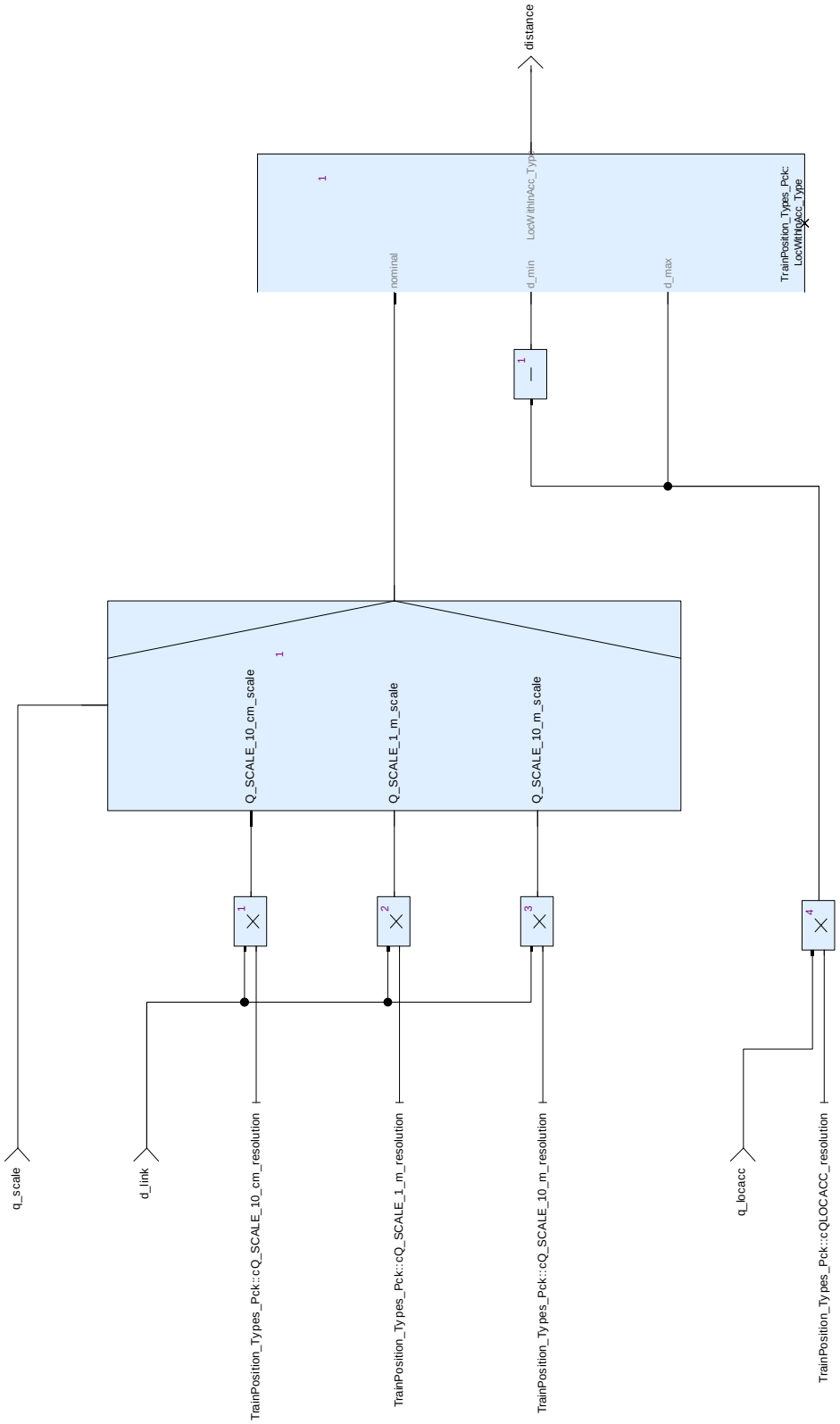


Figure 34: View of diagram_scaledDLINK_2_dlink_1 (scaledDLINK_2_dlink)

### 6.1.11. sub_2_distances Operator

Declared as **public function**

#### 6.1.11.1. Comments and Information

sub_2_distances Comments:

- Calculates the distance loc_2 - loc_1 between two locations

Table 103: sub_2_distances Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Calculates the distance loc_2 - loc_1 between two locations<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 6.1.11.2. Interface

Table 104: Inputs of sub_2_distances

| Name | Type | Comments and Information |
|---|---|---|
| loc_2 | TrainPosition_Types_Pck::LocWithInAcc_Type | |
| loc_1 | TrainPosition_Types_Pck::LocWithInAcc_Type | |

Table 105: Outputs of sub_2_distances

| Name | Type | Comments and Information |
|---|---|---|
| distance | TrainPosition_Types_Pck::LocWithInAcc_Type | |

#### 6.1.11.3. Operator Hierarchy

diagram : diagram_sub_2_distances_1

### 6.1.11.4. Graphical and Textual Diagrams

#### 6.1.11.4.1. View of diagram_sub_2_distances_1 (sub_2_distances)

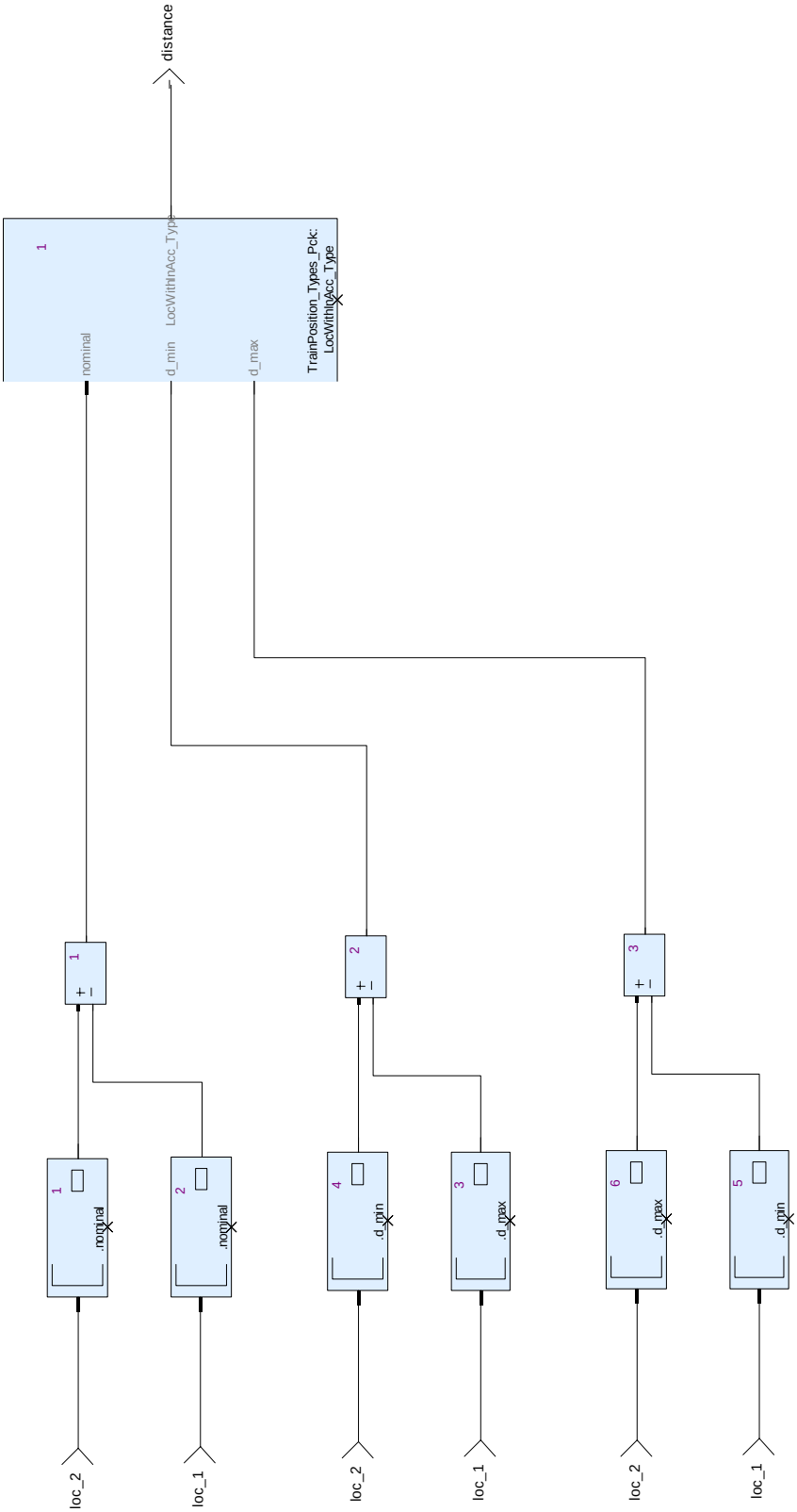


Figure 35: View of diagram_sub_2_distances_1 (sub_2_distances)

### 6.1.12. sub_2_odoDistances Operator

Declared as **`public function`**

#### 6.1.12.1. Comments and Information

sub_2_odoDistances Comments:

- Calculates the distance o2 - o1 based on odometry data

Table 106: sub_2_odoDistances Annotations

| Note Name | Attribute | Value |
|---|---|---|
| GdC_1 | Author | Uwe Steinke |
| | DateC | Created : 2014-05-22 |
| | DateM | Modified : 2014-05-22 |
| | Version | 00.02.00 |
| | to_c | True |
| Remark_1 | Description | Calculates the distance o2 - o1 based on odometry data<br>- Copyright Siemens AG, 2014<br>- Licensed under the EUPL V.1.1 ( http://joinup.ec.europa.eu/software/page/eupl/licence-eupl )<br>- Gist URL: ---<br>- Cryptography: No<br>- Author(s): Uwe Steinke<br><br>The use of this software is limited to non-vital applications.<br>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.<br>THEREFORE, NO LIABILITY WILL BE GIVEN FOR SUCH AND ANY OTHER KIND OF USE. |
| | to_c | True |

#### 6.1.12.2. Interface

Table 107: Inputs of sub_2_odoDistances

| Name | Type | Comments and Information |
|---|---|---|
| odo_2 | TrainPosition_Types_Pck::OdometryLocations_Type | |
| odo_1 | TrainPosition_Types_Pck::OdometryLocations_Type | |

Table 108: Outputs of sub_2_odoDistances

| Name | Type | Comments and Information |
|---|---|---|
| distance | TrainPosition_Types_Pck::LocWithInAcc_Type | |

#### 6.1.12.3. Operator Hierarchy

diagram : diagram_sub_2_odoDistances_1

### 6.1.12.4. Graphical and Textual Diagrams

#### 6.1.12.4.1. View of diagram_sub_2_odoDistances_1 (sub_2_odoDistances)

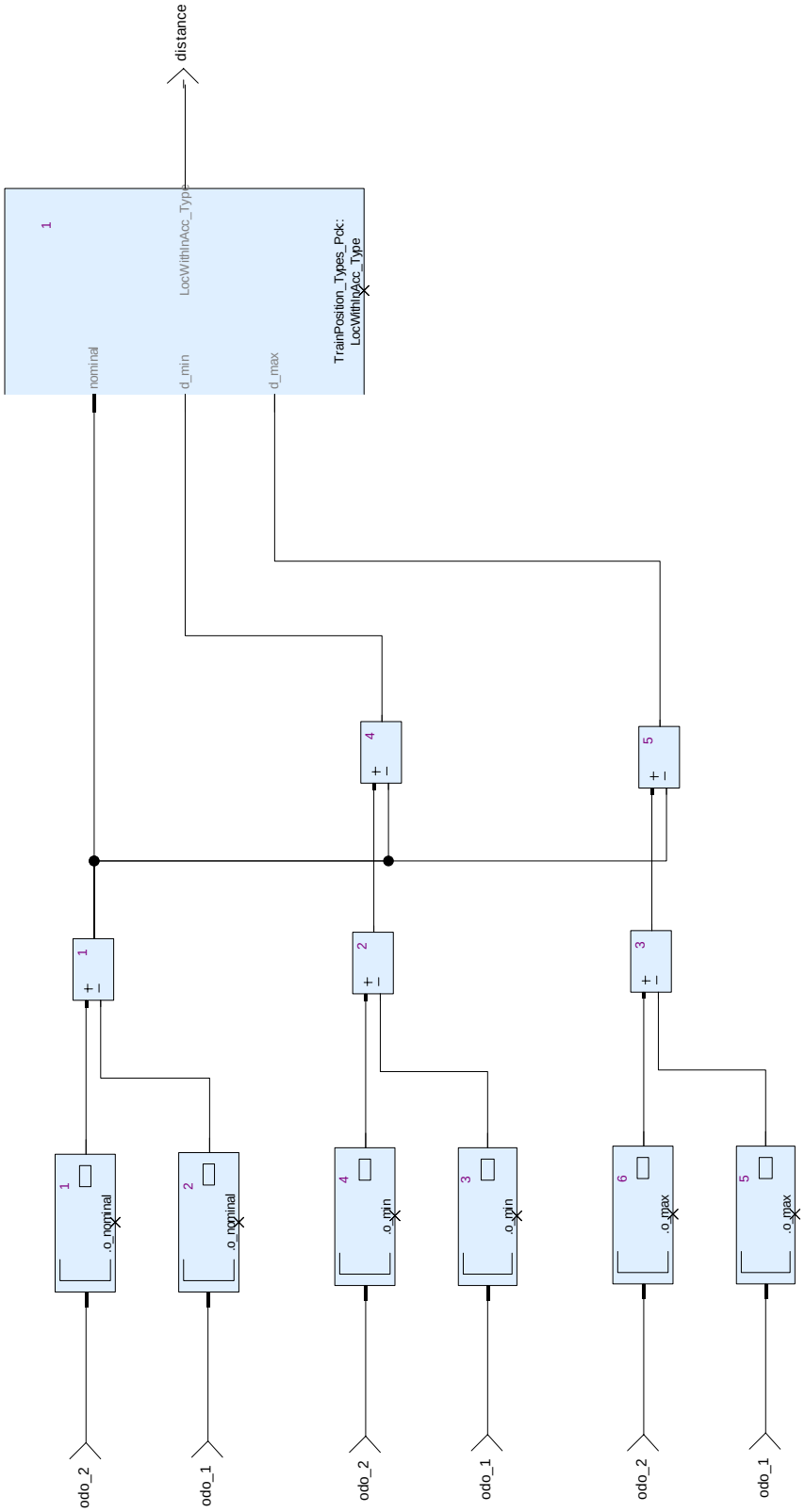


Figure 36: View of diagram_sub_2_odoDistances_1 (sub_2_odoDistances)

End of document.