ERTMS/ATO

ATO-OB / Recording-Monitoring devices FFFIS Application Layer

REF : SUBSET-140
ISSUE: 1.2.0
DATE : 29/06/24

1. MODIFICATION HISTORY

Issue Number Date	Section Number	Modification / Description
0.0.1 02-01-2019	All	First issue of the document
0.0.2 24-02-2020	All	First review of the document
0.0.3 02-10-2020	All	The document content has been changed according to the UNISIG ATO WP comments referring to the last version (0.0.2).
0.0.4 25-11-2020	All	The document content has been changed according to the UNISIG ATO WP comments referring to the last version (0.0.3).
0.0.5 15-12-2020	All	The document content has been changed according to the UNISIG ATO WP comments referring to the last version (0.0.4).
0.0.6 28-01-2021	All	The document content has been changed according to the UNISIG ATO WP comments referring to the last version (0.0.5).
0.0.7 07-04-21	All	Alignment of the definition and the resolution/formula for each variable referenced to a Reference Document, according to ERA/UNISIG comments.
0.0.8 15-07-21	All	Modification of the document according to EECT#074.
0.0.9 15-12-21		Improved descriptions Alignment to Subset-139 v0.0.21 Alignment to Subset-143 v0.0.10
0.0.10 2023-09-04	All	Modification of chapter 6 according to the agreements in TWG ARCHI (see Appendix 1 of SS-149 v 0.0.6), adding SS-149 as new reference, and alignment of the remaining document accordingly.
0.0.11 2023-09-28	Title, 4.1.1.1, 6.2.1.1	Final review agreements in TWG ARCHI
1.0.0 2023-10-04		Formal release of version 1.0.0
1.1.0 2023-11-30	Title, 4.1.1.1, 5.1.1.2, 6.5.1.1	Update based on review comments from ERA, agreed in TWG ARCHI 22
1.1.1 2024-05-13	6.4.4.2, 6.4.6.2, 6.4.8.2, 6.5.1.1	Typos corrections
1.2.0 2024-06-29	Template, page 1, table 1	Update due to UNISIG SG quality check, CCS TSI Application Guide release version

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4. INTRODUCTION

4.1. Scope and purpose of the document

4.1.1.1. The purpose of this document is to define the Application Layer of the interoperable FFFIS interface between the ATO on-board (ATO-OB) and devices intended for recording or monitoring purposes (e.g. the Juridical recorder (ORD) or the Online Monitoring System (OMS) [Ref 9]). The lower layers of communication details are specified in [Ref 8].

4.1.1.2. The scope of the document is to define the interoperable packets sent from the ATO-OB to the Recording/Monitoring devices.

4.2. Reference documents

4.2.1.1. This section presents the reference documents.

Ref. N°	Title	Reference	Author
[Ref 1]	ERTMS/ATO System Requirements Specification	SUBSET-125	UNISIG
[Ref 2]	System Requirements Specification	SUBSET-026	ERA, UNISIG, EEIG ERTMS Users Group
[Ref 3]	ERTMS/ATO Glossary	13E154	EEIG ERTMS Users Group
[Ref 4]	Glossary of Terms and Abbreviations	SUBSET-023	ERA, UNISIG, EEIG ERTMS Users Group
[Ref 5]	ERTMS/ATO ATO-OB / ATO-TS FFFIS Application Layer	SUBSET-126	UNISIG
[Ref 6]	ERTMS/ATO ATO-OB / ETCS-OB FFFIS Application Layer	SUBSET-130	UNISIG
[Ref 7]	ATO-OB / Rolling Stock Interface Specification FIS + FFFIS	SUBSET-139	UNISIG
[Ref 8]	ERTMS/ATO Interface Specification Communication Layers for On-board Communication	SUBSET-143	UNISIG
[Ref 9]	ERTMS/ETCS-ERTMS/ATO Online Monitoring System	SUBSET-149	UNISIG
[Ref 10]	ERTMS Data Applications FFFIS part: CCS Consist Network Communication Layers	SUBSET-147	UNISIG

Table 1 Reference documents

4.3. Abbreviations

4.3.1.1. For ATO related abbreviations see ERTMS/ATO Glossary [Ref 3].

4.3.1.2. For ETCS related abbreviations see SUBSET-023 [Ref 4].

4.4. Definitions

4.4.1.1. For ATO related definitions see ERTMS/ATO Glossary [Ref 3].

4.4.1.2. For ETCS related definitions see SUBSET-023 [Ref 4].

5. PRINCIPLES

5.1. Main Principles

5.1.1.1. The ATO-OB shall detect occurrences of specific events and provide the corresponding message(s) (see section 6.5, Table 12) to the Recording/Monitoring devices.

5.1.1.2. When such an event occurs, the ATO-OB will use the following date and time information to timestamp the corresponding message(s) to be sent over the interface according to Table 2:

a) the date and time of the occurrence of the event using Universal Time Co-ordinated (UTC) in accordance with the Train Time and Location Service (TTLS) as defined in [Ref 10].

b) The train position and speed at the occurrence of the event

c) The train identifier

5.1.1.3. When sending one message or several messages together in relation with the same triggering event, the encapsulated data shall be consistent with each other regarding the time stamping.

5.2. Definition of the Variables

5.2.1.1. All variables defined within this document shall comply with [Ref 8].

5.2.1.2. The variables already defined in ETCS are used in this interface by using the same name and giving the corresponding reference in its description and resolution/formula.

5.2.1.3. In the case that the length of an ETCS variable is not aligned with any of the data types defined in [Ref 8] and is not part of a BITSET, the needed amount of “0” values will be added in the most significant bits of the variable, to align it with the data type defined in the corresponding column of the packet description table.

5.3. Definition of the Packets

5.3.1.1. The following chapters will describe the user data only. All details on the way how User Data are transformed to packets can be found in [Ref 8]. Packets are multiple variables grouped into a single unit, with a defined internal structure.

6. DETAILED DESCRIPTION OF THE APPLICATION LEVEL

6.1. Introduction

6.1.1.1. This section details the application level of the interface for ATO data to be sent to the Recording/Monitoring devices.

6.2. ATO to Recording/Monitoring devices packet summary

6.2.1.1. The Table 2 gives the list of exchanged packets:

Packet Number (NID_PACKET_ATO)	Packet Name	Transmitting cycle [ms]	Data Class [Ref 8]
61	Traction_Brake_Pneumatic_Brake_Requested	NA	Message Data
62	Timing_Point	NA	Message Data
63	Doors_Command	NA	Message Data
64	Adhesion_System	NA	Message Data
65	JP_Received	NA	Message Data
66	Stopped_At_EOA	NA	Message Data
67	ATO_Communication_Link_Status	NA	Message Data
68	ATO_Status	NA	Message Data
90	ATO_OB_Proprietary_Data	NA	Message Data

Table 2 Packet summary

6.2.1.2. The packets in Table 2 are sent event-based.

6.2.1.3. The packet numbers defined in Table 2 correspond to NID_PACKET definition given in [Ref 8]. This interface uses Slot 3 (see [Ref 8]).

6.3. ATO Header

6.3.1.1. This section details the specific header of a packet sent by the ATO-OB to the Recording/Monitoring devices.

6.3.1.2. The information in the header allows each packet to be uniquely identified.

6.3.1.3. All the variables contained in the ATO Header shall represent the state of the ATO-OB at the moment the related event is triggered.

Packet Header				
Item	**Variable Name**	**Description**	**Data Type**	**Resolution/Formula**
001	NID_C	See [Ref 2] § 7.5.1.86.	UINT16	See [Ref 2] §7.5.1.86.
002	NID_SP	See [Ref 5] §7.3.10.2.	UINT32	See [Ref 5] §7.3.10.2.
003	D_Sending_Position	Position of the estimated front end of the train at the moment the related event is triggered (relatively from the beginning of the given SP) defined in [Ref 5].	UINT32	**Binary to numeric** (in centimetres) 16777215 = Undefined Location
004	V_EST	See [Ref 6] §7.2.2.2.	UINT16	See [Ref 6] §7.2.2.2.
005	NID_OPERATIONAL	See [Ref 2] §7.5.1.92	BCD32	See [Ref 2] §7.5.1.92

Table 3 ATO Header structure

6.4. ATO Packets Applicable Content

6.4.1. Introduction

6.4.1.1. This section defines the actual ATO information contained in the packet.

6.4.2. Traction_Brake_Pneumatic_Brake_Requested

6.4.2.1. This section details the ATO Applicable Content of a Traction_Brake_Pneumatic_Brake_Requested Packet sent by the ATO-OB to the Recording/Monitoring devices.

6.4.2.2. Traction_Brake_Pneumatic_Brake_Requested Applicable Content description:

Packet Number	*61*			
Item	**Variable Name**	**Description**	**Data Type**	**Resolution/Formula**
001	M_ATO_TraBrRq	See [Ref 7] §7.3.1	UINT8	See [Ref 7] §7.3.1
002	M_ATO_LocoBrRq	See [Ref 7] §7.3.1	UINT8	See [Ref 7] §7.3.1
003	Q_ATO_SupTB	See [Ref 7] §7.3.1	BITSET8	See [Ref 7] §7.3.1
004	M_ATO_RTBRq	See [Ref 7] §7.3.1	INT16	See [Ref 7] §7.3.1

Table 4 Traction_Brake_Pneumatic_Brake_Requested Applicable Content structure

6.4.3. Timing_Point

6.4.3.1. This section details the ATO Applicable Content of a Timing_Point Packet sent by the ATO-OB to the Recording/Monitoring devices.

6.4.3.2. Timing_Point Applicable Content description:

Packet Number		*62*			
Item	**Variable Name**		**Description**	**Data Type**	**Resolution/Formula**
001	NID_C		See [Ref 2] §7.5.1.86.	UINT16	See [Ref 2] §7.5.1.86.
002	NID_TP		TP identity of the TP the event indicated by Q_TP_STATUS is referring to.	UINT32	Binary to numeric. 4294967295 for undefined value.
	Bit	TP_INFO		BITSET8	
003	0	Q_EOJ_REACHED	Qualifier indicating if the End of Journey is reached or not.		**Values:** 0 = EoJ reached 1 = EoJ not reached
004	1..2	Q_TP_Alignment	Qualifier defining if the TP location is requested from the front, middle or rear of the train, defined in [Ref 5]..		See [Ref 5] §7.3.6.2.
005	3..6	Q_TP_STATUS	Status of the TP considered by the Packet.		**Values:** 0 = Train passed the TP (NID_TP = passed TP). 1 = Train stopped at the TP (NID_TP = TP stopped). 2 = Train departed from the TP (NID_TP = TP departed). 3 = Train held at the Stopping Point (NID_TP = TP the train is held to) 4 = Train held command revoked by JP Update/JP Revoke (NID_TP = TP the train is no longer held to) 5 = To be skipped by Driver (NID_TP = TP to be skipped) 6 = Skip revoked by Driver (NID_TP = TP associated to revoked skip command) 7 = To be skipped by ATO-TS (NID_TP = TP to be skipped) 8 = Skip revoked by ATO-TS (NID_TP = TP associated to revoked skip command)
006	7	Spare			
	Bit	STOPPING_DATA		BITSET8	

Packet Number		*62*			
Item	**Variable Name**		**Description**	**Data Type**	**Resolution/Formula**
007	0..4	Q_Stop_Location_Tolerance	[If TP_STATUS = 1] See [Ref 5] §7.3.9.2.		See [Ref 5] §7.3.9.2.
008	5..6	Q_Accurate_Stopping	[If TP_STATUS = 1] See [Ref 5] §7.3.10.2.		See [Ref 5] §7.3.10.2.
009	7	Spare	[If TP_STATUS = 1]		

Table 5 Timing_Point Applicable Content structure

6.4.4. Doors_Command

6.4.4.1. This section details the ATO Applicable Content of a Doors_Command Packet sent by the ATO-OB to the Recording/Monitoring devices.

6.4.4.2. Doors_Command Applicable Content description:

Packet Number			*63*		
Item	**Bit**	**Variable Name**	**Description**	**Data Type**	**Resolution/Formula**
001	0..2	Q_RST_DoorStat	See [Ref 7] §7.4.2	BITSET8	See [Ref 7] §7.3.2
002	3..7	Spare			
003	M_ATO_DoorLrel		See [Ref 7] §7.4.1	UINT8	See [Ref 7] §7.3.1
004	M_ATO_DoorRrel		See [Ref 7] §7.4.1	UINT8	See [Ref 7] §7.3.1
005	M_ATO_DoorLOp		See [Ref 7] §7.4.1	UINT8	See [Ref 7] §7.3.1
006	M_ATO_DoorROp		See [Ref 7] §7.4.1	UINT8	See [Ref 7] §7.3.1
007	M_ATO_DoorLCl		See [Ref 7] §7.4.1	UINT8	See [Ref 7] §7.3.1
008	M_ATO_DoorRCl		See [Ref 7] §7.4.1	UINT8	See [Ref 7] §7.3.1

Table 6 Doors_Command Applicable Content structure

6.4.5. Adhesion_System

6.4.5.1. This section details the ATO Applicable Content of an Adhesion_System Packet sent by the ATO-OB to the Recording/Monitoring devices.

6.4.5.2. Adhesion_System Applicable Content description:

Packet Number		*64*		
Item	**Variable Name**	**Description**	**Data Type**	**Resolution/Formula**
001	N_ATO_ADHE_ITER	Number of iterations of Temporary Constraints.	UINT8	**Special values:** 0 = no reduced adhesion conditions announced 32 - 255 = spare

Packet Number		*64*			
Item		**Variable Name**	**Description**	**Data Type**	**Resolution/Formula**
(N_ATO_ADHE_ITER) times	002	NID_C(l)	See [Ref 2] section 7.5.1.86.	UINT16	See [Ref 2] section 7.5.1.86.
	003	NID_SP(l)	See [Ref 5] §7.3.10.2.	UINT32	See [Ref 5] §7.3.10.2.
	004	Q_Adhesion_Category(l)	See [Ref 5] §7.3.6.2.	UINT8	See [Ref 5] §7.3.6.2.
	005	Q_Range(l)	See [Ref 5] §7.3.6.2.	UINT8	See [Ref 5] §7.3.6.2.
	006	D_TC_Start_Location(l)	See [Ref 5] §7.3.6.2.	UINT32	See [Ref 5] §7.3.6.2.
	007	D_TC_End_Location(l)	See [Ref 5] §7.3.6.2.	UINT32	See [Ref 5] §7.3.6.2.

Table 7 Adhesion_System Applicable Content structure

6.4.6. JP_Received

6.4.6.1. This section details the ATO Applicable Content of a JP_Received Packet sent by the ATO-OB to the Recording/Monitoring devices.

6.4.6.2. JP_Received Applicable Content description:

Packet Number	*65*			
Item	**Variable Name**	**Description**	**Data Type**	**Resolution/Formula**
001	NID_C	Identity number of the country or region as defined in [Ref 2] section 7.5.1.86, where the train is located. Unknown value has been added.	UINT16	**Values:** 0 – 1023 **Special Values:** 1024 = Unknown 1025 - 65535 = Spare
002	NID_ATOTS	ATO-TS identifier defined in [Ref 5]. Unknown value has been added.	UINT16	**Values:** 0 – 16383 **Special Values:** 16384 = Unknown 16385-65535 = Spare
003	T_JP_Reference_Timestamp_Date	Date of the timestamp of the Journey Profile Packet (see [Ref 5] §7.2 ATO Header) for which the acknowledgement is provided.	UINT16	Date of a timestamp in UTC. The variable represents the number of days from the 1st January 2010. Values from 0 (2010-01-01) to 32767 (2099-09-18)
004	T_JP_Reference_Timestamp_Seconds	Seconds of the timestamp of the Journey Profile Packet in UTC (see [Ref 5] §7.3.7.2 ATO Header) for which the acknowledgement is provided.	UINT32	See [Ref 5] §7.3.7.2.
005	N_JP_Reference_Packet_Counter	N_Packet_Counter of the Journey Profile Packet (see [Ref 5] §7.3.7.2 ATO Header) for which the acknowledgement is provided.	UINT8	See [Ref 5] §7.3.7.2.
006	Q_JP_STATUS	See [Ref 5] §7.3.6.2.	UINT8	See [Ref 5] §7.3.6.2.

Table 8 JP_Received Applicable Content structure

6.4.7. Stopped_At_EOA

6.4.7.1. This section details the ATO Applicable Content of a Stopped_At_EOA Packet sent by the ATO-OB to the Recording/Monitoring devices.

6.4.7.2. Stopped_At_EOA Applicable Content description:

Packet Number	***66***			
Item	**Variable Name**	**Description**	**Data Type**	**Resolution/Formula**
001	D_EOA	Distance between the train position and the EOA.	UINT32	**Resolution:** 1 cm
002	D_EOA_Offset	See [Ref 5] §7.3.9.2.	UINT32	See [Ref 5] §7.3.9.2.

Table 9 Stopped_At_EOA Applicable Content structure

6.4.8. ATO_Communication_Link_Status

6.4.8.1. This section details the ATO Applicable Content of an ATO_Communication_Link_Status Packet sent by the ATO-OB to the Recording/Monitoring devices.

6.4.8.2. ATO_Communication_Link_Status Applicable Content description:

Packet Number		***67***			
Item	**Variable Name**		**Description**	**Data Type**	**Resolution/Formula**
		ATO_COMMUNICATION_LINK_STATUS		BITSET8	
001	0	Q_ATO_OB_CURRENT_TS_LINK	State of the communication link between the ATO-OB and the current ATO-TS.		**Values:** 0 = Link down 1 = Link up
002	1	Q_ATO_OB_ADJACENT_TS_LINK	State of the communication link between the ATO-OB and the adjacent ATO-TS.		**Values:** 0 = Link down 1 = Link up
003	2	Q_ATO_OB_ETCS_LINK	State of the communication link between the ATO-OB and the ERTMS/ETCS-OB.		**Values:** 0 = NOT active 1 = Active
004	3	Q_ATO_OB_RST_LINK	State of the communication link between the ATO-OB and the Rolling Stock.		**Values:** 0 = NOT active 1 = Active
004	4..7	Spare			
005	M_ATO_VERSION_CURRENT_ATO_TS		ATO version, defined as M_ATO_Version in [Ref 5], in use.	BITSET16	See [Ref 5] §7.3.2.2.
006	M_ATO_VERSION_ADJACENT_ATO_TS		ATO version, defined as M_ATO_Version in [Ref 5], for cases where ATO-OB shall be connected to two ATO-TS.	BITSET16	See [Ref 5] §7.3.2.2.

Table 10 ATO_Communication_Link_Status Content Structure

6.4.9. ATO_Status

6.4.9.1. This section details the ATO Applicable Content of an ATO_Status sent by the ATO-OB to the Recording/Monitoring devices.

6.4.9.2. ATO_Status Applicable Content description:

Packet Number		***68***			
Item	**Variable Name**		**Description**	**Data Type**	**Resolution/Formula**
		ATO_STATE_CHANGE		BITS ET16	
001	0..3	M_ATO_STATE	See [Ref 5] §7.3.10.2.		See [Ref 5] §7.3.10.2.
002	4..12	M_ATO_OPERATIONAL_CONDITIONS	ATO operational conditions. See [Ref 1]. Bit 0 = 1 if the ETCS-OB applicable conditions for ATO Operational are fulfilled. Bit 1 = 1 if there is no Emergency Brake application by another system or the driver. Bit 2 = 1 if the TP marked as “End of Journey” of the current journey has not been reached (Stopping Point) or passed (Passing Point or Stopping Point to be skipped). Bit 3 = 1 if the last TP of the journey has not been passed. Bit 4 = 1 if all referenced SPs up to the Targeted TP are available on board. Bit 5 = 1 if data inconsistency affecting the next TP is not detected. Bit 6 = 1 if the train is located in a SP included in the current JP. Bit 7 = 1 if the train is not located within an ATO Inhibition Zone. Bit 8 = 1 if the ETCS Data and ATO Specific Data are valid		**Values:** See column “description”.
003	13..15	Spare			

Table 11 ATO_Status Applicable Content

6.4.10. ATO_OB_Proprietary_Data

6.4.10.1. This packet allows to record information that is specific to an ATO-OB.

6.4.10.2. This packet is identified by packet number 90.

6.5. Triggering events

6.5.1.1. The following table gives the list of events that trigger the sending of a message by the ATO-OB.

Packet number	Triggering event
61	When the ATO State is EG or DE and when the absolute traction/braking request changes from one range to another range, as defined by the hysteresis: • Range 0: 0 • Range 1: >0 up to 27 included • Range 2: from 23 to 77 included • Range 3: from 73 to 95 included • Range 4: from 91 to 100 included If any value of “Q_ATO_SupTB” changes the event is to be fired too. Whenever this message is sent for the first time in engaged state and the traction/brake request could match in two ranges the lower one shall be used.
62	Packet 62: If multiple events occur are to be handled at the same moment the following list of events is ordered in a descending priority. As long as events can be combined into one packet they can be grouped. If combination is not possible anymore the event is fired.
62	The train stops at a Stopping Point.
62	The train departs from a Stopping Point.
62	The train passes a Timing Point.
62	The ATO-OB receives a request from the ATO-TS or the driver to skip a Stopping Point.
62	The ATO-OB receives a request from the ATO-TS or the driver to revoke a Stopping Point to be Skipped and is able to consider it (conditions to accept/revoke a Stopping Point to be Skipped).
62	The train is held at a Stopping Point.
62	The condition to hold the train at a Stopping Point is revoked by JP Update or JP Overwrite.
63	When the ATO-OB detects a change about the Doors Status or sends a different command to the doors system.
64	When the ATO-OB receives information on the adhesion conditions from the ATO-TS.
65	When the ATO-OB receives a JP from the ATO-TS.

66	When the ATO stops the train in rear of an EOA with a configurable offset.
67	When the communication between the ATO-OB and the ATO-TS is established or lost.
67	When the communication between the ATO-OB and an adjacent ATO-TS is established or lost.
67	When the communication between the ATO-OB and the ETCS is established or lost.
67	When the communication between the ATO-OB and the Rolling Stock is established or lost.
68	When the ATO State changes.
68	When the train starts moving and the ATO is powered up but not engaged (not EG).
68	When one or several operational condition(s) change(s).

Table 12: List of triggering events and selected messages

6.6. Performances

6.6.1.1. Packets shall be sent within 1 second from event occurrence.