ERTMS/ATO

ATO-OB / ATO-TS FFFIS

Application Layer

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1. MODIFICATION HISTORY

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0.0.2 08-04-2014	All	Document updated after UNISIG ATO WG comments and review meetings (11-12/02/2014 and 11-12/03/2014).	UNISIG ATO WP
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0.1.0 24.03.2022	several	Editorial corrections	UNISIG ATO WP
0.1.1 07.02.2023	7.3.13.2 (SESSTerm packet, item 2)	“CAB closed” is replaced by “CAB inactive” according the comment #1 related to the SUBSET-126 from EECT#91	UNISIG ATO WP

0.1.2 07.04.2023	7.3.2.2 7.3.9.2, line #56 7.3.3.2. Line #5 Footer	Adding the following attributes to a handshake request: Q_ATO_Handing over N_ITER_BG changed from 3 bits to 4 bits. The definition has been updated according to the comment #5 related to the SUBSET-125 in the EECT 3rd consolidation review sheet. Version number updated	UNISIG ATO WP
1.0.0 05.07.2023	None	Baseline 1 1st release	UNISIG ATO WP

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5. INTRODUCTION

5.1. Scope and purpose of the document

5.1.1.1. The purpose of this System Interface Description document is to present the interoperable interface between the two subsystems of the Automatic Train Operation (ATO) system, namely the ATO trackside (ATO-TS) and the ATO on-board (ATO-OB). The scope of the document is to define the interoperable packets exchanged between the on-board subsystem (ATO-OB) and the trackside subsystem (ATO-TS) according to the ERTMS/ATO System Requirements Specification [Ref 1].

5.1.1.2. This document does not contain the communication requirements associated to the ATO-OB / ATO-TS Interface. These requirements are included in [Ref 1]§10.1.

5.1.1.3. Specific ATO Packets are defined in this document with a unique packet identification number.

5.2. Reference and applicable documents

5.2.1.1. This section presents the reference and applicable documents.

Ref. N°	Title	Reference
[Ref 1]	ERTMS/ATO System Requirements Specification	SUBSET-125
[Ref 2]	ERTMS/ETCS System Requirements Specification	SUBSET-026
[Ref 3]	ERTMS/ATO Glossary	13E154
[Ref 4]	FFFIS STM Application Layer	SUBSET-058
[Ref 5]	Glossary of Terms and Abbreviations	SUBSET-023
[Ref 6]	FIS Juridical Recording	SUBSET-027
[Ref 7]	Responsibilities and Rules for the Assignment of Values to ETCS Variables	SUBSET-054

Table 1 Reference and applicable documents

5.3. Abbreviations

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

5.3.1.2. For ETCS related abbreviations see SUBSET-023 [Ref 5].

5.4. Definitions

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

5.4.1.2. For ETCS related definitions see SUBSET-023 [Ref 5].

6. PRINCIPLES

6.1. Introduction

6.1.1.1. The composition of each packet element is presented using a table detailing each variable in order.

6.2. Definition of the Variables

6.2.1.1. Variables are used to encode single data values. Variables cannot be split in minor units.

6.2.1.2. Variables may have special values which are related to the basic meaning of the variable.

6.2.1.3. Special values which are not spare, have always the highest values in a variable (e.g. 32767 = “unknown”).

6.2.1.4. Spare values are located between the normal and special values in the variable range except where justified.

6.2.1.5. Names of variables are unique with respect to their meaning. A variable is used in context with the meaning as described in the variable definition. Variables with different meanings have different names.

6.2.1.6. One bit variables (Boolean) always use 0 for false and 1 for true.

6.2.1.7. Offsets for numerical values are avoided (0 is used for 0, 1 for 1, etc.) except where justified.

6.2.1.8. The encoding order shall respect the order of variables listed in the packet format (from top to bottom).

6.2.1.9. Encoding of variables shall start with the most significant bit. See example in Appendix A.1.

6.2.1.10. Note: A number of variables contain values which have to be assigned. Some of these values have to be unique to ensure that the system functions properly. A centralised handling of this assignment is therefore required (nationally or internationally, depending on the variable). The variables concerned have been marked. The values included in this document for these variables are therefore not to be used without prior verification of their validity. See SUBSET-054 [Ref 7] for further details.

6.3. Definition of the Packets

6.3.1.1. Packets are multiple variables grouped into a single unit, with a defined internal structure.

6.3.1.2. Optional variables inside a packet are marked with constraints. Only if the constraint is evaluated to true the variable and possible nested variables will follow in the packet. Otherwise the packet will continue with the next variable without constraint or with a constraint evaluated to true.

6.3.1.3. An ATO Packet consists of:

- A specific ATO Header. This header is generated by the subsystem (ATO-OB or ATO-TS) that sends the packet;
- The Applicable Content itself.

6.3.1.4. Any packet exchanged between ATO-OB and ATO-TS shall add the needed quantity of bits in order to be byte aligned.

6.3.1.4.1. Note: Thus, the maximum number of potentially added bits is 7 bits.

6.3.1.5. The structure of the HSReq, HSAck and HSRej (packets NID_PACKET_ATO 0, 1 and 2) shall be version independent as they are used for the ATO system version check.

7. DETAILED DESCRIPTION OF THE APPLICATION LEVEL

7.1. List of Packets

7.1.1.1. This section details the application level of the interface.

Packet Number (NID_PACKET_ATO)	Packet Name	Source	Sink	Page N°
0	Handshake Request	ATO-OB	ATO-TS	15
1	Handshake Acknowledgement	ATO-TS	ATO-OB	16
2	Handshake Reject	ATO-TS	ATO-OB	16
3	Journey Profile Request	ATO-OB	ATO-TS	17
4	Journey Profile	ATO-TS	ATO-OB	17
5	Journey Profile Acknowledgement	ATO-OB	ATO-TS	22
6	Segment Profile Request	ATO-OB	ATO-TS	23
7	Segment Profile	ATO-TS	ATO-OB	23
8	Status Report	ATO-OB	ATO-TS	39
9	Status Report Acknowledgement	ATO-TS	ATO-OB	41
10	Session Termination Request	ATO-TS	ATO-OB	42
11	Session Termination	ATO-OB	ATO-TS	42

Table 2 Packet summary

7.2. ATO Header

7.2.1.1. This section details the ATO specific header of a packet exchanged between the ATO-OB and the ATO-TS.

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

7.2.1.3. ATO Header composition:

ATO Header				
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
001	NID_PACKET_ATO	Packet number, used in the header for each packet, allowing the receiving equipment to identify the data which follows.	8 bits	Numbers **Special Values:** 12 - 255 = spare
002	NID_OPERATIONAL	Train Running Number, see [Ref 2], Section 7.5.1.92.	32 bits	See [Ref 2], Section 7.5.1.92.
003	NID_ENGINE	ETCS Identity, see [Ref 2], Section 7.5.1.88.	24 bits	See [Ref 2], Section 7.5.1.88.
004	T_Timestamp_Date	Date of timestamp of the packet.	15 bits	Date of a timestamp in UTC. The variable represents the number of days from the 1st January 2010. Values from 0 (01/01/2010) to 32767 (18/09/2099)
005	T_Timestamp_Seconds	Seconds of timestamp of the packet in UTC.	17 bits	Seconds of a timestamp in UTC. The variable represents the number of seconds from the beginning of the day. Values from 0 (00:00:00) to 86399 (23:59:59)
006	N_Packet_Counter	Packet counter sent from the sending subsystem. This value is a circulating counter. In case of an overflow the value might jump from the maximum value to the minimum value. The value is maintained by the sender for each NID_PACKET_ATO separately during the entire session.	8 bits	Binary to numeric

Table 3 ATO Header structure

7.3. ATO Packets Applicable Content

7.3.1. Introduction

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

7.3.2. Handshake Request Packet (HSReq)

7.3.2.1. This section details the structure of a HSReq Packet sent by ATO-OB to ATO-TS.

7.3.2.2. Handshake Request composition:

Packet Number	*0*			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
001	ATO Header	see chapter 7.2		-

Packet Number		*0*			
Item	**Variable Name**		**Description**	**Length**	**Resolution/Formula**
Handshake Details					
002	N_ITER		Number of iterations of ATO-OB supported versions.	5 bits	See [Ref 2], Section 7.5.1.80
003		M_ATO_Version (k)	ATO system version supported.	16 bits	1st byte for the major Version 2nd byte for the minor Version **Applicable values:** 0x0100 = ATO version 1.0
004	Q_ATO_Handing_Over		This attribute allows the ATO-TS to know if the handshake request is due to a handing over ATO-TS.	1 bit	0 = No handing over 1 = Handing over

Table 4 Handshake Request Packet structure

7.3.3. Handshake Acknowledgement Packet (HSAck)

7.3.3.1. This section details the structure of the HSAck Packet sent by ATO-TS to ATO-OB.

7.3.3.2. Handshake Acknowledgement composition:

Packet Number	*1*			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
001	ATO Header	see chapter 7.2		-
Handshake Acknowledgement Details				
002	NID_C	Identity of the ATO-TS's country or region.	10 bits	See [Ref 2], Section 7.5.1.86.
003	NID_ATOTS	Identifier of the ATO-TS.	14 bits	Binary to numeric
004	M_ATO_Version	ATO system version to be used.	16 bits	1st byte for the major Version 2nd byte for the minor Version **Applicable values:** 0x0100 = ATO version 1.0
005	T_Timeout_ATOTS_Response	Maximum time after which the ATO-OB must consider that a request has not been answered.	8 bits	Binary to numeric (in seconds)
006	T_Reporting_Time	Reporting time cycle for triggering a Status Report for data reporting purposes.	8 bits	Binary to numeric (in seconds)

Table 5 Handshake Acknowledgement Packet structure

7.3.4. Handshake Reject Packet (HSRej)

7.3.4.1. This section details the structure of the HSRej Packet sent by ATO-TS to ATO-OB.

7.3.4.2. Handshake Reject composition:

Packet Number	*2*			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
001	ATO Header	see chapter 7.2		-
Handshake Reject Details				
002	Q_Reject_Reason	Qualifier indicating the reason for the rejection.	2 bits	0 = ATO system version incompatible 1 = Another ATO-TS in charge 2 = ATO-TS in charge unknown 3 = Spare
ATO-TS Contact Information - If [Q_Reject_Reason == Another ATO-TS in charge]				
003	NID_C	If **[Q_Reject_Reason == Another ATO-TS in charge]** Identity of the ATO-TS's country or region.	10 bits	See [Ref 2], Section 7.5.1.86.
004	NID_ATOTS	If **[Q_Reject_Reason == Another ATO-TS in charge]** Identifier of the ATO-TS.	14 bits	Binary to numeric

Table 6 Handshake Reject Packet structure

7.3.5. Journey Profile Request Packet (JPReq)

7.3.5.1. This section details the structure of a JPReq Packet sent by the ATO-OB to the ATO-TS.

7.3.5.2. Journey Profile Request Packet composition:

Packet Number	*3*			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
001	ATO Header	see chapter 7.2		-
Journey Profile Request Details				
002	NID_C	Identity of the reference SP's country or region. Not relevant if NID_SP is undefined.	10 bits	See [Ref 2], Section 7.5.1.86.
003	NID_SP	Identity of the Segment Profile from which a Journey Profile is requested.	32 bits	Binary to numeric 4294967295 for undefined value.

Table 7 Journey Profile Request Packet structure

7.3.6. Journey Profile Packet (JP)

7.3.6.1. The section details the structure of a JP Packet sent by the ATO-TS to the ATO-OB.

7.3.6.2. Journey Profile Packet composition:

Packet Number	4			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
001	ATO Header	see chapter 7.2		-
Journey Profile Details				
002	Q_JP_Status	Status of the Journey Profile: 'Valid': JP containing the data requested. 'Unavailable': JP specifies that the requested part of the Journey Profile is currently not available yet (but all the previously sent JPs are still applicable). 'Invalid': JP specifies that the SP identifier asserted in the JPReq does not belong to the preceding JP already sent to the ATO-OB. 'Update': JP specifies that the Journey Profile has been updated by the TMS within the current visibility of the ATO-OB. 'Overwrite': JP specifies that the previously sent JPs shall be completely overwritten by this data.	3 bits	0 = Invalid 1 = Valid 2 = Unavailable 3 = Update 4 = Overwrite [5-7] = Spare
Segment Profile Reference - If [Q_JP_Status <> Invalid and Q_JP_Status <> Unavailable]				
003	N_ITER_SP	If **[Q_JP_Status <> Invalid and Q_JP_Status <> Unavailable]** Number of iterations of SPs. If N_ITER_SP is 0 then no data set is following.	8 bits	Binary to numeric
004	NID_C (k)	Identity of the SP's country or region.	10 bits	See [Ref 2], Section 7.5.1.86.
005	NID_SP (k)	SP identity.	32 bits	Binary to numeric
006	M_SP_Version (k)	Identifier of the segment profile version. See section Segment Profile Packet (SP).	16 bits	1 byte for the major version and 1 byte for the minor one.
007	Q_SP_DIR (k)	Qualifier to indicate the valid travelling direction of the SP.	1 bits	0 = Reverse 1 = Nominal
Timing Point Constraints				
008	N_ITER (k)	Number of iterations of TPs information. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
009	NID_TP (k,l)	TP identity. The NID_TP is unique within the NID_C of the Segment Profile.	32 bits	Binary to numeric.
010	T_Latest_Arrival_Date (k,l)	Date of the requested arrival time at the TP.	15 bits	Date of a timestamp in UTC. The variable represents the number of days from the 1st January 2010. Values from 0 (01/01/2010) to 32767 (18/09/2099)

Packet Number	4			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
011	T_Latest_Arrival_Seconds (k,l)	Seconds of the requested arrival time at the TP.	17 bits	Seconds of a timestamp in UTC. The variable represents the number of seconds from the beginning of the day. Values from 0 (00:00:00) to 86400 (24:00:00)
012	T_Arrival_Window (k,l)	Acceptable time allowance to be earlier at the TP.	10 bits	Binary to numeric (in seconds). The value is 0 for Stopping Points.
013	Q_TP_Alignment (k,l)	This qualifier defines if the TP location is applicable from the front, middle or rear of the train.	2 bits	0 = Front 1 = Middle 2 = Rear 3 = Spare
014	Q_Stop_Skip_Pass (k,l)	Specifies if the Timing Point is a Passing Point, an operational Stopping Point or a skipped Stopping Point.	2 bits	0 = Stopping Point 1 = Stopping Point to be skipped (with symbol shown to driver) 2 = Passing Point 3 = Spare
015	Q_TP_Information (k,l)	Specifies some information specific for the TP.	2 bits	0 = No specific information 1 = End of Journey [2-3] = Spare
016	Q_Day_Light_Saving (k,l)	This variable defines if the day light saving hour is applicable to calculate the local time.	1 bits	0 = No saving hour 1 = Saving hour
Stopping Point Information - If [Q_Stop_Skip_Pass == Stopping Point]				
017	Q_Opening_Door_Side (k,l)	If **[Q_Stop_Skip_Pass == Stopping Point]** Specifies if the ATO-OB has to manage the train doors opening and on which side the passenger exchange doors have to be opened. The side is relative to the direction of the Journey Profile.	2 bits	00 = none 01 = right 10 = left 11 = both
018	Q_Centralised_Opening (k,l)	If **[Q_Stop_Skip_Pass == Stopping Point]** This variable defines if the doors are to be opened centralised or by the passengers.	1 bits	0 = Opening by passengers 1 = Centralised automatic opening of the relevant doors
019	Q_Relaxed_Coupler (k,l)	If **[Q_Stop_Skip_Pass == Stopping Point]** This variable requests the train to stop with couplers relaxed.	1 bits	0 = no request for coupler relaxation 1 = request for coupler relaxation
Stopping Point Departure Details - If [Q_Stop_Skip_Pass == Stopping Point and Q_TP_Information <> End of Journey]				

Packet Number	4			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
020	Q_Train_Hold (k,l)	If **[Q_Stop_Skip_Pass == Stopping Point and Q_TP_Information <> End of Journey]** The variable defines if the train is requested to be held at the Stopping Point or not.	1 bits	0 = Do not hold Train 1 = Hold train
021	T_Departure_Date (k,l)	If **[Q_Stop_Skip_Pass == Stopping Point and Q_TP_Information <> End of Journey and Q_Train_Hold <> Hold train]** Date of the expected departure time from the Stopping Point.	15 bits	Date of a timestamp in UTC. The variable represents the number of days from the 1st January 2010. Values from 0 (01/01/2010) to 32767 (18/09/2099)
022	T_Departure_Seconds (k,l)	If **[Q_Stop_Skip_Pass == Stopping Point and Q_TP_Information <> End of Journey and Q_Train_Hold <> Hold train]** Seconds of the expected departure time from the Stopping Point.	17 bits	Seconds of a timestamp in UTC. The variable represents the number of seconds from the beginning of the day. Values from 0 (00:00:00) to 86399 (23:59:59)
023	T_Minimum_Dwell_Time (k,l)	If **[Q_Stop_Skip_Pass == Stopping Point and Q_TP_Information <> End of Journey and Q_Train_Hold <> Hold train]** Minimum dwell time at given Stopping Point (in seconds).	10 bits	Binary to numeric (in seconds)
024	Q_Automatic_Closing (k,l)	If **[Q_Stop_Skip_Pass == Stopping Point and Q_TP_Information <> End of Journey and Q_Train_Hold <> Hold train]** This variable defines if the ATO-OB has to manage the train doors Closing.	1 bits	0 = ATO-OB does not manage train doors closing 1 = ATO-OB manages train doors closing
Temporary Constraints				
025	N_ITER (k)	Number of iterations of Temporary Constraints. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
026	Q_TC_Type (k,l)	Type of the temporary constraint.	3 bits	0 = ASR 1 = Low Adhesion 2 = ATO Inhibition Zone 3 = DAS Inhibition Zone 4 = Current Limitation [5-7] = Spare
027	Q_Range (k,l)	Specifies if the temporary constraint starts, ends, starts and ends or covers the whole concerning Segment Profile.	2 bits	0 = Starts 1 = Ends 2 = StartsEnds 3 = WholeSP

Packet Number			4			
Item	**Variable Name**			**Description**	**Length**	**Resolution/Formula**
028			D_TC_Start_Location (k,l)	If **[Q_Range == Starts or Q_Range == StartsEnds]** Start location of the temporary constraint relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
029			D_TC_End_Location (k,l)	If **[Q_Range == Ends or Q_Range == StartsEnds]** End location of the temporary constraint relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
Additional Speed Restriction - If [Q_TC_Type == ASR]						
030			Q_FRONT (k,l)	If **[Q_TC_Type == ASR]** See [Ref 2], Section 7.5.1.109	1 bits	See [Ref 2], Section 7.5.1.109
031			V_Speed_Level (k,l)	If **[Q_TC_Type == ASR]** Value of the speed level restriction. The variable used is comparable to V_STATIC, as defined in [Ref 2], Section 7.5.1.171, hence only the first 120 values provided by the 7 bits are used to determine that speed Level.	7 bits	[0..120] x 5 km/h <=> [0..600] km/h; [121-127] = Spare
Low Adhesion - If [Q_TC_Type == Low Adhesion]						
032			Q_Adhesion_Category (k,l)	If **[Q_TC_Type == Low Adhesion]** Adhesion category aligned with the definition in EN15595 of the wheel-rail interface for the lower boundaries. **Dry Rail**: Conditions where 100% of the brake force of the vehicle can be applied with no axle sliding of more than 2% (adhesion level typically above 0.15μ) **Medium**: Conditions where the wheel/rail adhesion is in the range 0.15 – 0.10 (Damp rails with some contamination) **Normal Low**: Conditions where the wheel/rail adhesion is in the range 0.10 – 0.08 (Typical autumn mornings due to dew/dampness often combined with light overnight rust) **Low Adhesion**: Conditions where the wheel/rail adhesion is in the range 0.08 – 0.05 **Very Low Adhesion**: Conditions where the wheel/rail adhesion is in the range 0.05-0.03 **Extremely Low Adhesion**: Conditions where the wheel/rail adhesion is below 0.03	3 bits	0 = Dry Rail 1 = Dry Rail (Medium) 2 = Dry Rail (Low) 3 = Low Adhesion 4 = Very Low Adhesion 5 = Extremely Low Adhesion [6-7] = Spare
Current Limitation - If [Q_TC_Type == Current Limitation]						

Packet Number			4			
Item	**Variable Name**			**Description**	**Length**	**Resolution/Formula**
033			M_CURRENT (k,l)	If **[Q_TC_Type == Current Limitation]** See [Ref 2], Section 7.5.1.62.1 Note: a powerless section is indicated as a current limit “0” (zero)	10 bits	See [Ref 2], Section 7.5.1.62.1

Table 8 Journey Profile Packet structure

7.3.6.3. If the status of the JP is invalid or unavailable, the Journey Profile Details shall finish after Q_JP_Status (Item 002).

7.3.6.4. **Temporary Constraints**

7.3.6.4.1. The location dependent data type of the Temporary Constraints is ATO Area Type. The requirements as given in chapter 7.3.9.7 shall be applied.

7.3.6.4.2. For each type of constraint, the Temporary Constraints in a Journey Profile shall be listed in the order given by their starting location in the Segment Profile.

7.3.7. Journey Profile Acknowledgement Packet (JPAck)

7.3.7.1. This section details the structure of a Journey Profile Acknowledgement Packet sent by the ATO-OB to the ATO-TS in response to an updated/overwritten Journey Profile Packet.

7.3.7.2. Journey Profile Acknowledgement Packet composition:

Packet Number		5			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
001	ATO Header	see chapter 7.2		-
Journey Profile Acknowledgement Details				
002	T_JP_Reference_Timestamp_Date	Date of the timestamp of the Journey Profile Packet (see 7.2 ATO Header) for which the acknowledgement is provided.	15 bits	Date of a timestamp in UTC. The variable represents the number of days from the 1st January 2010. Values from 0 (01/01/2010) to 32767 (18/09/2099)
003	T_JP_Reference_Timestamp_Seconds	Seconds of the timestamp of the Journey Profile Packet in UTC (see 7.2 ATO Header) for which the acknowledgement is provided.	17 bits	Seconds of a timestamp in UTC. The variable represents the number of seconds from the beginning of the day. Values from 0 (00:00:00) to 86399 (23:59:59)

Packet Number		*5*			
Item	**Variable Name**		**Description**	**Length**	**Resolution/Formula**
004	N_JP_Reference_Packet_Counter		N_Packet_Counter of the Journey Profile Packet (see 7.2 ATO Header) for which the acknowledgement is provided.	8 bits	Binary to numeric

Table 9 Journey Profile Acknowledgement Packet structure

7.3.8. Segment Profile Request Packet (SPReq)

7.3.8.1. The section details the structure of a SPReq Packet sent by the ATO-OB to the ATO-TS.

7.3.8.2. Segment Profile Request Packet composition:

Packet Number		*6*			
Item	**Variable Name**		**Description**	**Length**	**Resolution/Formula**
001	ATO Header		see chapter 7.2		-
Segment Profile Request Details					
002	N_ITER		Number of iterations of SPs requested. The minimum value for the variable in this packet is 1.	5 bits	See [Ref 2], Section 7.5.1.80
003		NID_C (k)	Identity of the SP's country or region.	10 bits	See [Ref 2], Section 7.5.1.86.
004		NID_SP (k)	Identity of the requested Segment Profile.	32 bits	Binary to numeric

Table 10 Segment Profile Request Packet structure

7.3.9. Segment Profile Packet (SP)

7.3.9.1. This section details the structure of a Segment Profile Packet sent by the ATO-TS to the ATO-OB.

7.3.9.2. Segment Profile Packet composition:

Packet Number		*7*			
Item	**Variable Name**		**Description**	**Length**	**Resolution/Formula**
001	ATO Header		see chapter 7.2		-
Segment Profile Status					
002	N_ITER		Number of iterations of SPs in the packet.	5 bits	See [Ref 2], Section 7.5.1.80
003		NID_C (k)	Identity of the SP's country or region.	10 bits	See [Ref 2], Section 7.5.1.86.
004		NID_SP (k)	SP identity.	32 bits	Binary to numeric

Packet Number	7			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
005	Q_SP_Status (k)	Status of the Segment Profile: "Valid": SP requested. "Invalid": SP not found in ATO-TS database.	1 bits	0 = Invalid 1 = Valid
Segment Profile Details - If [Q_SP_Status <> Invalid]				
006	M_SP_Version (k)	If **[Q_SP_Status <> Invalid]** Identifier of the segment profile version.	16 bits	1 byte for the major version and 1 byte for the minor one.
007	L_SP (k)	If **[Q_SP_Status <> Invalid]** Length of the segment of railway covered by the SP.	24 bits	Binary to numeric (in centimetres) Minimum Value: 1
008	D_EoA_Offset (k)	If **[Q_SP_Status <> Invalid]** Distance to stop the train in rear of the EoA.	24 bits	Binary to numeric (in centimetres)
009	Q_UTC_Offset (k)	If **[Q_SP_Status <> Invalid]** Offset to add to the UTC time in order to calculate the local time.	7 bits	Binary to numeric Unsigned value Resolution: 15 min 0 = UTC - 14:00 56 = UTC ± 0 112 = UTC + 14:00 113 - 127 = Spare
010	M_SP_Altitude (k)	If **[Q_SP_Status <> Invalid]** Altitude at the beginning of the SP. Considering ETRS89 as reference. Note: ETRS89 is the EU-recommended frame of reference for geodata for Europe	20 bits	Binary to numeric (in centimetres) starting at -1000m
011	Q_ATOTS_Contact_Info_Dir (k)	If **[Q_SP_Status <> Invalid]** Qualifier indicating whether contact information of another ATO-TS valid for nominal travelling direction of the SP, valid for reverse travelling direction of the SP or no contact information follows.	2 bits	0 = No Contact info follows 1 = ATO-TS contact info for nominal direction follows 2 = ATO-TS contact info for reverse direction follows 3 = Spare
ATO-TS Contact Information - If [Q_ATOTS_Contact_Info_Dir == ATO-TS contact info for nominal direction follows or Q_ATOTS_Contact_Info_Dir == ATO-TS contact info for reverse direction follows]				
012	NID_C (k)	If **[Q_ATOTS_Contact_Info_Dir == ATO-TS contact info for nominal direction follows or Q_ATOTS_Contact_Info_Dir == ATO-TS contact info for reverse direction follows]** Identity of the ATO-TS's country or region.	10 bits	See [Ref 2], Section 7.5.1.86.

Packet Number	7			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
013	NID_ATOTS (k)	If **[Q_ATOTS_Contact_Info_Dir == ATO-TS contact info for nominal direction follows or Q_ATOTS_Contact_Info_Dir == ATO-TS contact info for reverse direction follows]** Identifier of the adjacent ATO-TS. The value of this variable is assigned to be unique, see clause 6.2.1.10	14 bits	Binary to numeric
014	NID_C (k)	If **[Q_ATOTS_Contact_Info_Dir == ATO-TS contact info for nominal direction follows or Q_ATOTS_Contact_Info_Dir == ATO-TS contact info for reverse direction follows]** Identity of the SP's country or region.	10 bits	See [Ref 2], Section 7.5.1.86.
015	NID_SP (k)	If **[Q_ATOTS_Contact_Info_Dir == ATO-TS contact info for nominal direction follows or Q_ATOTS_Contact_Info_Dir == ATO-TS contact info for reverse direction follows]** SP identity of the first segment in the adjacent ATO-TS area.	32 bits	Binary to numeric
Static Speed Profile Start				
016	V_STATIC (k)	Basic Static Speed Profile speed at the beginning of the Segment Profile. The variable used is comparable to V_STATIC, as defined in [Ref 2], Section 7.5.1.171.	7 bits	[0..120] x 5 km/h <=> [0..600] km/h; [121-127] = Spare
017	Q_FRONT (k)	see [Ref 2], Section 7.5.1.109 This is applicable only for step up.	1 bits	see [Ref 2], Section 7.5.1.109
Specific SSP				
018	N_ITER (k)	Number of iterations of Specific Static Speed Profiles. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
019	Q_DIFF (k,l)	See [Ref 2], Section 7.5.1.102.1.	2 bits	See [Ref 2], Section 7.5.1.102.1.
Cant Deficiency - If [Q_DIFF == Cant Deficiency specific category]				
020	NC_CDDIFF (k,l)	If **[Q_DIFF == Cant Deficiency specific category]** See [Ref 2], Section 7.5.1.82.1	4 bits	See [Ref 2], Section 7.5.1.82.1
Other Specific SSP - If [Q_DIFF == Other specific category, replaces the Cant Deficiency SSP or Q_DIFF == Other specific category, does not replace the Cant Deficiency SSP]				
021	NC_DIFF (k,l)	If **[Q_DIFF == Other specific category, replaces the Cant Deficiency SSP or Q_DIFF == Other specific category, does not replace the Cant Deficiency SSP]** See [Ref 2], Section 7.5.1.83.	4 bits	See [Ref 2], Section 7.5.1.83.

Packet Number	7			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
022	V_DIFF (k,l)	See [Ref 2], Section 7.5.1.156	7 bits	See [Ref 2], Section 7.5.1.156
Static Speed Profile Change				
023	N_ITER (k)	Number of iterations of Static Speed Profiles changes. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
024	D_Location (k,l)	Location of the Static Speed Profile change relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
025	V_STATIC (k,l)	Basic Static Speed Profile speed. The variable used is comparable to V_STATIC, as defined in [Ref 2], Section 7.5.1.171.	7 bits	[0..120] x 5 km/h <=> [0..600] km/h; [121-127] = Spare
026	Q_FRONT (k,l)	See [Ref 2], Section 7.5.1.109 This is applicable only for step up.	1 bits	see [Ref 2], Section 7.5.1.109
Specific SSP Change				
027	N_ITER (k,l)	Number of iterations of Specific Static Speed Profiles. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
028	Q_DIFF (k,l,m)	See [Ref 2], Section 7.5.1.102.1.	2 bits	See [Ref 2], Section 7.5.1.102.1.
Cant Deficiency Change - If [Q_DIFF == Cant Deficiency specific category]				
029	NC_CDDIFF (k,l,m)	If **[Q_DIFF == Cant Deficiency specific category]** See [Ref 2], Section 7.5.1.82.1	4 bits	See [Ref 2], Section 7.5.1.82.1
Other Specific SSP Change - If [Q_DIFF == Other specific category, replaces the Cant Deficiency SSP or Q_DIFF == Other specific category, does not replace the Cant Deficiency SSP]				
030	NC_DIFF (k,l,m)	If **[Q_DIFF == Other specific category, replaces the Cant Deficiency SSP or Q_DIFF == Other specific category, does not replace the Cant Deficiency SSP]** See [Ref 2], Section 7.5.1.83.	4 bits	See [Ref 2], Section 7.5.1.83.
031	V_DIFF (k,l,m)	See [Ref 2], Section 7.5.1.156	7 bits	See [Ref 2], Section 7.5.1.156
Gradient Start				
032	G_New_Gradient (k)	Value of the new gradient at the beginning of the Segment Profile. The variable used is comparable to G_A, as defined in [Ref 2], Section 7.4.2.6.	10 bits	Binary to numeric (0-1023) with resolution 0.1‰
033	Q_GDIR (k)	see [Ref 2], Section 7.5.1.110	1 bits	see [Ref 2], Section 7.5.1.110
Gradients Change				
034	N_ITER (k)	Number of iterations of gradient changes. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
035	D_Location (k,l)	Location of the gradient change relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)

Packet Number	7			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
036	G_New_Gradient (k,l)	Value of the new gradient. The variable used is comparable to G_A, as defined in [Ref 2], Section 7.4.2.6.	10 bits	Binary to numeric (0-1023) with resolution 0.1‰
037	Q_GDIR (k,l)	see [Ref 2], Section 7.5.1.110	1 bits	see [Ref 2], Section 7.5.1.110
Curve Start				
038	Q_Radius_Category (k)	Curve category at the beginning of the Segment Profile.	5 bits	0 = R>7000m 1 = 7000m≥R>4500m 2 = 4500m≥R>2800m 3 = 2800m≥R>2000m 4 = 2000m≥R>1500m 5 = 1500m≥R>1250m 6 = 1250m≥R>1075m 7 = 1075m≥R>925m 8 = 925m≥R>825m 9 = 825m≥R>725m 10 = 725m≥R>625m 11 = 625m≥R>525m 12 = 525m≥R>475m 13 = 475m≥R>425m 14 = 425m≥R>375m 15 = 375m≥R>325m 16 = 325m≥R>300m 17 = 300m≥R>275m 18 = 275m≥R>250m 19 = 250m≥R>225m 20 = 225m≥R>200m 21 = 200m≥R>175m 22 = 175≥R>150m 23 = = R≤150m [24-31] = Spare
Curves Change				
039	N_ITER (k)	Number of iterations of curve changes. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
040	D_Location (k,l)	Location of the curve change relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)

Packet Number	7			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
041	Q_Radius_Category (k,l)	Curve category.	5 bits	0 = R>7000m 1 = 7000m≥R>4500m 2 = 4500m≥R>2800m 3 = 2800m≥R>2000m 4 = 2000m≥R>1500m 5 = 1500m≥R>1250m 6 = 1250m≥R>1075m 7 = 1075m≥R>925m 8 = 925m≥R>825m 9 = 825m≥R>725m 10 = 725m≥R>625m 11 = 625m≥R>525m 12 = 525m≥R>475m 13 = 475m≥R>425m 14 = 425m≥R>375m 15 = 375m≥R>325m 16 = 325m≥R>300m 17 = 300m≥R>275m 18 = 275m≥R>250m 19 = 250m≥R>225m 20 = 225m≥R>200m 21 = 200m≥R>175m 22 = 175≥R>150m 23 = = R≤150m [24-31] = Spare
Power Voltage Start				
042	M_VOLTAGE (k)	See [Ref 2], Section 7.5.1.78	4 bits	See [Ref 2], Section 7.5.1.78
043	NID_CTRACTION (k)	If **[M_VOLTAGE <> Line not fitted with any traction system]** See [Ref 2], Section 7.5.1.86.1	10 bits	See [Ref 2], Section 7.5.1.86.1
Power Voltage Change				
044	N_ITER (k)	Number of iterations of voltage changes. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
045	D_Location (k,l)	Location of the voltage change relatively to the beginning of the SP	24 bits	Binary to numeric (in centimetres)
046	M_VOLTAGE (k,l)	See [Ref 2], Section 7.5.1.78	4 bits	See [Ref 2], Section 7.5.1.78

Packet Number	7			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
047	NID_CTRACTION (k,l)	If **[M_VOLTAGE <> Line not fitted with any traction system]** See [Ref 2], Section 7.5.1.86.1	10 bits	See [Ref 2], Section 7.5.1.86.1
Current Limitation Start				
048	M_CURRENT (k)	See [Ref 2], Section 7.5.1.62.1 Note: a powerless section is indicated as a current limit “0” (zero)	10 bits	See [Ref 2], Section 7.5.1.62.1
Current Limitation Change				
049	N_ITER (k)	Number of iterations of allowed current consumption changes. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
050	D_Location (k,l)	Location of the allowed current consumption change relatively to the beginning of the SP	24 bits	Binary to numeric (in centimetres)
051	M_CURRENT (k,l)	Current Consumption Limit See [Ref 2], Section 7.5.1.62.1 Note: a powerless section is indicated as a current limit “0” (zero)	10 bits	See [Ref 2], Section 7.5.1.62.1
Balise Group				
052	N_ITER (k)	Number of iterations of balise groups. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
053	Q_NEWNID_C (k,l)	Qualifier to indicate if NID_C of this balise group is following or the NID_C of the SP is valid for this balise group.	1 bits	0 = Use NID_C of SP 1 = NID_C to be used follows
054	NID_C (k,l)	If **[T_Q_NEWNID_C == NID_C to be used follows]** Identity of the BG's country or region.	10 bits	See [Ref 2], Section 7.5.1.86.
055	NID_BG (k,l)	See [Ref 2], Section 7.5.1.85.	14 bits	See [Ref 2], Section 7.5.1.85.
Balises				
056	N_ITER_BG (k,l)	Number of iterations of balises in the balise group, which are located on the k^{th} SP Note: the number of balises belonging to a balise group and located on an SP may be lower than the total number of balises of the balise group, in case this latter is split over two SPs.	4 bits	Binary to numeric
057	N_PIG (k,l,m)	See [Ref 2], Section 7, 5.1.81	3 bits	See [Ref 2], Section 7, 5.1.81
058	D_Location (k,l,m)	Location of the balise relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
Timing Points				
059	N_ITER (k)	Number of iterations of Timing Points. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80

Packet Number			*7*		
Item	**Variable Name**		**Description**	**Length**	**Resolution/Formula**
060		NID_TP (k,l)	TP identity. The NID_TP is unique within a NID_C.	32 bits	Binary to numeric.
061		D_Location (k,l)	Location of the Timing Point relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
062		Q_Stop_Location_ Tolerance (k,l)	Required stopping tolerance to use when the TP is a Stopping Point.	5 bits	0 = 10cm 1 = 20cm 2 = 30cm 3 = 40cm 4 = 50cm 5 = 1m 6 = 1,5m 7 = 2m 8 = 2,5m 9 = 3m 10 = 5m 11 = 7,5m 12 = 10m 13 = 15m 14 = 20m 15 = 25m 16 = 30m 17 = 50m 18 = 75m 19 = 100m [20-30] = Spare 31 = No requirement

Packet Number	7			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
063	Q_STP_Reached (k,l)	Distance from a Stopping Point to consider it as reached.	5 bits	0 = 10cm 1 = 20cm 2 = 30cm 3 = 40cm 4 = 50cm 5 = 1m 6 = 1,5m 7 = 2m 8 = 2,5m 9 = 3m 10 = 5m 11 = 7,5m 12 = 10m 13 = 15m 14 = 20m 15 = 25m 16 = 30m 17 = 50m 18 = 75m 19 = 100m [20-30] = Spare 31 = No requirement
Timing Point Name				
064	L_TEXT (k,l)	See [Ref 4], Section 8.1.11.	8 bits	See [Ref 4], Section 8.1.11.
065	X_TEXT (k,l,m)	Name of the TP.	8 bits	See [Ref 4], Section 8.1.120.
Platform Area				
066	N_ITER (k)	Number of iterations of Platform Areas. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
067	Q_Range (k,l)	Specifies if the Platform Area starts, ends, starts and ends or covers the whole concerning Segment Profile	2 bits	0 = Starts 1 = Ends 2 = StartsEnds 3 = WholeSP
068	D_Start_Location (k,l)	If **[Q_Range == Starts or Q_Range == StartsEnds]** Location of the platform start relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)

Packet Number	7			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
069	D_End_Location (k,l)	If **[Q_Range == Ends or Q_Range == StartsEnds]** Location of the platform end relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
Tunnel				
070	N_ITER (k)	Number of iterations of tunnels. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
071	Q_Range (k,l)	Specifies if the Tunnel starts, ends, starts and ends or covers the whole concerning Segment Profile.	2 bits	0 = Starts 1 = Ends 2 = StartsEnds 3 = WholeSP
072	Q_Tunnel_Category (k,l)	Category of the Tunnel.	2 bits	0 = Single track tunnel 1 = Double track tunnel 2 = Wide-cross section tunnel 3 = Spare
073	D_Start_Location (k,l)	If **[Q_Range == Starts or Q_Range == StartsEnds]** Location of the tunnel start relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
074	D_End_Location (k,l)	If **[Q_Range == Ends or Q_Range == StartsEnds]** Location of the tunnel end relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
Axle Load Speed Profile				
075	N_ITER (k)	Number of iterations of Axle Load Speed Profiles. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
076	Q_Range (k,l)	Specifies if the Axle Load Speed Profile starts, ends, starts and ends or covers the whole concerning Segment Profile.	2 bits	0 = Starts 1 = Ends 2 = StartsEnds 3 = WholeSP
077	M_AXLELOADCAT (k,l)	See [Ref 2], Section 7.5.1.62	7 bits	See [Ref 2], Section 7.5.1.62
078	V_New_Speed_Level (k,l)	Speed restriction to be applied if the axle load of the train ≥ M_AXLELOADCAT (k,v)	7 bits	[0..120] x 5 km/h <=> [0..600] km/h; [121-127] = Spare
079	Q_FRONT (k,l)	See [Ref 2], Section 7.5.1.109 This is applicable only for step up.	1 bits	see [Ref 2], Section 7.5.1.109

Packet Number	7			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
080	D_Start_Location (k,l)	If **[Q_Range == Starts or Q_Range == StartsEnds]** Location of the Axle Load Speed Profile start relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
081	D_End_Location (k,l)	If **[Q_Range == Ends or Q_Range == StartsEnds]** Location of the Axle Load Speed Profile end relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
Unprotected Level Crossing Stop				
082	N_ITER (k)	Number of iterations of stopping locations for unprotected level crossings. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
083	D_UnprotectedLx_Stop_Nominal (k,l)	Location of the stop in rear of an unprotected level crossing if the valid travelling direction of the SP is nominal. Undefined if for this travelling direction the location is not inside this SP.	24 bits	Binary to numeric (in centimetres) 16777215 = Undefined Location
084	D_UnprotectedLx_Stop_Reverse (k,l)	Location of the stop in rear of an unprotected level crossing if the valid travelling direction of the SP is reverse. Undefined if for this travelling direction the location is not inside this SP.	24 bits	Binary to numeric (in centimetres) 16777215 = Undefined Location
Permitted Braking Distance				
085	N_ITER (k)	Number of iterations of Permitted Braking Distance areas. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
086	Q_Range (k,l)	Specifies if the Permitted Braking Distance area starts, ends, starts and ends or covers the whole concerning Segment Profile.	2 bits	0 = Starts 1 = Ends 2 = StartsEnds 3 = WholeSP
087	D_Permitted_Braking_Distance (k,l)	Permitted Braking Distance value.	24 bits	Binary to numeric (in centimetres)
088	Q_PBD_SBEB (k,l)	Whether the permitted braking distance is to be achieved with the Service Brake or Emergency Brake.	1 bits	0 = Service Brake 1 = Emergency Brake
089	G_PBD (k,l)	A single gradient value applicable for the calculation	8 bits	Binary to numeric (0-255) with resolution 1‰
090	Q_GDIR_PBD (k,l)	Direction of the gradient.	1 bits	0 = Downhill 1 = Uphill

Packet Number	7			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
091	D_Start_Location (k,l)	If **[Q_Range == Starts or Q_Range == StartsEnds]** Location of the Permitted Braking Distance area start relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
092	D_End_Location (k,l)	If **[Q_Range == Ends or Q_Range == StartsEnds]** Location of the Permitted Braking Distance area end relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
Switch Off Regenerative Brake				
093	N_ITER (k)	Number of iterations of Switch off Regenerative Brake areas. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
094	Q_Range (k,l)	Specifies if the Switch off Regenerative Brake area starts, ends, starts and ends or covers the whole concerning Segment Profile.	2 bits	0 = Starts 1 = Ends 2 = StartsEnds 3 = WholeSP
095	D_Start_Location (k,l)	If **[Q_Range == Starts or Q_Range == StartsEnds]** Location of the Switch off Regenerative Brake area start relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
096	D_End_Location (k,l)	If **[Q_Range == Ends or Q_Range == StartsEnds]** Location of the Switch off Regenerative Brake area end relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
Switch Off Eddy Current Brake				
097	N_ITER (k)	Number of iterations of Switch off eddy current brake for service brake areas. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
098	Q_Range (k,l)	Specifies if the Switch off eddy current brake for service brake area starts, ends, starts and ends or covers the whole concerning Segment Profile.	2 bits	0 = Starts 1 = Ends 2 = StartsEnds 3 = WholeSP
099	D_Start_Location (k,l)	If **[Q_Range == Starts or Q_Range == StartsEnds]** Location of the Switch off eddy current brake for service brake area start relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)

Packet Number	7			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
100	D_End_Location (k,l)	If **[Q_Range == Ends or Q_Range == StartsEnds]** Location of the Switch off eddy current brake for service brake area end relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
Switch Off Eddy Current Emergency Brake				
101	N_ITER (k)	Number of iterations of Switch off eddy current brake for emergency brake areas. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
102	Q_Range (k,l)	Specifies if the Switch off eddy current brake for emergency brake area starts, ends, starts and ends or covers the whole concerning Segment Profile.	2 bits	0 = Starts 1 = Ends 2 = StartsEnds 3 = WholeSP
103	D_Start_Location (k,l)	If **[Q_Range == Starts or Q_Range == StartsEnds]** Location of the Switch off eddy current brake for emergency brake area start relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
104	D_End_Location (k,l)	If **[Q_Range == Ends or Q_Range == StartsEnds]** Location of the Switch off eddy current brake for emergency brake area end relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
Switch Off Magnetic Shoe Brake				
105	N_ITER (k)	Number of iterations of Switch off Magnetic Shoe Brake areas. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
106	Q_Range (k,l)	Specifies if the Switch off Magnetic Shoe Brake area starts, ends, starts and ends or covers the whole concerning Segment Profile.	2 bits	0 = Starts 1 = Ends 2 = StartsEnds 3 = WholeSP
107	D_Start_Location (k,l)	If **[Q_Range == Starts or Q_Range == StartsEnds]** Location of the Switch off Magnetic Shoe Brake area start relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
108	D_End_Location (k,l)	If **[Q_Range == Ends or Q_Range == StartsEnds]** Location of the Switch off Magnetic Shoe Brake area end relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
Area with Dynamic Brake force Inhibition				

Packet Number	*7*			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
109	N_ITER (k)	Number of iterations of areas with Dynamic Brake force inhibition. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
110	Q_Range (k,l)	Specifies if the Dynamic Brake Inhibition Area starts, ends, starts and ends or covers the whole concerning Segment Profile.	2 bits	0 = Starts 1 = Ends 2 = forceStartsEnds 3 = WholeSP
111	D_Start_Location (k,l)	If **[Q_Range == Starts or Q_Range == StartsEnds]** Location of the Dynamic Brake Force Inhibition Area start relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
112	D_End_Location (k,l)	If **[Q_Range == Ends or Q_Range == StartsEnds]** Location of the Dynamic Brake Force Inhibition Area end relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
Area with limited Dynamic Brake force				
113	N_ITER (k)	Number of iterations of areas with limited Dynamic Brake force. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
114	Q_Range (k,l)	Specifies if the Dynamic Brake Limitation Area starts, ends, starts and ends or covers the whole concerning Segment Profile.	2 bits	0 = Starts 1 = Ends 2 = forceStartsEnds 3 = WholeSP
115	M_Dynamic_Brake_Force_Limit (k,l)	Maximum Brake Force [kN] to be applied by the Dynamic Brake	16 bits	Range: 0 ... 3000 kN, resolution 1 kN, Special values: 3001 ... MAXNUM - 1: spare MAXNUM: Unknown
116	D_Start_Location (k,l)	If **[Q_Range == Starts or Q_Range == StartsEnds]** Location of the Dynamic Brake Force Limit Area start relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)
117	D_End_Location (k,l)	If **[Q_Range == Ends or Q_Range == StartsEnds]** Location of the Dynamic Brake Force Limit Area end relatively to the beginning of the SP.	24 bits	Binary to numeric (in centimetres)

Table 11 Segment Profile Packet structure

7.3.9.3. If the status of the Segment Profile is invalid, the Segment Profile Details shall finish after Q_SP_Status (Item 5).

7.3.9.4. **Segment Profile Location Dependent Data Types**

7.3.9.4.1. All location dependent data types of a Segment Profile can be clustered into the following categories, which are explained in the consecutive chapters:

- ATO Position Types
- ATO Profile Types
- ATO Area Types

7.3.9.4.2. Table 14 assigns the category to the location dependent ATO data types.

Location Dependent Data	**ATO Type**
Static Speed Profile	Profile
Gradients	Profile
Curves	Profile
Power Voltage	Profile
Current Limitation	Profile
Balises	Position
Timing Points	Position
Platform Areas	Area
Tunnels	Area
Axle Load Speed Profiles	Area
Unprotected LX	Position
Permitted Braking Distances	Area
Switch off regenerative brake areas	Area
Switch off eddy current brake for SB	Area
Switch off eddy current brake for EB	Area

Switch off magnetic shoe brake	Area
Inhibition of the Dynamic Brake	Area
Dynamic Brake Force Limit	Area

Table 12: Type Classification for Segment Profile Data

7.3.9.5. **ATO Position Types**

7.3.9.5.1. ATO Position Type elements are described by a distance relative to a reference point only and do not have any extension. Consequently, the location dependent data assigned to the Segment Profile is applicable at this position only.

7.3.9.5.2. At a specific position, only one element of the same position type shall be specified.

7.3.9.5.3. The data shall be sorted in ascending order of position.

7.3.9.6. **ATO Profile Types**

7.3.9.6.1. An ATO Profile Type always starts at the Segment Profile's start point and is applicable till (excluding) the next discontinuity given in the profile, if any.

7.3.9.6.2. For each ATO Profile Type, the element at the Segment Profile's origin shall be given.

7.3.9.6.3. The position of any discontinuity shall not be located at the Segment Profile's start point. Discontinuities are optional.

7.3.9.6.4. At a specific position, only one element of the same ATO Profile Type shall be specified.

7.3.9.6.5. The data shall be sorted in ascending order of position.

7.3.9.7. **ATO Area Types**

7.3.9.7.1. An ATO Area Type is defined by its start and end location and can cover multiple Segment Profiles. Only in case the area extremities are located within this particular Segment Profile they shall be given in this Segment Profile.

7.3.9.7.2. Data belonging to the same type/category (if applicable, e.g. M_AXLELOADCAT) shall be sorted in ascending order of their start offset and shall neither overlap nor be nested.

7.3.9.7.3. If the start offset is not given, it is assumed as zero.

7.3.9.7.4. The end offset, if given, shall be unequal to the start offset of this particular type.

7.3.9.8. **Speed values**

7.3.9.8.1. If at the same position multiple speed values of different categories/types (beside the static speed profile) are defined, they shall be sorted according to their category criterion. The sorting depends on the category/type:

a) NC_CDDIFF: Ascending
b) NC_DIFF: Ascending
c) M_AXLELOADCAT: Ascending

7.3.10. Status Report Packet (STR)

7.3.10.1. The section details the structure of a Status Report Packet sent by the ATO-OB to the ATO-TS.

7.3.10.2. Status Report Packet composition:

Packet Number	***8***			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
001	ATO Header	see chapter 7.2		-
Status Report Details				
002	M_ATO_State	The current ATO State in use.	4 bits	0 = Unknown 1 = CO 2 = NA 3 = AV 4 = RE 5 = EG 6 = DE 7 = FA [8-15] = Spare

Packet Number	8			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
003	Q_STR_Indicators	Bitset with the indicators state.	16 bits	bit0 = JP SP Consistency Error bit1 = Routing Error bit2 = Next Stopping Point Skip bit3 = Low adhesion reported by the driver bit4 = Operational conditions fulfilment bit5 = Train is moving bit6 = Unable to stop at the next Stopping Point bit7 = Slip/slide reported by TCMS/Train [bit8-bit15] = Spare
004	V_TRAIN_ATO	Current speed of the train when the STR is sent.	10 bits	Binary to numeric. Resolution: 1 km/h
005	L_TRAIN	See [Ref 2], Section 7.5.1.56.	12 bits	See [Ref 2], Section 7.5.1.56.
006	DRIVER_ID	See [Ref 6], Section 4.2.3.7.	128 bits	See [Ref 6], Section 4.2.3.7.
STR Sending Location				
007	NID_C	Identity of the SP's country or region. Not relevant if D_Sending_Position = Undefined Location.	10 bits	See [Ref 2], Section 7.5.1.86.
008	NID_SP	SP identity. Not relevant if D_Sending_Position = Undefined Location.	32 bits	Binary to numeric
009	D_Sending_Position	Position of the estimated front end of the train at the moment the STR is sent (relatively from the beginning of the given SP).	24 bits	Binary to numeric (in centimetres) 16777215 = Undefined Location
Previous TP Information				
010	NID_C	Identity of the previous TP's country or region. Not relevant if NID_TP is undefined.	10 bits	See [Ref 2], Section 7.5.1.86.
011	NID_TP	Previous TP identity. The NID_TP is unique within a NID_C.	32 bits	Binary to numeric. 4294967295 for undefined value.
012	Q_Pass_Stop_Depart	Qualifier to indicate if train has stopped at the TP, has departed from the TP or has passed the TP.	2 bits	0 = Train passed the TP 1 = Train stopped at the TP 2 = Train departed from the TP 3 = Undefined
Accurate Stopping - If [Q_Pass_Stop_Depart == Train stopped at the TP]				

Packet Number	*8*			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
013	Q_Accurate_Stopping	If **[Q_Pass_Stop_Depart == Train stopped at the TP]** This qualifier specifies if the train has stopped accurately or not at the Operational Stopping Point.	2 bits	0 = Undershoot 1 = Accurate 2 = Overshoot 3 = Spare
Timing Point Estimation				
014	N_ITER	Number of iterations of TPs information. If N_ITER is 0 then no data set is following.	5 bits	See [Ref 2], Section 7.5.1.80
015	NID_C (k)	Identifier of the next TP's country or region.	10 bits	See [Ref 2], Section 7.5.1.86.
016	NID_TP (k)	Next TP identity. The NID_TP is unique within a NID_C.	32 bits	Binary to numeric.
017	T_Arrival_Date (k)	Date to arrive at the TP.	15 bits	Date of a timestamp in UTC. The variable represents the number of days from the 1st January 2010. Values from 0 (01/01/2010) to 32767 (18/09/2099)
018	T_Arrival_Seconds (k)	Estimated time in seconds to arrive at the TP.	17 bits	Seconds of a timestamp in UTC. The variable represents the number of seconds from the beginning of the day. Values from 0 (00:00:00) to 86400 (24:00:00)

Table 13 Status Report Packet structure

7.3.11. Status Report Acknowledgement Packet (STRAck)

7.3.11.1. The section details the structure of a Status Report Acknowledgement Packet sent by the ATO-TS to the ATO-OB.

7.3.11.2. Status Report Acknowledgement Packet composition:

Packet Number	*9*			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
001	ATO Header	see chapter 7.2		-
Status Report Acknowledgement Details				
002	T_STR_Reference_Timestamp_Date	Date of the timestamp of the Status Report Packet (see 7.2 ATO Header) for which the acknowledgement is provided.	15 bits	Date of a timestamp in UTC. The variable represents the number of days from the 1st January 2010. Values from 0 (01/01/2010) to 32767 (18/09/2099)

Packet Number		*9*	
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
003	T_STR_Reference_Timestamp_Seconds	Seconds of the timestamp of the Status Report Packet in UTC (see 7.2 ATO Header) for which the acknowledgement is provided.	17 bits	Seconds of a timestamp in UTC. The variable represents the number of seconds from the beginning of the day. Values from 0 (00:00:00) to 86399 (23:59:59)
004	N_STR_Reference_Packet_Counter	N_Packet_Counter of the Status Report (see 7.2 ATO Header) for which the acknowledgement is provided.	8 bits	Binary to numeric

Table 14 Status Report Acknowledgement Packet structure

7.3.12. Session Termination Request Packet (SESSTermReq)

7.3.12.1. The section details the structure of a Session Termination Request Packet sent by the ATO-TS to the ATO-OB.

7.3.12.2. Session Termination Request Packet composition:

Packet Number		*10*	
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
001	ATO Header	see chapter 7.2		-

Table 15 Session Termination Request Packet structure

7.3.13. Session Termination Packet (SESSTerm)

7.3.13.1. The section details the structure of a Session Termination Packet sent by the ATO-OB to the ATO-TS.

7.3.13.2. Session Termination Packet composition:

Packet Number		*11*	
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
001	ATO Header	see chapter 7.2		-
Session Termination Details				

Packet Number	*11*			
Item	**Variable Name**	**Description**	**Length**	**Resolution/Formula**
002	Q_Termination_Reason	Qualifier indicating the reason for the communication session termination.	4bits	0 = End of Journey reached 1 = ATO-TS Termination Request 2 = Last SP left 3 = Cab inactive 4 = TRN or train length not valid 5 = ETCS-OB in NL 6 = ETCS-OB in SH 7 = ATO TS Handover cancelled 8 - 15 = Spare

Table 16 Session Termination Packet structure

APPENDIX

A.1. Example Encoded Handshake Request Packet

A.1.1. The following example shows the encoding of a Handshake Request Packet.

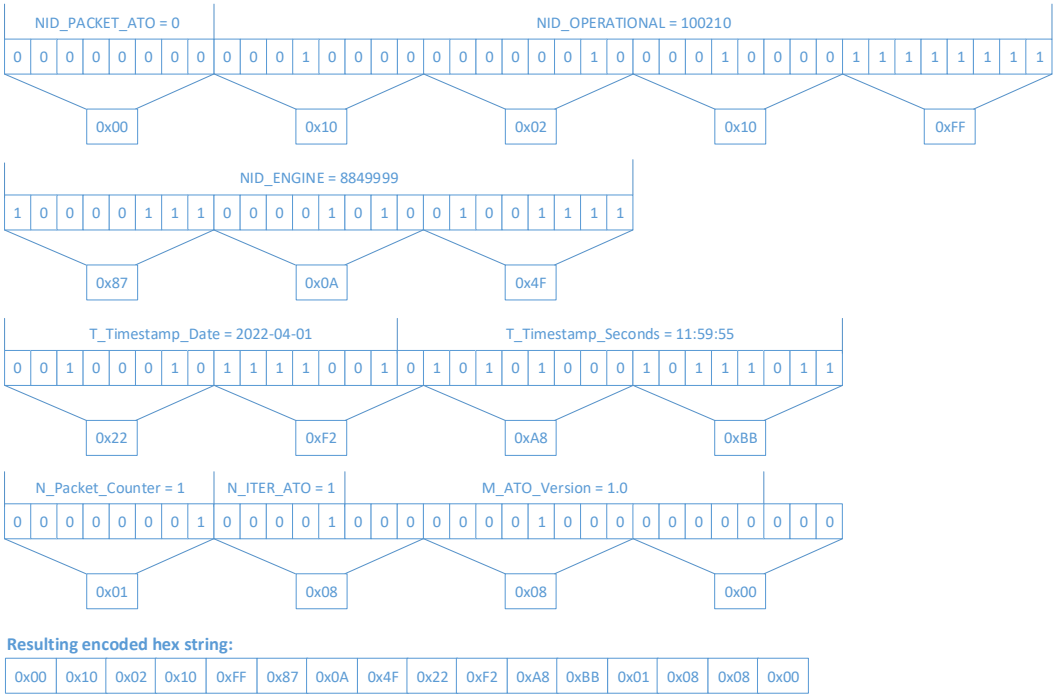

Figure 1 Encoded Handshake Request Packet

The hex string for the Handshake Request Packet example is as follows:

- 0x00100210FF870A4F22F2A8BB01080800