OCORA

Open CCS On-board Reference Architecture

Automated Train Protection On-Board (ATP-OB)

MLM Interface Analysis

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Version	Change Description	Name (Initials)	Date of change
1.01	Official version for OCORA Release R1	MT	03.12.2021

References

[1] OCORA-BWS01-010 – Release Notes
[2] OCORA-BWS01-020 – Glossary
[3] OCORA-BWS01-030 – Question and Answers
[4] OCORA-BWS01-040 – Feedback Form
[5] OCORA-BWS03-010 – Introduction to OCORA
[6] OCORA-BWS04-010 – Problem Statements

1 Introduction

1.1 Purpose of the document

The purpose of this document is to identify the interface of the MLM logical component. The Mode and Level Manager (MLM) manages transitions between mode and level. It provides mode and level state or switching information to other logical component. The methodology followed for the identification of input is based on the analysis of the subset 026 chapter 4. The transition conditions provide informations needed by the MLM to compute mode and level state. We identify informations already transmitted and specified in other logical component. The objective is also to reuse informations that are already defined.

This document is addressed to experts in the CCS domain and to any other person, interested in the OCORA concepts for on-board CCS. The reader is invited to provide feedback to the OCORA collaboration and can, therefore, engage in shaping OCORA. Feedback to this document and to any other OCORA documentation can be given by using the feedback form [4].

If you are a railway undertaking, you may find useful information to compile tenders for OCORA compliant CCS building blocks, for tendering complete on-board CCS system, or also for on-board CCS replacements for functional upgrades or for life-cycle reasons.

If you are an organization interested in developing on-board CCS building blocks according to the OCORA standard, information provided in this document can be used as input for your development.

1.2 Applicability of the document

The document is currently considered informative but may become a standard at a later stage for OCORA compliant on-board CCS solutions. Subsequent releases of this document will be developed based on a modular and iterative approach, evolving within the progress of the OCORA collaboration.

1.3 Contect of the document

This document is published as part of the OCORA Release R1, together with the documents listed in the release notes [1]. Before reading this document, it is recommended to read the Release Notes [1]. If you are interested in the context and the motivation that drives OCORA we recommend to read the Introduction to OCORA [5], and the Problem Statements [6]. The reader should also be aware of the Glossary [2] and the Question and Answers [3].

2 Transition Condition

N°	Condition	Transition Condition (susbet 026 §4)	Logical bloc provider	architecture choice	Signal
1	The driver isolates the ERTMS/ETCS on-board equipment	1	FVA	Separated VS and STM/NTP component allows each to function separately when one is isolated MLM has to deals with isolation condition of VS and each NTC	
2	a desk is open	2;22;23	FVA		cabin status
3	no “go sleeping” input signal is received any more	3	FVA		sleeping
4	train is at standstill	3;5;6;7;14;19;46;47;59;62;63;68	Movement detection On-Board/StandStill Detection MD-OB/SSD		standstill
5	The ERTMS/ETCS on-board equipment is powered	4			
6	ERTMS/ETCS level is 0 or NTC or 1	5	MLM (internal)		
7	driver selects Shunting mode	5;35	HMI-OB/ETCS-DMI		driver selection
8	ERTMS/ETCS level is 2 or 3	6;16;31	MLM (internal)		
9	reception of the information “Shunting granted by RBC”, due to a Shunting request from the driver	6	VS(euradio)		
10	the driver acknowledges the train trip	7;62;63;68	HMI-OB/ETCS-DMI		driver acknowledgement
11	the ERTMS/ETCS level is different from 0, NTC	7	MLM (internal)		
12	Staff Responsible mode is proposed to the driver	8	HMI-OB/ETCS-DMI		

N°	Condition	Transition Condition (susbet 026 §4)	Logical bloc provider	architecture choice	Signal
13	driver acknowledges	8	HMI-OB/ETCS-DMI	ack for SR	driver acknowledgement
14	valid Train Data is stored on board	10;62;63	Data Storage On-Board (DS-OB)		
15	MA + SSP +gradient are on-board	9;10;24;33;31;25;32;48;53	VS	condition Id 9/24/33/48/53=CR1238	
16	no specific mode is required by a Mode Profile	10;25;31;32	VS		
17	The train/engine overpasses the EOA/LOA with its min safe antenna position	12	VS		
18	ERTMS/ETCS level is 1	12;32	MLM (internal)		
19	The ERTMS/ETCS on-board equipment detects a fault that affects safety	13			
20	The “sleeping” input signal is received	14	FVA		sleeping
21	all desks connected to the ERTMS/ETCS on-board equipment are closed	14;26;27;28;30	FVA		cabin status
22	An ackn. request for On Sight is displayed to the driver	15	HMI-OB/ETCS-DMI		Acknowledgement request
23	the driver acknowledges	15	HMI-OB/ETCS-DMI	ack OS	driver acknowledgement
24	The train/engine overpasses the EOA/LOA with its min safe front end	16	VS		
25	The onboard reacts according to a linking reaction set to “trip”.	17	VS		
26	the train/engine receives and uses a trip order given by balise	18	VS		
27	override is not active	18;36;42;43;49;52;54;67	VS		
28	driver selects “exit Shunting	19	HMI-OB/ETCS-DMI		driver selection
29	unconditional emergency stop message is accepted	20	VS		

N°	Condition	Transition Condition (susbet 026 §4)	Logical bloc provider	architecture choice	Signal
30	ERTMS/ETCS level switches to 0	21	MLM (internal)		
31	”Stop Shunting on desk opening” information is stored onboard	22	MLM (internal)		
32	no ”Stop Shunting on desk opening” information is stored onboard)	23	MLM (internal)		
33	ERTMS/ETCS level switches to 1,2 or 3	25;34;39;61;71	MLM (internal)		
36	”Continue Shunting on desk closure” function is active	26	MLM (internal)		
37	the “passive shunting” input signal is received	26	FVA		Passive shunting
38	”Continue Shunting on desk closure” function is not active	27	MLM (internal)		
39	the ERTMS/ETCS on-board equipment is NOT powered	29			
40	no “passive shunting” input signal is received	30	FVA		Passive shunting
41	no trip order is given by balise	32	VS		
42	A Mode Profile defining an On Sight area is on-board	34;40;73	VS		
43	The max safe front end of the train is inside the On Sight area	34;40;73	VS (D_MAMODE, L_MAMODE) VL (D_LRBG, Q_LOCACC, L_DOUBTOVER)		
45	The ERTMS/ETCS on-board equipment is interfaced to the National System through an STM	35;38	STM Controler		
46	National Trip Procedure is active	35;38	STM Controler		
47	the identity of the over-passed balise group is not in the list of expected balises related to SR mode	36	VS		
48	driver selects “override	37	HMI-OB/ETCS-DMI		driver selection

N°	Condition	Transition Condition (susbet 026 §4)	Logical bloc provider	architecture choice	Signal
49	train speed is under or equal to the speed limit for triggering the “override” function	37	LOC-OB/VL (speed) and DS-OB/Operational Data Storage (V_NVALLOWOVTRP)		
50	The ERTMS/ETCS level switches to 0,1,2 or 3	38	MLM (internal)		
51	no MA has been accepted	39	VS		
53	T_NVCONTACT is passed	41	VS		
54	associated reaction is “train trip"	41	Operational Data Storage (M_NVCONTACT)		
55	The train/engine overpasses the SR distance with its estimated front end	43	VS (D_NVSTFF) VL (D_LRBG)	D_NVSTFF provided by VS because has to be synschronized by D_LRBG ? (relocation function) so not provided by operationnal data storage	
56	The train/engine overpasses the former EOA/LOA (when Override was activated) with the min safe antenna position	43	VS		
57	“override” function is active	44	VS		
58	ERTMS/ETCS level switches to 1	44;67	MLM (internal)		
59	no unconditional emergency stop message has been received	45	VS		
60	ERTMS/ETCS level switches to 2 or 3	45	MLM (internal)		
61	Driver selects NON LEADING	46	HMI-OB/ETCS-DMI		driver selection
62	The “non leading” input signal is received	46	FVA		Non-Leading
63	no “non leading” input signal is received any more	47	FVA		Non-Leading
64	reception of information “stop if in shunting	49	VS		

N°	Condition	Transition Condition (susbet 026 §4)	Logical bloc provider	architecture choice	Signal
65	An ackn. request for Shunting is displayed to the driver	50	HMI-OB/ETCS-DMI		Acknowledgement request
66	the driver acknowledges	50	HMI-OB/ETCS-DMI	ack request for shunting	driver acknowledgement
67	A Mode Profile defining the entry of a Shunting area is used on-board	51;61	VS		
68	The max safe front end of the train is inside the Shunting area	51;61	VS (M_MAMODE and D_MAMODE, L_MAMODE) VL (D_LRBG, Q_LOCACC, L_DOUBTOVER)	VS provide paraméter relocated, synchronized with (D_LRBG)	
69	the identity of the over-passed balise group is not in the list of expected balise groups related to SH mode	52	VS		
70	reception of information “stop if in Staff Responsible"	54	VS		
71	no list of expected balise groups related to SR mode has been received or the list of expected balise groups related to SR mode does not include the identity of the over-passed balise group	54	VS		
72	the ERTMS/ETCS level switches to “NTC”	56	MLM (internal)		
73	the ERTMS/ETCS level is “NTC”)	58	MLM (internal)		
74	an acknowledgement request for SN mode is displayed to the driver	58	HMI-OB/ETCS-DMI		Acknowledgement request
75	the driver acknowledges	58	HMI-OB/ETCS-DMI	ack request for SN	driver acknowledgement
76	driver has acknowledged the reversing	59	HMI-OB/ETCS-DMI		
77	an acknowledgement request for UN mode is displayed to the driver	60	HMI-OB/ETCS-DMI		Acknowledgement request
78	the driver acknowledges	60	HMI-OB/ETCS-DMI	ack request for UN	driver acknowledgement
81	the ERTMS/ETCS level is 0	62	MLM (internal)		

N°	Condition	Transition Condition (susbet 026 §4)	Logical bloc provider	architecture choice	Signal
83	the ERTMS/ETCS level is NTC	63	MLM (internal)		
84	The system version number X of a received balise telegram is greater than the highest version number X supported by the on-board equipment	65	VS		
85	ERTMS/ETCS level is 1, 2 or 3	65	MLM (internal)		
86	A balise group contained in the linking information is passed in the unexpected direction	66	VS		
87	trip order has been received	67	VS		
88	the ERTMS/ETCS level is 0 or NTC	68	MLM (internal)		
89	no valid Train Data is on-board	68	Operational Train Data Storage	or Configuration train data storage in case of fixed train data?	
90	Estimated train front end is in rear of the start location of either SSP or gradient profile stored on-board	69	VS		
91	An ackn. request for Limited Supervision is displayed to the driver	70	HMI-OB/ETCS-DMI	ack request for LS	Acknowledgement request
92	A Mode Profile defining a Limited Supervision area is on-board	71;72;74	VS		
93	The max safe front end of the train is inside the Limited Supervision area	71;72;74	VS (M_MAMODE and D_MAMODE, L_MAMODE) VL (D_LRBG, Q_LOCACC, L_DOUBTOVER)	VS provide paraméter relocated, synchronized with (D_LRBG)	
94	The estimated front end of the train is not inside an LS acknowledgement area	73	VS (M_MAMODE and D_MAMODE, L_MAMODE) VL (D_LRBG)	VS provide paraméter relocated, synchronized with (D_LRBG)	

N°	Condition	Transition Condition (susbet 026 §4)	Logical bloc provider	architecture choice	Signal
95	estimated front end of the train is not inside an OS acknowledgement area	74	VS (M_MAMODE and D_MAMODE, L_MAMODE) VL (D_LRBG)	VS provide paraméter relocated, synchronized with (D_LRBG)	
96	the ERTMS/ETCS on-board equipement starts to indicate to the driver that an unprotected LX is being approached	9	VS	CR1238	
97	The AD mode is requestd by the ERTMS/ATO on board	11	ATO-OB/AV	CR1238	
98	SSP and gradient are known for the whole length of the train	11	VS	CR1238	
99	the ERTMS/ETCS on-board does not command the service brake	11	VS	CR1238	
100	the ERTMS/ETCS on-board does not command the emergency brake	11;24	VS	CR1238	
101	the driver selects "ATO engage"	11	HMI-OB/ETCS-DMI	CR1238	
102	the AD mode is no longer requested by the ERTMS/ATO on-board	33	ATO-OB/AV	CR1238	
103	SSP and gradient are no longer known for the whole length of the train	48	VS	CR1238	
104	the driver selects "ATO disenagage"	53	HMI-OB/ETCS-DMI	CR1238	
105	the driver sets the ATO selector to "stand by"	53	HMI-OB/ETCS-DMI	CR1238	

3 MLM IN

Signal	Variable	Value	Elementary condition (sheet transition condition column A)	Emitter	reference of information already defined
cabin status	TR_OBU_CabStatusA TR_OBU_CabStatusB	a desk is open desk are closed	2;21	FVA	OCORA-TWS04-012_FVA-Standard-Communication-Interface-Specification_V-1-10.docx F-ETCS-In-01 SS-034: 2.5.1 SS-119: 5.4.1
sleeping	TR_OBU_TrainSleep TR_OBU_TrainSleep_Not	no “go sleeping” input signal is received any more The “sleeping” input signal is received	3;20	FVA	OCORA-TWS04-012_FVA-Standard-Communication-Interface-Specification_V-1-10.docx F-ETCS-In-07 SS-026: 4.4.6 / 4.6.3 SS-034: 2.2.1 SS-119: 5.1.1
non leading	TR_OBU_NLEnabled	The “non leading” input signal is received no “non leading” input signal is received any more	62;63	FVA	OCORA-TWS04-012_FVA-Standard-Communication-Interface-Specification_V-1-10.docx F-ETCS-In-09 SS-026:4.4.15 / 4.6.3 SS-034: 2.2.3 SS-119: 5.1.3

Signal	Variable	Value	Elementary condition (sheet transition condition column A)	Emitter	reference of information already defined
standstill		train is at standstill	4	MD-OB/Stand Still Detection	
driver selection	M_BUTTONS_ACT	driver selects Shunting mode driver selects “exit Shunting" driver selects “override" Driver selects "non leading"	7;28;48;61	HMI-OB/ETCS-DMI	subset 121
driver acknowledgement	M_ACK_DATA M_ACKED	the driver acknowledges the train trip the driver acknowledges SR the driver acknowledges OS the driver acknowledges SH the driver acknowledges SN the driver acknowledges UN	10;13;23;66;75;78	HMI-OB/ETCS-DMI	subset 121

Signal	Variable	Value	Elementary condition (sheet transition condition column A)	Emitter	reference of information already defined
Acknowledgement request	M_ACK_DATA M_ACK_DISPLAYED	An ackn. request for LS is displayed to the driver An ackn. request for UN is displayed to the driver An ackn. request for SN is displayed to the driver An ackn. request for SH is displayed to the driver An ackn. request for OS is displayed to the driver	22;65;74;77;91	HMI-OB/ETCS-DMI	subset 121
Passive shunting permission	TR_OBU_PassiveShunting	0 = passive shunting not permitted 1 = Passive shunting permitted	37;40	FVA	OCORA-TWS04-012_FVA-Standard-Communication-Interface-Specification F-ETCS-In-08 SS-026: 4.4.20 / 4.6.3 SS-034: 2.2.2 SS-119: 5.1.2
Isolation			1	FVA	
Train data validity		valid invalid	14;89	DS-OB	
train speed			49	VL	

Signal	Variable	Value	Elementary condition (sheet transition condition column A)	Emitter	reference of information already defined
speed limit for triggering override	V_NVALLOWOVTRP		49	DS-OB	
	M_NVCONTACT		54	DS-OB	
national trip procedure active			46	STM controler	
The ERTMS/ETCS on-board equipment is interfaced to the National System through an STM			45	STM controler	
MA + SSP +gradient are on-board			15	VS	
no specific mode is required by a Mode Profile			16	VS	
The train/engine overpasses the EOA/LOA with its min safe antenna position			17	VS	
The train/engine overpasses the EOA/LOA with its min safe front end			24	VS	
The onboard reacts according to a linking reaction set to “trip”.			25	VS	
the train/engine receives and uses a trip order given by balise			26	VS	
override activation		active non active	27;57	VS	
unconditional emergency stop message is accepted			29	VS	

Signal	Variable	Value	Elementary condition (sheet transition condition column A)	Emitter	reference of information already defined
no trip order is given by balise			41	VS	
A Mode Profile defining an On Sight area is on-board			42	VS	
the identity of the over-passed balise group is not in the list of expected balises related to SR mode			47	VS	
no MA has been accepted			51	VS	
T_NVCONTACT is passed			53	VS	
The train/engine overpasses the former EOA/LOA (when Override was activated) with the min safe antenna position			56	VS	
no unconditional emergency stop message has been received			59	VS	
reception of information “stop if in shunting			64	VS	
A Mode Profile defining the entry of a Shunting area is used on-board			67	VS	
the identity of the over-passed balise group is not in the list of expected balise groups related to SH mode			69	VS	
reception of information “stop if in Staff Responsible"			70	VS	

Signal	Variable	Value	Elementary condition (sheet transition condition column A)	Emitter	reference of information already defined
no list of expected balise groups related to SR mode has been received or the list of expected balise groups related to SR mode does not include the identity of the over-passed balise group			71	VS	
The system version number X of a received balise telegram is greater than the highest version number X supported by the on-board equipment			84	VS	
A balise group contained in the linking information is passed in the unexpected direction			86	VS	
trip order has been received			87	VS	
Estimated train front end is in rear of the start location of either SSP or gradient profile stored on-board			90	VS	
A Mode Profile defining a Limited Supervision area is on-board			92	VS	

Signal	Variable	Value	Elementary condition (sheet transition condition column A)	Emitter	reference of information already defined
Mode Profile	D_MAMODE L_MAMODE L_ACKMODE table for each mode profile stored on board Relocated		43;68;73;74;93	VS	
over-reading amount	Q_LOCACC L_DOUBTOVER		43	VL	
estimated front end	D_LRBG		43	VL	
SR distance	D_NVSTFF (relocated)		43	VS	
information “Shunting granted by RBC”			9	VS	
the ERTMS/ETCS on-board equipement starts to indicate to the driver that an unprotected LX is being approached			96	VS	
the ERTMS/ETCS on-board equipement starts to indicate to the driver that an unprotected LX is being approached			96	VS	
AD mode is request		requested no more requested	97;102	ATO-OB/AV	
SSP and gradient known for the whole length of the train		known no longer known	98;103	VS	
service brake command			99	VS	
emergency brake command			100	VS	

Signal	Variable	Value	Elementary condition (sheet transition condition column A)	Emitter	reference of information already defined
the driver selects "ATO engage"			101	HMI-OB/ETCS-DMI	
the driver selects "ATO disenagage"			104	HMI-OB/ETCS-DMI	
the driver sets the ATO selector to "stand by"			105	HMI-OB/ETCS-DMI	

4 MLM OUT

	ETCS LEVEL	ETCS MODE
Variable	M_LEVEL	M_MODE
Value	0,1,2,3,NTC	OS,SR,FS,SH,LS,SN,NP,IS,SF,NL,SL,AD
reference	subset 026-7	subset 026-7

Receiver of information	ETCS LEVEL	ETCS MODE
Vehicle supervisor	yes §4.8.3 accepted information	yes subset026 §4.5.2 Active functions table §4.7 DMI depending on modes §4.8.4 accepted information
ATO-AV	no	Mode FS ou AD subset 125 §9.1.1.2 a)
ATP-OB / STM controler	yes switch to LeveL NTC	yes switch to SN mode
ATP-OB / NTP(STM)	yes switch to LeveL NTC	yes switch to SN mode
ATP-OB / NTP(NTC-APP)	yes switch to LeveL NTC	yes switch to SN mode
Vehicle locator	no	no
IPM-OB	yes state of ATP-OB	yes state of ATP-OB
MDCM-OB	yes state of ATP-OB	yes state of ATP-OB
HMI-OB	yes Susbet 121 indicators visibility according DMI configuration	yes Susbet 121 indicators visibility according DMI configuration
MD-OB / CMD	no	yes activation of cold movement detector

	ETCS LEVEL	ETCS MODE
DR-OB	yes susbet 027 §4.2.2 General structure of messages	yes susbet 027 §4.2.2 General structure of messages
FVA		mode AD susbet 119 v1.2.4 §5.1.5

5 MLM Function

ID	Function
	Evaluate level
MLM_Func1	Evaluate mode : evaluate transition conditions between mode taking priorities into account
MLM_Func1	Detect switch of level
MLM_Func1	Continue shunting on desk opening
MLM_Func1	Detect presence in mode area (OS, LS , SH)
MLM_Func1	Detect speed under override speed condition
MLM_Func1	Calcul train position base on variable form VL (MaxSFE, Min SFE)
MLM_Func1	Compare distance : Train location / specific location (SR distance e.g.)

6 Open Points

Type	No	Question	Answer
OP	1	does the request for acknowledgement are recieved from the Dmi or from the VS ?	The better is from the DMI. In fact there are some conditions to be filfilled to propose the request to the driver
OP	2	Why a separated MLM ?	Pro : _ Life cycle of the logical bloc _ To conserve function even if EVC is isolated _ To allow project specific implementation _ logical bloc can be provided by different manufacturer Con: _ decomposition make validation more complex _
OP	3	Does MLM manage ATO mode ?	see transition condition ATO sheet for GoA2 some conditions to switch between ATO mode are external (HMI, FVA, MLM, VL) The majority comes from ATO internal If the ATO mode are evaluated outside the ATO-AV logical bloc, conditions that are evaluated by ATO should be send to MLM
OP	4	MLM can change function parameter for example change the value of D_NVROLL which is different in GoA1 and GoA2	

Type	No	Question	Answer
OP	5	Which stored information are stored in the "operationnal data storage" ? Are all information stored on-board stored in this centralized logical component ? For example : *"Stop Shunting on desk opening" information is stored onboard* is MLM internal or external ?	
OP	6	Are condition computed in VS or in MLM ? For example : *The max safe front end of the train is inside the On Sight area* is the condition directly provided by VS or does this information computed by MLM based on D_MAMODE (VS) and D_LRBG (VL) ?	