Speedway® Reader Application Series

Octane™ LLRP

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1 Introduction

1.1 Purpose

This document describes the LLRP capabilities of the Octane 4.8 software release for Speedway Revolution Readers including Octane LLRP custom extensions.

1.2 Scope

This document defines Octane 4.8 LLRP. It provides a summary to system architects to validate and understand the standard LLRP features supported by Octane 4.8 LLRP and the unique Octane LLRP custom extensions, which provide added capabilities. It provides detailed information to developers who are planning to support Impinj Readers via LLRP. Beginning with release 4.8 of this document, references to Speedway Reader have been deleted; the information in this document now only is valid on SpeedwayR Readers.

1.3 References

Table 1-1 References

Document	Version
EPCglobal: Low Level Reader Protocol (LLRP)	1.0.1
EPCglobal: UHF Class1 Gen2 Standard (C1G2)	1.2.0
Speedway Revolution Installation and Operations Guide	4.8
LLRP Toolkit Impinj Custom Extension Definition	10.14

1.4 Terms

AccessSpec – Access Specification is a data element passed to the Reader to describe a set of operations to perform on a tag. It includes a filter set (halt-filter) that describes the tag population on which this rule applies. It includes a list of read, write, lock, and kill commands to execute on each tag that matches the filter.

AISpec – Antenna Inventory Specification list is contained in a ROSpec and execute in order. Each AISpec contains RF parameters, inventory parameters, and duration.

AntennaConfiguration – Each AISpec could contain one or more AntennaConfiguration parameters. These describe the RF parameters (power, frequency, receive sensitivity) and Gen2 settings (mode, filters, session) to use during an AISpec execution.

Custom Extension – CE is an LLRP mechanism which allows vendors to add functionality beyond the standard behavior of LLRP.

EPCglobal – EPCglobal leads the development of industry driven standards for the Electronic Product Code (EPC) to support the use of RFID.

FOV – Field-of-view. The Reader observable world and angular extent that is visible at a given moment. This typically relates to antenna type, number, and position.

LLRP – The EPCglobal Low Level Reader Protocol is the industry standard.

LTK – The llrp-toolkit is an open source LLRP library development project.

RO – Reader Operations is the group chartered within EPCglobal to define LLRP.

ROSpec – Reader Operation Specification is a data element passed to the Reader to describe a bounded (start and end), triggered, and inventory operation.

1.5 Overview

This document defines Octane 4.8 LLRP. It provides a summary to system architects to validate and understand the standard features supported by Octane 4.8 LLRP. It also includes the unique Octane LLRP custom extensions which provide added capabilities. This document provides detailed information for developers who are planning to support Impinj Readers via Octane LLRP.

In April 2007, EPCglobal ratified the Low Level Reader Protocol (LLRP) standard, a specification for the network interface between the Reader and its controlling software or hardware. The UHF Gen 2 standard provided a standardized tag and Reader radio frequency (RF) air interface protocol. The LLRP specification was the practical and logical next step in facilitating the adoption of EPC and RFID technology.

Other standards have been proposed for the controller-to-reader network interface. Why has Impinj chosen LLRP as part of its Octane Software Solution? LLRP is modular with respect to air-protocol. LLRP allows basic configuration and operations independent of air protocol, which supports simple configuration of Readers without any knowledge of air protocol specifics. In LLRP 1.0, EPCglobal developed a parameter set to control the full functionality of Gen2 Readers. For protocol specific operation, LLRP's Gen2 parameter set provides simple access to Gen2 functionality such as read, write, lock, and kill. It also provides simple methods to select the Gen2 link parameters.

Previous standardization approaches did not go far enough to accommodate the needs of both Reader and application software providers: needs that included the ability to better leverage the competitive advantages of their respective products. In creating this new LLLRP standard, the advocating group led by Impinj and other RFID vendors, a rich set of vendor extension points allows Reader vendors the flexibility to innovate and differentiate their products within the standardized network framework. These innovations will drive future developments of the standard.

This document is divided into sections. Section 2 describes how to configure and establish LLRP connections with Octane. Section 3 describes the standard LLRP capabilities of Octane 4.8 as supported on Impinj hardware platforms. Section 4 specifies the Octane LLRP custom extension available on Speedway Revolution Reader. Section 5 discusses advanced tag topics. Section 6 contains tables defining how each extension is encoded and decoded into LLRP messages and parameters.

1.6 Document Conventions

Throughout this document, references are made to both standard and extended LLRP messages, parameters and fields. To help visually distinguish between these different types Table 1-2 provides details on the conventions that are used.

Table 1-2 Document Style Conventions

Style	Example	Type
CAPS _UNDERSCORES	SET_READER_CONFIG	LLRP message
ItalicsCamelCase	*AntennaConfiguration*	LLRP parameter
UnderlineCamelCase	ResetToFactoryDefault	LLRP field
‘Single-Quoted’ String’	‘Upon N Tags or End of AISpec’	Enumerated field value

2 Octane LLRP Connections

Octane LLRP allows both Reader and Client initiated connections. By default, the Reader is listening for LLRP connections on the IANA-assigned TCP port 5084. Users can modify the LLRP listening port via the Octane RShell or web interface. Users can enable Octane LLRP to make outgoing connections to a configurable server and port number. The address, port, and retry timers can be configured via the Octane RShell or web interface. See the Octane User's Guide for details on changing the LLRP connection configuration.

Octane LLRP will accept the first incoming connection on this port, and reject subsequent connections as long as the first connection is active. If a connection request is received, the Reader will check the health of any existing connection. If the client TCP connection does not respond within 3.5 seconds, the Reader will automatically close the dead connection and accept the new connection. When reconnecting after a network outage, it may take up to 3.5 seconds to accept a connection.

3 Octane LLRP Capabilities

The following table displays the capabilities supported by the Octane LLRP implementation as defined by the LLRP standard. The table is organized by LLRP feature and Reader model. Not all Reader models support each Octane feature. Where relevant, the Reader reports these capabilities via the LLRP GET_READER_CAPABILTIES_RESPONSE message.

Table 3-1 Octane LLRP Capabilities

LLRP Feature	Speedway Revolution			Informational Notes
	R220	R420	R640	
Model Name	2001001	2001002	2001003	
Firmware Version	4.8.0.240	4.8.0.240	4.8.0.240	
GPI	4	4	4	These 4 GPI (referenced in LLRP as GPI 1-4) correspond to GPIN0-GPIN3 as stated in the Speedway Revolution User's Guide.
GPO	4	4	4	These 4 GPO (referenced in LLRP as GPO 1-4) correspond to GPOUT0-GPOUT3 as stated in the Speedway Revolution User's Guide. See section 3.1.9 for details on GPO persistence.
Antenna	2	4	4	The antennas correspond to antenna ports 1-n, depending on the product capabilities.
UTC (real-world) Clock	√	√	√	
Air Protocol Support	1	1	1	UHF Class 1 Generation 2 (C1G2)
Number of ROSpecs	1	1	1	
ROSpec Priority Support	1	1	1	Priority must always be set to 0.
RFSurvey Support	–	–	–	
Number of AISpecs per ROSpec	16	16	16	
Number of InventoryParameterSpecs per AISpec	1	1	1	
State-Aware Singulation Support	–	–	–	See section 4.2.3 for alternate control of singulation strategies.
Number of Inventory Filters	2	2	2	See Section 3.1.6 for details.

LLRP Feature	Speedway Revolution			Informational Notes
	R220	R420	R640	
Truncate Flag Support	–	–	–	Truncate flag must always be set to 0 (unspecified).
Number of AccessSpecs	512	512	512	
Number of OpSpecs per AccessSpec	8	8	8	
ClientRequestOpSpec Support	–	–	–	
Number of Gen2 Modes	Varies	Varies	Varies	Number depends on product, model, and regulatory region. Use LLRP capabilities to discover available modes. See section 3.1.4 for automatically setting the Gen2 mode.
Buffer Overflow Warning Support	√	√	√	
Buffered Report Support	√	√	√	See section 3.1.13 for usage details.
AirProtocolInventory CommandSettings per AntennaConfiguration	1	1	1	
BlockWrite Support	√	√	√	
BlockErase Support	–	–	–	
Disconnected Operation Support	√	√	√	Reader will continue to execute ROSpecs and AccessSpecs when disconnected. To stop disconnected operation, disable or delete all ROSpecs and AccessSpecs before disconnecting. See section 3.1.13 for details on how events and reports are handled in this mode of operation.
Set AntennaProperties Support	–	–	–	

LLRP Feature	Speedway Revolution			Informational Notes
	R220	R420	R640	
TLS Encrypted Connection Support	–	–	–	Only TCP connections are supported.
Web Interface	√	√	√	

3.1 Octane LLRP Usage Notes

3.1.1 Octane Future Extensions

To be compatible with future versions of Octane extensions, your application must ignore all custom parameters with subtypes which it cannot understand when received at any valid LLRP or Octane extension point. In addition, it should treat any out of range enumerations as error conditions.

3.1.2 LLRP Response Timeout

Most commands will complete within milliseconds (nominally << 1 second). However, the following exceptions should be noted. See Section 4 for details on timing of the Octane LLRP Custom extensions.

- GET_READER_CONFIG_RESPONSE with the *AntennaProperties* parameter can take up to 10 seconds as the Reader is checking the status and connectivity of its antennas.

3.1.3 LLRP Message Size

Messages longer than 10 Kbytes (Speedway) or 64 Kbytes (Speedway Revolution) received by the Reader will cause a READER_EVENT_NOTIFICATION message containing a *ConnectionCloseEvent* parameter to be sent, followed by a close of the LLRP connection.

Reader transmit buffer is limited to 512 Kbytes. This corresponds to roughly 2000 *TagReportData* parameters per RO_ACCESS_REPORT. Client implementations should configure the *ROReportSpec* properly to avoid excessively large individual reports.

3.1.4 C1G2RFControl Parameter

Speedway Gen2 modes are selected by Impinj system engineering to provide the best performance. No Tari adjustment is necessary. Tari values passed by the client will be ignored.

Octane supports automatic control and optimization of Gen2 Mode settings (Autoset) for Reader operating environment. In previous versions of Octane software, there were separate Autoset Dense Interrogator and Single Interrogator modes. Starting with Octane 4.8, SpeedwayR now provides a single Autoset mode that optimizes over both environments. In addition, Octane supports several pre-configure Gen2 modes.

- A *C1G2SinulationControl* ModeIndex of 1000 configures the Reader to choose the best Gen2 link parameters for the environment using forward link parameters. *ModeIdentifier* 1000 link parameters reported in the *C1G2UHFRFModeTableEntry* should be ignored.

Table 3-2 documents the official names of the Gen2 modes supported by Speedway and Speedway Revolution. Reader modes vary depending on the Reader model and regulatory region.

Table 3-2 Official Octane Gen2 Mode Names

ModeIdentifier	Official Name
0	Max Throughput
1	Hybrid Mode (High throughput (M=2))
2	Dense Reader (M=4)
3	Dense Reader (M=8)
4	Max Miller (High throughput (M=4))
1000	AutoSet
1001	AutoSet Single Interrogator – This mode is now identical to mode 1000.

3.1.5 Gen2 Read Command

Gen2 supports a read command with zero length. This instructs the Reader to read the entire bank of Gen2 memory starting with the word indicated by the read address. The Octane releases covered by this document do not support reading with a zero word length.

3.1.6 Per-Antenna Configuration

LLRP supports per-antenna configuration for many standard parameters. The following parameters must be configured the same for all enabled antennas in a particular AISpec or an error is returned. All other parameters can be set to unique per-antenna values.

- *C1G2RFControl* parameter
  - ModeIndex must be configured the same.
- *RFTransmitter* parameter
  - HopTableID must be configured the same.
  - ChannelIndex must be configured the same.
  - TransmitPower may be configured to unique per-antenna values.
- *C1G2Filter* parameter
  - All fields and sub-parameters must be configured the same.
- *C1G2SingulationControl* parameter
  - Session must be configured the same.
  - TagPopulation must be configured the same.
  - TagTransitTime must be configured the same.

Impinj extension parameters that control antenna settings may also be restricted in a similar manner. For details regarding custom parameter requirements, see the individual sections documenting the extension.

3.1.7 LLRP Data Persistence

LLRP configuration data including data set by SET_READER_CONFIG, ADD_ROSPEC, and ADD_ACCESSSPEC messages are persistent across LLRP connections. However, a reboot of the device will reset these parameters to their default values. For information on increasing data persistence, see section 4.1.3. For information on the default values, see section 8.

3.1.8 LLRP Receive Sensitivity

The SpeedwayR Reader references the RSSI sensitivity levels to an absolute sensitivity of -80 dBm. In order to set a receive sensitivity level of -47 dBm, the user must identify the *ReceiveSensitivityTableEntry* parameter within the *GeneralDeviceCapabilities* such that:

-80 dBm + ReceiveSensitivityValue = -47 dBm

In this case, ReceiveSensitivityValue is calculated as 33, which corresponds to Index 25 in the Octane 4.8 LLRP capabilities. To complete the example, to set the receive sensitivity level to -47 dBm for an antenna, the ReceiverSensitivity field of the *RFReceiver* parameter should be set to 25. See Table 9-3 for the receive sensitivity capabilities of the SpeedwayR Reader.

3.1.9 LLRP GPO Control

When a user disconnects from LLRP, the output state of the port pins remains as it was when connected. If the unit reboots, the GPO will be restored to the last saved GPO configuration. See section 4.1.3 for details on saving the configuration. In the absence of a saved configuration, the GPO will resort to the default configuration. (See section 8.)

3.1.10 LLRP AntennaEvent Parameter

The *AntennaEvent* parameter within a READER_EVENT_NOTIFICATION message reports the current connected state of the antenna. The Octane firmware can detect during inventory operation when antennas are connected or disconnected.

SpeedwayR tracks the state of the antennas continuously and will only generate a READER_EVENT_NOTIFICATION with the *AntennaEvent* parameter if a delta is detected from the last reported status. If an antenna was reported disconnected previously and a new AISpec is started, client implementations should not expect another event to be reported until the antenna is reconnected.

The recommended method for tracking antenna connectivity is to issue a GET_READER_CONFIG upon connecting to the Reader. The Reader will report the current connected state of each antenna via the *AntennaProperties* parameter. The client can then monitor the connection for any new READER_EVENT_NOTIFICATION messages containing *AntennaEvent* parameters and update the state as appropriate. This process is done asynchronously with respect to inventory control.

3.1.11 LLRP Trigger Details

LLRP allows multiple types of start, stop, and report triggers. For some trigger types, additional information is required in the form of optional parameters. The LLRP specification is clear that these parameters must be present for a given trigger type. The LLRP does not clearly state what happens if one of these parameters appears when the trigger type does not require its presence. Octane LLRP assumes that these parameters can be present if, and only if, the trigger type

requires them. As an example, if the *GPITriggerValue* parameter is present within the *ROSpecStartTrigger* of a ROSpec when the ROSpecStartTriggerType is set to 'Periodic', Octane will return an error.

3.1.12 LLRP Non-Specific Tag Errors

LLRP access operations (Read, Write, Kill, Lock, BlockWrite and BlockErase) all contain a result type of 'Non-Specific Tag Error' within the appropriate *C1G2OpSpecResult* parameter. Because the LLRP specification does not expose all possible C1G2 tag access error codes, the Octane firmware uses this error code as a catchall for the more specific tag errors. Table 3-3 documents the possible errors that may have occurred during the tag access if the Octane firmware reports a 'Non-Specific Tag Error'.

Table 3-3 Octane Non-Specific Tag Error Translation

LLRP Access Operation	Possible Specific Tag Errors
C1G2Read	CRC Error Memory Locked Memory Overrun
C1G2Write	Invalid Password Tag Lost
C1G2Kill	Tag Cannot be Killed Tag Lost
C1G2Lock	Memory Permalocked Memory Overrun Invalid Password Tag Lost
C1G2BlockWrite	Invalid Password Tag Lost
C1G2BlockErase	N/A (not supported in Octane 4.8)

3.1.13 LLRP Buffered Events and Reports

By default, HoldEventsAndReportsUponReconnect is false in the Reader's configuration. In this mode, any events or reports generated by the Reader without a client LLRP connection are silently discarded. If a client wishes to have the Reader buffer reports generated absent a client connection, it must set HoldEventsAndReportsUponReconnect to true. The Reader will then buffer generated reports internally until it receives an ENABLE_EVENTS_AND_REPORTS message from the client. Upon receiving this message, all buffered reports will be delivered and future events and reports will be delivered as they are generated. Note that in this mode only reports are buffered; events are always discarded.

3.1.14 LLRP TagTransitTime Field

The TagTransitTime field within the *C1G2SingulationControl* parameter is defined as "…the measure of expected tag mobility in the field of view…" by the LLRP Specification. Internally, the Reader uses this value as part of a coarse low duty-cycle control mechanism. As such,

unusually large values for this field are ignored and the value is instead saturated at a maximum. For Speedway Revolution, this maximum is 10 seconds. The Reader will accept larger values, but they will have no impact on the Reader operation.

It should be noted that the use of this field for low duty-cycle control is crude at best. It is recommended that the low duty-cycle extension be used for precise control of Reader RF transmissions. See section 4.2.7 for details.

3.1.15 LLRP ROReportSpec Parameter

The *ROReportSpec* parameter is treated as an autonomous parameter by the Reader. This varies slightly from other parameters, such as *AntennaConfiguration* which can be decomposed. For example, if an AISpec contains an *AntennaConfiguration* parameter that does not contain an *RFReceiver* parameter, the Reader will consult the default configuration for the *RFReceiver* settings to use for that antenna. On the other hand, if a ROSpec contains a *ROReportSpec* parameter that does not have an *AirProtocolEPCMemorySelector* parameter (within *TagReportContentSelector*), or an *ImpinjTagReportContentSelector* parameter, the Reader assumes that those parameters are turned off for the subject *ROReportSpec*. The Reader does **not** consult the default configuration for these settings. Therefore any *ROReportSpec* parameter appearing in a ROSpec is autonomous and complete and will override all *ROReportSpec* settings in the default configuration.

3.1.16 LLRP Keepalive Messages

LLRP provides a heartbeat mechanism between the Reader and client applications via KEEPALIVE and KEEPALIVE_ACK messages. The Reader is configured to initiate KEEPALIVE messages via the *KeepaliveSpec* in SET_READER_CONFIG. However, the LLRP Specification does not state what action the Reader may take if its KEEPALIVE messages are not acknowledged by the client. Some versions of Octane firmware can be configured to either ignore KEEPALIVE_ACK messages, or to process these messages and use them to infer the health of a current connection. See section 4.2.12 for details.

3.1.17 LLRP Transmit Power

LLRP defines transmit power as an offset into the Reader's *TransmitPowerLevelTableEntry* table advertised in the *UHFBandCapabilities*. Because the capabilities of one product may differ from another, the absolute transmit power in dBm should not be inferred from the value configured in the TransmitPower field of *RFTransmitter*. For example, a TransmitPower index of 61 is 30 dBm on Speedway, while on Speedway Revolution the same 30 dBm absolute power is a TransmitPower index of 81. Client applications should always reference the Reader's advertised capabilities when determining absolute power values.

3.1.18 C1G2 Version 1.2.0 Support

Octane 4.8 is based on LLRP version 1.0.1, which does not support C1G2 version 1.2.0. It is anticipated that future versions of LLRP will add support for features included in C1G2 1.2.0. However, to provide access to a subset of the C1G2 1.2.0 features while the standard bodies complete efforts on a new version of LLRP, Octane includes vendor extensions to expose the underlying air protocol features. Please refer to the documentation for the individual extensions for more information.

4 Octane LLRP Custom Extensions

Octane extends LLRP with custom extensions to provide critical functionality unique to Impinj Reader products. These features utilize the custom extension mechanism provided by LLRP. Table 4-1 summarizes the Octane LLRP custom extensions and a description of the features usage.

For each Octane LLRP custom extension, the documentation includes a description of the feature, a discussion of LLRP dependencies, the allowable extension points for the extension, and the definition of API elements. The subsections below outline the information provided for each Octane LLRP custom extension and its relevance to the developer or system architect using Octane LLRP:

Description: The description subsection contains specific information about the extension including what it does and how to use it. This section contains the high-level information required to implement the extension.

LLRP Dependency: The LLRP Dependency subsection describes how the contents of the extension affect other standard LLRP fields and parameters. Many extensions provide additional functionality over what standard LLRP offers. The settings in the standard version of the protocol elements may be modified or overridden entirely by the presence of an extension parameter. Where applicable, the LLRP dependency section will clarify the behavior.

Allowable Extension Points: The allowable extension point subsection describes where the extension is permitted within the LLRP messaging structure. Not all parameters within LLRP allow the presence of custom parameters. The LLRP specification documents the permitted locations of custom extensions. Octane further restricts each individual custom extension and where they may appear within LLRP messages. Each custom parameter (not applicable for custom messages) lists the LLRP extension points at which the parameter may appear. Within the LLRP custom extension points, Octane LLRP Custom extension parameters can appear in any order.

Definition: The definition subsection of each Octane extension defines the fields and sub-parameters that make up the extension. Field types and definitions for enumerated values are included in this section.

Table 4-1 Octane Custom LLRP Extension Summary

Octane LLRP Extension	Speedway Revolution			Sections	Summary Description
	R220	R420	R640		
Enable Extensions	√	√	√	4.1.1 4.1.2	Required to utilize any of the Octane LLRP custom extensions features.
Detailed Version Information	√	√	√	4.2.8	Provides detailed version information for the subcomponents that make up the Reader.
Sub-Regulatory Region Control and Reporting	√	√	√	4.2.2	Used when regulatory regions offer several distinct modes of operation or when a single Reader offers multiple regulatory regions. The response to this command can take up to 10 seconds, because the Reader must reconfigure itself for the new region.
Inventory Search Mode	√	√	√	4.2.3	Configures the inventory algorithms for optimum performance. This is an alternate method to the *StateAwareSingulation* parameter in LLRP that requires detailed Gen2 knowledge.
Fixed Frequency Lists	√	√	√	4.2.4	Allows the client to control and configure automatic frequency selection for regulatory regions with fixed frequency operation.
Reduced Power	–	√	√	4.2.5 4.2.6	Provides Reduced Power operation level configurability on certain channels within the FCC regulatory region.
Low Duty Cycle	√	√	√	4.2.7	Provides clients the ability to configure a low duty cycle mode to limit interference. The Reader manages the duty cycle based on tag observation statistics.
Save Settings	√	√	√	4.1.3 4.1.4	Allows the application to save configuration settings in the Reader. The response to this command can take up to 2 seconds, while the Reader commits the configuration to persistent storage.

Octane LLRP Extension	Speedway Revolution			Sections	Summary Description
	R220	R420	R640		
GPI Debounce	√	√	√	4.2.9	Configures the minimum period between general-purpose input (GPI) transitions reported by the Reader. Debounce allows the Reader to be directly connected to mechanical switches or other “noisy” inputs.
Advanced GPO	√	√	√	4.2.10	Allows for more advanced use of the Reader general-purpose outputs (GPOs). GPOs may be pulsed for a specified duration, or may be tied to a specific Reader operational status.
Temperature Reporting	√	√	√	4.2.11	Allows for polled reporting of the internal Reader temperature.
Link State Monitoring	√	√	√	4.2.12	Configures the Reader to monitor the state of a LLRP connection using the LLRP KEEPALIVE mechanism.
Report Buffer Behavior	√	√	√	4.2.13	Instructs the Reader on how to buffer reports it sends to client applications. It can be used to decrease latency of tag reports at the expense of both Reader and Client CPU utilization.
Access Spec Configuration	√	√	√	4.2.14 4.2.15 4.2.16	Allows for fine-tuned control over AccessSpec execution including the number of words sent over the air interface during a BlockWrite operation, and how many times an operation is retried before declaring failure.
C1G2 BlockPermalock	√	√	√	4.2.17 4.2.18 4.2.19 4.2.20	Exposes the C1G2 air protocol BlockPermalock operation.

Octane LLRP Extension	Speedway Revolution			Sections	Summary Description
	R220	R420	R640		
QT Technology™	√	√	√	4.2.21 4.2.22 4.2.23 4.2.24	Allows the Reader to access and configure the QT Technology™ of the Impinj Monza 4QT tags. For more information about this feature, reference the Monza 4QT datasheet.
Serialized TID	√	√	√	4.2.25 4.2.26 4.2.32	Allows the Reader to report both the EPC and TID as part of normal inventory, without the need for an explicit AccessSpec.
RF Phase Angle	√	√	√	4.2.25 4.2.27 4.2.33	Reports the RF phase angle of the communication with the tag over the air interface.
High Resolution RSSI	√	√	√	4.2.25 4.2.28 4.2.34	Reports the peak power of the tag backscatter in a higher resolution than is available via LLRP.
GPS Location	√	√	√	4.2.25 4.2.29 4.2.35 4.2.38 4.2.39 4.2.40	Allows the Reader to report its GPS location when attached to a supported GPS-capable device. The GPS location can be obtained instantaneously, or included within tag reports.
Optimized Read	√	√	√	4.2.25 4.2.30	Allows for the reporting of additional tag memory content during inventory without the use of AccessSpecs. The reads are optimized by the Reader for enhanced performance.
AISpec Looping	√	√	√	4.2.37	Allows the Reader to loop execution of AISpecs.

4.1 Custom Messages

The following subsections describe the custom messages supported in Octane LLRP.

4.1.1 IMPINJ_ENABLE_EXTENSIONS Message

4.1.1.1 Description

This top-level extension custom message is used to enable the exchange of all other Impinj extensions. By default, all of the Impinj extensions are unavailable to the Client, and the Reader will respond to any Impinj extensions with an error. The Client sends the custom message to the Reader after the connection establishes if it uses Impinj extensions. If the connection is lost, the extensions revert to the unavailable state. However, Reader features controlled by earlier use of the extensions will remain configured through connections unless otherwise noted.

By sending this message to the Reader, the Client acknowledges the ability to process all Impinj extensions. The Client must ignore any unrecognized information received from the Reader, including the following:

- Unknown custom messages
- Unknown custom parameters
- Unknown reserved enumeration values in custom parameters
- Use of reserved bits within custom parameters and messages

4.1.1.2 LLRP Dependencies

The IMPINJ_ENABLE_EXTENSIONS message only applies for the duration of the current LLRP connection. If the LLRP connection is broken and re-established, the application must re-issue this command.

4.1.1.3 Definition

Table 4-2 IMPINJ_ENABLE_EXTENSIONS Message

IMPINJ_ENABLE_EXTENSIONS **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.1.1.

4.1.2 IMPINJ_ENABLE_EXTENSIONS_RESPONSE Message

4.1.2.1 Description

This custom message is the Reader response to an IMPINJ_ENABLE_EXTENSIONS message. If the Reader is capable of enabling the Impinj extensions, the Reader returns the success code in the *LLRPStatus* parameter. If there is an error, the Reader returns an appropriate error code.

4.1.2.2 LLRP Dependencies

This custom message has no LLRP dependencies.

4.1.2.3 Definition

Table 4-3 IMPINJ_ENABLE_EXTENSIONS_RESPONSE Message

IMPINJ_ENABLE_EXTENSIONS_RESPONSE *Status*: *LLRPStatus* Parameter **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.1.2.

4.1.3 IMPINJ_SAVE_SETTINGS Message

4.1.3.1 Description

This IIMPINJ_SAVE_SETTINGS custom message instructs the Reader to save the current configuration to persistent storage. The saved parameters then become the Reader's power-on and reset settings. The specific configuration parameters saved to persistent storage are specified using the Boolean fields. These Booleans are implemented as a bit-field (see section 6.1.3) and unused reserved bits must be set to zero. Note that there is no way to recall this configuration during runtime. The configuration is only applied after a Reader power-on or reset.

Speedway Revolution: The entire reader state is saved to persistent storage. This includes settings from SET_READER_CONFIG in addition to any configured ROSpecs and AccessSpecs. The current state of ROSpecs and AccessSpecs are preserved with one exception, the 'Active' ROSpec is saved in the 'Inactive' (but enabled) state. This means a ROSpec with an 'Immediate' start trigger will be saved in the 'Inactive' state but will then run immediately upon power-on or reset. Similarly, a ROSpec with a GPI start trigger will run upon the first GPI transition after power-on or reset. For AccessSpecs, the countdown value (if any) upon receiving this custom message is saved. Automatic update of the persistent configuration during Reader operation is not supported.

4.1.3.2 LLRP Dependencies

The configuration of the Reader when the IMPINJ_SAVE_SETTINGS message is received will become the default configuration for all Reader resets. However, a SET_READER_CONFIG command with *the* ResetToFactoryDefault flag set will override the persistent settings. The Reader will initialize with factory settings on subsequent resets until another IMPINJ_SAVE_SETTINGS command is received.

4.1.3.3 Definition

Table 4-4 IMPINJ_SAVE_SETTINGS Message

IMPINJ_SAVE_SETTINGS SaveConfiguration: Boolean **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.1.3.

4.1.4 IMPINJ_SAVE_SETTINGS_RESPONSE Message

4.1.4.1 Description

This custom save-settings message is the response by the Reader to an IMPINJ_SAVE_SETTINGS message. If the Reader was capable of saving the current configuration to persistent storage, the Reader returns the success code in the *LLRPStatus* parameter. If there is an error, the Reader returns an appropriate error code.

4.1.4.2 LLRP Dependencies

This custom message has no LLRP dependencies.

4.1.4.3 Definition

Table 4-5 IMPINJ_SAVE_SETTINGS_RESPONSE Message

IMPINJ_SAVE_SETTINGS_RESPONSE *Status*: *LLRPStatus* Parameter **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.1.4.

4.2 Custom Parameters

The following subsections describe the custom messages supported in Octane LLRP.

4.2.1 ImpinjRequestedData Parameter

4.2.1.1 Description

Allow the Client to choose specific extensions for inclusion in either a GET_READER_CAPABILITIES_RESPONSE or a GET_READER_CONFIG_RESPONSE message with this custom parameter. If the Client requests 'All' in the command message and Impinj extensions have been enabled, then all Impinj extensions will be included in the response. In order to reduce the response size, the Client requests a specific response parameter using this extension.

Note: this only applies to direct extensions of these two response messages. Custom extensions nested within parameters already present in either of these response messages will be included provided the Reader has received the IMPINJ_ENABLE_EXTENSIONS message. While this parameter may appear in either a GET_READER_CAPABILITIES or a GET_READER_CONFIG message, not all ranges for the enumerated RequestedData field are valid in both messages.

4.2.1.2 LLRP Dependencies

There are no LLRP dependencies for this custom parameter. The standard LLRP requested data field is processed independently from the custom requested data field with the exception that 'All' in the standard field also means 'All' in the custom field if this parameter is omitted and extensions have been enabled.

4.2.1.3 Allowable Extension Points

- GET_READER_CAPABILITIES message (field values 1000 – 1999)
- GET_READER_CONFIG message (field values 2000 – 2999)

4.2.1.4 Definition

Table 4-6 ImpinjRequestedData Parameter

ImpinjRequestedData **Parameter**

RequestedData**:** Unsigned Integer.
Possible Values:

Value	Description
1000	'All_Capabilities'
1001	'Impinj_Detailed_Version'
1002	'Impinj_Frequency_Capabilities'
2000	'All_Configuration'
2001	'Impinj_Sub_Regulatory_Region'
2002	'Impinj_Forklift_Configuration'
2003	'Impinj_GPI_Debounce_Configuration'
2004	'Impinj_Reader_Temperature'
2005	'Impinj_Link_Monitor_Configuration'
2006	'Impinj_Report_Buffer_Configuration'
2007	'Impinj_Access_Spec_Configuration'
2008	'Impinj_GPS_NMEA_Sentences'
2009	'Impinj_Advanced_GPO_Configuration'
All others	Reserved for future use

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.1.

4.2.2 ImpinjSubRegulatoryRegion Parameter

4.2.2.1 Description

Use this custom parameter when a particular regulatory region supports multiple operational modes. The Reader validates the RegulatoryRegion field against the regulatory regions for which the reader was manufactured and only allows compatible regions to be set. Note that when setting the sub-regulatory region using the SET_READER_CONFIG message, the ResetToFactoryDefault field must be set to true. This will delete any configured ROSpecs and AccessSpecs. Failure to set the ResetToFactoryDefault field will result in an error. The Client should subsequently issue a GET_READER_CAPABILITIES command after updating the regulatory region as the change may have affected the advertised Reader capabilities.

After the Reader accepts this parameter, it will begin to reload appropriate regulatory settings: this can take several seconds. Applications should plan for an additional delay of several seconds

for the SET_READER_CONFIG_RESPONSE. Note: An LLRP ResetToFactoryDefault that changes the RegulatoryRegion will result in the same behavior.

Not all regulatory regions are supported by each Reader model. Table 4-7 documents support regions by Reader model.

Table 4-7 ImpinjSubRegulatoryRegion Supported Reader Models

Region	Speedway Revolution		
	R220	R420	R640
0: FCC part 15.247	√	√	√
1: ETSI EN 300-220	N/A	N/A	N/A
2: ETSI EN 302-208	–	–	–
3: Hong Kong 920-925 MHz	√	√	√
4: Taiwan 922-928 MHz	√	√	√
5: Japan 952-954 MHz	N/A	N/A	N/A
6: Japan 952-955 MHz, 10mW max power	N/A	N/A	N/A
7: ETSI EN 302-208 (version 1.2.1)	√	√	√
8: Korea 917-921 MHz	√	√	√
9: Malaysia 919-923MHz	√	√	√
10: China 920-925 MHz	√	√	√
11: Japan 952-956 MHz (without LBT)	√	√	-
12: South Africa 915-919 MHz	√	√	√
13: Brazil 902-907/915-928 MHz	√	√	√
14: Thailand 920-925 MHz	√	√	√
15: Singapore 920-925 MHz	√	√	√
16: Australia 920-926 MHz	√	√	√
17: India 865-867 MHz	√	√	√
18: Uruguay 916-928 MHz	√	√	√
19: Vietnam 920-925 MHz	√	√	√
20: Israel 915-917 MHz	√	√	√
21: Philippines 918-920 MHz	√	√	√
22: Canada Post 902-928 MHz	√	√	√
23: Indonesia 923-925 MHz	√	√	√
24: New Zealand 921.5-928MHz	√	√	√

4.2.2.2 LLRP Dependencies

When a particular LLRP region supports multiple operational modes this parameter is required. For example, if the LLRP ETSI region supports both with and without LBT. For regions not supporting multiple modes, the Reader will set this parameter automatically based on the hardware version of the Reader and the region information specified at manufacturing.

4.2.2.3 Allowable Extension Points

- GET_READER_CONFIG_RESPONSE message
- SET_READER_CONFIG message

4.2.2.4 Definition

Table 4-8 ImpinjSubRegulatoryRegion Parameter

ImpinjSubRegulatoryRegion **Parameter**

RegulatoryRegion**:** Unsigned Short Integer.
Possible Values:

Value	Description
0	'FCC part 15.247'
1	'ETSI EN 300-220'
2	'ETSI EN 302-208 (with LBT)'[1]
3	'Hong Kong 920-925 MHz'
4	'Taiwan 922-928 MHz'
5	'Japan 952-954 MHz'[2]
6	'Japan 952-955 MHz, 10mW max power'
7	'ETSI EN 302-208 (version 1.2.1)'
8	'Korea 917-921 MHz'
9	'Malaysia 919-923 MHz'
10	'China 920-925 MHz'
11	'Japan 952-956 MHz (without LBT)'
12	'South Africa 915-919 MHz'
13	'Brazil 902-907 and 915-928 MHz'
14	'Thailand 920-925 MHz'
15	'Singapore 920-925 MHz'
16	'Australia 920-926 MHz'
17	'India 865-867 MHz'
18	'Uruguay 916-928 MHz'
19	'Vietnam 920-925 MHz'
20	'Israel 915-917 MHz'
21	'Philippines 918-920 MHz'
22	'Canada Post 902-928 MHz'
23	'Indonesia 923-925 MHz'
24	'New Zealand 921.5-928 MHz'
25-65535	Reserved for future use

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.2.

4.2.3 ImpinjInventorySearchMode Parameter

4.2.3.1 Description

Specify the Impinj-specific inventory search mode used by a particular antenna using this custom parameter. The inventory search mode may be configured as either part of the default Reader

[1] *2: ETSI EN 302-208 (with LBT)* is deprecated and internally mapped to *7: ETSI EN 302-208 (version 1.2.1)*.

[2] *5: Japan 952-954 MHz* is no longer supported. It has been replaced by *11: Japan 952-956 (without LBT).*

configuration (via a SET_READER_CONFIG message), or as part of individual AISpecs within a ROSpec (via an ADD_ROSPEC message). For any AISpec, each enabled antenna must be configured to use the same search algorithm. Mismatched antenna settings will result in an error reported by the Reader.

4.2.3.2 Allowable Extension Points

- *C1G2InventoryCommand* parameter

4.2.3.3 LLRP Dependencies

Impinj Readers implement state unaware singulation and therefore the Client does not control how the Reader attempts to singulate tags. This parameter provides a high-level control over the search algorithm and consequently does not interfere with any of the standard LLRP settings.

When the InventorySearchMode is set to zero, the Reader will pick the inventory search mode that provides the most consistent performance for the session and timing parameters provided by LLRP.

4.2.3.4 Definition

Table 4-9 ImpinjInventorySearchMode Parameter

ImpinjInventorySearchMode **Parameter**

InventorySearchMode**:** Unsigned Short Integer.
Possible Values:

Value	Description
0	'Reader selected mode' (default)
1	'Single target inventory' High tag count, high-throughput applications where a reduction in repeated tag observation is acceptable.
2	'Dual target inventory' Low to medium tag count or low-throughput applications where repeated tag observation is desirable.
3	'Single target inventory' (with suppressed duplicate observations). Maximum tag count, high-throughput applications where a single observation of each tag is acceptable. This search mode suppresses repeated observations for extended periods of time while tags are energized. (Available only for use with Session 1.)
4-65535	Reserved for future use

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.3.

4.2.4 ImpinjFixedFrequencyList Parameter

4.2.4.1 Description

Use this custom parameter to allow the Reader to make intelligent decisions about which channel to use in fixed frequency or intelligent hopping regulatory regions. The FixedFrequencyMode field determines how the Reader will select the active channel. When set to zero (disabled), the

Reader ignores this parameter and instead uses the frequency information in the LLRP *RFTransmitter* parameter. When set to one, the Reader chooses the active channel automatically based on the rules of the regulatory region. When set to two, the Reader chooses the active channel from a configurable list of channel indices based on the *ImpinjFrequencyCapabilities* parameter advertised in the Reader's capabilities. The maximum number of channels allowed in the configurable list displays in Table 4-10. A repeated channel index means the Reader will test the channel multiple times. When FixedFrequencyMode is set to zero or one, the ChannelList array is ignored.

This parameter may only be added in an operational mode, such as 'not disabled' when the Reader is operating in a fixed frequency or intelligent hopping regulatory region. The parameter contents must be consistent across all enabled antennas in an AISpec.

Table 4-10 ImpinjFixedFrequencyList Regulatory Information

Region	Available FixedFrequencyMode	Maximum ChannelList Size
0: FCC part 15.247	0	N/A
1: ETSI EN 300-220	N/A	N/A
2: ETSI EN 302-208	See region 7	See region 7
3: Hong Kong 920-925 MHz	0	N/A
4: Taiwan 922-928 MHz	0	N/A
5: Japan 952-954 MHz	N/A	N/A
6: Japan 952-955 MHz, 10mW max power	N/A	N/A
7: ETSI EN 302-208 (version 1.2.1)	0, 1, 2	4
8: Korea 917-921 MHz	0	N/A
9: Malaysia 919-923MHz	0	N/A
10: China 920-925 MHz	0, 1, 2	16
11: Japan 952-956 MHz (without LBT)	0, 1, 2	4
12: South Africa 915-919 MHz	0	N/A
13: Brazil 902-907/915-928 MHz	0	N/A
14: Thailand 920-925 MHz	0	N/A
15: Singapore 920-925 MHz	0	N/A
16: Australia 920-926 MHz	0	N/A
17: India 865-867 MHz	0, 1, 2	4
18: Uruguay 916-928 MHz	0	N/A
19: Vietnam 920-925 MHz	0	N/A
20: Israel 915-917 MHz	0	N/A

Region	Available FixedFrequencyMode	Maximum ChannelList Size
21: Philippines 918-920 MHz	0, 1, 2	4
22: Canada Post 902-928 MHz	0	N/A
23: Indonesia 923-925 MHz	0	N/A
24: New Zealand 921.5-928MHz	0	N/A

4.2.4.2 LLRP Dependencies

When present and enabled, this parameter overrides the ChannelIndex field of the *RFTransmitter* parameter. The Reader will always return the last value set in the ChannelIndex field if queried, but if a Client sets this custom parameter, that value must be ignored.

4.2.4.3 Allowable Extension Points

- *C1G2InventoryCommand* parameter

4.2.4.4 Definition

Table 4-11 ImpinjFixedFrequencyList Parameter

***ImpinjFixedFrequencyList* Parameter**

FixedFrequencyMode**:** Unsigned Short Integer.
Possible Values:

Value	Description
0	'Disabled' (default)
1	'Reader will choose the channel from those allowed in the current regulatory region'
2	'Reader will choose the channel from the channel indices provided in the ChannelList field'
3-65535	Reserved for future use

*ChannelList***:** Short Array. An array of indices into the Reader's *ImpinjFrequencyCapabilities* to be used.

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.4.

4.2.5 ImpinjFrequencyCapabilities Parameter

4.2.5.1 Description

The frequency capabilities custom parameter is included in the Reader's capabilities and carries each frequency supported by the Reader (see section 4.2.6 for more information).
The FrequencyList field is a one-based array of frequencies in kHz.

4.2.5.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.5.3 Allowable Extension Points

- GET_READER_CAPABILITIES_RESPONSE

4.2.5.4 Definition

Table 4-12 ImpinjFrequencyCapabilities Parameter

***ImpinjFrequencyCapabilities* Parameter**
FrequencyList**:** Unsigned Integer Array. Frequency in kHz. **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.5

4.2.6 ImpinjReducedPowerFrequencyList Parameter

4.2.6.1 Description

Permit the Reader to apply a reduced power to specific channels listed in the ChannelList when operating in the FCC regulatory region using this custom parameter. The ReducedPowerMode field determines how the Reader will interpret the channels listed. When set to zero (disabled), the Reader ignores this parameter. When set to one, during inventory and access the Reader will apply a reduced power level to the list of channel indices derived from the FrequencyList supplied by the *ImpinjFrequenciesCapabilities* parameter advertised in the Reader's capabilities (Section 4.2.5). The reduced power level is not configurable, and defaults to the lowest device power possible. The maximum number of channels allowed in the configurable list display in Table 4-13. When ReducedPowerMode is one, the ChannelList must contain at least two channels and no one channel may be repeated.

This parameter is valid only when the Reader is operating in the FCC regulatory region (see Table 4-13). The parameter contents must be consistent across all enabled antennas in an AISpec.

Table 4-13 ImpinjReducedPowerFrequencyList Regulatory Information

Region	Available ReducedPowerMode	Maximum ChannelList Size
0: FCC part 15.247	0, 1	16
1. ETSI EN 300-220	N/A	N/A
2: ETSI EN 302-208	See region 7	See region 7
3: Hong Kong 920-925 MHz	0	N/A
4: Taiwan 922-928 MHz	0	N/A
5: Japan 952-954 MHz	N/A	N/A
6: Japan 952-955 MHz, 10mW max power	N/A	N/A
7: ETSI EN 302-208 (version 1.2.1)	0	N/A
8: Korea 917-921 MHz	0	N/A
9: Malaysia 919-923MHz	0	N/A
10: China 920-925 MHz	0	N/A
11: Japan 952-956 MHz (without LBT)	0	N/A
12: South Africa 915-919 MHz	0	N/A
13: Brazil 902-907/915-928 MHz	0	N/A
14: Thailand 920-925 MHz	0	N/A
15: Singapore 920-925 MHz	0	N/A
16: Australia 920-926 MHz	0	N/A
17: India 865-867 MHz	0	N/A
18: Uruguay 916-928 MHz	0	N/A
19: Vietnam 920-925 MHz	0	N/A
20: Israel 915-917 MHz	0	N/A
21: Philippines 918-920 MHz	0	N/A
22: Canada Post 902-928 MHz	0	N/A
23: Indonesia 923-925 MHz	0	N/A
24: New Zealand 921.5-928MHz	0	N/A

4.2.6.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.6.3 Allowable Extension Points

- *C1G2InventoryCommand* parameter

4.2.6.4 Definition

Table 4-14 ImpinjReducedPowerFrequencyList Parameter

***ImpinjReducedPowerFrequencyList* Parameter**

ReducedPowerMode**:** Unsigned Short Integer.
Possible Values:

Value	Description
0	'Disabled' (default)
1	'Reader apply the reduced power level to the Channels specified in the ChannelList'
2-65535	'Reserved for future use'

ChannelList**:** Unsigned Short Array. A maximum of sixteen one-based indices into the Reader's FrequencyList as advertised in the *ImpinjFrequencyCapabilities* parameter to apply the reduced power during inventory and access.

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.6

4.2.7 ImpinjLowDutyCycle Parameter

4.2.7.1 Description

Provide additional control of the RF duty cycle of the Reader beyond control provided by the TagTransitTime field in the LLRP *C1G2SingulationControl* parameter using this custom parameter. During inventory, if the Reader detects zero tags in the field-of-view (definition is model-specific, see below), EmptyFieldTimeout specifies in milliseconds the time the Reader will wait before entering low duty cycle mode. In this low duty cycle mode, the Reader will rescan the FOV every FieldPingInterval milliseconds, checking for tags. When a tag is detected, full duty cycle will resume. The Reader will exit low duty cycle mode at the start of each AISpec and restart the empty field timers.

For regulatory region compliance, low duty cycle operation will occur in some regions whether low duty cycle operation parameters are specified or not. For such regions, if valid low duty cycle operation parameter values are specified, the Reader may choose to adjust the specified values in order to maintain regulatory region compliance. This parameter is invalid in regions using LBT (see Table 4-15).

The FOV is defined as the tags visible by a single antenna, independent of the other antennas enabled in the current AISpec. Thus, each antenna manages its own FOV, empty field timer, and field ping timer. As such, the low duty cycle settings may be configured independently from other antennas enabled in the current AISpec. The only requirement is that if one antenna in the AISpec uses the *ImpinjLowDutyCycle* parameter, all antennas must use the extension. The timer values however, may vary between enabled antennas.

As an example, assume EmptyFieldTimeout is set to 500 milliseconds and FieldPingInterval is set to 200 milliseconds for one of the antennas in the current AISpec. Once that antenna detects zero

tags in the field-of-view, that antenna's empty field timer is started. If that antenna subsequently detects tags, the timer stops. If that antenna detects zero tags for 500 ms, a timeout occurs and the antenna enters low duty cycle mode. During this mode, the antenna will switch on briefly every 200 ms to check for tags in its FOV. While this is all occurring, the same algorithm is running on each of the other enabled antennas independently.

Table 4-15 ImpinjLowDutyCycle Regulatory Information

Region	Available LowDutyCycleMode
0: FCC part 15.247	0, 1
1. ETSI EN 300-220	N/A
2: ETSI EN 302-208	See region 7
3: Hong Kong 920-925 MHz	0, 1
4: Taiwan 922-928 MHz	0, 1
5: Japan 952-954 MHz	N/A
6: Japan 952-955 MHz, 10mW max power	N/A
7: ETSI EN 302-208 (version 1.2.1)	0, 1
8: Korea 917-921 MHz	0, 1
9: Malaysia 919-923MHz	0, 1
10: China 920-925 MHz	0, 1
11: Japan 952-956 MHz (without LBT)	0, 1
12: South Africa 915-919 MHz	0, 1
13: Brazil 902-907/915-928 MHz	0, 1
14: Thailand 920-925 MHz	0, 1
15: Singapore 920-925 MHz	0, 1
16: Australia 920-926 MHz	0, 1
17: India 865-867 MHz	0, 1
18: Uruguay 916-928 MHz	0, 1
19: Vietnam 920-925 MHz	0, 1
20: Israel 915-917 MHz	0, 1
21: Philippines 918-920 MHz	0, 1
22: Canada Post 902-928 MHz	0, 1
23: Indonesia 923-925 MHz	0, 1
24: New Zealand 921.5-928MHz	0, 1

4.2.7.2 LLRP Dependencies

If present and enabled, this parameter will override the TagTransitTime field in the LLRP *C1G2SingulationControl* parameter. The Reader will always return the last value set in the TagTransitTime field if queried, but if a Client has set this custom parameter, that value must be ignored.

4.2.7.3 Allowable Extension Points

- *C1G2InventoryCommand* parameter

4.2.7.4 Definition

Table 4-16 ImpinjLowDutyCycle Parameter

***ImpinjLowDutyCycle* Parameter**

LowDutyCycleMode**:** Unsigned Short Integer.
Possible Values:

Value	Description
0	'Disabled' (default)
1	'Enabled'
2-65535	Reserved for future use

EmptyFieldTimeout**:** Unsigned Short Integer. The time in milliseconds the Reader will wait, having detected no tags on all enabled antennas, before switching to low duty cycle mode.

FieldPingInterval**:** Unsigned Short Integer. The time in milliseconds before the Reader switches on the transmitter to search for tags in the field during low duty cycle mode.

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.7.

4.2.8 ImpinjDetailedVersion Parameter

4.2.8.1 Description

Provide detailed information about the individual components running on the Reader with this custom parameter. The primary platform version is available in the ReaderFirmwareVersion field in the *GeneralDeviceCapabilities* parameter of the Reader's capabilities. However, there are sub-components of the Reader that contain independent version information that is unavailable in this manner. This parameter provides this detailed information. The meaning behind each field varies by Reader model. Table 4-17 provides the translation for each model type.

Table 4-17 ImpinjDetailedVersion Field Descriptions

Field	Speedway Revolution
ModelName	The model name of the reader.
SerialNumber	The serial number of the reader.

Field	Speedway Revolution
SoftwareVersion	The primary platform firmware version (SOP). Same as ReaderFirmwareVersion.
FirmwareVersion	The firmware version of the Command Sequencer component.
FPGAVersion	The firmware version of the FPGA component.
PCBAVersion	The hardware version of the PCBA component.

4.2.8.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.8.3 Allowable Extension Points

- GET_READER_CAPABILITIES_RESPONSE message

4.2.8.4 Definition

Table 4-18 ImpinjDetailedVersion Parameter

***ImpinjDetailedVersion* Parameter**

Field Description
------- -----------

ModelName: UTF-8 String

SerialNumber: UTF-8 String

SoftwareVersion: UTF-8 String

FirmwareVersion: UTF-8 String

FPGAVersion: UTF-8 String

PCBAVersion: UTF-8 String

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.8.

4.2.9 ImpinjGPIDebounceConfiguration Parameter

4.2.9.1 Description

Control the GPI debounce timing with this custom parameter. The GPIPortNum field is the 1-based GPI number, identical to GPIPortNum in the *GPIPortCurrentState* LLRP parameter. Once

a transition, rising or falling, is detected subsequent transitions are ignored for GPIDebounceTimerMSec milliseconds. This timer value must be a multiple of 10ms. Setting GPIDebounceTimerMSec to zero effectively disables debounce. The GPI debounce timer affects triggered ROSpecs and GPI event reporting.

4.2.9.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.9.3 Allowable Extension Points

- GET_READER_CONFIG_RESPONSE message
- SET_READER_CONFIG message

4.2.9.4 Definition

Table 4-19 ImpinjGPIDebounceConfiguration Parameter

***ImpinjGPIDebounceConfiguration* Parameter**
GPIPortNum**:** Unsigned Short Integer. GPIDebounceTimerMSec**:** Unsigned Integer. The debounce duration in milliseconds. Must be a multiple of 10 ms. Zero turns off the debounce algorithm for this GPI. **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.9.

4.2.10 ImpinjAdvancedGPOConfiguration Parameter

4.2.10.1 Description

Control the advanced GPO feature of Speedway Revolution readers using this custom parameter. When set to Normal (default) the GPO is set via the regular LLRP SET_READER_CONFIG message. When set to Pulsed, the GPO changes state based on the SET_READER_CONFIG message, and will change to the opposite state after GPOPulseDurationMSec milliseconds. When set to 'Reader_Operational_Status', 'LLRP_Connection_Status, Reader_Inventory_Status', 'Network_Connection_Status' or 'Reader_Inventory_Tags_Status' the GPO status acts like a Boolean value. When high (true, 1), the corresponding status is true, meaning the reader is operating, has a LLRP connection, is inventorying, has a network connection or tags are being singulated (respectively). When low (false, 0), the opposite is the case. The GPO may lag the actual internal status, notably the worst case delay on the 'Network_Connection_Status' can be up to 17 seconds.

4.2.10.2 LLRP Dependencies

Whenever a GPO has been associated with a specific reader status, it cannot be set via the normal LLRP protocol. If a SET_READER_CONFIG message is received that attempts to change the state of a GPO associated with a specific reader status, the message will be rejected by the reader.

4.2.10.3 Allowable Extension Points

- GET_READER_CONFIG_RESPONSE message
- SET_READER_CONFIG message

4.2.10.4 Definition

Table 4-20 ImpinjAdvancedGPOConfiguration Parameter

***ImpinjAdvancedGPOConfiguration* Parameter**

GPOPortNum**:** Unsigned Short Integer.

GPOMode**:** Unsigned Short Integer.
Possible Values:

Value	Description
0	'Normal' (default)
1	'Pulsed'
2	'Reader_Operational_Status'
3	'LLRP_Connection_Status'
4	'Reader_Inventory_Status'
5	'Network_Connection_Status'
6	'Reader_Inventory_Tags_Status'
7-65535	Reserved for future use

GPOPulseDurationMSec**:** Unsigned Integer. The duration of the GPO pulse. This field is only valid when GPOMode is set to Pulsed. When GPOMode is Pulsed, this value must be non-zero. The duration is specified in milliseconds.

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.10.

4.2.11 ImpinjReaderTemperature Parameter

4.2.11.1 Description

Report the current temperature of the Reader in degrees Celsius with this custom parameter. The temperature that is reported is the internal temperature of the Reader, not the ambient temperature of the Reader surroundings. The temperature is accurate to within ±2°C across all operating temperatures.

4.2.11.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.11.3 Allowable Extension Points

- GET_READER_CONFIG_RESPONSE message

4.2.11.4 Definition

Table 4-21 ImpinjReaderTemperature Parameter

***ImpinjReaderTemperature* Parameter**
Temperature**:** Signed Short Integer. The current temperature in degrees Celsius.
Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.11.

4.2.12 ImpinjLinkMonitorConfiguration Parameter

4.2.12.1 Description

Configure the Reader to monitor LLRP link health using KEEPALIVE and KEEPALIVE_ACK messages using this custom parameter. When disabled or unsupported (see Table 4-1), the Reader ignores KEEPALIVE_ACK messages entirely. When this parameter is enabled, if the Reader fails to receive LinkDownThreshold consecutive KEEPALIVE_ACK messages from the Client, the Reader will close the current connection. Note that this parameter must be configured in conjunction with the *KeepaliveSpec* LLRP parameter in the standard LLRP configuration. The frequency with which the Reader is configured to send KEEPALIVE messages, along with the threshold set in this parameter determines how long the Reader will tolerate missing KEEPALIVE_ACK messages. The Reader uses the LLRP MessageID field to correlate KEEPALIVE and KEEPALIVE_ACK messages. Clients must send the same MessageID when responding to Reader KEEPALIVE requests.

4.2.12.2 LLRP Dependencies

This custom parameter must be set in conjunction with the LLRP *KeepaliveSpec* parameter. Setting this parameter alone, without configuring a Periodic *KeepaliveSpec* has no effect.

4.2.12.3 Allowable Extension Points

- GET_READER_CONFIG_RESPONSE message
- SET_READER_CONFIG message

4.2.12.4 Definition

Table 4-22 ImpinjLinkMonitorConfiguration Parameter

***ImpinjLinkMonitorConfiguration* Parameter**

LinkMonitorMode**:** Unsigned Short Integer.
Possible Values:

Value	Description
0	'Disabled' (default)
1	'Enabled'
2-65535	Reserved for future use

LinkDownThreshold**:** Unsigned Short Integer. The number of consecutive KEEPALIVE_ACK response messages not received before the Reader closes the current connection.

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.12.

4.2.13 ImpinjReportBufferConfiguration Parameter

4.2.13.1 Description

Configure how the Reader buffers asynchronous reports sent to the Client with this custom parameter. In Normal mode, the Reader buffers RO_ACCESS_REPORT messages internally for an optimal time period before transmission over the network. Response messages, KEEPALIVE messages, and READER_EVENT_NOTIFICATION messages are not affected, and are sent immediately. In 'Low_Latency' mode, the Reader sends RO_ACCESS_REPORT messages as soon as they are available. In general, the default mode is well suited to most applications. Applications requiring immediate access to inventory reports may require 'Low_Latency' mode, but users should first evaluate network and system load.

4.2.13.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.13.3 Allowable Extension Points

- GET_READER_CONFIG_RESPONSE message
- SET_READER_CONFIG message

4.2.13.4 Definition

Table 4-23 ImpinjReportBufferConfiguration Parameter

***ImpinjReportBufferConfiguration* Parameter**
ReportBufferMode**:** Unsigned Short Integer. *Possible Values*: Value — Description 0 — 'Normal' (default) 1 — 'Low_Latency' 2-65535 — Reserved for future use **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.13.

4.2.14 ImpinjAccessSpecConfiguration Parameter

4.2.14.1 Description

Allow additional control over how the Reader executes AccessSpecs using this custom parameter. This parameter does not contain any specific controls, but it encapsulates individual parameters that do. Each parameter contained within is optional, allowing for maximum flexibility for Client implementations.

4.2.14.2 LLRP Dependencies

This custom parameter has no LLRP dependencies, although the parameters contained within may. Reference the individual parameters for information on how they affect LLRP behavior.

4.2.14.3 Allowable Extension Points

- GET_READER_CONFIG_RESPONSE message
- SET_READER_CONFIG message
- *AccessSpec* parameter

4.2.14.4 Definition

Table 4-24 ImpinjAccessSpecConfiguration Parameter

***ImpinjAccessSpecConfiguration* Parameter**
*ImpinjBlockWriteWordCount***:** <ImpinjBlockWriteWordCount parameter> [optional] *ImpinjOpSpecRetryCount***:** <ImpinjOpSpecRetryCount parameter> [optional] *Custom Extension Point List***:** List of <Impinj custom parameter> [optional]

See section 6.2.14.

4.2.15 ImpinjBlockWriteWordCount Parameter

4.2.15.1 Description

Configure the number of words sent at a time to a tag when processing a *C1G2BlockWrite* OpSpec custom parameter. The LLRP *C1G2BlockWrite* parameter has a word vector containing the data to be written to a tag. Internally the Reader breaks this vector up into individual C1G2 BlockWrite commands. This parameter determines the number of words sent via each BlockWrite command. Note that it is the user's responsibility to ensure that the tag population supports the BlockWrite word count configured via this parameter. BlockWrite commands to tags that do not support the configured word count will fail. The Reader automatically aligns *C1G2BlockWrite* commands to appropriate boundaries and accounts for odd data lengths. The default word count is one.

4.2.15.2 LLRP Dependencies

This custom parameter determines the number of words sent at a time over the C1G2 air interface when processing a LLRP *C1G2BlockWrite* parameter.

4.2.15.3 Allowable Extension Points

- None included in *ImpinjAccessSpecConfiguration* parameter.

4.2.15.4 Definition

Table 4-25 ImpinjBlockWriteWordCount Parameter

***ImpinjBlockWriteWordCount* Parameter**
WordCount**:** Unsigned Short Integer. Allowable range is 1-2.
Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.15.

4.2.16 ImpinjOpSpecRetryCount Parameter

4.2.16.1 Description

Configure the number of times an OpSpec operation will be automatically retried by the Reader before failure is declared using this custom parameter. The Reader intelligently chooses which types of failures to retry. For example, the Reader will not retry if the tag indicates that the operation failed due to a memory locked or memory overrun, operations that have no chance of succeeding. However, if the operation failed due to transient errors, such as CRC errors due to interference, the Reader will automatically retry RetryCount attempts before failure is declared. LLRP dictates that OpSpec failure be declared once a single operation has failed, therefore the default RetryCount is 0.

4.2.16.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.16.3 Allowable Extension Points

- None included in the *ImpinjAccessSpecConfiguration* parameter.

4.2.16.4 Definition

Table 4-26 ImpinjOpSpecRetryCount Parameter

***ImpinjOpSpecRetryCount* Parameter**

RetryCount**:** Unsigned Short Integer.
Possible Values:

Value	Description
0-3	The number of times each operation is retried.

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.16.

4.2.17 ImpinjBlockPermalock Parameter

4.2.17.1 Description

Configure this OpSpec custom parameter which configures the C1G2 BlockPermalock status of a particular memory bank from a tag. The AccessPassword field is the password required to move the tag into the secured state if needed.

4.2.17.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.17.3 Allowable Extension Points

- *AccessCommandOpSpec* choice parameter.

4.2.17.4 Definition

Table 4-27 ImpinjBlockPermalock Parameter

***ImpinjBlockPermalock* Parameter**
OpSpecID: Unsigned Short Integer. AccessPassword**:** Unsigned Integer. MB**:** Integer. The memory bank on which to perform the BlockPermalock. *Possible Values*: 0-3 BlockPointer**:** Unsigned Short Integer. Specifies the starting address for BlockMask in units of 16 blocks. BlockMask**:** Unsigned Short Integer Array. Specifies the blocks to lock, starting at BlockPointer and ending ((16*(BlockMask array length)) – 1) blocks later. **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.17.

4.2.18 ImpinjBlockPermalockOpSpecResult Parameter

4.2.18.1 Description

This custom parameter is the result of an *ImpinjBlockPermalock* OpSpec.

4.2.18.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.18.3 Allowable Extension Points

- *AccessCommandOpSpecResult* choice parameter.

4.2.18.4 Definition

Table 4-28 ImpinjBlockPermalockOpSpecResult Parameter

***ImpinjBlockPermalockOpSpecResult* Parameter**

OpSpecID**:** Unsigned Short Integer.

Result**:** Integer.
Possible Values:

Value	Description
0	'Success'
1	'Insufficient power to perform block permalock operation'
2	'Non-specific tag error'
3	'No response from tag'
4	'Non-specific Reader error'
5	'Incorrect password error'
6	'Tag memory overrun error'

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.18.

4.2.19 ImpinjGetBlockPermalockStatus Parameter

4.2.19.1 Description

Retrieve the OpSpec *C1G2 BlockPermalock* status of a particular memory bank from a tag using this custom parameter. The AccessPassword field is the password required to move the tag into the secured state if needed.

4.2.19.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.19.3 Allowable Extension Points

- *AccessCommandOpSpec* choice parameter.

4.2.19.4 Definition

Table 4-29 ImpinjGetBlockPermalockStatus Parameter

***ImpinjGetBlockPermalockStatus* Parameter**
OpSpecID: Unsigned Short Integer. AccessPassword**:** Unsigned Integer. MB**:** Integer. The memory bank on which to retrieve the BlockPermalock status. *Possible Values*: 0-3 BlockPointer**:** Unsigned Short Integer. Specifies the starting address to retrieve in units of 16 blocks. BlockRange**:** Unsigned Short Integer. Specifies the range of blocks to retrieve, starting at BlockPointer and ending ((16*BlockRange) – 1) blocks later. **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.19.

4.2.20 ImpinjGetBlockPermalockStatusOpSpecResult Parameter

4.2.20.1 Description

This custom parameter is the result of an *ImpinjGetBlockPermalockStatus* OpSpec.

4.2.20.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.20.3 Allowable Extension Points

- *AccessCommandOpSpecResult* choice parameter.

4.2.20.4 Definition

Table 4-30 ImpinjGetBlockPermalockStatusOpSpecResult Parameter

***ImpinjGetBlockPermalockStatusOpSpecResult* Parameter**

OpSpecID**:** Unsigned Short Integer.

PermalockStatus**:** Unsigned Short Integer Array. Specifies the Permalock status of each block requested.

Result**:** Integer.
Possible Values:

Value	Description
0	'Success'
1	'Non-specific tag error'
2	'No response from tag'
3	'Non-specific Reader error'
4	'Incorrect password error'
5	'Tag memory overrun error'

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.20.

4.2.21 ImpinjSetQTConfig Parameter

4.2.21.1 Description

Set the OpSpec for the QT Technology™ configuration on Impinj Monza 4QT tags with this custom parameter. For more information on the meaning of the fields within this parameter and the use cases for this technology, please reference the Impinj Monza 4QT datasheet.

Some tags may not be reported when you use Serialized TID reporting and Monza4-QT tags with both public and short range modes. For details please see Speedway Revolution Serialized TID Reporting and Monza4 Tags in the Advanced Topics section.

4.2.21.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.21.3 Allowable Extension Points

- *AccessCommandOpSpec* choice parameter.

4.2.21.4 Definition

Table 4-31 ImpinjSetQTConfig Parameter

***ImpinjSetQTConfig* Parameter**

OpSpecID**:** Unsigned Short Integer.

AccessPassword**:** Unsigned Integer.

DataProfile: Integer. Determines which data profile is exposed by the tag.
Possible Values:

Value	Description
1	'Private. The tag exposes its private data profile.'
2	'Public. The tag exposes its public data profile.'
0,3-255	'Reserved for future use'

AccessRange: Integer. Determines the range at which the tag may be accessed (Read, Write, Lock, etc.). The range at which the tag is inventoried is not affected.
Possible Values:

Value	Description
1	'Normal_Range.' The tag responds to access operations At the maximum range supported by the environment.
2	Short_Range. The tag only responds to access operations from a short range.
0,3-255	Reserved for future use

Persistence**:** Integer. Determines how long the changes made to the QT configuration with this OpSpec remain in effect.
Possible Values:

Value	Description
1	'Temporary.' The changes made by this command only last until the tag is powered down, at which time the previous configuration is restored.
2	'Permanent.' The changes made by this command are stored permanently to nonvolatile memory.
0,3-255	Reserved for future use

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.21.

4.2.22 ImpinjSetQTConfigOpSpecResult Parameter

4.2.22.1 Description

This custom parameter is the result of an *ImpinjSetQTConfig* OpSpec.

4.2.22.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.22.3 Allowable Extension Points

- *AccessCommandOpSpecResult* choice parameter.

4.2.22.4 Definition

Table 4-32 ImpinjSetQTConfigOpSpecResult Parameter

***ImpinjSetQTConfigOpSpecResult* Parameter**

OpSpecID**:** Unsigned Short Integer.

Result**:** Integer.
Possible Values:

Value	Description
0	'Success'
1	'Insufficient power to perform QT write operation'
2	'Non-specific tag error'
3	'No response from tag'
4	'Non-specific Reader error'
5	'Incorrect password error'

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.22.

4.2.23 ImpinjGetQTConfig Parameter

4.2.23.1 Description

Retrieve the OpSpec QT Technology™ configuration on Impinj Monza 4QT tags using this custom parameter. For more information on the meaning of the fields within this parameter, and the use cases for this technology, please reference the Impinj Monza 4QT datasheet.

4.2.23.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.23.3 Allowable Extension Points

- *AccessCommandOpSpec* choice parameter.

4.2.23.4 Definition

Table 4-33 ImpinjGetQTConfig Parameter

ImpinjGetQTConfig Parameter
OpSpecID**:** Unsigned Short Integer.
AccessPassword**:** Unsigned Integer.
Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.23.

4.2.24 ImpinjGetQTConfigOpSpecResult Parameter

4.2.24.1 Description

This custom parameter is the result of an *ImpinjGetQTConfig* OpSpec.

4.2.24.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.24.3 Allowable Extension Points

- *AccessCommandOpSpecResult* choice parameter.

4.2.24.4 Definition

Table 4-34 ImpinjGetQTConfigOpSpecResult Parameter

***ImpinjGetQTConfigOpSpecResult* Parameter**

OpSpecID: Unsigned Short Integer.

Result: Integer.
Possible Values:

Value	Description
0	'Success'
1	'Non-specific tag error'
2	'No response from tag'
3	'Non-specific Reader error'
4	'Incorrect password error'

DataProfile: Integer. Determines which data profile is exposed by the tag.
Possible Values:

Value	Description
0	'Unknown'
1	'Private' The tag exposes its private data profile.
2	'Public' The tag exposes its public data profile.
3-255	Reserved for future use

AccessRange: Integer. Determines the range at which the tag may be accessed (Read, Write, Lock, etc.). The range at which the tag is inventoried is not affected.
Possible Values:

Value	Description
0	'Unknown'.
1	'Normal_Range'. The tag responds to access operations at the maximum range supported by the environment.
2	'Short_Range'. The tag only responds to access operations from a short range.
3-255	Reserved for future use

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.24.

4.2.25 ImpinjTagReportContentSelector Parameter

4.2.25.1 Description

Configure additional parameters to be reported via the *TagReportData* parameter with this custom parameter. Each optional parameter individually enables/configures a particular feature. Note that because of how the *ROReportSpec* parameter is handled (see section 3.1.15), if the

optional parameter used to control a particular feature is absent, the feature is considered disabled. See the documentation for the actual parameters for full feature descriptions.

4.2.25.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.25.3 Allowable Extension Points

- *ROReportSpec* parameter.

4.2.25.4 Definition

Table 4-35 ImpinjTagReportContentSelector Parameter

***ImpinjTagReportContentSelector* Parameter**
ImpinjEnableSerializedTID: <ImpinjEnableSerializedTID parameter> [optional]
ImpinjEnableRFPhaseAngle: <ImpinjEnableRFPhaseAngle parameter> [optional]
ImpinjEnablePeakRSSI: <ImpinjEnablePeakRSSI parameter> [optional]
ImpinjEnableGPSCoordinates: <ImpinjEnableGPSCoordinates parameter> [optional]
ImpinjEnableOptimizedRead: <ImpinjEnableOptimizedRead parameter> [optional]
Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.25.

4.2.26 ImpinjEnableSerializedTID Parameter

4.2.26.1 Description

Configure the ImpinjSerializedTID feature using this custom parameter. See section 4.2.32.

Some tags may not be reported when you use Serialized TID reporting and Monza4-QT tags with both public and short range modes. For details please see Speedway Revolution Serialized TID Reporting and Monza4 Tags in the Advanced Topics section.

4.2.26.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.26.3 Allowable Extension Points

- None. Extension points are included in the *ImpinjTagReportContentSelector* parameter.

4.2.26.4 Definition

Table 4-36 ImpinjEnableSerializedTID Parameter

***ImpinjEnableSerializedTID* Parameter**

SerializedTIDMode**:** Unsigned Short Integer.
Possible Values:

Value	Description
0	'Disabled' (default)
1	'Enabled'
2-65535	Reserved for future use

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.26.

4.2.27 ImpinjEnableRFPhaseAngle Parameter

4.2.27.1 Description

Configure the ImpinjRFPhaseAngle feature with this custom parameter. See section 4.2.33.

4.2.27.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.27.3 Allowable Extension Points

- None. Extension points are included in the *ImpinjTagReportContentSelector* parameter.

4.2.27.4 Definition

Table 4-37 ImpinjEnableRFPhaseAngle Parameter

***ImpinjEnableRFPhaseAngle* Parameter**

RFPhaseAngleMode: Unsigned Short Integer.
Possible Values:

Value	Description
0	'Disabled' (default)
1	'Enabled'
2-65535	Reserved for future use

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.27.

4.2.28 ImpinjEnablePeakRSSI Parameter

4.2.28.1 Description

Configure the ImpinjPeakRSSI feature using this custom parameter. See section 4.2.34.

4.2.28.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.28.3 Allowable Extension Points

- None. Extension points are included in the *ImpinjTagReportContentSelector* parameter.

4.2.28.4 Definition

Table 4-38 ImpinjEnablePeakRSSI Parameter

***ImpinjEnablePeakRSSI* Parameter**

PeakRSSIMode: Unsigned Short Integer.
Possible Values:

Value	Description
0	'Disabled' (default)
1	'Enabled'
2-65535	Reserved for future use

Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.28.

4.2.29 ImpinjEnableGPSCoordinates Parameter

4.2.29.1 Description

Configure the ImpinjGPSCoordinates feature with this custom parameter. See section 4.2.35.

4.2.29.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.29.3 Allowable Extension Points

- None. Extensions points are included in the *ImpinjTagReportContentSelector* parameter.

4.2.29.4 Definition

Table 4-39 ImpinjEnableGPSCoordinates Parameter

***ImpinjEnableGPSCoordinates* Parameter**
GPSCoordinatesMode**:** Unsigned Short Integer. *Possible Values*: Value — Description 0 — 'Disabled' (default) 1 — 'Enabled' 2-65535 — Reserved for future use **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.29.

4.2.30 ImpinjEnableOptimizedRead Parameter

4.2.30.1 Description

Configure the *ImpinjOptimizedRead* feature using this custom parameter. *ImpinjOptimizedRead* allows for the reporting of additional tag memory content during an inventory without the use of AccessSpecs. The Reader optimizes the execution of these reads for improved overall inventory performance.

The memory bank and location of the reads are specified using the *C1G2Read* parameter, just as they are when using AccessSpecs. Similarly, the results of the reads are reported using the *C1G2ReadOpSpecResult* parameter within the *TagReportData* parameter. Reads issued using the *ImpinjOptimizedRead* feature are reported the same as reads using AccessSpecs and thus users should ensure the OpSpecIDs used for the operations are unique.

Users may configure up to two optimized read operations. One departure from the AccessSpec model is optimized reads are always attempted, even if the first read fails. So for example, if the first read results in a failure due to a memory overrun, the second read will still be attempted. Therefore, if there are two optimized reads configured it is guaranteed that there will be two *C1G2ReadOpSpecResult* parameters in each *TagReportData* parameter generated by the Reader.

Because this feature was designed for optimized inventory performance, any retries configured via the *ImpinjOpSpecRetryCount* parameter (see section 4.2.16) do not apply.

4.2.30.2 LLRP Dependencies

When the ImpinjOptimizedRead feature is enabled, AccessSpecs may still be configured and executed. The results of the AccessSpec execution will be reported within the *TagReportData* parameter, **after** the results of the optimized read. Users should enable the reporting of the *AccessSpecID* parameter and use unique OpSpecIDs to correlate the results to the actions.

4.2.30.3 Allowable Extension Points

- None. Extension points are included in *ImpinjTagReportContentSelector* parameter.

4.2.30.4 Definition

Table 4-40 ImpinjEnableOptimizedRead Parameter

***ImpinjEnableOptimizedRead* Parameter**
OptimizedReadMode**:** Unsigned Short Integer. *Possible Values*: Value — Description 0 — 'Disabled' (default) 1 — 'Enabled' 2-65535 — Reserved for future use *C1G2Read***:** List of <C1G2Read parameter> [optional, maximum of 2] **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.30.

4.2.31 ImpinjEnableRFDopplerFrequency Parameter

4.2.31.1 Description

Configure the *ImpinjRFDopplerFrequency* feature with this custom parameter. See section 6.2.31.

4.2.31.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.31.3 Allowable Extension Points

- None. Extension points are included in *ImpinjTagReportContentSelector* parameter.

4.2.31.4 Definition

Table 4-41 ImpinjEnableRFDopplerFrequency Parameter

***ImpinjEnableRFDopplerFrequency* Parameter**
RFDopplerFrequencyMode**:** Unsigned Short Integer. *Possible Values*: Value — Description 0 — 'Disabled' (default) 1 — 'Enabled' 2-65535 — Reserved for future use **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.31.

4.2.32 ImpinjSerializedTID Parameter

4.2.32.1 Description

Report the contents of the tag TID memory bank for Monza 4 tags supporting the *ImpinjSerializedTID* feature with this custom parameter. Reference the Monza 4 datasheets to determine which tags support this feature. Tags inventoried that do not support the feature will omit this parameter from the *TagReportData* within the RO_ACCESS_REPORT. To read the TID memory of tags not supporting this feature, an explicit *AccessSpec* is required.

4.2.32.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.32.3 Allowable Extension Points

- *TagReportData* parameter.

4.2.32.4 Definition

Table 4-42 ImpinjSerializedTID Parameter

***ImpinjSerializedTID* Parameter**
TID**:** Unsigned Short Array. The contents of the tag TID memory bank.
Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.32.

4.2.33 ImpinjRFPhaseAngle Parameter

4.2.33.1 Description

Report the RF phase angle of a singulated tag during normal inventory (EPC backscatter) using this custom parameter. The PhaseAngle field is a scaled, 12-bit value, with 0 representing 0° (0 radians), and 4096 representing 360° (2π radians).

As an example, if the reported phase angle is 1985, the corresponding angle can be calculated as:

$$1985 \times \left(\frac{360°}{4096}\right) = 174.46° \text{ or } 1985 \times \left(\frac{2\pi rad}{4096}\right) = 3.04 rad$$

If report accumulation is enabled via the *ROReportSpec* for the currently executing ROSpec, the RF phase angle reported via this parameter is the phase angle of the last tag singulation. No accumulation of phase data is available.

4.2.33.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.33.3 Allowable Extension Points

- *TagReportData* parameter.

4.2.33.4 Definition

Table 4-43 ImpinjRFPhaseAngle Parameter

***ImpinjRFPhaseAngle* Parameter**
PhaseAngle**:** Unsigned Short Integer. The scaled phase angle of the tag response during normal inventory. See the Description for a calculation example. **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.33.

4.2.34 ImpinjPeakRSSI Parameter

4.2.34.1 Description

Reportthe peak RSSI of the tag during the current reporting interval with this custom parameter. Standard LLRP reports peak RSSI in whole dBm units. This parameter provides the same RSSI value in more precise dBm x 100 units. Applications requiring precise RSSI calculations may enable this parameter instead of (or in addition to) the *PeakRSSI* LLRP parameter.

4.2.34.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.34.3 Allowable Extension Points

- *TagReportData* parameter.

4.2.34.4 Definition

Table 4-44 ImpinjPeakRSSI Parameter

***ImpinjPeakRSSI* Parameter**
RSSI**:** Signed Short Integer. The peak received power of the EPC backscatter in dBm x 100. **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.34.

4.2.35 ImpinjGPSCoordinates Parameter

4.2.35.1 Description

Report the GPS coordinates of the Reader when the tag was singulated with this custom parameter. If the GPS receiver has not acquired a location fix, this parameter will not be included in the report. If LLRP accumulation is enabled, the reported coordinates correspond to the last known Reader location when the tag was singulated. The GPS coordinates are reported in signed micro-degrees, so a minor conversion is required to convert the reported value to typically used GPS coordinate formats.

As an example, if the reported GPS coordinates are 41948240 latitude and -87655562 longitude, this would correspond to (41.948240, -87.655562) or (41° 56’ 53.664” N, 87° 39’ 20.023” W).

4.2.35.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.35.3 Allowable Extension Points

- *TagReportData* parameter.

4.2.35.4 Definition

Table 4-45 ImpinjGPSCoordinates Parameter

ImpinjGPSCoordinates **Parameter**
Latitude**:** Signed Integer. Latitude coordinates in micro-degrees.
Longitude**:** Signed Integer. Longitude coordinates in micro-degrees.
Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section6.2.35.

4.2.36 ImpinjRFDopplerFrequency Parameter

4.2.36.1 Description

Report the estimated RF carrier Doppler frequency shift using this custom parameter. The estimate is made over the duration of each tag EPC and has units of Hz. This 16-bit parameter has twelve integer bits and four fractional bits. Accuracy and precision depend on Reader mode and measurement length.

If report accumulation is enabled via the *ROReportSpec* for the currently executing ROSpec, the RF Doppler frequency reported via this parameter is the Doppler frequency of the last tag singulation. No accumulation of Doppler frequency data is available.

4.2.36.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.36.3 Allowable Extension Points

- *TagReportData* parameter.

4.2.36.4 Definition

Table 4-46 ImpinjRFDopplerFrequency Parameter

ImpinjRFDopplerFrequency **Parameter**
DopplerFrequency**:** Signed Short Integer. RF carrier Doppler shift measured over EPC duration. **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.36.

4.2.37 ImpinjLoopSpec Parameter

4.2.37.1 Description

Allow the Reader to loop execution of AISpecs within a ROSpec using this custom parameter. If included within the list of *SpecParameters* in a ROSpec, it must be the last *SpecParameter* present. There also must be at least one AISpec preceding the *ImpinjLoopSpec* parameter. If either condition is not met, the Reader will respond with an error.

4.2.37.2 LLRP Dependencies

This custom parameter overrides the end of a ROSpec. When the last AISpec completes execution, the first AISpec will be executed again until the ROSpec has been executed LoopCount iterations.

4.2.37.3 Allowable Extension Points

- *SpecParameter* parameter.

4.2.37.4 Definition

Table 4-47 ImpinjLoopSpec Parameter

ImpinjLoopSpec **Parameter**
LoopCount**:** Unsigned Integer. The number of times to loop execution of the AISpecs of the ROSpec (0 means unlimited). **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.37.

4.2.38 ImpinjGPSNMEASentences Parameter

4.2.38.1 Description

This custom parameter encapsulates the various NMEA (National Marine Electronic Association) sentences supported by the GPS device attached to the Reader. The Sierra Wireless PinPoint XT cellular modem supports GGA and RMC sentences. For more information regarding these sentences, visit the NMEA website.

4.2.38.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.38.3 Allowable Extension Points

- GET_READER_CONFIG_RESPONSE message.

4.2.38.4 Definition

Table 4-48 ImpinjGPSNMEASentences Parameter

ImpinjGPSNMEASentences **Parameter**
ImpinjGGASentence: <ImpinjGGASentence Parameter> [optional]
ImpinjRMCSentence: <ImpinjRMCSentence Parameter> [optional]
Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.38.

4.2.39 ImpinjGGASentence Parameter

4.2.39.1 Description

This custom parameter contains the current GPS information of the Reader's location as reported in NMEA GGA sentence format. If the GPS device has not acquired a location fix, the string is reported empty.

4.2.39.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.39.3 Allowable Extension Points

- None. Extension points are included in *ImpinjGPSNMEASentences* parameter.

4.2.39.4 Definition

Table 4-49 ImpinjGGASentence Parameter

***ImpinjGGASentence* Parameter**
GGASentence: UTF-8 String
Custom Extension Point List: List of <Impinj custom parameter> [optional]

See section 6.2.39.

4.2.40 ImpinjRMCSentence Parameter

4.2.40.1 Description

This custom parameter contains the current GPS information of the Reader's location as reported in NMEA RMC sentence format. If the GPS device has not acquired a location fix, the string is reported empty.

4.2.40.2 LLRP Dependencies

This custom parameter has no LLRP dependencies.

4.2.40.3 Allowable Extension Points

- None. Extension points are included in *ImpinjGPSNMEASentences* parameter.

4.2.40.4 Definition

Table 4-50 ImpinjRMCSentence Parameter

***ImpinjRMCSentence* Parameter**
RMCSentence**:** UTF-8 String **Custom Extension Point List:** List of <Impinj custom parameter> [optional]

See section 6.2.40.

5 Advanced Topics

5.1 Speedway Revolution Serialized TID Reporting and Monza4 Tags

Some tags may not be reported when you use Serialized TID reporting and Monza4-QT tags with both public and short range modes. The Speedway Revolution has an optional Serialized TID reporting feature that is intended to provide *more* information efficiently. The Monza4 has an optional public, short range feature that is intended to provide *less* information for privacy reasons. When the two features are used together some tags may not be reported, yet everything is working exactly as intended.

The Speedway Revolution Serialized TID reporting feature -- EPC+TID for short -- causes the Reader to ask the tags for their Serialized TID during routine inventory operations. Usually tags are asked only for their EPC. By asking the tags to immediately send their TID fewer interactions with the tag are needed to obtain both EPC and TID, and performance or the number of tags per second is better. When EPC+TID reporting is enabled the Reader strives to consistently report both EPC and TID.

If a tag responds with only the EPC the Speedway Revolution immediately issues a read TID operation. If a transient error occurs the tag is skipped, not reported, and is retried later. If a persistent error occurs the Speedway Revolution reports only the EPC to the application.

The Monza4 tag has two independent modes, both intended to protect privacy. While a Monza4 tag is in *public mode* it intentionally does not provide the TID when asked for EPC+TID. While a Monza4 tag is in *short range* mode it intentionally does not support certain operations -- including a read TID operation -- unless it is close to the Reader antenna.

Here is the reason tags are sometimes not reported at all. The Speedway Revolution requests EPC+TID from a Monza4 tag that is in public mode and short range mode. The Monza4 tag responds with only the EPC. The Speedway Revolution immediately tries to read the TID. What happens next depends on whether the Monza4 is close to the antenna or not. If the Monza4 is close to the Reader antenna the read TID operation works and the EPC and TID are reported to the application. However, if the Monza4 tag is over a meter, from the antenna the read TID operation *is simply ignored*. The Monza4 tag deems reading the tag as a possible privacy invasion. The Speedway Revolution interprets the lack of response from the tag as a transient error and *does not report the tag* on the expectation that a retry will be successful. The retry will never be successful until the tag is brought near the antenna and inside the read zone.

6 Custom Extension Encoding

This section describes the encoding of Impinj custom extensions.

6.1 Custom Messages

All LLRP custom messages are encoded with a common header to ensure a unique namespace across all LLRP implementations. This header appears in each of the custom messages below for completeness. Byte and bit order are shown as the first and second row of the table respectively. The vendor ID field will contain the Impinj Private Enterprise Number (PEN) – 25882. A unique subtype indicator will define each custom extension message.

Table 6-1 Impinj Custom Message Header

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Rsvd			Ver			Message Type=1023										Message Length [31:16]															
Message Length [15:0]																Message ID [31:16]															
Message ID [15:0]																Vendor ID [31:16]= **25882**															
Vendor ID (continued)																Subtype=Varies															

6.1.1 IMPINJ_ENABLE_EXTENSIONS

Table 6-2 IMPINJ_ENABLE_EXTENSIONS Message Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Rsvd			Ver			Message Type=1023										Message Length [31:16]															
Message Length [15:0]																Message ID [31:16]															
Message ID [15:0]																Vendor ID [31:16]															
Vendor ID [15:0]																Subtype=21				Reserved [31:24]											
Reserved [23:0]																															
Impinj Custom Parameter (0-n)																															

See section 4.1.1.

6.1.2 IMPINJ_ENABLE_EXTENSIONS_RESPONSE

Table 6-3 IMPINJ_ENABLE_EXTENSIONS_RESPONSE Message Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Rsvd			Ver			Message Type=1023										Message Length [31:16]															
Message Length [15:0]																Message ID [31:16]															
Message ID [15:0]																Vendor ID [31:16]															
Vendor ID [15:0]																Subtype=22															
LLRPStatus Parameter																															
Impinj Custom Parameter (0-n)																															

See section 4.1.2.

6.1.3 IMPINJ_SAVE_SETTINGS

Table 6-4 IMPINJ_SAVE_SETTINGS Message Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Rsvd			Ver			Message Type=1023										Message Length [31:16]															
Message Length [15:0]																Message ID [31:16]															
Message ID [15:0]																Vendor ID [31:16]															
Vendor ID [15:0]																Subtype=23				C	Reserved										
Impinj Custom Parameter (0-n)																															

Abbreviations: C Save Configuration

See section 4.1.3.

6.1.4 IMPINJ_SAVE_SETTINGS_RESPONSE

Table 6-5 IMPINJ_SAVE_SETTINGS_RESPONSE Message Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Rsvd			Ver			Message Type=1023										Message Length [31:16]															
Message Length [15:0]																Message ID [31:16]															
Message ID [15:0]																Vendor ID [31:16]															
Vendor ID [15:0]																Subtype=24															
LLRPStatus Parameter																															
Impinj Custom Parameter (0-n)																															

See section 4.1.4.

6.2 Custom Parameters

All LLRP custom parameters are encoded with a common header to ensure a unique namespace across LLRP implementations. This header appears in each of the custom parameters below for completeness. Byte and bit order are shown as the first and second row of the table respectively. The vendor ID field will contain the Impinj Private Enterprise Number (PEN) – 25882. A unique subtype indicator will define each custom extension parameter.

Table 6-6 Impinj Custom Parameter Header

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=**25882**																															
Subtype=Varies																															

6.2.1 ImpinjRequestedData Parameter

Table 6-7 ImpinjRequestedData Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=21																															
RequestedData																															
Impinj Custom Parameter (0-n)																															

See section 4.2.1.

6.2.2 ImpinjSubRegulatoryRegion Parameter

Table 6-8 ImpinjSubRegulatoryRegion Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=22																															
RegulatoryRegion																															
Impinj Custom Parameter (0-n)																															

See section 4.2.2.

6.2.3 ImpinjInventorySearchMode Parameter

Table 6-9 ImpinjInventorySearchMode Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=23																															
InventorySearchMode																															
Impinj Custom Parameter (0-n)																															

See section 4.2.3.

6.2.4 ImpinjFixedFrequencyList Parameter

Table 6-10 ImpinjFixedFrequencyList Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=26																															
FixedFrequencyMode																Reserved															
ChannelList Count																ChannelList Index #1															
…																ChannelList Index #n															
Impinj Custom Parameter (0-n)																															

See section4.2.4.

6.2.5 ImpinjFrequencyCapabilities Parameter

Table 6-11 ImpinjFrequencyCapabilities Parameter Binary Binding

0										1										2									3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=30																															
FrequencyList Count																FrequencyList Index #1 [31:16]															
FrequencyList Index #1 [15:0]																…															
…																FrequencyList Index #n [31:16]															
FrequencyList Index #n [15:0]																															
Impinj Custom Parameter (0-n)																															

See section 4.2.5

6.2.6 ImpinjReducedPowerFrequencyList Parameter

Table 6-12 ImpinjReducedPowerFrequencyList Parameter Binary Binding

0										1										2									3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=27																															
ReducedPowerMode																Reserved															
ReducedPowerChannelList Count																ReducedPowerChannelList Index #1															
…																ReducedPowerChannelList Index #n															
Impinj Custom Parameter (0-n)																															

See section 4.2.6.

6.2.7 ImpinjLowDutyCycle Parameter

Table 6-13 ImpinjLowDutyCycle Parameter Binary Binding

0										1										2									3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=28																															
LowDutyCycleMode																EmptyFieldTimeout															
FieldPingInterval																															
Impinj Custom Parameter (0-n)																															

See section4.2.7.

6.2.8 ImpinjDetailedVersion Parameter

Table 6-14 ImpinjDetailedVersion Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=29																															
ModelName Byte Count																															
ModelName=Variable length UTF-8 string																															
SerialNumber Byte Count																															
SerialNumber=Variable length UTF-8 string																															
SoftwareVersion Byte Count																															
SoftwareVersion=Variable length UTF-8 string																															
FirmwareVersion Byte Count																															
FirmwareVersion=Variable length UTF-8 string																															
FPGAVersion Byte Count																															
FPGAVersion=Variable length UTF-8 string																															
PCBAVersion Byte Count																															
PCBAVersion=Variable length UTF-8 string																															
Impinj Custom Parameter (0-n)																															

See section 4.2.8.

6.2.9 ImpinjGPIDebounceConfiguration Parameter

Table 6-15 ImpinjGPIDebounceConfiguration Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=36																															
GPIPortNum																GPIDebounceTimerMSec [31:16]															
GPIDebounceTimerMSec [15:0]																															
Impinj Custom Parameter (0-n)																															

See section 4.2.9.

6.2.10 ImpinjAdvancedGPOConfiguration Parameter

Table 6-16 ImpinjAdvancedGPOConfiguration Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=64																															
GPIPortNum																GPOMode															
GPOPulseDurationMSec																															
Impinj Custom Parameter (0-n)																															

See section 4.2.10.

6.2.11 ImpinjReaderTemperature Parameter

Table 6-17 ImpinjReaderTemperature Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=37																															
Temperature																															
Impinj Custom Parameter (0-n)																															

See section 4.2.11.

6.2.12 ImpinjLinkMonitorConfiguration Parameter

Table 6-18 ImpinjLinkMonitorConfiguration Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=38																															
LinkMonitorMode																LinkDownThreshold															
Impinj Custom Parameter (0-n)																															

See section 4.2.12.

6.2.13 ImpinjReportBufferConfiguration Parameter

Table 6-19 ImpinjReportBufferConfiguration Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=39																															
ReportBufferMode																															
Impinj Custom Parameter (0-n)																															

See section 4.2.13.

6.2.14 ImpinjAccessSpecConfiguration Parameter

Table 6-20 ImpinjAccessSpecConfiguration Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=40																															
ImpinjBlockWriteWordCount (0-1)																															
Impinj Custom Parameter (0-n)																															

See section 4.2.14.

6.2.15 ImpinjBlockWriteWordCount Parameter

Table 6-21 ImpinjBlockWriteWordCount Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=41																															
WordCount																															
Impinj Custom Parameter (0-n)																															

See section 4.2.15.

6.2.16 ImpinjOpSpecRetryCount Parameter

Table 6-22 ImpinjOpSpecRetryCount Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=63																															
RetryCount																															
Impinj Custom Parameter (0-n)																															

See section 4.2.16.

6.2.17 ImpinjBlockPermalock Parameter

Table 6-23 ImpinjBlockPermalock Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=42																															
OpSpecID																AccessPassword[31:16]															
AccessPassword[15:0]																MB	Reserved									BlockPointer[15:8]					
BlockPointer[7:0]										BlockMaskWordCount																					
BlockMask																															
Impinj Custom Parameter (0-n)																															

See section 4.2.17.

6.2.18 ImpinjBlockPermalockOpSpecResult Parameter

Table 6-24 ImpinjBlockPermalockOpSpecResult Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=43																															
Result										OpSpecID																					
Impinj Custom Parameter (0-n)																															

See section 4.2.18.

6.2.19 ImpinjGetBlockPermalockStatus Parameter

Table 6-25 ImpinjGetBlockPermalockStatus Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=44																															
OpSpecID																AccessPassword[31:16]															
AccessPassword[15:0]																MB	Reserved									BlockPointer[15:8]					
BlockPointer[7:0]										BlockRange																					
Impinj Custom Parameter (0-n)																															

See section 4.2.19.

6.2.20 ImpinjGetBlockPermalockStatusOpSpecResult Parameter

Table 6-26 ImpinjGetBlockPermalockStatusOpSpecResult Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=45																															
Result										OpSpecID																					
StatusWordCount[7:0]																															
PermalockStatus																															
Impinj Custom Parameter (0-n)																															

See section 4.2.20.

6.2.21 ImpinjSetQTConfig Parameter

Table 6-27 ImpinjSetQTConfig Parameter Binary Binding

0										1										2									3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=46																															
OpSpecID																AccessPassword[31:16]															
AccessPassword[15:0]																DataProfile								AccessRange							
Persistence						Reserved[31:8]																									
Reserved[7:0]																															
Impinj Custom Parameter (0-n)																															

See section 4.2.21.

6.2.22 ImpinjSetQTConfigOpSpecResult Parameter

Table 6-28 ImpinjSetQTConfigOpSpecResult Parameter Binary Binding

0										1										2									3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=47																															
Result						OpSpecID																									
Impinj Custom Parameter (0-n)																															

See section 4.2.22.

6.2.23 ImpinjGetQTConfig Parameter

Table 6-29 ImpinjGetQTConfig Parameter Binary Binding

0										1										2									3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=48																															
OpSpecID																AccessPassword[31:16]															
AccessPassword[15:0]																															
Impinj Custom Parameter (0-n)																															

See section 4.2.23.

6.2.24 ImpinjGetQTConfigOpSpecResult Parameter

Table 6-30 ImpinjGetQTConfigOpSpecResult Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=49																															
Result						OpSpecID																		DataProfile							
AccessRange						Reserved[31:8]																									
Reserved[7:0]																															
Impinj Custom Parameter (0-n)																															

See section 4.2.24.

6.2.25 ImpinjTagReportContentSelector Parameter

Table 6-31 ImpinjTagReportContentSelector Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=50																															
ImpinjEnableSerializedTID Parameter (0-1)																															
ImpinjEnableRFPhaseAngle Parameter (0-1)																															
ImpinjEnablePeakRSSI Parameter (0-1)																															
ImpinjEnableGPSCoordinates Parameter (0-1)																															
Impinj Custom Parameter (0-n)																															

See section 4.2.25.

6.2.26 ImpinjEnableSerializedTID Parameter

Table 6-32 ImpinjEnableSerializedTID Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=51																															
SerializedTIDMode																															
Impinj Custom Parameter (0-n)																															

See section 4.2.26.

6.2.27 ImpinjEnableRFPhaseAngle Parameter

Table 6-33 ImpinjEnableRFPhaseAngle Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=52																															
RFPhaseAngleMode																															
Impinj Custom Parameter (0-n)																															

See section 4.2.27.

6.2.28 ImpinjEnablePeakRSSI Parameter

Table 6-34 ImpinjEnablePeakRSSI Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=53																															
PeakRSSIMode																															
Impinj Custom Parameter (0-n)																															

See section 4.2.28.

6.2.29 ImpinjEnableGPSCoordinates Parameter

Table 6-35 ImpinjEnableGPSCoordinates Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=54																															
GPSCoordinatesMode																															
Impinj Custom Parameter (0-n)																															

See section 4.2.29.

6.2.30 ImpinjEnableOptimizedRead Parameter

Table 6-36 ImpinjEnableGPSCoordinates Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=65																															
OptimizedReadMode																															
C1G2Read Parameter (0-2)																															
Impinj Custom Parameter (0-n)																															

See section 4.2.30.

6.2.31 ImpinjEnableRFDopplerFrequency Parameter

Table 6-37 ImpinjEnableRFDopplerFrequency Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=67																															
RFDopplerFrequencyMode																															
Impinj Custom Parameter (0-n)																															

See section 4.2.31.

6.2.32 ImpinjSerializedTID Parameter

Table 6-38 ImpinjSerializedTID Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=55																															
TIDWordCount																TID Word #1															
…																TID Word #n															
Impinj Custom Parameter (0-n)																															

See section 4.2.32.

6.2.33 ImpinjRFPhaseAngle Parameter

Table 6-39 ImpinjRFPhaseAngle Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=56																															
PhaseAngle																															
Impinj Custom Parameter (0-n)																															

See section 4.2.33.

6.2.34 ImpinjPeakRSSI Parameter

Table 6-40 ImpinjPeakRSSI Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=57																															
RSSI																															
Impinj Custom Parameter (0-n)																															

See section 4.2.34.

6.2.35 ImpinjGPSCoordinates Parameter

Table 6-41 ImpinjGPSCoordinates Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=58																															
Latitude																															
Longitude																															
Impinj Custom Parameter (0-n)																															

See section 4.2.35.

6.2.36 ImpinjRFDopplerFrequency Parameter

Table 6-42 ImpinjRFDopplerFrequency Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=68																															
DopplerFrequency																															
Impinj Custom Parameter (0-n)																															

See section 4.2.36.

6.2.37 ImpinjLoopSpec Parameter

Table 6-43 ImpinjLoopSpec Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=59																															
LoopCount																															
Impinj Custom Parameter (0-n)																															

See section 4.2.37.

6.2.38 ImpinjGPSNMEASentences Parameter

Table 6-44 ImpinjGPSNMEASentences Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=60																															
ImpinjGGASentence Parameter (0-1)																															
ImpinjRMCSentence Parameter (0-1)																															
Impinj Custom Parameter (0-n)																															

See section 4.2.38.

6.2.39 ImpinjGGASentence Parameter

Table 6-45 ImpinjGGASentence Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=61																															
GGASentence Byte Count																															
GGASentence=Variable length UTF-8 string																															
Impinj Custom Parameter (0-n)																															

See section 4.2.39.

6.2.40 ImpinjRMCSentence Parameter

Table 6-46 ImpinjRMCSentence Parameter Binary Binding

0										1										2										3	
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Reserved						Type=1023										Parameter Length															
Vendor ID=25882																															
Subtype=62																															
RMCSentence Byte Count																															
RMCSentence=Variable length UTF-8 string																															
Impinj Custom Parameter (0-n)																															

See section 4.2.40.

7 Octane LLRP Toolkit Information

Octane LLRP is tested against some libraries produced by the open source **llrp-toolkit** (LTK) project. The following table shows the compatibility of Octane 4.8 with the LTK. For building custom versions of the LTK visit the toolkit site: http://www.sourceforge.net/projects/llrp-toolkit.

Table 7-1 Octane LTK Compatibility

Language	Version	Availability	Notes
Perl	1.0.x	Sourceforge	Available as open source; not fully tested against Speedway or Speedway Revolution.
C	10.14.0	Impinj	
C++	10.14.0	Impinj	
C# .NET	10.14.0	Impinj	
Java	10.14.0	Impinj	

8 Octane LLRP Default Values

The following table describes the factory default values for LLRP and Octane custom extension parameters for the available Octane regulatory regions. Commanding the Reader to restore LLRP factory defaults via the ResetToFactoryDefault field of the LLRP SET_READER_CONFIG message will restore the Reader to these factory defaults. Non-LLRP settings such as network settings, root password, or other settings programmable via a separate API on the Reader are not affected.

Table 8-1 Octane LLRP Default Configuration Values (1)

	FCC	ETSI	Hong Kong	Taiwan	Japan	Korea	Malaysia	China
Channel Index	N/A	Index 3 Channel 10 866.9 MHz	N/A	N/A	Index 1 Channel 2 952.4 MHz	N/A	N/A	Index 1 Channel 3 920.625 MHz
Hop Table ID	1	N/A	1	1	N/A	1	1	N/A
Transmit Power	30 dBm (TransmitPower index varies by product)							
Receive Sensitivity	0 dB above maximum sensitivity							
Gen2 Mode ID	1000 (Autoset)							
Session	Session 1							
Tag Transit Time	0							
Tag Population	32							
RO Spec	No ROSpecs are configured							
Access Spec	No AccessSpecs are configured							
RO Report Trigger	Tag data will be reported on each singulation (N=1)							
Tag Report Data	AntennaID, PeakRSSI, and FirstSeenTimestamp are enabled							
Access Report Trigger	Access data will be reported at the completion of each AccessSpec							
Keep Alive	Disabled							
Reader Events	Antenna and ReaderExceptionEvents are enabled							
Hold Events and Reports	False							
GPI Configuration	All GPI are disabled							
GPI Debounce Timer	20 milliseconds							
GPO State	All GPO are driven low							
Impinj Extensions	Disabled							
Impinj Sub-Regulatory Region	0	7	3	4	11	8	9	10
Impinj Fixed Frequency List	Disabled							
Impinj Low Duty Cycle	Disabled							

	FCC	ETSI	Hong Kong	Taiwan	Japan	Korea	Malaysia	China
Impinj Reduced Power Frequency List	Disabled							
Impinj Inventory Search Mode	Reader will select the appropriate search mode							
Link State Monitoring	Disabled							
Report Buffer Behavior	Normal							
Block Write Word Count	1							
Serialized TID Reporting	Disabled							
RF Phase Reporting	Disabled							

Table 8-2 Octane LLRP Default Configuration Values (2)

	South Africa	Brazil	Thailand	Singa-pore	Australia	India	Uruguay	Vietnam	Israel
Channel Index	N/A	N/A	N/A	N/A	N/A	Index 3 Channel 10 866.9 MHz	N/A	N/A	N/A
Hop Table ID	1	1	1	1	1	N/A	1	1	1
Transmit Power	30 dBm (TransmitPower index varies by product)								
Receive Sensitivity	0 dB above maximum sensitivity								
Gen2 Mode ID	1000 (Autoset)								
Session	Session 1								
Tag Transit Time	0								
Tag Population	32								
RO Spec	No ROSpecs are configured								
Access Spec	No AccessSpecs are configured								
RO Report Trigger	Tag data will be reported on each singulation (N=1)								
Tag Report Data	AntennaID, PeakRSSI, and FirstSeenTimestamp are enabled								
Access Report Trigger	Access data will be reported at the completion of each AccessSpec								
Keep Alive	Disabled								
Reader Events	Antenna and ReaderExceptionEvents are enabled								
Hold Events and Reports	False								
GPI Configuration	All GPI are disabled								
GPI Debounce Timer	20 milliseconds								
GPO State	All GPO are driven low								
Impinj Extensions	Disabled								
Impinj Sub-Regulatory Region	12	13	14	15	16	17	18	19	20
Impinj Fixed Frequency List	Disabled								
Impinj Low Duty Cycle	Disabled								

	South Africa	Brazil	Thailand	Singa-pore	Australia	India	Uruguay	Vietnam	Israel
Impinj Reduced Power Frequency List	Disabled								
Impinj Inventory Search Mode	Reader will select the appropriate search mode								
Link State Monitoring	Disabled								
Report Buffer Behavior	Normal								
Block Write Word Count	1								
Serialized TID Reporting	Disabled								
RF Phase Reporting	Disabled								

Table 8-3 Octane LLRP Default Configuration Values (3)

	Philippines	Canada Post	Indonesia	New Zealand					
Channel Index	Index 3 Channel 1 918.25 MHz	N/A	N/A	N/A					
Hop Table ID	N/A	1	1	1					
Transmit Power	30 dBm (TransmitPower index varies by product)								
Receive Sensitivity	0 dB above maximum sensitivity								
Gen2 Mode ID	1000 (Autoset)								
Session	Session 1								
Tag Transit Time	0								
Tag Population	32								
RO Spec	No ROSpecs are configured								
Access Spec	No AccessSpecs are configured								
RO Report Trigger	Tag data will be reported on each singulation (N=1)								
Tag Report Data	AntennaID, PeakRSSI, and FirstSeenTimestamp are enabled								
Access Report Trigger	Access data will be reported at the completion of each AccessSpec								
Keep Alive	Disabled								
Reader Events	Antenna and ReaderExceptionEvents are enabled								
Hold Events and Reports	False								
GPI Configuration	All GPI are disabled								
GPI Debounce Timer	20 milliseconds								
GPO State	All GPO are driven low								
Impinj Extensions	Disabled								
Impinj Sub-Regulatory Region	21	22	23	24					
Impinj Fixed Frequency List	Disabled								
Impinj Low Duty Cycle	Disabled								

	Philippines	Canada Post	Indonesia	New Zealand					
Impinj Reduced Power Frequency List	Disabled								
Impinj Inventory Search Mode	Reader will select the appropriate search mode								
Link State Monitoring	Disabled								
Report Buffer Behavior	Normal								
Block Write Word Count	1								
Serialized TID Reporting	Disabled								
RF Phase Reporting	Disabled								

9 Regulatory Region Information

The following tables in this section provide the capabilities of the Octane firmware in each regulatory region. This is informative only. For an accurate and complete list of a Reader's capabilities in a particular regulatory region, use the LLRP GET_READER_CAPABILITIES message.

- Table 9-1 documents the information contained in the *TransmitPowerLevelTableEntry* parameter list within *UHFBandCapabilities*.
- Table 9-2 documents the information contained in the FrequencyList field within *ImpinjFrequencyCapabilities*.
- Table 9-3 documents the information contained in the *ReceiveSensitivityTableEntry* parameter list within *GeneralDeviceCapabilities*.

Table 9-1 Regional Transmit Power Capabilities (dBm)

Region	Speedway Revolution[3]		
	R220	R420	R640
0: FCC part 15.247	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50
1. ETSI EN 300-220	N/A	N/A	N/A
2: ETSI EN 302-208	See region 7	See region 7	See region 7
3: Hong Kong 920-925 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50
4: Taiwan 922-928 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50
5: Japan 952-954 MHz	N/A	N/A	N/A
6: Japan 952-955 MHz, 10mW max power	N/A	N/A	N/A
7: ETSI EN 302-208 (version 1.2.1)	10.00 – 31.50	10.00 – 31.50	10.00 – 27.50
8: Korea 917-921 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50
9: Malaysia 919-923MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 27.75
10: China 920-925 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 27.75
11: Japan 952-956 MHz (without LBT)	10.00 – 30.00	10.00 – 30.00	N/A
12: South Africa 915-919 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50
13: Brazil 902-907/915-928 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50
14: Thailand 920-925 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50

[3] Speedway Revolution only supports power above 30.0 dBm when powered via an external power supply. Power is limited to 30.0 dBm when powered via PoE.

Region	Speedway Revolution[3]		
	R220	R420	R640
15: Singapore 920-925 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 27.75
16: Australia 920-926 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50
17: India 865-867 MHz	10.00 – 31.50	10.00 – 31.50	10.00 – 28.25
18: Uruguay 916-928 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50
19: Vietnam 920-925 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 27.75
20: Israel 915-917 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 25.50
21: Philippines 918-920 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50
22: Canada Post 902-928 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50
23: Indonesia 923-925 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 27.75
24: New Zealand 921.5-928 MHz	10.00 – 32.50	10.00 – 32.50	10.00 – 28.50

Table 9-2 Regional Frequency Capabilities

Region	Frequency Information	
	ChannelIndex	Frequency (MHz)
0: FCC part 15.247	1	902.750
	2	903.250
	3	903.750
	4	904.250
	5	904.750
	6	905.250
	7	905.750
	8	906.250
	9	906.750
	10	907.250
	11	907.750
	12	908.250
	13	908.750
	14	909.250
	15	909.750
	16	910.250
	17	910.750
	18	911.250
	19	911.750
	20	912.250
	21	912.750
	22	913.250
	23	913.750
	24	914.250
	25	914.750
	26	915.250
	27	915.750
	28	916.250
	29	916.750
	30	917.250
	31	917.750
	32	918.250
	33	918.750
	34	919.250
	35	919.750
	36	920.250
	37	920.750
	38	921.250
	39	921.750
	40	922.250
	41	922.750
	42	923.250
	43	923.750
	44	924.250
	45	924.750
	46	925.250

Region	Frequency Information		
	ChannelIndex		Frequency (MHz)
	47		925.750
	48		926.250
	49		926.750
	50		927.250
1. ETSI EN 300-220	N/A		N/A
2: ETSI EN 302-208	See region 7		See region 7
3: Hong Kong 920-925 MHz	N/A[4]	1	920.250
	1	2	920.750
	2	3	921.250
	3	4	921.750
	4	5	922.250
	5	6	922.750
	6	7	923.250
	7	8	923.750
	8	9	924.250
	N/A4	10	924.750
4: Taiwan 922-928 MHz	1		922.250
	2		922.750
	3		923.250
	4		923.750
	5		924.250
	6		924.750
	7		925.250
	8		925.750
	9		926.250
	10		926.750
	11		927.250
	12		927.750
5: Japan 952-954 MHz	N/A		N/A
6: Japan 952-955 MHz, 10mW max power	1		952.200
	2		952.400
	3		952.600
	4		952.800
	5		953.000
	6		953.200
	7		953.400
	8		953.600
	9		953.800
	10		954.000
	11		954.200
	12		954.400

[4] Speedway does not support 920.250 MHz or 924.750 MHz in the Hong Kong region. These frequencies are only available on Speedway Revolution.

Region	Frequency Information	
	ChannelIndex	Frequency (MHz)
	13	954.600
	14	954.800
7: ETSI EN 302-208 (version 1.2.1)	1	865.700
	2	866.300
	3	866.900
	4	867.500
8: Korea 917-921 MHz	1	917.300
	2	917.900
	3	918.500
	4	919.100
	5	919.700
	6	920.300
9: Malaysia 919-923MHz	1	919.250
	2	919.750
	3	920.250
	4	920.750
	5	921.250
	6	921.750
	7	922.250
	8	922.750
10: China 920-925 MHz	1	920.625
	2	920.875
	3	921.125
	4	921.375
	5	921.625
	6	921.875
	7	922.125
	8	922.375
	9	922.625
	10	922.875
	11	923.125
	12	923.375
	13	923.625
	14	923.875
	15	924.125
	16	924.375
11: Japan 952-956 MHz (without LBT)	1	952.400
	2	953.600
	3	954.800
	4	956.000
12: South Africa 915-919 MHz	1	915.600
	2	915.800
	3	916.000
	4	916.200
	5	916.400
	6	916.600
	7	916.800

Region	Frequency Information	
	ChannelIndex	Frequency (MHz)
	8	917.000
	9	917.200
	10	917.400
	11	917.600
	12	917.800
	13	918.000
	14	918.200
	15	918.400
	16	918.600
	17	918.800
13: Brazil 902-907/915-928 MHz	1	902.750
	2	903.250
	3	903.750
	4	904.250
	5	904.750
	6	905.250
	7	905.750
	8	906.250
	9	906.750
	10	907.250
	11	915.250
	12	915.750
	13	916.250
	14	916.750
	15	917.250
	16	917.750
	17	918.250
	18	918.750
	19	919.250
	20	919.750
	21	920.250
	22	920.750
	23	921.250
	24	921.750
	25	922.250
	26	922.750
	27	923.250
	28	923.750
	29	924.250
	30	924.750
	31	925.250
	32	925.750
	33	926.250
	34	926.750
	35	927.250

Region	Frequency Information		
	ChannelIndex		Frequency (MHz)
14: Thailand 920-925 MHz	N/A[5]	1	920.250
	1	2	920.750
	2	3	921.250
	3	4	921.750
	4	5	922.250
	5	6	922.750
	6	7	923.250
	7	8	923.750
	8	9	924.250
	N/A5	10	924.750
15: Singapore 920-925 MHz	N/A[6]	1	920.250
	1	2	920.750
	2	3	921.250
	3	4	921.750
	4	5	922.250
	5	6	922.750
	6	7	923.250
	7	8	923.750
	8	9	924.250
	N/A6	10	924.750
16: Australia 920-926 MHz	1		920.250
	2		920.750
	3		921.250
	4		921.750
	5		922.250
	6		922.750
	7		923.250
	8		923.750
	9		924.250
	10		924.750
	11		925.250
	12		925.750
17: India 865-867 MHz	1		865.100
	2		865.700
	3		866.300
	4		866.900
18: Uruguay 916-928 MHz	1		916.250
	2		916.750
	3		917.250
	4		917.750

[5] Speedway does not support 920.250 MHz or 924.750 MHz in the Thailand region. These frequencies are only available on Speedway Revolution.

[6] Speedway does not support 920.250 MHz or 924.750 MHz in the Singapore region. These frequencies are only available on Speedway Revolution.

Region	Frequency Information	
	ChannelIndex	Frequency (MHz)
	5	918.250
	6	918.750
	7	919.250
	8	919.750
	9	920.250
	10	920.750
	11	921.250
	12	921.750
	13	922.250
	14	922.750
	15	923.250
	16	923.750
	17	924.250
	18	924.750
	19	925.250
	20	925.750
	21	926.250
	22	926.750
	23	927.250
19: Vietnam 920-925 MHz	1	920.250
	2	920.750
	3	921.250
	4	921.750
	5	922.250
	6	922.750
	7	923.250
	8	923.750
	9	924.250
	10	924.750
20: Israel 915-917 MHz	1	916.250
21: Philippines 918-920 MHz	1	918.250
	2	918.750
	3	919.250
	4	919.750
22: Canada Post 902-928 MHz	1	902.750
	2	903.250
	3	905.750
	4	906.250
	5	906.750
	6	907.250
	7	907.750
	8	908.250
	9	908.750
	10	909.250
	11	909.750
	12	910.250
	13	910.750

Region	Frequency Information	
	ChannelIndex	Frequency (MHz)
	14	911.250
	15	911.750
	16	912.250
	17	912.750
	18	913.250
	19	913.750
	20	914.250
	21	914.750
	22	915.250
	23	917.750
	24	918.250
	25	918.750
	26	919.250
	27	919.750
	28	920.250
	29	920.750
	30	921.250
	31	921.750
	32	922.250
	33	922.750
	34	923.250
	35	923.750
	36	924.250
	37	924.750
	38	925.250
	39	925.750
	40	926.250
	41	926.750
	42	927.250
23: Indonesia 923-925 MHz	42	923.250
	43	923.750
	44	924.250
	45	924.750
24: New Zealand 921.5-928 MHz	40	922.250
	41	922.750
	42	923.250
	43	923.750
	44	924.250
	45	924.750
	46	925.250
	47	925.750
	48	926.250
	49	926.750
	50	927.250

Table 9-3 Regional Receive Sensitivity Capabilities

Region	Receive Sensitivity Information
0: FCC part 15.247	Max, -70 dBm – -30 dBm
1. ETSI EN 300-220	N/A
2: ETSI EN 302-208	See region 7
3: Hong Kong 920-925 MHz	Max, -70 dBm – -30 dBm
4: Taiwan 922-928 MHz	Max, -70 dBm – -30 dBm
5: Japan 952-954 MHz	N/A
6: Japan 952-955 MHz, 10mW max power	Max, -70 dBm – -30 dBm
7: ETSI EN 302-208 (version 1.2.1)	Max, -70 dBm – -30 dBm
8: Korea 917-921 MHz	Max, -70 dBm – -30 dBm
9: Malaysia 919-923MHz	Max, -70 dBm – -30 dBm
10: China 920-925 MHz	Max, -70 dBm – -30 dBm
11: Japan 952-956 MHz (without LBT)	Max, -70 dBm – -30 dBm
12: South Africa 915-919 MHz	Max, -70 dBm – -30 dBm
13: Brazil 902-907/915-928 MHz	Max, -70 dBm – -30 dBm
14: Thailand 920-925 MHz	Max, -70 dBm – -30 dBm
15: Singapore 920-925 MHz	Max, -70 dBm – -30 dBm
16: Australia 920-926 MHz	Max, -70 dBm – -30 dBm
17: India 865-867 MHz	Max, -70 dBm – -30 dBm
18: Uruguay 916-928 MHz	Max, -70 dBm – -30 dBm
19: Vietnam 920-925 MHz	Max, -70 dBm – -30 dBm
20: Israel 915-917 MHz	Max, -70 dBm – -30 dBm
21: Philippines 918-920 MHz	Max, -70 dBm – -30 dBm
22: Canada Post 902-928 MHz	Max, -70 dBm – -30 dBm
23: Indonesia 923-925 MHz	Max, -70 dBm – -30 dBm
24: New Zealand 921.5-928 MHz	Max, -70 dBm – -30 dBm

10 Revision History

Date	Revision	Comments
02/21/2008	3.0	Original document created for Octane 3.0 release
01/12/2009	3.2	Document updated for Octane 3.2 release
04/24/2009	4.0	Document updated for Octane 4.0 release
08/12/2009	4.2	Document updated for Octane 4.2 release
04/07/2010	4.4	Document updated for Octane 4.4 release
05/26/2010	4.4 rev 2	Document updated for Octane 4.4.1 release
11/1/2010	4.6	Document updated for Octane 4.6 release
12/1/10	4.6 rev 2	Document updated for Octane 4.6 release
4/25/11	4.8	Document updated for Octane 4.8 release. Removed documentation specific to Speedway, document going forward covers only Speedway Revolution.

Notices: