

Control Route Suitability

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Reviewers:

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Date and version:

24/10/2013 - v1 - creation

30/10/2013 - v2 - updated with requirements and variables

04/11/2013 - v3 - fixed author names

06/11/2013 - v4 - refactored modelisation to make functional view more centered on Control Route Suitability and kernel functions. Removed useless or internal variables. Added packets requirements and subset 23 definitions. Fixed previously stated issues.

08/11/2013 – v5 – version for review

Input documents:

Subset 26 §3.12.2, § A.3.4.1.3, §4.5.2, §4.10, §6.5.1.5.2, §7.4.2.21, §7.4.3.5, §8.4.2, §8.4.3

Subset 23

General description

At operational level, there are 3 options for an infrastructure owner to avoid the entry of a train with characteristics not compatible with a given infrastructure :

- Procedures (time tables are predefined for a list of authorised trains)
- Check of the validated train data sent by ETCS onboard equipment (only valid for L2 and L3 applications)
- Sending of route suitability data to ETCS onboard equipment that define which values concerning loading gauge, traction system and axle load category a train must meet to be allowed to enter the route

The implementation of the « control route suitability » function in an interoperable kernel permits to deal with route suitability data when required by a given infrastructure.

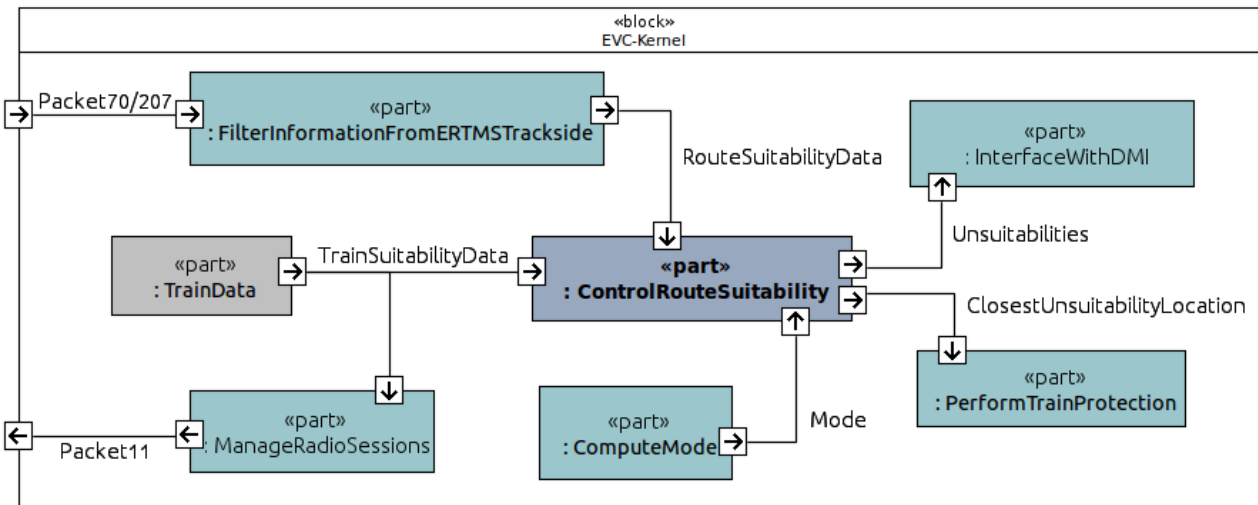
This function manages 3 cases of route unsuitabilities:

- loading gauge profile of the train not compatible with the line gauge authorised by infrastructure,
- traction system of the train not compatible with the country traction system
- the train axle load category is higher than the maximum authorised by infrastructure

Function description

1) Context

At implementation level, the interactions of the « control route suitability » function with the other macro functions of ETCS kernel are represented in the Internal Block Diagram shown below.



More precisely, regarding the inputs :

- Train data is generated by « capture train data for mission » with a data subset dedicated to train suitability data. These train data are also sent to « Manage radio sessions » interfaced with GSM-R for the cases where route suitability supervision is performed by the trackside.
- « Compute mode » provides the active mode of ETCS onboard equipment. Control route suitability function is only active in FS, OS and LS mode.
- « Filter information from ERTMS trackside » provides route suitability data to the kernel. A check of M_VERSION is performed on balise telegram or radio message to select packet 70 or 207.
- Location to shorten track information (not represented on the figure) represents a location where MA, track description and linking information must be deleted (see 026-A3.4 Handling of Accepted and Stored Information in specific Situations).

The route suitability data refers initially to a balise group reference NID_LRBG for the start location of the route suitability information. This trackside reference is converted into a unique onboard reference REF corresponding to the last valid balise group crossed by ETCS onboard equipment. The function « determine train location » (not represented on the figure) relocates the train on the balise group but also relocates all trackside profile data on the new reference REF taking into account the linking information between the balise groups.

With this principle, « control route suitability » and « perform train protection » work in the same referential, train and targets are located in reference to REF.

More precisely, regarding the outputs :

- « Interface with DMI » sends unsuitability information to DMI, if any.
- « Perform train protection » supervises the new EOA provided by the closest unsuitability, if any.

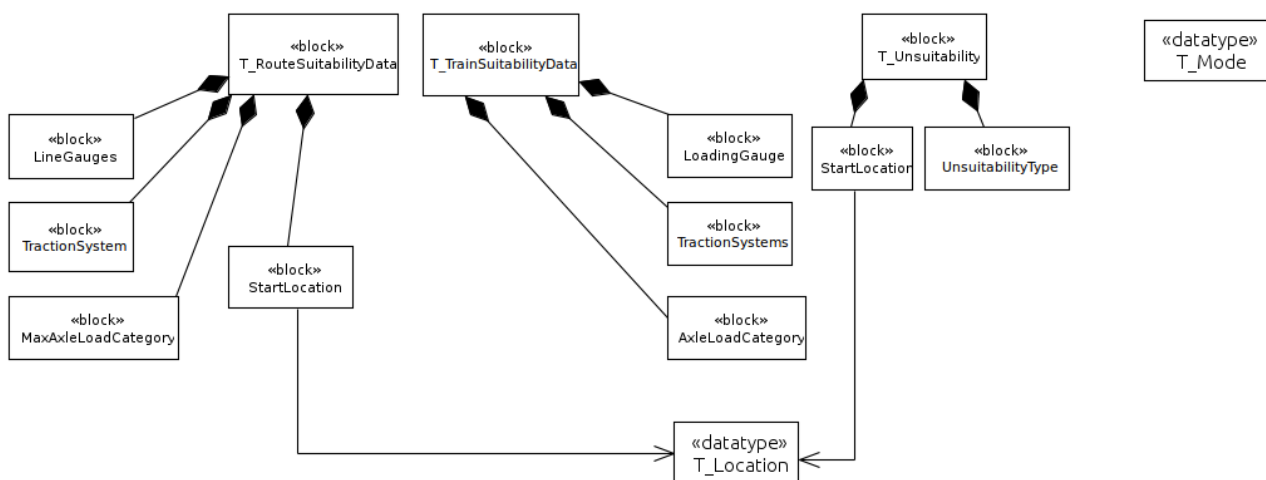
2) Behavior (traceability to UNISIG between brackets)

- Initially, there is no route suitability restriction [3.12.2.10]

- When the function receives new route suitability data [3.12.2.2], the new identified route unsuitability information of any type (loading gauge or traction system or axle load) shall replace all stored route unsuitability information of the same type.
- The function shall delete the stored route suitability data from a given location, if required by another function (location to shorten track information [A3.4])
- The function shall delete the stored route suitability data when it detects a change of mode according to the conditions defined in [4.10].
- The function shall check route suitability data in FS, LS and OS mode [4.5.2]
- The function shall check if the train is suitable with respect to the received route suitability data as follows [3.12.2.3] :
 - a. there is a route unsuitability if the loading gauge of the train M_LOADINGGAUGE is not in the list of loading gauges supported by the track (M_LINEGAUGE).
 - b. there is a route unsuitability if the axle load category of the train is above the permitted one received from trackside, (M_AXLELOADCAT).
 - c. there is a route unsuitability if the list of traction systems supported by the train does not include the traction system supported by the track (M_VOLTAGE and NID_CTRACTION)
- In case of unsuitability [3.12.2.4]:
 - a. The driver shall be informed by a text message (one per type of unsuitability) about all new route unsuitabilities (corresponding to the current train data) at their reception. This displayed information shall be re-evaluated at each reception of new route unsuitability information.
 - b. The location where the closest route unsuitability begins shall be identified (closest unsuitability location) as EOA/SVL to allow train supervision functions to avoid the entry of the train in the unsuitable area.

Variables

The inputs and outputs data types of the « control route suitability » function are summarised in the SysML diagram below :



Chapter 7 of 026 provides the packet details as follows :

Packet 70

Description	The packet gives the characteristics needed to enter a route.		
Transmitted by	Any		
Content	Variable	Length	Comment
	NID_PACKET	8	
	Q_DIR	2	
	L_PACKET	13	
	Q_SCALE	2	
	Q_TRACKINIT	1	
	D_TRACKINIT	15	Only if Q_TRACKINIT = 1
	D_SUITABILITY	15	Only If Q_TRACKINIT = 0, D_SUITABILITY and the following variables follows
	Q_SUITABILITY	2	
	M_LINEGAUGE	8	If Q_SUITABILITY= loading gauge
	M_AXLELOADCAT	7	If Q_SUITABILITY= Max axle load.
	M_VOLTAGE	4	If Q_SUITABILITY = traction system
	NID_CTRACTION	10	If Q_SUITABILITY = traction system and M_VOLTAGE \neq 0
	N_ITER	5	
	D_SUITABILITY(k)	15	
	Q_SUITABILITY(k)	2	

	M_LINEGAUGE(k)	8	If Q_SUITABILITY(k) = loading gauge
	M_AXLELOADCAT(k)	7	If Q_SUITABILITY(k) = Max axle load.
	M_VOLTAGE(k)	4	If Q_SUITABILITY(k) = traction system
	NID_CTRACTION(k)	10	If Q_SUITABILITY(k) = traction system and M_VOLTAGE(k) ≠ 0

Packet 207

Description	The packet gives the characteristics needed to enter a route.		
Transmitted by	Any		
Content	Variable	Length	Comment
	NID_PACKET	8	
	Q_DIR	2	
	L_PACKET	13	
	Q_SCALE	2	
	Q_TRACKINIT	1	
	D_TRACKINIT	15	Only if Q_TRACKINIT = 1
	D_SUITABILITY	15	Only If Q_TRACKINIT = 0, D_SUITABILITY and the following variables follows
	Q_SUITABILITY	2	
	M_LINEGAUGE	8	If Q_SUITABILITY = loading gauge
	M_AXLELOADCAT	7	If Q_SUITABILITY = Max axle load.
	M_VOLTAGE	4	If Q_SUITABILITY = traction system

	NID_CTRACTION	10	If Q_SUITABILITY = traction system and M_VOLTAGE \neq 0
	N_ITER	5	
	D_SUITABILITY(k)	15	
	Q_SUITABILITY(k)	2	
	M_LINEGAUGE(k)	8	If Q_SUITABILITY = loading gauge
	M_AXLELOADCAT(k)	7	If Q_SUITABILITY = Max axle load.
	M_VOLTAGE(k)	4	If Q_SUITABILITY = traction system
	NID_CTRACTION(k)	10	If Q_SUITABILITY = traction system and M_VOLTAGE \neq 0

Packet 11

Description	Validated train data.		
Transmitted to	RBC		
Content	Variable	Length	Comment
	NID_PACKET	8	
	L_PACKET	13	
	NC_CDTRAIN	4	
	NC_TRAIN	15	
	L_TRAIN	12	
	V_MAXTRAIN	7	
	M_LOADINGGAUGE	8	
	M_AXLELOADCAT	7	
	M_AIRTIGHT	2	
	N_AXLE	10	

	N_ITER	5	
	M_VOLTAGE(k)	4	Identity of the traction system
	NID_CTRACTION(k)	10	NID_CTRACTION(k) given only if M_VOLTAGE(k) \neq 0
	N_ITER	5	
	NID_NTC(k)	8	Type of National System available

APPENDIX : workshop templates (old information)

TO BE UPDATED WITH PREVIOUS INFORMATION IF REQUIRED

Functions

Name	Occurrence	Type	Description
Name	1	T_Text	ControlRouteSuitability
Definition	1	T_Definition	compares RouteSuitabilityData (Packet70) from trackside with TrainData to determine the list of unsuitabilities replaces movement authority data with the closest unsuitability location if there is some
<i>Input</i>	<i>0..n</i>	<i>T_Variable</i>	<i>RouteSuitabilityData (Packet70), TrainData</i>
<i>Output</i>	<i>0..n</i>	<i>T_Variable</i>	<i>ListOfUnsuitabilities</i>
<i>Local</i>	<i>0..n</i>	<i>T_Variable</i>	SA-1, SA-2, SA-3, SA-4, SA-5
<i>Parameter</i>	<i>0..n</i>	<i>T_Constant</i>	
<i>Requirement</i>	<i>0..n</i>	<i>T_Requirement</i>	
<i>Block</i>	<i>1 (optional)</i>	<i>T_FunctionalBlock</i>	
<i>Parent</i>	<i>0..1</i>	<i>T_Function</i>	
<i>Allocation</i>	<i>1</i>	<i>T_System</i>	Kernel
<i>Safety</i>	<i>1</i>	Boolean	

Variables

Name	Occurrence	Type	Description
Name	1	T_Text	RouteSuitabilityData
Definition	1	T_Definition	Data transmitted to the ERTMS/ETCS on-board equipment to allow it to check its ability to run on the track as indicated by the movement authority. It includes data related to loading gauge, traction system and axle load category.
Source	1	T_SourceDocument	Subset-23, Subset-26-3
Nature	1	T_VariableNature	Packet70

MinimalValue	0..1	T_Text	
MaximalValue	0..1	T_Text	
SpecialValue	0..n	T_Text	
Allocation	1	<ul style="list-style-type: none"> • Interface • Packet • Internal 	
Requirement	1..n	T_Requirement	SRS-3.12.2.1,
Store	0..1	T_Variable	
Resolution	0..1	T_VariableNature	
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	TrainData
Definition	1	T_Definition	Defined set of data which gives information about the train. Data that characterises a train and which is required by ERTMS/ETCS in order to supervise a train movement.
Source	1	T_SourceDocument	Subset-23, Subset-26-3
Nature	1	T_VariableNature	
MinimalValue	0..1	T_Text	
MaximalValue	0..1	T_Text	
SpecialValue	0..n	T_Text	
Allocation	1	<ul style="list-style-type: none"> • Interface • Packet • Internal 	
Requirement	1..n	T_Requirement	SA-1, SA-2, SA-3, SA-4
Store	0..1	T_Variable	
Resolution	0..1	T_VariableNature	
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	ListOfUnsuitabilities
Definition	1	T_Definition	List of route suitabilities where incompatibilities occur for this train.
Source	1	T_SourceDocument	Subset-26-3
Nature	1	T_VariableNature	
MinimalValue	0..1	T_Text	
MaximalValue	0..1	T_Text	

SpecialValue	0..n	T_Text	
Allocation	1	<ul style="list-style-type: none"> Interface Packet Internal 	
Requirement	1..n	T_Requirement	SA-1, SA-2, SA-3, SA-4
Store	0..1	T_Variable	
Resolution	0..1	T_VariableNature	
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	ClosestUnsuitabilityLocation
Definition	1	T_Definition	The closest location (from the train location) corresponding to the unsuitabilities of ListOfUnsuitabilities
Source	1	T_SourceDocument	
Nature	1	T_VariableNature	
MinimalValue	0..1	T_Text	
MaximalValue	0..1	T_Text	
SpecialValue	0..n	T_Text	
Allocation	1	<ul style="list-style-type: none"> Interface Packet Internal 	SA-1, SA-2, SA-3, SA-4
Requirement	1..n	T_Requirement	
Store	0..1	T_Variable	
Resolution	0..1	T_VariableNature	
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	EndOfAuthority
Definition	1	T_Definition	Location to which the train is permitted to proceed and where target speed = zero.
Source	1	T_SourceDocument	
Nature	1	T_VariableNature	
MinimalValue	0..1	T_Text	
MaximalValue	0..1	T_Text	
SpecialValue	0..n	T_Text	
Allocation	1	<ul style="list-style-type: none"> Interface 	

		<ul style="list-style-type: none"> • Packet • Internal 	
<i>Requirement</i>	<i>1..n</i>	<i>T_Requirement</i>	<i>SA-5, SA-8</i>
Store	0..1	T_Variable	
Resolution	0..1	T_VariableNature	
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	SupervisedLocation
Definition	1	T_Definition	Supervised location
Source	1	T_SourceDocument	Subset-26-3
Nature	1	T_VariableNature	
MinimalValue	0..1	T_Text	
MaximalValue	0..1	T_Text	
SpecialValue	0..n	T_Text	
Allocation	1	<ul style="list-style-type: none"> • Interface • Packet • Internal 	
<i>Requirement</i>	<i>1..n</i>	<i>T_Requirement</i>	<i>SA-5, SA-8</i>
Store	0..1	T_Variable	
Resolution	0..1	T_VariableNature	
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	ReleaseSpeed
Definition	1	T_Definition	A speed value to allow a train to approach the end of its movement authority. Needed for intermittent transmission to enable the train to approach a signal that has cleared in order to reach the information point at the signal.
Source	1	T_SourceDocument	Subset-23, Subset-26-3
Nature	1	T_VariableNature	
MinimalValue	0..1	T_Text	
MaximalValue	0..1	T_Text	
SpecialValue	0..n	T_Text	
Allocation	1	<ul style="list-style-type: none"> • Interface • Packet • Internal 	

<i>Requirement</i>	<i>1..n</i>	<i>T_Requirement</i>	<i>SA-5</i>
Store	0..1	T_Variable	
Resolution	0..1	T_VariableNature	
Safety	1	Boolean	

Requirements

Name	Occurrence	Type	Description
Name	1	T_Text	SA-1
Definition	1	T_Definition	The Kernel shall compare RouteSuitabilityData with TrainData, and build the list of unsuitabilities (if any).
Nature	1	<ul style="list-style-type: none"> • Structural • Functional • Definition 	
Source	1	T_SourceDocument	
Discussion	1 (Optional)	T_Text	subset-26
Parent	0..1	T_Requirement	SRS-3.12.2.3
Allocation	0..1	T_System	Kernel
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	SA-2
Definition	1	T_Definition	a) The Kernel shall add an unsuitability to the list of unsuitabilities if TrainData.M_LOADINGGAUGE is not in the list indicated by RouteSuitabilityData.M_LINEGAUGE.
Nature	1	<ul style="list-style-type: none"> • Structural • Functional • Definition 	
Source	1	T_SourceDocument	
Discussion	1 (Optional)	T_Text	subset-26
Parent	0..1	T_Requirement	SRS-3.12.2.3, SRS-7.4.2.21 Kernel
Allocation	0..1	T_System	
Safety	1	Boolean	

Name	Occurrence	Type	Description
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Name	1	T_Text	SA-3
Definition	1	T_Definition	b) The Kernel shall add an unsuitability to the list of unsuitabilities if the traction system indicated by RouteSuitabilityData.M_VOLTAGE and RouteSuitabilityData.NID_CTRACTION is not in TrainData.ListOfAcceptedTractionSystems
Nature	1	<ul style="list-style-type: none"> • Structural • Functional • Definition 	
Source	1	T_SourceDocument	subset-26
Discussion	1 (Optional)	T_Text	
Parent	0..1	T_Requirement	SRS-3.12.2.3, SRS-7.4.2.21
Allocation	0..1	T_System	Kernel
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	SA-4
Definition	1	T_Definition	c) The Kernel shall add an unsuitability to the list of unsuitabilities if TrainData.AxleLoadCategory > RouteSuitabilityData.M_AXLELOADCAT
Nature	1	<ul style="list-style-type: none"> • Structural • Functional • Definition 	
Source	1	T_SourceDocument	subset-26
Discussion	1 (Optional)	T_Text	
Parent	0..1	T_Requirement	SRS-3.12.2.3, SRS-7.4.2.21
Allocation	0..1	T_System	Kernel
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	SA-5
Definition	1	T_Definition	If ListOfUnsuitabilities contains at least one unsuitability, the Kernel shall set ClosestUnsuitabilityLocation with the closest location corresponding to the unsuitabilities of the list, and replace both EndOfAuthority and SupervisedLocation with ClosestUnsuitabilityLocation, and set ReleaseSpeed to a NO_RELEASE_SPEED value.

Nature	1	<ul style="list-style-type: none"> • Structural • Functional • Definition 	
Source	1	T_SourceDocument	subset-26
Discussion	1 (Optional)	T_Text	
Parent	0..1	T_Requirement	SRS-3.12.2.4
Allocation	0..1	T_System	Kernel
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	SRS-4.5.2
Definition	1	T_Definition	Function RouteSuitability shall be active in FS, LS and OS modes.
Nature	1	<ul style="list-style-type: none"> • Structural • Functional • Definition 	
Source	1	T_SourceDocument	subset-26
Discussion	1 (Optional)	T_Text	
Parent	0..1	T_Requirement	
Allocation	0..1	T_System	Kernel
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	SRS-3.12.2.10
Definition	1	T_Definition	The train is permitted to run without any route suitability data given from the track. No default values shall be used or supervised by the on-board equipment, i.e. the initial state is that no restrictions related to route suitability exists.
Nature	1	<ul style="list-style-type: none"> • Structural • Functional • Definition 	
Source	1	T_SourceDocument	subset-26
Discussion	1 (Optional)	T_Text	
Parent	0..1	T_Requirement	
Allocation	0..1	T_System	Kernel
Safety	1	Boolean	

Name	Occurrence	Type	Description
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Name	1	T_Text	SRS-4.10.1.3
Definition	1	T_Definition	When entering mode FS, LS, OS or PT, stored route suitability data shall remain unchanged. When entering any other mode (except non-relevant modes SF and IS), it shall be deleted.
Nature	1	<ul style="list-style-type: none"> • Structural • Functional • Definition 	
Source	1	T_SourceDocument	subset-26
Discussion	1 (Optional)	T_Text	
Parent	0..1	T_Requirement	
Allocation	0..1	T_System	Kernel
Safety	1	Boolean	

Exported Requirements :

Name	Occurrence	Type	Description
Name	1	T_Text	SRS-3.12.2.2
Definition	1	T_Definition	The trackside shall send the route suitability data as location data when needed.
Source	1	T_SourceDocument	subset-26
Allocation	0..1	T_System	Trackside
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	SA-6
Definition	1	T_Definition	The DMI shall inform the driver about all unsuitabilities from ListOfUnsuitabilities.
Source	1	T_SourceDocument	subset-26
Allocation	0..1	T_System	DMI
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	SA-7

Definition	1	T_Definition	The Kernel shall send route suitability parts of TrainData through Packet11 to the RBC.
Source	1	T_SourceDocument	subset-26
Allocation	0..1	T_System	Kernel but other function
Safety	1	Boolean	

Name	Occurrence	Type	Description
Name	1	T_Text	SRS-3.12.2.9.1
Definition	1	T_Definition	Note: This allows for route suitability supervision to be used in systems external to the ERTMS/ETCS system.
Source	1	T_SourceDocument	subset-26
Allocation	0..1	T_System	Trackside
Safety	1	Boolean	