JANUS MPR4.1 READER - INTERFACE CONTROL DOCUMENT

PRODUCT:	**JANUS MPR4.1 READER - LANE CONTROLLER INTERFACE**
DOCUMENT NUMBER:	**ICD 360479-121**
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Document Revision Control

Applicability: Janus MPR4.1 Reader - Lane Controller Interface

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Version Date	Revision	Changes	Editor
20 June, 2023	B	Approved Release	GT
20 June, 2023	B4	Incorporate feedback from reviewers: • §1.2.1: Remove references to legacy MPR1 Reader • §2.2.5 – Table 2.2-6, §2.2.5.1 – Table 2.2-7, §2.3.4 – Table 2.3-5, , §2.3.4.1 – Table 2.3-6, §2.4.4 – Table 2.4-4, §2.4.4 – Table 2.4-5, §2.4.5 – Table 2.4-6, §9.1 – Table 9.1.2: Add note that Title21 messages have been defined but not implemented on MPR2.4 Readers at the time of publication of this document. • §2.3.4.1 – Table 2.3-6: Remove references to legacy MPR1 Reader serial loop-through messages. Delete Note (5) relating to said messages and renumber remaining note(s). • §2.3.4 – Table 2.3-5, §2.3.4.1 – Table 2.3-6, §2.4.4 – Table 2.4-4, §2.4.4 – Table 2.4-5, §9.1 – Table 9.1.2: Correction: Title21 Estimated Vehicle Speed Reports are supported by the Title21 protocol. • §9.2 – Table 9.2-1: Correct table to include support for reporting *Transponder RSSI*, *Range Change Rate*, and *Average |I||Q| Data* extended information fields for the Title21 protocol. • §9.12.5: Remove text stating message is not yet implemented • §9.12.6: Remove text stating EVS field functionality is not yet implemented. • §9.13.6: Fix missing section reference, and correct descriptive text to reference MPR4.1 readers.	GT
Jan. 13, 2023	B3	• Update nomenclature of Reader to MPR4.1 throughout. • Cover Page: Updated/revised U.S. site address. • §1.2.1: Update AD2 reference to have correct document number and naming. • §2.2.2 – Table 2.2-2 – Note 2: Clarify how a terminated LC Ethernet link reconnects. • §2.2.2 – Table 2.2-2: Fix missing compatibility for the Sync Message regarding the JANUS family of readers. • §2.2.5: Add section identifying new *Transponder Write Control Message Set* Lane Controller to Reader messages. • §2.3.4 – Table 2.3-5, §2.3.4.1 – Table 2.3-6: Added missing TDM (Format A – TRBA) Handshake, Estimated Vehicle Speed, and Departure Messages to table. • §2.3.4 – Table 2.3-5, §2.3.4.1 – Table 2.3-6: Add Title21 Write Control Response Message to table.	GT

		• §2.2.1 – Table 2.2-1, §2.2.2 – Table 2.2-2, §2.2.2.1 – Table 2.2-3, §2.2.3.1 – Table 2.2-5: Added JANUS MPR2.4 Lane Controller to Reader message compatibility information. • §2.3.1 – Table 2.3-1, §2.3.2 – Table 2.3-2, §2.3.3.1 – Table 2.3-4, §2.3.4.1 – Table 2.3-6: Added JANUS MPR2.4 Reader to Lane Controller message compatibility information. • §2.5.1 – Table 2.5-1: Correct 'Initial Read Message' to read 'TDM Initial Read Message' to avoid possible confusion. Added note to clarify TDM Initial Read, Transponder and Post Capture protocol and to refer to Multi-Protocol Message set for Initial Read, Transponder and Post Capture message for other supported protocols. • §2.4.4 – Table 2.4-4: Added Message Category Table to help simplify identification of differences between protocols for the *Multi-Protocol Message Set*. • §2.4.4 – Table 2.4-4: Added Title21 Write Control Response Message to table. • §2.4.5: New section added detailing supported protocols for the *Transponder Write Control Message Set*. • §3.2 – Figure 3.2-1, §3.2.1, §3.2.2, §3.5 – Figure 3.5-1: Amended standard maximum application message payload field length to 400 bytes.: Amended standard maximum Application Message Payload field length to 400 bytes. • §3.3 – Figure 3.1-1, §3.3.2, §3.3.3, §3.6 – Figure 3.6-1: Amended TCP Long-Lived maximum Application Message Payload field length to 400 bytes. • §9.1 – Table 9.1-2: Added missing TDM (Format A – TRBA) Handshake, Estimated Vehicle Speed, and Departure Report Message Format Codes. • §9.1 – Table 9.1-2: Added Title21 Write Control Response Message Format Code. • §9.2 – Table 9.2-1: Added Write Control message to list of messages that can be appended with an Extended Information – Timestamp field. • §9.12.7: Added new section describing Title21 Write Control Response Message. • §9.13.4, §9.13.5, §9.13.6: Added missing TDM (Format A – TRBA) Multi-Protocol Handshake, Estimated Vehicle Speed, and Departure Report Message definitions. • §10: Added new section describing new *Transponder Write Control Message Set*	
August 8, 2019	B2	• Document Revision Control: Correct Version Date of Initial Draft. • §2.3.1 – Table 2.3-1, Inserted §6.2.4 and Table 6.2-3: Added TDM Initial Read (IA – Format A – TRBA) message definition. • §2.3.1 – Table 2.3-1, Inserted §6.2.10 and Table 6.2-6: Added TDM Post Capture Report (PA – Format A – TRBA) message definition. • §2.3.1 – Table 2.3-1, Inserted §6.2.20 and Table 6.2-12: Added TDM Transaction Report (TA – Format A – TRBA) message definition. • §2.3.4 – Table 2.3-5, §2.3.4.1 – Table 2.3-6, §2.4.4 – Table 2.4-4, §4.1 – Table 4.1-1 and Table 4.1-2, , §4.2, §4.4, §9.1 – Table 9.1-2, §9.3: Updated/clarified notes with respect to Estimated Vehicle Speed and Departure Reports.	GT

		• §6.2.1 – Table 6.2-1: Remove unnecessary option value for Reader *TYPE* field. • §6.2.1 – Table 6.2-1, §6.2.15 – Table 6.2-9: Clarified COM port related fields as being ignored by and/or not relevant to the MPR4.1 Reader, and retained for legacy compatibility only. • §6.2.1 – Table 6.2-1, §6.2.14 – Table 6.2-7, §6.2.15 – Table 6.2-8: Clarified Test Tag related fields as being ignored by and/or not relevant to the MPR4.1 Reader and retained for legacy compatibility only. • §6.2.3: Corrected/amended references to TDM protocol. • §6.2.15: Remove range error text related to COM port behaviour. • §9.3 – Figure 9.3-1 and Table 9.3-1: Updated Multi-Protocol Departure Message Format. • §9.6.6 – Table 9.6-6, §9.7.6 – Table 9.7-6, §9.8.6 – Table 9.8-6, §9.9.6 – Table 9.9-6, §9.10.6 – Table 9.10-6, §9.11.6 – Table 9.11-6, §9.12.6 – Table 9.12-6, §9.13.3 – Table 9.13-3: Changed *Departure Information* field length from 62 to 183. • §9.9.5, §9.11.5, §9.12.5, §9.13.2: Add note Indicating that this specific message, although defined, is not currently implemented. • §9.9.6, §9.11.6, §9.12.6, §9.13.3: Add note indicating that the estimated vehicle speed functionality is currently not fully implemented for this protocol.	
April 29, 2019	B1	Initial Draft.	GT

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1. INTRODUCTION

1.1 Scope and Purpose

This document specifies the messaging protocol between the JANUS MPR4.1 Reader (MPR) and the attached Lane Controller(s) (LC's). The messages specified herein are sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface, also specified herein.

The JANUS MPR4.1 Reader and the attached Lane Controllers shall use the Transmission Control Protocol (TCP) and Internet Protocol, version 4 (IPv4) protocols (hereafter referred to as "TCP/IP") to send and receive messages over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface.

In addition, the JANUS MPR4.1 Reader may be optionally configured to send a special class of messages – Handshake Messages – to the Lane Controller over the JANUS MPR-4.1 Reader – Lane Controller Ethernet Interface. Handshake Messages shall be sent to the Lane Controller over the JANUS MPR-4.1 Reader – Lane Controller Ethernet Interface using the User Datagram Protocol (UDP).

1.2 Applicable and Reference Documents

The following documents, at the revision listed, are referenced by, and are applicable to the Interface protocols and characteristics defined in this document.

Where there is no revision listed, the current revision at the time of issue of this document applies.

In the event of a conflict between the text of this document and the references cited herein, the references shall take precedence, unless otherwise indicated. When the references cited herein are superseded by an approved revision, the approved superseding revision shall apply.

1.2.1 Applicable Documents

The following documents and/or drawings are applicable to the interface specifications to the extent specified herein:

[AD1] JANUS MPR4.1 – Parameter Catalog

[AD2] UM 360479-100 Issue B JANUS MPR4.1 Reader Operations And Maintenance Manual

1.2.2 Reference Documents

The following documents are referenced:

[RD1] RFC 0791 Internet Protocol, DARPA Internet Program Protocol Specification, September 1981

[RD2] RFC 0793 Transport Control Protocol, DARPA Internet Program Protocol Specification, September 1981

[RD3] RFC 0768 User Datagram Protocol, J. Postel, ISI, August 1980.

[RD4] IEEE 802.3 - 2008 IEEE Standard for Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements, Part 3: Carrier sense multiple access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.

[RD5] *Internetworking with TCP/IP – Volume III (Client-Server Programming and Applications)*, Comer & Stevens, Prentice-Hall, 1993. ISBN 0-13-474222-2

1.3 Definitions, Acronyms, Abbreviations

The following definitions, acronyms, abbreviations and interpretations apply throughout this document:

ACK	Acknowledge (Packet)
ASCII	American Standard Code for Information Interchange
bps	bits per second
BAT	Balance Adjustment Table
CGC	Channel Group Controller
CRC	Cyclic Redundancy Check
CTM	Control Module
EPC	Electronic Product Code
ETC	Electronic Toll Collection
FDM	Frequency Division Multiplexing
FIFO	First In, First Out
ICD	Interface Control Document
IP	Internet Protocol
IPv4	Internet Protocol (version 4)
ISO	International Standards Organization
LC	Lane Controller
LSB	Least Significant Bit
MFT	Multiple Fault Threshold
MPR	Multi-Protocol Reader
MRFM	Multi-Protocol Radio-Frequency Module
MSB	Most Significant Bit
NAK	Negative-Acknowledge (Packet)
ORT	Open-Road Tolling
PC	Protocol Control
PTO	Protocol Timeout

RF	Radio Frequency
RFID	Radio Frequency Identification
RR	Restart Request
RSN	Receive Sequence Number
RSSI	Received Signal Strength Indicator
SCP	Secure Copy
SFT	Single Fault Threshold
SSN	Send Sequence Number
S/W	Software
TBC	To Be Confirmed
TBD	To Be Determined
TCP	Transport Control Protocol
TCP/IP	Transport Control Protocol / Internet Protocol
TCPLL	TCP Long-Lived (Connection)
TDM	Time Division Multiplexing
TID	Tag-Identification or Tag Identifier, depending on context
TRBA	Toll Rate / Balance Adjustment
UART	Universal Asynchronous Receiver/Transmitter
UDP	User Datagram Protocol
UID	Unique Identifier
UII	Unique Item Identifier
UM	User Memory
UML	Unified Modeling Language

2. INTERFACE DESCRIPTION

2.1 Backwards Compatibility

Messages included in the JANUS MPR4.1 *Basic Message Set* are backwards compatible with those of legacy JANUS and JANUS MPR1 / MPR2 / MPR2.3 / MPR2.4 Readers. Please refer to §2.2.1 and §2.3.1 for additional details on the backwards compatibility of messages in the JANUS MPR4.1 Reader *Basic Message Set*.

Messages included in the JANUS MPR4.1 Reader *Ethernet Message Set* are also backwards compatible with legacy JANUS, and JANUS MPR1 / MPR2 / MPR2.3 / MPR2.4 Readers. Please refer to §2.2.2 and §2.3.2 for additional details on the backwards compatibility of messages in the JANUS MPR-4.1 Reader *Ethernet Message Set*.

The messages described in the JANUS MPR4.1 Reader '*Reader Configuration and Software Management / Update Message Set*' are backwards compatible with the JANUS MPR2, JANUS MPR2.3 and JANUS MPR2.4 Readers only. Please refer to §2.2.3.1 and §2.3.3.1 for additional details on the backwards compatibility of the JANUS MPR4.1 Reader '*Reader Configuration and Software Management / Update Message Set*'.

The JANUS MPR4.1 Reader provides a super-set of available Multi-Protocol messages that are used to report Multi-Protocol transactions to the Lane Controller. Certain messages included in the JANUS MPR4.1 Reader *Multi-Protocol Message Set* are backwards compatible with those of the legacy JANUS MPR1 /MPR2 / MPR2.3 / MPR2.4 Readers. For additional details on the backwards compatibility of the JANUS MPR4.1 Reader *Multi-Protocol Message Set*, please refer to §2.3.4.1.

Please note that, since legacy Badger and IAG Readers did not support an Ethernet Interface to the lane controller, the messaging defined in this ICD is essentially compatible with legacy JANUS, and JANUS MPR1 / MPR2 / MPR2.3 / MPR2.4 Readers only. While the Application-level message formats are the same as some of those messages implemented in legacy Badger/IAG Readers, the Transport-level protocols are not. Hence, the messaging defined in this ICD is not compatible with legacy Badger/IAG Readers.

2.2 Summary of Lane Controller to Reader Messages

2.2.1 Lane Controller to Reader Messages – Basic Message Set

The messages shown in Table 2.2-1 define the Lane Controller to Reader messages that comprise the *Basic Message Set* of the JANUS MPR4.1 Reader. Depending on the Reader configuration, these messages may be accepted over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface.

Table 2.2-1: Lane Controller to Reader Messages – Basic Message Set

LC to Reader Message	Expected Reader (application) Response	JANUS / MPR1 / MPR2 / MPR2.3 / MPR2.4 Compatible
Configuration Request Message	Configuration Message	✓
Lane Active Message	None (**See Note *1***)	✓
Lane Guard Message	None (**See Note *1***)	✓
Lane Off-Line Message	None (**See Note *1***)	✓
Reboot Request Message	None (**See Note *2***)	✓
Re-Report Request Message	None (**See Note *3***)	✓

Read Time Message	Time Message	✓
[Precision] Read Time Message	[Precision] Time Message	✓ (**See Note *7***)
Set Configuration Message	None (**See Note *4***)	✓
Vehicle Speed Message	None (**See Note *5***)	✓
Status Request Message	Status Message	✓
Set Time Message	None	✓
Transaction Number Reset Message	None	✓
Voting Time Message *(Note: also reader to LC)*	None (**See Note *6***)	✓

Notes:

(1) **-** The JANUS MPR4.1 Reader shall asynchronously transmit a Status Response Message if the Lane/Channel Status has changed.

(2) **-** As part of a successful Reader reboot, the JANUS MPR4.1 Reader shall implicitly transmit an Initialization Message to the Lane Controller (see §6.2.4 for details).

(3) **-** If the given channel is configured to be either a guard channel or is off-line, the Reader shall echo the Re-Report Request Message (with some additional information) to the Lane Controller. If a transponder is present in the capture zone, the Reader shall transmit a Transponder message to the Lane Controller. If no transponder is present in the capture zone, there shall be no response from the Reader.

(4) **-** The JANUS MPR4.1 Reader shall asynchronously transmit a Status Response Message if a change in Lane/Channel Status and/or a change Synchronization Status has occurred in response to the Set Configuration request.

(5) **-** The JANUS MPR4.1 Reader shall asynchronously transmit a Voting Time Message if the new vehicle speed information results in a new dynamically computed voting time that is different from the previous voting time setting.

(6) **-** The JANUS MPR4.1 Reader shall asynchronously transmit a Voting Time Message if the newly requested voting time is different from the previous voting time setting.

(7) - The optional Precision Read Time and optional Precision Time Message Response messages are not supported in JANUS and JANUS MPR1 Readers. The optional Precision Read Time and optional Precision Time Message Response messages are fully supported in JANUS MPR2 / MPR2.3 / MPR2.4 Readers.

2.2.2 Lane Controller to Reader Messages – Ethernet Interface Message Set

When communicating to the Lane Controller over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface, specific messages are defined for the Lane Controller, as shown in Table 2.2-2 (See §3, §7 for details).

Table 2.2-2: Lane Controller to Reader Messages – Ethernet Interface Message Set

LC to Reader Message	Expected Reader (application) Response	JANUS / MPR1 / MPR2 / MPR2.3 Compatible	JANUS MPR2.4 Compatible
(TCPLL) Acknowledge Transmission Message (**See Note *1***)	None (**See Note *2***)		✓
Sync Message (**See Note *3***)		✓	✓

Notes:

(1) **-** The Acknowledge Transmission Message is only applicable when the JANUS MPR4.1 Reader is configured to communicate to the LC over the MPR4.1 Reader – Lane Controller Ethernet Interface using *TCP Long-Lived* (TCPLL) connections (see §2.11 and §3.4.5 for details).

(2) **-** If, when using *TCP Long Lived Connections,* the JANUS MPR4.1 Reader does not receive an explicit *Acknowledge Transmission* message acknowledgement in time, then the Reader shall immediately buffer the message it is attempting to transmit. The Reader shall then shut down the connection, buffer any as yet un-transmitted messages and attempt to reconnect to the LC using the standard TCP 3-way handshake connection establishment process. Any messages that require transmission between the time the connection to the LC is dropped and the time the connection is resumed are also buffered. Draining of buffered messages commences upon successful reconnection to the LC.

(3) - Sync Messages sent from the Lane Controller to the Reader are sent in response to a Sync Message that has first been received from the Reader (see §7.1.2).

2.2.2.1 Lane Controller to Reader Messages – Ethernet Interface Message Set – Backwards Compatibility

The backwards compatibility of the Lane Controller to Reader Messages that comprise the *Ethernet Interface Message Set* is shown in Table 2.2-3.

Table 2.2-3: Lane Controller to Reader Messages – Ethernet Interface Message Set – Backwards Compatibility

LC to Reader Message	JANUS Compatible	JANUS MPR1 Compatible	JANUS MPR2 / MPR2.3 Compatible	JANUS MPR2.4 Compatible
(TCPLL) Acknowledge Transmission Message (**See Note *1***)				✓
Sync Message (**See Note *2***)		✓	✓	✓

Notes:

(1) **-** The Acknowledge Transmission Message is only applicable when the JANUS MPR4.1 Reader is configured to communicate to the LC over the MPR4.1 Reader – Lane Controller Ethernet Interface using *TCP Long-Lived* (TCPLL) connections (see §2.11 and §3.4.5 for details).

(2) - Sync Messages sent from the Lane Controller to the Reader are sent in response to a Sync Message that has first been received from the Reader (see §7.1.2).

2.2.3 Lane Controller to Reader Messages – Reader Configuration and Software Management / Update Message Set

The Lane Controller to Reader Messages shown in Table 2.2-4 are defined for both the Reader and the Lane Controller in support of the JANUS MPR4.1 Reader Configuration and Software Management / Update functionality. Depending on the Reader configuration, these messages may be accepted over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface.

Table 2.2-4: Lane Controller to Reader Messages – Reader Configuration and Software Management / Update Message Set

LC to Reader Message	Expected Reader (application) Response
Configuration – Get Parameter Message	Configuration – Parameter Value Message (**See Note *1***)
Configuration – Set Parameter Message	None (**See Note *2***)
Software Update / Management – Get Free Space Message	Software Update / Management – Filesystem Space Available Message
Software Update / Management – Query Update Count Message	Software Update / Management –Available Update Count Message
Software Update / Management – Get Update Identifier Message	Software Update / Management – Identifier Reference Message (**See Note *3***)
Software Update / Management – Verify Update Message	Software Update / Management – Status Message
Software Update / Management – Activate Update Message	None (**See Notes *3* / *4***)
Software Update / Management – Delete Update Message	Software Update / Management – Status Message
Software Update / Management – Update (Bulk) Configuration Message	Software Update / Management – Status Message
Software Update / Management – Generate (Bulk) Configuration File Message	Software Update / Management – (Bulk) Configuration File Info Message (**See Note *3***)

Notes:

(1) **-** The JANUS MPR4.1 Reader shall respond with a Configuration – Get/Set Error Message if a *'Configuration – Get'* error condition is detected.

(2) **-** The JANUS MPR4.1 Reader shall respond with a Configuration – Get/Set Error Message if a '*Configuration – Set*' error condition is detected.

(3) - The JANUS MPR4.1 Reader shall respond with a Software Update / Management – Status Message if an error condition is detected

(4) - As part of a successful software restart, the JANUS MPR4.1 Reader shall implicitly transmit an Initialization Message to the Lane Controller (see §6.2.4 for details).

2.2.3.1 Lane Controller to Reader Messages – Reader Configuration and Software Management / Update Message Set – Backwards Compatibility

The backwards compatibility of the Lane Controller to Reader Messages that comprise the *Reader Configuration and Software Management / Update Message Set* is shown in Table 2.2-5.

Table 2.2-5: Lane Controller to Reader Messages – Reader Configuration and Software Management / Update Message Set – Backwards Compatibility

LC to Reader Message	JANUS Compatible	JANUS MPR1 Compatible	JANUS MPR2 / MPR2.3 / MPR2.4 Compatible
Configuration – Get Parameter Message			✓
Configuration – Set Parameter Message			✓
Software Update / Management – Get Free Space Message			✓
Software Update / Management – Query Update Count Message			✓
Software Update / Management – Get Update Identifier Message			✓
Software Update / Management – Verify Update Message			✓
Software Update / Management – Activate Update Message			✓
Software Update / Management – Delete Update Message			✓
Software Update / Management – Update (Bulk) Configuration Message			✓
Software Update / Management – Generate (Bulk) Configuration File Message			✓

2.2.4 Lane Controller to Reader Messages – Multi-Protocol Message Set

There are currently no Lane Controller to Reader messages defined for the *Multi-Protocol Message Set.*

2.2.5 Lane Controller to Reader Messages – Transponder Write-Control Message Set

The Lane Controller to Reader Messages shown in Table 2.2-6 are defined for both the Reader and the Lane Controller in support of the JANUS MPR4.1 transponder write functionality. These messages may be accepted over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface.

Table 2.2-6: Lane Controller to Reader Messages – Transponder Write-Control Message Set

LC to Reader Message	Expected Reader (application) Response
Transponder Write Control (Title21 Transponder Read w/Acknowledge Request) Message (**See Notes *1*. *2***)	Title21 Write Response Message

Notes:

(1) **-** Applicable only when the Title21 protocol is configured and the *Title21 Enable Acknowledge Message* parameter is enabled

(2) – At the time of publication of this document, while Title21 messages are defined, they are not fully implemented in the MPR2.4 Reader.

2.2.5.1 Lane Controller to Reader Messages – Transponder Write-Control Message Set – Backwards Compatibility

The backwards compatibility of the Lane Controller to Reader Messages that comprise the *Transponder Write-Control Message Set* is shown in Table 2.2-7.

Table 2.2-7: Lane Controller to Reader Messages – Transponder Write-Control Message Set – Backwards Compatibility

LC to Reader Message	JANUS Compatible	JANUS MPR1 Compatible	JANUS MPR2 / MPR2.3 Compatible	JANUS MPR2.4 Compatible
Transponder Write Control (Title21 Transponder Read w/Acknowledge Request) Message (**See Notes *1*, *2***)				✓

Notes:

(1) – Applicable only when the Title21 protocol is configured and *Title21 Enable Acknowledge Message* parameter is enabled.

(2) – At the time of publication of this document, while Title21 messages are defined, they are not fully implemented in the MPR2.4 Reader.

2.3 Summary of Reader to Lane Controller Messages

2.3.1 Reader to Lane Controller Messages – Basic Message Set

The messages shown in Table 2.3-1 define the Reader to Lane Controller messages that comprise the *Basic Message Set* of the JANUS MPR4.1 Reader. These messages may be transmitted to the Lane Controller over either the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface, depending on Reader configuration.

Table 2.3-1: Reader to Lane Controller Messages – Basic Message Set

Reader to LC Message	Expected Lane Controller (application) Response	JANUS / MPR1 / MPR2 / MPR2.3 / MPR2.4 Compatible
Configuration Message	None	✓
TDM Initial Read Message (**See Note *1***)	None	✓
TDM Initial Read (Format A – TRBA) Message (**See Note *1***)	None	✓
Initialization Message	None	✓
TDM Post Capture Message (**See Note *1***)	None	✓
TDM Post Capture (Format A – TRBA) Message (**See Note *1***)	None	✓
Status Message	None	✓
TDM Transponder Message (**See Note *1***)	None	✓
TDM Transponder (Format A – TRBA) Message (**See Note *1***)	None	✓
[Precision] Time Message	None	✓ (**See Note *2***)
Voting Time Message *(Note: also LC to reader)*	None	✓

Notes:

(1) **-** The JANUS MPR4.1 Reader S/W has the capability of being able to report a timestamp as an optional trailing Extended-Information field for all TDM Transponder Transaction (Initial Read, Voting, Post Capture, Estimated Vehicle Speed and Departure) Report Messages (see §6.1 for details).

(2) **-** The optional Precision Read Time and optional Precision Time Message Response messages are not supported in JANUS and JANUS MPR1 Readers. The optional Precision Read Time and optional Precision Time Message Response messages are fully supported in JANUS MPR2 / MPR2.3 / MPR2.4 Readers.

2.3.2 Reader to Lane Controller Messages – Ethernet Interface Message Set

When communicating to the Lane Controller over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface, specific messages are defined for both the Reader and the Lane Controller, as shown in Table 2.3-2 (See §3, §7 for details).

Table 2.3-2: Reader to Lane Controller Messages – Ethernet Interface Message Set

Reader to LC Message	Expected Lane Controller (application) Response	JANUS / MPR1 / MPR2 / MPR2.3 / MPR2.4 Compatible
Sync Message	Sync Message	✓

When either the Reader or the Lane Controller receives a Sync Message, a sequence number will accompany it. The JANUS MPR4.1 Reader shall increment the sequence number each time it originates a new Sync message. The Lane Controller must echo this sequence number back to the Reader by responding with a Sync message of its own.

2.3.3 Reader to Lane Controller Messages – Reader Configuration and Software Management / Update Message Set

The Reader to Lane Controller Messages shown in Table 2.3-3 are defined for both the Reader and the Lane Controller in support of the JANUS MPR4.1 Reader Configuration and Software Management / Update functionality. Depending on the Reader configuration, these messages may be transmitted to the Lane Controller over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface.

Table 2.3-3: Reader to Lane Controller Messages – Reader Configuration and Software Management / Update Message Set

Reader to LC Message	Expected Lane Controller (application) Response
Configuration – Parameter Value Message	None
Configuration – Get/Set Error Message	None
Software Update / Management – Filesystem Space Available Message	None
Software Update / Management – Available Update Count Message	None
Software Update / Management – Update Identifier-Reference Message	None
Software Update / Management – (Bulk) Configuration File Info Message	None
Software Update / Management – Status Message	None

2.3.3.1 Reader to Lane Controller Messages – Reader Configuration and Software Management / Update Message Set – Backwards Compatibility

The backwards compatibility of the Reader to Lane Controller Messages that comprise the *Reader Configuration and Software Management / Update Message Set* is shown in Table 2.3-4.

Table 2.3-4: Reader to Lane Controller Messages – Reader Configuration and Software Management / Update Message Set – Backwards Compatibility

LC to Reader Message	JANUS Compatible	JANUS MPR1 Compatible	JANUS MPR2 / MPR2.3 / MPR2.4 Compatible
Configuration – Parameter Value Message			✓
Configuration – Get/Set Error Message			✓
Software Update / Management – Filesystem Space Available Message			✓
Software Update / Management – Available Update Count Message			✓
Software Update / Management – Update Identifier-Reference Message			✓
Software Update / Management – (Bulk) Configuration File Info Message			✓
Software Update / Management – Status Message			✓

2.3.4 Reader to Lane Controller Messages – Multi-Protocol Message Set

The Reader to Lane Controller Messages shown in Table 2.3-5 are defined for both the Reader and the Lane Controller in support of the JANUS MPR4.1 Multi-Protocol capability. Depending on the Reader configuration, these messages may be transmitted to the Lane Controller over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface.

Table 2.3-5: Reader to Lane Controller Messages – Multi-Protocol Message Set

Reader to LC Message	Expected Lane Controller (application) Response
ATA Handshake Message (8-Bit ASCII Alphanumeric Data)	None
ATA Initial Read Message (8-Bit ASCII Alphanumeric Data)	None
ATA Transponder Message (8-Bit ASCII Alphanumeric Data)	None
ATA Post Capture Message (8-Bit ASCII Alphanumeric Data)	None
ATA Estimated Vehicle Speed Message (8-Bit ASCII Alphanumeric Data)	None
ATA Departure Message (8-Bit ASCII Alphanumeric Data)	None
TDM Handshake Message	None
TDM Estimated Vehicle Speed Message (**See Note *1***)	None

Reader to LC Message	Expected Lane Controller (application) Response
TDM Departure Message (**See Note *2***)	None
TDM Handshake (Format A – TRBA) Message	None
TDM Estimated Vehicle Speed (Format A – TRBA) Message (**See Note *1***)	None
TDM Departure (Format A -TRBA) Message (**See Note *2***)	None
ISO 18000-6B Handshake Message	None
ISO 18000-6B Initial Read Message	None
ISO 18000-6B Transponder Message	None
ISO 18000-6B Post Capture Message	None
ISO 18000-6B Estimated Vehicle Speed Message (**See Note *1***)	None
ISO 18000-6B Departure Message (**See Note *2***)	None
ISO 18000-6B eATA Handshake Message (8-Bit ASCII Alphanumeric Data)	None
ISO 18000-6B eATA Initial Read Message (8-Bit ASCII Alphanumeric Data)	None
ISO 18000-6B eATA Transponder Message (8-Bit ASCII Alphanumeric Data)	None
ISO 18000-6B eATA Post Capture Message (8-Bit ASCII Alphanumeric Data)	None
ISO 18000-6B eATA Estimated Vehicle Speed Message (8-Bit ASCII Alphanumeric Data) (**See Note *1***)	None
ISO 18000-6B eATA Departure Message (8-Bit ASCII Alphanumeric Data) (**See Note *2***)	None
ISO 18000-6B Combined UID+eATA Handshake Message	None
ISO 18000-6B Combined UID+eATA Initial Read Message	None
ISO 18000-6B Combined UID+eATA Transponder Message	None
ISO 18000-6B Combined UID+eATA Post Capture Message	None
ISO 18000-6B Combined UID+eATA Estimated Vehicle Speed Message (**See Note *1***)	None
ISO 18000-6B Combined UID+eATA Departure Message (**See Note *2***)	None
ISO 18000-6C Handshake Message (**See Note *3***)	None
ISO 18000-6C Initial Read Message (**See Note *4***)	None
ISO 18000-6C Transponder Message (**See Note *4***)	None
ISO 18000-6C Post Capture Message (**See Note *4***)	None
ISO 18000-6C Estimated Vehicle Speed Message (**See Note *4***)	None
ISO 18000-6C Departure Message (**See Note *4***)	None

Reader to LC Message	Expected Lane Controller (application) Response
SeGo Handshake Message	None
SeGo Initial Read Message	None
SeGo Transponder Message	None
SeGo Post Capture Message	None
SeGo Estimated Vehicle Speed Message	None
SeGo Departure Message	None
Title21 Handshake Message (**See Note *6***)	None
Title21 Initial Read Message (**See Note *6***)	None
Title21 Transponder Message (**See Note *6***)	None
Title21 Post Capture Message (**See Note *6***)	None
Title21 Estimated Vehicle Speed Message (**See Note *6***)	None
Title21 Departure Message (**See Note *6***)	None
Title21 Transponder Write-Control Response Message (**See Notes *5*, *6***)	None

Notes:

(1) **-** The complete estimated vehicle speed functionality is currently not fully implemented for the TDM, and ISO 18000-6B protocols. Estimated Vehicle Speed Reports are not available for the TDM protocol. For the ISO 18000-6B protocol, the JANUS MPR4.1 Reader only supports Estimated Vehicle Speed Reports for the '*Standard (UID only)' Read Mode*.

(2) **-** The complete estimated vehicle speed functionality is currently not fully implemented for the TDM, and ISO 18000-6B protocols. The *Speed Information* section of this message shall be correspondingly populated with all 0's (zeroes) for TDM reports. For the ISO 18000-6B protocol, the *Speed Information* section of this message shall only be populated with non-zero values if the Reader is configured to use the ISO 18000-6B *'Standard (UID only)' Read Mode*.

(3) **-** The JANUS MPR4.1 Reader S/W has the capability of being able to report ISO 18000-6C EPC/UII memory area CRC/PC bits (bits 0x00-0x1F) as an optional trailing Extended-Information field for ISO 18000-6C Multi-Protocol Handshake Messages (see §9.2 for details).

(4) – The JANUS MPR4.1 Reader S/W has the capability of being able to report ISO 18000-6C EPC/UII memory area CRC/PC bits (bits 0x00-0x1F) as an optional trailing Extended-Information field for ISO 18000-6C Multi-Protocol Transaction (Initial Read, Voting, Post Capture, Estimated Vehicle Speed, and Departure) Messages (see §9.2 for details).

(5)- Applicable only when the Title21 protocol is configured and the *Title21 Enable Acknowledge Message* parameter is enabled.

(6) – At the time of publication of this document, while Title21 messages are defined, they are not fully implemented in the MPR2.4 Reader.

2.3.4.1 Reader to Lane Controller Messages – Multi-Protocol Message Set – Backwards Compatibility

The backwards compatibility of the Reader to Lane Controller Messages that comprise the *Multi-Protocol Message Set* is shown in Table 2.3-6.

Table 2.3-6: Reader to Lane Controller Messages – Multi-Protocol Message Set – Backwards Compatibility

Reader to LC Message	JANUS Compatible	JANUS MPR1 Compatible	JANUS MPR2 Compatible	JANUS MPR2.3 Compatible	JANUS MPR2.4 Compatible
ATA Handshake Message (8-Bit ASCII Alphanumeric Data)		✓	✓	✓	✓
ATA Initial Read Message (8-Bit ASCII Alphanumeric Data)		✓	✓	✓	✓
ATA Transponder Message (8-Bit ASCII Alphanumeric Data)		✓	✓	✓	✓
ATA Post Capture Message (8-Bit ASCII Alphanumeric Data)		✓	✓	✓	✓
ATA Estimated Vehicle Speed Message (8-Bit ASCII Alphanumeric Data)			✓	✓	✓
ATA Departure Message (8-Bit ASCII Alphanumeric Data)					✓
TDM Handshake Message	✓	✓	✓	✓	✓
TDM Estimated Vehicle Speed Message (**See Note *1***)					✓
TDM Departure Message (**See Note *2***)					✓
TDM Handshake (Format A – TRBA) Message	✓	✓	✓	✓	✓
TDM Estimated Vehicle Speed (Format A – TRBA) Message (**See Note *1***)					✓
TDM Departure (Format -A TRBA) Message (**See Note *2***)					✓
ISO 18000-6B Handshake Message		✓	✓	✓	✓
ISO 18000-6B Initial Read Message		✓	✓	✓	✓
ISO 18000-6B Transponder Message		✓	✓	✓	✓
ISO 18000-6B Post Capture Message		✓	✓	✓	✓
ISO 18000-6B Estimated Vehicle Speed Message (**See Note *1***)				✓	✓
ISO 18000-6B Departure Message (**See Note *2***)					✓

Reader to LC Message	JANUS Compatible	JANUS MPR1 Compatible	JANUS MPR2 Compatible	JANUS MPR2.3 Compatible	JANUS MPR2.4 Compatible
ISO 18000-6B eATA Handshake Message (8-Bit ASCII Alphanumeric Data)		✓	✓	✓	✓
ISO 18000-6B eATA Initial Read Message (8-Bit ASCII Alphanumeric Data)		✓	✓	✓	✓
ISO 18000-6B eATA Transponder Message (8-Bit ASCII Alphanumeric Data)		✓	✓	✓	✓
ISO 18000-6B eATA Post Capture Message (8-Bit ASCII Alphanumeric Data)		✓	✓	✓	✓
ISO 18000-6B eATA Estimated Vehicle Speed Message (8-Bit ASCII Alphanumeric Data) (**See Note *1**)				✓	✓
ISO 18000-6B eATA Departure Message (8-Bit ASCII Alphanumeric Data) (**See Note *2***)					✓
ISO 18000-6B Combined UID+eATA Handshake Message			✓	✓	✓
ISO 18000-6B Combined UID+eATA Initial Read Message			✓	✓	✓
ISO 18000-6B Combined UID+eATA Transponder Message			✓	✓	✓
ISO 18000-6B Combined UID+eATA Post Capture Message			✓	✓	✓
ISO 18000-6B Combined UID+eATA Estimated Vehicle Speed Message (**See Note *1***)				✓	✓
ISO 18000-6B Combined UID+eATA Departure Message (**See Note *2***)					✓
ISO 18000-6C Handshake Message (**See Note *3***)			✓	✓	✓
ISO 18000-6C Initial Read Message (**See Note *4***)			✓	✓	✓
ISO 18000-6C Transponder Message (**See Note *4***)			✓	✓	✓
ISO 18000-6C Post Capture Message (**See Note *4***)			✓	✓	✓
ISO 18000-6C Estimated Vehicle Speed Message (**See Note *4***)				✓	✓
ISO 18000-6C Departure Message (**See Note *4***)					✓

Reader to LC Message	JANUS Compatible	JANUS MPR1 Compatible	JANUS MPR2 Compatible	JANUS MPR2.3 Compatible	JANUS MPR2.4 Compatible
SeGo Handshake Message			✓	✓	✓
SeGo Initial Read Message			✓	✓	✓
SeGo Transponder Message			✓	✓	✓
SeGo Post Capture Message			✓	✓	✓
SeGo Estimated Vehicle Speed Message				✓	✓
SeGo Departure Message					✓
Title21 Handshake Message (**See Note *6***)					✓
Title21 Initial Read Message (**See Note *6***)					✓
Title21 Transponder Message (**See Note *6***)					✓
Title21 Post Capture Message (**See Note *6***)					✓
Title21 Estimated Vehicle Speed Message (**See Note *6***)					✓
Title21 Departure Message (**See Note *6***)					✓
Title21 Transponder Write-Control Response Message (**See Notes *5*, *6***)					✓

Notes:

***(1)* -** The complete estimated vehicle speed functionality is currently not fully implemented for the TDM, and ISO 18000-6B protocols. Estimated Vehicle Speed Reports are not available for the TDM protocol. For the ISO 18000-6B protocol, the JANUS MPR4.1 Reader only supports Estimated Vehicle Speed Reports for the '*Standard (UID only)' Read Mode*.

***(2)* -** The complete estimated vehicle speed functionality is currently not fully implemented for the TDM and ISO 18000-6B protocols. The *Speed Information* section of this message shall be correspondingly populated with all 0's (zeroes) for TDM reports. For the ISO 18000-6B protocol, the *Speed Information* section of this message shall only be populated with non-zero values if the Reader is configured to use the ISO 18000-6B *'Standard (UID only)' Read Mode*.

***(3)* -** The JANUS MPR4.1 Reader S/W has the capability of being able to report ISO 18000-6C EPC/UII memory area CRC/PC bits (bits 0x00-0x1F) as an optional trailing Extended-Information field for ISO 18000-6C Multi-Protocol Handshake Messages (see §9.2 for details).

***(4)* –** The JANUS MPR4.1 Reader S/W has the capability of being able to report ISO 18000-6C EPC/UII memory area CRC/PC bits (bits 0x00-0x1F) as an optional trailing Extended-Information field for ISO 18000-6C Multi-Protocol Transaction (Initial Read, Voting, Post Capture, Estimated Vehicle Speed and Departure) Report Messages (see §9.2 for details).

***(5)*-** Applicable only when the Title21 protocol is configured and the *Title21 Enable Acknowledge Message* parameter is enabled.

***(6)* –** At the time of publication of this document, while Title21 messages are defined, they are not fully implemented in the MPR2.4 Reader.

2.4 Supported Messages by Protocol

The JANUS MPR4.1 Reader can support various transponder protocols. This section, and the subsections that follow, provide a cross reference of availability and/or support for the messages defined herein, with respect to JANUS MPR4.1 Reader supported transponder protocols.

2.4.1 Supported Messages by Protocol – Basic Message Set

Table 2.4-1 shows the support/availability of messages by protocol for the JANUS MPR4.1 *Basic Message Set*. Messages identified with a checkmark (✓) are available/supported for the specified protocol(s).

Table 2.4-1: Supported Messages by Protocol – Basic Message Set

	Protocol					
Message	**TDM**	**Title21**	**ISO 18000-6B**	**ISO 18000-6C**	**ATA**	**SeGo**
Configuration Message	✓	✓	✓	✓	✓	✓
Configuration Request Message	✓	✓	✓	✓	✓	✓
TDM Initial Read Message (**See Note *1***)	✓					
TDM Initial Read (Format A – TRBA) Message (**See Note *1***)	✓					
Initialization Message	✓	✓	✓	✓	✓	✓
Lane Active Message	✓	✓	✓	✓	✓	✓
Lane Guard Message	✓	✓	✓	✓	✓	✓
Lane Off-Line Message	✓	✓	✓	✓	✓	✓
TDM Post Capture Message (**See Note *1***)	✓					
TDM Post Capture (Format A – TRBA) Message (**See Note *1***)	✓					
Reboot Request Message	✓	✓	✓	✓	✓	✓
Re-Report Request Message	✓					
[Precision] Read Time Message	✓	✓	✓	✓	✓	✓
Status Message	✓	✓	✓	✓	✓	✓
Set Configuration Message	✓	✓	✓	✓	✓	✓
Vehicle Speed Message	✓	✓	✓	✓	✓	✓
Status Request Message	✓	✓	✓	✓	✓	✓
Set Time Message	✓	✓	✓	✓	✓	✓

Message	Protocol					
	TDM	Title21	ISO 18000-6B	ISO 18000-6C	ATA	SeGo
Reader Heartbeat (Sync) Message	✓	✓	✓	✓	✓	✓
TDM Transponder Message (**See Note *1***)	✓					
TDM Transponder (Format A – TRBA) Message (**See Note *1***)	✓					
[Precision] Time Message	✓	✓	✓	✓	✓	✓
Transaction Number Reset Message	✓	✓	✓	✓	✓	✓
Voting Time Message	✓	✓	✓	✓	✓	✓

Notes:

(1) **-** The TDM protocol Initial Read, Transponder, and Post Capture messages that are part of the Basic Message set are legacy messages that are specific to the TDM protocol only. For information on Initial Read, Transponder and Post Capture messages for the other protocols supported by the JANUS MPR4.1 Reader, please refer to §9.

2.4.2 Supported Messages by Protocol – Ethernet Interface Message Set

The support/availability of messages by protocol for the JANUS MPR4.1 *Ethernet Interface Message Set* is shown in Table 2.4-2. Messages identified with a checkmark (✓) are available/supported for the specified protocol(s).

Table 2.4-2: Supported Messages by Protocol – Ethernet Interface Message Set

Message	Protocol					
	TDM	Title21	ISO 18000-6B	ISO 18000-6C	ATA	SeGo
(TCPLL) Acknowledge Transmission Message (**See Note *1***)	✓	✓	✓	✓	✓	✓
Sync Message	✓	✓	✓	✓	✓	✓

Notes:

(1) **-** The Acknowledge Transmission Message is only applicable when the JANUS MPR4.1 Reader is configured to communicate to the LC over the MPR4.1 Reader – Lane Controller Ethernet Interface using *TCP Long-Lived* (TCPLL) connections (see §2.11 and §3.4.5 for details).

2.4.3 Supported Messages by Protocol – Reader Configuration and Software Management / Update Message Set

The support/availability of messages by protocol for the JANUS MPR4.1 *Reader Configuration and Software Management / Update Message Set* is shown in Table 2.4-3. Messages identified with a checkmark (✓) are available/supported for the specified protocol(s).

Table 2.4-3: Supported Messages by Protocol – Reader Configuration and Software Management / Update Message Set

	Protocol					
Message	**TDM**	**Title21**	**ISO 18000-6B**	**ISO 18000-6C**	**ATA**	**SeGo**
Configuration – Get/Set Error Message	✓	✓	✓	✓	✓	✓
Configuration – Get Parameter Message	✓	✓	✓	✓	✓	✓
Configuration – Set Parameter Message	✓	✓	✓	✓	✓	✓
Configuration – Parameter Value Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Activate Update Message	✓	✓	✓	✓	✓	✓
Software Update / Management – (Bulk) Configuration File Info Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Update (Bulk) Configuration Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Delete Update Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Get Free Space Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Generate (Bulk) Configuration File Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Get Update Identifier Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Filesystem Space Available Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Available Update Count Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Query Update Count Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Update Identifier-Reference Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Status Message	✓	✓	✓	✓	✓	✓
Software Update / Management – Verify Update Message	✓	✓	✓	✓	✓	✓

2.4.4 Supported Messages by Protocol – Multi-Protocol Message Set

Table 2.4-5 shows an overview list of supported/available message categories by protocol for the JANUS MPR4.1 *Multi-Protocol Message Set*. Messages identified with a checkmark (✓) are available/supported for the specified protocol(s). Messages identified with a cross (✗) are applicable to the specified protocol(s) but are not currently supported. For those messages marked with a "**BM**", the identified function is not part of the *Multi-Protocol Message Set*, *per se*, but are supported as part of the *Basic Message Set* (*c.f. §6*).

For a list of the specific Multi-Protocol messages, identified by protocol, that comprise the Multi-Protocol Message Set, please refer to Table 2.4-5. Further details on the specific messages themselves can be found in the definitions section for each identified message.

Table 2.4-4: Supported Message Categories by Protocol – Multi-Protocol Message Set

Message Category	TDM	Title21	ISO 18000-6B	ISO 18000-6C	ATA	SeGo
Handshake Message	✓	✓ (**See Note *6***)	✓	✓ (**See Note *3***)	✓	✓
Initial Read Message	✓ **BM**	✓ (**See Note *6***)	✓	✓ (**See Note *4***)	✓	✓
Transponder Message	✓ **BM**	✓ (**See Note *6***)	✓	✓ (**See Note *4***)	✓	✓
Post Capture Message	✓ **BM**	✓ (**See Note *6***)	✓	✓ (**See Note *4***)	✓	✓
Estimated Vehicle Speed Message	✗ (**See Note *1***)	✓ (**See Note *6***)	✓ (**See Note *1***)	✓ (**See Note *4***)	✓	✓
Departure Message	✗ (**See Note *2***)	✓ (**See Note *6***)	✓ (**See Note *2***)	✓ (**See Note *4***)	✓	✓
Write Control Response Message		✓ (**See Notes *5*, *6***)				

Notes:

***(1)* -** The complete estimated vehicle speed functionality is currently not fully implemented for the TDM, and ISO 18000-6B protocols. Estimated Vehicle Speed Reports are not available for the TDM protocol. For the ISO 18000-6B protocol, the JANUS MPR4.1 Reader only supports Estimated Vehicle Speed Reports for the '*Standard (UID only)' Read Mode*.

(2) - The complete estimated vehicle speed functionality is currently not fully implemented for the TDM, and ISO 18000-6B protocols. The *Speed Information* section of this message shall be correspondingly populated with all 0's (zeroes) for TDM reports. For the ISO 18000-6B protocol, the *Speed Information* section of this message shall only be populated with non-zero values if the Reader is configured to use the ISO 18000-6B *'Standard (UID only)' Read Mode*.

(3) - The JANUS MPR4.1 Reader S/W has the capability of being able to report ISO 18000-6C EPC/UII memory area CRC/PC bits (bits 0x00-0x1F) as an optional trailing Extended-Information field for ISO 18000-6C Multi-Protocol Handshake Messages (see §9.2 for details).

(4) – The JANUS MPR4.1 Reader S/W has the capability of being able to report ISO 18000-6C EPC/UII memory area CRC/PC bits (bits 0x00-0x1F) as an optional trailing Extended-Information field for ISO 18000-6C Multi-Protocol Transaction (Initial Read, Voting, Post Capture, Estimated Vehicle Speed and Departure) Report Messages (see §9.2 for details).

(5)- Applicable only when the Title21 protocol is configured and the *Title21 Enable Acknowledge Message* parameter is enabled.

(6) – At the time of publication of this document, while Title21 messages are defined, they are not fully implemented in the MPR2.4 Reader.

Table 2.4-5: Supported Messages by Protocol – Multi-Protocol Message Set

	Protocol					
Message	**TDM**	**Title21**	**ISO 18000-6B**	**ISO 18000-6C**	**ATA**	**SeGo**
ATA Handshake Message (8-Bit ASCII Alphanumeric Data)					✓	
ATA Initial Read Message (8-Bit ASCII Alphanumeric Data)					✓	
ATA Transponder Message (8-Bit ASCII Alphanumeric Data)					✓	
ATA Post Capture Message (8-Bit ASCII Alphanumeric Data)					✓	
ATA Estimated Vehicle Speed Message (8-Bit ASCII Alphanumeric Data)					✓	
ATA Departure Message (8-Bit ASCII Alphanumeric Data)					✓	
TDM Handshake Message	✓					
TDM Estimated Vehicle Speed Message	✗ (**See Note *1***)					
TDM Departure Message	✗ (**See Note *2***)					
TDM Handshake (Format A – TRBA) Message	✓					

Message	Protocol					
	TDM	Title21	ISO 18000-6B	ISO 18000-6C	ATA	SeGo
TDM Estimated Vehicle Speed (Format A – TRBA) Message	× (**See Note *1***)					
TDM Departure (Format A – TRBA) Message	× (**See Note *2***)					
ISO 18000-6B Handshake Message			✓			
ISO 18000-6B Initial Read Message			✓			
ISO 18000-6B Transponder Message			✓			
ISO 18000-6B Post Capture Message			✓			
ISO 18000-6B Estimated Vehicle Speed Message			✓ (**See Note *1***)			
ISO 18000-6B Departure Message			✓ (**See Note *2***)			
ISO 18000-6B eATA Handshake Message (8-Bit ASCII Alphanumeric Data)			✓			
ISO 18000-6B eATA Initial Read Message (8-Bit ASCII Alphanumeric Data)			✓			
ISO 18000-6B eATA Transponder Message (8-Bit ASCII Alphanumeric Data)			✓			
ISO 18000-6B eATA Post Capture Message (8-Bit ASCII Alphanumeric Data)			✓			
ISO 18000-6B eATA Estimated Vehicle Speed Message (8-Bit ASCII Alphanumeric Data)			× (**See Note *1***)			
ISO 18000-6B eATA Departure Message (8-Bit ASCII Alphanumeric Data)			× (**See Note *2***)			
ISO 18000-6B Combined UID+eATA Handshake Message			✓			
ISO 18000-6B Combined UID+eATA Initial Read Message			✓			

Message	Protocol					
	TDM	Title21	ISO 18000-6B	ISO 18000-6C	ATA	SeGo
ISO 18000-6B Combined UID+eATA Transponder Message			✓			
ISO 18000-6B Combined UID+eATA Post Capture Message			✓			
ISO 18000-6B Combined UID+eATA Estimated Vehicle Speed Message			✓ (**See Note *1***)			
ISO 18000-6B Combined UID+eATA Departure Message			✓ (**See Note *2***)			
ISO 18000-6C Handshake Message				✓ (**See Note *3***)		
ISO 18000-6C Initial Read Message				✓ (**See Note *4***)		
ISO 18000-6C Transponder Message				✓ (**See Note *4***)		
ISO 18000-6C Post Capture Message				✓ (**See Note *4***)		
ISO 18000-6C Estimated Vehicle Speed Message				✓ (**See Note *4***)		
ISO 18000-6C Departure Message				✓ (**See Note *4***)		
SeGo Handshake Message						✓
SeGo Initial Read Message						✓
SeGo Transponder Message						✓
SeGo Post Capture Message						✓
SeGo Estimated Vehicle Speed Message						✓
SeGo Departure Message						✓

	Protocol					
Message	**TDM**	**Title21**	**ISO 18000-6B**	**ISO 18000-6C**	**ATA**	**SeGo**
Title21 Handshake Message		✓ (**See Note *6***)				
Title21 Initial Read Message		✓ (**See Note *6***)				
Title21 Transponder Message		✓ (**See Note *6***)				
Title21 Post Capture Message		✓ (**See Note *6***)				
Title21 Estimated Vehicle Speed Message		✓ (**See Note *6***)				
Title21 Departure Message		✓ (**See Note *6***)				
Title21 Write Control Response Message		✓ (**See Notes *5*, *6***)				

Notes:

(1) **-** The complete estimated vehicle speed functionality is currently not fully implemented for the TDM, and ISO 18000-6B protocols. Estimated Vehicle Speed Reports are not available for the TDM protocol. For the ISO 18000-6B protocol, the JANUS MPR4.1 Reader only supports Estimated Vehicle Speed Reports for the '*Standard (UID only)' Read Mode*.

(2) **-** The complete estimated vehicle speed functionality is currently not fully implemented for the TDM, and ISO 18000-6B protocols. The *Speed Information* section of this message shall be correspondingly populated with all 0's (zeroes) for TDM reports. For the ISO 18000-6B protocol, the *Speed Information* section of this message shall only be populated with non-zero values if the Reader is configured to use the ISO 18000-6B *'Standard (UID only)' Read Mode*.

(3) **-** The JANUS MPR4.1 Reader S/W has the capability of being able to report ISO 18000-6C EPC/UII memory area CRC/PC bits (bits 0x00-0x1F) as an optional trailing Extended-Information field for ISO 18000-6C Multi-Protocol Handshake Messages (see §9.2 for details).

(4) – The JANUS MPR4.1 Reader S/W has the capability of being able to report ISO 18000-6C EPC/UII memory area CRC/PC bits (bits 0x00-0x1F) as an optional trailing Extended-Information field for ISO

18000-6C Multi-Protocol Transaction (Initial Read, Voting, Post Capture, Estimated Vehicle Speed and Departure) Report Messages (see §9.2 for details).

(5)- Applicable only when the Title21 protocol is configured and the *Title21 Enable Acknowledge Message* parameter is enabled.

(6) – At the time of publication of this document, while Title21 messages are defined, they are not fully implemented in the MPR2.4 Reader.

2.4.5 Supported Messages by Protocol – Transponder Write-Control Message Set

The support/availability of messages by protocol for the JANUS MPR4.1 *Transponder Write Control Message Set* is shown in Table 2.4-6. Messages identified with a checkmark (✓) are available/supported for the specified protocol(s).

Table 2.4-6: Supported Messages by Protocol – Transponder Write-Control Message Set

	Protocol					
Message	**TDM**	**Title21**	**ISO 18000-6B**	**ISO 18000-6C**	**ATA**	**SeGo**
Transponder Write Control (Title21 Transponder Read w/Acknowledge Request) Message (**See Notes *1*, *2***)		✓				

Notes:

(1) - Applicable only when the Title21 protocol is configured and *Title21 Enable Acknowledge Message* parameter is enabled.

(2) – At the time of publication of this document, while Title21 messages are defined, they are not fully implemented in the MPR2.4 Reader.

2.5 Transaction Report Codes

Whenever a transponder is reported to the Lane Controller, a transaction status code is provided with the result of the Reader's programming and/or read attempt (*c.f.* §6.2.19) for additional information). For diagnostic purposes, an equivalent JANUS transaction log entry is made. Table 2.5-1 lists the defined *Transaction Report Codes* for the JANUS MPR4.1 Reader.

Table 2.5-1: Transaction Report Codes

Condition	JANUS Log Indication	Transponder Message Type / Transaction Status Codes	
		Real-Time	Buffered
Program Successful: Indicates the transponder was programmed successfully. *(This is the usual report type, unless the reader is configured in read-only mode)*	"Pgm"	RS	BS
Program Fail: Indicates the transponder was not programmed successfully.	"PF"	RF	BF
Program Unverified: Indicates the transponder programming could not be verified. The transponder's scratchpad memory may or may not be updated.	"PU"	RU	BU
Memory Locked (ISO 18000-6C Only): Indicates the specified memory (UM) location is locked and/or permalocked and is either not writeable or not readable.	"Locked"	RL	BL
Memory Overrun (ISO 18000-6C Only): Indicates the specified memory (UM) does not exist or the EPC/PC length field is not supported by the tag.	"OvrRun"	RO	BO
Initial Read of OBU in Capture Zone: Optional informational report. Arrival of new tag in capture zone.	"IREAD"	RR (See Note *1*)	BR (See Note *1*)
Transponder Voting Report: Indicates that voting has completed for a given tag, and that tag has been assigned to a particular channel.	"VOTE"	R<x> (See Note *2*)	B<x> (See Note *2*)
Post Capture (new data): Optional informational report, if revised lane assignment or programming status is available.	"POST"	R<x> (See Note *3*)	B<x> (See Note *3*)
Estimated Vehicle Speed: Optional informational report. Indicates the estimated vehicle speed for a given tag.	"SPEED"	R (See Note *4*)	B (See Note *4*)

		Transponder Message Type / Transaction Status Codes	
Condition	**JANUS Log Indication**	**Real-Time**	**Buffered**
Departure Report: Optional informational report. An 'extended' form of voting report that also includes estimated vehicle speed information.	**"DEPART"**	**R<x>** **(See Note *5*)**	**B<x>** **(See Note *5*)**
Decommissioned Tag: Tag read but is not commissioned. Reader does not attempt to program a decommissioned tag.	**"Decom"**	**RD**	**BD**
Non IAG/TDM Tag: Tag read but, not IAG/TDM-compatible. Reader does not attempt to program a non-IAG/TDM tag.	**"NonIAG"**	**RX**	**BX**
Read Successful: Normal report when the reader is configured in "read-only" mode.	**"Read"**	**RR**	**BR**
Cross Reader Transaction: Optional informational report. Tag was reported and assigned by an **adjacent** Reader. This reporting allows the transaction number to be accounted for, if desired, for the purpose of reconciling transaction numbers assigned by the Reader. In some cases, the Reader will assign a transaction number to a cross-reader transaction. By default, this report is disabled (*c.f.* §6.2.19) for more details)	**"CrossR"**	**RC**	**BC**

Notes:

(1) **-** Initial Reads are reported via messages with a prefix of **'IA'**, and are generally Real-Time Read messages. Multi-Protocol Initial Reads are reported via messages with a prefix of **'MA'** and have a format code ending in **0x1** (hexadecimal). Initial Read messages are, by default, not buffered. *Note: Buffered Initial Read messages will only be sent to the Lane Controller if* 'Initial Read Report Message Buffering' *is ENABLED.*

(2) **–** Transponder Voting Report status codes are of the form **'R<x>'** or **'B<x>'** where **<x>** is one of the available Transaction Status codes (*i.e.* **S**, **F**, **U**, **R**, **D**, **X**, **C**). Voting Reports are reported via messages with a prefix of **'TA'**. For Multi-Protocol messages, Post Captures are reported with a prefix of **'MA'** with a format code ending in **0x2** (hexadecimal). Voting Report messages are buffered.

(3) **-** Post Capture status codes are of the form **'R<x>'** or **'B<x>'** where **<x>** is one of the available Transaction Status codes (*i.e.* **S**, **F**, **U**, **R**, **D**, **X**, **C**). Post Captures are reported via messages with a prefix of **'PA'**. For Multi-Protocol messages, Post Captures are reported with a prefix of **'MA'** with a format code ending in **0x3** (hexadecimal). Post Capture messages are buffered, since the volume of these messages is expected to be low, and also since they provide valuable information.

(4) **–** Estimated Vehicle Speed status codes are of the form **'R'** or **'B'**. Estimated Vehicle Speed messages do not contain transaction status information. Estimated Vehicle Speed Messages are reported with a prefix of **'MA'** with a format code ending in **0x6** (hexadecimal). Estimated Vehicle Speed messages are buffered.

(5) **–** Departure Report status codes are of the form **'R<x>'** or **'B<x>'** where **<x>** is one of the available Transaction Status codes (*i.e.* **S**, **F**, **U**, **R**, **D**, **X**, **C**). Departure Reports are reported via messages with a prefix of **'MA'** with a format code ending in **0x7** (hexadecimal). Departure Report messages are, by default, not buffered. *Note: Buffered Departure Report messages will only be sent to the Lane Controller if 'Departure Report Message Buffering' is ENABLED.*

2.6 Application Message Encapsulation

2.6.1 JANUS MPR4.1 Reader – Lane Controller Ethernet Interface

Messages that are exchanged between the JANUS MPR4.1 Reader and the Lane Controller over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface (including Handshake Messages sent over UDP) are encapsulated according to the Data Transport Format specified in §3.

The application messages specified herein form the "*Application Message Payload*" field of the Data Transport Application-Layer Message Format specified in §3.2.

For JANUS MPR4.1 Readers that are configured to utilize *TCP Long-Lived Connections* with the Lane Controller, the application messages specified herein form the "*Application Message Payload*" field of the TCPLL Application-Layer Message/Packet Format specified in §3.3.

Furthermore, overall message length and error protection are handled at the Data Transport level, as specified in §3.

2.7 Multiplexed Reporting Mode

2.7.1 JANUS MPR4.1 Reader – Lane Controller Ethernet Interface

Multiplexing mode is accomplished via a table that maps the Reader channel to the destination IP address / port of the Lane Controller. The Reader is considered to be in "Multiplexed Reporting Mode" *whenever an LC Ethernet destination is activated.* Ethernet destinations are activated by appropriate selection of the Reader's Lane Controller "*Destination*" configuration parameter (*c.f.* [AD2]). "Multiplexed Reporting Mode" basically populates the RF Channel Number (1-4) in certain messages (see message descriptions).

By default, the JANUS MPR4.1 Reader operates in "*Multiplexed Reporting Mode*".

Special Notes for Multiplexed Reporting Mode – Ethernet Interface:

(1) All messages sent by the JANUS MPR4.1 Reader to the Lane Controller over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface shall have the "RF Channel" field populated (*i.e.* it shall contain a number).

(2) When using the *Reader Configuration – Get / Set Message* (*c.f.* §8.1) message sub-set over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface, the RF Channel Number field ***must be populated***. *If the RF Channel Field is missing or incorrectly populated, the* Configuration - Get / Set *request shall be ignored.* In addition, all *Reader Configuration – Get / Set* messages sent by the JANUS MPR4.1 Reader to the Lane Controller over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface shall have the "RF Channel" field populated (*i.e.* it shall contain a number).

2.8 Buffering of Transponder Messages

The JANUS MPR4.1 Reader buffers tag transaction messages when the communications link to the Lane Controller is impaired. These buffered tag transaction messages are non-volatile across a Reader reset or power cycle event. If the buffer memory becomes full, new transactions will overwrite the oldest buffered transactions.

The memory available for tag transaction buffering is dynamically distributed between the JANUS MPR4.1 Reader – Lane Controller Ethernet interfaces. There is no fixed allocation for each reporting link. If only one (1) link is down, the entire memory buffer can be accessed for transactions on that link; if two links are down, both links share the entire transaction buffer space.

2.8.1 JANUS MPR4.1 Reader – Lane Controller Ethernet Interface

When communicating to the Lane Controller over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface, the Reader starts buffering transaction reports if it detects a communications problem on a link. On the Ethernet link, a communication problem may occur due to the following error scenarios:

- Ethernet cable disconnect
- TCP/IP connection request failure and/or timeout
- TCP/IP message transmission failure and/or timeout

Furthermore, when the JANUS MPR4.1 Reader is configured to utilize *TCP Long-Lived Connections* with the Lane Controller, the Reader will drop the connection with the Lane Controller and commence buffering due to the following error scenarios:

- Failure to receive an *Acknowledge Transmission* message from the Lane Controller (after having attempted to transmit an application message to the Lane Controller), within the Lane Controller Ethernet TCP socket timeout period.
- TCP Socket Keepalive (Socket Option) timeout
- TCP User Timeout (Socket Option) expiry

Note that the Lane Controller Ethernet TCP socket timeout is configurable on the JANUS MPR4.1 Reader.

2.8.1.1 Buffering and Dual-Destination Reporting

The JANUS MPR4.1 Reader supports two (2) message buffering/reporting modes when *Dual-Destination* reporting is *ENABLED*:

- '*Standard (Legacy)*' Mode, and;
- '*Fully Independent*' Mode

A description of the how the JANUS MPR4.1 Reader performs *Dual-Destination* buffering, based on the setting of the '*Dual-Destination Buffering Mode*' setting is given in the subsections that follow. For a description of how the

JANUS MPR4.1 Reader performs reporting of buffered transactions when *Dual-Destination* reporting is *ENABLED,* please refer to §2.9.1.

2.8.1.1.1 'Standard (Legacy)' Dual-Destination Buffering Mode

This mode of buffering operation is backwards compatible with the original JANUS MPR2/MPR2.3 implementation of *Dual-Destination* reporting, buffering, and draining. If *Dual-Destination* reporting is *ENABLED* for the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface, and the *Dual-Destination Buffering Mode* is set to '*Standard (Legacy)*' then transaction buffering ***shall only occur*** if a communication problem is detected on ***both*** the Main- and the Dual-Destination-Links for a given channel (*i.e. both links must have a fault condition for message buffering to occur*).

2.8.1.1.2 'Fully Independent' Dual-Destination Buffering Mode

The JANUS MPR4.1 Reader allows for the capability of fully independent LC message buffering between Main- and Dual-Ethernet Destinations while the Reader is configured for *Dual-Destination* reporting. If *Dual-Destination* reporting is *ENABLED* for the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface, and the *Dual-Destination Buffering Mode* is set to '*Fully Independent*', then transaction buffering shall commence ***independently*** on ***either*** the Main- ***or*** the Dual-Destination-Link if ***either*** connection to the LC is interrupted, ***or both*** in the event that both Main- and Dual-Destination-Links have failed.

Note that the '*Fully Independent*' mode of operation is automatically selected when entering *Dual-Destination* reporting mode for the first time, but can be configured by the user as required.

2.9 Reporting of Buffered Transactions

Buffered transactions are reported on a *First-in, First-out* (FIFO) basis.

When an Ethernet link between the Lane Controller and the Reader is re-established (when communicating over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface), the Reader begins transmitting its buffered transactions. This operation is also known as *Transaction Buffer Draining*. Any new transaction that occurs on a given lane while the Reader is uploading buffered transactions will immediately be reported to the Lane Controller as a real time transaction. Reporting of buffered transactions will resume after transmission of the new transaction.

Buffered transactions are tagged with a "**B**" in the *Type* field of the *Transponder Message*; Real-time transactions are tagged with an "**R**" in the *Type* field of the *Transponder Message.*

Messages from the Lane Controller shall continue to be acknowledged and acted upon during the buffered transaction upload process (*e.g. Set Time*, *Status Request*).

2.9.1 Reporting of Buffered Transactions and Dual-Destination Reporting

The JANUS MPR4.1 Reader supports two (2) message buffering/reporting modes when *Dual-Destination* reporting is *ENABLED*:

- '*Standard (Legacy)*' Mode, and;
- '*Fully Independent*' Mode

A description of the how the JANUS MPR4.1 Reader performs reporting of buffered transactions to the Lane Controller while *Dual-Destination* reporting is *ENABLED*, based on the setting of the '*Dual-Destination Buffering Mode*' setting, is given in the subsections that follow. For a description of how the JANUS MPR4.1 Reader performs buffering of transactions when *Dual-Destination* reporting is *ENABLED,* please refer to §2.8.1.1.

2.9.1.1 Reporting of Buffered Transactions in 'Standard (Legacy)' Dual-Destination Buffering Mode

This mode of buffering operation is backwards compatible with the original JANUS MPR2/MPR2.3 implementation of *Dual-Destination* reporting, buffering, and draining. If *Dual-Destination* reporting is *ENABLED* for the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface, and the *Dual-Destination Buffering Mode* is set to '*Standard (Legacy)*', then reporting/draining of buffered transactions will only occur if the communications has been re-established on ***both*** the Main- and the Dual-Destination-Links for a given channel (*i.e. both links must be clear of fault conditions for reporting of buffered messages to occur*).

2.9.1.2 Reporting of Buffered Transactions in 'Fully Independent' Dual-Destination Buffering Mode

The JANUS MPR4.1 Reader introduces the capability of fully independent reporting of buffered LC messages between Main- and Dual-Ethernet-Destinations while the Reader is configured for *Dual-Destination* reporting. If *Dual-Destination* reporting is *ENABLED* for the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface, and the *Dual-Destination Buffering Mode* is set to '*Fully Independent*', then the reporting/draining of buffered transactions shall commence ***independently*** for the given link – ***either*** the Main- ***or*** the Dual-Destination-Link when it's connection is restored (***or both*** in the event that both Links are restored simultaneously).

Note that the '*Fully Independent*' mode of operation is automatically selected when entering *Dual-Destination* reporting mode for the first time, but can be configured by the user as required.

2.10 JANUS MPR4.1 Reader – Lane Controller Ethernet Interface – TCP/IP Setup

While TCP/IP sockets are bidirectional in nature, TCP/IP communications follow a client/server approach and thus both the Reader and the Lane Controller must have client and server abilities when communicating over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface. By using two sockets for both the Reader and the Lane Controller, neither side has to wait passively for the other end to initiate the connection. When either side is ready to send data to the other, they can establish a connection (client-side) on an established listening port (server-side) and then send their data. Each of the server-side sockets for the Reader and the Lane Controller will then process any data that was sent. A simplified diagram of this arrangement is shown in Figure 2.10-1:

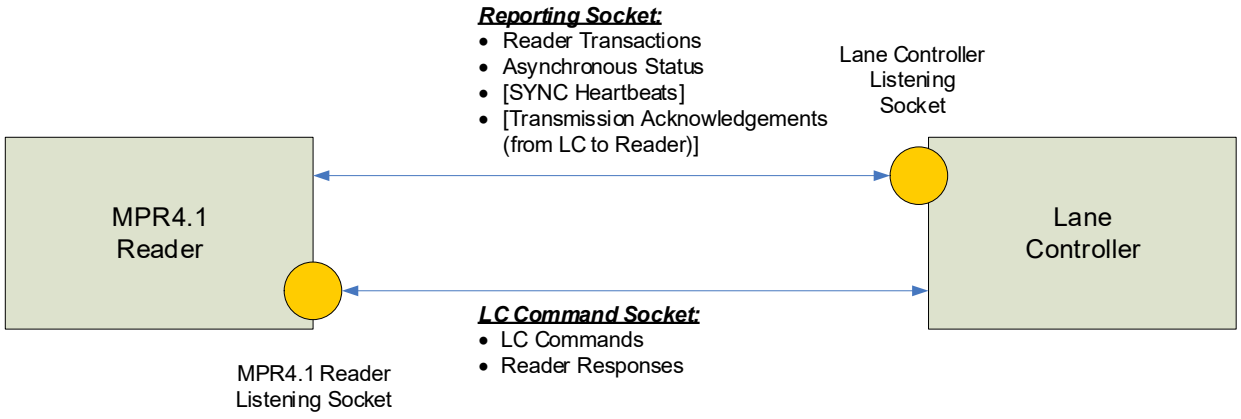

Figure 2.10-1: JANUS MPR4.1 Reader / Lane Controller Sockets

The JANUS MPR4.1 Reader listening socket is configurable via the web interface. The default value for the listening port number shall be 6666.

The Reader will have a channel to IP address/port mapping table that will determine which IP address and port will be associated with a particular Lane Controller. This will allow any number of channels to be each mapped to unique Lane Controller destinations, to be mapped in multiplexed fashion to a common destination, or to be mapped to a combination thereof. For example, the table may look something like that as shown in Table 2.10-1:

Table 2.10-1: Example Reader IP-Address/Port Mapping Table

Channel	Host	Port
1	192.168.60.10	6030
2	192.168.60.30	6000
3	192.168.60.30	6000
4	192.168.60.40	3125

2.10.1 JANUS MPR4.1 Reader / Lane Controller Socket Connections

This section describes the mechanisms used by both the JANUS MPR4.1 Reader and the Lane Controller to send messages to and receive messages from one another. As shown in Figure 2.10-1, both the JANUS MPR4.1 Reader and the Lane Controller utilize:

- Server-side listening sockets to await incoming connection requests from the peer.
- Client-side originator sockets to connect to the peer and send a message to it (and await a reply, if required)

2.10.1.1 Iterative, Connection-Oriented Server (Receiver) Algorithm

The JANUS MPR4.1 Reader or the Lane Controller processes incoming connection/messaging requests in the same way. An iterative, connection-oriented server algorithm [RD5] is used, as follows:

(1) Create a socket and bind to the well-known address for the service being offered.

(2) Place the socket in passive mode, making it ready for use by a server.

(3) Accept the next connection request (from the peer client) from the socket, and obtain a new socket for the connection.

(4) Read the request message from the client, and if required, send a reply message back to the client according to the Application Message protocol.

(5) Close the connection and return to step (3) to accept a new connection.

2.10.1.2 Connection-Oriented Client (Originator) Algorithm

When either the JANUS MPR4.1 Reader or the Lane Controller needs to originate and send a message to the peer device, a connection-oriented client algorithm [RD5] is used as follows:

(1) Find the IP address and protocol port number of the peer server with which communication is desired.

(2) Allocate a Socket

(3) Specify that the connection needs an arbitrary, unused protocol port on the local machine, and allow TCP to choose one.

(4) Connect the socket to the server.

(5) Communicate to the server using the Application Message protocol (send request and await reply, if required)

(6) Close the connection.

2.11 JANUS MPR4.1 Reader – Lane Controller Ethernet Interface – TCP Long-Lived Connections

Like the JANUS MPR2.4 Reader, the JANUS MPR4.1 allows for a new paradigm for socket connections between the Reader and the Lane Controller for JANUS Readers. This new paradigm is called a *TCP Long-Lived* (TCPLL) Connection.

Unlike the Standard (Legacy) mode of communicating with the Lane Controller, for *TCP Long-Lived* (TCPLL) Connections, there are no socket disconnects upon completion of the transmission of messages. For normal operation of TCPLL-Connections , once the client side opens a socket to the peer server side and socket communications link is established, the socket link stays up for the duration of operation. A new connection does not need to be established when sending a new message to the peer, and no longer is it required to tear that connection down after the message has been sent. This results in a reduction in overhead traffic on the Reader-to-Lane Controller Ethernet Link.

For the Socket Connections between the Reader and the Lane Controller, the existing paradigm of using two bidirectional sockets is still in effect. One bi-directional socket is used by the Reader for Asynchronous Transaction and/or Status reporting from the Reader to the Lane Controller. The other socket is for use by the Lane Controller as a Command Socket to enable the Lane Controller to send commands to, and receive applicable responses from the Reader. The paradigm of utilizing a single bidirectional port connection that can be used for *all* communications between the Reader and the Lane Controller will be considered in a subsequent development iteration.

As shown in Figure 2.10-1, both the Reader and the Lane Controller must have client and server abilities when communicating over the LC Ethernet Interface when using TCPLL Connections.

The Reader will attempt to establish a connection to the LC via the LC Listening Socket. Once the Reader-to-LC connection is established, the Reader will use this connection to issue Transaction Reports (Initial Read, Vote, Post Capture, Estimated Vehicle Speed, Departure) and Asynchronous Status Reports to the LC. For TCPLL Connections, the use of SYNC Heartbeat messages on this socket connection are optional with a configurable transmission frequency.

If it is necessary for the LC to be able to issue control commands to the Reader, then the LC shall establish a connection to the Reader via the Reader Listening Socket. Once the LC-to-Reader connection is established, the LC can use this connection to issue control commands to and receive applicable responses from the Reader.

2.11.1 MPR4.1 Reader / Lane Controller TCP Long Lived Socket Connections

This section describes the mechanisms used by both the JANUS MPR4.1 Reader and the LC to send messages to and receive messages from one another. As shown in Figure 2.10-1, both the JANUS MPR4.1 Reader and the LC utilize:

- Server-side listening sockets to await incoming connection requests from the peer.
- Client-side originator sockets to connect to the peer and send a message to it (and await a reply, if required)

2.11.1.1 TCPLL Iterative, Connection-Oriented Server (Receiver) Algorithm

The JANUS MPR4.1 Reader and the LC both process incoming connection/messaging requests in a like manner. An iterative, connection-oriented server algorithm is used, as follows:

(1) Create a socket and bind to the well-known address for the service being offered.

(2) Place the socket in passive mode, making it ready for use by a server.

(3) Accept the next connection request (from the peer client) from the socket, and obtain a new socket for the connection.

(4) Repeatedly read messages from the client, and if required, send a reply message back to the client according to the Application Message protocol.

Note that unlike the Standard (Legacy) mode, for TCPLL-Connections, there are no socket disconnects upon completion of the transmission of messages. For normal operation of TCPLL-Connections, once the socket communications link is established, the socket link stays up for the duration of operation.

2.11.1.2 TCPLL Connection-Oriented Client (Originator) Algorithm

When either the JANUS MPR4.1 Reader or the Lane Controller needs to originate and send a message to the peer device, a connection-oriented client algorithm is used as follows:

(1) Find the IP address and protocol port number of the peer server with which communication is desired.

(2) Allocate a Socket.

(3) Specify that the connection needs an arbitrary, unused protocol port on the local machine, and allow TCP to choose one.

(4) Connect the socket to the server.

(5) Repeatedly communicate to the server using the Application Message protocol (send request and await reply, if required).

Note that unlike the Standard (Legacy) mode, for TCPLL-Connections, there are no socket disconnects upon completion of the transmission of messages. For normal operation of TCPLL-Connections, once the socket communications link is established, the socket link stays up for the duration of operation.

2.12 JANUS MPR4.1 Reader – Lane Controller Ethernet Interface – Handshake Messaging UDP Setup

If the "*Raw Handshake Reporting*" option is enabled on the JANUS MPR4.1 Reader, Handshake Messages shall be reported to the Lane Controller. Due to the large volume of Handshake Messages that can be sent from the JANUS MPR4.1 Reader to the Lane Controller, ***the JANUS MPR4.1 Reader shall send all Handshake Messages to the Lane Controller using the* User Datagram Protocol *(UDP).***

UDP communications follow a client/server approach, and thus, ***the Lane Controller must have UDP server capabilities in order to receive JANUS MPR4.1 Reader Handshake Messages***. A simplified diagram of this arrangement is shown in Figure 2.12-1.

Figure 2.12-1: JANUS MPR4.1 Reader / Lane Controller Handshake Messaging (UDP) Sockets

The JANUS MPR4.1 Reader has a channel to IP address/port mapping table that determines which IP address and (TCP) port is associated with a particular Lane Controller (see §2.10 for details). JANUS MPR4.1 Reader Handshake Messages shall be sent to the Lane Controller on a UDP port with the same number as that currently specified on the Web Interface for (TCP-based) Lane Controller Ethernet messages. For example, if Channel 1 on the JANUS MPR4.1 Reader is configured to send Lane Controller Ethernet messages to a Lane Controller with IP Address 192.168.60.10 at (TCP) port 6030, then if "Handshake Reporting" is enabled, the JANUS MPR4.1 Reader shall send UDP Handshake Messages to *that same IP Address (192.168.60.10) on UDP Port 6030*.

2.12.1 JANUS MPR4.1 Reader / Lane Controller Handshake Messaging Socket Connections

This section describes the mechanisms used by both the JANUS MPR4.1 Reader and the Lane Controller to send Handshake Messages and receive Handshake Messages, respectively. As shown in Figure 2.12-1, the JANUS MPR4.1 Reader utilizes a Client-side originator socket to connect to the peer and send a Handshake Message to it, while the Lane Controller utilizes a UDP Server-side socket to await incoming Handshake Messages from the peer.

2.12.1.1 Iterative, Connectionless Server (Receiver) Algorithm

The Lane Controller should process incoming Handshake Messages by using an iterative, connectionless server algorithm [RD5], as follows:

(1) Create a socket and bind to the well-known address for the service being offered.

(2) Repeatedly read the next request from a client, and if required, formulate a response and send a reply back to the client according to the application protocol.

Note that the Lane Controller's server socket remains unconnected and can accept incoming UDP datagrams from any client.

2.12.1.2 Connectionless Client (Originator) Algorithm

When the JANUS MPR4.1 Reader originates Handshake Messages to the peer Lane Controller, a connectionless client algorithm [RD5] shall be used, as follows:

(1) Find the IP address and protocol port number of the peer server with which communication is desired.

(2) Allocate a Socket

(3) Specify that the connection needs an arbitrary, unused protocol port on the local machine, and allow UDP to choose one.

(4) Specify the server to which messages must be sent.

(5) Communicate to the server using the Application Message protocol (send request and await reply, if required).

3. JANUS MPR4.1 READER – LANE CONTROLLER ETHERNET INTERFACE – DATA TRANSPORT FORMAT / PROTOCOL

The TCP/IP protocol possesses its own data-link / transport-layer protocol for sequencing, error detection and acknowledgement of messages. Therefore, the messaging format for the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface is a fairly simple one.

This section describes the application-layer message format between the Reader and the Lane Controller, using the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface.

3.1 Overview

Each TCP/IP transport-layer packet sent by the Reader or Lane Controller must be acknowledged by the TCP/IP transport-layer of the receiving peer. If not acknowledged within a certain time, the sender is expected to resend the packet. The TCP/IP transport-layer protocol implicitly performs this packet acknowledgement function to provide a reliable stream-oriented connection between the Reader and the Lane Controller, and vice versa. The exception to this is when the Reader is configured to use *TCP Long Lived Connections*, in which case, explicit Acknowledge Transmission messages (*c.f.* §3.4.5) are required.

If a communications error is detected on the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface, the Reader starts buffering transactions and tries to re-establish the link to the Lane Controller.

3.2 Standard (Legacy) Application-Layer Message/Packet Format

The Standard (Legacy) application-layer message/packet format for the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface is illustrated in Figure 3.2-1. All JANUS MPR4.1 Reader application messages communicated between the JANUS MPR4.1 Reader and the Lane Controller (and vice versa) over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface shall be encapsulated as shown. Additional information on the specific fields within this application-layer message/packet can be found in the subsections that follow.

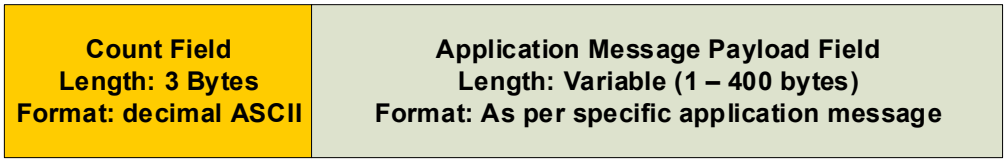

Figure 3.2-1: JANUS MPR4.1 Reader – Lane Controller Ethernet Interface – Standard (Legacy) Application-Layer Message/Packet Format

3.2.1 Count Field

The Count Field is a 3-byte field that specifies the size, in decimal ASCII, of the Application Message Payload that follows. The valid range of this field is “000” – “400”.

3.2.2 Application Message Payload Field

The Application Message Payload Field contains the application message to be sent from the Reader to the Lane Controller, or vice versa. This field shall contain a free-form message of no larger than 400 characters in length and shall be formatted according to the formatting rules for the specific application message to be transmitted.

3.3 TCP Long-Lived Connections Application-Layer Message/Packet Format

Because of the stream nature of TCP sockets, the application-layer message/packet format for the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface is changed slightly when TCP-Long-Lived connections are un use, as illustrated in Figure 3.3-1.

Note the addition of STX and ETX message start and end delimiters, respectively. All JANUS MPR4.1 Reader application messages communicated between the JANUS MPR4.1 Reader and the Lane Controller (and vice versa) over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface shall be encapsulated, as shown in Figure 3.3-1, when the *Ethernet Transmission Mode* is set to *TCP Long-Lived*. Additional information on the specific fields within this application-layer message/packet can be found in the subsections that follow.

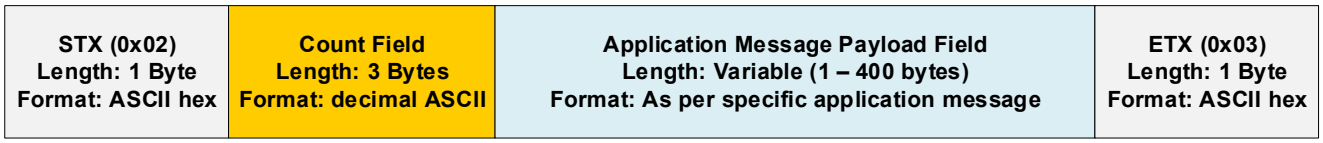

Figure 3.3-1: JANUS MPR4.1 Reader – Lane Controller Ethernet Interface – TCP Long-Lived Connections Application-Layer Message/Packet Format

3.3.1 STX Field

The STX field is a 1-byte field of fixed value (0x02 Hex) that delimits the start of the Application-Layer Message/Packet for TCP Long-Lived connection transmissions.

3.3.2 Count Field

The Count Field is a 3-byte field that specifies the size, in decimal ASCII, of the Application Message Payload that follows. The valid range of this field is “000” – “400”.

3.3.3 Application Message Payload Field

The Application Message Payload Field contains the application message to be sent from the Reader to the Lane Controller, or vice versa. This field will contain a free-form message of no larger than 400 characters in length and will be formatted according to the formatting rules for the specific application message to be transmitted.

3.3.4 ETX Field

The ETX field is a 1-byte field of fixed value (0x03 Hex) that delimits the end of the Application-Layer Message/Packet for TCP Long-Lived connection transmissions.

3.4 Communication Considerations and Startup

3.4.1 TCPLL Configurable Ethernet Heartbeat/Sync Messages

When operating in Standard (Legacy) Connection Mode, Ethernet Heartbeat (*i.e.* Sync 'SYcxx') messages were sent to the LC if there had been no message sent to the Lane Controller for at least one (1) second. It was expected that the Lane Controller echo, in its entirety, any *Sync Message* it received back to the JANUS MPR4.1 Reader within the configured LC *Ethernet TCP-Socket Timeout* period.

For TCP Long-Lived connections, the transmission of Heartbeats themselves, along with their transmission rate are now configurable. Heartbeats are enabled by default, with a transmission interval of one (1) second. Users of the LC Ethernet Interface can now choose to either enable, or disable the transmission of Ethernet Heartbeat messages when TCP Long-Lived connections are configured. If the User elects to leave Heartbeats enabled, the transmission interval is now configurable from between one (1) to thirty (30) seconds.

3.4.2 Reducing Message Latency – Turning Off the Nagle Algorithm

The Nagle algorithm aggregates a sequence of small messages together into larger TCP packets to reduce network congestion and utilize network resources more efficiently. The Nagle algorithm was designed to alleviate the network overhead caused by floods of many small TCP packets on a network. Because it incorporates a wait-state, the Nagle algorithm often causes average latency to increase slightly, especially on lightly loaded networks.

The JANUS MPR4.1 Reader disables the Nagle Algorithm on all socket connections it establishes with the Lane Controller. It is recommended that the Lane Controller do the same on all socket connections established with the JANUS Reader.

The **`TCP_NODELAY`** socket option remains the standard mechanism for disabling the Nagle algorithm. Using this option (by passing it to **`setsockopt()`** or an equivalent function) disables Nagle.

3.4.3 TCP Long-Lived Connections and TCP Socket Keepalives

When utilizing TCP Long-Lived connections, the JANUS MPR4.1 Reader shall, by default, enable TCP keepalives on all of its socket connections with the LC as an additional defense mechanism against dropped connections. Furthermore, TCP Keepalives can serve to prevent the connection being dropped as a result of the release of connection resources stored within intermediate nodes, such as routers or firewalls, due to periods of link inactivity.

For TCP Long-Lived connections, it is recommended that this feature also be enabled on the LC side of the connection.

There are 4 socket option parameters that form the standard mechanism for controlling the behaviour of TCP Keepalives, as shown in Table 3.4-1.

Table 3.4-1: JANUS MPR4.1 TCP Long Lived Connection TCP Keepalive Parameters

Parameter	Description	TCP Socket Option	Reader Valid Range	Reader Default	Reader Configurable
TCP Keepalive Enable	A socket option that enables TCP Keepalives on a given socket.	**SO_KEEPALIVE**	1 – Enabled (*)	Enabled by default on all TCP Long-Lived Connections	No. *(Automatically enabled for all TCP Long-Lived connections)*
TCP Keepalive Time	The time (in seconds) a connection needs to remain idle before TCP begins sending Keepalive probes, if the SO_KEEPALIVE option has been set on the socket.	**TCP_KEEPIDLE**	5 – 7200 seconds	10 seconds	Yes
TCP Keepalive Probes	The maximum number of Keepalive probes TCP should send before dropping the connection	**TCP_KEEPCNT**	1 – 20	3	Yes
TCP Keepalive Interval	The time (in seconds) between individual TCP Keepalive probes.	**TCP_KEEPINTVL**	1 – 100	2	Yes

3.4.4 TCP Long-Lived Connections and the TCP User Timeout Socket Option

Since Linux version 2.6.37 there is an option called the *TCP User Timeout* that specifies the maximum time in milliseconds that transmitted data may remain unacknowledged before TCP will forcibly close the corresponding connection and return **ETIMEDOUT** to the application. This feature can be used to detect the presence of link drops (*e.g.* cable disconnects and/or peer crashes), especially if Ethernet Heartbeats have been disabled.

Setting a specific *TCP User Timeout* can allow a JANUS MPR4.1 TCP Long-Lived connection to survive extended periods without end-to-end connectivity when using larger values. Smaller values of the *TCP User Timeout* allows the TCP Long-Lived connection to 'fail fast' (preferred). Otherwise, failure detection may take up to 20 minutes in a normal WAN environment.

When utilizing TCP Long-Lived Connections, the JANUS MPR4.1 Reader shall automatically set the *TCP User Timeout* to a custom configurable value between 5 and 60 seconds. The default value shall be five (5) seconds. It is recommended that this feature also be set on the LC side of the connection, as well.

The **TCP_USER_TIMEOUT** option is the standard mechanism for specifying the *TCP User Timeout* on a given socket. This option can be set during any state of a TCP connection, but is effective only during the synchronized states of said connection (*i.e.* **ESTABLISHED**, **FIN-WAIT-1**, **FIN-WAIT-2**, **CLOSE-WAIT**, **CLOSING**, and **LAST-ACK**).

It is important to note that, when used with the TCP Keepalive (**SO_KEEPALIVE**) option, **TCP_USER_TIMEOUT** will override keepalive to determine when to close a connection due to keepalive failure. Some TCP implementations, such as those in BSD systems, use a different abort policy for TCP Keepalives than for user data. Thus, the TCP Keepalive mechanism might abort a connection that would otherwise have survived the transient period without connectivity. *Therefore, if a connection that enables TCP Keepalives is also using the TCP User Timeout Option, then the TCP Keepalive timer MUST be set to a value larger than that of the adopted User Timeout.*

3.4.5 TCP Long-Lived Connections and Explicit Message Acknowledgement

First, a bit of background information.

When *send()* is called on a socket, say, it doesn't really immediately transmit anything. It is essentially just a system call that performs a memory copy from the application process to the stack/kernel. At some point in time later, the stack/kernel will grab that data and actually transmit it to the peer (*e.g.*. LC application) after correspondingly packaging the data into segments and packets. The *send()* call does not wait for the data to be sent to the network, nor does it wait for the receiving peer application to acknowledge the data that was sent. The *send()* call can only return an error if one of the following conditions occurs:

- The socket (descriptor) is invalid.

  e.g. The socket connection has not been established, or has been effectively terminated in some way, such as FIN, RST, or timeout - see below.

- There is no more room in the transmit buffers to copy the data.

When the TCP stack *actually* transmits the data over the physical layer to the peer, it expects a valid acknowledgement within a reasonable amount of time (The guaranteed delivery service portion of TCP). If an acknowledgement is not received within that amount of time, the stack retransmits the data to the peer (*i.e.* LC application) . How often is a retransmission performed? That depends, since each TCP implementation has its own way of doing things. But, in general, the norm is to utilize the notion of exponential back-offs. (*i.e.* first wait 1 second, then 2, then 4, and so on...) On some stacks this process of exponential back-off can take ***minutes***.

The main points here are that:

(1) The return value of the *send()* call provides no indication with respect to the data actually reaching the peer (*i.e.* LC application).

(2) In the case of an interruption, TCP will declare a connection dead only after a seriously large time period (*e.g.* standard Linux performs on the order of fifteen (15) retries - that roughly equates to a time period of more than five (5) minutes).

So, practically, there ***are*** situations where TCP ***neither*** provides '*immediate'* indication if the peer drops out, ***nor*** does it '*immediately*' indicate that the data passed to the *send()* call has successfully made it to the receiving application on the other end.

Which brings us to the topic of discussion: *Explicit Message Acknowledgement*.

In order to achieve essentially a 100% guarantee that no transaction report messages will be lost in the event of a connection disruption between the Reader and the LC, an *Explicit Message Acknowledgement* scheme is used. For each data (*i.e.* non-Heartbeat/SYNC) message that the Reader sends to the LC over the *Reader-to-Lane Controller Reporting Socket* when the Reader is configured to use *TCP Long-Lived* Connections, the LC shall correspondingly respond with a short acknowledgement message that indicates to the Reader that the message was successfully received by the LC. The format of this explicit acknowledgement, called the *Acknowledge Transmission* (AT) message is described in §7.1.1.

If a message acknowledgement is not received in time, then the Reader knows that it needs to immediately buffer the message it is trying to transmit. The Reader will then shut down the connection, buffer any as yet un-transmitted messages and attempt to reconnect to the LC. Any messages that require transmission between the time the connection to the LC is dropped and the time the connection is resumed are also buffered. Draining of buffered messages commences upon successful reconnection to the LC.

3.4.6 TCPLL Lane Controller IP Address/Port Mapping Restrictions

The Reader essentially has two channel-to-IP Address/Port mapping tables that determine which IP Address and Port is associated with a particular Lane Controller reporting destination – one for the configured *LC Main Destination* and one for the optionally configured *LC Dual Destination*. This allows any number of channels:

- To be each mapped to unique Lane Controller destinations;
- To be mapped in multiplexed fashion to a common destination; or,
- To be mapped to a combination thereof.

When a connection request comes in from the LC, the Reader checks the source IP Address of the request and compares it to the currently mapped LC destinations. If it finds a matching mapped destination for the same IP Address, then it forwards the accepted socket to the mapped process that is responsible for communications with that LC destination.

For TCP Long-Lived Connections, there presently is a restriction on how the Reader may be configured to report to different destinations and still have correct connectivity behaviour when the LC connects to the Reader for the purpose of issuing the Reader command messages. Since the Reader uses IP Addresses (excluding Ports) as the basis for determining the (destination) process mapping, any unique LC destination (either a physical device and/or a logical process, *etc*.) that wishes to connect to the Reader in order to issue commands to it, must be identified by a unique IP Address.

For the simplest case, *this means that the Reader must be configured such that the IP Address of both Main and Dual Ethernet Destinations must be distinct*. Otherwise, if the IP Addresses are the same, then whichever LC device/process connects last will destroy the connection of the other LC device/process that connected first.

The following scenarios describe different destination mappings with respect to TCP Long-Lived Connections and the IP Address uniqueness requirement.

3.4.6.1 Scenario #1 – All Channels Report to the Same Destination IP Address/Port Per Destination

Table 3.4-2: Scenario #1 – All Channels Report to the Same Destination IP Address/Port Per Destination

Channel	Destination	IP Address	Port
1	MAIN	192.168.60.10	6000
	DUAL	192.168.60.20	6000
2	MAIN	192.168.60.10	6000
	DUAL	192.168.60.20	6000
3	MAIN	192.168.60.10	6000
	DUAL	192.168.60.20	6000
4	MAIN	192.168.60.10	6000
	DUAL	192.168.60.20	6000

In this scenario, shown in Table 3.4-2, the Reader is configured to report all channels to a single Main and single Dual Lane Controller, respectively. The Main and Dual LC's have uniquely independent IP Addresses. In this particular example, all channels are being reported to the same port on each of the Main and/or Dual destinations. For the purposes of this example, both the Main Controller and the Dual Controller are both set to Port 6000. However, if necessary they can be set to different values, *provided that the values are the same across all channels for a given Controller.*

In this scenario, a single unique LC device/process is responsible for controlling all channels for each respective destination, Main or Dual. Both the Main and the Dual LC device/process must establish its own unique TCP Long-Lived Connection to the Reader in order to be able to issue commands to it. Because each Destination, both the

Main and the Dual, have unique IP Addresses, there are no potential issues for conflict with either Destination when they attempt to establish a TCP Long-Lived connection to a Reader configured in this way.

3.4.6.2 Scenario #2 – Multiple Independent LC's Per Channel on an IP Address Basis

Table 3.4-3: Scenario #2 – Multiple Independent LC's Per Channel on an IP Address Basis

Channel	Destination	Host	Port
1	MAIN	192.168.60.10	6030
	DUAL	192.168.60.20	6030
2	MAIN	192.168.60.11	6030
	DUAL	192.168.60.21	6030
3	MAIN	192.168.60.12	6030
	DUAL	192.168.60.22	6030
4	MAIN	192.168.60.13	6030
	DUAL	192.168.60.23	6030

In this scenario, the Reader is configured to independently report to unique Main and Dual Lane Controllers on a per channel basis, as shown in Table 3.4-3. For each channel, each Main and Dual LC Destination are configured to report to a unique IP address. In this particular example, the destination Ports are all configured to be the same, but for the purposes of this discussion, they can be considered effectively as *don't care*.

In this scenario, a single unique LC device/process is responsible for controlling each individual channel both for the Main, as well as the Dual Destination. Each LC device/process responsible for a given channel, must establish its own unique TCP Long-Lived Connection to the Reader in order to be able to issue commands to it. Because each individual channel for both Destinations, Main and the Dual, has a unique IP Addresses, there are no potential issues for conflict when any unique destination attempts to establish a TCP Long-Lived connection to a Reader configured in this way.

3.4.6.3 Scenario #3 – Channels Mapped on a Port Basis

Table 3.4-4: Scenario #3a – Multiple Independent LC's Per Channel on a Port Basis

Channel	Destination	Host	Port
1	MAIN	192.168.60.10	6000
	DUAL	192.168.60.20	6000
2	MAIN	192.168.60.10	6001
	DUAL	192.168.60.20	6001
3	MAIN	192.168.60.10	6002
	DUAL	192.168.60.20	6002
4	MAIN	192.168.60.10	6003
	DUAL	192.168.60.20	6003

Table 3.4-5: Scenario #3b – Two LC's Per Destination Mapped on a Port Basis

Channel	Destination	Host	Port
1	MAIN	192.168.60.10	6000
	DUAL	192.168.60.20	6000
2	MAIN	192.168.60.10	6000
	DUAL	192.168.60.20	6000
3	MAIN	192.168.60.10	6020
	DUAL	192.168.60.20	6020
4	MAIN	192.168.60.10	6020
	DUAL	192.168.60.20	6020

Table 3.4-6: Scenario #3c – Main/Dual Destinations Mapped to the same IP Address but Different Ports

Channel	Destination	Host	Port
1	MAIN	192.168.60.10	6000
	DUAL	192.168.60.10	7000
2	MAIN	192.168.60.10	6000
	DUAL	192.168.60.10	7000
3	MAIN	192.168.60.10	6000
	DUAL	192.168.60.10	7000
4	MAIN	192.168.60.10	6000
	DUAL	192.168.60.10	7000

Table 3.4-7: Scenario #3d – Main/Dual Destinations Mapped to the same IP Address but Different Ports per Channel

Channel	Destination	Host	Port
1	MAIN	192.168.60.10	6000
	DUAL	192.168.60.10	7000
2	MAIN	192.168.60.10	6001
	DUAL	192.168.60.10	7001
3	MAIN	192.168.60.10	6002
	DUAL	192.168.60.10	7002
4	MAIN	192.168.60.10	6003
	DUAL	192.168.60.10	7003

In Scenarios 3a and 3b, the Reader is configured to independently report to unique Main and Dual Lane Controllers with IP Addresses 192.168.60.10, and 192.168.60.20, respectively. However, now we are mapping to multiple individual LC Processes/Ports across the Reader channels for the case of Scenario 3a, as shown in Table 3.4-4. For the case of Scenario 3b, shown in Table 3.4-5, we are mapping to two LC Processes/Ports for each Destination – the first Process/Port being responsible for Channels 1-2, and the Second Process/Port at the same IP Address being responsible for channels 3-4.

In Scenarios 3c, and 3d, the Reader is configured to report to unique Main and Dual Lane Controllers with same IP Address, 192.168.60.10. In Scenario 3c, shown in Table 3.4-6, the Main and Dual Lane Controller are mapped with different Ports – 6000 and 7000, respectively. In Scenario 3d, we go one step further and map the individual Reader channels each to a unique port for both Lane Controllers, as shown in Table 3.4-7.

All of these scenarios present a challenge for the Reader to correctly be able to ascertain which internal LC Ethernet Destination process to use to route the appropriate incoming connection request from a given Lane Controller. Because the Reader uses the IP Address in attempting to determining the destination mapping, each of these cases – and similar ones like them – present a problem that the Reader essentially cannot solve.

The result is that, for Scenarios 3a, and 3b, (Table 3.4-4, and/or Table 3.4-5) there will end up being only one LC being able to connect from each Destination (Main or Dual). Each successive LC that attempts to establish a TCP Long-Lived connection with the Reader will effectively wipe out the any connection that was made before it. Furthermore, the channel destination mappings will likely not be correct, possibly resulting in some potential cross-channel side effects when certain commands are issued.

A similar effect occurs for Scenarios 3c and 3d (Table 3.4-6 and/or Table 3.4-7) where not only will the IP Address duplication between ports result in the destruction of previous connection instances, but now, in addition, there is the additional IP Address conflict between Destinations – Main and Dual.

3.4.7 Socket Timeout

The Reader and Lane Controller shall use a timeout parameter for connect, send and/or receive operations. This timeout will represent the maximum amount of time to wait before a TCP/IP connect, send, and/or receive operation will be considered to have failed.

For the JANUS MPR4.1 Reader, the *default LC Ethernet TCP-Socket Timeout* value is 500ms. This value is configurable from 100ms to 5000ms.

If the Socket timeout expires, the Reader or Lane Controller will assume the link is down and can then attempt to re-establish the connection to the peer

.

3.4.7.1 Socket Timeout and TCP Long-Lived Connections

For the case of *TCP Long-Lived Connections*, the *LC Ethernet TCP-Socket Timeout* parameter controls the timeout for the following *TCP Long-Lived* socket operations:

(1) The expected amount of time it takes to complete a TCP/IP socket connection with the LC.

(2) If a Heartbeat/Sync message is transmitted to the LC, it represents the amount of time in which a suitable response is expected to be received from the LC.

(3) The amount of time, after a Data (*i.e.* non-Heartbeat/SYNC) Message has been sent to the LC over the *Reader-to-LC Reporting Socket*, in which an *Acknowledge Transmission* (AT) Message is expected to be received from the LC to indicate that the Transaction Message was successfully received.

If the Socket Timeout expires for any of the above listed operations, the Reader or Lane Controller will assume the link is down and can then attempt to re-establish the connection to the peer.

3.4.8 Protocol Violations

3.4.8.1 Standard (Legacy) Mode Protocol Violations

A Standard (Legacy) Mode message protocol violation results when the following header errors occur:

- Application Message Payload Field length does not correspond to the Count field

In the event that the Reader receives such a message, an error message will be written to the system log and the message will be discarded.

3.4.8.2 TCP Long-Lived Connection Mode Protocol Violations

When the JANUS MPR4.1 Reader is configured to communicate with the LC using *TCP Long-Lived* Connections, a message protocol violation results when the following header errors occur:

- STX Delimiter not present in packet data.
- Application Message Payload Field length does not correspond to the Count field.
- Expected ETX delimiter missing from the packet, based on contents of Count field.

In the event that the Reader receives such a message, an error message will be written to the system log and the message will be discarded.

3.4.9 Startup

When the JANUS MPR4.1 Reader starts up, the first message that it will send is the Initialization Message (*c.f.* §6.2.4).

3.5 Message Examples – Standard (Legacy) Mode

Some examples of Standard (Legacy) Mode messages along with the application-layer message format, for reference, are shown in Figure 3.5-1.

Application Message Format:

Count Field Length: 3 Bytes Format: decimal ASCII	Application Message Payload Field Length: Variable (1 – 400 bytes) Format: As per specific application message

Example Sync Message:

005	SY101

Example Status Response Message:

012	SB2100-A0000

Example Time Message:

016	TM<space>100809<space>113724

Figure 3.5-1: JANUS MPR4.1 Reader – Lane Controller Ethernet Interface – Standard (Legacy) Mode Application-Layer Message Examples

3.6 Message Examples – TCP Long-Lived Connections Mode

Some examples of *TCP Long-Lived Connections* Mode messages along with the *TCP Long-Lived* application-layer message format, for reference, are shown in Figure 3.6-1.

TCP Long-Lived Connections Application Message Format:

STX (0x02) Length: 1 Byte Format: ASCII hex	Count Field Length: 3 Bytes Format: decimal ASCII	Application Message Payload Field Length: Variable (1 – 400 bytes) Format: As per specific application message	ETX (0x03) Length: 1 Byte Format: ASCII hex

Example Sync Message:

STX (0x02)	005	SY101	ETX (0x03)

Example Status Response Message:

STX (0x02)	012	SB2100-A0000	ETX (0x03)

Example Time Message:

STX (0x02)	016	TM<space>100809<space>113724	ETX (0x03)

Figure 3.6-1: JANUS MPR4.1 Reader – Lane Controller Ethernet Interface – TCP Long-Lived Connections Mode Application-Layer Message Examples

3.7 Maximum Transfer Rates

The maximum data transfer rates between the JANUS MPR4.1 Reader and the attached Lane Controllers over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface are governed by the IEEE 802.3 (Ethernet) Standard [RD4].

4. MESSAGE PROTOCOL OVERVIEW

4.1 Overview

Note that all protocols described herein are independent of the lower level Data Transport Format specified for the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface (described in §3).

The JANUS MPR4.1 Reader Multi-Protocol Messaging has several "modes" of protocol behavior depending on the configuration parameters shown in Table 4.1-1.

Table 4.1-1: JANUS MPR4.1 Reader Multi-Protocol Message Mode Configuration Parameters

JANUS MPR4.1 Reader Multi-Protocol Message Mode Configuration Parameter	Description
Voting Report	Instructs the JANUS MPR4.1 Reader to send a Voting Report (*i.e.* Transponder Message) to the Lane Controller at voting time expiry.
Initial Read Report	Instructs the JANUS MPR4.1 Reader to send an Initial Read Report to the Lane Controller the first time a new transponder is seen. A system integrator may use Initial Read messages to potentially optimize vehicle framing algorithms and overall ETC system performance.
Raw Handshake Report	Instructs the JANUS MPR4.1 Reader to send a Handshake Message to the Lane Controller (via the Ethernet UDP Interface) each time a transponder is read. ***The JANUS MPR4.1 Reader MUST be configured to use the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface option BEFORE the*** **Report Handshakes** ***parameter can be ENABLED.***
Post-Capture-Zone Report	Instructs the JANUS MPR4.1 Reader to generate and send a Post Capture Report to the Lane Controller when the Reader detects a change in the programming status of the Transponder (*e.g.* from fail to success), or a lane assignment change. This report is generated at a multiple of the voting time (configurable) after the normal transaction report. Post Capture Reports may be used to potentially optimize ETC system performance.
Departure Report	Instructs the JANUS MPR4.1 Reader to generate and send a Departure Report Message to the Lane Controller after a configurable period of time, in milliseconds after a Transponder is last seen. ***Note: The Departure Report is currently only fully implemented for the ISO 18000-6B (in*** **Standard (UID only) Read Mode**, ***ATA, ISO 18000-6C, and Sego protocols. The*** **Speed Information** ***section of this message shall be populated with all 0's (zeroes) for TDM, Title21 and ISO 18000-6B (in non*** **'Standard (UID only)' Read Mode)** ***protocol reports***.
Estimated Vehicle Speed Report	Instructs the JANUS MPR4.1 Reader to generate and send an Estimated Vehicle Speed Report to the Lane Controller when the Reader deems that the transaction has completed (*i.e.* the transponder has left the Reader zone) and the vehicle speed regression analysis has completed. ***Note: The Estimated Vehicle Speed Report is currently only available for the ISO 18000-6B (in*** **'Standard (UID only)' Read Mode)**, ***ATA, ISO 18000-6C, and SeGo protocols.***

The various "modes" are selected by enabling the configuration parameters described in Table 4.1-1 in the specific combinations shown in Table 4.1-2. Specific details of each operational mode are discussed in the subsections that follow.

Table 4.1-2: JANUS MPR4.1 Reader Multi-Protocol Message "Modes"

JANUS MPR4.1 Reader Multi-Protocol Messaging "Mode"	***Voting Report* Parameter Setting**	***Initial Read Report* Parameter Setting**	***Raw Handshake Report* Parameter Setting**	***Post-Capture-Zone Report* Parameter Setting**	***Estimated Vehicle Speed Report* Parameter Setting**	***Departure Report* Parameter Setting**	**Supported LC Destinations**
'Standard' Messaging Mode: Report Standard (Voting Report / Transponder Message, Initial Read Report, Post Capture Report, Estimated Vehicle Speed Report, Departure Report) Messages to the Lane Controller. *Raw Handshake Messages are NOT reported to the Lane Controller in 'Standard' Mode.*	***ENABLED***	*OPTIONAL*	***DISABLED***	*OPTIONAL*	*OPTIONAL* ***[See Note 4]***	*OPTIONAL* ***[See Note 5]***	Ethernet (TCP)
'Raw Handshake Report' Messaging Mode: Report Transponder Handshakes Only to the Lane Controller	***DISABLED***	***DISABLED***	***ENABLED***	***DISABLED***	***DISABLED*** ***[See Note 4]***	***DISABLED*** ***[See Note 5]***	Ethernet (TCP / UDP) ***[See Note 1]***
'Combined' Messaging Mode: Report Transponder Handshakes AND Standard (Voting Report / Transponder Message, Initial Read Report, Post Capture Report, Estimated Vehicle Speed Report, Departure) Messages to the Lane Controller.	*OPTIONAL* ***[See Note 3]***	*OPTIONAL* ***[See Note 3]***	***ENABLED***	*OPTIONAL* ***[See Note 3]***	*OPTIONAL* ***[See Note 3]*** ***[See Note 4]***	*OPTIONAL* ***[See Note 3]*** ***[See Note 5]***	Ethernet (TCP / UDP) ***[See Note 2]***

Notes:

(1) - It is important to note that even though no Transponder Messages are sent to the Lane Controller over TCP in this mode, the Lane Controller MUST implement a TCP listening socket in order to correctly process the SYNC messages that are sent to the Lane Controller by the JANUS MPR4.1 Reader on the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface (see §3 for details).

(2) – '*Standard*' messages are transmitted over TCP; '*Raw Handshake Report*' messages are transmitted over UDP.

(3) – If the *Raw Handshake* Report parameter is enabled, at least one of *Voting Report, Generate Initial Report*, *Generate Post-Capture-Zone Report*, and/or *Generate Estimated Vehicle Speed Report* must be enabled for the Reader to be in '*Combined*' *Messaging Mode*.

(4) – ***Estimated Vehicle Speed Reports*** **are currently only available for the ISO 18000-6B (in *'Standard (UID only)' Read Mode*), ATA, ISO 18000-6C, and SeGo protocols.**

(5) – Departure Reports **are currently only fully implemented for the ISO ISO 18000-6B (in *'Standard (UID only)' Read Mode*), ATA, ISO 18000-6C, and SeGo protocols. The *Speed Information* section of the *Departure Report* will be populated with 0's (zeros) for the TDM, Title21 and ISO 18000-6B (in non '*Standard (UID only)' Read Mode*).**

4.2 'Standard' Messaging Mode

'Standard' Messaging Mode is a "typical" operational mode for the JANUS MPR4.1 Reader. Setting the "*Voting Report*" configuration parameter to be enabled and the "*Raw Handshake Reports*" configuration parameter to be disabled, places the Reader in "*Standard" Messaging Mode*. When operating in this mode, the JANUS MPR4.1 Reader transmits the "standard" reports to the Lane Controller, as follows:

- Optional *Initial Read Reports* on the first read of a transponder, consisting of "IA" messages as defined in §6.2.3, or "MA" – *n*1 format messages as defined in §9.
- *Transponder Messages*, at Voting Time expiration, consisting of "TA" messages as defined in §6.2.19, or "MA" – *n*2 format messages as defined in §9.
- Optional *Post Capture Reports,* on expiration of the optional Post Capture time, consisting of "PA" messages as defined in §6.2.9, or "MA" – *n*3 format messages as defined in §9.
- Optional *Estimated Vehicle Speed Reports* (for ISO 18000-6B (in '*Standard (UID only)' Read Mode*), ATA, ISO 18000-6C, and SeGo protocols only), upon transaction/regression analysis completion, consisting of "MA" – *n6* format messages as defined in §9.
- Having seen the transponder at least once, optional *Departure Reports* (fully populated for ISO 18000-6B (in '*Standard (UID only)' Read Mode*), ATA, ISO 18000-6C, and SeGo protocols only), after the transponder has no longer been seen for at least the *Departure Report Delay* time. *Departure Reports* consist of "MA" – *n7* format messages as defined in §9.

A simplified UML diagram of this interaction is illustrated in Figure 4.2-1.

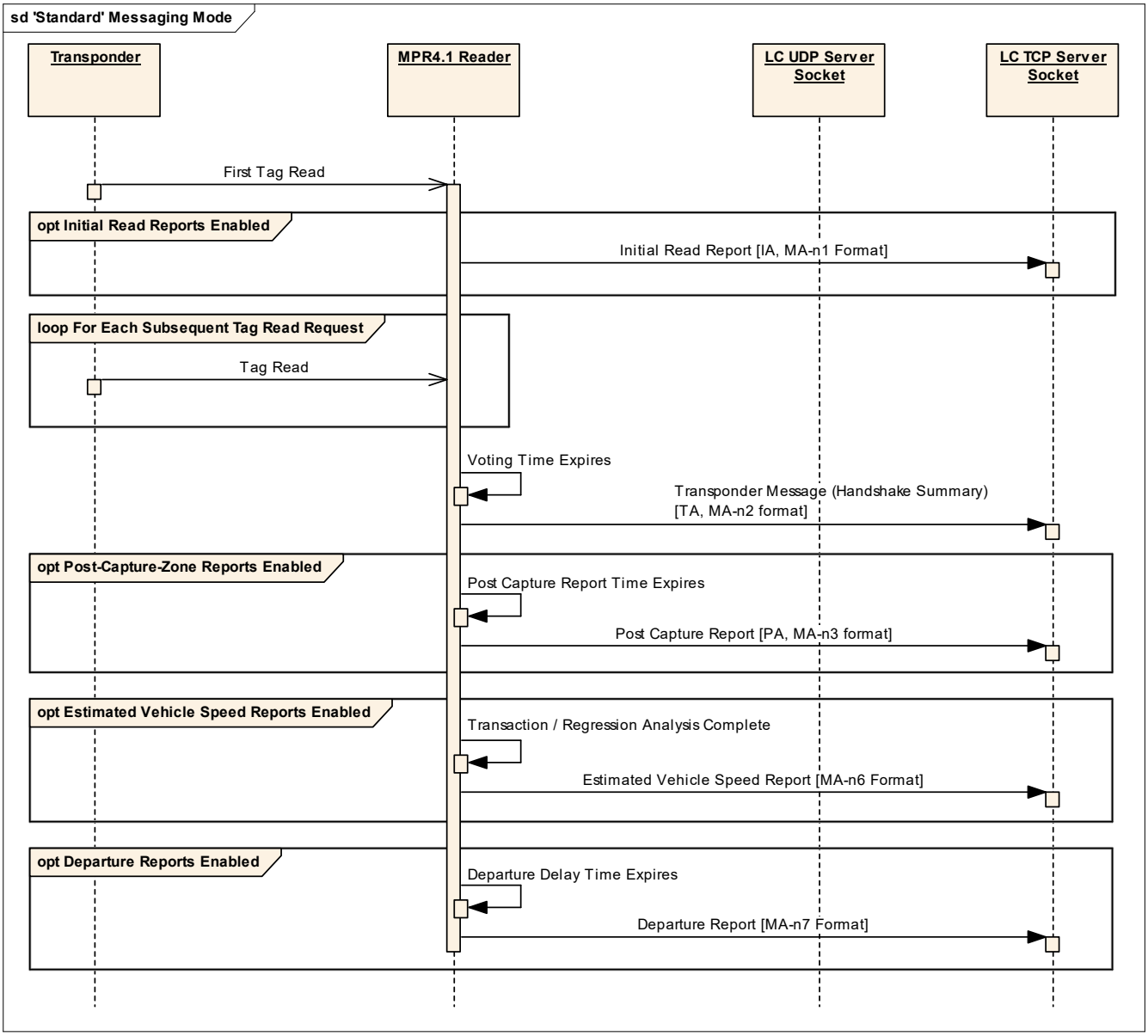

Figure 4.2-1: JANUS MPR4.1 Reader 'Standard' Messaging Mode

4.3 'Raw Handshake Report' Messaging Mode

'Raw Handshake Report' Messaging Mode is activated when the "*Raw Handshake Reports"* configuration parameter is enabled. The *Voting Report, Initial Read Report, Post-Capture-Zone Report*, *Estimated Vehicle Speed Report,* and *Departure* Report parameters are all disabled in this mode. When operating in this mode, the JANUS MPR4.1 Reader transmits *only* Handshake Messages to the Lane Controller, as follows:

- Each time the Transponder is Read, a Handshake message is sent to the Lane Controller, consisting of an "MA" – *n0* format message as defined in §9.

Note that JANUS MPR4.1 Reader Handshake Messages are transmitted to the Lane Controller via the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface. ***The JANUS MPR4.1 Reader MUST be configured to use the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface option BEFORE the* Report Handshakes *parameter can be ENABLED.*** A simplified UML diagram of this interaction is illustrated in Figure 4.3-1.

It is important to note that even though no Transponder Messages are sent to the Lane Controller over TCP in this mode, the Lane Controller MUST implement a TCP listening socket in order to correctly process the SYNC messages that are sent to the Lane Controller by the JANUS MPR4.1 Reader on the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface (see §3 for details).

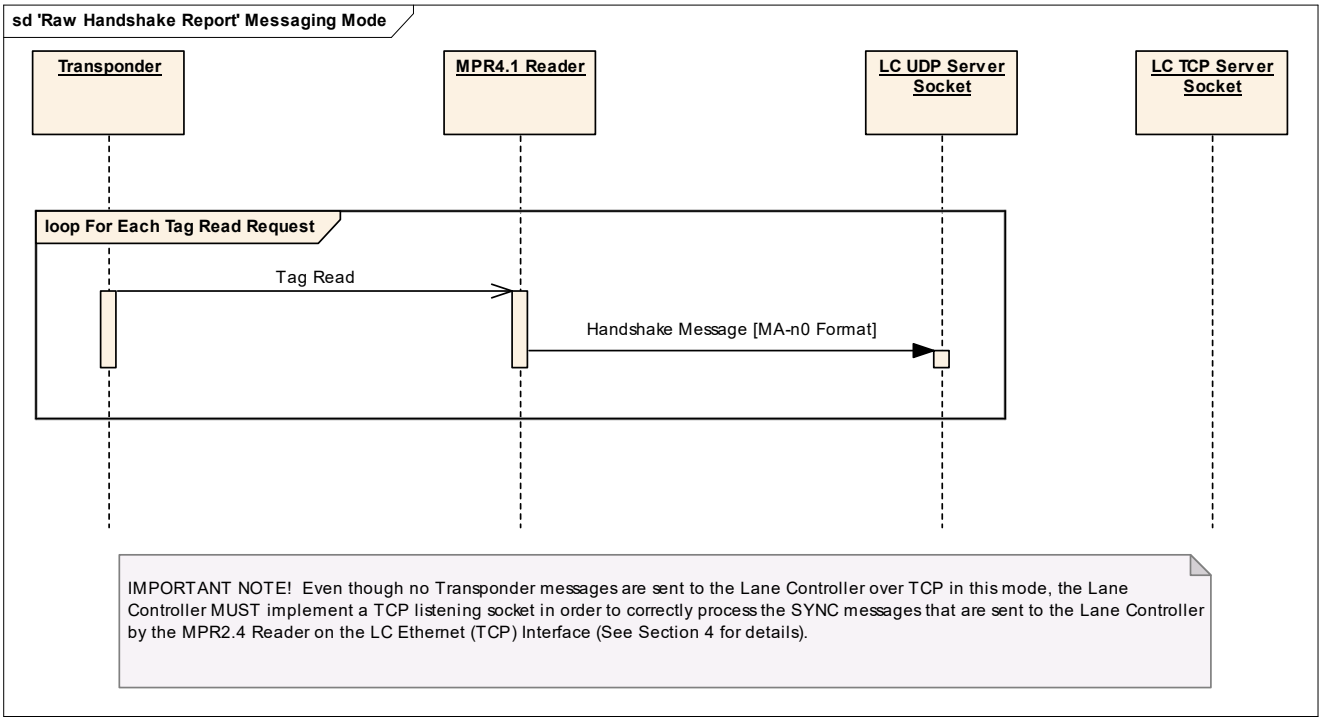

Figure 4.3-1: JANUS MPR4.1 Reader 'Raw Handshake Report' Messaging Mode

4.4 'Combined' Messaging Mode

'Combined' Messaging Mode (*i.e.* combines *'Standard'* Messaging Mode with *'Raw Handshake Report'* Messaging Mode) is activated when the *Raw Handshake Report* parameter is enabled and at least one of the *Voting Report, Initial Read Report, Post-Capture-Zone Report, Estimated Vehicle Speed Report,* and/or *Departure Report* parameters is enabled. When operating in this mode, the JANUS MPR4.1 Reader transmits both Handshake Messages and the enabled "standard" reports to the Lane Controller, as follows:

- Each time the Transponder is Read, a Handshake message is sent to the Lane Controller, consisting of an "MA" – *n0* format message as defined in §9.
- Optional *Initial Read Reports* on the first read of a transponder, consisting of "IA" messages as defined in §6.2.3, or "MA" – *n*1 format messages as defined in §9.
- Optional *Transponder Messages*, at Voting Time expiration, consisting of "TA" messages as defined in §6.2.19, or "MA" – *n*2 format messages as defined in §9.
- Optional *Post Capture Reports,* on expiration of the optional Post Capture time, consisting of "PA" messages as defined in §6.2.9, or "MA" – *n*3 format messages as defined in §9.
- Optional *Estimated Vehicle Speed Reports* (for ISO 18000-6B (in '*Standard (UID only)*' *Read Mode*), ATA, ISO 18000-6C, and SeGo protocols only), upon transaction/regression analysis completion, consisting of "MA" – *n6* format messages as defined in §9.
- Having seen the transponder at least once, optional *Departure Reports* (fully populated for ISO 18000-6B (in '*Standard (UID only)*' *Read Mode*), ATA, ISO 18000-6C, and SeGo protocols only), after the transponder has no longer been seen for at least the *Departure Report Delay* time. *Departure Reports* consist of "MA" – *n7* format messages as defined in §9.

Note that JANUS MPR4.1 Reader Handshake Messages are transmitted to the Lane Controller via the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface. ***The JANUS MPR4.1 Reader MUST be configured to use the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface option BEFORE the*** **Report Handshakes** ***parameter can be ENABLED.*** JANUS MPR4.1 Reader "standard" messages are sent to the Lane Controller via the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface. A simplified UML diagram of this interaction is illustrated in Figure 4.4-1.

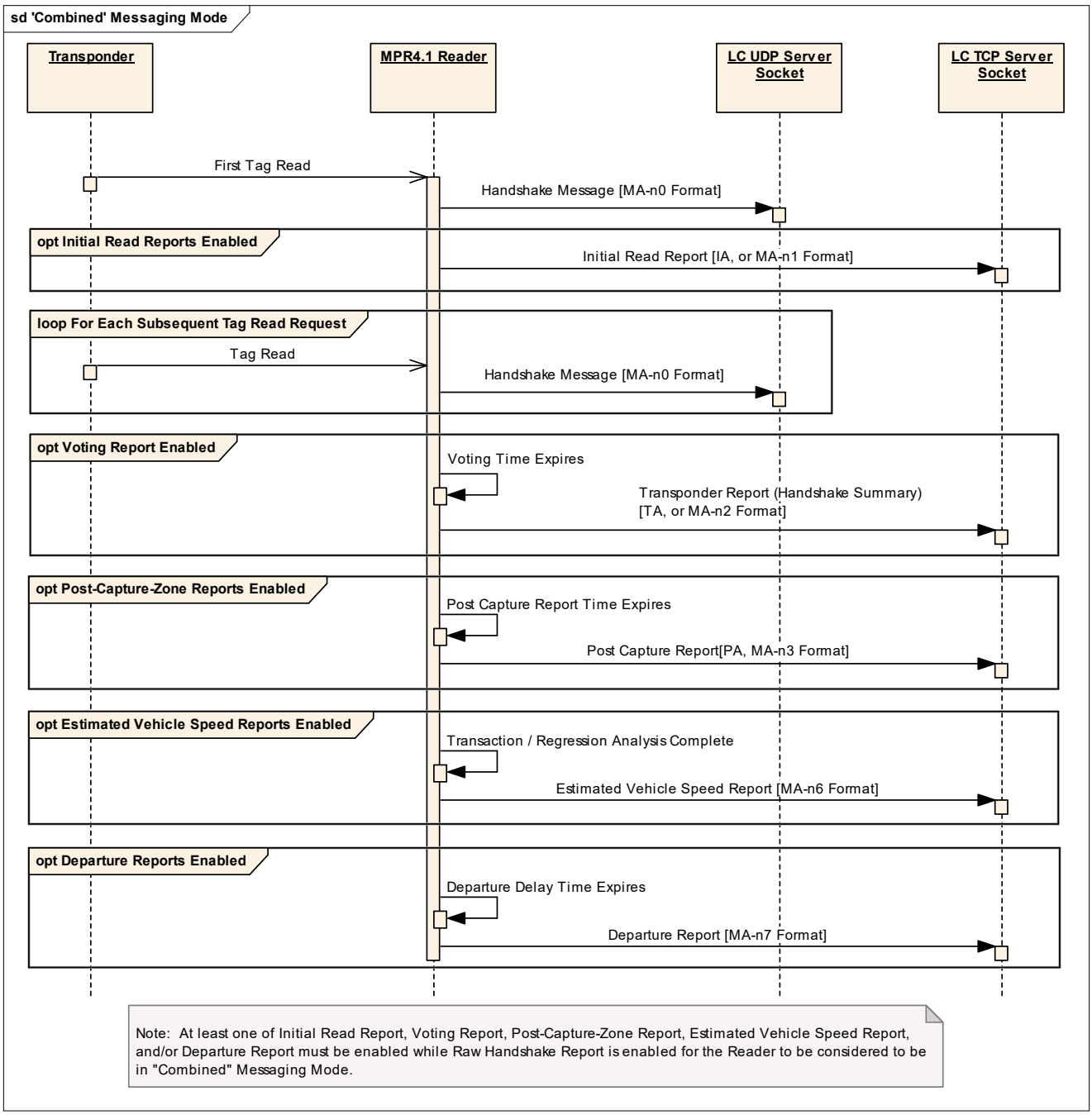

Figure 4.4-1: JANUS MPR4.1 Reader 'Combined' Messaging Mode

4.5 Reader Software Update / Management Protocol Overview

The JANUS MPR4.1 Reader provides the capability of remote update and management of the Reader Software through the JANUS MPR4.1 Reader – Lane Controller Interface. A capability for performing a bulk upload and/or download of all of the JANUS MPR4.1 Reader configuration parameters is also provided.

4.5.1 Software Update / Management

Performing a JANUS MPR4.1 Reader Software Update is a multi-step process, an example of which is shown in Figure 4.5-1. In a typical update scenario, the following steps would be performed:

1. Obtain the amount of free space on the Reader Filesystem.
2. Obtain the number of versions currently installed on the Reader.
3. Obtain the Update Identifier (and Factory/Active status) of each version currently installed on the Reader.
4. If there is not enough free space on the Reader to accommodate the new software version, select one or more older versions and delete them from the Reader.
5. Secure copy the update to the Reader
6. Verify the update that has been uploaded to the Reader
7. Activate the update that has been successfully verified on the Reader.

4.5.1.1 Obtaining the Amount of Free Space on the Reader Filesystem

In order to obtain the amount of free space on the Reader Filesystem, the Lane Controller issues a *Get Free Space Message* [UF] to the Reader. The Reader shall respond with a *Filesystem Space Available Message* [UM] indicating the amount of available free space, in bytes, on the Reader Filesystem.

4.5.1.2 Obtaining the Number of Versions Currently Installed on the Reader

To get the number of Software Versions that are currently installed on the Reader, the Lane Controller issues a *Query Update Count Message* [UQ] to the Reader. The Reader shall respond with a *Number of Available Updates Message* [UN], indicating how many software versions *including the Factory Version*, are currently present on the Reader.

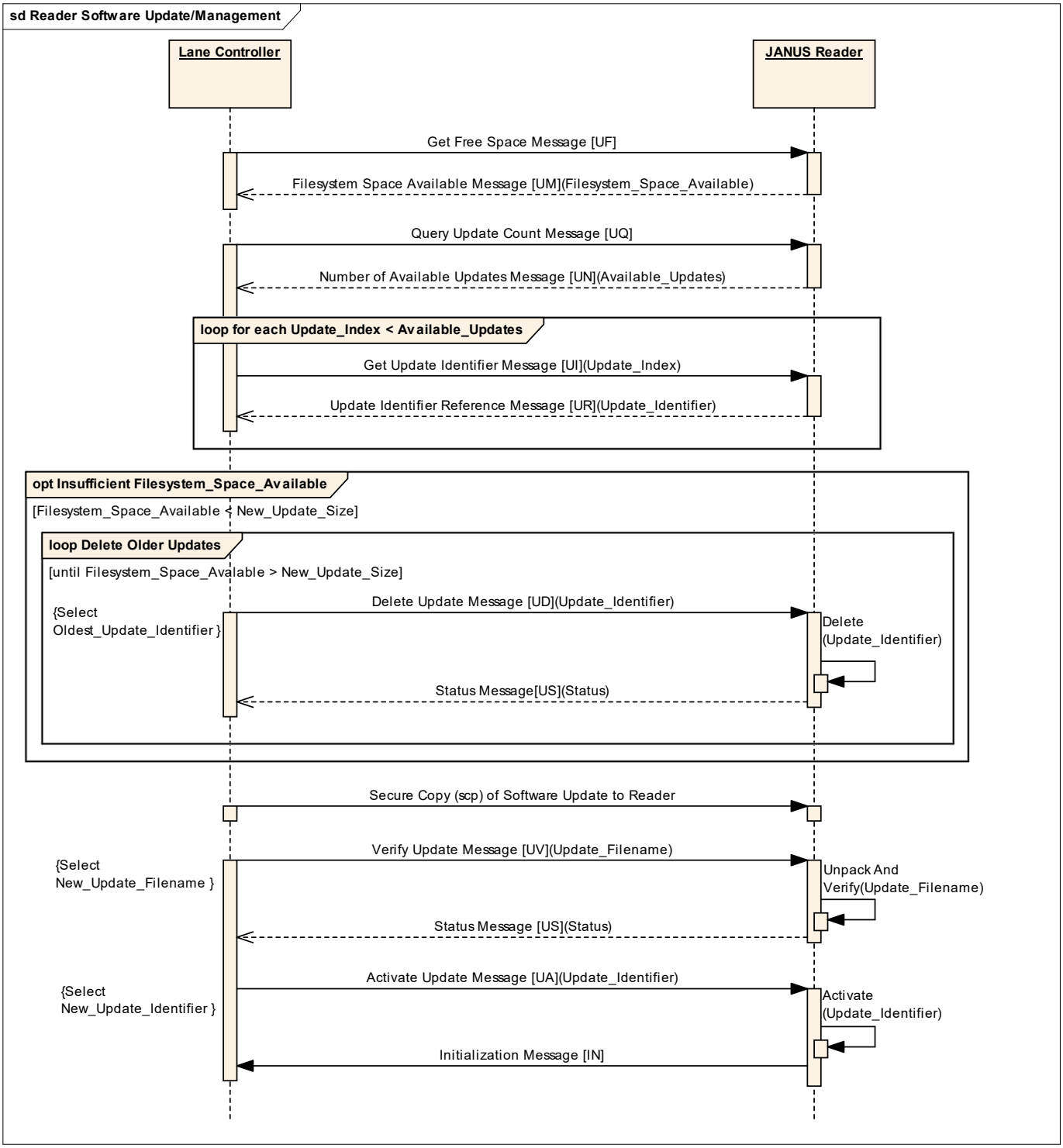

Figure 4.5-1: Example Software Update / Management Sequence

4.5.1.3 Obtaining the Update Identifier / Status of Each Version Currently Installed on the Reader

The next step is to retrieve from the Reader the Identifier and Factory / Activeness Status of each software version that is currently installed on the JANUS MPR4.1 Reader. To accomplish this, the Lane Controller sends to the Reader a *Get Update Identifier Message* [UI] with an *Update Index* field that references the unique index number for each software version present on the Reader. Allowable *Update Index* field values range from 0 to {*Number of Updates*} – 1.

For each *Get Update Identifier Message* received from the Lane Controller, the Reader shall respond with an *Update Identifier Reference Message* [UR], which returns the Software Update Identifier of the software version corresponding to the associated *Update Index*, along with two status flags indicating whether the referenced software version is:

(a) The Factory installed software version; and/or

(b) The active (*i.e.* currently running) software version.

4.5.1.4 Deleting Older Versions if Insufficient Space is Available

If the new software update is larger than the amount of available space on the Reader Filesystem, then one or more older revisions of software must be deleted from the Reader in order to free up sufficient space on the Reader Filesystem to accommodate the new update. To accomplish this, the Lane Controller sends one or more *Delete Update Messages* [UD] with the Update Identifier field set to the identifier of the update that the Lane Controller wishes to delete.

Upon completion of the request, the Reader shall respond with a *Software Update / Management Status Message* [US] signifying either a detected failure or an indication of successful completion.

Note that it is not permitted to either:

a) Delete the active (i.e. currently running) software version; and/or

b) Delete the Factory software version

from the JANUS MPR4.1 Reader. *If such an operation is attempted, the Reader will reject the request and respond with a* Software Update / Management Status Message [US]*, with the* Status *field set to:* "**`Delete identifier (n) points to factory or active software`**", *where* n *represents the* Update Identifier *in question.*

4.5.1.5 Secure Copy of the New Software Update to the Reader

To transfer the new software update from the Lane Controller to the Reader, the Lane Controller uploads a given software update file to the JANUS MPR4.1 Reader via Secure Copy (scp). This can be accomplished by issuing the following Secure Copy (scp) command on the Lane Controller:

```
scp <Software_Update_File> mpr2user@<Reader_IP_Address>:
```

where **`<Software_Update_File>`** is the name of the software update file to upload to the JANUS MPR4.1 Reader and **`<Reader_IP_Address>`** is IP Address of the JANUS MPR4.1 Reader.

4.5.1.6 Verification of the Uploaded Software Update

Before the new software update can be activated, the newly uploaded software update file must undergo a verification procedure. To initiate this verification, the Lane Controller issues a *Verify Update Message* [UV] with the *Update File Name* field set to the full file name of the software update file that was uploaded to the reader via Secure Copy (scp).

Upon completion of the verification procedure, the Reader shall respond with a *Software Update / Management Status Message* [US] indicating whether an error was encountered during the verification procedure or the operation completed successfully.

After verification, the file uploaded by the Lane Controller via Secure Copy (scp) is either:

a) Relocated to the software update repository on the Reader if the verification was successful; or

b) Deleted from the Reader if the verification failed.

4.5.1.7 Activation of the New Software Update

The final step in the update process is the activation of the new software update. To activate a given software version, the Lane Controller Issues an *Activate Update Message* [UA] to the JANUS MPR4.1 Reader with the *Update Identifier* field set to the identifier of the software version to Activate. Optionally, the Lane Controller may set this field to 'FACTORY' or 'LATEST' to activate the base factory version of software on the Reader, or the latest version available on the Reader, respectively.

Upon successful completion of the Reader software activation, the Reader shall implicitly transmit an *Initialization Message* [IN] (*c.f.* §6.2.4) to the Lane Controller. If, on the other hand, if an error condition is detected during the update, the JANUS MPR4.1 Reader shall respond to the Lane Controller with a *Software Update / Management Status Message* [US] indicating the nature of the detected error.

4.5.2 Bulk Configuration Upload

Performing a Bulk Configuration upload is a two-step process as shown in Figure 4.5-2. The first step in the process is the uploading of a given configuration file to the JANUS MPR4.1 Reader via Secure Copy (scp). This can be accomplished by issuing the following Secure Copy (scp) command on the Lane Controller:

```
scp <Config_File> mpr2user@<Reader_IP_Address>:
```

where **<Config_File>** is the name of the configuration file to upload to the JANUS MPR4.1 Reader and **<Reader_IP_Address>** is the IP Address of the JANUS MPR4.1 Reader.

Once the Secure Copy of the configuration file to the Reader has completed, the Lane Controller issues an *Update (Bulk) Configuration* [UC] command to the JANUS MPR4.1 Reader that specifies which configuration file the Reader should load. This will instruct the Reader to load the configuration values from the specified file.

Note: The Reader parses and validates the configuration file on a line-by-line basis. Configuration values are extracted and loaded from each configuration parameter line that has been successfully parsed and validated. The Reader skips any configuration parameter line that either fails to parse or fails its validation checks. When the Reader reaches the end of the configuration file and the Reader has detected that one or more configuration parameter lines have either failed to parse or have failed validation checking, the Reader shall respond with a Software Update / Management Status [US] *message with the* Status *field set to indicate that an error has occurred (See §8.2.12).*

Note: The Reader will only update its configuration with parameters that are present in the uploaded configuration file specified in the Update (Bulk) Configuration *[IUC] command. To prevent the Reader from modifying one or more specific configuration parameter(s), simply delete the respective configuration parameter line(s) from the configuration file before uploading it to the Reader.*

Special Case Note: To prevent a potential 'lock-out' situation, the Reader will NOT allow an update to either the* Ethernet 1 (LC 1Gbps) IP Address *and/or the* Default Gateway IP *parameters, if they are present in the specified configuration file.

The JANUS MPR4.1Reader shall respond with a *Software Update / Management Status* [US] message that will either confirm success or report detected errors for the requested operation.

Note: When the Update Configuration processing is complete, the configuration file that was uploaded to the Reader shall be deleted from the JANUS MPR4.1 Reader Filesystem.

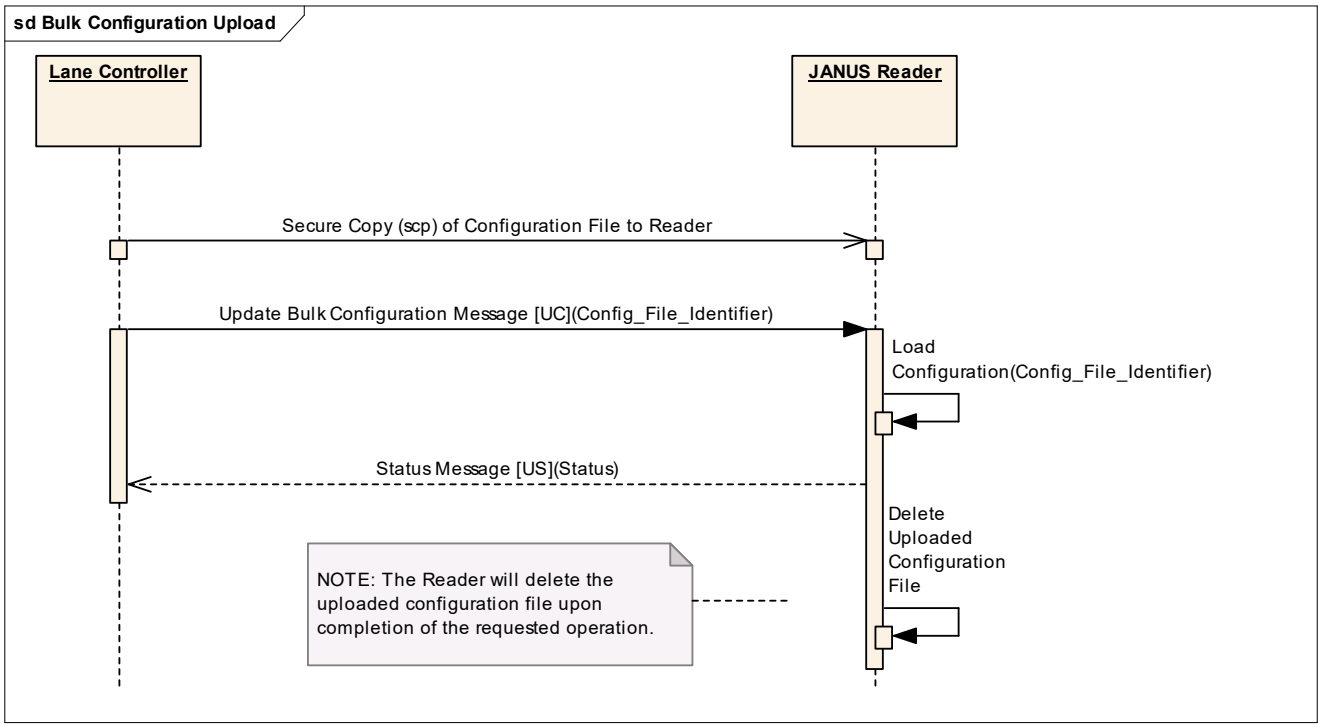

Figure 4.5-2: Bulk Configuration Upload

4.5.3 Bulk Configuration Download

Performing a Bulk Configuration download is a two-step process as shown in Figure 4.5-3. The Lane Controller first issues a *Generate (Bulk) Configuration File Message* [UG] to the JANUS MPR4.1 Reader to generate a new (Bulk) Configuration File on the Reader, suitable for download by the Lane Controller. *Note that the Reader will delete any previously existing (Bulk) Configuration Files present on the Reader Filesystem prior to the generation of the new (Bulk) Configuration File.*

Upon completion of the (Bulk) Configuration File generation process, the Reader shall respond to the Lane Controller with a *(Bulk) Configuration File Info Message* [UB] with the *Configuration File Name* field set to the name of the newly generated (Bulk) Configuration file. If, on the other hand, an error was encountered, the Reader shall instead respond with a *Software Update / Management Status Message* [US], describing the nature of the error.

The second and final step is the downloading of the newly generated configuration file from the JANUS MPR4.1 Reader to the Lane Controller via Secure Copy (scp). This can be accomplished by issuing the following Secure Copy (scp) command on the Lane Controller:

```
scp mpr2user@<Reader_IP_Address>:<Config_File> <LC_Dest_Path>
```

where **<Reader_IP_Address>** is the IP Address of the JANUS MPR4.1 Reader, **<Config_File>** is the name of the configuration file to download from the JANUS MPR4.1 Reader (supplied by the Reader in the *(Bulk)*

Configuration File Info Message) , and **<LC_Dest_Path>** is the copy destination path on a local directory on the Lane Controller.

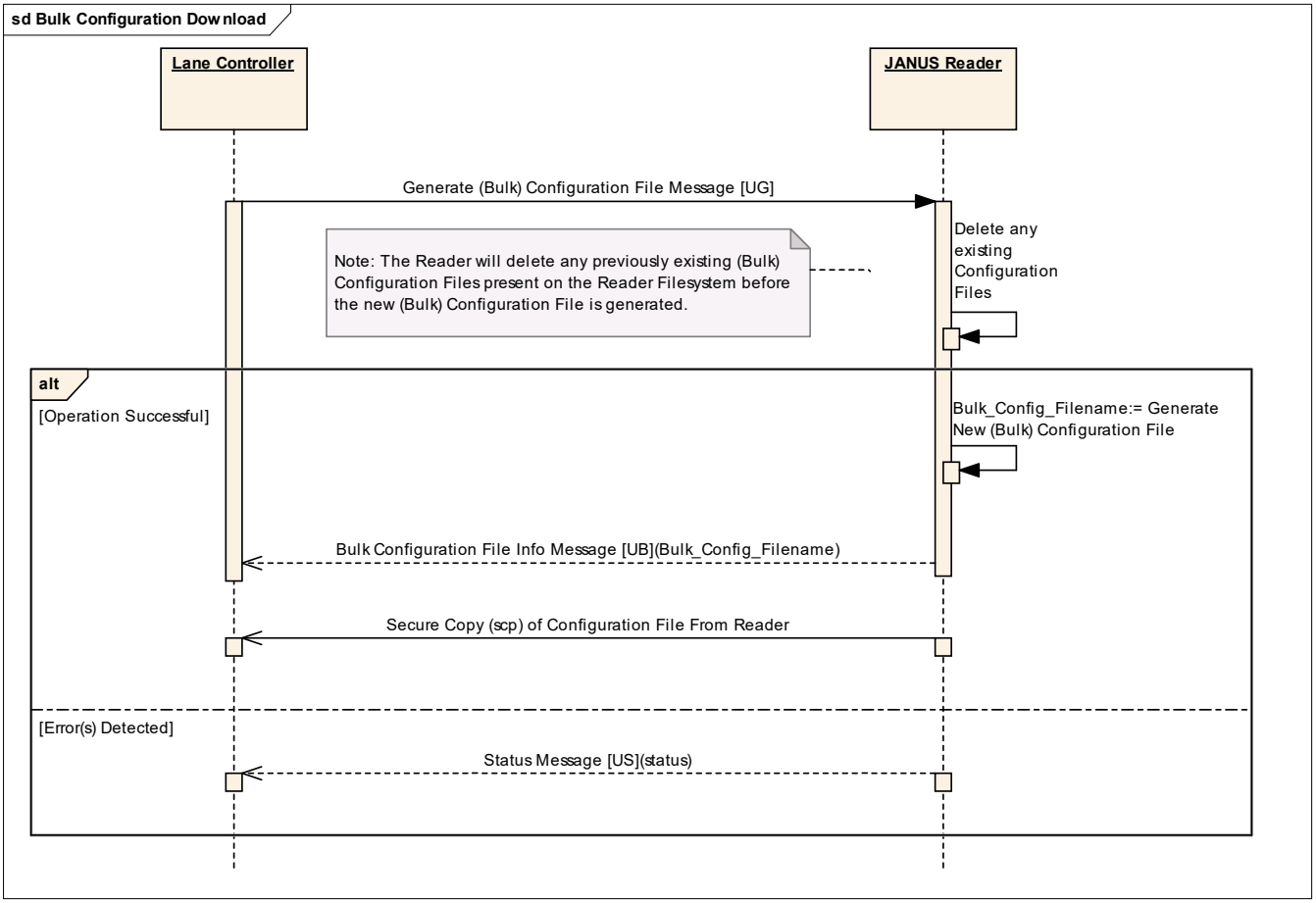

Figure 4.5-3: Bulk Configuration Download

5. APPLICATION MESSAGE ATTRIBUTES

For all messages defined in *Message Set* sections that follow, the following rules apply:

- All messaging shall be transmitted using packed ASCII-based message structures
- Square brackets indicate an optional message (or message component) that may, or may not be transmitted.

The information provided for each message is shown in Table 4.5-1:

Table 4.5-1: Reader / Lane Controller Application Message Attributes

Message Attribute	Description
Direction	Indicates the sender and receiver of the message
Description	A description of what the message contains and its intended use.
Format	How the message is assembled. All messages consist of printable characters. The following shorthand symbols are used: • An underscore character ("_") or the notation "<space>" indicates an ASCII space character. • 'alpha' denotes an ASCII alphabetic character ('A' – 'Z'). • 'dec' denotes an ASCII numeric character ('0' – '9'). • 'hex' denotes an ASCII hexadecimal character ('0' – '9', 'A' – 'F'). • 'alnum' denotes an ASCII alphanumeric character between **0x20** (32dec) and **0x5F** (95dec) in value (*i.e.* {**<space> ! " # $ % & ' ( ) * + , - . /**}, '**0**' – '**9**', {**: ; < = > ? @**}, '**A**' – '**Z**', {**[\ ] ^ _**}) Square brackets denote optional parameters that may be omitted. Time fields are shown as follows: • MM = month (01 – 12) • DD = day (01 – 31) • YY = year (00 – 99); 00 = 2000, 01 = 2001, etc. (covers the years 1970-2069) • HH = hour (00 – 23) • mm = minutes (00 – 59) • SS = seconds (00 – 59) • sss = milliseconds (000 – 999) All field lengths are specified in bytes.
Response	Indicates the receiver (Reader or Lane Controller) application response.

6. BASIC MESSAGE SET

This section specifies the basic application messages used for communication between the JANUS MPR4.1 Reader and the Lane Controller that are supported by the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface.

The *Basic Message Set* primarily deals with messaging originally conceived to support the TDM (IAG) Protocol. Many messages are backwards compatible with older IAG and Badger Readers (*c.f.* §2.1 for additional details). Also included in the *Basic Message Set* are messages dealing with, but not limited to:

- Getting and setting of basic configuration parameters
- Basic status reporting
- Getting and setting of Reader time (for non-NTP configurations)
- Lane RF control
- Voting Time Control

6.1 Basic Message Extended Information Field

The *Extended Information* field is an optional, variable-length field that conveys additional message information depending upon the configuration of the JANUS MPR4.1 Reader. If the JANUS MPR4.1 Reader is configured to report extended information, this field will be populated with those values that have been chosen to be reported in the Reader configuration**. If no extended information has been requested in the Reader configuration, the *Extended Information* field *WILL NOT BE PRESENT* in JANUS MPR4.1 Reader-to-Lane Controller messages.**

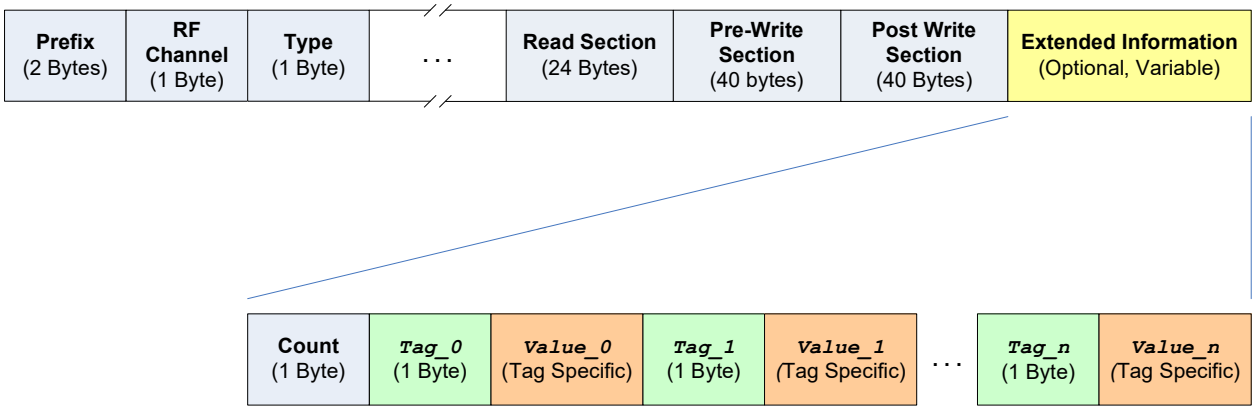

Figure 6.1-1: Basic Message Extended Information Format

Figure 6.1-1, above illustrates the *Extended Information* field appended to the end of a typical TDM Transponder Message. As shown in Figure 6.1-1, data is encoded into the *Extended Information* field in the form of **`{Tag, Value}`** pairs. Each **`{Tag}`** is encoded as one (1) ASCII hexadecimal character. **`{Value}`** data is encoded in a tag-specific fashion. The first byte of the *Extended Information* field is the *Count* sub-field (encoded in ASCII decimal), which specifies the total number of **`{Tag, Value}`** pairs encoded within the *Extended Information* field, if present.

Table 6.1-1 specifies the defined **`{Tag, Value}`** encodings for the *Extended Information* field of the Basic Message Set. (*Please note that any* **`{Tag}`** *values not explicitly listed in* Table 6.1-1 *are considered RESERVED*).

Table 6.1-1: Basic Message Extended Information `{Tag, Value}` Encodings

`{Tag}`	`{Value}` Name	`{Value}` Length & Format	`{Value}` Range	`{Value}` Contents	Message Applicability
0	*Timestamp*	16 dec	0 – 4294967295999999	The number of microseconds since the Epoch (1970-01-01 00:00:00 +0000 [UTC]) corresponding to the successful read event.	All Basic Message Set Initial Read, Transponder, Post Capture, and Status Messages.
All other values	*RESERVED*	*N/A*	*N/A*	*N/A*	*N/A*

6.2 Basic Messages

6.2.1 Configuration (CA) Message

Direction: Reader to Lane Controller.

Description: Message sent by the Reader in response to a Configuration Request (*c.f.* §6.2.2) message from the Lane Controller.

Note that there are two components reported: the *Global Reader Configuration* and the *RF Channel* ("lane") *Configuration*.

Format:

Table 6.2-1: Configuration (CA) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{CA}	Configuration Message: • CA = Reader Configuration
RF Channel	1 dec	1 – 4	Channel Identifier
TIME	13 dec	MMDDYY <space> HHmmSS	Reader Time
AID	3 dec	000 – 127	Agency identification number.
PID	3 dec	000 – 127	Plaza identification number.
RID	4 dec	0000 – 4095	Reader ID – Traffic Management reader identification number.
TYPE	1 alpha	{M, N}	Reader type: • M = primary
SYNC	1 dec	0 – 1	Inter-Reader RF Synchronization: • 0 = sync feature disabled • 1 = sync feature enabled (**See Note *1***)
TTO	3 dec	001 – 300	Number of seconds before a transponder can be re-reported.
TMP	1 dec	0 – 1	Traffic Management Programming: • 0 = don't program Traffic Management section with reader ID & timestamp • 1 = program Traffic Management section with reader ID & timestamp
TFRM	1 dec	0 – 3	Specifies handling of transaction field: • 0 = Do not reprogram transaction field. • 1 = reprogram with 16 bit random number. • 2 = reprogram with 16 bit sequential txn number • 3 = reprogram with 8 bit random number and 8 bit sequential number

Field Name	Length & Format	Range	Contents
TTP	2 dec	10 – 99	Number of seconds between test tag interrogations. *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
SFT	2 dec	01 – 99	Single RF-module fault threshold. Number of consecutive test tag errors before a lane is considered bad. *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
MFT	1 dec	0 – 8	Multiple RF-module fault threshold. Number of RF modules that must be simultaneously bad (*i.e.* in SFT state) before causing a switchover to the slave reader. Normally set to the number of lanes equipped with test tags. *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
PTO	1 dec	0 – 9	Protocol time-out. Number of 100 ms time units (less one) in which a ACK must be received before the reader re-transmits a message to the lane controller (9 = 1 second) *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
Reserved	7 alnum	<space>	*Reserved section ignored by JANUS*
CC	1 dec	0 – 1	Remote Configuration: • 0 = don't allow remote reader configuration • 1 = allow remote reader configuration
Separator	1 alnum	'–' (<dash>)	A <dash> character separator separates the Global Configuration Elements from the Lane Configuration Elements
LANE ST	1 alpha	{A, G, O}	Lane status: • A = active • G = guard • O = off-line
LANE NUM	2 dec	00 – 31	Lane number programmed into transponder

Field Name	Length & Format	Range	Contents
LANE TTAG	1 dec	0 – 1	Test Tag configuration: • 0 = no Test Tag in lane • 1 = Test Tag in lane *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
COM ST	1 dec	0 – 1	COM port: • 0 = off-line • 1 = on-line *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
COM BR	2 dec	{96, 19, 57, 11}	COM port bit rate: • 96 = 9600 bps • 19 = 19200 bps • 57 = 57600 bps • 11 = 115200 bps *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
COM PA	1 alpha	{N, O, E}	COM port parity: • N = none • O = odd • E = even *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
COM CS	1 dec	5 – 8	COM port – number of bits per character *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
COM SB	1 dec	{1, 5, 2}	COM port – number of stop bits (*5 = 1.5 stop bits*) *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
COM FC	1 alpha	{N, H, X}	COM port flow control: • N = none • H = hardware • X = xon / xoff *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*

Notes:

(1)- For the Inter-Reader RF Synchronization to be considered *ENABLED* (*i.e.* to report a '**1**' in the SYNC field), the following condition applies:

(a) The JANUS MPR4.1 Reader must have at least one (1) Sync protocol item configured within its Tag Protocol Configuration

Inter-Reader RF Synchronization is considered to be *DISABLED* if this condition is not met. Please refer to [AD2] for details on how to configure Inter-Reader RF Synchronization on the JANUS MPR4.1 Reader.

Response: No response expected from Lane Controller

Sample configuration message ('**_**' indicates an ASCII <space> character):

CA1030180_0000220000000000M130002300589_____1-A010119N81N

6.2.2 Configuration Request (CR) Message

Direction: Lane Controller to Reader.

Description: This message is sent by the lane controller in order to obtain the current configuration of the reader (both global and RF channel specific).

Format:

CR**<channel>**

Where **<channel> =** RF channel number (1 – 4).

Response: The Reader responds with a *Configuration Message* (*c.f.* §6.2.1).

6.2.3 TDM Initial Read (IA) Message

Direction: Reader to Lane Controller.

Description: Optional informational message sent to the Lane Controller when a TDM transponder first enters the capture zone.

This message applies when the "*Initial Report*" configuration parameter option is enabled on the JANUS MPR4.1 Reader. *Note that the initial read channel may differ from the transaction report generated at voting time*.

Format:

Table 6.2-2: TDM Initial Read (IA) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{IA}	TDM Initial Read Message: • IA = Initial Read Report
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (tag has just gone through lane) • B = buffered message (*report is from transaction buffer*) *Note: Buffered Initial Read messages will only be sent to the Lane Controller if* 'Initial Read Report Message Buffering' *is ENABLED.*
Transaction Status	1 alpha	R	Transaction Status: • R = read
Txn Number	5 dec	00000 – 65535	Transaction Number
TDM Transponder (Read Section) Data	24 hex	N / A	The contents of the TDM Transponder read-only section. (12 bytes encoded in ASCII HEX = 96 bits)
TDM Transponder (Pre-Write Section) Data	40 hex	N / A	The contents of the TDM Transponder write section before programming. (20 bytes encoded in ASCII HEX = 160 bits)
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §6.1 for details on this field)

Response: No response expected from Lane Controller.

6.2.4 TDM Initial Read (IA – Format A – TRBA) Message

Direction: Reader to Lane Controller

Description: Optional informational message sent to the Lane Controller when a TDM Toll / Balance transponder first enters the capture zone.

This message applies when:

(1) The "*Initial Read*" option is enabled on the web interface,

(2) The JANUS MPR4.1 Reader is processing a TDM Toll Rate / Balance Adjustment Transponder, *and*

(3) The JANUS MPR4.1 Reader *LC Report Format – Toll Rate / Balance Adjustment Tag Report Format* configuration parameter is set to '*Toll Rate / Balance Adj Format*'.

Note that if condition (1) and (2) are satisfied and condition (3) is NOT MET, the Reader will issue a "standard" Initial Read Message as defined in §6.2.3..

Format: *This format is required due to the size differences of the Read / Write sections of an ISTHA formatted internal transponder.*

Table 6.2-3: TDM Initial Read (IA – Format A - TRBA) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{IA}	TDM Initial Read Message: • IA = Initial Read Report
RF Channel	1 dec	1 – 4	RF Channel Identifier
Format Code	1 alpha	A	Format Code: • A = TDM Toll / Balance (ISTHA Formatted) Transponder
Type	1 alpha	{R, B}	• R = real-time message (tag has just gone through lane) • B = buffered message (*report is from transaction buffer*) *Note: Buffered Initial Read messages will only be sent to the Lane Controller if* 'Initial Read Report Message Buffering' *is ENABLED.*
Transaction Status	1 alpha	R	Transaction Status: • R = read
Txn Number	5 dec	00000 – 65535	Transaction Number
TDM Transponder (Read Section) Data	18 hex	N / A	The contents of the TDM Toll / Balance Transponder read-only section (9 bytes encoded in ASCII HEX = 72 bits)
TDM Transponder (Pre-Write Section) Data	46 hex	N / A	The contents of TDM Toll / Balance Transponder write section before programming (23 bytes encoded in ASCII HEX = 184 bits)

Field Name	Length & Format	Range	Contents
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §6.1 for details on this field)

Response: No response expected from Lane Controller.

6.2.5 Initialization (IN) Message

Direction: Reader to Lane Controller

Description: After power-up or reset, the Initialization Message is sent within a restart packet on all configured Lane Controller destinations.

The Reader reports the contents of the Reader real-time clock, and the JANUS MPR4.1 Reader firmware version.

Format:

Table 6.2-4: Initialization (IN) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{IN}	Initialization Message • IN = Initialization Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Cause	2 alpha	{RS}	2 character string indicating the reason for the initialization message: • RS = Reader power up or reset
Date / Time	14 dec	MMDDYY <space> HHmmSS <space>	Contents of Reader Real-Time clock
Firmware Version	15 alnum	N / A	JANUS MPR4.1 Reader Firmware Version. *A 15-character, fixed-length firmware version string (padded with trailing blanks if needed)*

Response: No response expected from Lane Controller.

6.2.6 Lane Active (LA) Message

Direction: Lane Controller to Reader.

Description: Sent by the Lane Controller to set an RF channel ("lane") active.

This turns on the specified RF Module. Transponders are interrogated by the reader and are reported to the lane controller.

Transponder fields are reprogrammed according to the parameters (RW, TMP, TCP, AID, PID, RID, TIME, TFRM, LANE NUM).

Format:

LA**<channel>**

Where **<channel> =** RF channel number (1 – 4)

e.g., **`LA4`** (makes RF Channel 4 active)

Response: [The Reader shall transmit an asynchronous *Status Message* (*c.f.* §6.2.14) to the Lane Controller if and only if the lane status has changed.]

6.2.7 Lane Guard (LG) Message

Direction: Lane Controller to Reader.

Description: Sent by the Lane Controller to make a channel a *Guard Channel*. Any transponders assigned to a *Guard Channel* are not reported to the Lane Controller.

Transponder user fields (*e.g.*, timestamp, Plaza ID, etc.) are not modified.

Format:

LG**<channel>**

Where **<channel> =** RF channel number (1 – 4)

e.g., **`LG2`** (makes RF Channel 2 a *Guard Channel*)

Response: [The Reader shall transmit an asynchronous *Status Message* (*c.f.* §6.2.14) to the Lane Controller if and only if the lane status has changed.]

6.2.8 Lane Off-Line (LO) Message

Direction: Lane Controller to Reader.

Description: Sent by the Lane Controller to set an RF channel ("lane") offline.

This message turns off the RF interrogation in the lane. Transponders are not interrogated, reported, or re-programmed.

Unlike the IAG reader, setting an RF channel from active to offline does not clear the memory of the last three (3) transponders assigned to that lane. If the RF channel is then set active again, those tags are not re-reported if they reappear in the channel within the timeout period.

Format:

LO**<channel>**

Where **<channel> =** RF channel number (1 – 4)

e.g., **`LO2`** (sets RF Channel 2 to offline)

Response: [The Reader shall transmit an asynchronous *Status Message* (*c.f.* §6.2.14) to the Lane Controller if and only if the lane status has changed.]

6.2.9 TDM Post Capture (PA) Message

Direction: Reader to Lane Controller

Description: This message is an optional informational message. This message is generated if the "*Post-Capture-Zone Report*" feature is enabled, and the Reader detects a change in the programming status of the TDM transponder (*e.g.* from fail to success), or a lane assignment change. This report is generated at a multiple of the voting time (configurable) after the normal transaction report.

Post Capture messages are buffered (*the volume of post capture messages is expected to be low relative to normal transaction messages).*

Format:

Table 6.2-5: TDM Post Capture (PA) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{PA}	TDM Post Capture Message: • PA = TDM Post Capture Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Transaction Status	1 alpha	{S, F, U, R, X, D, C}	(Revised) Transaction Status: • S = Successful • F = Programming Failed • U = Programming Unverified • R = Read Only • X = Non-IAG Transponder • D = Decommissioned Transponder • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled.*
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00. An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*

Field Name	Length & Format	Range	Contents
TDM Transponder (Read Section) Data	24 hex	N/A	The contents of the TDM Transponder read-only section. (12 bytes encoded in ASCII HEX = 96 bits)
TDM Transponder (Pre-write Section) Data	40 hex	N/A	The contents of the TDM Transponder write section before programming. (20 bytes encoded in ASCII HEX = 160 bits)
TDM Transponder (Post-write Section) Data	40 hex	N/A	The contents of the TDM Transponder write section if programming is attempted. (20 bytes encoded in ASCII HEX = 160 bits)
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §6.1 for details on this field)

Response: No response expected from Lane Controller.

6.2.10 TDM Post Capture (PA – Format A – TRBA) Message

Direction: Reader to Lane Controller

Description: This message is an optional informational message. This message applies when:

(1) The "*Post-Capture-Zone Report*" option is enabled on the web interface,

(2) The JANUS MPR4.1 Reader is processing a TDM Toll Rate / Balance Adjustment Transponder, *and*

(3) The JANUS MPR4.1 Reader *LC Report Format – Toll Rate / Balance Adjustment Tag Report Format* configuration parameter is set to '*Toll Rate / Balance Adj Format*'.

Note that if condition (1) and (2) are satisfied and condition (3) is NOT MET, the Reader will issue a "standard" Post Capture Report Message as defined in §6.2.9.

This message is generated if the "*Post-Capture-Zone Report*" feature is enabled, and the Reader detects a change in the programming status of the TDM Transponder (*e.g.* from fail to success), or a lane assignment change. This report is generated at a multiple of the voting time (configurable) after the normal transaction report.

Post Capture messages are buffered (the volume of post capture messages is expected to be low relative to normal transaction messages).

Format: *This new format is required due to the size differences of the Read / Write sections of an ISTHA formatted internal transponder.*

Table 6.2-6: TDM Post Capture (PA – Format A - TRBA) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{PA}	TDM Post Capture Message: • PA = TDM Post Capture Message
RF Channel	1 dec	1 – 8	RF Channel Identifier
Format Code	1 alpha	A	Format Code: • A = TDM Toll / Balance (ISTHA Formatted) Transponder
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)

Field Name	Length & Format	Range	Contents
Trans. Status	1 alpha	{S, F, U, R, X, D, C}	(Revised) Transaction Status: • S = successful • F =program failed • U = program unverified • R = read only • X = non-IAG tag • D = decommissioned tag • C = Cross-Reader Report (informational, optional) Tag reported by adjacent reader). *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the web interface.*
Assign. Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00. An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
Read Section	18 hex	N / A	The contents of the TDM Transponder read-only section (9 bytes encoded in ASCII HEX = 72 bits)
Pre-write section	46 hex	N / A	The contents of the TDM Transponder write section before programming (23 bytes encoded in ASCII HEX = 184 bits)
Post-write section	46 hex	N / A	The contents of the TDM Transponder write section if programming is attempted (23 bytes encoded in ASCII HEX = 184 bits)
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §6.1 for details on this field)

Response: No response expected from Lane Controller.

6.2.11 Reboot Request (RB) Message

Direction: Lane Controller to Reader

Description: Issues a request to the Reader (CTM) to reboot.

Format: RB

Response: [If the *Reboot Request* is successful, the Reader shall implicitly transmit an *Initialization Message* [IN] to the Lane Controller as part of the JANUS MPR4.1 Reader software startup sequence (see §3.4.9 for additional details.]

6.2.12 Re-Report Request (RR) Message

Direction: Lane Controller to Reader

Description: Used by the Lane Controller in certain lane-based (non-open road) customer configurations to force the reader to re-report a transponder if it happens to be under the associated antenna. When this feature is used, the Lane Controller typically ignores any tag report received before the *Re-Report Request Message* is sent from the Lane Controller to the Reader.

As this feature was developed initially for a lane-based system, please contact Kapsch TrafficCom before using this feature in an Open-Road Tolling *(ORT) environment.*

Format:

RR**<channel>**

Where **<channel> =** RF channel number (1 – 4).

e.g., **RR2** (request a Re-Report for RF channel 2)

Response: [**'RR<space>O'** – If the *Re-Report Request Message* was issued against a channel that is configured to be offline.]

[**'RR<space>G'** – If the *Re-Report Request Message* was issued against a channel that is configured to be a *Guard Lane*.]

[If a transponder is present, the reader shall asynchronously transmit a *Transponder Message* to the Lane Controller. The toll collection timestamp will be updated, along with the transaction number.]

Note that the Reader shall not transmit any messages to the Lane Controller if no transponder is present in the capture zone.

6.2.13 [Precision] Read Time (RT) Message

Direction: Lane Controller to Reader

Description: Request the JANUS MPR4.1 Reader to report its current time. The standard format of this message is backwards compatible with IAG and Badger Readers. This message supports an optional extended version of the standard Read Time (RT) message. The extended message supports the option of requesting the JANUS MPR4.1 Reader time with millisecond resolution.

Format: RT**[**<space>**<precision>]**

where:

<precision> = 'P' to request Reader time with millisecond resolution

e.g. **`RT`** (to request Reader time in (standard) second resolution. *This request is compatible with legacy IAG and Badger readers*).

`RT<space>P` (to request Reader time in (precision) millisecond resolution)

Response: The Reader shall respond with a *[Precision] Time Message* (*c.f.* §6.2.20).

6.2.14 Status (SA) Message

Direction: Reader to Lane Controller.

Description: The JANUS MPR4.1 Reader transmits this message to the Lane Controller under the following circumstances:

- In direct response to a *Status* Request (solicited) from the Lane Controller; and/or
- Whenever any of the applicable fields in the *Status Message* have changed, either as a result of a Reader configuration change, or as the result of a change in Reader status due to some event or condition (*e.g.*, channel active to offline, sync error).

Format:

Table 6.2-7: Status (SA) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{SA}	Status Message: • SA = Status Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Reader Active Flag	1 dec	0 – 1	Reader Active Flag: • 0 = inactive, reader not processing tags • 1 = active, reader processing (and reporting) tags
Sync Status	1 dec	0 – 1	Synchronization Status: • 0 = no sync error (or sync not configured) • 1 = loss of synchronization (sync cable may be cut) *Setting synchronization off while sync is active does not generate a status message.*
CGC Status	1 dec	0 – 1	CGC Status: • 0 = CGC board operational • 1 = CGC board failure (not responding to health checks)
Separator	1 alnum	'-' <dash>	<dash> character separator
Lane Status	1 alpha	{A, G, O}	Lane Status: • A = Lane Active • G =Lane Guard • O = Lane Off-Line
Reserved	1 dec	0	The Reader shall report a '0' in this field.

Field Name	Length & Format	Range	Contents
Lane Fault	1 dec	0 – 1	Lane Fault Status: • 0 = lane OK • 1 = number of consecutive test tag faults in this lane greater than or equal to SFT *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
Num Faults	2 dec	00 – 99	Provides a running count of the **total** test tag errors on the RF Channel, consecutive or not. After reaching 99, this field wraps around to 00. *Set to 00 after power-up or reset* *This field has no meaning for the JANUS MPR4.1 Reader and is retained for legacy message compatibility only.*
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §6.1 for details on this field)

Response: No response expected from Lane Controller.

6.2.15 Set Configuration (SC) Message

Direction: Lane Controller to Reader.

Description: Allows a Lane Controller to remotely configure the reader (*if remote configuration is enabled*). Remote configuration can be enabled or disabled via the Reader Configuration Web Interface. If remote configuration is disabled, the *Set Configuration* Message is ignored.

Format:

SC**<channel>**[**<global-config>**] [**<lane-config>**]

Where:

<channel> = Ethernet Connection Instance = 1 – 4

<global-config> is defined as shown in Table 6.2-8.

<lane-config> is defined as shown in Table 6.2-9.

Either global or lane configuration is optional. A lane can thus be reconfigured without modifying global reader parameters. To reconfigure the lane parameters only, the Lane Controller can issue a shorter "SC<space>**<lane-config>**" command.

Table 6.2-8 defines the Message Elements for the **<global-config>** portion of the *Set Configuration* Message; Table 6.2-9 defines the Message Elements for the **<lane-config>** portion of the *Set Configuration* Message.

Table 6.2-8: Set Configuration (SC) Message <global-config> Elements

Field Name	Length & Format	Range	Contents
TIME	13 dec	MMDDYY <space> HHmmSS	Reader Time
AID	3 dec	000 – 127	Agency identification number.
PID	3 dec	000 – 127	Plaza identification number.
RID	4 dec	0000 – 4095	Reader ID – Traffic Management reader identification number.
TYPE	1 alpha	{M, S, N}	Reader type: • M = primary • S = secondary • N = standalone / non-redundant *This field is included for backwards compatibility only. This field is ignored by the JANUS MPR4.1 Reader.*
SYNC	1 dec	0 – 1	Inter-Reader RF synchronization: • 0 = sync feature disabled • 1 = sync feature enabled (**See Note *1***)
TTO	3 dec	001 – 300	Number of seconds before a transponder can be re-reported.
TMP	1 dec	0 – 1	Traffic Management Programming: • 0 = don't program Traffic Management section with reader ID & timestamp • 1 = program Traffic Management section with reader ID & timestamp
TFRM	1 dec	0 – 3	Specifies handling of transaction field: • 0 = Do not reprogram transaction field. • 1 = reprogram with 16 bit random number. • 2 = reprogram with 16 bit sequential txn number • 3 = reprogram with 8 bit random number and 8 bit sequential number
TTP	2 dec	10 – 99	Number of seconds between test tag interrogations. *This field is included for backwards compatibility only. This field is ignored by the JANUS MPR4.1 Reader.*

Field Name	Length & Format	Range	Contents
SFT	2 dec	01 – 99	Single RF-module fault threshold. Number of consecutive test tag errors before a lane is considered bad. *This field is included for backwards compatibility only. This field is ignored by the JANUS MPR4.1 Reader.*
MFT	1 dec	0 – 8	Multiple RF-module fault threshold. Number of RF modules that must be simultaneously bad (*i.e.* in SFT state) before causing a switchover to the slave reader. Normally set to the number of lanes equipped with test tags. *This field is included for backwards compatibility only. This field is ignored by the JANUS MPR4.1 Reader.*
PTO	1 dec	0 – 9	Protocol time-out. Number of 100 ms time units (less one) in which a ACK must be received before the reader re-transmits a message to the lane controller (9 = 1 second) *This field is included for backwards compatibility only. This field is ignored by the JANUS MPR4.1 Reader.*
Reserved	7 alnum	X (don't care)	*Reserved section ignored by the JANUS MPR4.1 Reader*
CC	1 dec	0 – 1	Remote Configuration: • 0 = don't allow remote reader configuration • 1 = allow remote reader configuration

Notes:

(1)- For the Inter-Reader RF Synchronization to be considered *ENABLED* (*i.e.* to report a '1' in the SYNC field), the following condition applies:

(a) The JANUS MPR4.1 Reader must have at least one (1) Sync protocol item configured within its Tag Protocol Configuration

Inter-Reader RF Synchronization is considered to be *DISABLED* if this condition is not met. Please refer to [AD2] for details on how to configure Inter-Reader RF Synchronization on the JANUS MPR4.1 Reader.

Table 6.2-9: Set Configuration (SC) Message <lane-config> Elements

Field Name	Length & Format	Range	Contents
Separator	1 alnum	'-' (<dash>)	A <dash> character separator separates the Global Configuration Elements from the Lane Configuration Elements
LANE ST	1 alpha	{A, G, O}	Lane status: • A = active • G = guard • O = off-line
LANE NUM	2 dec	00 – 31	Lane number programmed into transponder
LANE TTAG	1 dec	0 – 1	Test Tag configuration: • 0 = no Test Tag in lane • 1 = Test Tag in lane *This field is included for backwards compatibility only. This field is ignored by the JANUS MPR4.1 Reader.*
COM ST	1 dec	0 – 1	COM port: • 0 = off-line • 1 = on-line *This field is included for backwards compatibility only. This field ignored by the JANUS MPR4.1 Reader .*
COM BR	2 dec	{96, 19, 57, 11}	COM port bit rate: • 96 = 9600 bps • 19 = 19200 bps • 57 = 57600 bps • 11 = 115200 bps *This field is included for backwards compatibility only. This field ignored by the JANUS MPR4.1 Reader*
COM PA	1 alpha	{N, O, E}	COM port parity: • N = none • O = odd • E = even *This field is included for backwards compatibility only. This field ignored by the JANUS MPR4.1 Reader*
COM CS	1 dec	5 – 8	COM port – number of bits per character *This field is included for backwards compatibility only. This field ignored by the JANUS MPR4.1 Reader*

Field Name	Length & Format	Range	Contents
COM SB	1 dec	{1, 5, 2}	COM port – number of stop bits (*5 = 1.5 stop bits*) *This field is included for backwards compatibility only. This field ignored by the JANUS MPR4.1 Reader*
COM FC	1 alpha	{N, H, X}	COM port flow control: • N = none • H = hardware • X = xon / xoff *This field is included for backwards compatibility only. This field ignored by the JANUS MPR4.1 Reader*

Special Note: Range Errors:

A range error in a field of the Set Configuration *message causes the Reader to stop parsing the remainder of the message. The Reader sends no error messages in the event of a range error.*

Response: [The Reader shall transmit an asynchronous *Status Message* (*c.f.* §6.2.14) to the Lane Controller if and only if the Reader status has changed as a result of the new configuration.]

*The Lane Controller can issue a Configuration Request (*c.f. *§6.2.2) message to the Reader to verify that the settings have been applied.*

6.2.16 Vehicle Speed (SP) Message

Direction: Lane Controller to Reader

Description: Sent by the Lane Controller to assist the Reader in determining the optimum voting time.

The message contains the measured speed of a single vehicle going through the specified channel's Capture Zone. *Note that this measurement is provided at some unspecified time after the vehicle is outside the communication zone; the Reader does not use this message to trigger reporting of a tag transaction).*

If configured to do so, the Reader converts the vehicle speed into a voting time that maximizes the use of the Capture Zone. This is performed with a moving average with the number of samples specified in the Reader configuration.

Vehicle Speed messages are optional and are not needed for fixed voting time configurations. *This message is ignored by the Reader if it is configured to use a fixed Voting Time.*

Expected Frequency: The Reader shall support the receipt of this message for every vehicle identified by a Lane Controller.

Format:

Table 6.2-10: Vehicle Speed (SP) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{SP}	Vehicle Speed Message: • SP = Vehicle Speed Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Speed	3 dec	000 – 199	The value of the vehicle speed
Units	3 alpha	{KMH, MPH}	Units of Vehicle Speed Measurement: • KMH = kilometers per hour • MPH = miles per hour

Response: [The Reader shall asynchronously transmit a *Voting Time* Message (*c.f.* §6.2.23) to the Lane Controller if the Voting Time changes as a result of any updates in Vehicle Speed.]

6.2.17 Status Request (SR) Message

Direction: Lane Controller to Reader

Description: Used by the Lane Controller in order to obtain the current Reader status.

Note that the Reader may also send Status Messages *asynchronously (*i.e. *at any time) without the Lane Controller having requested it* (see §6.2.14).

Format:

SR**<channel>**

Where **<channel> =** RF channel number (1 – 4).

e.g., **SR2** (requests channel 2 status)

Response: The Reader shall respond with a *Status Message* (*c.f.* §6.2.14).

6.2.18 Set Time (ST) Message

Direction: Lane Controller to Reader

Description: This message sets the current Reader time.

Format: ST<space>MMDDYY<space>HHMMSS

Where:

MM = month (01 – 12)

DD = day (01 – 31)

YY = year (70 – 37) [*i.e.* 70 = 1970 … 99 = 1999, 00 = 2000, 01 = 2001, *etc.*]

(Note Badger reader difference: Badger allowed up to 2069)

HH = hour (00 – 23)

MM = minutes (00 – 59)

SS = seconds (00 – 59)

(*Note: HHMMSS Set-Time value is in UTC*)

Response: No response from Reader.

6.2.19 TDM Transponder (TA) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*Voting Report*" feature is enabled. This message is issued by the Reader after a TDM transponder has been read and assigned to a channel (*i.e.* after voting time expires). The reporting latency can be controlled by adjusting the *Voting Time* and/or the *Reporting Delay Time*.

Format:

Table 6.2-11: TDM Transponder (TA) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{TA}	TDM Transponder Message: • TA = TDM Transponder Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Transaction Status	1 alpha	{S, F, U, R, X, D, C}	Transaction Status: • S = Successful • F = Programming Failed • U = Programming Unverified • R = Read Only • X = Non-IAG Transponder • D = Decommissioned Transponder • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled.*
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00. An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
TDM Transponder (Read Section) Data	24 hex	N/A	The contents of the TDM Transponder read-only section. (12 bytes encoded in ASCII HEX = 96 bits)

Field Name	Length & Format	Range	Contents
TDM Transponder (Pre-write Section) Data	40 hex	N/A	The contents of the TDM Transponder write section before programming. (20 bytes encoded in ASCII HEX = 160 bits)
TDM Transponder (Post-write Section) Data	40 hex	N/A	The contents of the TDM Transponder write section if programming is attempted. (20 bytes encoded in ASCII HEX = 160 bits)
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §6.1 for details on this field)

Response: No response expected from Lane Controller

6.2.20 TDM Transponder (TA – Format A – TRBA) Message

Direction: Reader to Lane Controller

Description: This message is an optional informational message. This message applies when:

(1) The "*Post-Capture-Zone Report*" option is enabled on the web interface,

(2) The JANUS MPR4.1 Reader is processing a TDM Toll Rate / Balance Adjustment Transponder, *and*

(3) The JANUS MPR4.1 Reader *LC Report Format – Toll Rate / Balance Adjustment Tag Report Format* configuration parameter is set to '*Toll Rate / Balance Adj Format*'.

Note that if condition (1) and (2) are satisfied and condition (3) is NOT MET, the Reader will issue a "standard" Transponder (Majority Voting) Message as defined in §6.2.19.

The Reader issues this message after a TDM Transponder has been read and assigned to a channel (after voting time expires). Adjusting the voting time or the reporting delay time can control the reporting latency.

Format: *This new format is required due to the size differences of the Read / Write sections of an ISTHA formatted internal transponder.*

Table 6.2-12: TDM Transponder (TA – Format A – TRBA) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{TA}	TDM Transponder Message: • TA = TDM Transponder Message
RF Channel	1 dec	1 – 8	RF Channel Identifier
Format Code	1 alpha	A	Format Code: A = TDM Toll / Balance (ISTHA Formatted) Transponder
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Transaction Status	1 alpha	{S, F, U, R, X, D, C}	Transaction Status: • S = successful • F =program failed • U = program unverified • R = read only • X = non-IAG tag • D = decommissioned tag • C = Cross-Reader Report (informational, optional) Tag reported by adjacent reader). *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the web interface.*

Field Name	Length & Format	Range	Contents
Assign. Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction *First report after reset or power-up indicates 00. An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
TDM Transponder (Read Section) Data	18 hex	N / A	The contents of the TDM Transponder read-only section (9 bytes encoded in ASCII HEX = 72 bits)
TDM Transponder (Pre-write section) Data	46 hex	N / A	The contents of the TDM Transponder write section before programming (23 bytes encoded in ASCII HEX = 184 bits)
TDM Transponder (Post-write section) Data	46 hex	N / A	The contents of the TDM Transponder write section if programming is attempted (23 bytes encoded in ASCII HEX =184 bits)
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §6.1 for details on this field)

Response: No response expected from Lane Controller.

6.2.21 [Precision] Time (TM) Message

Direction: Reader to Lane Controller

Description: This message contains the current time stored in the JANUS MPR4.1 Reader, and is the JANUS MPR4.1 Reader response to a *[Precision] Read Time* message (*c.f.* §6.2.13). The standard format of this message is backwards compatible with IAG and Badger Readers. This message supports an optional extended version of the standard *Time* (TM) message. This message now supports the option of reporting the JANUS MPR4.1 Reader time with millisecond resolution.

Format: TM<space>**[P]**MMDDYY<space>HHmmSS**[.sss]**

Where:

MM = month (01 – 12)

DD = day (01 – 31)

YY = year (00 – 99)

HH = hour (00 – 23)

mm = minutes (00 – 59)

SS = seconds (00 – 59)

sss = milliseconds (000 – 999)

(*Note: The **[P]** identifier and **[.sss]** fields are optional and will only be present if a Read Precision Time (*i.e.* **`RT<space>P`**) command is sent to the Reader. Please refer to the description of the [Precision] Read Time command in §6.2.13 for additional details)

(*Note: The reported **[P]**MMDDYY<space>HHmmSS**[.sss]** time value depends on which time zone the Reader is configured to be in. If NTP is disabled, the Reader shall report time in UTC. If NTP is enabled, the Reader shall report the time in the configured time-zone)

Response: No response expected from Lane Controller.

6.2.22 Transaction Number Reset (TR) Message

Direction: Lane Controller to Reader

Description: Resets the transaction counter maintained by the JANUS MPR4.1 Reader.

The JANUS MPR4.1 Reader maintains a transaction counter which, by default, is programmed into a 16-bit area of the transponder. The transaction number increments every time the Reader attempts to program a new tag. The first tag programmed after a "*Transaction Reset*" command is transaction number 1.

*Note: The "*Transaction Number Programming*" configuration parameter controls how the transaction number is actually programmed into a transponder.*

Format: TR

Response: No response from Reader.

6.2.23 Voting Time (VT) Message

Direction: Bidirectional (Lane Controller to Reader and/or Reader to Lane Controller, depending on context)

Description: **Lane Controller to Reader:**

The Lane Controller can set a specific voting time by sending this message to the Reader.

Reader to Lane Controller:

This message is issued by the Reader to report a change in the current voting time, as a result of either:

- A User-Initiated and/or Lane Controller directed configuration change; or
- An update to the voting time via the JANUS MPR4.1 Reader dynamic voting algorithm.

Format: There are two Lane Controller to Reader formats depending on whether (or not) the Reader is configured to use *Multiplexed Reporting Mode* (*See* §2.7 *for additional information on multiplexed reporting mode*), as follows:

- **Lane Controller to Reader:**

  VT**<channel>**[**<value>**] (new voting time for specific channel)

  Where:

  <channel> specifies the RF channel (`1 – 8`) for which to either set or request the voting time;

  <value>, if present, instructs the Reader to set a new voting time for the specified **<channel>**. The **<value>** field is a 4-digit decimal value with the new voting time in milliseconds between (`0050 – 9999`) milliseconds. A **<value>** of `0000` instructs the Reader to disable voting for lane assignment for the specified **<channel>**.

  Note: If ***<value>*** *is omitted, the Reader shall interpret this as a request from the Lane Controller for the Reader to report the current voting time setting for the specified* ***<channel>****. The Reader shall then respond with a Voting Time Message to report the requested voting time setting*

  .

- **Reader to Lane Controller:**

  The Reader to Lane Controller *Voting Time* message format is show in Table 6.2-13.

Table 6.2-13: Voting Time (VT) Message Format – Reader to Lane Controller

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{VT}	Voting Time Message: • VT = Voting Time Message (*Reader is reporting a change in voting time*)
RF Channel	1 dec	1 – 4	RF Channel Identifier
Voting Time	4 dec	{0000, 0050 – 9999}	A 4-digit decimal value with the new voting time in milliseconds (between `'0050'` – `'9999'` ms). A `'0000'` indicates that voting for lane assignment is disabled.

Response:

- **Lane Controller to Reader:**

  [If the **<value>** field is present in the Lane Controller Request, the Reader shall asynchronously transmit a *Voting Time Message* (*c.f.* Table 6.2-13) to the Lane Controller if the new Voting Time is different from the current setting.]

  [If the **<value>** field is absent from the Lane Controller Request, the Reader shall asynchronously transmit a *Voting Time Message* (*c.f.* Table 6.2-13) to the Lane Controller indicating the current voting time setting.]

- **Reader to Lane Controller:**

  No response expected from Lane Controller.

7. JANUS MPR4.1 READER – LANE CONTROLLER ETHERNET INTERFACE – MESSAGE SET

This section describes specific JANUS MPR4.1 Reader – Lane Controller Ethernet Interface application messages used for communication between the JANUS MPR4.1 Reader and the Lane Controller over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface.

The *Ethernet Interface Message Set* deals with specific messaging used over the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface that differs from the *Basic Message Set* (which was originally conceived to support the TDM/IAG Protocol over a legacy serial interface).

7.1 JANUS MPR4.1 Reader – Lane Controller Ethernet Interface Messages

7.1.1 Acknowledge Transmission (AT) Message

Direction: Lane Controller to Reader.

Description: This message is sent by the Lane Controller to acknowledge receipt of ***any and all non-SYNC*** messages sent by the Reader over the *Reader-to-Lane Controller Reporting Socket* (*c.f.* §2.10) when the Reader is configured to use *TCP Long-Lived* Connections.

***If the Lane Controller does not send the Acknowledge Transmission message back to the Reader within the* Ethernet TCP-Socket Timeout, the Reader will consider the link to be faulty and shall commence buffering and disconnect the connection between the Reader and the Lane Controller.**

Format:

Table 7.1-1: Acknowledge Transmission (AT) Message – Ethernet Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{AT}	Acknowledge Transmission Message: • AT = Acknowledge Transmission Message

Response: No response from Reader

Example: A typical sequence of Reader messages and *Acknowledge Transmission Messages* between a JANUS MPR4.1 Reader and an Ethernet connected Lane Controller would appear as shown in Figure 7.1-1. *Note that all non-SYNC messages asynchronously sent by the Reader to the Lane Controller (over the* Reader-To-Lane Controller Reporting Socket *(c.f. §2.10)) are acknowledged by the Lane Controller via the* Acknowledge Transmission *Message.*

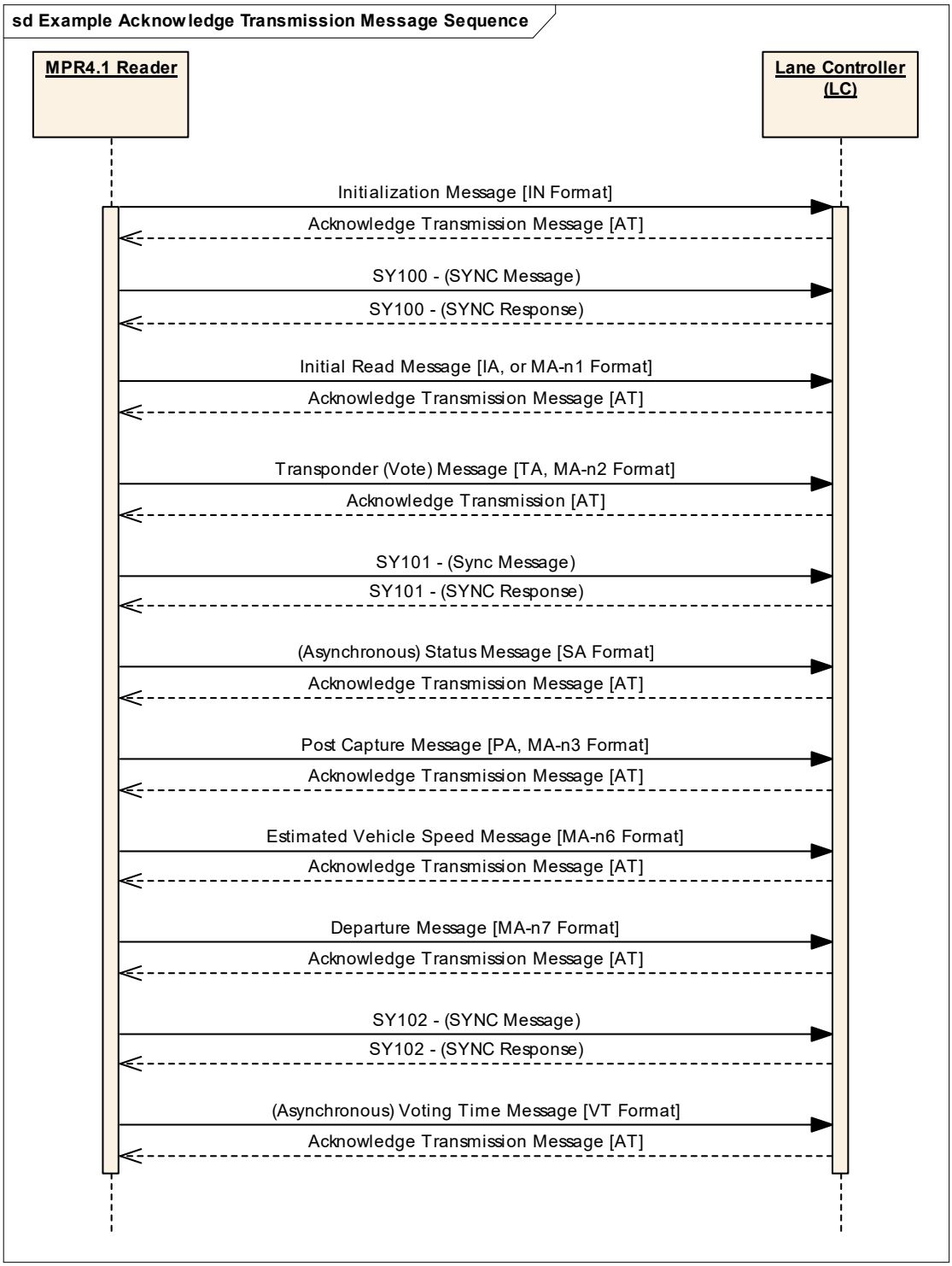

Figure 7.1-1: Example (TCPLL) Acknowledge Message Sequence

7.1.2 Sync (SY) Message – Ethernet

Direction: Reader to Lane Controller

Description: Message sent to all Lane Controllers that are configured to communicate via the JANUS MPR4.1 Reader – Lane Controller Ethernet interface.

This message shall be sent periodically to ensure that the Lane Controller software is still alive. This message will be sent to the Lane Controller if there has been no message sent to the Lane Controller for at least one (1) second.

The Reader shall increment its own sequence numbers between successful *Sync Message* exchanges (see example below). The Lane Controller shall echo the sequence number that it receives.

Format:

Table 7.1-2: Sync (SY) Message

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	SY	SY = Sync Message
Instance	1 dec	1 – 4	Lane controller destination instance – for internal Reader use only
Sequence Number	2 dec	00 – 99	A number incremented by the JANUS Reader between successful Sync messages

Response: The Lane Controller shall echo in its entirety, any *Sync Message* it receives back to the JANUS Reader within the configured Lane Controller Ethernet TCP-Socket Timeout period.

Example: A typical sequence of *Sync Messages* between a JANUS MPR4.1 Reader and an Ethernet connected Lane Controller would appear as shown in Figure 7.1-2:

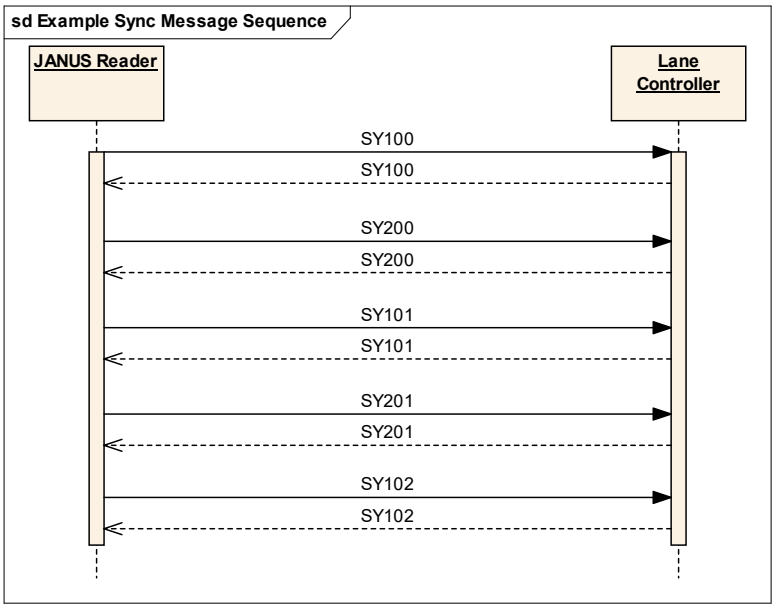

Figure 7.1-2: Example Sync Message Sequence

8. READER CONFIGURATION & SOFTWARE UPDATE / MANAGEMENT MESSAGE SET

This section describes the messages that are supported by the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface that are used to provide the JANUS MPR4.1 Reader (Remote) Configuration and Software Update / Management functionality. Described in this section are:

- *Reader Configuration – Get/Set Messages*: Messages that have been defined to support, in a generic way, the reading/writing of individual configuration parameters from/to the JANUS MPR4.1 Reader. (See §8.1 for details).
- *Reader Software Update/Management Messages*: Messages that have been defined to support the updating and management of the JANUS MPR4.1 Reader software. Also included as part of this functionality is a '*Bulk Configuration'* upload/download feature that allows for the transfer of entire configuration parameter sets to/from the JANUS MPR4.1 Reader (See §8.2 for details).

8.1 Reader Configuration – Get / Set Messages

8.1.1 Configuration – Get / Set Error (CE) Message

Direction: Reader to Lane Controller

Description: This message is issued by the JANUS MPR4.1 Reader in response to an error condition detected during processing of a received Configuration – *Get Parameter* (*c.f.* §8.1.2) or Configuration – *Set Parameter* (*c.f.* §8.1.3) message.

Format:

Table 8.1-1: Configuration – Get / Set Error (CE) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{CE}	Configuration Message: • CE = Configuration – Get / Set Error Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Parameter ID	6 alnum	{Valid Parameter ID's specified in [AD1]}	The 6-character string specified in [AD1] that uniquely identifies a JANUS MPR4.1 Reader configuration parameter. **This field will be set to match the *Parameter ID* field of the *Get / Set Parameter* request for which the error condition was detected.**
(Opening) Instance Delimiter	1 alnum	'['	(Opening) Parameter Instance Delimiter consisting of an open square bracket ('[')
Parameter Instance	2 dec	00 – 99	The zero-padded, 2-character parameter instance identifier. **This field will be set to match the *Parameter Instance* field of the *Get / Set Parameter* request for which the error condition was detected.**
(Closing) Instance Delimiter	1 alnum	']'	(Closing) Parameter Instance Delimiter consisting of a close square bracket (']')

Field Name	Length & Format	Range	Contents
Error Message	100 alnum	-	A fixed-length string (padded with <space> (0x20) characters as appropriate) indicating the nature of the detected error.

Response: No response expected from Lane Controller.

8.1.2 Configuration – Get Parameter (CG) Message

Direction: Lane Controller to Reader

Description: This message is issued by the Lane Controller in order to obtain the current value of a specific JANUS MPR4.1 Reader configuration parameter.

Format:

Table 8.1-2: Configuration – Get Parameter (CG) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{CG}	Configuration Message: • CG = Configuration – Get Parameter Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Parameter ID	6 alnum	{Valid Parameter ID's specified in [AD1]}	The 6-character string specified in [AD1] that uniquely identifies a JANUS MPR4.1 Reader configuration parameter
(Opening) Instance Delimiter	1 alnum	'['	(Opening) Parameter Instance Delimiter consisting of an open square bracket ('[')
Parameter Instance	2 dec	00 – 99	The zero-padded, 2-character parameter instance identifier.
(Closing) Instance Delimiter	1 alnum	']'	(Closing) Parameter Instance Delimiter consisting of a close square bracket (']')

Response: The JANUS MPR4.1 Reader responds with a Configuration – *Parameter Value Message* (See §8.1.4).

[If an error condition is detected in the Configuration – *Get Parameter Message*, the JANUS MPR4.1 Reader shall respond with a Configuration – *Get / Set Error Message* with *Parameter ID* and *Parameter Instance* fields set to match the offending *Get* request (See §8.1.1).]

8.1.3 Configuration – Set Parameter (CS) Message

Direction: Lane Controller to Reader

Description: This message is issued by the Lane Controller in order to modify the current value of a specific JANUS MPR4.1 Reader configuration parameter.

Format:

Table 8.1-3: Configuration – Set Parameter (CS) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{CS}	Configuration Message: • CS = Configuration – Set Parameter Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Parameter ID	6 alnum	{Valid Parameter ID's specified in [AD1]}	The 6-character string specified in [AD1] that uniquely identifies a JANUS MPR4.1 Reader configuration parameter.
(Opening) Instance Delimiter	1 alnum	'['	(Opening) Parameter Instance Delimiter consisting of an open square bracket ('[')
Parameter Instance	2 dec	00 – 99	The zero-padded, 2-character parameter instance identifier.
(Closing) Instance Delimiter	1 alnum	']'	(Closing) Parameter Instance Delimiter consisting of a close square bracket (']')
Parameter Data **{Type}**	1 dec	{0, 1, 2}	The data type of the configuration parameter specified in [AD1]. Identifies the type of data that is present in the variable length *Parameter Value* field, as follows: • 0 = unsigned integer • 1 = string • 2 = IP Address / Port See Table 8.1-4 for a list of *Parameter Data* **{Type}** values and their associated *Parameter Data* **{Value}** encodings.
Parameter Data **{Value}**	Variable	See Table 8.1-4	Variable Length Parameter **{Value}** field. Contains the *Parameter Data* **{Value}** specified by the preceding *Parameter* **{Type}** field. See Table 8.1-4 for a list of *Parameter Data* **{Type}** values and their associated *Parameter Data* **{Value}** encodings.

Table 8.1-4: Configuration – Set Command Parameter Data {Type, Value} Encodings

{Type}	{Value} Type	{Value} Length & Format	{Value} Range	{Value} Contents
0	unsigned integer	10 dec	0000000000 – 4294967295	32-bit, zero padded, unsigned integer value.
1	string	64 alnum	-	64-byte, <space>-padded string. If contained {**Value**} is less than 64 bytes in length, {**Value**} will be padded with <space> (0x20) characters.
2	IP Address / Port	21 alnum	aaa.bbb.ccc.ddd:ppppp	Dotted decimal IP Address / Port notation. • Dotted decimal IP Address fields (aaa /bbb / ccc / ddd) = 000 – 255 • Port number field (ppppp) = 00000 – 65535
All other values	*RESERVED*	*N/A*	*N/A*	*N/A*

Response: [If an error condition is detected in the Configuration – *Set Parameter Message*, the JANUS MPR4.1 Reader shall respond with a Configuration – *Get / Set Error Message* with *Parameter ID* and *Parameter Instance* fields set to match the offending *Set* request (See §Table 8.1-1).]

8.1.4 Configuration – Parameter Value (CV) Message

Direction: Reader to Lane Controller

Description: This message is issued by the JANUS MPR4.1 Reader in response to a successful Configuration – *Get Parameter* (*c.f.* §8.1.2) request message from the Lane Controller. The JANUS MPR4.1 Reader returns the value of the requested configuration parameter in this message.

Format:

Table 8.1-5: Configuration – Parameter Value (CV) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{CV}	Configuration Message: • CV = Configuration – Parameter Value Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Parameter ID	6 alnum	{Valid Parameter ID's specified in [AD1]}	The 6-character string specified in [AD1] that uniquely identifies a JANUS MPR4.1 Reader configuration parameter. **This field will be set to match the *Parameter ID* field of the respective *Get Parameter* request.**
(Opening) Instance Delimiter	1 alnum	'['	(Opening) Parameter Instance Delimiter consisting of an open square bracket ('[')
Parameter Instance	2 dec	00 – 99	The zero-padded, 2-character parameter instance identifier. **This field will be set to match the *Parameter Instance* field of the respective *Get Parameter* request.**
(Closing) Instance Delimiter	1 alnum	']'	(Closing) Parameter Instance Delimiter consisting of a close square bracket (']')
Parameter Data **{Type}**	1 dec	{0, 1, 2}	The data type of the configuration parameter specified in [AD1]. Identifies the type of data that is present in the variable length *Parameter Value* field, as follows: • 0 = unsigned integer • 1 = string • 2 = IP Address / Port See Table 8.1-6 for a list of *Parameter Data* **{Type}** values and their associated *Parameter Data* **{Value}** encodings.
Parameter Data **{Value}**	Variable	See Table 8.1-6	Variable Length Parameter **{Value}** field. Contains the *Parameter Data* **{Value}** specified by the preceding *Parameter* **{Type}** field. See Table 8.1-6 for a list of *Parameter Data* **{Type}** values and their associated *Parameter Data* **{Value}** encodings.

Table 8.1-6: Configuration – Parameter Value Data {Type, Value} Encodings

{Type}	{Value} Type	{Value} Length & Format	{Value} Range	{Value} Contents
0	unsigned integer	10 dec	0000000000 – 4294967295	32-bit, zero padded, unsigned integer value.
1	string	64 alnum	-	64-byte, <space>-padded string. If contained {**Value**} is less than 64 bytes in length, {**Value**} will be padded with <space> (0x20) characters.
2	IP Address / Port	21 alnum	aaa.bbb.ccc.ddd:ppppp	Dotted decimal IP Address / Port notation. • Dotted decimal IP Address fields (aaa /bbb / ccc / ddd) = 000 – 255 • Port number field (ppppp) = 00000 – 65535
All other values	*RESERVED*	*N/A*	*N/A*	*N/A*

Response: No response expected from Lane Controller.

8.2 Reader Software Update / Management Messages

8.2.1 Activate Update (UA) Message

Direction: Lane Controller to Reader

Description: This command instructs the JANUS MPR4.1 Reader to activate the selected (pre-verified) software version available on the Reader.

Format:

Table 8.2-1: Software Update / Management – Activate Update (UA) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UA}	Software Update / Management Message: • UA= Software Update / Management – Activate Update Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Update Identifier	50 alnum	-	A fixed-length string (padded with <space> (0x20) characters as appropriate) identifying the software version that the Reader should activate. (*e.g.* **`2012nov03a-MPR2-1b735`**) Special Identifiers: • Set to 'FACTORY' to activate the base factory version of software on the Reader • Set to 'LATEST' to activate the latest version available on the Reader *NOTE: This field is case-sensitive.*

Response: [If an error condition is detected during the update activation process, the JANUS MPR4.1 Reader shall respond with a Software Update / Management – *Status Message* [US] with *Status* field set to indicate the nature of the error (See §8.2.12).]

[If the activation request is successful, the Reader shall implicitly transmit an *Initialization Message* [IN] to the Lane Controller as part of the JANUS Reader software startup sequence (see §6.2.4 for additional details.]

8.2.2 (Bulk) Configuration File Info (UB) Message

Direction: Reader to Lane Controller

Description: Response message sent by the Reader to inform the Lane Controller that the generation of the JANUS MPR4.1 Reader configuration file (in response to the *Generate (Bulk) Configuration File* [UG] Message (*c.f.* §8.2.6)) has completed successfully, and that the Lane Controller may now retrieve the Reader configuration by transferring the file with the specified *Configuration File Name*.

In order to complete the transfer of (Bulk) Configuration Data from the JANUS MPR4.1 Reader to the Lane Controller, it becomes the responsibility of the Lane Controller, after receiving this message from the JANUS MPR4.1 Reader, to Secure Copy (scp) the newly generated (Bulk) Configuration File from the Reader to the Lane Controller.

Format:

Table 8.2-2: Software Update / Management – (Bulk) Configuration File Info (UB) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UB}	Software Update / Management Message: • UB = Software Update / Management – (Bulk) Configuration File Info Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Configuration File Name	65 alnum	-	A fixed-length string (padded with <space> (0x20) characters as appropriate) specifying the file name of the (Bulk) Configuration file generated by the Reader in response to the *Generate (Bulk) Configuration File* request from the Lane Controller. *NOTE: This field is case-sensitive.*

Response: No response expected from Lane Controller.

8.2.3 Update (Bulk) Configuration (UC) Message

Direction: Lane Controller to Reader

Description: This message is issued by the Lane Controller upon completion of a secure copy (scp) of a given software configuration file to the Reader. This command instructs the JANUS MPR4.1 Reader to load the configuration values stored in the configuration file that has just been uploaded to the Reader.

Note: The Reader parses and validates the configuration file on a line-by-line basis. Configuration values are extracted and loaded from each configuration parameter line that has been successfully parsed and validated. The Reader skips any configuration parameter line that either fails to parse or fails its validation checks. When the Reader reaches the end of the configuration file and the Reader has detected that one or more configuration parameter lines have either failed to parse or have failed validation checking, the Reader shall respond with a Software Update / Management Status [US] *message with the* Status *field set to indicate that an error has occurred (See §8.2.12).*

Note: The Reader will only update its configuration with parameters that are present in the uploaded configuration file specified by Configuration File Name. *To prevent the Reader from modifying one or more specific configuration parameter(s), simply delete the respective configuration parameter line(s) from the configuration file before uploading it to the Reader.*

Special Case Note: To prevent a potential 'lock-out' situation, the Reader will NOT allow an update to either the* Ethernet 1 (LC 1Gbps) IP Address*, the* Ethernet 1 (LC 1Gbps) Subnet Mask*, and/or the* Default Gateway IP *parameters, if they are present in the specified configuration file.

When the Update Configuration processing is complete, the configuration file that was uploaded to the Reader shall be deleted from the JANUS Reader Filesystem

Format:

Table 8.2-3: Software Update / Management – Update (Bulk) Configuration (UC) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UC}	Software Update / Management Message: • UC = Software Update / Management – Update (Bulk) Configuration Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Configuration File Name	65 alnum	-	A fixed-length string (padded with <space> (0x20) characters as appropriate) specifying the name of the configuration file that the Reader will use to update its configuration. *NOTE: This field is case-sensitive.*

Response: [If successful, the Reader shall respond with a Software Update / Management – *Status Message* [US] with the *Status* field set to "OK" (See §8.2.12).]

[If an error condition is detected during the Update (Bulk) Configuration process, the JANUS MPR4.1 Reader shall respond with a Software Update / Management – *Status Message* [US] with *Status* field set to indicate the nature of the error (See §8.2.12).]

8.2.4 Delete Update (UD) Message

Direction: Lane Controller to Reader

Description: This command instructs the JANUS MPR4.1 Reader to delete the selected (pre-verified) software version available on the Reader.

It is not permitted to either:

a) Delete the active (i.e. currently running) software version; and/or

b) Delete the Factory software version

from the JANUS MPR4.1 Reader.

Format:

Table 8.2-4: Software Update / Management – Delete Update (UD) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UD}	Software Update / Management Message: • UD= Software Update / Management – Delete Update Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Update Identifier	50 alnum	-	A fixed-length string (padded with <space> (0x20) characters as appropriate) identifying the software version that the Reader should delete. (*e.g.* **`2012nov03a-MPR2-lb735`**) *NOTE: This field is case-sensitive.*

Response: [If successful, the Reader shall respond with a Software Update / Management – *Status Message* [US] with the *Status* field set to "OK" (See §8.2.12).]

[If an error condition is detected during the update delete process, the JANUS MPR4.1 Reader shall respond with a Software Update / Management – *Status Message* [US] with *Status* field set to indicate the nature of the error (See §8.2.12).]

8.2.5 Get Free Space (UF) Message

Direction: Lane Controller to Reader

Description: This message is issued by the Lane Controller in order to obtain the current amount of free space available for additional Reader software updates.

Format:

Table 8.2-5: Software Update / Management – Get Free Space (UF) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UF}	Software Update / Management Message: • UF = Software Update / Management – Get Free Space Message
RF Channel	1 dec	1 – 4	RF Channel Identifier

Response: The JANUS MPR4.1 Reader responds with a Software Update / Management – *Filesystem Space Available Message* [UM] (See §8.2.8).

8.2.6 Generate (Bulk) Configuration File (UG) Message

Direction: Lane Controller to Reader

Description: This command instructs the JANUS MPR4.1 Reader to generate a configuration file suitable for transfer to the Lane Controller, based on the current Reader configuration values.

Any (Bulk) Configuration files present on the Reader shall be automatically deleted when the Reader executes the request to generate the (Bulk) Configuration file.

Format:

Table 8.2-6: Software Update / Management – Generate (Bulk) Configuration File (UG) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UG}	Software Update / Management Message: • UG = Software Update / Management – Generate (Bulk) Configuration File Message
RF Channel	1 dec	1 – 4	RF Channel Identifier

Response: [If successful, the Reader shall respond with a Software Update / Management – *(Bulk) Configuration File Info Message* [UB] with the *Configuration File Name* field set to the name of the newly generated (Bulk) Configuration File (See §8.2.2).]

[If an error condition is detected during the (Bulk) Configuration File generation process, the JANUS MPR4.1 Reader shall respond with a Software Update / Management – *Status Message* [US] with *Status* field set to indicate the nature of the error (See §8.2.12).]

8.2.7 Get Update Identifier (UI) Message

Direction: Lane Controller to Reader

Description: This message is issued by the Lane Controller in order to obtain the identifier of a given software version that is available on the Reader.

Format:

Table 8.2-7: Software Update / Management – Get Update Identifier (UI) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UI}	Software Update / Management Message: • UI = Software Update / Management Get Update Identifier Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Update Index	1 dec	0 – (*n*-1)	Update Index. An index number between 0 and {*Number of Available Updates*} – 1.

Response: The JANUS MPR4.1 Reader responds with a Software Update / Management – *Update Identifier-Reference Message* [UR] (See §8.2.11).

[If an error condition is detected in *the* Software Update / Management – *Get Update Identifier Message*, the JANUS MPR4.1 Reader shall respond with a Software Update / Management – *Status Message* [US] with *Status* field set to indicate the nature of the error (See §8.2.12).]

8.2.8 Filesystem Space Available (UM) Message

Direction: Reader to Lane Controller

Description: This message is issued by the JANUS MPR4.1 Reader in response to a successful Software Update / Management – *Get Free Space* [UF] request (*c.f.* §8.2.5) message from the Lane Controller. The JANUS MPR4.1 Reader reports the amount of filesystem space available for additional software updates in this message.

Format:

Table 8.2-8: Software Update / Management – Filesystem Space Available (UM) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UM}	Software Update / Management Message: • UM = Software Update / Management – Filesystem Space Available Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Filesystem Space Available	20 dec	00000000000000000000 – 18446744073709551615	The filesystem space available for additional software updates, in bytes.

Response: No response expected from Lane Controller

8.2.9 Available Update Count (UN) Message

Direction: Reader to Lane Controller

Description: This message is issued by the JANUS MPR4.1 Reader in response to a successful Software Update / Management – *Query Update Count* [UQ] request (*c.f.* §8.2.10) message from the Lane Controller. The JANUS MPR4.1 Reader reports the number of currently available software versions present on the Reader.

Format:

Table 8.2-9: Software Update / Management – Available Update Count (UN) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UN}	Software Update / Management Message: • UN = Software Update / Management – Available Update Count Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Available Updates	1 dec	0 – 9	The number of available software versions present on the Reader. *The Factory software version is included in this count*.

Response: No response expected from Lane Controller

8.2.10 Query Update Count (UQ) Message

Direction: Lane Controller to Reader

Description: This message is issued by the Lane Controller in order to obtain the number of currently available software versions that are present on the Reader.

Format:

Table 8.2-10: Software Update / Management – Query Update Count (UQ) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UQ}	Software Update / Management Message: • UQ = Software Update / Management Query Update Count Message
RF Channel	1 dec	1 – 4	RF Channel Identifier

Response: The JANUS MPR4.1 Reader responds with a Software Update / Management – *Available Update Count Message* [UN] (See §8.2.9).

8.2.11 Update Identifier-Reference (UR) Message

Direction: Reader to Lane Controller

Description: This message is issued by the JANUS MPR4.1 Reader in response to a successful Software Update / Management – *Get Update Identifier* [UI] request (*c.f.* §8.2.7) message from the Lane Controller. The JANUS MPR4.1 Reader reports the identifier of the available software version on the Reader associated with the requested update index.

Format:

Table 8.2-11: Software Update / Management – Update Identifier-Reference (UR) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UR}	Software Update / Management Message: • UR = Software Update / Management – Update Identifier-Reference Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Update Index	1 dec	0 – 9	Update Index. An index number between 0 and {*Number of Available Updates*} – 1.
Factory Software Version	1 dec	0 – 1	Identifies whether or not the specified version is the Factory Software Version: • 0 = Specified update is NOT the Reader Factory Version • 1 = Specified update is the Reader Factory Version
Active Software Version	1 dec	0 – 1	Identifies whether or not the specified version is the currently running Active Software Version: • 0 = Specified update is NOT the currently running Active Software Version • 1 = Specified update is the currently running Active Software Version
Update Identifier	50 alnum	-	A fixed-length string (padded with <space> (0x20) characters as appropriate) containing the identifier of the software version associated with the specified *Update Index*. (*e.g.* **`2012nov03a-MPR2-1b735`**) *NOTE: This field is case-sensitive.*

Response: No response expected from Lane Controller

8.2.12 Software Update / Management Status (US) Message

Direction: Reader to Lane Controller

Description: This message is issued by the JANUS MPR4.1 Reader in response to operation successfully completed, or an error condition detected during processing of a received Software Update / Management message, depending on conditions.

Format:

Table 8.2-12: Software Update / Management Status (US) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{US}	Software Update / Management Message: • US = Software / Update Management Status Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Status	100 alnum	-	A fixed-length string (padded with <space> (0x20) characters as appropriate) indicating the status of the detected error. Set to “OK” if the requested operation was successful. Otherwise, this field will be populated with a text string indicating the nature of the error.

Response: No response expected from Lane Controller.

8.2.13 Verify Update (UV) Message

Direction: Lane Controller to Reader

Description: This message is issued by the Lane Controller upon completion of a secure copy (scp) of a given software update to the Reader. This command instructs the JANUS MPR4.1 Reader to perform verification of the software version specified by the *Update File Name* field.

After verification, the file uploaded by the Lane Controller via Secure Copy (scp) is either:

a) Relocated to the software update repository on the Reader if the verification was successful; or

b) Deleted from the Reader if the verification failed.

Format:

Table 8.2-13: Software Update / Management – Verify Update (UV) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{UV}	Software Update / Management Message: • UV = Software Update / Management – Verify Update Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Update File Name	62 alnum	-	A fixed-length string (padded with <space> (0x20) characters as appropriate) specifying the file name of software version that the Reader should verify. (*e.g.* **`2012nov03a-MPR2-lb735.en.sign.md5`**) *NOTE: This field is case-sensitive.*

Response: [If successful, the Reader shall respond with a Software Update / Management – *Status Message* [US] with the *Status* field set to "OK" (See §8.2.12).]

[If an error condition is detected during the update verification process, the JANUS MPR4.1 Reader shall respond with a Software Update / Management – *Status Message* [US] with *Status* field set to indicate the nature of the error (See §8.2.12).]

9. MULTI-PROTOCOL MESSAGE SET

This section specifies the Multi-Protocol application messages sent by the JANUS MPR4.1 Reader that are supported by the JANUS MPR4.1 Reader – Lane Controller Ethernet Interface. All JANUS MPR4.1 Reader Multi-Protocol Messages share a common message format.

Messages are grouped according to the relevant function / protocol, as follows:

- ISO 18000-6B Multi-Protocol Messages
- ISO 18000-6C Multi-Protocol Messages
- ATA Multi-Protocol Messages
- ISO 18000-6B eAta Multi-Protocol Messages
- SeGo Multi-Protocol Messages
- ISO 18000-6B Combined UID+eATA Multi-Protocol Messages
- Title21 Multi-Protocol Messages
- TDM Multi-Protocol Messages

Note: *Please refer to §2.6 on how the Multi-Protocol application messages specified herein are encapsulated into their respective Data-Transport Layer (JANUS MPR4.1 Reader – Lane Controller Ethernet Interface) protocol packets. For additional information on message timestamping, please refer to §9.2.*

9.1 Multi-Protocol Common Message Format

All JANUS MPR4.1 Reader Multi-Protocol Messages are derived from the Multi-Protocol Common Message Format as illustrated in Figure 9.1-1. There are four (4) invariant fields across all JANUS MPR4.1 Reader Multi-Protocol Messages:

- Prefix
- RF Channel
- Type
- Format

The *Format* field serves as an identifier that informs the Lane Controller of the specific contents that are contained within the *Multi-Protocol Specific Message Payload* field. Table 9.1-1 describes, in detail, the common message fields of the Multi-Protocol Common Message Format.

Prefix (2 Bytes)	**RF Channel** (1 Byte)	**Type** (1 Byte)	**Format** (2 Bytes)	**Multi-Protocol Specific Message Payload** (Variable)	**Extended Information** (Optional, Variable)

Figure 9.1-1: Multi-Protocol Common Message Format

Table 9.1-1: Multi-Protocol Common Message Fields

Common Message Field	Length (bytes) & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{B, R}	• B = buffered message (report is from transaction buffer) • R = real-time message (tag has just gone through lane)
Format	2 hex	00 – FF	Message Format Identifier. Identifies format of Multi-Protocol Specific Message Payload that follows. (see Table 9.1-2 for details)
Multi-Protocol Specific Message Payload	Multi-Protocol Message Dependent	Multi-Protocol Message Dependent	A varying length field containing various Multi-Protocol specific data. The *Format* field identifies this field's contents.
Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Table 9.1-2 lists the defined values for the *Format* field of the Multi-Protocol Common Message Format (*Please note that any value not explicitly listed in Table 9.1-2 is considered RESERVED*)

Table 9.1-2: Multi-Protocol Format Codes

Multi-Protocol Format Code (ASCII Hex)	Description
10	ISO 18000-6B Handshake Message
11	ISO 18000-6B Initial Read Message
12	ISO 18000-6B Transponder Message
13	SO 18000-6B Post Capture Message
16	ISO 18000-6B Estimated Vehicle Speed Message (**See Note *1***)
17	ISO-18000-6B Departure Message (**See Note *2***)
20	ISO 18000-6C Handshake Message
21	ISO 18000-6C Initial Read Message
22	ISO 18000-6C Transponder Message
23	ISO 18000-6C Post Capture Message
26	ISO 18000-6C Estimated Vehicle Speed Message
27	ISO 18000-6C Departure Report

Multi-Protocol Format Code (ASCII Hex)	Description
40	ATA Handshake Message (8-Bit ASCII Alphanumeric Data)
41	ATA Initial Read Message (8-Bit ASCII Alphanumeric Data)
42	ATA Transponder Message (8-Bit ASCII Alphanumeric Data)
43	ATA Post Capture Message (8-Bit ASCII Alphanumeric Data)
46	ATA Estimated Vehicle Speed Message (8-Bit ASCII Alphanumeric Data)
47	ATA Departure Message (8-Bit ASCII Alphanumeric Data)
60	ISO 18000-6B eATA Handshake Message (8-Bit ASCII Alphanumeric Data)
61	ISO 18000-6B eATA Initial Read Message (8-Bit ASCII Alphanumeric Data)
62	ISO 18000-6B eATA Transponder Message (8-Bit ASCII Alphanumeric Data)
63	ISO 18000-6B eATA Post Capture Message (8-Bit ASCII Alphanumeric Data)
66	ISO 18000-6B eATA Estimated Vehicle Speed Message (8-Bit ASCII Alphanumeric Data) (**See Note *1***)
67	ISO 18000-6B eATA Departure Message (8-Bit ASCII Alphanumeric Data) (**See Note *2***)
70	SeGo Handshake Message
71	SeGo Initial Read Message
72	SeGo Transponder Message
73	SeGo Post Capture Message
76	SeGo Estimated Vehicle Speed Message
77	SeGo Departure Report
80	ISO 18000-6B Combined UID+eATA Handshake Message
81	ISO 18000-6B Combined UID+eATA Initial Read Message
82	ISO 18000-6B Combined UID+eATA Transponder Message
83	ISO 18000-6B Combined UID+eATA Post Capture Message
86	ISO 18000-6B Combined UID+eATA Estimated Vehicle Speed Message (**See Note *1***)
87	ISO 18000-6B Combined UID+eATA Departure Message (**See Note *2***)
90	Title21 Handshake Message (**See Note *4***)
91	Title21 Initial Read Message (**See Note *4***)
92	Title21 Transponder Message (**See Note *4***)
93	Title21 Post Capture Message (**See Note *4***)
96	Title21 Estimated Vehicle Speed Message (**See Note *4***)
97	Title21 Departure Report (**See Note *4***)
9F	Title21 Transponder Write Control Response Message (**See Notes *3*, *4***)
A0	TDM Handshake Message
A6	TDM Estimated Vehicle Speed Message (**See Note *1***)
A7	TDM Departure Message (**See Note *2***)
B0	TDM Handshake (Format A – TRBA) Message

Multi-Protocol Format Code (ASCII Hex)	Description
B6	TDM Estimated Vehicle Speed (Format A – TRBA) Message (**See Note *1***)
B7	TDM Departure (Format A – TRBA) Message (**See Note *2***)
All other values	*RESERVED*

Notes:

(1) **-** The complete estimated vehicle speed functionality is currently not fully implemented for the TDM, and ISO 18000-6B protocols. Estimated Vehicle Speed Reports are not available for the TDM protocol. For the ISO 18000-6B protocol, the JANUS MPR4.1 Reader only supports Estimated Vehicle Speed Reports for the '*Standard (UID only)' Read Mode*.

(2) **-** The complete estimated vehicle speed functionality is currently not fully implemented for the TDM, and ISO 18000-6B protocols. The *Speed Information* section of this message shall be correspondingly populated with all 0's (zeroes) for TDM reports. For the ISO 18000-6B protocol, the *Speed Information* section of this message shall only be populated with non-zero values if the Reader is configured to use the ISO 18000-6B *'Standard (UID only)' Read Mode*.

(3)- Applicable only when the Title21 protocol is configured and the *Title21 Enable Acknowledge Message* parameter is enabled.

(4) – At the time of publication of this document, while Title21 messages are defined, they are not fully implemented in the MPR2.4 Reader.

9.2 Multi-Protocol Message Extended Information Field

The *Extended Information* field is an optional, variable-length field that conveys additional message information depending upon the configuration of the JANUS MPR4.1 Reader. If the JANUS MPR4.1 Reader is configured to report extended information, this field will be populated with those values that have been chosen to be reported in the Reader configuration**. If no extended information has been requested in the Reader configuration, the *Extended Information* field *WILL NOT BE PRESENT* in JANUS MPR4.1 Reader-to-Lane Controller messages.**

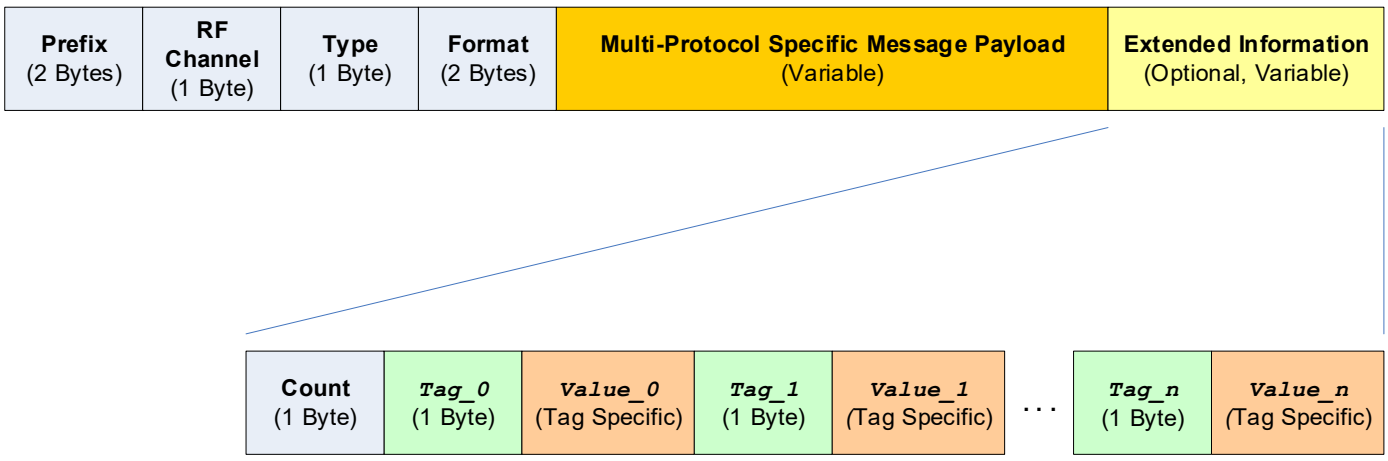

Figure 9.2-1: Multi-Protocol Extended Information Format

As shown in Figure 9.2-1, data is encoded into the *Extended Information* field in the form of **`{Tag, Value}`** pairs. Each **`{Tag}`** is encoded as one (1) ASCII hexadecimal character. **`{Value}`** data is encoded in a tag-specific fashion. The first byte of the *Extended Information* field is the *Count* sub-field (encoded in ASCII decimal), which specifies the total number of **`{Tag, Value}`** pairs encoded within the *Extended Information* field, if present.

Table 9.2-1 specifies the defined **`{Tag, Value}`** encodings for the *Extended Information* field of the Multi-Protocol Common Message Format (*Please note that any* **`{Tag}`** *values not explicitly listed in Table 9.2-1 are considered RESERVED*).

Table 9.2-1: Multi-Protocol Extended Information `{Tag, Value}` Encodings

`{Tag}`	`{Value}` Name	`{Value}` Length & Format	`{Value}` Range	`{Value}` Contents	Message Applicability
0	*Timestamp*	16 dec	0 – 4294967295999999	The number of microseconds since the Epoch (1970-01-01 00:00:00 +0000 [UTC]) corresponding to the successful read event.	All Multi-Protocol Initial Read, Transponder, Post Capture, Estimated Vehicle Speed, Departure, Handshake, Write Response and Status Messages
1	*Transponder RSSI*	5 dec	00000 – 99999	Received signal strength indicator (RSSI) for tag data	Multi-Protocol Handshake Messages Only (***This feature is available for all MPR4.1 reader supported protocols***)
2	*Envelope Reference Point*	1 hex	Bit-Mapped	• Bit 0 (LSB): Set to 1 if Handshake occurs at a point where the tag is passing, or has passed directly under center of antenna, 0 otherwise.	Multi-Protocol Handshake Messages Only (***This feature is currently not implemented***)
3	*Range Change Rate*	3 dec	000 – 127	Set to '127' if not measured or unavailable.	Multi-Protocol Handshake Messages Only (***This feature is currently only available for the Title21, ISO 18000-6B, ISO 18000-6C, ATA and SeGo protocols***)

{Tag}	{Value} Name	{Value} Length & Format	{Value} Range	{Value} Contents	Message Applicability
4	*Average |I|, |Q| Data*	11 alnum	{00000 – 65535} / {00000 – 65535}	Magnitudes |I| and |Q| of average I signal and Q signal channel values, respectively. |I| and |Q| values are separated by a slash ('/') character	Multi-Protocol Handshake Messages Only (***This feature is currently only available for the Title21, ISO 18000-6B, ISO 18000-6C, ATA, and SeGo protocols***)
5	*ISO 18000-6C EPC/UII Memory CRC/PC bits*	8 hex	0x00000000 – 0xFFFFFFFF	The contents of the ISO 18000-6C Transponder EPC/UII Memory (Memory Bank 01) CRC and tag *Protocol Control* (PC) bits. [32 bits from 0x00 – 0x1F, inclusive]	All ISO 18000-6C Multi-Protocol Initial Read, Transponder, Post Capture, Estimated Vehicle Speed, and Handshake Messages (***This feature is only available for the ISO 18000-6C protocol***)
All other values	*RESERVED*	*N/A*	*N/A*	*N/A*	*N/A*

9.3 Multi-Protocol Departure Message Format

The JANUS MPR4.1 Reader can be configured to issue Multi-Protocol Departure messages to the Lane Controller. Departure Messages are reported to the Lane Controller after a configurable period of time, in milliseconds – known as the *Departure Delay* – has elapsed since a given transponder has last been read.

The Departure Message is a hybrid combination of a Transponder (Voting) Message and an Estimated Vehicle Speed Message, and is applicable to all protocols. The Departure Message extends the Transponder (Voting) Message with additional data that includes a *Channel Handshake Count*, *RSSI* (*Peak* and *Total*), *Timestamps* (*First* and *Last*), the *Lane Number*, and *Estimated Vehicle Speed* information.

Note that for certain protocols (such as TDM, Title21 and ISO 18000-6B (in non 'Standard (UID only)' Read Mode*)), the* Estimated Vehicle Speed *functionality is not currently fully supported. For these protocols, the* Estimated Vehicle Speed *component of the* Departure Message *shall be populated with all zeroes (0's).*

All Departure Messages utilize the common Multi-Protocol Message Prefix ("**MA**") with a format code ending in **0x7** (hexadecimal). A diagram of the format of a JANUS MPR4,1 Reader Departure Message is illustrated in Figure 9.3-1. A generic description of the additional fields that comprise a JANUS MPR4.1 Reader Departure message is provided in Table 9.3-1.

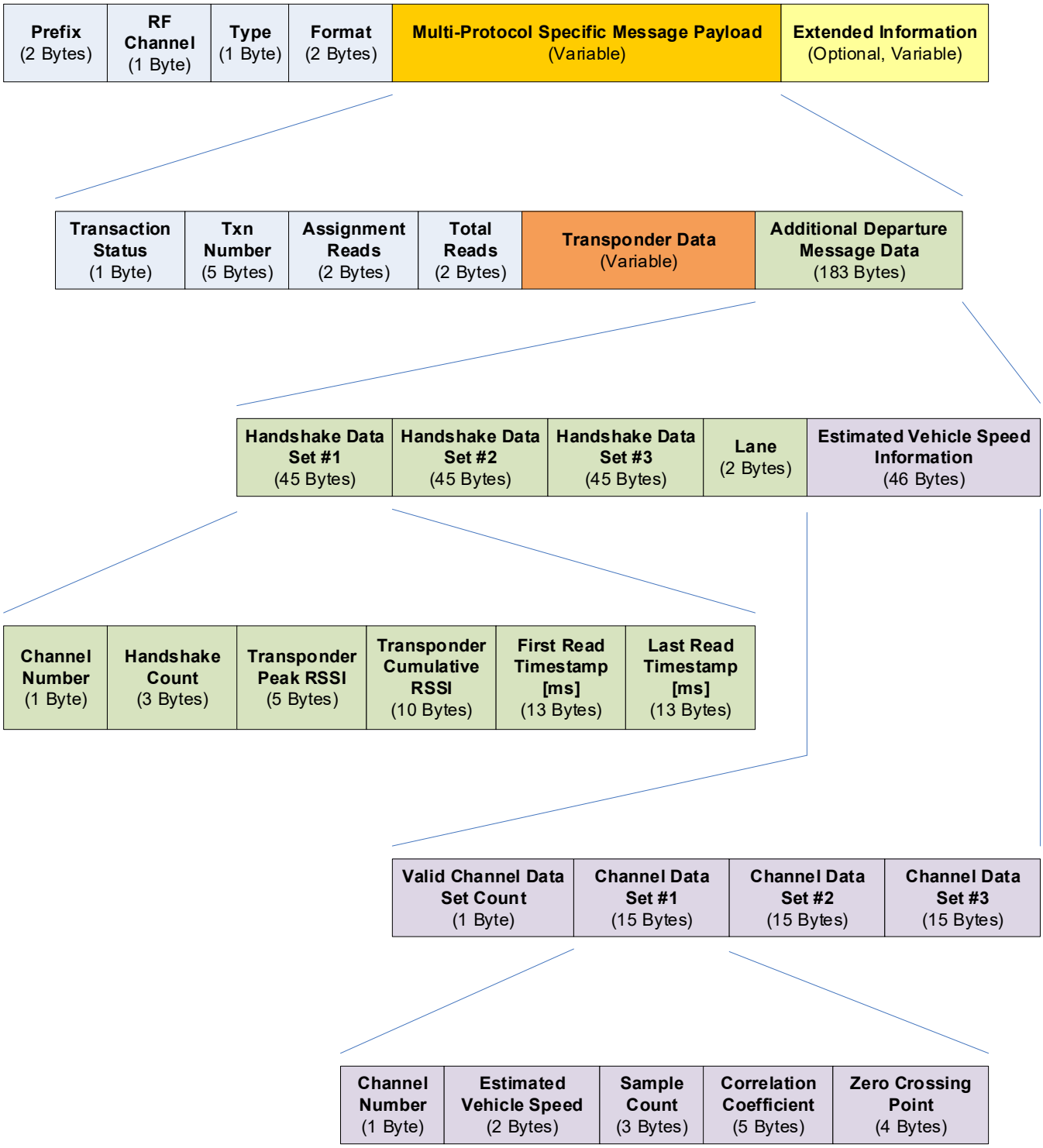

Figure 9.3-1: Multi-Protocol Departure Message Format

Table 9.3-1: Additional Departure Message Data Fields

Field Name	Length & Format	Range	Contents
Handshake Data Set #1 – Channel Number	1 dec	1 – 4	RF Channel Identifier indicating the RF Channel with the highest number of handshakes recorded for the given transaction.
Handshake Data Set #1 – Handshake Count	3 dec	000 – 999	The total number of handshakes (reads) that occurred on the 1st Handshake Data Set Channel up to and including the last read of the transponder. *Handshake Counts greater than 999 are indicated as 999.*
Handshake Data Set #1 – Transponder Peak RSSI	5 dec	00000 – 99999	The peak Received Signal Strength Indicator (RSSI) value for all handshakes that occurred on the 1st Handshake Data Set Channel.
Handshake Data Set #1 – Transponder Cumulative RSSI	10 dec	0 - 2147483647	The cumulative Received Signal Strength Indicator (RSSI) value for all handshakes that occurred on the 1st Handshake Data Set Channel.
Handshake Data Set #1 – First Read Timestamp	13 dec	0 - 4294967295999	The timestamp of the first read that occurred on the 1st Handshake Data Set Channel, in milliseconds since the Epoch (1970-01-01 00:00:00 +0000 [UTC])
Handshake Data Set #1 – Last Read Timestamp	13 dec	0 - 4294967295999	The timestamp of the last read that occurred on the 1st Handshake Data Set Channel, in milliseconds since the Epoch (1970-01-01 00:00:00 +0000 [UTC])
Handshake Data Set #2 – Channel Number	1 dec	1 – 4	RF Channel Identifier indicating the RF Channel with the 2nd highest number of handshakes recorded for the given transaction.
Handshake Data Set #2 – Handshake Count	3 dec	000 – 999	The total number of handshakes (reads) that occurred on the 2nd Handshake Data Set Channel up to and including the last read of the transponder. *Handshake Counts greater than 999 are indicated as 999.*
Handshake Data Set #2 – Transponder Peak RSSI	5 dec	00000 – 99999	The peak Received Signal Strength Indicator (RSSI) value for all handshakes that occurred on the 2nd Handshake Data Set Channel.
Handshake Data Set #2 – Transponder Cumulative RSSI	10 dec	0 - 2147483647	The cumulative Received Signal Strength Indicator (RSSI) value for all handshakes that occurred on the 2nd Handshake Data Set Channel.

Field Name	Length & Format	Range	Contents
Handshake Data Set #2 – First Read Timestamp	13 dec	0 - 4294967295999	The timestamp of the first read that occurred on the 2nd Handshake Data Set Channel, in milliseconds since the Epoch (1970-01-01 00:00:00 +0000 [UTC])
Handshake Data Set #2 – Last Read Timestamp	13 dec	0 - 4294967295999	The timestamp of the last read that occurred on the 2nd Handshake Data Set Channel, in milliseconds since the Epoch (1970-01-01 00:00:00 +0000 [UTC])
Handshake Data Set #3 – Channel Number	1 dec	1 – 4	RF Channel Identifier indicating the RF channel with the 3rd highest number of handshakes recorded for the given transaction.
Handshake Data Set #3 – Handshake Count	3 dec	000 – 999	The total number of handshakes (reads) that occurred on the 3rd Handshake Data Set Channel up to and including the last read of the transponder. *Handshake Counts greater than 99 are indicated as 99.*
Handshake Data Set #3 – Transponder Peak RSSI	5 dec	00000 – 99999	The peak Received Signal Strength Indicator (RSSI) value for all handshakes that occurred on the 3rd Handshake Data Set Channel.
Handshake Data Set #3 – Transponder Cumulative RSSI	10 dec	0 - 2147483647	The cumulative Received Signal Strength Indicator (RSSI) value for all handshakes that occurred on the 3rd Handshake Data Set Channel.
Handshake Data Set #3 – First Read Timestamp	13 dec	0 - 4294967295999	The timestamp of the first read that occurred on the 3rd Handshake Data Set Channel, in milliseconds since the Epoch (1970-01-01 00:00:00 +0000 [UTC])
Handshake Data Set #3 – Last Read Timestamp	13 dec	0 - 4294967295999	The timestamp of the last read that occurred on the 3rd Handshake Data Set Channel, in milliseconds since the Epoch (1970-01-01 00:00:00 +0000 [UTC])
Lane number	2 dec	00 – 31	Antenna / Lane number of assigned channel. *May be different from what is programmed into transponder.*
Number of Valid Channel Data Sets	1 dec	1 – 3	The number of channels for which an Estimated Vehicle Speed / Envelope Reference Point Channel Data Set was calculated. ***Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).***

Field Name	Length & Format	Range	Contents
Channel Data Set #1 – Channel Number	1 dec	1 – 4	The channel number for the 1st Channel Data Set
Channel Data Set #1 – Estimated Vehicle Speed	2 dec	00 – 99	Estimated Vehicle Speed (mph) for the 1st Channel Data Set.
Channel Data Set #1 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 1st Channel Data Set.
Channel Data Set #1 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 1st Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #1 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 1st Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #2– Channel Number	1 dec	1 – 4	The channel number for the 2nd Channel Data Set.
Channel Data Set #2 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 2nd Channel Data Set.
Channel Data Set #2 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 2nd Channel Data Set.
Channel Data Set #2 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 2nd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #2 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 2nd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #3 – Channel Number	1 dec	1 – 4	The channel number for the 3rd Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #3 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 3rd Channel Data Set.
Channel Data Set #3 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 3rd Channel Data Set.
Channel Data Set #3 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 3rd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #3 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 3rd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***

9.4 Multi-Protocol Handshake Message Payload Common Fields

The JANUS MPR4.1 Reader Multi-Protocol Handshake messages (Format = '*n*0', where '0' ≤ *n* ≤ 'B') all contain a common Multi-Protocol Specific Message Payload that is encapsulated within the Multi-Protocol Common Message Format as shown in Figure 9.4-1 and described in detail in Table 9.4-1. There is one (1) invariant field that is common to these Handshake Messages:

- Frame Number Field

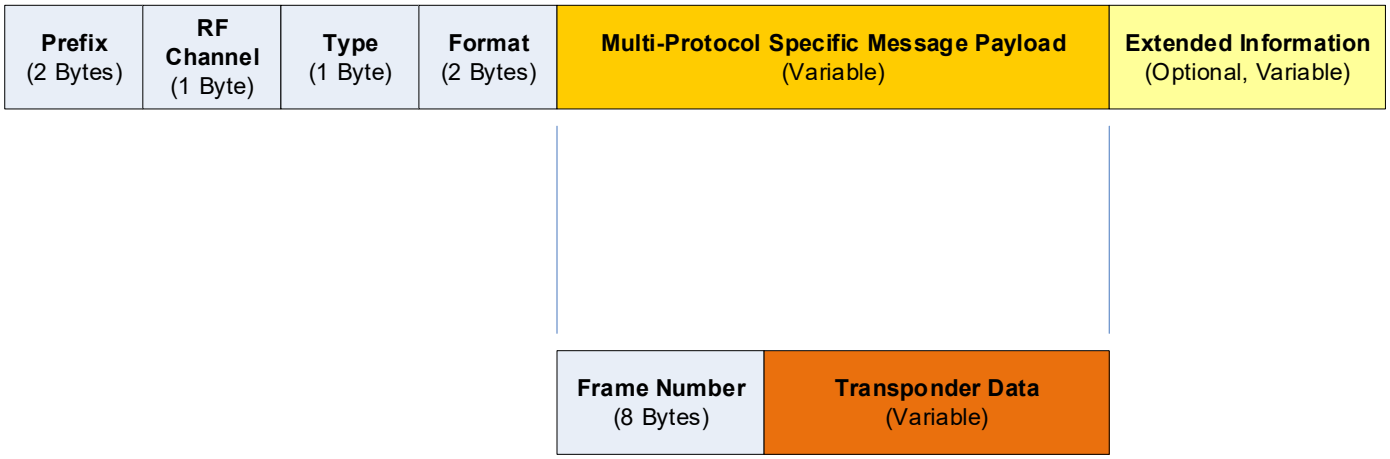

Figure 9.4-1: JANUS MPR4.1 Reader Handshake Message Payload Encapsulation and Format

Table 9.4-1: JANUS MPR4.1 Reader Handshake Message Payload Format Fields

Common Message Format Field	Length & Format	Range	Contents
Frame Number	8 hex	00000000 – FFFFFFFF	The frame count corresponding to the successful read event. This counter automatically rolls over when FFFFFFFF is reached.

Transponder Data	Transponder Data Dependent	Transponder Data Dependent	The Transponder Data that was read.
			• *For ISO 18000-6B Tags:* The contents of the ISO 18000-6B transponder default memory page (UID).
			• *For ISO 18000-6B eATA Tags*: Depending on Reader configuration, either:
			  ○ The contents of the ISO 18000-6B transponder default memory page (UID); or
			  ○ The contents of the eATA transponder data (memory pages 0x70,0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details); or
			  ○ The contents of the ISO 18000-6B transponder default memory page (UID) *together with* the contents of the eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).
			• *For ISO 18000-6C Tags:* The contents of the ISO 18000-6C transponder EPC/UII and either the contents of the ISO 18000-6C transponder TID *or* UM memory banks, depending on the configured ISO 18000-6C Read Mode.
			• *For ATA Tags:* The contents of the ATA transponder data in 8-bit ASCII alphanumeric format (See §9.5 for details)
			• *For TDM Tags:* The contents of the TDM transponder read section followed by the contents of the TDM transponder write section
			• *For SeGo Tags:* The contents of the SeGo transponder default memory page.
			• *For Title21 Tags:* The 32-bit transponder ID encoded in 8-bit ASCII hexadecimal format.

9.5 ATA / ISO 18000-6B eATA Transponder Data Formats

9.5.1 ATA Transponder Data Formats

ATA transponders have their data encoded in 6-bit ASCII format. The JANUS MPR4.1 Reader allows for the following way of encoding this information when transmitting it to the Lane Controller:

- *8-bit ASCII Alphanumeric Representation (of ATA Transponder data)* – The ATA Transponder data shall be presented to the Lane Controller using the ATA 8-bit Alphanumeric Format (Format=0x4*n*) series of messages (*c.f.* §9.8). For each ATA message sent to the Lane Controller using this message set, the *ATA Transponder* Data field contains the 20-byte (8-bit) ASCII alphanumeric representation of the decoded 20-byte (8-bit) binary mapping of the 16 bytes of transponder ATA data originally encoded in 6-bit ASCII.

The representation is best illustrated through an example, as shown below:

Example:

For an ATA Transponder printed with the following identifier: `CPFI01052229`

*The 16 bytes of Transponder Raw Data (note that **underlined** nybbles are not utilized in the decode process) gathered by JANUS MPR4.1 Reader MRFM is:*

`8F 09 A9 41 14 15 49 2B 49 95 A6 38 E3 81 B4 43`

Breaking this value into 6-bit chunks, we obtain the following decoding as shown in Table 9.5-1:

Table 9.5-1: ATA Transponder Data Representation Format Example

6-Bit (Binary) Raw Transponder Data	8-Bit (Binary) Hexadecimal Equivalent	8-Bit ASCII Alphanumeric Representation
100011	0x23	'C'
110000	0x30	'P'
100110	0x26	'F'
101001	0x29	"I'
010000	0x10	'0'
010001	0x11	'1'
010000	0x10	'0'
010101	0x15	'5'
010010	0x12	'2'
010010	0x12	'2'
10 *(FRAME CHECKSUM – Not Used in Decode)*	*N/A*	*N/A*
11 *(FRAME MARKER – Not Used in Decode)*	*N/A*	*N/A*
010010	0x12	'2'
011001	0x19	'9'
010110	0x16	'6'
100110	0x26	'F'
001110	0x0E	'.'
001110	0x0E	'.'
001110	0x0E	'.'
000001	0x01	'!'
101101	0x2D	'M'
000100	0x04	'$'
00 *(FRAME CHECKSUM – Not Used in Decode*	*N/A*	*N/A*
11 *(FRAME MARKER – Not Used in Decode*	*N/A*	*N/A*

Therefore, for this particular ATA Transponder:

- *The Reader would transmit ATA 8-bit Alphanumeric messages (Format=0x4n) with the ATA* Transponder Data *field set to the following 20-byte ASCII string:*

  "**CPFI010522296F...!M$**"

9.5.2 ISO 18000-6B eATA Transponder Data Formats

Similarly for ISO 18000-6B eATA transponders, the JANUS MPR4.1 Reader allows for multiple ways of encoding the transponder ID information when transmitting it to the Lane Controller based on the setting of the '*ISO 18000-6B Data Reporting Format*' configuration parameter, as follows:

- *Option 0 – Standard UID Representation (of ISO 18000-6B Transponder data)* – When Option 0 is selected, the ISO 18000-6B UID data shall be presented to the Lane Controller using the ISO 18000-6B Format (Format=0x1*n*) series of messages (*c.f.* §9.6). For each ISO 18000-6B message sent to the Lane Controller using this message set, the *ISO 18000-6B Transponder Data* field contains the 16-byte ASCII hexadecimal representation of the contents of the ISO 18000-6B transponder default memory page (UID). ***Note: Clone tag filtering is not performed if Option 0 is selected for ISO 18000-6B reporting.***
- *Option 1 – 8-bit ASCII Alphanumeric Representation (of ISO 18000-6B eATA Transponder data)* – When Option 1 is selected, the ISO 18000-6B eATA data shall be presented to the Lane Controller using the ISO 18000-6B eATA Report 8-Bit Alphanumeric Format (Format=0x6*n*) series of messages (*c.f.* §9.9). For each ISO 18000-6B eATA message sent to the Lane Controller using this message set, the *eATA Transponder Data* field contains the 20-byte (8-bit) ASCII alphanumeric representation of the decoded 20-byte (8-bit) binary mapping of the 16 bytes of transponder eATA data originally encoded in 6-bit ASCII. ***Note: Clone Tag filtering is enabled when Option 2 is selected for ISO 18000-6B reporting.***
- *Option 3 – Combined UID+eATA (8-bit ASCII Alphanumeric Representation of ISO 18000-6B eATA Transponder data)* – When Option 3 is selected, both the ISO 18000-6B UID *and* eATA data shall be presented to the Lane Controller using the ISO 18000-6B Combined UID+eATA Report Format (Format=0x8*n*) series of messages (*c.f.* §9.11). For each ISO 18000-6B Combined UID+eATA message sent to the Lane Controller using this message set:
    - The *ISO 18000-6B Transponder (UID) Data* field contains the 16-byte ASCII hexadecimal representation of the contents of the ISO 18000-6B transponder default memory page (UID), ***and***;
    - The *eATA Transponder Data* field contains the 20-byte (8-bit) ASCII alphanumeric representation of the decoded 20-byte (8-bit) binary mapping of the 16 bytes of transponder eATA data originally encoded in 6-bit ASCII.

  Note: Clone Tag filtering is enabled when Option 3 is selected for ISO 18000-6B reporting.

The differences between the different representation options are best illustrated through an example, as shown below:

Example:

For an ISO-18000 6B (eATA) Transponder printed with the following identifiers:

`CPFI01054583 / E022494700101777`

The 8 byte UID from the contents of the transponder default memory page is: `E022494700101777`

*For Option 1 and Option 2 settings, the 16 bytes of eATA Transponder Raw Data (note that **underlined** nybbles are not utilized in the decode process) gathered by JANUS MPR4.1 Reader MRFM is:*

`8F 09 A9 41 14 15 51 5F 61 35 99 38 E3 81 B4 40`

Breaking this value into 6-bit chunks, we obtain the following decoding as shown in Table 9.5-2.

Table 9.5-2: ISO 18000-6B eATA Transponder Data Representation Format Example

6-Bit (Binary) Raw Transponder Data	8-Bit (Binary) Hexadecimal Equivalent	Option 1 – 8-Bit ASCII Alphanumeric Representation
100011	0x23	'C'
110000	0x30	'P'
100110	0x26	'F'
101001	0x29	"I'
010000	0x10	'0'
010001	0x11	'1'
010000	0x10	'0'
010101	0x15	'5'
010100	0x14	'4'
010101	0x15	'5'
11 *(FRAME CHECKSUM – Not Used in Decode)*	*N/A*	*N/A*
11 *(FRAME MARKER – Not Used in Decode)*	*N/A*	*N/A*
011000	0x18	'8'
010011	0x13	'3'
010110	0x16	'6'
101001	0x19	'9'
001110	0x0E	'.'
001110	0x0E	'.'
001110	0x0E	'.'
000001	0x01	'!'
101101	0x2D	'M'
000100	0x04	'$'
00 *(FRAME CHECKSUM – Not Used in Decode*	*N/A*	*N/A*
11 *(FRAME MARKER – Not Used in Decode*	*N/A*	*N/A*

Therefore, for this particular ISO 18000-6B Transponder:

- *If Option 0 is selected, the Reader would transmit ISO 18000-6B Format messages (Format=0x1n) with the* ISO 18000-6B Transponder Data *field set to the following 16-byte ASCII hexadecimal equivalent of the contents of the transponder default memory page (UID):*

  "**E022494700101777**"

- *If Option 1 were selected, the Reader would transmit ISO 18000-6B eATA Report 8-bit Alphanumeric Format messages (Format = 0x6n) with the eATA* Transponder Data *field set to the following 20-byte ASCII string:*

  "**CPFI0105458369...!M$**"

- *If Option 2 were selected, the Reader would transmit ISO 18000-6B Combined UID+eATA Format messages (Format=0x8n) with the* ISO 18000-6B UID Transponder Data *field set to the following 16-byte ASCII hexadecimal equivalent of the contents of the transponder default memory page (UID):*

  "**E022494700101777**";

  ***And** the eATA* Transponder Data *field set to the following 20-byte ASCII string:*

  "**CPFI0105458369...!M$**"

9.6 ISO 18000-6B Multi-Protocol Messages

9.6.1 ISO 18000-6B Handshake (10 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*Raw Handshake Reports*" configuration parameter is enabled and '*ISO 18000-6B Reporting*' is set to '*Standard UID Format*'. The Reader issues this message over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface after an ISO 18000-6B Tag has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface only.

Format:

Table 9.6-1: ISO 18000-6B Handshake (10 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	R	• R = real-time message (tag has just gone through lane) *(Handshake Messages are NEVER buffered*)
Format	2 hex	10	Format Code 10 – ISO 18000-6B Handshake Message
Frame Number	8 hex	00000000 – FFFFFFFF	The frame count corresponding to the successful read event. This counter automatically rolls over when FFFFFFFF is reached. *Note: the frame count is global across all Reader channels AND protocols.*
ISO 18000-6B *Transponder Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.6.2 ISO 18000-6B Initial Read (11 – Format) Message

Direction: Reader to Lane Controller

Description: Optional informational message sent to the Lane Controller when the ISO 18000-6B transponder first enters the capture zone.

This message applies when the JANUS MPR4.1 Reader "*Initial Read Report*" configuration parameter is enabled and '*ISO 18000-6B Reporting*' is set to '*Standard UID Format*'. *Note that the initial read channel might differ from the transaction report generated at voting time*.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.6-2: ISO 18000-6B Initial Read (11 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (tag has just gone through lane) • B = buffered message (*report is from transaction buffer*) *Note: Buffered Initial Read messages will only be sent to the Lane Controller if* 'Initial Read Report Message Buffering' *is ENABLED.*
Format	2 hex	11	Format Code 11 – ISO 18000-6B Initial Read Message
Transaction Status	1 alpha	R	Transaction Status: • R = read
Txn Number	5 dec	00000 – 65535	Transaction Number
ISO 18000-6B *Transponder Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.6.3 ISO 18000-6B Transponder (12 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader '*ISO 18000-6B Reporting*' is set to '*Standard UID Format*'. The Reader issues this message after an ISO 18000-6B Tag has been read and assigned to a channel (after voting time expires). Adjusting the voting time or the reporting delay time can control the reporting latency.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.6-3: ISO 18000-6B Transponder (12 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	12	Format Code 12 – ISO 18000-6B Transponder Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*
ISO 18000-6B *Transponder Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.6.4 ISO 18000-6B Post Capture (13 – Format) Message

Direction: Reader to Lane Controller

Description: This message is an optional informational message. This message is generated if the '*ISO 18000-6B Reporting*' is set to '*Standard UID Format*' and "*Post-Capture-Zone Reports*" feature is enabled, and the Reader detects a lane assignment change. This report is generated at a multiple of the voting time (configurable) after the normal transaction report.

Post Capture messages are buffered (the volume of post capture messages is expected to be low relative to normal transaction messages).

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.6-4: ISO 18000-6B Post Capture (13 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	13	Format Code 13 – ISO 18000-6B Post Capture Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*
ISO 18000-6B *Transponder Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).

Field Name	Length & Format	Range	Contents
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See § 9.2 for details on this field)

Response: No response expected from Lane Controller.

9.6.5 ISO 18000-6B Estimated Vehicle Speed (16 – Format) Message

Direction: Reader to Lane Controller

Description: This message is generated if the "*Estimated Vehicle Speed Report*" feature is enabled, and the Reader has completed calculating the estimated vehicle speed values for the transponder in question.

The reported Sample Count values used in the calculation of Estimated Vehicle Speed may be less than the total number of handshakes reported for the same transaction in the Voting and/or Post-Capture reports. This is more likely to occur at low vehicle speeds.

Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).

Note: A Zero Crossing Point value of 9999ms is indicative of a data set error (i.e. Rx Noise and/or data clipping). The LC must ignore the Estimated Vehicle Speed provided in this message if a Zero Crossing Point value of 9999ms is reported.

Estimated Vehicle Speed messages are buffered.

This message is sent over the JANUS MPR-4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.6-5: ISO 18000-6B Estimated Vehicle Speed (16 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	16	Format Code 16 – ISO 18000-6B Estimated Vehicle Speed Message
Txn Number	5 dec	00000 – 65535	Transaction Number
Number of Valid Channel Data Sets	1 dec	1 – 3	The number of channels for which an Estimated Vehicle Speed / Envelope Reference Point Channel Data Set was calculated. ***Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).***
Channel Data Set #1 – Channel Number	1 dec	1 – 4	The channel number for the 1st Channel Data Set
Channel Data Set #1 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 1st Channel Data Set.
Channel Data Set #1 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 1st Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #1 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 1st Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #1 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 1st Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #2– Channel Number	1 dec	1 – 4	The channel number for the 2nd Channel Data Set.
Channel Data Set #2 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 2nd Channel Data Set.
Channel Data Set #2 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 2nd Channel Data Set.
Channel Data Set #2 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 2nd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #2 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 2nd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #3 – Channel Number	1 dec	1 – 4	The channel number for the 3rd Channel Data Set.
Channel Data Set #3 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 3rd Channel Data Set.
Channel Data Set #3 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 3rd Channel Data Set.
Channel Data Set #3 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 3rd Channel Data Set. The higher the value, the better the quality of the estimate.

Field Name	Length & Format	Range	Contents
Channel Data Set #3 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 3rd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
ISO 18000-6B *Transponder Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.6.6 ISO 18000-6B Departure (17 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when '*ISO 18000-6B Reporting*' is set to '*Standard UID Format*'. The JANUS MPR4.1 Reader issues this message to the Lane Controller after the *Departure Delay* time has elapsed since the last time a given ISO 18000-6B Transponder has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.6-6: ISO 18000-6B Departure (17 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	17	Format Code 17 – ISO 18000-6B Departure Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
ISO 18000-6B *Transponder Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).
Departure Information	183 alnum	N/A	Departure Message Additional Information (See §9.3 for details on this field)
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.7 ISO 18000-6C Multi-Protocol Messages

9.7.1 ISO 18000-6C Handshake (20 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*Raw Handshake Report*" configuration parameter is enabled. The Reader issues this message over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface after an ISO 18000-6C Tag has been read.

Note that the contents of the ISO 18000-6C Transponder Data (TID) *and* ISO 18000-6C Transponder Data (UM) *fields are dependent on the selection of the "*ISO 18000-6C Read Mode" *and* "6C Read Only-Mode" *configuration parameters. The user may elect to receive ISO 18000-6C messages using one of the following four (4) options:*

- "EPC Only" Read – *Reading of EPC data only; or*
- "EPC + TID" Read – *Reading of EPC plus TID data; or*
- "EPC + UM" Read – *Reading of EPC plus UM data (96 bits); or*
- "EPC + UM" Read/Write – *Reading of EPC plus reading/writing of UM data (64 bits).*

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface only.

Format:

Table 9.7-1: ISO 18000-6C Handshake (20 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	R	• R = real-time message (tag has just gone through lane) *(Handshake Messages are NEVER buffered*)
Format	2 hex	20	Format Code 20 – ISO 18000-6C Handshake Message
Frame Number	8 hex	00000000 – FFFFFFFF	The frame count corresponding to the successful read event. This counter automatically rolls over when FFFFFFFF is reached. *Note: the frame count is global across all Reader channels AND protocols.*
ISO 18000-6C Transponder Data (EPC/UII)	32 hex	N/A	The contents of the ISO 18000-6C Transponder EPC/UII Memory (Memory Bank 01) [128 bits from 0x20 – 0x9F, inclusive]
ISO 18000-6C Transponder Data (TID)	48 hex	N/A	The contents of the ISO 18000-6C Transponder TID Memory (Memory Bank 10) [192 bits from 0x00 – 0xBF, inclusive] (**See Notes *1*, *2*, *3*, *4***)

Field Name	Length & Format	Range	Contents
ISO 18000-6C Transponder Data (UM)	28 hex	N/A	The contents of the ISO 18000-6C Transponder UM Memory (Memory Bank 11) [Up to 112 bits from 0x00 – 0x6F, inclusive] (**See Notes *1*, *2*, *3*, *4***) *Unused bits in this field are populated with zeros [0's].*
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Notes:

(1) - *To read* EPC *data only, the "*ISO 18000-6C Read Mode" *parameter must be set to "*EPC Only"*; while in "*EPC Only Read" *mode, the JANUS MPR4.1 Reader shall populate the* TID *and* UM *message fields with zeroes [0's].*

(2) - *To read* EPC *and* TID *data, the "*ISO 18000-6C Read Mode" *parameter must be set to "*EPC + TID"*; while in "*EPC + TID Read" *mode, the JANUS MPR4.1 Reader shall populate the* UM *message field with zeroes [0's].*

(3) - *To read* EPC and *96 bits of* UM *data, the "*ISO 18000-6C Read Mode*" parameter must be set to "*EPC + UM*" **and the** "6C Read-Only Mode" **parameter must be enabled**; while in "*EPC + UM*" read mode, the JANUS MPR4.1 Reader shall populate the* TID *message field with zeroes [0's]. Any unused bits in the* UM *message field shall be populated with zeroes [0's].*

(4) - *To read EPC and read/write 64 bits of* UM *data, the "*ISO 18000-6C Read Mode*" parameter must be set to "*EPC + UM*" **and the** "6C Read-Only Mode" **parameter must be disabled**; while in "*EPC + UM*" read/write mode, the JANUS MPR4.1 Reader shall populate the* TID *message field with zeroes [0's]. Any unused bits in the* UM *message field shall be populated with zeroes [0's].*

Response: No response expected from Lane Controller.

9.7.2 ISO 18000-6C Initial Read (21 – Format) Message

Direction: Reader to Lane Controller

Description: Optional informational message sent to the Lane Controller when the ISO 18000-6C transponder first enters the capture zone.

This message applies when the JANUS MPR4.1 Reader *"Initial Read Report*" configuration parameter is enabled. *Note that the initial read channel might differ from the transaction report generated at voting time*.

Note that the contents of the ISO 18000-6C Transponder Data (TID) *and* ISO 18000-6C Transponder Data (UM) *fields are dependent on the selection of the "*ISO 18000-6C Read Mode" *and* "6C Read Only-Mode" *configuration parameters. The user may elect to receive ISO 18000-6C messages using one of the following four (4) options:*

- "EPC Only" Read – *Reading of EPC data only; or*
- "EPC + TID" Read – *Reading of EPC plus TID data; or*
- "EPC + UM" Read – *Reading of EPC plus UM data (96 bits); or*
- "EPC + UM" Read/Write – *Reading of EPC plus reading/writing of UM data (64 bits).*

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.7-2: ISO 18000-6C Initial Read (21 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (tag has just gone through lane) • B = buffered message (*report is from transaction buffer*) *Note: Buffered Initial Read messages will only be sent to the Lane Controller if* 'Initial Read Report Message Buffering' *is ENABLED.*
Format	2 hex	21	Format Code 21 – ISO 18000-6C Initial Read Message
Transaction Status	1 alpha	R	Transaction Status: • R = read
Txn Number	5 dec	00000 – 65535	Transaction Number
ISO 18000-6C Transponder Data (EPC/UII)	32 hex	N/A	The contents of the ISO 18000-6C Transponder EPC/UII Memory (Memory Bank 01) [128 bits from 0x20 – 0x9F, inclusive]
ISO 18000-6C Transponder Data (TID)	48 hex	N/A	The contents of the ISO 18000-6C Transponder TID Memory (Memory Bank 10) [192 bits from 0x00 – 0xBF, inclusive] (**See Notes *1*, *2*, *3*, *4***)

Field Name	Length & Format	Range	Contents
ISO 18000-6C Transponder Data (UM)	28 hex	N/A	The contents of the ISO 18000-6C Transponder UM Memory (Memory Bank 11) [Up to 112 bits from 0x00 – 0x6F, inclusive] (**See Notes *1*, *2*, *3*, *4***) *Unused bits in this field are populated with zeros [0's].*
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Notes:

(1) - *To read* EPC *data only, the "*ISO 18000-6C Read Mode" *parameter must be set to "*EPC Only"*; while in "*EPC Only Read" *mode, the JANUS MPR4.1 Reader shall populate the* TID *and* UM *message fields with zeroes [0's].*

(2) - *To read* EPC *and* TID *data, the "*ISO 18000-6C Read Mode" *parameter must be set to "*EPC + TID"*; while in "*EPC + TID Read" *mode, the JANUS MPR4.1 Reader shall populate the* UM *message field with zeroes [0's].*

(3) - *To read* EPC and *96 bits of* UM *data, the "*ISO 18000-6C Read Mode*" parameter must be set to "*EPC + UM*" **and the** "6C Read-Only Mode" **parameter must be enabled**; while in "*EPC + UM*" read mode, the JANUS MPR4.1 Reader shall populate the* TID *message field with zeroes [0's]. Any unused bits in the* UM *message field shall be populated with zeroes [0's].*

(4) - *To read EPC and read/write 64 bits of* UM *data, the "*ISO 18000-6C Read Mode*" parameter must be set to "*EPC + UM*" **and the** "6C Read-Only Mode" **parameter must be disabled**; while in "*EPC + UM*" read/write mode, the JANUS MPR4.1 Reader shall populate the* TID *field with zeroes [0's]. Any unused bits in the* UM *message field shall be populated with zeroes [0's].*

Response: No response expected from Lane Controller.

9.7.3 ISO 18000-6C Transponder (22 – Format) Message

Direction: Reader to Lane Controller

Description: The Reader issues this message after an ISO 18000-6C Tag has been read and assigned to a channel (after voting time expires). Adjusting the voting time or the reporting delay time can control the reporting latency.

Note that the contents of the ISO 18000-6C Transponder Data (TID) *and* ISO 18000-6C Transponder Data (UM) *fields are dependent on the selection of the* "ISO 18000-6C Read Mode" *and* "6C Read Only-Mode" *configuration parameters. The user may elect to receive ISO 18000-6C messages using one of the following four (4) options:*

- "EPC Only" Read – *Reading of EPC data only; or*
- "EPC + TID" Read – *Reading of EPC plus TID data; or*
- "EPC + UM" Read – *Reading of EPC plus UM data (96 bits); or*
- "EPC + UM" Read/Write – *Reading of EPC plus reading/writing of UM data (64 bits).*

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.7-3: ISO 18000-6C Transponder (22 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	22	Format Code 22 – ISO 18000-6C Transponder Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • S = Successful (**See Note *5***) • O = Memory Overrun (**See Notes *5*, *6***) • L = Memory Locked (**See Notes *5*, *7***) • F = General (unspecified) Programming Failure (**See Notes *5*, *8***) • R = Read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number

Field Name	Length & Format	Range	Contents
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00. An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
ISO 18000-6C Transponder Data (EPC/UII)	32 hex	N/A	The contents of the ISO 18000-6C Transponder EPC/UII Memory (Memory Bank 01) [128 bits from 0x20 – 0x9F, inclusive]
ISO 18000-6C Transponder Data (TID)	48 hex	N/A	The contents of the ISO 18000-6C Transponder TID Memory (Memory Bank 10) [192 bits from 0x00 – 0xBF, inclusive] (**See Notes *1*, *2*, *3*, *4***)
ISO 18000-6C Transponder Pre-Write (UM) Data	28 hex	N/A	The contents of the ISO 18000-6C Transponder UM Memory (Memory Bank 11) prior to programming [Up to 112 bits from 0x00 – 0x6F, inclusive] (**See Notes *1*, *2*, *3*, *4***) *Unused bits in this field are populated with zeros [0's].*
ISO 18000-6C Transponder Post-Write (UM) Data	28 hex	N/A	The contents of the ISO 18000-6C Transponder UM Memory (Memory Bank 11) subsequent to programming [Up to 112 bits from 0x00 – 0x6F, inclusive] (**See Notes*1*, *2*, *3*, *4***) *Unused bits in this field are populated with zeros [0's].*
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Notes:

(1) - *To read* EPC *data only, the "*ISO 18000-6C Read Mode" *parameter must be set to "*EPC Only"*; while in "*EPC Only Read" *mode, the JANUS MPR4.1 Reader shall populate the* TID *and* UM *message fields with zeroes [0's].*

(2) - *To read* EPC *and* TID *data, the "*ISO 18000-6C Read Mode" *parameter must be set to "*EPC + TID"*; while in "*EPC + TID Read" *mode, the JANUS MPR4.1 Reader shall populate the* UM *message field with zeroes [0's].*

(3) - *To read* EPC and *96 bits of* UM *data, the "*ISO 18000-6C Read Mode*" parameter must be set to "*EPC + UM*" **and the** "6C Read-Only Mode" **parameter must be enabled**; while in "*EPC + UM*" read mode,*

the JANUS MPR4.1 Reader shall populate the TID *message field with zeroes [0's]. Any unused bits in the* UM *message field shall be populated with zeroes [0's].*

(4) - *To read EPC and read/write 64 bits of* UM *data, the "*ISO 18000-6C Read Mode*" parameter must be set to "*EPC + UM*" **and the** "*6C Read-Only Mode" ***parameter must be disabled****; while in "*EPC + UM*" read/write mode, the JANUS MPR4.1 Reader shall populate the* TID *message field with zeroes [0's]. Any unused bits in the* UM *message field shall be populated with zeroes [0's].*

(5) - Transaction status codes 'S', 'O', 'L', 'F' will only be reported if the JANUS MPR4.1 Reader is configured to read/write 64 bits of UM data (**See Note *4***)

(6) - A transaction status code 'O' (Memory Overrun) indicates that the specified UM memory location does not exist or the EPC/PC length field is not supported by the tag.

(7) - A transaction status code 'L' (Memory Locked) indicates that the specified UM memory location is locked and/or perma-locked and is either not writeable or not readable.

(8) - The transactions status code 'F' (General Programming Failure) is a catch-all for errors not covered by other codes.

Response: No response expected from Lane Controller.

9.7.4 ISO 18000-6C Post Capture (23 – Format) Message

Direction: Reader to Lane Controller

Description: This message is an optional informational message. This message is generated if the "*Post-Capture-Zone Reports*" feature is enabled, and the Reader detects a change in the programming status of the ISO 18000-6C transponder (*e.g.* from fail to success), or a lane assignment change. This report is generated at a multiple of the voting time (configurable) after the normal transaction report.

Post Capture messages are buffered (*the volume of post capture messages is expected to be low relative to normal transaction messages).*

Note that the contents of the ISO 18000-6C Transponder Data (TID) *and* ISO 18000-6C Transponder Data (UM) *fields are dependent on the selection of the "*ISO 18000-6C Read Mode" *and* "6C Read Only-Mode" *configuration parameters. The user may elect to receive ISO 18000-6C messages using one of the following four (4) options:*

- "EPC Only" Read – *Reading of EPC data only; or*
- "EPC + TID" Read – *Reading of EPC plus TID data; or*
- "EPC + UM" Read – *Reading of EPC plus UM data (96 bits); or*
- "EPC + UM" Read/Write – *Reading of EPC plus reading/writing of UM data (64 bits).*

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.7-4: ISO 18000-6C Post Capture (23 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	23	Format Code 23 – ISO 18000-6C Post Capture Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • S = Successful (**See Note *5***) • O = Memory Overrun (**See Notes *5*, *6***) • L = Memory Locked (**See Notes *5*, *7***) • F = General (unspecified) Programming Failure (**See Notes *5*, *8***) • R = Read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number

Field Name	Length & Format	Range	Contents
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00. An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
ISO 18000-6C Transponder Data (EPC/UII)	32 hex	N/A	The contents of the ISO 18000-6C Transponder EPC/UII Memory (Memory Bank 01) [128 bits from 0x20 – 0x9F, inclusive]
ISO 18000-6C Transponder Data (TID)	48 hex	N/A	The contents of the ISO 18000-6C Transponder TID Memory (Memory Bank 10) [192 bits from 0x00 – 0xBF, inclusive] (**See Notes *1*, *2*, *3*, *4***)
ISO 18000-6C Transponder Pre-Write (UM) Data	28 hex	N/A	The contents of the ISO 18000-6C Transponder UM Memory (Memory Bank 11) prior to programming [Up to 112 bits from 0x00 – 0x6F, inclusive] (**See Notes *1*, *2*, *3*, *4***) *Unused bits in this field are populated with zeros [0's].*
ISO 18000-6C Transponder Post-Write (UM) Data	28 hex	N/A	The contents of the ISO 18000-6C Transponder UM Memory (Memory Bank 11) subsequent to programming [Up to 112 bits from 0x00 – 0x6F, inclusive] (**See Notes *1*, *2*, *3*, *4***) *Unused bits in this field are populated with zeros [0's].*
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Notes:

(1) - *To read* EPC *data only, the "*ISO 18000-6C Read Mode" *parameter must be set to "*EPC Only"*; while in "*EPC Only Read" *mode, the JANUS MPR4.1 Reader shall populate the* TID *and* UM *message fields with zeroes [0's].*

(2) - *To read* EPC *and* TID *data, the "*ISO 18000-6C Read Mode" *parameter must be set to "*EPC + TID"*; while in "*EPC + TID Read" *mode, the JANUS MPR4.1 Reader shall populate the* UM *message field with zeroes [0's].*

(3) - *To read* EPC and *96 bits of* UM *data, the "*ISO 18000-6C Read Mode*" parameter must be set to "*EPC + UM*" **and the** "6C Read-Only Mode" **parameter must be enabled**; while in "*EPC + UM*" read mode,*

the JANUS MPR4.1 Reader shall populate the TID *message field with zeroes [0's]. Any unused bits in the* UM *message field shall be populated with zeroes [0's].*

(4) - *To read EPC and read/write 64 bits of* UM *data, the "*ISO 18000-6C Read Mode*" parameter must be set to "*EPC + UM*" **and the** "*6C Read-Only Mode" ***parameter must be disabled****; while in "*EPC + UM*" read/write mode, the JANUS MPR4.1 Reader shall populate the* TID *message field with zeroes [0's]. Any unused bits in the* UM *message field shall be populated with zeroes [0's].*

(5) - Transaction status codes 'S', 'O', 'L', 'F' will only be reported if the JANUS MPR4.1 Reader is configured to read/write 64 bits of UM data (**See Note *4***)

(6) - A transaction status code 'O' (Memory Overrun) indicates that the specified UM memory location does not exist or the EPC/PC length field is not supported by the tag.

(7) - A transaction status code 'L' (Memory Locked) indicates that the specified UM memory location is locked and/or perma-locked and is either not writeable or not readable.

(8) - The transactions status code 'F' (General Programming Failure) is a catch-all for errors not covered by other codes.

Response: No response expected from Lane Controller.

9.7.5 ISO 18000-6C Estimated Vehicle Speed (26 – Format) Message

Direction: Reader to Lane Controller

Description: This message is generated if the "*Estimated Vehicle Speed Report*" feature is enabled, and the Reader has completed calculating the estimated vehicle speed values for the transponder in question.

The reported Sample Count values used in the calculation of Estimated Vehicle Speed may be less than the total number of handshakes reported for the same transaction in the Voting and/or Post-Capture reports. This is more likely to occur at low vehicle speeds.

Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).

Note: A Zero Crossing Point value of 9999ms is indicative of a data set error (i.e. Rx Noise and/or data clipping). The LC must ignore the Estimated Vehicle Speed provided in this message if a Zero Crossing Point value of 9999ms is reported.

Estimated Vehicle Speed messages are buffered.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.7-5: ISO 18000-6C Estimated Vehicle Speed (26 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	26	Format Code 26 – ISO 18000-6C Estimated Vehicle Speed Message
Txn Number	5 dec	00000 – 65535	Transaction Number
Number of Valid Channel Data Sets	1 dec	1 – 3	The number of channels for which an Estimated Vehicle Speed / Envelope Reference Point Channel Data Set was calculated. ***Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).***
Channel Data Set #1 – Channel Number	1 dec	1 – 4	The channel number for the 1st Channel Data Set
Channel Data Set #1 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 1st Channel Data Set.
Channel Data Set #1 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 1st Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #1 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 1st Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #1 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 1st Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #2– Channel Number	1 dec	1 – 4	The channel number for the 2nd Channel Data Set.
Channel Data Set #2 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 2nd Channel Data Set.
Channel Data Set #2 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 2nd Channel Data Set.
Channel Data Set #2 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 2nd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #2 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 2nd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #3 – Channel Number	1 dec	1 – 4	The channel number for the 3rd Channel Data Set.
Channel Data Set #3 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 3rd Channel Data Set.
Channel Data Set #3 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 3rd Channel Data Set.
Channel Data Set #3 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 3rd Channel Data Set. The higher the value, the better the quality of the estimate.

Field Name	Length & Format	Range	Contents
Channel Data Set #3 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 3rd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
ISO 18000-6C Transponder Data (EPC/UII)	32 hex	N/A	The contents of the ISO 18000-6C Transponder EPC/UII Memory (Memory Bank 01) [128 bits from 0x20 – 0x9F, inclusive]
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.7.6 ISO 18000-6C Departure (27 – Format) Message

Direction: Reader to Lane Controller

Description: The JANUS MPR4.1 Reader issues this message to the Lane Controller after the *Departure Delay* time has elapsed since the last time a given ISO 18000-6C Transponder has been read.

Note that the contents of the ISO 18000-6C Transponder Data (TID) *and* ISO 18000-6C Transponder Data (UM) *fields are dependent on the selection of the "*ISO 18000-6C Read Mode" *and* "6C Read Only-Mode" *configuration parameters. The user may elect to receive ISO 18000-6C messages using one of the following four (4) options:*

- "EPC Only" Read – *Reading of EPC data only; or*
- "EPC + TID" Read – *Reading of EPC plus TID data; or*
- "EPC + UM" Read – *Reading of EPC plus UM data (96 bits); or*
- "EPC + UM" Read/Write – *Reading of EPC plus reading/writing of UM data (64 bits).*

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.7-6: ISO 18000-6C Departure (27 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	27	Format Code 27 – ISO 18000-6C Departure Message
Transaction Status	1 alpha	{S, O, L, F, R, C}	Transaction Status: • S = Successful (**See Note *5***) • O = Memory Overrun (**See Notes *5*, *6***) • L = Memory Locked (**See Notes *5*, *7***) • F = General (unspecified) Programming Failure (**See Notes *5*, *8***) • R = Read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number

Field Name	Length & Format	Range	Contents
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel.*First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
ISO 18000-6C Transponder Data (EPC/UII)	32 hex	N/A	The contents of the ISO 18000-6C Transponder EPC/UII Memory (Memory Bank 01) [128 bits from 0x20 – 0x9F, inclusive]
ISO 18000-6C Transponder Data (TID)	48 hex	N/A	The contents of the ISO 18000-6C Transponder TID Memory (Memory Bank 10) [192 bits from 0x00 – 0xBF, inclusive] (**See Notes *1*, *2*, *3*, *4***)
ISO 18000-6C Transponder Pre-Write (UM) Data	28 hex	N/A	The contents of the ISO 18000-6C Transponder UM Memory (Memory Bank 11) prior to programming [Up to 112 bits from 0x00 – 0x6F, inclusive] (**See Notes *1*, *2*, *3*, *4***) *Unused bits in this field are populated with zeros [0's].*
ISO 18000-6C Transponder Post-Write (UM) Data	28 hex	N/A	The contents of the ISO 18000-6C Transponder UM Memory (Memory Bank 11) subsequent to programming [Up to 112 bits from 0x00 – 0x6F, inclusive] (**See Notes*1*, *2*, *3*, *4***) *Unused bits in this field are populated with zeros [0's].*
Departure Information	183 alnum	N/A	Departure Message Additional Information (See §9.3 for details on this field)
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Notes:

(1) - *To read* EPC *data only, the "*ISO 18000-6C Read Mode" *parameter must be set to "*EPC Only"*; while in "*EPC Only Read" *mode, the JANUS MPR4.1 Reader shall populate the* TID *and* UM *message fields with zeroes [0's].*

(2) - *To read* EPC *and* TID *data, the "*ISO 18000-6C Read Mode" *parameter must be set to "*EPC + TID"*; while in "*EPC + TID Read" *mode, the JANUS MPR4.1 Reader shall populate the* UM *message field with zeroes [0's].*

(3) - *To read* EPC and *96 bits of* UM *data, the "*ISO 18000-6C Read Mode*" parameter must be set to "*EPC + UM*" **and the** "*6C Read-Only Mode" ***parameter must be enabled**; while in "*EPC + UM*" read mode, the JANUS MPR4.1 Reader shall populate the* TID *message field with zeroes [0's]. Any unused bits in the* UM *message field shall be populated with zeroes [0's].*

(4) - *To read EPC and read/write 64 bits of* UM *data, the "*ISO 18000-6C Read Mode*" parameter must be set to "*EPC + UM*" **and the** "*6C Read-Only Mode" ***parameter must be disabled**; while in "*EPC + UM*" read/write mode, the JANUS MPR4.1 Reader shall populate the* TID *message field with zeroes [0's]. Any unused bits in the* UM *message field shall be populated with zeroes [0's].*

(5) - Transaction status codes 'S', 'O', 'L', 'F' will only be reported if the JANUS MPR4.1 Reader is configured to read/write 64 bits of UM data (**See Note *4***)

(6) - A transaction status code 'O' (Memory Overrun) indicates that the specified UM memory location does not exist or the EPC/PC length field is not supported by the tag.

(7) - A transaction status code 'L' (Memory Locked) indicates that the specified UM memory location is locked and/or perma-locked and is either not writeable or not readable.

(8) - The transactions status code 'F' (General Programming Failure) is a catch-all for errors not covered by other codes.

Response: No response expected from Lane Controller.

9.8 ATA (8-Bit Alphanumeric Format) Multi-Protocol Messages

9.8.1 ATA Handshake (40 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*Raw Handshake Report*" configuration parameter is enabled. The Reader issues this message over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface when an ATA Tag has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface only.

Format:

Table 9.8-1: ATA Handshake (40 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel identifier
Type	1 alpha	R	• R = real-time message (tag has just gone through lane) *(Handshake Messages are NEVER buffered*)
Format	2 hex	40	Format Code 40 – ATA Handshake Message (8-Bit Alphanumeric Format)
Frame Number	8 hex	00000000 – FFFFFFFF	The frame count corresponding to the successful read event. This counter automatically rolls over when FFFFFFFF is reached. *Note: the frame count is global across all Reader channels AND protocols.*
ATA Transponder Data	20 alnum	N/A	The contents of the ATA transponder data in 8-bit ASCII alphanumeric format (See §9.5 for details). **(See Notes *1*, *2*)**
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Notes:

(1) - If the Reader detects invalid ATA frame checksums and/or the Reader is unable to extract a valid transponder serial number from the incoming data stream, a 'Phantom' read handshake is reported by replacing the last two bytes of the ATA Transponder Data Field with two (2) '#' signs (ASCII Hex 0x23).

(2) - If the Reader is configured to perform ATA Data CRC verification and the verification of the ATA Data CRC fails, a 'Bad ATA Data CRC' handshake is reported by replacing the last two bytes of the ATA Transponder Data Field with two (2) '@' signs (ASCII Hex 0x40).

Response: No response expected from Lane Controller.

9.8.2 ATA Initial Read (41 – Format) Message

Direction: Reader to Lane Controller

Description: Optional informational message sent to the Lane Controller when the ATA transponder first enters the capture zone.

This message applies when the JANUS MPR4.1 Reader "*Initial Read Report*" configuration parameter is enabled. *Note that the initial read channel might differ from the transaction report generated at voting time*.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interfaces.

Format:

Table 9.8-2: ATA Initial Read (41 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (tag has just gone through lane) • B = buffered message (*report is from transaction buffer*) *Note: Buffered Initial Read messages will only be sent to the Lane Controller if* 'Initial Read Report Message Buffering' *is ENABLED.*
Format	2 hex	41	Format Code 41 – ATA Initial Read Message (8-Bit Alphanumeric Format)
Transaction Status	1 alpha	R	Transaction Status: • R = read
Txn Number	5 dec	00000 – 65535	Transaction Number
ATA Transponder Data	20 alnum	N/A	The contents of the ATA transponder data in 8-bit ASCII alphanumeric format (See §9.5 for details).
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.8.3 ATA Transponder (42 – Format) Message

Direction: Reader to Lane Controller

Description: The Reader issues this message after an ATA Tag has been read and assigned to a channel (after voting time expires). Adjusting the voting time or the reporting delay time can control the reporting latency.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.8-3: ATA Transponder (42 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	42	Format Code 42 – ATA Transponder Message (8-Bit Alphanumeric Format)
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*
ATA Transponder Data	20 alnum	N/A	The contents of the ATA transponder data in 8-bit ASCII alphanumeric format (See §9.5 for details).
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.8.4 ATA Post Capture (43 – Format) Message

Direction: Reader to Lane Controller

Description: This message is an optional informational message. This message is generated if the "*Post-Capture-Zone Reports*" feature is enabled, and the Reader detects a lane assignment change. This report is generated at a multiple of the voting time (configurable) after the normal transaction report.

Post Capture messages are buffered (*the volume of post capture messages is expected to be low relative to normal transaction messages).*

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.8-4: ATA Post Capture (43 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	43	Format Code 43 – ATA Post Capture Message (8-Bit Alphanumeric Format)
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*
ATA Transponder Data	20 alnum	N/A	The contents of the ATA transponder data in 8-bit ASCII alphanumeric format (See §9.5 for details).

Field Name	Length & Format	Range	Contents
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.8.5 ATA Estimated Vehicle Speed (46 – Format) Message

Direction: Reader to Lane Controller

Description: This message is generated if the "*Estimated Vehicle Speed Report*" feature is enabled, and the Reader has completed calculating the estimated vehicle speed values for the transponder in question.

The reported Sample Count values used in the calculation of Estimated Vehicle Speed may be less than the total number of handshakes reported for the same transaction in the Voting and/or Post-Capture reports. This is more likely to occur at low vehicle speeds.

Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).

Note: A Zero Crossing Point value of 9999ms is indicative of a data set error (i.e. Rx Noise and/or data clipping). The LC must ignore the Estimated Vehicle Speed provided in this message if a Zero Crossing Point value of 9999ms is reported.

Estimated Vehicle Speed messages are buffered.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.8-5: ATA Estimated Vehicle Speed (46 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	36	Format Code 46 – ATA Estimated Vehicle Speed Message (8-bit Alphanumeric Format)
Txn Number	5 dec	00000 – 65535	Transaction Number
Number of Valid Channel Data Sets	1 dec	1 – 3	The number of channels for which an Estimated Vehicle Speed / Envelope Reference Point Channel Data Set was calculated. ***Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).***
Channel Data Set #1 – Channel Number	1 dec	1 – 4	The channel number for the 1st Channel Data Set
Channel Data Set #1 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 1st Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #1 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 1st Channel Data Set.
Channel Data Set #1 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 1st Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #1 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 1st Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #2– Channel Number	1 dec	1 – 4	The channel number for the 2nd Channel Data Set.
Channel Data Set #2 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 2nd Channel Data Set.
Channel Data Set #2 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 2nd Channel Data Set.
Channel Data Set #2 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 2nd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #2 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 2nd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #3 – Channel Number	1 dec	1 – 4	The channel number for the 3rd Channel Data Set.
Channel Data Set #3 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 3rd Channel Data Set.
Channel Data Set #3 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 3rd Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #3 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 3rd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #3 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 3rd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
ATA Transponder Data	20 alnum	N/A	The contents of the ATA transponder data in 8-bit ASCII alphanumeric format (See §9.5 for details).
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.8.6 ATA Departure (47 – Format) Message

Direction: Reader to Lane Controller

Description: The JANUS MPR4.1 Reader issues this message to the Lane Controller after the *Departure Delay* time has elapsed since the last time a given ATA Transponder has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.8-6: ATA Departure (47 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	47	Format Code 47 – ATA Departure Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
ATA Transponder Data	20 alnum	N/A	The contents of the ATA transponder data in 8-bit ASCII alphanumeric format (See §9.5 for details).
Departure Information	183 alnum	N/A	Departure Message Additional Information (See §9.3 for details on this field)

Field Name	Length & Format	Range	Contents
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.9 ISO 18000-6B eATA Report (8-Bit Alphanumeric Format) Multi-Protocol Messages

9.9.1 ISO 18000-6B eATA Handshake (60 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*Raw Handshake Report*" configuration parameter is enabled and "*ISO 18000-6B Reporting*" is set to "*eATA 8-bit ASCII Alphanumeric Format*". The Reader issues this message over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface when an ISO 18000-6B eATA Tag has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface only.

Format:

Table 9.9-1: ISO 18000-6B eATA Handshake (60 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	R	• R = real-time message (tag has just gone through lane) *(Handshake Messages are NEVER buffered*)
Format	2 hex	60	Format Code 60 – ISO 18000-6B eATA Handshake Message (8-Bit Alphanumeric Format)
Frame Number	8 hex	00000000 – FFFFFFFF	The frame count corresponding to the successful read event. This counter automatically rolls over when FFFFFFFF is reached. *Note: the frame count is global across all Reader channels AND protocols.*
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.9.2 ISO 18000-6B eATA Initial Read (61 – Format) Message

Direction: Reader to Lane Controller

Description: Optional informational message sent to the Lane Controller when the ISO 18000-6B eATA transponder first enters the capture zone.

This message applies when the JANUS MPR4.1 Reader "*Initial Read Report*" configuration parameter is enabled and "*ISO 18000-6B Reporting*" is set to "eATA *8-bit ASCII Alphanumeric Format*". *Note that the initial read channel might differ from the transaction report generated at voting time*.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.9-2: ISO 18000-6B eATA Initial Read (61 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (tag has just gone through lane) • B = buffered message (*report is from transaction buffer*) *Note: Buffered Initial Read messages will only be sent to the Lane Controller if* 'Initial Read Report Message Buffering' *is ENABLED.*
Format	2 hex	61	Format Code 61 – ISO 18000-6B eATA Initial Read Message (8-Bit Alphanumeric Format)
Transaction Status	1 alpha	R	Transaction Status: • R = read
Txn Number	5 dec	00000 – 65535	Transaction Number
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.9.3 ISO 18000-6B eATA Transponder (62 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 "*ISO 18000-6B Reporting*" is set to "eATA *8-bit ASCII Alphanumeric Format*". The Reader issues this message after an ISO 18000-6B eATA Tag has been read and assigned to a channel (after voting time expires). Adjusting the voting time or the reporting delay time can control the reporting latency.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.9-3: ISO 18000-6B eATA Transponder (62 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	62	Format Code 62 – ISO 18000-6B eATA Transponder Message (8-Bit Alphanumeric Format)
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).

Field Name	Length & Format	Range	Contents
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.9.4 ISO 18000-6B eATA Post Capture (63 – Format) Message

Direction: Reader to Lane Controller

Description: This message is an optional informational message that applies when the JANUS MPR4.1 Reader "*ISO 18000-6B Reporting*" is set to "eATA *8-bit Alphanumeric Format*". This message is generated if the "*Post-Capture-Zone Reports*" feature is enabled, and the Reader detects a lane assignment change. This report is generated at a multiple of the voting time (configurable) after the normal transaction report.

Post Capture messages are buffered (the volume of post capture messages is expected to be low relative to normal transaction messages).

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.9-4: ISO 18000-6B eATA Post Capture (63 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	63	Format Code 63 – ISO 18000-6B eATA Post Capture Message (8-Bit Alphanumeric Format)
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*

Field Name	Length & Format	Range	Contents
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.9.5 ISO 18000-6B eATA Estimated Vehicle Speed (66 – Format) Message

Direction: Reader to Lane Controller

Description: **THIS MESSAGE, ALTHOUGH DEFINED, IS CURRENTLY NOT IMPLEMENTED.**

This message is generated if the "*Estimated Vehicle Speed Report*" feature is enabled, and the Reader has completed calculating the estimated vehicle speed values for the transponder in question.

The reported Sample Count values used in the calculation of Estimated Vehicle Speed may be less than the total number of handshakes reported for the same transaction in the Voting and/or Post-Capture reports. This is more likely to occur at low vehicle speeds.

Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).

Note: A Zero Crossing Point value of 9999ms is indicative of a data set error (i.e. Rx Noise and/or data clipping). The LC must ignore the Estimated Vehicle Speed provided in this message if a Zero Crossing Point value of 9999ms is reported.

Estimated Vehicle Speed messages are buffered.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interfaces.

Format:

Table 9.9-5: ISO 18000-6B eATA Estimated Vehicle Speed (56 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	66	Format Code 66 – ISO 18000-6B eATA Estimated Vehicle Speed Message (8-Bit Alphanumeric Format)
Txn Number	5 dec	00000 – 65535	Transaction Number
Number of Valid Channel Data Sets	1 dec	1 – 3	The number of channels for which an Estimated Vehicle Speed / Envelope Reference Point Channel Data Set was calculated. ***Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).***
Channel Data Set #1 – Channel Number	1 dec	1 – 4	The channel number for the 1st Channel Data Set
Channel Data Set #1 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 1st Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #1 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 1st Channel Data Set.
Channel Data Set #1 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 1st Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #1 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 1st Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #2– Channel Number	1 dec	1 – 4	The channel number for the 2nd Channel Data Set.
Channel Data Set #2 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 2nd Channel Data Set.
Channel Data Set #2 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 2nd Channel Data Set.
Channel Data Set #2 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 2nd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #2 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 2nd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #3 – Channel Number	1 dec	1 – 4	The channel number for the 3rd Channel Data Set.
Channel Data Set #3 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 3rd Channel Data Set.
Channel Data Set #3 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 3rd Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #3 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 3rd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #3 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 3rd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.9.6 ISO 18000-6B eATA (8-Bit Alphanumeric Format) Departure (67 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when "*ISO 18000-6B Reporting*" is set to "eATA *8-bit ASCII Alphanumeric Format*". The JANUS MPR4.1 Reader issues this message to the Lane Controller after the *Departure Delay* time has elapsed since the last time a given ISO 18000-6B Transponder has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Note: The complete estimated vehicle speed functionality is currently NOT FULLY IMPLEMENTED for the ISO 18000-6B protocol in non-*'Standard (UID only)' Read Mode*. The* Estimated Vehicle Speed Information *field contained within the* Departure Information *field (c.f. §9.3) of this message shall be correspondingly populated with all 0's (zeroes).

Format:

Table 9.9-6: ISO 18000-6B eATA Departure (67 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	67	Format Code 67 – ISO 18000-6B eATA Departure Message (8-Bit Alphanumeric Format)
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*

Field Name	Length & Format	Range	Contents
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).
Departure Information	183 alnum	N/A	Departure Message Additional Information (See §9.3 for details on this field)
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.10 SeGo Multi-Protocol Messages

9.10.1 SeGo Handshake (70 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*Raw Handshake Reports*" configuration parameter is enabled. The Reader issues this message over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface after a SeGo Tag has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface only.

Format:

Table 9.10-1: SeGo Handshake (70 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	R	• R = real-time message (tag has just gone through lane) *(Handshake Messages are NEVER buffered*)
Format	2 hex	70	Format Code 70 – SeGo Handshake Message
Frame Number	8 hex	00000000 – FFFFFFFF	The frame count corresponding to the successful read event. This counter automatically rolls over when FFFFFFFF is reached. *Note: the frame count is global across all Reader channels AND protocols.*
SeGo *Transponder Data*	32 hex	N/A	The contents of the SeGo transponder default memory page.
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.10.2 SeGo Initial Read (71 – Format) Message

Direction: Reader to Lane Controller

Description: Optional informational message sent to the Lane Controller when the SeGo transponder first enters the capture zone.

This message applies when the JANUS MPR4.1 Reader "*Initial Read Report*" configuration parameter is enabled. *Note that the initial read channel might differ from the transaction report generated at voting time*.

This message is sent over the JANUS MPR-4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.10-2: SeGo Initial Read (71 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (tag has just gone through lane) • B = buffered message (*report is from transaction buffer*) *Note: Buffered Initial Read messages will only be sent to the Lane Controller if* 'Initial Read Report Message Buffering' *is ENABLED.*
Format	2 hex	71	Format Code 71 – SeGo Initial Read Message
Transaction Status	1 alpha	R	Transaction Status: • R = read
Txn Number	5 dec	00000 – 65535	Transaction Number
SeGo *Transponder Data*	32 hex	N/A	The contents of the SeGo transponder default memory page.
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.10.3 SeGo Transponder (72 – Format) Message

Direction: Reader to Lane Controller

Description: The Reader issues this message after a SeGo Tag has been read and assigned to a channel (after voting time expires). Adjusting the voting time or the reporting delay time can control the reporting latency.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.10-3: SeGo Transponder (72 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	72	Format Code 72 – SeGo Transponder Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*
SeGo *Transponder Data*	32 hex	N/A	The contents of the SeGo transponder default memory page.
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.10.4 SeGo Post Capture (73 – Format) Message

Direction: Reader to Lane Controller

Description: This message is generated if the "*Post-Capture-Zone Reports*" feature is enabled, and the Reader detects a lane assignment change. This report is generated at a multiple of the voting time (configurable) after the normal transaction report.

Post Capture messages are buffered (the volume of post capture messages is expected to be low relative to normal transaction messages).

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.10-4: SeGo Post Capture (73 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	73	Format Code 73 – SeGo Post Capture Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*
SeGo *Transponder Data*	32 hex	N/A	The contents of the SeGo transponder default memory page.

Field Name	Length & Format	Range	Contents
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.10.5 SeGo Estimated Vehicle Speed (76 – Format) Message

Direction: Reader to Lane Controller

Description: This message is generated if the "*Estimated Vehicle Speed Report*" feature is enabled, and the Reader has completed calculating the estimated vehicle speed values for the transponder in question.

The reported Sample Count values used in the calculation of Estimated Vehicle Speed may be less than the total number of handshakes reported for the same transaction in the Voting and/or Post-Capture reports. This is more likely to occur at low vehicle speeds.

Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).

Note: A Zero Crossing Point value of 9999ms is indicative of a data set error (i.e. Rx Noise and/or data clipping). The LC must ignore the Estimated Vehicle Speed provided in this message if a Zero Crossing Point value of 9999ms is reported.

Estimated Vehicle Speed messages are buffered.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.10-5: SeGo Estimated Vehicle Speed (76 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	76	Format Code 76 – SeGo Estimated Vehicle Speed Message
Txn Number	5 dec	00000 – 65535	Transaction Number
Number of Valid Channel Data Sets	1 dec	1 – 3	The number of channels for which an Estimated Vehicle Speed / Envelope Reference Point Channel Data Set was calculated. ***Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).***
Channel Data Set #1 – Channel Number	1 dec	1 – 4	The channel number for the 1st Channel Data Set
Channel Data Set #1 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 1st Channel Data Set.
Channel Data Set #1 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 1st Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #1 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 1st Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #1 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 1st Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #2– Channel Number	1 dec	1 – 4	The channel number for the 2nd Channel Data Set.
Channel Data Set #2 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 2nd Channel Data Set.
Channel Data Set #2 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 2nd Channel Data Set.
Channel Data Set #2 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 2nd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #2 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 2nd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #3 – Channel Number	1 dec	1 – 4	The channel number for the 3rd Channel Data Set.
Channel Data Set #3 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 3rd Channel Data Set.
Channel Data Set #3 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 3rd Channel Data Set.
Channel Data Set #3 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 3rd Channel Data Set. The higher the value, the better the quality of the estimate.

Field Name	Length & Format	Range	Contents
Channel Data Set #3 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 3rd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
SeGo Transponder Data	32 hex	N/A	The contents of the SeGo transponder default memory page.
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.10.6 SeGo Departure (77 – Format) Message

Direction: Reader to Lane Controller

Description: The JANUS MPR4.1 Reader issues this message to the Lane Controller after the *Departure Delay* time has elapsed since the last time a given SeGo Transponder has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.10-6: SeGo Departure (77 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	77	Format Code 77 – SeGo Departure Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel.*First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
SeGo *Transponder Data*	32 hex	N/A	The contents of the SeGo transponder default memory page.
Departure Information	183 alnum	N/A	Departure Message Additional Information (See §9.3 for details on this field)
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.11 ISO 18000-6B Combined UID+eATA Report Multi-Protocol Messages

9.11.1 ISO 18000-6B Combined UID+eATA Handshake (80 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*Raw Handshake Report*" configuration parameter is enabled and "*ISO 18000-6B Reporting*" is set to "*Combined UID+eATA Format*". The Reader issues this message over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface when an ISO 18000-6B eATA Tag has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface only.

Format:

Table 9.11-1: ISO 18000-6B Combined UID+eATA Handshake (80 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	R	• R = real-time message (tag has just gone through lane) *(Handshake Messages are NEVER buffered*)
Format	2 hex	80	Format Code 80 – ISO 18000-6B Combined UID+eATA Handshake Message
Frame Number	8 hex	00000000 – FFFFFFFF	The frame count corresponding to the successful read event. This counter automatically rolls over when FFFFFFFF is reached. *Note: the frame count is global across all Reader channels AND protocols.*
ISO 18000-6B *Transponder (UID) Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.11.2 ISO 18000-6B Combined UID+eATA Initial Read (81 – Format) Message

Direction: Reader to Lane Controller

Description: Optional informational message sent to the Lane Controller when the ISO 18000-6B eATA transponder first enters the capture zone.

This message applies when the JANUS MPR4.1 Reader "*Initial Read Report*" configuration parameter is enabled and "*ISO 18000-6B Reporting*" is set to "*Combined UID+eATA Format*". *Note that the initial read channel might differ from the transaction report generated at voting time*.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.11-2: ISO 18000-6B Combined UID+eATA Initial Read (81 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (tag has just gone through lane) • B = buffered message (*report is from transaction buffer*) *Note: Buffered Initial Read messages will only be sent to the Lane Controller if* 'Initial Read Report Message Buffering' *is ENABLED.*
Format	2 hex	81	Format Code 81 – ISO 18000-6B Combined UID+eATA Initial Read Message
Transaction Status	1 alpha	R	Transaction Status: • R = read
Txn Number	5 dec	00000 – 65535	Transaction Number
ISO 18000-6B *Transponder (UID) Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.11.3 ISO 18000-6B Combined UID+eATA Transponder (82 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*ISO 18000-6B Reporting*" is set to "*Combined UID+eATA Format*". The Reader issues this message after an ISO 18000-6B eATA Tag has been read and assigned to a channel (after voting time expires). Adjusting the voting time or the reporting delay time can control the reporting latency.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.11-3: ISO 18000-6B Combined UID+eATA Transponder (82 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	82	Format Code 82 – ISO 18000-6B Combined UID+eATA Transponder Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*
ISO 18000-6B *Transponder (UID) Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).

Field Name	Length & Format	Range	Contents
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.11.4 ISO 18000-6B Combined UID+eATA Post Capture (83 – Format) Message

Direction: Reader to Lane Controller

Description: This message is an optional informational message that applies when the JANUS MPR4.1 Reader "*ISO 18000-6B Reporting Format*" is set to "*Combined UID+eATA Format*". This message is generated if the "*Post-Capture-Zone Reports*" feature is enabled, and the Reader detects a lane assignment change. This report is generated at a multiple of the voting time (configurable) after the normal transaction report.

Post Capture messages are buffered (the volume of post capture messages is expected to be low relative to normal transaction messages).

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.11-4: ISO 18000-6B Combined UID+eATA Post Capture (83 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	83	Format Code 83 – ISO 18000-6B Combined UID+eATA Post Capture Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*
ISO 18000-6B *Transponder (UID) Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).

Field Name	Length & Format	Range	Contents
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.11.5 ISO 18000-6B Combined UID+eATA Estimated Vehicle Speed (86 – Format) Message

Direction: Reader to Lane Controller

Description: **THIS MESSAGE, ALTHOUGH DEFINED, IS CURRENTLY NOT IMPLEMENTED.**

This message is generated if the "*Estimated Vehicle Speed Report*" feature is enabled, and the Reader has completed calculating the estimated vehicle speed values for the transponder in question.

The reported Sample Count values used in the calculation of Estimated Vehicle Speed may be less than the total number of handshakes reported for the same transaction in the Voting and/or Post-Capture reports. This is more likely to occur at low vehicle speeds.

Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).

Note: A Zero Crossing Point value of 9999ms is indicative of a data set error (i.e. Rx Noise and/or data clipping). The LC must ignore the Estimated Vehicle Speed provided in this message if a Zero Crossing Point value of 9999ms is reported.

Estimated Vehicle Speed messages are buffered.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.11-5: ISO 18000-6B Combined UID+eATA Estimated Vehicle Speed (86 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	86	Format Code 86 – ISO 18000-6B Combined UID+eATA Estimated Vehicle Speed Message (8-Bit Alphanumeric Format)
Txn Number	5 dec	00000 – 65535	Transaction Number
Number of Valid Channel Data Sets	1 dec	1 – 3	The number of channels for which an Estimated Vehicle Speed / Envelope Reference Point Channel Data Set was calculated. ***Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).***
Channel Data Set #1 – Channel Number	1 dec	1 – 4	The channel number for the 1st Channel Data Set
Channel Data Set #1 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 1st Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #1 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 1st Channel Data Set.
Channel Data Set #1 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 1st Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #1 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 1st Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #2– Channel Number	1 dec	1 – 4	The channel number for the 2nd Channel Data Set.
Channel Data Set #2 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 2nd Channel Data Set.
Channel Data Set #2 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 2nd Channel Data Set.
Channel Data Set #2 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 2nd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #2 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 2nd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #3 – Channel Number	1 dec	1 – 4	The channel number for the 3rd Channel Data Set.
Channel Data Set #3 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 3rd Channel Data Set.
Channel Data Set #3 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 3rd Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #3 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 3rd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #3 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 3rd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
ISO 18000-6B *Transponder (UID) Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.11.6 ISO 18000-6B Combined UID+eATA Departure (87 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when "*ISO 18000-6B Reporting*" is set to "*Combined UID+eATA Format*". The JANUS MPR4.1 Reader issues this message to the Lane Controller after the *Departure Delay* time has elapsed since the last time a given ISO 18000-6B Transponder has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Note: The complete estimated vehicle speed functionality is currently NOT FULLY IMPLEMENTED for the ISO 18000-6B protocol in non-'*Standard (UID only)' Read Mode*. The* Estimated Vehicle Speed Information *field contained within the* Departure Information *field (*c.f. *§9.3) of this message shall be correspondingly populated with all 0's (zeroes).

Format:

Table 9.11-6: ISO 18000-6B Combined UID+eATA Departure (87 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	87	Format Code 87 – ISO 18000-6B Combined UID+eATA Departure Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel.*First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*

Field Name	Length & Format	Range	Contents
ISO 18000-6B *Transponder (UID) Data*	16 hex	N/A	The contents of the ISO 18000-6B transponder default memory page (UID).
eATA Transponder Data	20 alnum	N/A	The contents of the ISO 18000-6B eATA transponder data (memory pages 0x70, 0x78) in 8-bit ASCII alphanumeric format (See §9.5 for details).
Departure Information	183 alnum	N/A	Departure Message Additional Information (See §9.3 for details on this field)
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.12 Title21 Multi-Protocol Messages

9.12.1 Title21 Handshake (90 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*Raw Handshake Reports*" configuration parameter is enabled. The Reader issues this message over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface after a Title21 Tag has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface only.

Format:

Table 9.12-1: Title21 Handshake (90 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	R	• R = real-time message (tag has just gone through lane) *(Handshake Messages are NEVER buffered*)
Format	2 hex	90	Format Code 90 – Title21 Handshake Message
Frame Number	8 hex	00000000 – FFFFFFFF	The frame count corresponding to the successful read event. This counter automatically rolls over when FFFFFFFF is reached. *Note: the frame count is global across all Reader channels AND protocols.*
Title21 *Transponder Data*	8 hex	N/A	The contents of the Title21 Transponder ID (4 bytes encoded in ASCII HEX = 32 bits).
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.12.2 Title21 Initial Read (91 – Format) Message

Direction: Reader to Lane Controller

Description: Optional informational message sent to the Lane Controller when the Title21 transponder first enters the capture zone.

This message applies when the JANUS MPR4.1 Reader "*Initial Read Report*" configuration parameter is enabled. *Note that the initial read channel might differ from the transaction report generated at voting time*.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.12-2: Title21 Initial Read (91 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (tag has just gone through lane) • B = buffered message (*report is from transaction buffer*) *Note: Buffered Initial Read messages will only be sent to the Lane Controller if* 'Initial Read Report Message Buffering' *is ENABLED.*
Format	2 hex	91	Format Code 91 – Title21 Initial Read Message
Transaction Status	1 alpha	R	Transaction Status: • R = read
Txn Number	5 dec	00000 – 65535	Transaction Number
Title21 *Transponder Data*	8 hex	N/A	The contents of the Title21 Transponder ID (4 bytes encoded in ASCII HEX = 32 bits).
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.12.3 Title21 Transponder (92 – Format) Message

Direction: Reader to Lane Controller

Description: The Reader issues this message after a Title21 Tag has been read and assigned to a channel (after voting time expires). Adjusting the voting time or the reporting delay time can control the reporting latency.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.12-3: Title21 Transponder (92 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	92	Format Code 92 – Title21 Transponder Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*
Title21 *Transponder Data*	8 hex	N/A	The contents of the Title21 Transponder ID (4 bytes encoded in ASCII HEX = 32 bits).
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.12.4 Title21 Post Capture (93 – Format) Message

Direction: Reader to Lane Controller

Description: This message is an optional informational message. This message is generated if the "*Post-Capture-Zone Reports*" feature is enabled, and the Reader detects a lane assignment change. This report is generated at a multiple of the voting time (configurable) after the normal transaction report.

Post Capture messages are buffered (*the volume of post capture messages is expected to be low relative to normal transaction messages).*

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.12-4: Title21 Post Capture (93 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	93	Format Code 93 – Title21 Post Capture Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *First report after reset or power-up indicates 00.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99.*
Title21 *Transponder Data*	8 hex	N/A	The contents of the Title21 Transponder ID (4 bytes encoded in ASCII HEX = 32 bits).

Field Name	Length & Format	Range	Contents
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.12.5 Title21 Estimated Vehicle Speed (96 – Format) Message

Direction: Reader to Lane Controller

Description: This message is generated if the "*Estimated Vehicle Speed Report*" feature is enabled, and the Reader has completed calculating the estimated vehicle speed values for the transponder in question.

The reported Sample Count values used in the calculation of Estimated Vehicle Speed may be less than the total number of handshakes reported for the same transaction in the Voting and/or Post-Capture reports. This is more likely to occur at low vehicle speeds.

Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).

Note: A Zero Crossing Point value of 9999ms is indicative of a data set error (i.e. Rx Noise and/or data clipping). The LC must ignore the Estimated Vehicle Speed provided in this message if a Zero Crossing Point value of 9999ms is reported.

Estimated Vehicle Speed messages are buffered.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.12-5: Title21 Estimated Vehicle Speed (96 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	96	Format Code 96 – Title21 Estimated Vehicle Speed Message
Txn Number	5 dec	00000 – 65535	Transaction Number
Number of Valid Channel Data Sets	1 dec	1 – 3	The number of channels for which an Estimated Vehicle Speed / Envelope Reference Point Channel Data Set was calculated. ***Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).***
Channel Data Set #1 – Channel Number	1 dec	1 – 4	The channel number for the 1st Channel Data Set
Channel Data Set #1 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 1st Channel Data Set.
Channel Data Set #1 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 1st Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #1 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 1st Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #1 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 1st Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #2– Channel Number	1 dec	1 – 4	The channel number for the 2nd Channel Data Set.
Channel Data Set #2 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 2nd Channel Data Set.
Channel Data Set #2 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 2nd Channel Data Set.
Channel Data Set #2 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 2nd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #2 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 2nd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #3 – Channel Number	1 dec	1 – 4	The channel number for the 3rd Channel Data Set.
Channel Data Set #3 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 3rd Channel Data Set.
Channel Data Set #3 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 3rd Channel Data Set.
Channel Data Set #3 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 3rd Channel Data Set. The higher the value, the better the quality of the estimate.

Field Name	Length & Format	Range	Contents
Channel Data Set #3 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 3rd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Title21 *Transponder Data*	8 hex	N/A	The contents of the Title21 Transponder ID (4 bytes encoded in ASCII HEX = 32 bits).
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.12.6 Title21 Departure (97 – Format) Message

Direction: Reader to Lane Controller

Description: The JANUS MPR4.1 Reader issues this message to the Lane Controller after the *Departure Delay* time has elapsed since the last time a given Title21 Transponder has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.12-6: Title21 Departure (97 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	97	Format Code 97 – Title21 Departure Message
Transaction Status	1 alpha	{R, C}	Transaction Status: • R = read only • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled in the Web Interface.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS non-TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
Title21 *Transponder Data*	8 hex	N/A	The contents of the Title21 Transponder ID (4 bytes encoded in ASCII HEX = 32 bits).
Departure Information	183 alnum	N/A	Departure Message Additional Information (See §9.3 for details on this field)
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.12.7 Title21 Transponder Write-Control Response (9F – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader is configured to have the Title21 protocol in the Frame Sequence and the "*Enable Title21 Acknowledge Message"* parameter is enabled. The JANUS MPR4.1 Reader issues this message to the Lane Controller after receipt and processing of a *Title21 Write Control* Message from the Lane Controller. This message is used to convey to the Lane Controller either the acceptance, or rejection of a given *Title21 Write Control* Message received from the Lane Controller.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface only.

Note that since this message is only sent as a response to a specific request from the Lane Controller over the Reader Command Socket, it is not required for the Lane Controller to send back an Acknowledge Transmission Message *(*c.f. *§7.1.1) upon receipt of this message when the Reader is configured to use TCP Long-Lived Sockets.*

Format:

Table 9.12-7: Title21 Transponder Write-Control Response (9F – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R}	• R = real-time message *Title21 Write Control Response Messages are not buffered*
Format	2 hex	9F	Format Code 9F – Title21 Write Response Message
Write Command Sequence Number	5 dec	00000 – 65535	Write Command Sequence Number. Set to match the Write Command Sequence Number of the applicable message initially received from the Lane Controller *Incremented by Lane Controller for each unique new write command issued to the Reader.*
Title21 Transponder ID	8 hex	(0x00000001 – 0xFFFFFFFF)	The ID of the Title21 transponder applicable to Title21 write request received from the Lane Controller (interpreted as an unsigned integer in ASCII Hex format). *(Note: 0x00000000 is the global address and is considered reserved)*
TDMA Write Response Status	2 hex	Special (See Table 9.12-8, below)	A status code indicating either acceptance, or rejection of the referenced command received from the Lane Controller. *(See Table 9.12-8, below, for a list of applicable Status Codes)*
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Table 9.12-8: Title21 Transponder Write-Control Response Status Codes

TDMA Write Command Status Code	Meaning
00	Command Accepted
11	Command Rejected – Invalid Channel Value
12	Command Rejected – Invalid Format Code
13	Command Rejected – Invalid Title21 Transponder ID
14	Command Rejected – Invalid Title21 Transaction Status Code
15	Command Rejected – Invalid Command Sequence Number
31	Command Rejected – Title21 Transponder ID not found in Tag List
41	Command Rejected – Reader not configured with Acknowledge Messages Enabled

Response: No response expected from Lane Controller

9.13 TDM Multi-Protocol Messages

9.13.1 TDM Handshake (A0 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*Raw Handshake Report*" configuration parameter is enabled. The Reader issues this message over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface when an TDM Tag has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface only.

Format:

Table 9.13-1: TDM (Standard) Handshake (A0 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	R	• R = real-time message (tag has just gone through lane) *(Handshake Messages are NEVER buffered*)
Format	2 hex	A0	Format Code A0 – TDM (Standard) Handshake Message
Frame Number	8 hex	00000000 – FFFFFFFF	The frame count corresponding to the successful read event. This counter automatically rolls over when FFFFFFFF is reached. *Note: the frame count is global across all Reader channels AND protocols.*
TDM Transponder (Read Section) Data	24 hex	N/A	The contents of the TDM Transponder read-only section. (12 bytes encoded in ASCII HEX = 96 bits)
TDM Transponder (Write Section) Data	40 hex	N/A	The contents of the TDM Transponder write section. (20 bytes encoded in ASCII HEX = 160 bits)
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.13.2 TDM (Standard) Estimated Vehicle Speed (A6 – Format) Message

Direction: Reader to Lane Controller

Description: **THIS MESSAGE, ALTHOUGH DEFINED, IS CURRENTLY NOT IMPLEMENTED.**

This message is generated if the "*Estimated Vehicle Speed Report*" feature is enabled, and the Reader has completed calculating the estimated vehicle speed values for the transponder in question.

The reported Sample Count values used in the calculation of Estimated Vehicle Speed may be less than the total number of handshakes reported for the same transaction in the Voting and/or Post-Capture reports. This is more likely to occur at low vehicle speeds.

Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).

Note: A Zero Crossing Point value of 9999ms is indicative of a data set error (i.e. Rx Noise and/or data clipping). The LC must ignore the Estimated Vehicle Speed provided in this message if a Zero Crossing Point value of 9999ms is reported.

Estimated Vehicle Speed messages are buffered.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Format:

Table 9.13-2: TDM Estimated Vehicle Speed (A6 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	A6	Format Code A6 – TDM (Standard) Estimated Vehicle Speed Message
Txn Number	5 dec	00000 – 65535	Transaction Number
Number of Valid Channel Data Sets	1 dec	1 – 3	The number of channels for which an Estimated Vehicle Speed / Envelope Reference Point Channel Data Set was calculated. ***Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).***
Channel Data Set #1 – Channel Number	1 dec	1 – 4	The channel number for the 1st Channel Data Set

Field Name	Length & Format	Range	Contents
Channel Data Set #1 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 1st Channel Data Set.
Channel Data Set #1 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 1st Channel Data Set.
Channel Data Set #1 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 1st Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #1 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 1st Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #2– Channel Number	1 dec	1 – 4	The channel number for the 2nd Channel Data Set.
Channel Data Set #2 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 2nd Channel Data Set.
Channel Data Set #2 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 2nd Channel Data Set.
Channel Data Set #2 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 2nd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #2 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 2nd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #3 – Channel Number	1 dec	1 – 4	The channel number for the 3rd Channel Data Set.
Channel Data Set #3 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 3rd Channel Data Set.

Field Name	Length & Format	Range	Contents
Channel Data Set #3 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 3rd Channel Data Set.
Channel Data Set #3 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 3rd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #3 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 3rd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
TDM Transponder (Read Section) Data	24 hex	N/A	The contents of the TDM Transponder read-only section. (12 bytes encoded in ASCII HEX = 96 bits)
TDM Transponder (Write Section) Data	40 hex	N/A	The contents of the TDM Transponder write section. (20 bytes encoded in ASCII HEX = 160 bits)
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.13.3 TDM (Standard) Departure (A7 – Format) Message

Direction: Reader to Lane Controller

Description: The JANUS MPR4.1Reader issues this message to the Lane Controller after the *Departure Delay* time has elapsed since the last time a given TDM Transponder has been read.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface.

Note: The complete estimated vehicle speed functionality is currently NOT FULLY IMPLEMENTED for the TDM protocol. The* Estimated Vehicle Speed Information *contained within the* Departure Information *field (c.f. §9.3) of this message shall be correspondingly populated with all 0's (zeroes).

Format:

Table 9.13-3: TDM Departure (A7 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	A7	Format Code A7 – TDM (Standard) Departure Message
Transaction Status	1 alpha	{S, F, U, R, X, D, C}	Transaction Status: • S = Successful • F = Programming Failed • U = Programming Unverified • R = Read Only • X = Non-IAG Transponder • D = Decommissioned Transponder • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *An RPV counts as 1 read.*

Field Name	Length & Format	Range	Contents
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
TDM Transponder (Read Section) Data	24 hex	N/A	The contents of the TDM Transponder read-only section. (12 bytes encoded in ASCII HEX = 96 bits)
TDM Transponder (Pre-write Section) Data	40 hex	N/A	The contents of the TDM Transponder write section before programming. (20 bytes encoded in ASCII HEX = 160 bits)
TDM Transponder (Post-write Section) Data	40 hex	N/A	The contents of the TDM Transponder write section if programming is attempted. (20 bytes encoded in ASCII HEX = 160 bits)
Departure Information	183 alnum	N/A	Departure Message Additional Information (See §9.3 for details on this field)
(Optional) Extended Information	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller

9.13.4 TDM (Format A – TRBA) Handshake (B0 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*Raw Handshake Report*" configuration parameter is enabled. The Reader issues this message over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface when a TDM Toll / Balance Tag has been read.

This message applies when:

(1) The "*Raw Handshake Report*" option is enabled on the web interface,

(2) The JANUS MPR4.1 Reader is processing a TDM Toll Rate / Balance Adjustment Transponder, *and*

(3) The JANUS MPR4.1 Reader *LC Report Format – Toll Rate / Balance Adjustment Tag Report Format* configuration parameter is set to '*Toll Rate / Balance Adj Format*'.

*Note that if condition (1) and (2) are satisfied and condition (3) is NOT MET, the Reader will issue a "standard" TDM Handshake Message as defined in §**Error! Reference source not found.**.*

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (UDP) Interface only.

Format:

Table 9.13-4: TDM (Format A - TRBA) Handshake (B0 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	R	• R = real-time message (tag has just gone through lane) *(Handshake Messages are NEVER buffered*)
Format	2 hex	B0	Format Code B0 – TDM (Format A – TRBA) Handshake Message
Frame Number	8 hex	00000000 – FFFFFFFF	The frame count corresponding to the successful read event. This counter automatically rolls over when FFFFFFFF is reached. *Note: the frame count is global across all Reader channels AND protocols.*
TDM Transponder (Read Section) Data	18 hex	N/A	The contents of the TDM Transponder read-only section. (9 bytes encoded in ASCII HEX = 72 bits)
TDM Transponder (Write Section) Data	46 hex	N/A	The contents of the TDM Transponder write section. (23 bytes encoded in ASCII HEX = 184 bits)
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.13.5 TDM (Format A – TRBA) Estimated Vehicle Speed (B6 – Format) Message

Direction: Reader to Lane Controller

Description: **THIS MESSAGE, ALTHOUGH DEFINED, IS CURRENTLY NOT IMPLEMENTED.**

This message is generated if the "*Estimated Vehicle Speed Report*" feature is enabled, and the Reader has completed calculating the estimated vehicle speed values for the transponder in question.

This message applies when:

(1) The "*Estimated Vehicle Speed Report*" option is enabled on the web interface,

(2) The JANUS MPR4.1 Reader is processing a TDM Toll Rate / Balance Adjustment Transponder, *and*

(3) The JANUS MPR4.1 Reader *LC Report Format – Toll Rate / Balance Adjustment Tag Report Format* configuration parameter is set to '*Toll Rate / Balance Adj Format*'.

*Note that if condition (1) and (2) are satisfied and condition (3) is NOT MET, the Reader will issue a "standard" TDM Estimated Vehicle Speed Message as defined in §**Error! Reference source not found.**.*

The reported Sample Count values used in the calculation of Estimated Vehicle Speed may be less than the total number of handshakes reported for the same transaction in the Voting and/or Post-Capture reports. This is more likely to occur at low vehicle speeds.

Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).

Note: A Zero Crossing Point value of 9999ms is indicative of a data set error (i.e. Rx Noise and/or data clipping). The LC must ignore the Estimated Vehicle Speed provided in this message if a Zero Crossing Point value of 9999ms is reported.

Estimated Vehicle Speed messages are buffered.

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface only.

Format:

Table 9.13-5: TDM (Format A – TRBA) Estimated Vehicle Speed (B6 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 – 4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	B6	Format Code B6 – TDM (Format A – TRBA) Estimated Vehicle Speed Message
Txn Number	5 dec	00000 – 65535	Transaction Number

Field Name	Length & Format	Range	Contents
Number of Valid Channel Data Sets	1 dec	1 – 3	The number of channels for which an Estimated Vehicle Speed / Envelope Reference Point Channel Data Set was calculated. ***Note: Any unused Channel Data Set Fields shall be populated with zeroes (0's).***
Channel Data Set #1 – Channel Number	1 dec	1 – 4	The channel number for the 1st Channel Data Set
Channel Data Set #1 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 1st Channel Data Set.
Channel Data Set #1 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 1st Channel Data Set.
Channel Data Set #1 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 1st Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #1 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 1st Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #2– Channel Number	1 dec	1 – 4	The channel number for the 2nd Channel Data Set.
Channel Data Set #2 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 2nd Channel Data Set.
Channel Data Set #2 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 2nd Channel Data Set.
Channel Data Set #2 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 2nd Channel Data Set. The higher the value, the better the quality of the estimate.

Field Name	Length & Format	Range	Contents
Channel Data Set #2 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 2nd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
Channel Data Set #3 – Channel Number	1 dec	1 – 4	The channel number for the 3rd Channel Data Set.
Channel Data Set #3 – Estimated Vehicle Speed	2 dec	00 –99	Estimated Vehicle Speed (mph) for the 3rd Channel Data Set.
Channel Data Set #3 – Sample Count	3 dec	000 – 999	The number of handshake samples used in calculating the speed estimation for the 3rd Channel Data Set.
Channel Data Set #3 – Correlation Coefficient	5 alnum	0.000 – 1.000	A measure of the quality of the estimation of vehicle speed for the 3rd Channel Data Set. The higher the value, the better the quality of the estimate.
Channel Data Set #3 – Zero Crossing Point	4 dec	0000 – 9999	Zero Crossing Point. Indicates the time offset, measured in milliseconds from first read of transponder, where the tag is passing, or has passed directly under the centre of the antenna for the 3rd Channel Data Set. ***Note: A Zero Crossing Point value of 9999 indicates a data set error.***
TDM Transponder (Read Section) Data	18 hex	N/A	The contents of the TDM Transponder read-only section. (9 bytes encoded in ASCII HEX = 72 bits)
TDM Transponder (Write Section) Data	46 hex	N/A	The contents of the TDM Transponder write section. (23 bytes encoded in ASCII HEX = 184 bits)
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller.

9.13.6 TDM (Format A – TRBA) Departure (B7 – Format) Message

Direction: Reader to Lane Controller

Description: This message applies when the JANUS MPR4.1 Reader "*Departure Report*" parameter is enabled. The JANUS MPR4.1 Reader issues this message to the Lane Controller after the *Departure Delay* time has elapsed since the last time a given TDM Transponder has been read.

This message applies when:

(1) The "*Departure Report*" option is enabled on the web interface,

(2) The JANUS MPR4.1 Reader is processing a TDM Toll Rate / Balance Adjustment Transponder, *and*

(3) The JANUS MPR4.1Reader *LC Report Format – Toll Rate / Balance Adjustment Tag Report Format* configuration parameter is set to '*Toll Rate / Balance Adj Format*'.

Note that if condition (1) and (2) are satisfied and condition (3) is NOT MET, the Reader will issue a "standard" TDM Departure Message as defined in §9.13.3

This message is sent over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface only.

Note: The complete estimated vehicle speed functionality is currently NOT FULLY IMPLEMENTED for the TDM protocol. The* Estimated Vehicle Speed Information *contained within the* Departure Information *field (c.f. §9.3) of this message shall be correspondingly populated with all 0's (zeroes).

Format:

Table 9.13-6: TDM (Format A – TRBA) Departure (B7 – Format) Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{MA}	Multi-Protocol Message: • MA = Multi-Protocol Message
RF Channel	1 dec	1 –4	RF Channel Identifier
Type	1 alpha	{R, B}	• R = real-time message (*tag has just gone through lane*) • B = buffered message (*report is from transaction buffer*)
Format	2 hex	B7	Format Code B7 – TDM (Format A - TRBA) Departure Message

Field Name	Length & Format	Range	Contents
Transaction Status	1 alpha	{S, F, U, R, X, D, C}	Transaction Status: • S = Successful • F = Programming Failed • U = Programming Unverified • R = Read Only • X = Non-IAG Transponder • D = Decommissioned Transponder • C = Cross-Reader Report (informational, optional) – Tag reported by adjacent reader *Note: To receive a "C" report the "Cross-reader reporting" option must be enabled.*
Txn Number	5 dec	00000 – 65535	Transaction Number
Assignment Reads	2 dec	00 – 99	The number of handshakes (reads) that occurred on the assigned channel up to voting time for the CURRENT transaction. *An RPV counts as 1 read.*
Total Reads	2 dec	00 – 99	The total number of handshakes (reads) that occurred on the assigned channel for the PREVIOUS TDM transaction on the same RF channel. *First report after reset or power-up indicates 00. Total reads greater than 99 indicated as 99. An RPV counts as 1 read.*
TDM Transponder (Read Section) Data	18 hex	N/A	The contents of the TDM Transponder read-only section. (9 bytes encoded in ASCII HEX = 72 bits)
TDM Transponder (Pre-write Section) Data	46 hex	N/A	The contents of the TDM Transponder write section before programming. (23 bytes encoded in ASCII HEX = 184 bits)
TDM Transponder (Post-write Section) Data	46 hex	N/A	The contents of the TDM Transponder write section if programming is attempted. (23 bytes encoded in ASCII HEX = 184 bits)
Departure Information	183 alnum	N/A	Departure Message Additional Information (See §9.3 for details on this field)
(Optional) *Extended Information*	Optional, Variable	Reader Configuration Dependent	An optional varying length field containing additional extended message information. (See §9.2 for details on this field)

Response: No response expected from Lane Controller

10. TRANSPONDER WRITE-CONTROL MESSAGE SET

When operating with certain protocols in *Read/Write* Mode, the JANUS MPR4.1 Reader allows for the Lane Controller to specify what is to be written/transmitted to a given transponder during the transaction. If so enabled, the JANUS MPR4.1 Reader shall accept *Write Control* messages from the Lane Controller that direct the JANUS MPR4.1 Reader to write/transmit specific data into/to a given transponder.

10.1 Title21 Protocol Write-Control Messaging

The JANUS MPR4.1 Title21 Write Control Messaging functionality provides a means for the Lane Controller to instruct the JANUS MPR4.1 Reader to issue an acknowledge message to a specific Title21 transponder. This acknowledge message informs a specific transponder that it has been successfully processed *and also instructs that transponder to stop responding to subsequent identical Reader polling requests*.

This acknowledge message may be used to terminate the transaction at the request of the Lane Controller, and shall only be transmitted by the JANUS MPR4.1 Reader in response to a correctly formed Title21 Transponder Write Control message issued from the Lane Controller while the Transponder is in the RF capture zone.

.In order to be able to use the Title21 Protocol Write Control, it is necessary to have the Reader configured for the Title21 protocol in the Frame Sequence. Additionally, the "*Enable Title21 Acknowledge Message*" parameter must be enabled.

Note that acceptance by the Reader does not indicate that the actual transmit operation itself was successful, just that the given Title21 Write Control Message *itself was free from errors and/or successfully processed by the Reader.*

A simplified diagram showing this message exchange between the JANUS MPR4.1 Reader and the Lane Controller is shown in Figure 10.1-1. Note, as shown in the diagram, that once the Acknowledge Message has been issued to the Transponder from the JANUS MPR2.4 Reader, the Transponder no longer replies to the Reader Polling Message(s) from the same Reader.

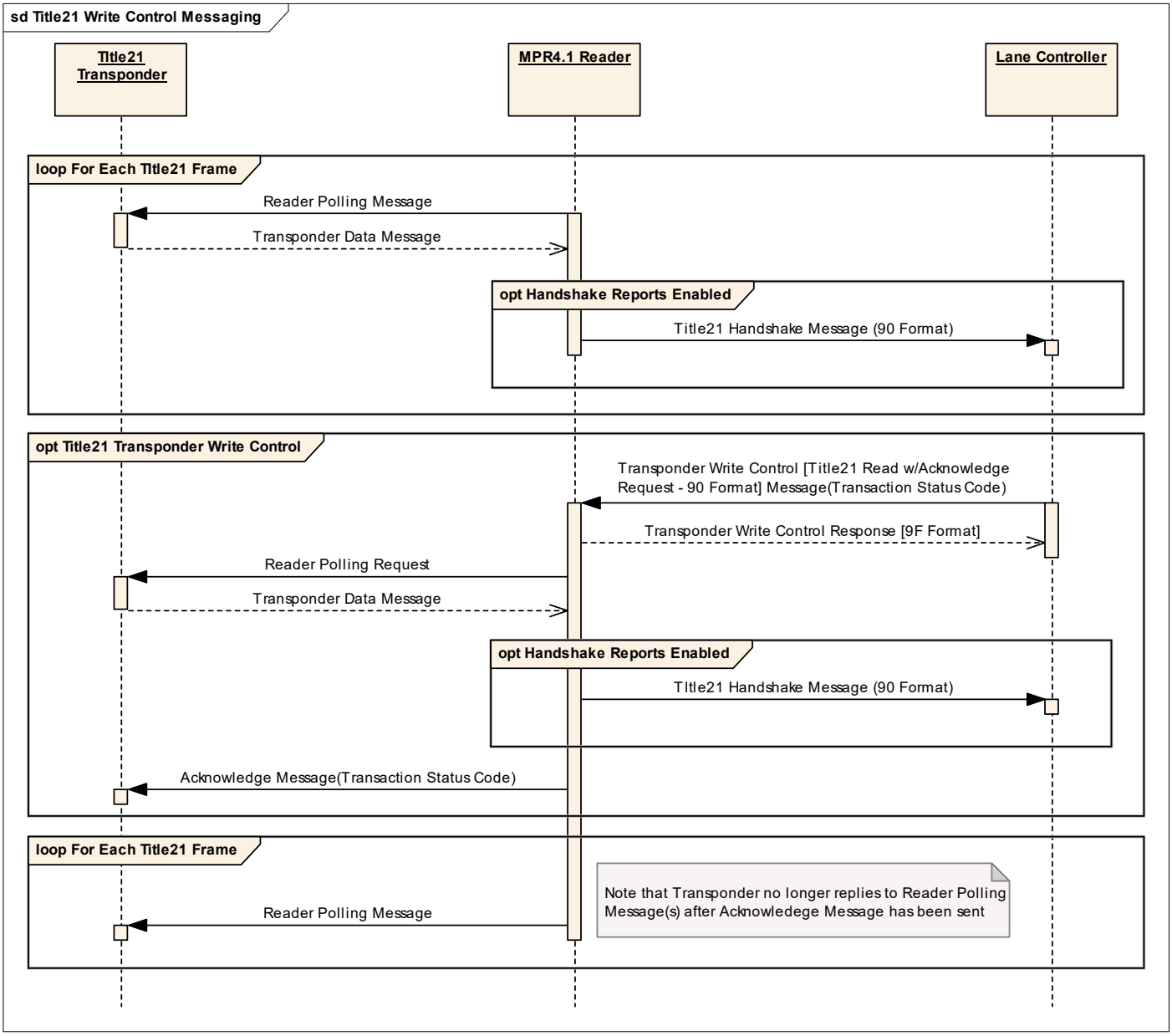

Figure 10.1-1: Title21 Protocol Transponder Write-Control Simplified Messaging Sequence

10.1.1 Transponder Write Control (90 Format – Title21 Transponder Read w/Acknowledge Request Message

Direction: Lane Controller to Reader

Description: This message is applicable when the JANUS MPR4.1 Reader is configured with the Title21 protocol in the Frame Sequence and allowance of the transmission of Title21 Acknowledge Messages with the "*Enable Title21 Acknowledge Message*" parameter enabled. This message instructs the Reader to transmit an Acknowledge (Reader Transaction Type 2) Message to the specified Title21 transponder. This Acknowledge Message informs the specified Title21 transponder that it has been successfully processed *and also instructs that transponder to stop responding to subsequent identical Reader polling requests*.

This message is accepted over the JANUS MPR4.1 Reader – Lane Controller Ethernet (TCP) Interface only.

Format:

Table 10.1-1: Transponder Write Control (90 Format) – Title21 Transponder Read w/Acknowledge Request Message Format

Field Name	Length & Format	Range	Contents
Prefix	2 alpha	{TW}	Transponder Write-Control Message
RF Channel	1 alpha or 1 dec	1 – 4	RF Channel Identifier • 1 – 4 = reader in multiplexed reporting mode (See §2.7 for additional information on multiplexed reporting mode)
Format	2 hex	90	Format Code 90 – Transponder Write Control (Title21 Transponder Read w/Acknowledge Request) Message
Write Command Sequence Number	5 dec	00000 – 65535	Write Command Sequence Number. *Incremented by Lane Controller for each unique new write command issued to the Reader.*
Title21 Transponder ID	8 hex	(0x00000000 – 0xFFFFFFFF)	Specifies the ID of the Title21 transponder to be acknowledged (interpreted as an 32-bit unsigned integer in ASCII HEX format).
Title21 Transaction Status Code	4 hex	(0x0000 – 0xFFFF)	Specifies the Title21 Transaction Status Code used to provide status information to the Title21 transponder (interpreted as a 16-bit unsigned integer in ASCII HEX format).

Response: The JANUS MPR4.1 Reader shall respond with a Title21 Write Control Response Message (*c.f.* §9.12.7) indicating whether or not the requested command has been accepted by the Reader. *Note that acceptance by the Reader does not indicate that the actual operation of transmitting the Acknowledge Message itself was successful, just that the given* Title21 Write Control Message *itself was free from errors and/or successfully processed by the Reader*.

A. APPENDIX A – STANDARD (LEGACY) TCP/IP SOCKET LIFECYCLES

A.1. JANUS MPR4.1 Reader to Lane Controller Socket-Lifecycle

The JANUS MPR4.1 Reader to Lane Controller socket-lifecycle is shown in Figure A-1. Note that a new client socket (and correspondingly a new server socket on the peer) is created for each message that is sent from the Reader to the Lane Controller. If a (mandatory) reply message is expected, then the Reader will wait for it before closing the socket. Upon completion of the messaging cycle, both the Reader client socket and the Lane Controller server socket to which it is connected are closed.

Note that the Lane Controller server listening socket remains open for as long as the Lane Controller is operational.

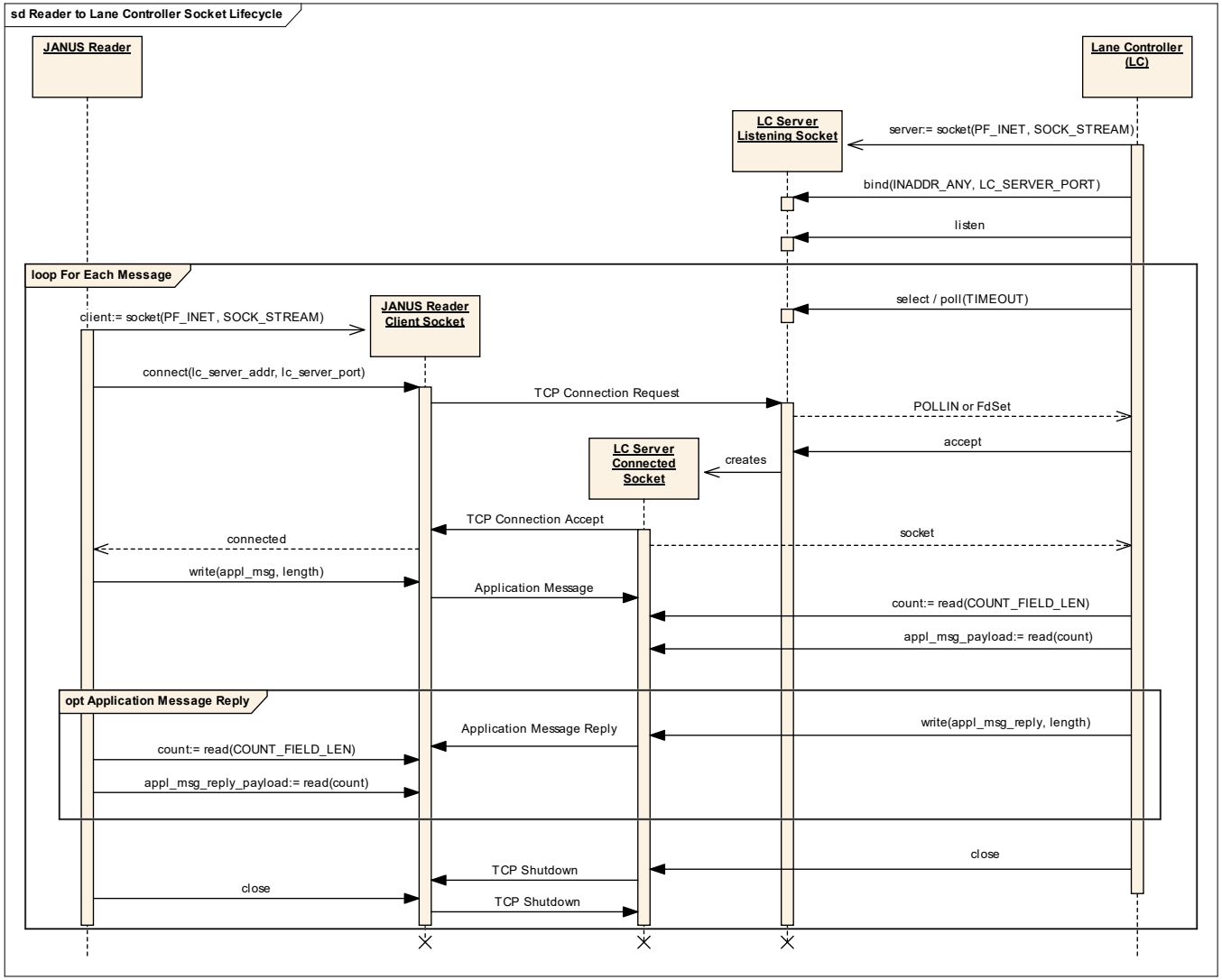

Figure A-1: JANUS MPR4.1 Reader to Lane Controller Socket Lifecycle

A.2. Lane Controller to JANUS MPR4.1 Reader Socket-Lifecycle

The Lane Controller to JANUS MPR4.1 Reader socket-lifecycle is the exact inverse of the JANUS MPR4.1 Reader to Lane Controller socket lifecycle described in §A.1. That is, when the Lane Controller wishes to send a message to the JANUS MPR4.1 Reader, the client/server roles are reversed from that shown in Figure A-1. In this instance, the Lane Controller becomes the client, and the Reader becomes the server (refer to Figure A-1, with the client and server roles reversed). Note that a new client socket is created for each message that is sent from the Lane Controller to the Reader. If a (mandatory) reply message is expected, then the Lane Controller will wait for it before closing the socket. Upon completion of the messaging cycle, both the Lane Controller client socket and the Reader server socket to which it is connected are closed.

Note that the JANUS MPR4.1 Reader server listening socket remains open for as long as the Reader is operational.

B. APPENDIX B – TCP LONG-LIVED CONNECTIONS SOCKET LIFECYCLES

B.1. JANUS MPR4.1 Reader to Lane Controller TCP Long-Lived Socket-Lifecycle

The JANUS MPR4.1 Reader to Lane Controller socket-lifecycle for TCP Long-Lived Connections is shown in Figure B-1. For the sake of simplicity, packet boundary (<STX> / <ETX> delimiters) processing and transmission of *Acknowledge Transmission* (AT) messages in response to Transaction Messages from the Reader are not shown.

Note that under normal, error-free circumstances, a new client socket on the Reader (and correspondingly a new server socket on the LC peer) is created only once. Once the connection has been established, communication between the Reader and the LC proceeds. The Reader will transmit messages to the LC and read any applicable responses (*e.g.* Heartbeat/Sync and/or Transmission Acknowledgements) from the LC as required. *Note that unlike the Standard (Legacy) mode of communications, the TCP connection remains open; the Reader will not close the TCP connection upon completion of each message cycle. For TCP Long-Lived connections, under normal error-free conditions, once a TCP connection is established between the Reader and the LC, the connection remains up for as long as the Reader and/or the LC remain powered on.*

Note also, that the Lane Controller server listening socket remains open for as long as the Lane Controller is operational.

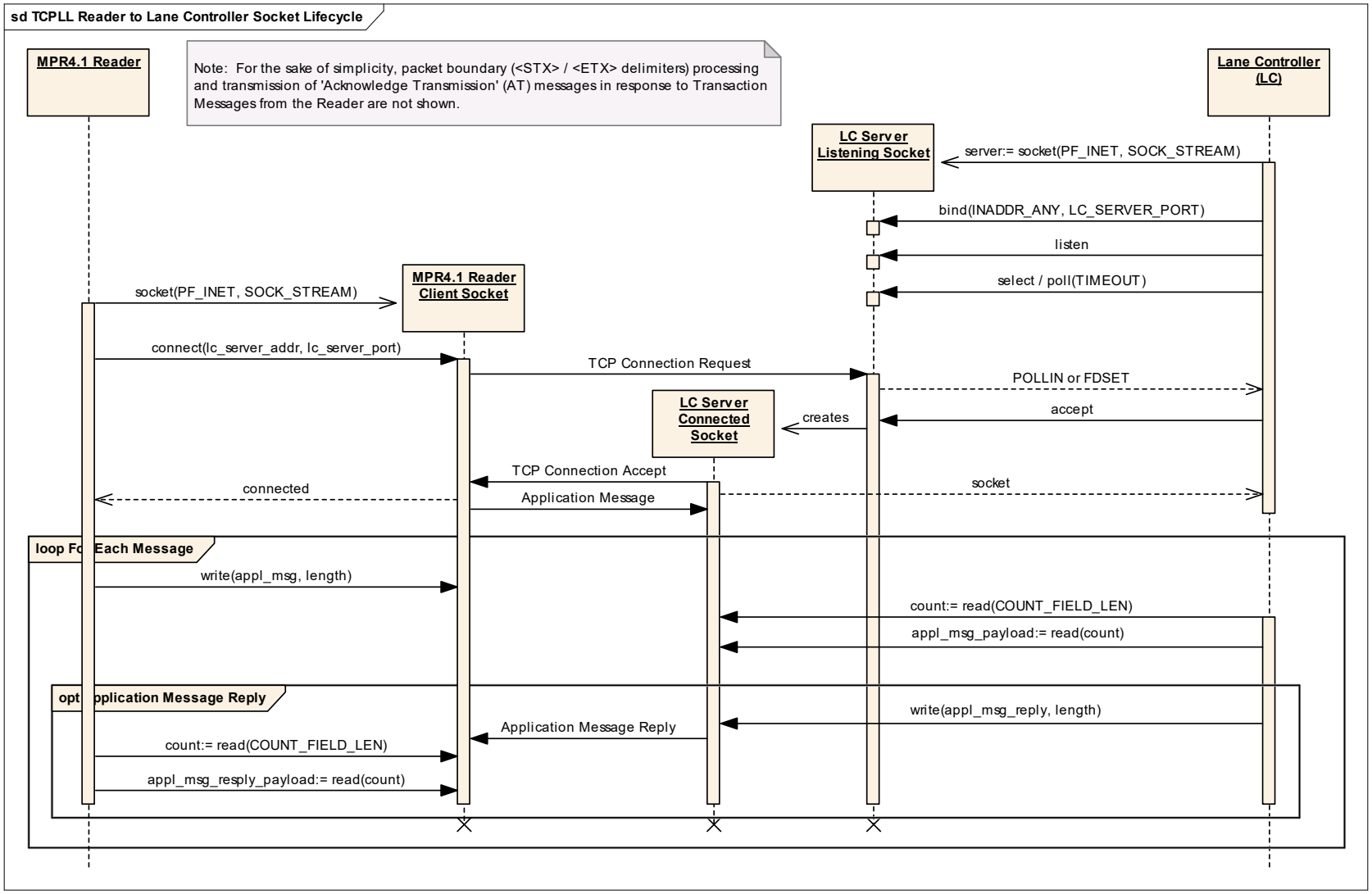

Figure B-1: JANUS MPR4.1 TCP Long-Lived Reader to Lane Controller Socket Lifecycle

B.2. Lane Controller to JANUS MPR4.1 Reader TCP Long-Lived Socket-Lifecycle

The Lane Controller to JANUS MPR4,1 Reader socket-lifecycle for TCP Long-Lived Connection is the exact inverse of the MPR4.1 Reader to Lane Controller socket lifecycle as previously described, above. That is, when the Lane Controller wishes to send a message to the JANUS MPR4.1 Reader, the client/server roles are reversed from that shown in Figure B-1. In this instance, the Lane Controller becomes the client and the Reader becomes the server (refer to Figure B-1 with the client and server roles reversed). Note that under normal, error-free circumstances, a new client socket on the Lane Controller (and correspondingly a new server socket on the Reader peer) is created only once. Once the connection has been established, communication between the Reader and the LC proceeds. The LC will transmit messages to the LC and read any applicable responses from the Reader, as required. *Note that unlike the Standard (Legacy) mode of communications, the TCP connection remains open; the LC will not close the TCP connection upon completion of each message cycle. For TCP Long-Lived connections, under normal error-free conditions, once a TCP connection is established between the LC and the Reader, the connection remains up for as long as the Reader and/or the LC remain powered on.*

Note also, that the JANUS MPR4.1 Reader server listening socket remains open for as long as the Reader is operational.

C. APPENDIX C – UDP SOCKET LIFECYCLES

C.1. JANUS MPR4.1 Reader to Lane Controller UDP Socket-Lifecycle

The JANUS MPR4.1 Reader to Lane Controller UDP socket-lifecycle is shown in Figure C-1. Note that on both the client (JANUS MPR4.1 Reader) and the server (Lane Controller) a UDP socket is created only once, and remains in existence for as long as the device remains operational.

Furthermore, unlike it's TCP cousins (*c.f.* §A, or §B), the UDP client `connect` call does not initiate any packet exchange. Instead, it merely records the remote endpoint (LC Server) information in the client socket data structure for later use. Hence, even if the `connect` call succeeds, it does not mean that the remote endpoint address is valid or that the server (*i.e.* Lane Controller) is reachable.

Each time the JANUS MPR4.1 Reader calls `send` on its client socket, UDP sends a single Handshake Message to the peer Lane Controller. Similarly, each call of `recvfrom` by the Lane Controller on its server socket returns one complete Handshake Message, assuming the Lane Controller has specified a sufficiently large enough receive buffer. Unlike TCP, the Lane Controller UDP server does not need to make repeated calls to `recvfrom` in order to obtain a single Handshake Message.

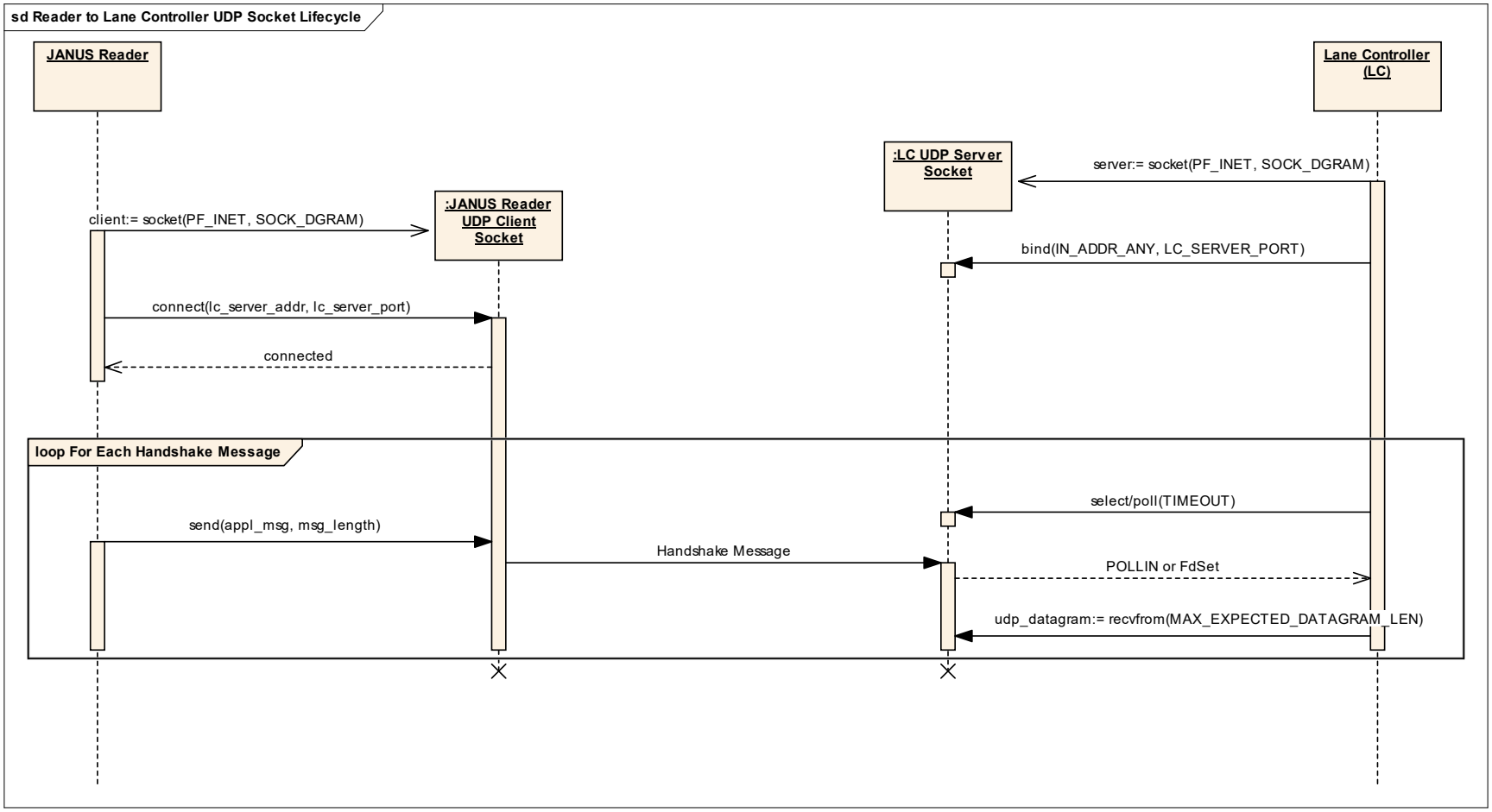

Figure C-1: JANUS MPR4.1 Reader to Lane Controller UDP Socket Lifecycle