Intel® RFID Sensor Platform (Intel® RSP)

Application Interface (API)

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No computer system can be absolutely secure.

Revision History

Date	Revision	Description
09/20/2018	0.8	Initial draft release
11/04/2018	0.91	Document cleanup. Added Gateway reference API
11/07/2018	0.92	Added Legal comments
11/09/2018	1.0	Updated revision for clear Production Release
11/09/2018	1.1	Added Reference Documents to section 1.2. Updated Connect Response schema in section 4.4.4.2. Repaginated document for readability.
12/18/2018	1.2	Revised symbols from © to ®, revised title from RFID to RFID, updated Reference Data Flow Figure 14.
1/02/2019	1.3	TM&B – Intel® RFID Sensor Platform (Intel® RSP). Section Added Note * The Intel® RSP H4000 is only available through special order at this time. Contact your Intel® representative for more information.
1/09/2019	1.4	TM&B – add Intel® RSP to Hx000 devices. RFID in tables (not code) added Intel® Edit title: Intel® RFID Sensor Platform Application Interface (API) Guide Intel® RSP H1000, Intel® RSP H3000, and Intel® RSP H4000
4/18/2019	2019Q2	Updated the BIST Results format. Removed set_dense_reader_mode command. Identified deprecated fields.

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Tables

1 Introduction

This document defines the protocols and message content between the Intel® RFID Sensor Platform (Intel® RSP) Sensor and the Gateway.

1.1 Terminology

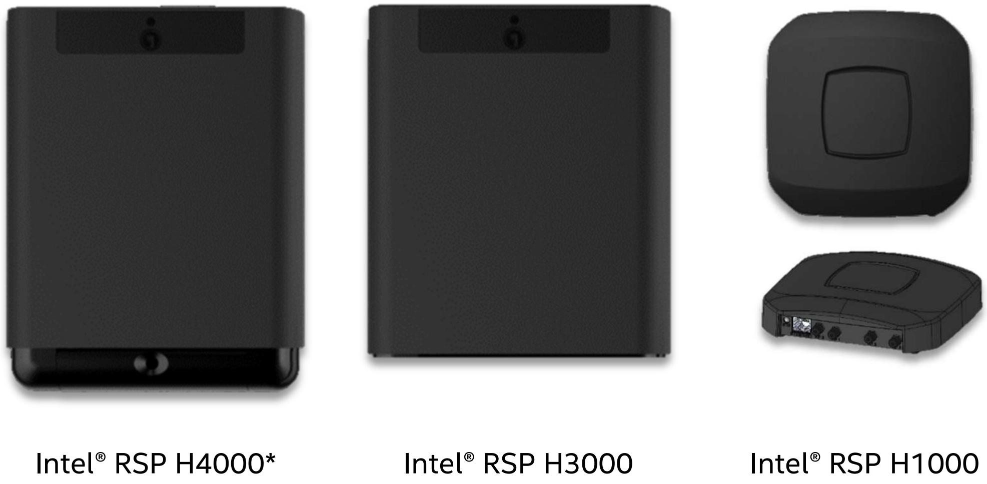
Term	Description
Sensor	Intel® RFID Sensor Platform (Intel® RSP)
Gateway	Gateway with the Intel® RFID Sensor Platform SW Toolkit
NFC	Near Field Communications

1.2 Reference Documents

Document	Document No./Location
Intel® RFID Sensor Platform (Intel® RSP) User & Installation Guide	338088
Intel® RSP Software Toolkit - Sensor NFC App Installation & User Guide	338454

2 Product Description

The Intel® RSP H1000, Intel® RSP H3000 and Intel® RSP H4000* are members of the Intel® RFID Sensor Platform (Intel® RSP) family of devices. These devices have capabilities for several on-board sensors including an EPC Gen 2 UHF RFID Interrogator (reader). These sensors are designed to work stand-alone, or in a network of other "Smart Sensors" as part of an Internet-of-Things (IoT) system in an inventory-tracking environment where computing power is pushed out to the edge devices.



Intel® RSP H4000* Intel® RSP H3000 Intel® RSP H1000

Figure 1 Intel® RFID Sensor Platform Hx000 Family

* The Intel® RSP H4000 is only available through special order at this time. Contact your Intel® representative for more information.

3 System Description

The Intel® RSP Hx Sensor can operate by itself as a standalone UHF RFID reader or with a larger network of sensors controlled by a Gateway Server as shown in the figure below. The system is comprised of one or more Sensors and a Gateway for control and orchestration. Customers may also integrate a cloud component for data storage and analytics. CUSTOMERS ARE SOLELY RESPONSIBLE FOR THE DESIGN AND OPERATION OF THEIR SYSTEM, INCLUDING COMPLIANCE WITH ALL APPLICABLE LAWS AND FOR IDENTIFYING AND IMPLEMENTING THE APPROPRIATE LEVEL OF SECURITY AND DATA PROTECTION.

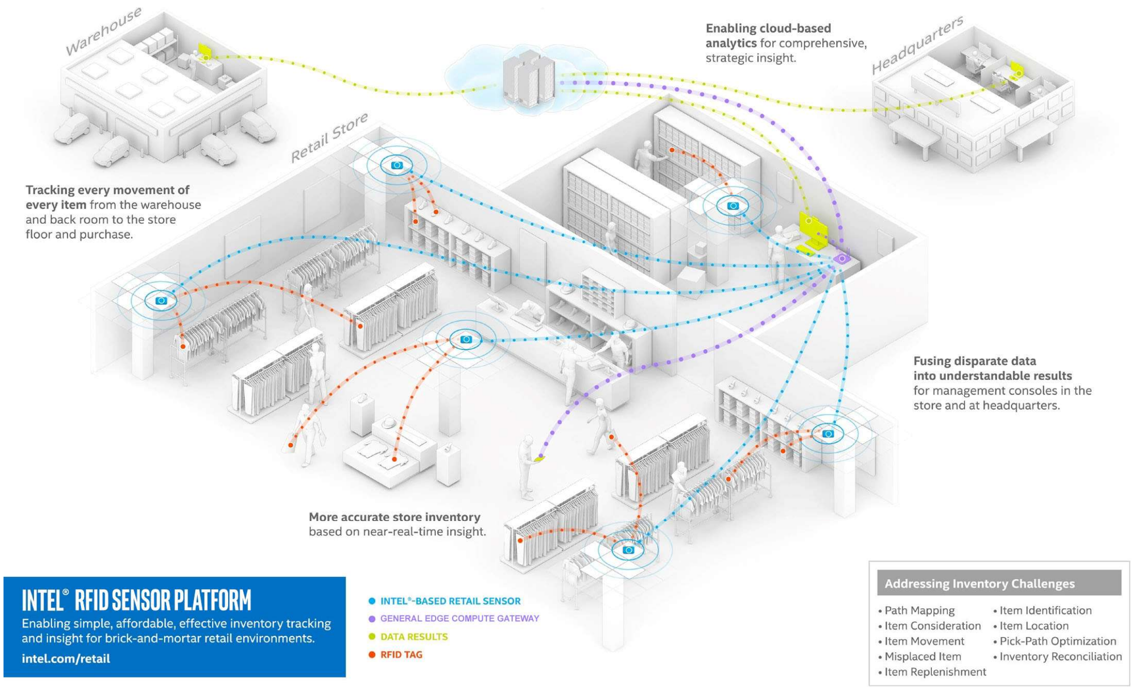

Warehouse
Enabling cloud-based analytics for comprehensive, strategic insight.
Headquarters
Retail Store
Tracking every movement of every item from the warehouse and back room to the store floor and purchase.
Fusing disparate data into understandable results for management consoles in the store and at headquarters.
More accurate store inventory based on near-real-time insight.
INTEL® RFID SENSOR PLATFORM
Enabling simple, affordable, effective inventory tracking and insight for brick-and-mortar retail environments.
intel.com/retail
● INTEL®-BASED RETAIL SENSOR
● GENERAL EDGE COMPUTE GATEWAY
● DATA RESULTS
● RFID TAG
Addressing Inventory Challenges
• Path Mapping
• Item Consideration
• Item Movement
• Misplaced Item
• Item Replenishment
• Item Identification
• Item Location
• Pick-Path Optimization
• Inventory Reconciliation

Figure 2 Intel® RSP System Overview

The performance of this system is in the secure networked communication and coordination that exists between the sensors themselves and between the sensor and the Gateway. Whether a system deployment has 5 or 500 Intel® RFID Sensor Platform sensors, this communication and coordination greatly simplifies initial configuration as well as the operational management.

3.1 Data Flow

From a data flow perspective, RFID reader interrogates the tag population within its field of view and passes information regarding the tags as well as information from other various on-board sensors to the Gateway. The Gateway appliance does more than just aggregate the data from the sensor population; it also orchestrates the behavior of each sensor to optimize the overall in-store data collection process. Inventory Events, Alerts and System Status can be forwarded from the Gateway device to applications running in a customer's cloud infrastructure. Figure 3 illustrates the flow of data and control within the Intel® RSP.

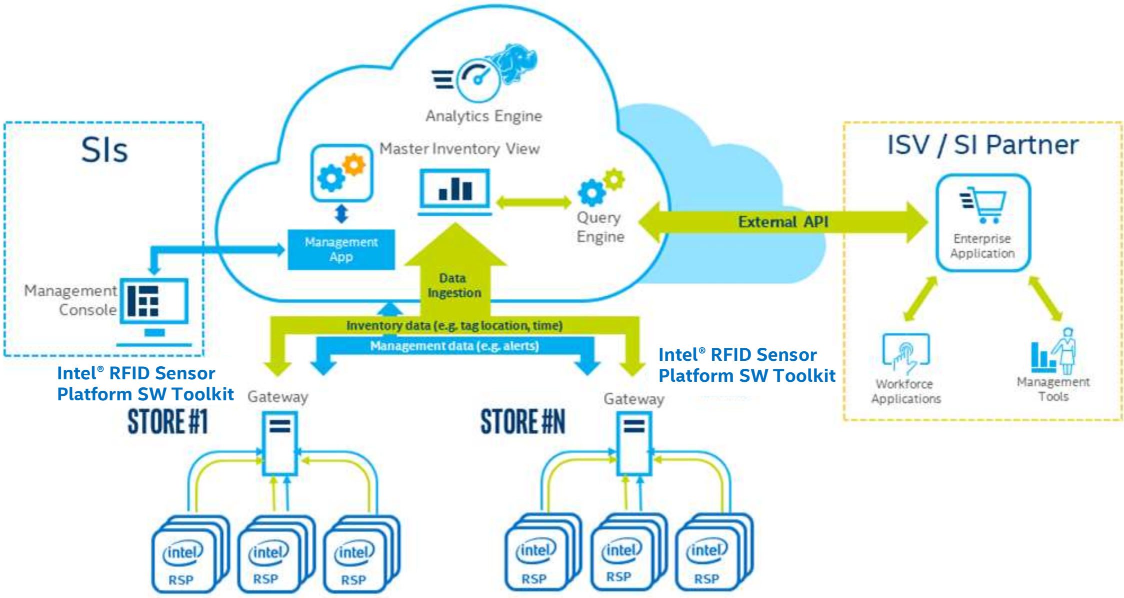


Figure 3 Example Intel® RFID Sensor Platform System Data Flow

3.2 Applications

Customers may utilize their own infrastructure for applications that ingest the events from the Gateway, allowing them to determine item identification, location, movement and status. CUSTOMERS ARE SOLELY RESPONSIBLE FOR THEIR OWN CLOUD INFRASTRUCTURE AND APPLICATIONS, INCLUDING FOR IDENTIFYING AND IMPLEMENTING THE APPROPRIATE LEVEL OF SECURITY FOR THE DATA COLLECTED VIA THE DEVICES.

3.3 Gateway

The Gateway, with the Intel® RSP SW Toolkit loaded on it, performs sensor control, sensor management, sensor data aggregation, data processing, event generation and event management all over a secure data channel. It also supports configuration and management from a local interface. CUSTOMERS ARE SOLELY RESPONSIBLE FOR CONFIGURING THEIR MQTT BROKER FOR THE APPROPRIATE LEVEL OF SECURITY FOR THE DATA COLLECTED VIA THE DEVICES.

3.4 Intel® RFID Sensor Platform (Intel® RSP)

The Intel® RSP devices provide the ability to remotely and securely command, control, status, and data collection via Ethernet. Data from RFID tag reads as well as data from other on-board sensors is published to an MQTT broker. The data API is based on JSON RPC commands, responses and indications. JSON-RPC is a text based, stateless, lightweight remote procedure call (RPC) protocol.

3.5 JSON RPC

The Intel® RSP provides a secure remote capability for command, control, status and data collection via JSON Remote Procedure Call (RPC) over an encrypted MQTT channel. CUSTOMERS ARE SOLELY RESPONSIBLE FOR CONFIGURING THEIR MQTT BROKER FOR THE APPROPRIATE LEVEL OF SECURITY FOR THE DATA COLLECTED VIA THE DEVICES.

The Intel® RSP command set for the Gateway follows the JSON RPC 2.0 specification. JSON-RPC is a stateless, lightweight protocol that is transport agnostic.

3.5.1 Request Object

The Request object has the following members listed below.

- **jsonrpc**
  - A String specifying the version of the JSON-RPC protocol.
- **method**
  - A String containing the name of the method to be invoked.
- **params**
  - A Structured value that holds the parameter values to be used during the invocation of the method.
  - This member may be omitted.
- **id**
  - An identifier containing a String or Number value (if included).
  - This member is used to correlate the context between the two objects.

3.5.2 Notification Object

A Notification is a Request object without an "id" member. A Request object that is a Notification signifies that a corresponding Response object is not expected.

3.5.3 Response Object

The Response is expressed as a single JSON Object, with the following members:

- **jsonrpc**
  - A String specifying the version of the JSON-RPC protocol.
- **result**
  - The presence of this member indicates successful execution of the corresponding method.
  - This member is not present when the execution of the method resulted in an error.
- **error**
  - The presence of this member indicates unsuccessful execution of the corresponding method.
  - This member is not present when the execution of the method was successful.
  - When present, the error Object contains the following members:
    - **code**

        - An integer that indicates the error type that occurred.
      - **message**
        - A String providing a short description of the error.
      - **data**
        - A Primitive or Structured value that contains additional information about the error (optional).
  - See table below for supported error codes.
- **id**
  - This member is always present on a response and contains the same value as the id member in the corresponding Request Object.
  - This member is not present on indications.

3.5.4 Error Codes

The Intel® RFID Sensor Platform provides on of the following error codes when an error occurs.

Table 1 JSON RPC Error Code Fields

Code	Message	Meaning
-32001	Wrong State	Cannot be executed in the current state
-32002	Not supported	The requested functionality is not supported
-32100	No facility assigned	The RSP has no Facility ID assigned yet
-32601	Method not found	The method does not exist
-32602	Invalid Parameter	Out of range or invalid format
-32603	Internal Error	Intel® RFID Sensor Platform application error
-32700	Parse error	Invalid JSON Object

3.6 MQTT

The Intel® RSP Sensor Platform supports MQTT machine-to-machine "Internet of Things" connectivity protocol. By subscribing and publishing to a configurable set of "topics", the Intel® RFID Sensor Platform can coordinate with a Gateway with the Intel® RFID Sensor Platform SW Toolkit (Intel® RSP SW Toolkit) loaded on it.

3.7 REST

The Intel® RFID Sensor Platform obtains critical configuration data via REST endpoints. These endpoints are provided to the sensor by the tools loaded on the Gateway as part of the "zeroconf" discovery process shown in section 4.3.1 of this document.

4 Gateway Command Set

4.1 JSON RPC Commands and Responses

Table 2 Gateway to Intel® RFID Sensor Platform Commands

Command	Brief Description
connect	Request MQTT Topic information from the GW
get_state	Retrieve the capabilities and current configuration
set_frequency_plan	Set the Region of Operation frequency plan
set_antenna_config	Configure the per antenna port parameters
set_select	Define a set of tag select criteria
set_post_match	Define a the post singulation match criteria
apply_behavior	Define a set of RFID parameters and command a single or multiple inventory round(s)
start_inventory	Command a single or multiple inventory round(s) using the set of default RFID parameters
stop_inventory	Stop the inventory round in progress.
tag_read_memory	Read up to 32 16-bit words from the tag memory
tag_write_memory	Write up to 32 16-bit words to the tag memory
get_tag_database	Retrieve the Tag Database from the RSP
get_bist_results	Query the Built In Self-Test (BIST) data of the RSP
set_device_alert	Configures and/or acknowledges device alerts
set_alert_threshold	Configure a particular “device_alert" threshold
ack_alert	Acknowledge a particular “device_alert"
set_motion_event	Configure the “motion_event" thresholds
get_sw_version	Retrieve the software versions of the RSP
load_defaults	Command to load the power on default settings
capture_image	Capture an image using the onboard camera
start_video	Start streaming video using the onboard camera
stop_video	Stop streaming video using the onboard camera
set_led	Control the Intel® RFID Sensor Platform LED
reset	Perform a soft reset of the Embedded RFID module
reboot	Perform a reboot of the entire sensor platform
shutdown	Perform a clean shutdown of the entire sensor
set_facility_id	Set the Facility ID string assigned to this sensor
set_dense_reader_mode	Command the use of “Dense Reader Mode”

4.2 JSON RPC Indications

Table 3 Intel® RFID Sensor Platform to Gateway Indications

Indication	Brief Description
device_alert	Indicates a Built-In-Test event has occurred
heartbeat	Indicates the Intel® RSP is still operational
motion_event	Indicates the detection of motion from the IR sensor
status_update	Indicates a change in status
inventory_data	Indicates the receipt of RFID tag information
inventory_complete	Indicates that the inventory round is complete

Table 4 Gateway to Intel® RFID Sensor Platform Indications

Indication	Brief Description
gw_status_update	Gateway status update announcement

4.3 Intel® RFID Sensor Platform Example Use-Cases

4.3.1 Gateway Discovery

A goal of the Intel® RFID Sensor Platform is to be as much of a “zero-conf" installation as possible. Once power is applied, the Intel® RSP autonomously acquires a network address via DHCP and discover the Gateway with Intel® RSP SW Toolkit loaded. The sensor also supports encryption via a TLS connection to the MQTT broker. Each Intel® RSP can be provisioned via NFC with credentials to support mutual authentication between the sensor and the Gateway. Figure 6 illustrates the message exchange involved in this use case.

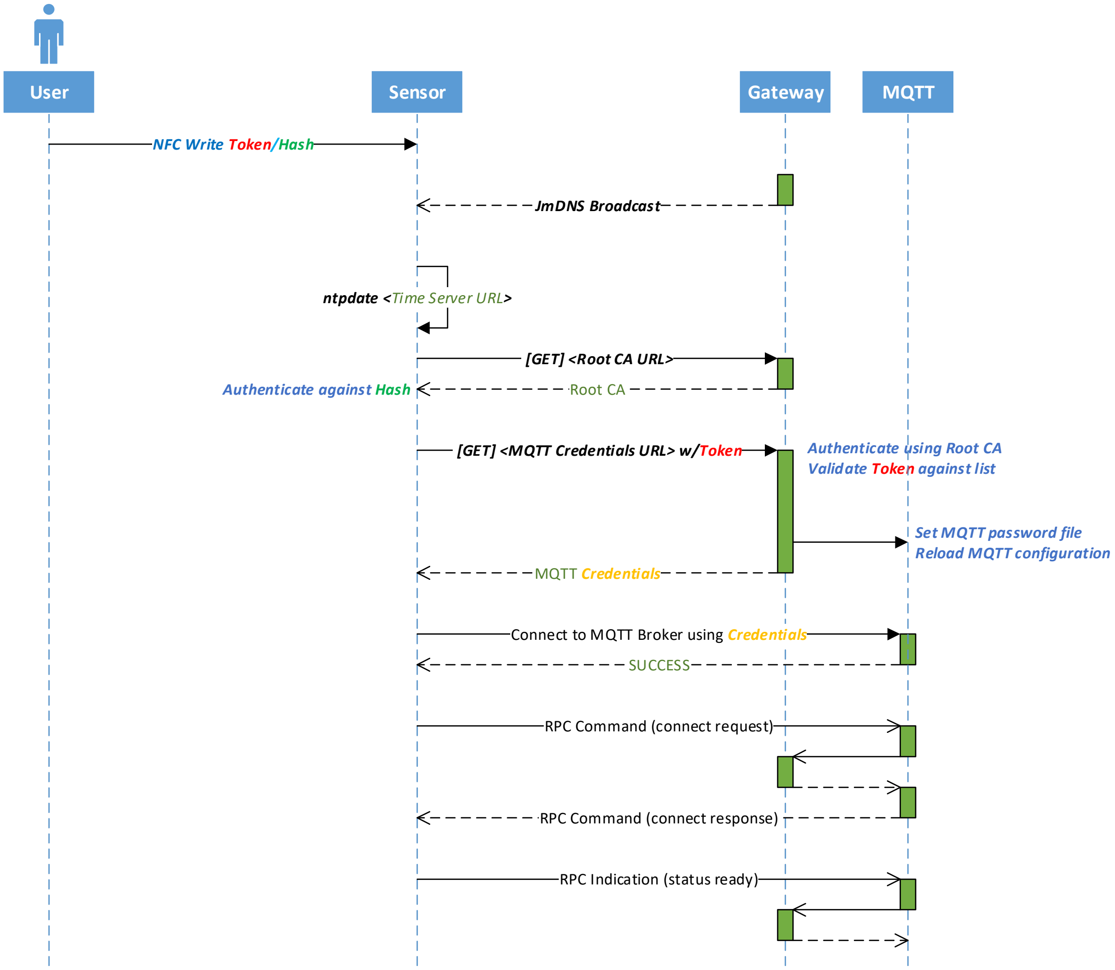

User
Sensor
Gateway
MQTT
NFC Write Token/Hash
JmDNS Broadcast
ntpdate <Time Server URL>
[GET] <Root CA URL>
Authenticate against Hash
Root CA
[GET] <MQTT Credentials URL> w/Token
Authenticate using Root CA
Validate Token against list
Set MQTT password file
Reload MQTT configuration
MQTT Credentials
Connect to MQTT Broker using Credentials
SUCCESS
RPC Command (connect request)
RPC Command (connect response)
RPC Indication (status ready)

Figure 4 Gateway Discovery

4.3.2 Simple Inventory

Without the need for specific parameter configuration, the Intel® RFID Sensor Platform is provisioned with a set of default configuration values. The Gateway may at any time explicitly revert to the use of these default values prior to issuing an inventory command. The image below illustrates the message exchange involved in this use case.

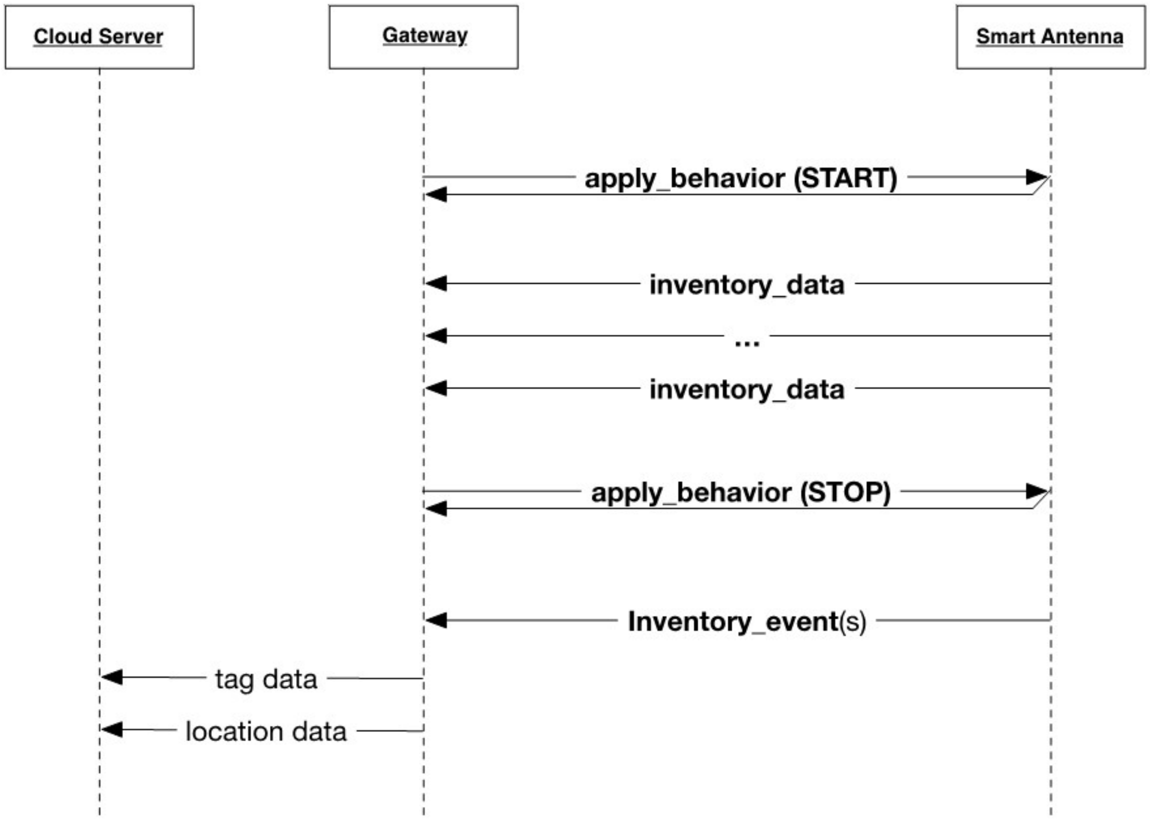


Figure 5 Simple Inventory

4.3.3 Managing Large Tag Populations

The Gateway can segregate a large tag population into several smaller ones using the “select", “group" and “inventory" functions. Segregation allows the Intel® RFID Sensor Platform to more accurately inventory a tag population by avoiding collisions. This same functionality can also be used to isolate a single tag that might be located in a challenging RF environment or perhaps physically oriented in a less than optimal fashion.

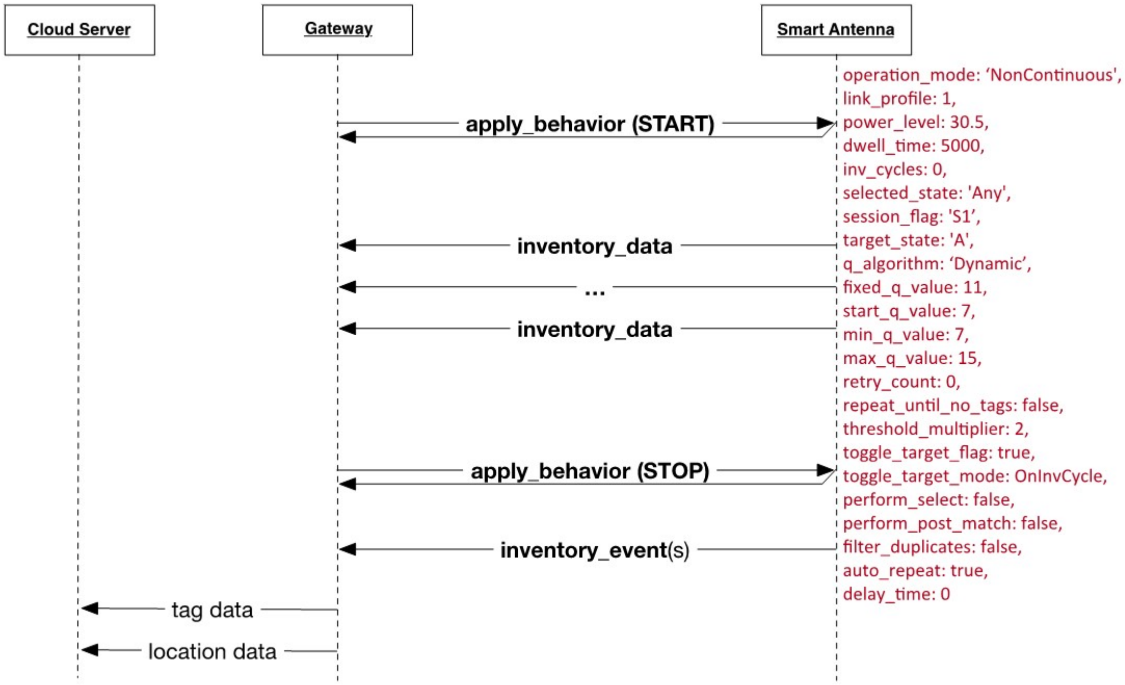
A challenge in managing larger tag populations is dealing with “tag collisions" during the query-response (more than one tag responding at exactly the same time). The Intel® RFID Sensor Platform offers an adaptive algorithm (Dynamic-Q) function to mitigate tag collisions. An adaptive Q algorithm increases the reading efficiency significantly thereby reducing the time it takes to completely inventory a large tag population. The Intel® RFID Sensor Platform “set_q_algorithm" allows the Gateway to optimally configure the Q Algorithm based on a known tag population. Dynamic-Q is used by default, which relieves the Gateway from having to explicitly issue the “set_q_algorithm" command.

For maximum flexibility, the Intel® RFID Sensor Platform exposes all of the above functionality as separate commands. Providing separate commands empowers the Gateway with the means of optimizing its interaction (if desired) with larger tag populations.

For ease of use, the Intel® RFID Sensor Platform combines all of the above functionality into a single macro “filter_inventory" command. This command eliminates the need for the Gateway to explicitly define how the filter criteria are implemented.

4.3.3.1 Normal Scan (Dual Target)

This Use-Case illustrates the most common situation where a number of tagged items are being continuously inventoried on an RFID-enabled “smart shelf" or perhaps an overhead Intel® RFID Sensor Platform in an RFID-enabled “smart store". This mode will allow multiple reads per tag for a moderate update of tag status to alert the RFID system should a tagged item be moved. No tag filtering is specified. The below figure illustrates the message exchange involved in this use case.



```
operation_mode: ‘NonContinuous',
link_profile: 1,
power_level: 30.5,
dwell_time: 5000,
inv_cycles: 0,
selected_state: 'Any',
session_flag: 'S1’,
target_state: 'A',
q_algorithm: ‘Dynamic’,
fixed_q_value: 11,
start_q_value: 7,
min_q_value: 7,
max_q_value: 15,
retry_count: 0,
repeat_until_no_tags: false,
threshold_multiplier: 2,
toggle_target_flag: true,
toggle_target_mode: OnInvCycle,
perform_select: false,
perform_post_match: false,
filter_duplicates: false,
auto_repeat: true,
delay_time: 0
```

Figure 6 Normal Scan, Dual Target

4.3.3.2 High Mobility (Dual Target)

This Use-Case addresses the situation where a number of tagged items are being continuously inventoried, and higher numbers of reads per tag are required to detect tag mobility. Figure 7 illustrates the message exchange involved in this use case.

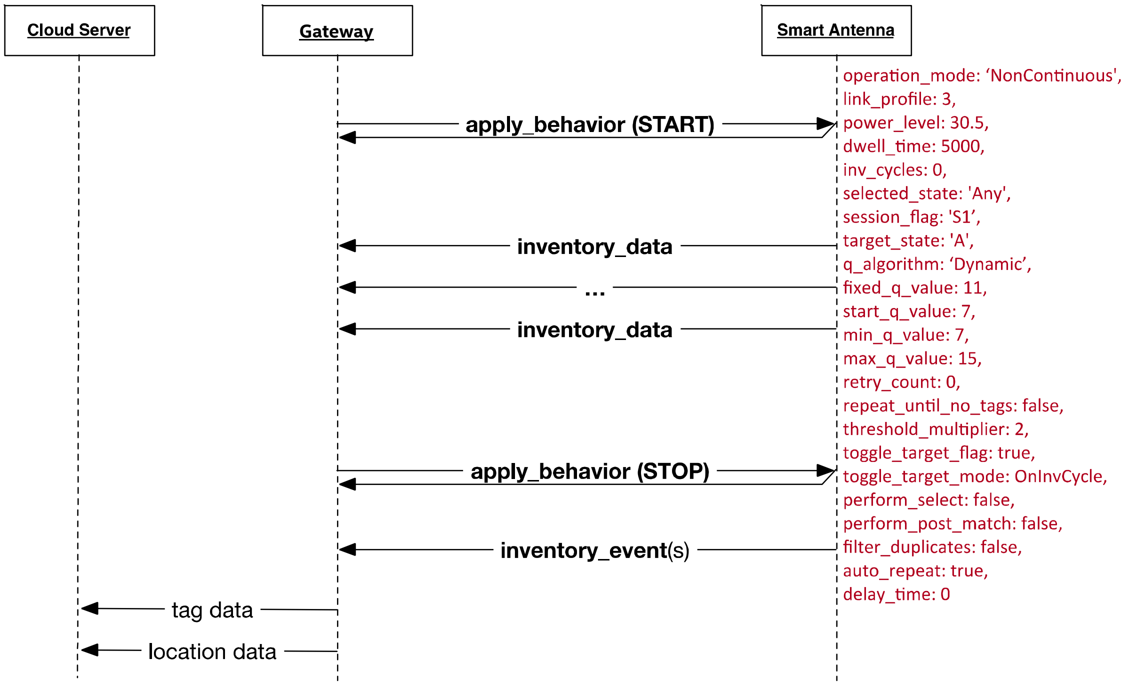
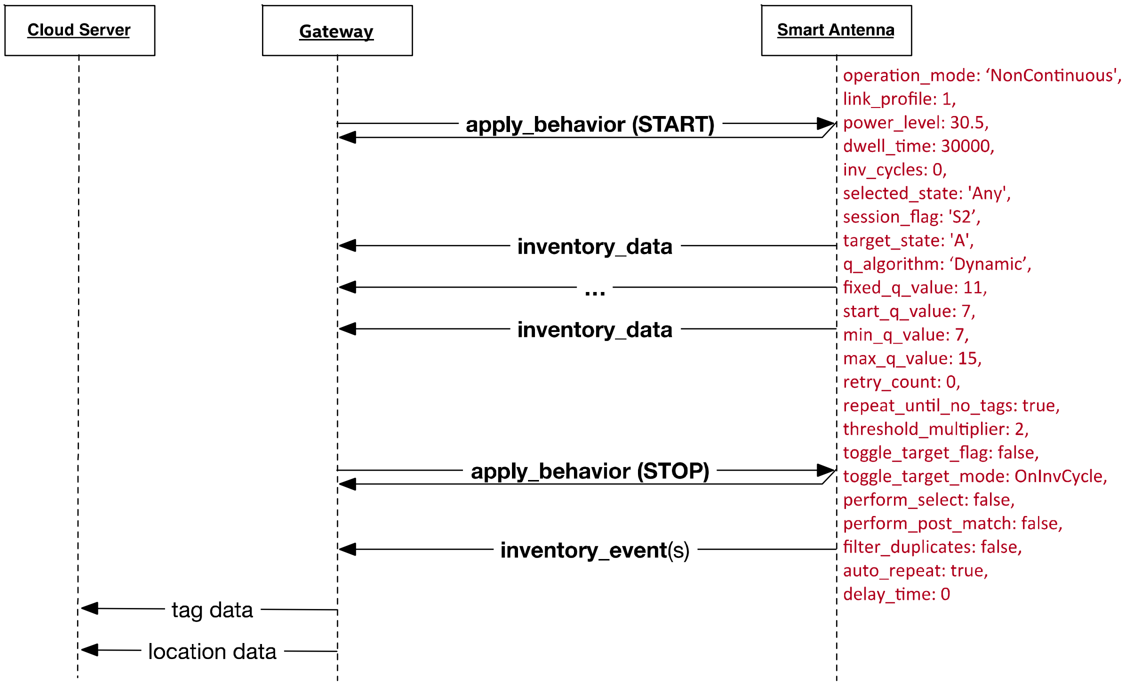


Figure 7 High Mobility (Dual Target)

4.3.3.3 Deep Scan (Single Target)

This Use-Case illustrates a thorough “Deep Scan" using the most robust RF link to insure that all tags within the coverage area are successfully read at least once. This mode also uses suppression to allow weaker tags to respond without competing with the multiple responses of other tags and is recommended only in situations where multiple reads per tag is not required. Sessions 2 and 3 are used to provide longer suppression times while scanning. Alternating between sessions 2 and 3 (and between A and B) allows for a rapid recovery when rescanning the tag population. This use-case insures that even the most distant tags with the weakest backscatter signal can be eventually read. The figure below illustrates the message exchange involved in this use case.



operation_mode: ‘NonContinuous',
link_profile: 1,
power_level: 30.5,
dwell_time: 30000,
inv_cycles: 0,
selected_state: 'Any',
session_flag: 'S2’,
target_state: 'A',
q_algorithm: ‘Dynamic’,
fixed_q_value: 11,
start_q_value: 7,
min_q_value: 7,
max_q_value: 15,
retry_count: 0,
repeat_until_no_tags: true,
threshold_multiplier: 2,
toggle_target_flag: false,
toggle_target_mode: OnInvCycle,
perform_select: false,
perform_post_match: false,
filter_duplicates: false,
auto_repeat: true,
delay_time: 0

Figure 8 Deep Scan (Single target)

4.3.4 Searching for a Single Tag or Group of Tags

There are two ways to search for an individual tag or group of tags using the Intel® RSP Sensor Platform.

The “select" function configures the Intel® RFID Sensor Platform with set of tag filter criteria and instructs those tags that match that filter criteria to modify a certain register flag, forcing it to a known value prior to singulation. The tag protocol operation (i.e. read, write, kill) is applied only to those tags that meet the filter criteria. When tag populations are relatively large (> 1000) or when it is critical to apply a tag protocol operation to only a single tag, this method of filtering is preferred. A good example of an applied use of the "select" function would be at the point-of-sale (POS) where tags could be deactivated (killed) prior to exiting a controlled area.

The "post-match" function configures the Intel® RFID Sensor Platform with set of tag filter criteria that is applied "post" singulation or after a particular tag protocol operation is performed. Even though the tag still has to compete in the RF environment of the singulation process, the only data sent to the Gateway is from those tags that match the filter criteria defined in the "post match" function. “Post Match" filtering is a single step process, tag memory is not modified and all tags respond to the inventory request. When tag populations are relatively small (< 1000), this method of filtering on certain tags is more efficient. A good example of an applied use of the "post match" function would be when searching a larger tag population with a hand scanner for a particular tag or group of tags.

4.3.4.1 Tag "Select"

This Use-Case shows an example of the tag "select" function to search for a single tag or group of tags. The image below illustrates the message exchange involved in this use case.

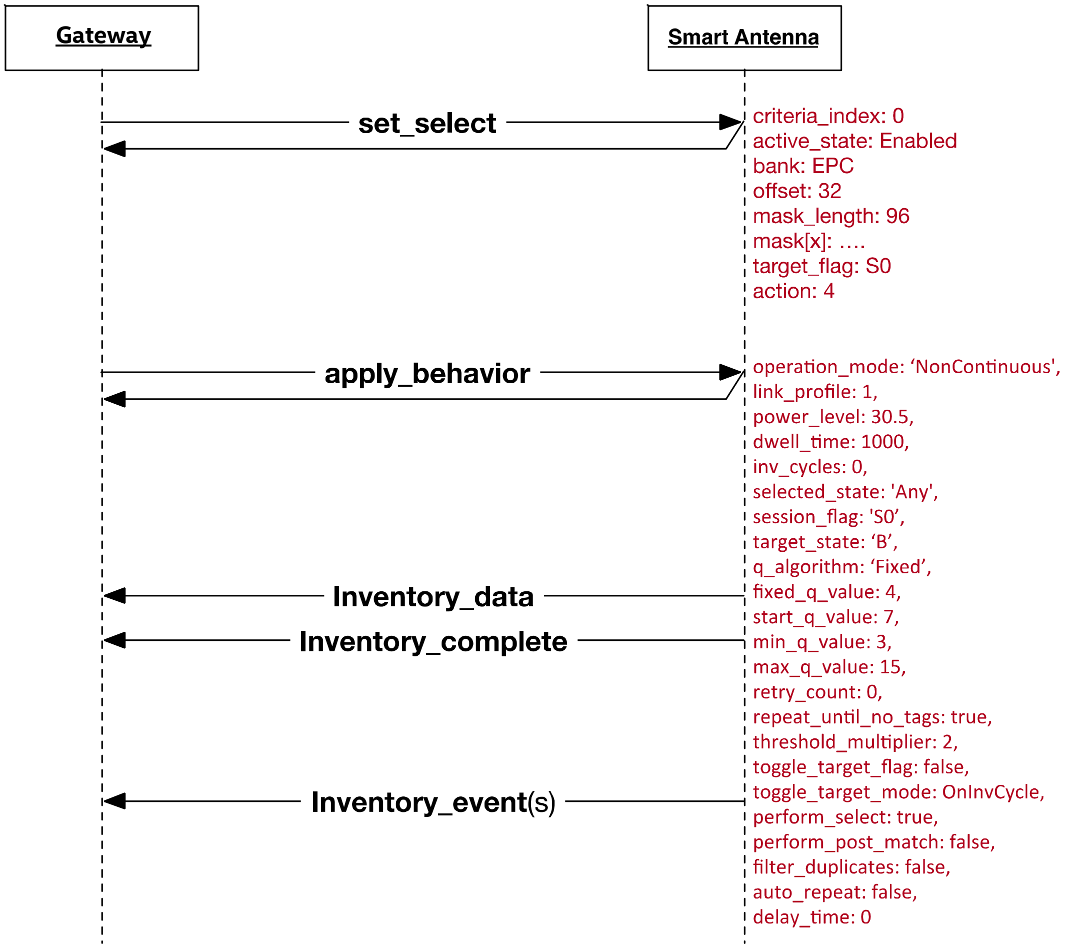


Figure 9 Tag "Select"

4.3.4.2 "Post Match" Filtered Inventory

This Use-Case shows an example of the tag "post match" function to search for a single tag or group of tags. The figure below illustrates the message exchange involved in this use case.

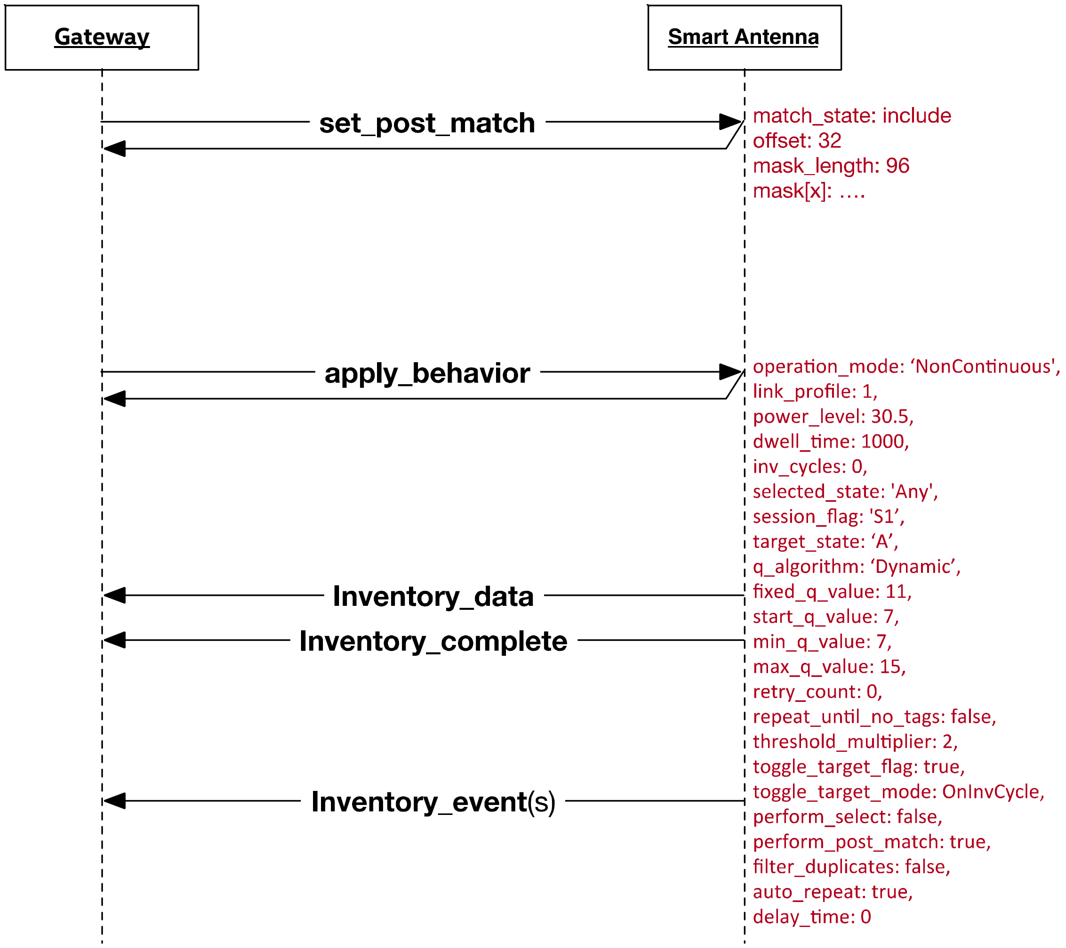


Figure 10 Configuring a Post-Match Inventory

4.3.5 Tag Read/Write

The Use Case in the figure below demonstrates how the Gateway can read from or write to a specific tag. One example might be to read the tag manufacturer ID from the TID memory bank. Such an operation cannot be done while an inventory is in progress.

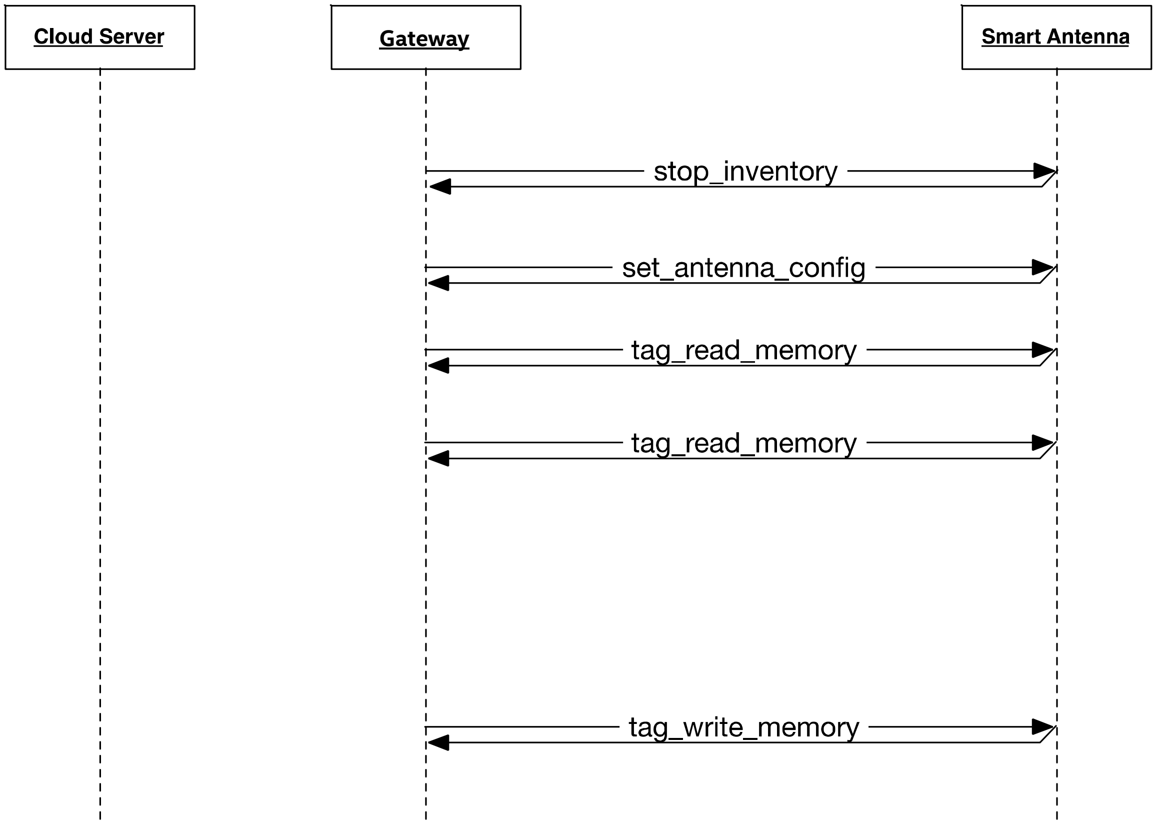


Figure 11 Tag Read/Write

4.3.6 Acknowledging Device Alerts

The Use Case in image below demonstrates how the Gateway acknowledges a Device Alert. Device alerts that are not acknowledged will continue to generate device_alert indications for as long as the reported condition persists.

.

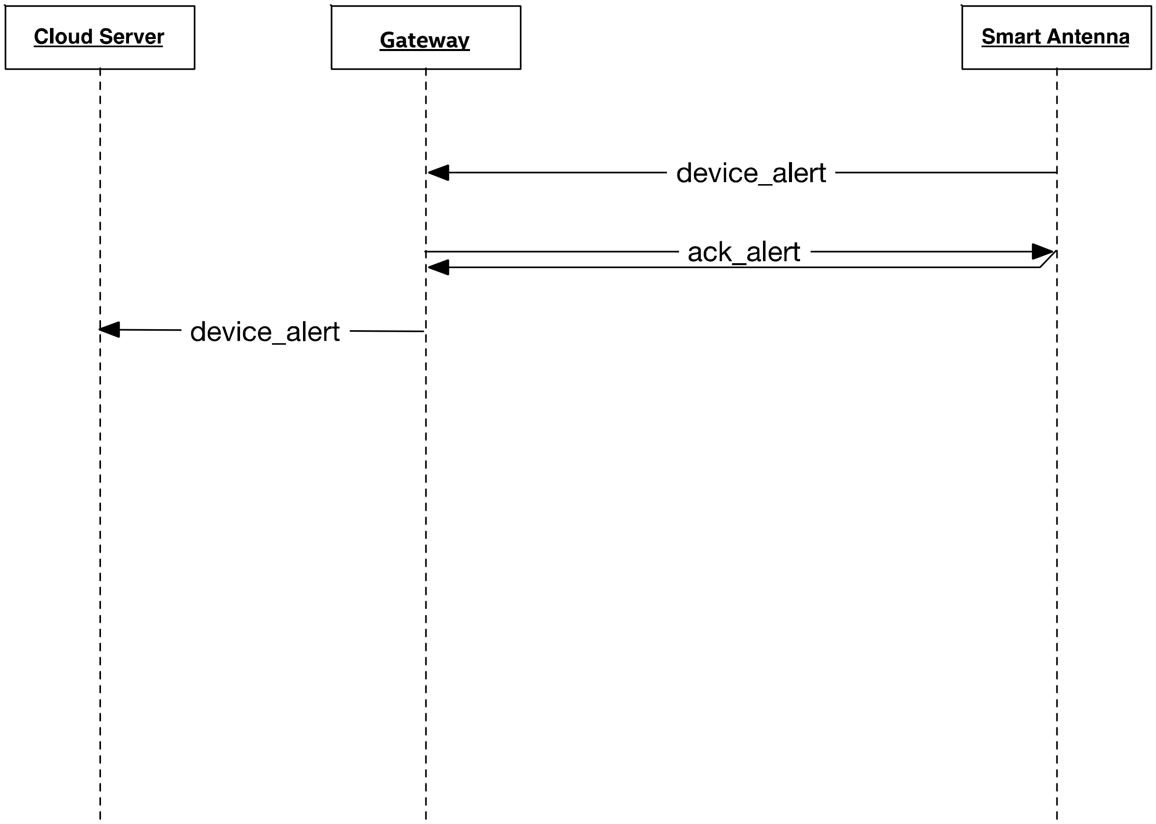


Figure 12 Acknowledging Device Alerts

4.3.7 Loss of Gateway

The Gateway has the ability to send status updates to the Intel®RFID Sensor Platform units on a separate MQTT topic to indicate its health and current functional state. In the event of a Gateway failure, the MQTT client will send out the Last Will on that same topic. Figure 10 below illustrates the actions taken by the Intel® RFID Sensor Platform units when that message is received.

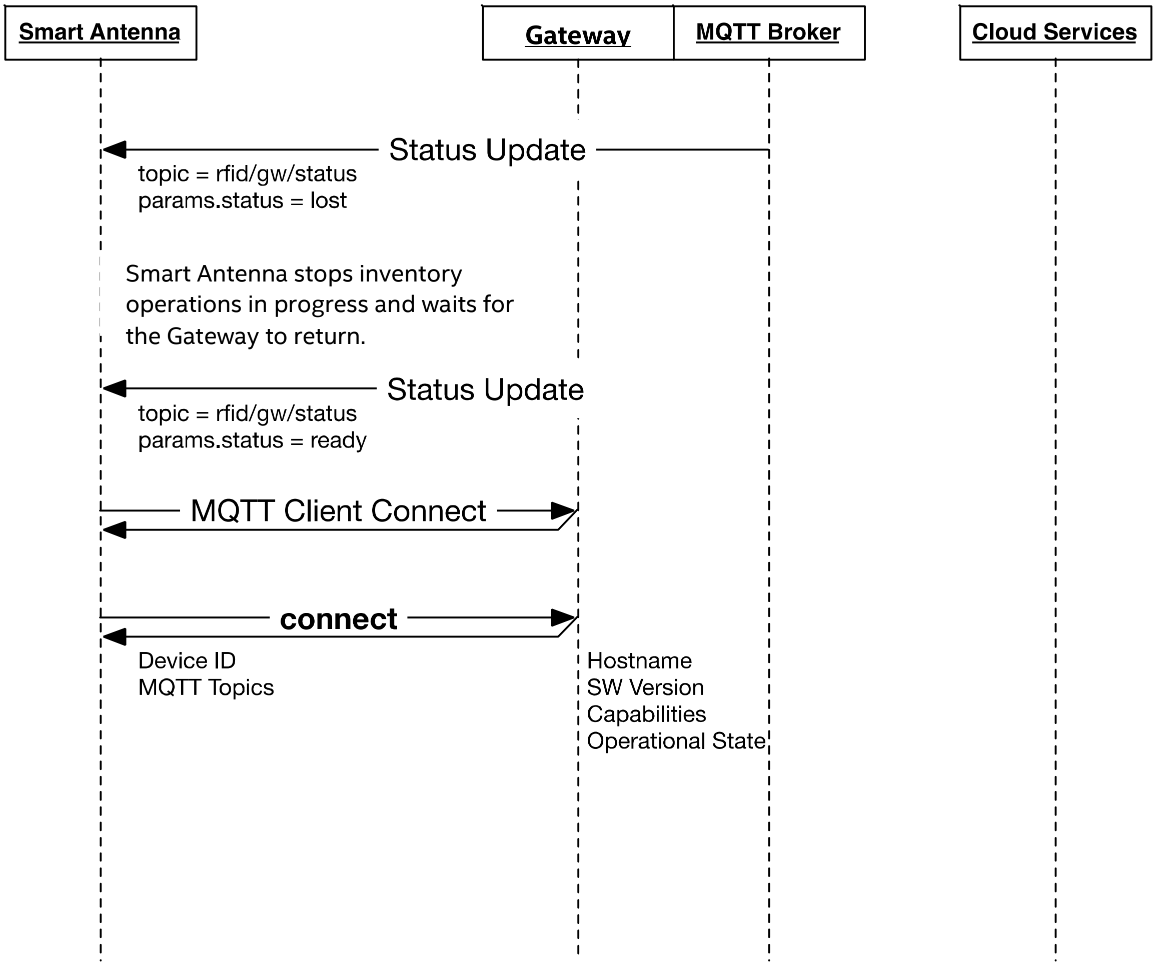


Figure 13 Gateway Lost

4.4 Detailed JSON Schema Definitions

4.4.1 Service Announcement using JmDNS

The Gateway (or its proxy) announces basic Gateway Services using the JmDNS service announcement. The following table defines the ServiceInfo parameters.

Table 5 JmDNS ServiceInfo Parameters

Parameter	Definition
type	A string value defined as "_rfid._tcp.local."
name	A string value defined as "RFID-Gateway"
port	An integer value defined as 0.
text	A string value defined as a JSON Object (see below)

4.4.1.1 JmDNS Text Field

The following JSON Object is an example "text" string.

```
{
   "sensor_token_required":true,
   "root_cert_url":"http://some-server.com/endpoint",
   "mqtt_credentials_url":"https://some-server.com/endpoint",
   "ntp_host":"RFID-Gateway-01.local"
}
```

Table 6 ServiceInfo JSON Text Parameters

Parameter	Definition
sensor_token_required	Boolean to indicate the use of a provisioning tag
root_cert_url	The URL for accessing the cloud CA root certificate
mqtt_credentials_url	The URL for accessing the mqtt credentials
ntp_host	The address or hostname of the local NTP server.

4.4.2 Root Cert Endpoint

The Root Certificate Endpoint returns the CA Root certificate (in one-line PEM format) used for this installation of the Intel® RSP. When "sensor_token_required" is true, the sensor must include the token read from the provisioning tag in the HTTP header. The following JSON response is an example of the data returned from this endpoint.

```
{
  "one_line_pem":"-----BEGIN CERTIFICATE-----
\nMIIEKzCCAxOgAwIBAgIJAOCJFM85pZzDMA0GCSqGSIb3DQEBCwUAMIGrMQswCQY
D\nVQQGEwJVUzETMBEGA1UECAwKQ2FsaWZvcm5pYTERMA8GA1UEBwwIQ2FybHNiYW
Qx\nHzAdBgNVBAoMFkVuY2luaXRhcyBMYWJvcmF0b3JpZXMxDTALBgNVBAsMBFJGS
UQx\nGjAYBgNVBAMMEWVuY2luaXRhc2xhYnMuY29tMSgwJgYJKoZIhvcNAQkBFhlj
b250\nYWN0QGVuY2luaXRhc2xhYnMuY29tMB4XDTE2MTAzMDIyNDY0NVoXDTE3MTA
zMDIy\nNDY0NVowgasxCzAJBgNVBAYTAlVTMRMwEQYDVQQIDApDYWxpZm9ybmlhMR
EwDwYD\nVQQHDAhDYXJsc2JhZDEfMB0GA1UECgwWRW5jaW5pdGFzIExhYm9yYXRvc
mllczEN\nMAsGA1UECwwEUkZJRDEaMBgGA1UEAwwRZW5jaW5pdGFzbGFicy5jb20x
KDAmBgkq\nhkiG9w0BCQEWGWNvbnRhY3RAZW5jaW5pdGFzbGFicy5jb20wggEiMA0
GCSqGSIb3\nDQEBAQUAA4IBDwAwggEKAoIBAQDgB+m9NQyd4pcqfYSi++DmO2aCmX
oNPmfJzAFZ\nxsgjIIlKweDujpt3At3Zk3ogZNPQTkaYCVdwnABs3tMmjiGOhqgHE
mXXsDUUtFiR\nkObtehBc6khqIrE/eRR94P0B/NXHvuKrgeQxIO2nv9Q6E16H/mlV
1udTtPHQrQ4w\n91gkShWjmXe7LfBh/mdEPM9F1TbG9CgV46QBN2Fl0ouFvC89t88
IqcKlBVNr3xvx\niCwaWQs0wWcHinF+rDtX2mjRYLV4ItfLd5AYiuVk1id24KowMg
VDofgLLtBU7NJK\nq9ojUBIcaSgPfUATKrqegyVUImUSlS6M9R9oIYFujxPcJyW/A
gMBAAGjUDBOMB0G\nA1UdDgQWBBRdbPlmWZ8X9ofsz5kWXHAgqtVnizAfBgNVHSME
GDAWgBRdbPlmWZ8X\n9ofsz5kWXHAgqtVnizAMBgNVHRMEBTADAQH/MA0GCSqGSIb
3DQEBCwUAA4IBAQAk\n8o41WUQjleryN/aGStX8zj8cF6XA9Hnb4+HAPUAry4Q2cf
dGu9uLHVBy2DQ46m3D\nUomVMXd+Q8EG09Iq6PHMlWVbYnkh2+fTiQkZaRM5BBC7l
pQZcVi/ka7giklEv78y\nYGx9RoRgWVFWUhANdpRByWIVBuVxLiStrjOzqIF1X/uC
Xw8XHb48Ip6tDlfOa+rs\noTlw32CgDQBI5iM397zPoPcB71xXwBC4JaQr0Uk4neP
GRarZKqY8/CYcBYlQEkbJ\nT/1NbXO2T4ixVjjvysw8blFedx1QqZ2ijAVXYBnLDq
FoOF6uuaSmazuJ/gSQc9cv\nle28t5HuKhIAq4CR9c/k\n-----END
CERTIFICATE-----\n"
}
```

Table 7 ServiceInfo JSON Text Parameters

Parameter	Definition
one_line_pem	The Root CA Certificate in one-line PEM format.

4.4.3 MQTT Credentials Endpoint

The MQTT Credentials Endpoint returns a JSON object containing the information needed to connect to the MQTT broker. The sensor includes a self-generated username along with the 256-bit token as part of the HTTPS body. The token is used by the Gateway to authenticate the sensor. When "sensor_token_required" is false, the sensor does not include the token information in the body.

4.4.3.1 POST

```
{
  "username": "RSP-958a7b",
  "sensor_token":"123456789ABCDEF0123456789ABCDEF0"
}
```

Table 8 MQTT Credentials Endpoint POST

Parameter	Definition
username	A username string (typically the hostname of the device)
sensor_token	A hexadecimal string representation of a 256-bit token

4.4.3.2 Response

```
{
   "mqtt_uri":"ssl://RFID-Gateway-01.local:8883",
   "mqtt_topic_prefix":"rfid/rsp",
   "mqtt_password":"lu1qamFVhBdlVIbKfzdGuOCulPuS1bcY"
}
```

Table 9 MQTT Credentials Endpoint Response

Parameter	Definition
mqtt_uri	The URI containing the protocol, address or hostname and port of the MQTT broker
mqtt_topic_prefix	The MQTT topic prefix is prepended to the sub-topics used between the GW and Intel® RSP. The valid topics are... < mqtt_topic_prefix >/connect < mqtt_topic_prefix >/connect/< device_id > < mqtt_topic_prefix >/command/< device_id > < mqtt_topic_prefix >/response/< device_id > < mqtt_topic_prefix >/rsp_status/< device_id > < mqtt_topic_prefix >/data/< device_id> < mqtt_topic_prefix >/gw_status
mqtt_password	The password used when connecting to the MQTT broker

4.4.4 Connecting to the Gateway

The Connect message exchange is used to notify the Gateway that a new device has come online and provision that device with the information it needs. Below are the parameter definitions and example JSON schema for the Connect Request and Response.

4.4.4.1 Connect Request

```
{
   "jsonrpc":"2.0",
   "method":"connect",
   "params":{
      "hostname":"RSP-5a778d",
      "hwaddress":"98:4f:ee:5a:77:8d",
      "app_version":"1.2.0",
      "module_version":"1.1.0",
      "num_physical_ports":1,
      "motion_sensor":true,
      "camera":false,
      "wireless":false,
      "configuration_state":"Default",
      "operational_state":"Idle"
   },
   "id":"12345"
}
```

Table 10 Connect Request Parameters

Parameter	Definition
hostname	The Linux* hostname of this device.
hwaddress	The MAC address of the interface in use.
app_version	The version string of the Intel® RFID Sensor Platform application.
module_version	The version string of the embedded RFID module.
num_physical_ports	The number of antenna ports available on this device.
motion_sensor	Whether or not this platform is equipped with a motion sensor. The valid values are true and false.
camera	Whether or not this platform is equipped with a camera. The valid values are true and false
wireless	Whether or not this platform is equipped with a wireless module. The valid values are true and false

4.4.4.2 Connect Response

```
{
   "jsonrpc":"2.0",
   "result":{
      "sent_on":1424976117309,
      "facility_id":"Store57"
      "software_repos": [
         "https://rsp-repo.local:80/all",
         "https://rsp-repo.local:80/armv7at2hf-neon",
         "https://rsp-repo.local:80/armv7at2hf-neon-mx6qdl",
         "https://rsp-repo.local:80/hx000"
      ],
      "ssh_public_key": "ecdsa-sha2-nistp521
AAAAE2VjZHNhLXNoYTItbmlzdHA1MjEAAAAIbmlzdHA1MjEAAACFBAH3SaiN50uYdhrYG7h
BqpG3PL26FDiyW6/EXFLEhsABoLayyM+tAOztaOshQgtlIkJdCBTPmvp6skg9pPQtTrj5bw
COwjTLRr8j7lA+puWp7TOYAxefxHK+ShSXxdX0cT25WUPO+h5OypUTbHuzAqc5XNpY02j6m
P+PzbesyKTQkzcsBQ== tshockley@tshock-U16"
   },
   "id":"12345"
}
```

Table 11 Connect Response Parameters

Parameter	Definition
sent_on	The millisecond timestamp of this response.
facility_id	The ID string if the facility assigned to this RSP.
software_repos	A list of strings representing the software repositories.
ssh_public_key	The public key used for SSH access. This key replaces the manufacturer’s public key.

4.4.5 Retrieving the Capabilities of the Intel® RFID Sensor Platform

The Get State Request message provides the Gateway with a mechanism to get capabilities and current state of the Intel® RFID Sensor Platform. Below is the JSON schema and parameter definitions for the Request and Response.

4.4.5.1 Get State Request

```
{
   "jsonrpc":"2.0",
   "method":"get_state",
   "id":"12345"
}
```

4.4.5.2 Get State Response

```
{
   "jsonrpc":"2.0",
   "result":{
      "device_id":"RSP-5a778d",
      "hwaddress":"98:4f:ee:5a:77:8d",
      "app_version":"1.0.0",
      "module_version":"1.1.0",
      "num_physical_ports":1,
      "motion_sensor":true,
      "camera":false,
      "wireless":false,
      "configuration_state":"Default"
      "operational_state":"Idle"
   },
   "id":"12345"
}
```

Table 12 Get State Response Parameters

Parameter	Definition
device_id	The ID string assigned to this device.
hwaddress	The MAC address of the interface in use.
app_version	The version string of the Intel® RFID Sensor Platform application.
module_version	The version string of the embedded RFID module.
num_physical_ports	The number of antenna ports available on this device.
motion_sensor	Whether or not this platform is equipped with a motion sensor. The valid values are true and false.
camera	Whether or not this platform is equipped with a camera. The valid values are true and false.
wireless	Whether or not this platform is equipped with a wireless module. The valid values are true and false

4.4.6 Setting the Antenna Configuration

The Intel® RFID Sensor Platform is capable of storing up to 8 different virtual antenna port configurations. Each virtual port configuration is mapped to one of the physical antenna ports of the Intel® RSP. This message allows the Gateway to configure just one or all eight ports in a single JSON message. Below is the JSON schema and parameter definitions for the Request and Response.

4.4.6.1 Set Antenna Configuration Request

```
{
   "jsonrpc":"2.0",
   "method":"set_antenna_config",
   "params":[
      {
         "index":0,
         "state":"Enabled",
         "power_level":31.5,
         "dwell_time":1000,
         "inv_cycles":0,
         "physical_port":0
      },
      {
         "index":1,
         "state":"Disabled",
         "power_level":30.5,
         "dwell_time":5000,
         "inv_cycles":0,
         "physical_port":0
      },
      {
         "index":2,
         "state":"Enabled",
         "power_level":25.5,
         "dwell_time":0,
         "inv_cycles":200,
         "physical_port":1
      },
      {
         "index":3,
         "state":"Disabled",
         "power_level":25.5,
         "dwell_time":0,
         "inv_cycles":100,
         "physical_port":1
      }
   ],

   "id":"12345"
}
```

Table 13 Set Antenna Configuration Request Parameters

Parameter	Definition
index	The virtual antenna port being configured. The valid range is 0 – 7.
state	The state of the virtual port being configured. The valid values are “Enabled" and “Disabled".
power_level	The power output level in dBm of the virtual port being configured (0.1 dB resolution steps). The valid range is 0 – 31.5.
dwell_time	The maximum amount of time (ms) spent on this virtual port before switching to the next virtual port during an inventory cycle. If this parameter is zero, the “inv_cycles" parameter may not be zero. The valid range is 0 – 65535.
inv_cycles	The maximum amount of inventory cycles to attempt on this virtual port before switching to the next virtual port during an inventory cycle. If this parameter is zero, the “dwell_time" parameter may not be zero. The valid range is 0 – 65535.
physical_port	The physical antenna port this virtual port is mapped to. The valid range is 0 – “num_physical_ports".

4.4.6.2 Set Antenna Configuration Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.7 Setting Select Criteria

The Intel® RFID Sensor Platform allows the Gateway to partition a large tag population into smaller ones by filtering on certain portions of the tags memory banks, then toggling flag bits to prevent selected tags from responding again within a given session; this is done by sending the Intel® RFID Sensor Platform tag “select". Below is the JSON schema and parameter definitions for the Request and Response.

4.4.7.1 Set Select Request

```
{
   "jsonrpc":"2.0",
   "method":"set_select",
   "params":{
      "criteria_index":0,
      "active_state":"Enabled",
      "bank":"RESERVED",
      "offset":0,
      "mask_length":96,
      "mask_data":"0x30143639F8419145BEEF0130",
      "target_flag":"S1",
      "action":"A_B"
   },
   "id":"12345"
}
```

Table 14 Select Request Parameters

Parameter	Definition
criteria_index	The particular set of select criteria being configured. The valid values are 0 – 7.
active_state	The state of select criteria specified by “criteria_index". The valid values are “Enabled" and “Disabled".
bank	The memory bank whose contents are to be compared against the mask data. The valid values are: “RESERVED", “EPC", “TID" and “USER".
offset	The offset in bits, from the start of the memory bank, to apply against the tag mask. If offset falls beyond the end of the memory bank, the tag is considered non-matching.
mask_length	The length of the tag mask in bits. A length of zero will cause all tags to match. The mask is a 256-bit value so the valid range of this parameter is 0 – 256.
mask_data	A String representing the select mask.
target_flag	The specific flag being targeted for modification according to the “action" field. The valid values are: “S0", “S1", “S2", “S3" and “SL".

<table>
<tr><td>action</td><td>A String specifying the action applied to the tag population.
<table>
<tr><td>Action</td><td>Tag Mask Match</td><td>Tag Mask No Match</td></tr>
<tr><td>“A_B"</td><td>Assert SL or set “target_flag" to “A"</td><td>Deassert SL or set “target_flag" to “B"</td></tr>
<tr><td>“A_NONE"</td><td>Assert SL or set “target_flag" to “A"</td><td>No action</td></tr>
<tr><td>“NONE_B"</td><td>No action</td><td>Deassert SL or set “target_flag" to “B"</td></tr>
<tr><td>“INVERT_NONE"</td><td>Invert “target_flag"</td><td>No action</td></tr>
<tr><td>“B_A"</td><td>Deassert SL or set “target_flag" to “B"</td><td>Assert SL or set “target_flag" to “A"</td></tr>
<tr><td>“B_NONE"</td><td>Deassert SL or set “target_flag" to “B"</td><td>No action</td></tr>
<tr><td>“NONE_A"</td><td>No action</td><td>Assert SL or set “target_flag" to “A"</td></tr>
<tr><td>“NONE_INVERT"</td><td>No action</td><td>Invert “target_flag"</td></tr>
</table>
</td></tr>
</table>

4.4.7.2 Set Select Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.8 Setting Post Singulation Match Criteria

The Intel® RFID Sensor Platform allows the Gateway to filter the tag data based on EPC value by configuring Post Singulation Match Criteria. Below is the JSON schema and parameter definitions for the Request and Response.

4.4.8.1 Set Post Match Request

```
{
   "jsonrpc":"2.0",
   "method":"set_post_match",
   "params":{
      "match_state":"Include",
      "offset":0,
      "mask_length":96,
      "mask_data":"0x30143639F8419145BEEF0130"
   },
   "id":"12345"
}
```

Table 15 Set Post MatchRequest Parameters

Parameter	Definition
match_state	Determines if the associated tag-protocol operation will be applied to tags that match the mask or not. The valid values are "Include" and "Exclude".
offset	The offset in bits, from the start of the EPC, to apply against the mask. The valid range is 0 – 511.
mask_length	The length of the tag mask in bits. A length of zero will cause all tags to match. The mask is a 256-bit value so the valid range of this parameter is 0 – 255.
mask_data	A String representing the EPC mask.

4.4.8.2 Set Post Match Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.9 Apply Behavior

The Intel® RFID Sensor Platform supports this macro to apply all of the non-tag filtering parameters and start reading all in one command. Below is the JSON schema and parameter definitions for the Request and Response.

4.4.9.1 Apply Behavior Request

```
{
   "jsonrpc":"2.0",
   "method":"apply_behavior",
   "params":{
      "action":"START",
      "action_time":1424976117309,
      "behavior":{
         "id":"DefaultBehavior",
         "operation_mode":"NonContinuous",
         "inventory_mode":"EPConly",
         "link_profile":1,
         "power_level":30.5,
         "dwell_time":5000,
         "inv_cycles":0,
         "selected_state":"Any",
         "session_flag":"S1",
         "target_state":"A",
         "q_algorithm":"Dynamic",
         "fixed_q_value":10,
         "repeat_until_no_tags":false,
         "start_q_value":3,
         "min_q_value":3,
         "max_q_value":15,
         "retry_count":1,
         "threshold_multiplier":7,
         "toggle_target_flag":true,
         "toggle_mode":"OnInvCycle",
         "perform_select":false,
         "perform_post_match":false,
         "filter_duplicates":false,
         "auto_repeat":true,
         "delay_time":0
      }
   },
   "id":"12345"
}
```

Table 16 Apply Behavior Parameters

Parameter	Definition
action	Specifies the action to be taken. The valid values are “START" and “STOP".
action_time	Specifies the millisecond epoch time to apply the behavior. If zero or not included, the behavior is applied immediately.
behavior	Optional set of behavior parameters (see below).
id	The ID string assigned to this behavior
operation_mode	The embedded RFID module transmit operation mode. The valid values are "Continuous" and "NonContinuous". The default value is "NonContinuous".
inventory_mode	The embedded RFID module inventory mode. The valid values are "EPConly" and "EPCplusTID". The default value is "EPConly".
link_profile	The RF Link Profile to be used for this behavior. (see Table 17 Link Profile Parameters) The valid range is 0 – 4.
power_level	The power output level in dBm to be used for this behavior. The valid range is 0 – 31.5.
dwell_time	The maximum amount of time (ms) spent on a particular virtual port before switching to the next virtual port during an inventory cycle. If this parameter is zero, the “inv_cycles" parameter may not be zero. The valid range is 0 – 65535.
inv_cycles	The maximum amount of inventory cycles to attempt on a particular virtual port before switching to the next virtual port during an inventory cycle. If this parameter is zero, the “dwell_time" parameter may not be zero. The valid range is 0 – 65535.
selected_state	Specifies the state of the “SL" flag to be used for this behavior when specifying a select protocol operation. The valid values are: “Any", “Deasserted" and “Asserted".
session_flag	Specifies which inventory session flag is matched against the state specified by “target_state". The valid values are “S0", “S1", “S2", “S3”.
target_state	Specifies the state of the inventory session flag specified by “session_flag" that are to apply the subsequent tag protocol operation. The valid values are “A" and “B".
q_algorithm	The specific Q algorithm being configured. The valid values are “Fixed" and “Dynamic". When using a “Fixed" algorithm, the number of time slots is 2^Q. When using a “Dynamic" algorithm, the Smart Sensor Platform’s embedded module will vary the number of slots dynamically based on the number of tags responding.

fixed_q_value	The fixed Q value to use (valid when q_algorithm = Fixed). The valid range of this parameter is 0 – 15.
repeat_until_no_tags	Specifies whether or not the singulation algorithm should continue until no more tags are singulated. The valid values are “true" or “false".
start_q_value	The initial Q value to use at the beginning of an inventory round (valid when q_algorithm = Dynamic). The valid range of this parameter is 0 – 15.
min_q_value	The minimum Q value that would ever be used during an inventory round (valid when q_algorithm = Dynamic). The valid range of this parameter is 0 – 15.
max_q_value	The maximum Q value that would ever be used during an inventory round (valid when q_algorithm = Dynamic). The valid range of this parameter is 0 – 15.
threshold_multiplier	A 4X multiplier applied to the Q-adjustment threshold as part of the dynamic-Q algorithm. The valid range of this parameter is 0 – 255.
retry_count	The number of times to try another execution of the singulation algorithm before either toggling the target flag or terminating the operation. The valid range of this parameter is 0 – 255.
toggle_target_flag	Specifies whether or not to toggle the targeted flag. The valid values are “true" or “false".
toggle_mode	When toggle_target_flag is true, this value specifies when to toggle the targeted flag. The valid values are “None”, “OnInvCycle", OnInvRound”, or “OnReadRate".
perform_select	Specifies whether or not to perform a select command based on the previously configured criteria (see 0). The valid values are “true" and “false".
perform_post_match	Specifies whether or not to perform a post singulation match based on the previously configured criteria (see 0). The valid values are “true" and “false".
filter_duplicates	Specifies whether or not the Intel® RFID Sensor Platform should filter out duplicate tag information before sending to the Gateway. The valid values are “true" or “false".

4.4.9.2 Apply Behavior Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

Table 17 Link Profile Parameters

Parameter / Profile Index	0	1	2	3	4
Modulation Type	DSB-ASK	PR-ASK	PR-ASK	DSB-ASK	DSB-ASK
Tari Duration (us)	25	25	25	6.25	6.25
Data 0/1 Difference	1	0.5	0.5	0.5	0.5
Pulse Width (us)	12.5	12.5	12.5	3.13	3.13
R-T Calculation (us)	75	62.5	62.5	15.63	15.63
T-R Calculation (us)	200	85.33	71.11	20	33.33
Divide Ratio	8	21.33	21.33	8	21.33
Data Encoding	FM0	Miller-4	Miller-4	FM0	FM0
Pilot Tone	1	1	1	1	1
Link Frequency (kHz)	40	250	300	400	640
Data Rate (kbps)	40	62.5	75	400	640

Table 18 Session Flag Persistence Values

Session	Tag Energized	Tag Not Energized
S0	Indefinite	None
S1	500 ms < persistence < 5 s	2 s < persistence
S2	Indefinite	2 s < persistence
S3	Indefinite	2 s < persistence

4.4.10 Performing a Simple Inventory

The Intel® RFID Sensor Platform provides the Gateway a means of executing single or multiple inventory rounds using the default parameters and previously configured select or post-match criteria. Below is the JSON schema and parameter definitions for the Request and Response.

4.4.10.1 Inventory Start Request

```
{
   "jsonrpc":"2.0",
   "method":"start_inventory",
   "params":{
      "perform_select":true,
      "perform_post_match":false,
      "filter_duplicates":false,
      "auto_repeat":false,
      "delay_time":0
   },
   "id":"12345"
}
```

Table 19 Single Inventory Request Parameters

Parameter	Description
perform_select	Specifies whether or not to perform a select command based on the previously configured criteria (see 0). The valid values are “true” and “false”.
perform_post_match	Specifies whether or not to perform a post singulation match based on the previously configured criteria (see 0). The valid values are “true” and “false”.
filter_duplicates	Specifies whether or not the Intel® RFID Sensor Platform should filter out duplicate tag information before sending to the Gateway. The valid values are “true” and “false”.
auto_repeat	Specifies whether or not to continue performing inventory rounds until the “stop_inventory" command is received. The valid values are “true” and “false”.
delay_time	The amount of time (ms) that the transmitter is turned off between subsequent inventory rounds. Used when "auto_repeat" is true to control the transmit duty cycle. The valid range is 0 – 65535.

4.4.10.2 Inventory Start Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.11 Stopping an Inventory In-Progress

The Gateway can command the Intel® RFID Sensor Platform to stop the current inventory round in process to end all auto repeat functionality. Below is the JSON schema and parameter definitions for the Request and Response.

4.4.11.1 Inventory Stop Request

```
{
   "jsonrpc":"2.0",
   "method":"stop_inventory",
   "id":"12345"
}
```

4.4.11.2 Inventory Stop Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.12 Reading from Tag Memory

The Intel® RFID Sensor Platform provides a macro command for the Gateway to read the contents of a specific EPC Gen2 tag memory bank using the default parameters. Below is the JSON schema and parameter definitions for the Tag Read Request and Response.

4.4.12.1 Tag Read Memory Request

```
{
   "jsonrpc":"2.0",
   "method":"tag_read_memory",
   "params":{
      "epc":"30143639F8419145BEEF0103",
      "password":0x12345678,
      "bank":"USER",
      "word_offset":0,
      "word_count":12,
      "retry_count":0
   },
   "id":"12345"
}
```

Table 20 Tag Read Memory Request Parameters

Parameter	Definition
epc	The EPC of the tag being interrogated.
password	The 32-bit access password.
Bank	The memory bank to read from. The valid values are: “TID", “USER" and “RESERVED”.
word_offset	The offset from the start of the memory bank, in units of 16-bit words (0 – 31).
word_count	The number of 16-bit words to read (1 – 32).
retry_count	The number of times to try another execution of the singulation algorithm before either toggling the target flag or terminating the operation. The valid range of this parameter is 0 – 255.

4.4.12.2 Tag Read Memory Response

```
{
   "jsonrpc":"2.0",
   "result":{
      "sent_on":1424976117309,
      "data":"0x1234567890ABCDEF"
   },
   "id":"12345"
}
```

Table 21 Tag Read Memory Response Parameters

Parameter	Definition
sent_on	The millisecond timestamp of this response.
data	A string representing data read from the tag memory

4.4.13 Writing to Tag Memory

The Intel® RFID Sensor Platform provides a macro command for the Gateway to read the contents of a specific EPC Gen2 tag memory bank using the default parameters. Below is the JSON schema and parameter definitions for the Tag Read Request and Response.

4.4.13.1 Tag Write Memory Request

```
{
   "jsonrpc":"2.0",
   "method":"tag_write_memory",
   "params":{
      "epc":"100000000000000000000002A1",
      "password":0x12345678,
      "bank":"USER",
      "word_offset":0,
      "retry_count":0,
      "data":"0x1234567890ABCDEF"
   },
   "id":"12345"
}
```

Table 22 Tag Write Memory Request Parameters

Parameter	Definition
epc	The EPC of the tag being addressed.
password	The 32-bit access password.
bank	The memory bank to write to. The valid values are: "TID", "USER" and "RESERVED".
word_offset	The offset from the start of the memory bank, in units of 16-bit words (0 – 31).
retry_count	The number of times to try another execution of the singulation algorithm before either toggling the target flag or terminating the operation. The valid range of this parameter is 0 – 255.
data	A string representing the data to be written to tag memory

4.4.13.2 Tag Write Memory Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.14 Retrieving the Tag Database Information

The Intel® RFID Sensor Platform has the capability of locally storing information regarding all the tags it has seen since the last database flush. This command allows the Gateway to retrieve this database as well as flush its contents. Below is the JSON schema and parameter definitions for the Request and Response.

4.4.14.1 Get Tag Database Request

```
{
   "jsonrpc":"2.0",
   "method":"get_tag_database",
   "params":{
      "flush_database":true
   },
   "id":"12345"
}
```

Table 23 Tag Database Request Parameters

Parameter	Definition
flush_database	Specifies whether or not to flush the contents of the Intel® RFID Sensor Platform Tag Database after sending the response. The valid values are “true” and “false”.

4.4.14.2 Get Tag Database Response

```
{
   "jsonrpc":"2.0",
   "result":{
      "sent_on":1424976117309,
      "device_id":"RSP-abcdef",
      "facility_id":"CH11",
      "data":[
         {
            "epc":"100000000000000000002A1",
            "ant_port":0,
            "last_read":1424976118798,
            "seen_count":1253,
            "avg_rssi":-719
         },
         {
            "epc":"100000000000000000002A3",
            "antenna_id":0,
            "last_read_on":1424976118906,
            "seen_count":387,
            "avg_rssi":-563
         }
      ]
   },
   "id":"12345"
}
```

Table 24 Tag Database Response Parameters

Parameter	Definition
sent_on	The millisecond timestamp of this indication.
device_id	The ID assigned to the reporting Intel® RFID Sensor Platform.
facility_id	The ID assigned to the facility where the reporting Intel® RFID Sensor Platform is located.
data	An array of RFID tag records.

Each Data record contains the following fields.

epc	The EPC of the tag associated with this record.
ant_port	The physical antenna port used to discover this tag.
first_read	The millisecond timestamp of the first measurement.
last_read	The millisecond timestamp of the last measurement.
seen_count	The number of times this tag was read by this device.
rssi	The average strength in 0.1 dBm of the received backscatter signal from the RFID tag.

4.4.15 Retrieving Built-In-Self-Test (BIST) Information

The Intel® RFID Sensor Platform has a Built-In-Self-Test (BIST) mechanisms to provide the Gateway with health status and performance monitoring capabilities.   Below is the JSON schema and parameter definitions for the Request and Response.

4.4.15.1 Get BIST Results Request

```
{
   "jsonrpc":"2.0",
   "method":"get_bist_results",
   "id":"12345"
}
```

4.4.15.2 Get BIST Results Response

```
{
   "jsonrpc":"2.0",
   "result":{
      "rf_module_error":false,
      "rf_status_code":0,
      "rf_module_temp":37,
      "ambient_temp":24,
      "time_alive":534762,
      "cpu_usage":23,
      "mem_used_percent":37,
      "mem_total_bytes":1017576,
      "camera_installed":false,
      "temp_sensor_installed":true,
      "accelerometer_installed":true,
      "region":"USA",
      {
         "port":0,
         "forward_power_dbm10":240,
         "reverse_power_dbm10":-17,
         "connected":true
      },{
         "port":1,
         "forward_power_dbm10":240,
         "reverse_power_dbm10":-10,
         "connected":true
      },{
         "port":2,
         "forward_power_dbm10":240,
         "reverse_power_dbm10":240,
         "connected":false
      },{
         "port":3,
         "forward_power_dbm10":240,
         "reverse_power_dbm10":240,
         "connected":false
      },
      "device_moved":false
   },
   "id":"12345"
}
```

Table 25 Get BIST Results Response Parameters

Parameter	Definition
rf_module_error	Error in the Intel® RFID Sensor Platform's embedded RFID module. The valid values are true and false.
rf_status_code	The error status code returned from the RFID module. See Impinj® Indy® MAC Error Code Definitions.
ambient_temp	Temperature in degrees Celsius as measured on the periphery of the Intel® RFID Sensor Platform circuit board.
rf_module_temp	Temperature in degrees Celsius as measured near the power amplifier (PA) of the embedded RFID module.
time_alive	Time in milliseconds since the last Linux boot of the Intel® RFID Sensor Platform.
cpu_usage	Total CPU utilization in percent, averaged over the last one second.
mem_used_percent	Total processor memory utilization (%).
mem_total_bytes	Total memory installed in bytes.
camera_installed	The valid values are true and false.
temp_sensor_installed	The valid values are true and false.
accelerometer_installed	The valid values are true and false.
region	A string representing the currently configured Geographic Region.
device_moved	The pointing angle of the Intel® RFID Sensor Platform has changed. The valid values are "true and false.

A list of four RF Port Status Fields.

port	The RF antenna port currently being reported. The valid values are 0 – 3.
forward_power_dbm10	The forward power measured by the embedded module in units of 10ths of a dBm. The valid values range from 0 to 315.
reverse_power_dbm10	The reverse power measured by the embedded module in units of 10ths of a dBm. The valid values range from 0 to 315.
connected	A Boolean value indicating whether or not this antenna port is properly connected. The valid values are "true and false.

4.4.16 Set Device Alert

The Intel® RFID Sensor Platform Built-In-Self-Test (BIST) can be configured to provide the Gateway with a Device Alert Indication whenever a configured threshold has been exceeded. Where appropriate, the Gateway can configure multiple thresholds for each alert type, one for each severity level. Below are the definitions and example JSON schema for the Request and Response.

4.4.16.1 Set Device Alert Request

```
{
   "jsonrpc":"2.0",
   "method":"set_device_alert",
   "params":[
      {
         "alert_number":103,
         "severity":"warning",
         "threshold":80,
         "acknowledge":false,
         "mute":false
      },
      {
         "alert_number":103,
         "severity":"urgent",
         "threshold":90,
         "acknowledge":false,
         "mute":false
      },
      {
         "alert_number":101,
         "severity":"critical",
         "threshold":80,
         "acknowledge":false,
         "mute":false
      },
      {
         "alert_number":151,
         "severity":null,
         "threshold":null,
         "acknowledge":false,
         "mute":true
      }
   ],
   "id":"12345"

}
```

Table 26 Set Device Alert Request

Parameter	Definition
alert_number	The unique number identifying the type of alert. The valid range is 100 – 199. 100 – RfModuleError (Boolean) 101 – HighAmbientTemp (degrees C) 102 – HighCpuTemp (degrees C) 103 – HighCpuUsage (% utilization) 104 – HighMemoryUsage (% of max memory) 151 – DeviceMoved (Boolean)
severity	The prioritized severity level being configured. The valid range of values is… "info", "warning", "urgent", and "critical".
threshold	The value above/below, which will trigger the alert. If the alert is Boolean, a value of 0 indicates to send the alert when the tested condition is false and a value of 1 indicates to send the alert when the tested condition is true.
acknowledge	Temporarily silence current alerts of this type. The valid values are true and false.
mute	Silence current and future alerts of this type. The valid values are true and false.

4.4.16.2 Set Device Alert Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.17 Set Alert Thresholds

The Intel® RFID Sensor Platform Built-In-Self-Test (BIST) can be configured to provide the Gateway with a Device Alert Indication whenever a configured threshold has been exceeded. Below are the definitions and example JSON schema for the Request and Response.

4.4.17.1 Set Alert Threshold Request

```
{
   "jsonrpc":"2.0",
   "method":"set_alert_threshold",
   "params":{
      "alert_number":103,
      "severity":"warning",
      "threshold":80
   },
   "id":"12345"
}
```

Table 27 Set Alert Threshold Request

Parameter	Definition
alert_number	The unique number identifying the type of alert. The valid range is 100 – 199. 100 – RfModuleError (Boolean) 101 – HighAmbientTemp (degrees C) 102 – HighCpuTemp (degrees C) 103 – HighCpuUsage (% utilization) 104 – HighMemoryUsage (% of max memory) 151 – DeviceMoved (Boolean)
severity	The prioritized severity level being configured. The valid range of values is… "info", "warning", "urgent", and "critical".
threshold	The value above/below, which will trigger the alert. If the alert is Boolean, a value of 0 indicates to send the alert when the tested condition is false and a value of 1 indicates to send the alert when the tested condition is true.

4.4.17.2 Set Alert Threshold Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.18 Acknowledge Alert

The Gateway may temporarily acknowledge or completely mute a Device Alert when it occurs. Below are the definitions and example JSON schema for the Request and Response.

4.4.18.1 Acknowledge Alert Request

```
{
   "jsonrpc":"2.0",
   "method":"ack_alert",
   "params":{
      "alert_number":103,
      "acknowledge":true,
      "mute":false
   },
   "id":"12345"
}
```

Table 28 Acknowledge Alert Request

Parameter	Definition
alert_number	The unique number identifying the type of alert. The valid range for the Intel® RFID Sensor Platform is 100 – 199. 100 – RfModuleError (Boolean) 101 – HighAmbientTemp (degrees C) 102 – HighCpuTemp (degrees C) 103 – HighCpuUsage (% utilization) 104 – HighMemoryUsage (% of max memory) 151 – DeviceMoved (Boolean)
acknowledge	Temporarily silence current alerts of this type. The valid values are true and false.
mute	Silence current and future alerts of this type. The valid values are true and false.

4.4.18.2 Acknowledge Alert Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.19 Set Motion Event

The Intel® RFID Sensor Platform can be configured to provide the Gateway with Motion Event Indications as defined in section 4.4.27. This command allows the Gateway to unsubscribe from the motion event. Below is the JSON schema and parameter definitions for the Request and Response.

4.4.19.1 Set Motion Event Request

```
{
   "jsonrpc":"2.0",
   "method":"set_motion_event",
   "params":{
      "send_events":true,
      "capture_images":true
   },
   "id":"12345"
}
```

Table 29 Set Motion Event Parameters

Parameter	Definition
send_events	Specifies whether or not the Intel® RFID Sensor Platform will send the "motion_event" indication when it detects heat in motion. The valid values are true and false. The default value is true.
capture_images	Specifies whether or not the Intel® RFID Sensor Platform will also capture an image (if camera equipped) using the default camera settings. The valid values are true and false. The default value is true.

4.4.19.2 Set Motion Event Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.20 SW Version Information

The Intel® RFID Sensor Platform can provide the Gateway with software version information on request. Below is the JSON schema and parameter definitions for the Request and Response.

4.4.20.1 Get SW Version Request

```
{
   "jsonrpc":"2.0",
   "method":"get_sw_version",
   "id":"12345"
}
```

Table 30 Get SW Version Response Parameters

Parameter	Definition
app_version	The version string of the Intel® RFID Sensor Platform application.
module_version	The version string of the embedded RFID module.

4.4.20.2 Get SW Version Response

```
{
   "jsonrpc":"2.0",
   "result":{
      "app_version":"1.0.0",
      "module_version":"1.1.0"
   },
   "id":"12345"
}
```

4.4.21 Loading the Default Configuration

The Intel® RFID Sensor Platform provides the Gateway with a means of returning all settings to their default value. Below is the JSON schema for the Request and Response.

4.4.21.1 Load Defaults Request

```
{
   "jsonrpc":"2.0",
   "method":"load_defaults",
   "id":"12345"
}
```

4.4.21.2 Load Defaults Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.22 Visual Indicator

The Intel® RFID Sensor Platform provides a mechanism for the Gateway to control the state of the visual indicator (LED). Below is the JSON schema and parameter definitions for the Request and Response.

Table 31 Visual Indicator Request Parameters

Parameter	Definition
params	State of the Intel® RFID Sensor Platform LED indicator. The valid values are “Normal", "Beacon", “Disabled" and "Test".

4.4.22.1 Set LED Request

```
{
   "jsonrpc":"2.0",
   "method":"set_led",
   "params":"Disabled",
   "id":"12345"
}
```

4.4.22.2 Set LED Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.23 Intel® RSP Platform Control

The Intel® RFID Sensor Platform provides the Gateway with a small set of platform control messages. Below is the JSON schema for each Request type and the common Response.

4.4.23.1 Reset Request

```
{
   "jsonrpc":"2.0",
   "method":"reset",
   "id":"12345"
}
```

4.4.23.2 Reboot Request

```
{
   "jsonrpc":"2.0",
   "method":"reboot",
   "id":"12345"
}
```

4.4.23.3 Shutdown Request

```
{
   "jsonrpc":"2.0",
   "method":"shutdown",
   "id":"12345"
}
```

4.4.23.4 Common Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.24 Facility Identifier

The Intel® RFID Sensor Platform provides a unique Facility ID as part of its data, alert and event indications. This command allows the Gateway to set the Facility ID remotely. Below is the JSON schema and parameter definitions for the Request and Response.

Table 32 Set Facility ID Parameters

Parameter	Definition
facility_id	The ID string if the facility that this RSP is assigned to.

4.4.24.1 Set Facility Request

```
{
   "jsonrpc":"2.0",
   "method":"set_facility_id",
   "params":"levi505",
   "id":"12345"
}
```

4.4.24.2 Set Facility Response

```
{
   "jsonrpc":"2.0",
   "result":true,
   "id":"12345"
}
```

4.4.25 Device Alert Indication

Whenever a Built-In-Test failure or sensor event occurs, the Intel® RFID Sensor Platform will send the following “device_alert" indication to notify the Gateway. Below are the parameter definitions and an example JSON schema for the Indication.

Table 33 Device Alert Parameters

Parameter	Definition
sent_on	The millisecond timestamp of this indication.
device_id	The ID assigned to the reporting Intel® RFID Sensor Platform.
facility_id	The ID assigned to the facility where the reporting Intel® RFID Sensor Platform is located.
alert_number	A unique number identifying the type of alert. The valid range for the Intel® RFID Sensor Platform is 100 – 200. 100 – RfModuleError 101 – HighAmbientTemp 102 – HighCpuTemp 103 – HighCpuUsage 104 – HighMemoryUsage 151 – DeviceMoved
alert_description	A corresponding human readable text description.
severity	A prioritized severity level of the alert. The valid range of values is… "info", "warning", "urgent", and "critical".
optional	A series of optional number or string parameters providing further information about the alert.

```
{
   "jsonrpc":"2.0",
   "method":"device_alert",
   "params":{
      "sent_on":1424976117309,
      "device_id":"RSP-abcdef",
      "facility_id":"CH11",
      "alert_number":100,
      "alert_description":"RfModuleError",
      "severity":"warning",
      "optional":{
         "string":"MTI_Error",
         "number":769
      }
   }
}
```

4.4.26 Heartbeat Indication

Every 30 seconds, the Intel® RFID Sensor Platform will send a Heartbeat Indication according to the following JSON schema.

Table 34 Heartbeat Indication Parameters

Parameter	Definition
sent_on	The millisecond timestamp of this indication.
device_id	The ID assigned to the reporting Intel® RFID Sensor Platform.
facility_id	The ID assigned to the facility where the reporting Intel® RFID Sensor Platform is located.
location	*deprecated*
video_url	The url where the video is available for viewing. This field is only present when streaming video is available.

```
{
   "jsonrpc":"2.0",
   "method":"heartbeat",
   "params":{
      "sent_on":1424976117309,
      "device_id":"RSP-abcdef"
      "facility_id":"CH11",
      "location":{},
      "video_url":null
   }
}
```

4.4.27 Motion Event Indication

When the Intel® RFID Sensor Platform detects heat in motion, it notifies the Gateway with the following JSON schema.

Table 35 Motion Event Indication Parameters

Parameter	Definition
sent_on	The millisecond timestamp of this indication.
device_id	The ID assigned to the reporting Intel® RFID Sensor Platform.
facility_id	The ID assigned to the facility where the reporting Intel® RFID Sensor Platform is located.
image_resolution	*deprecated*
image_url	*deprecated*
location	*deprecated*

```
{
   "jsonrpc":"2.0",
   "method":"motion_event",
   "params":{
      "sent_on":1424976117309,
      "device_id":"RSP-5a778d",
      "facility_id":"CH11",
      "image_resolution":null,
      "image_url":null,
      "location": {}
   }
}
```

4.4.28 Status Indication

The Intel® RFID Sensor Platform supports sending operational status indications to the Gateway according to the following JSON schema.

Table 36 Status Indication Parameters

Parameter	Definition
sent_on	The millisecond timestamp of this indication.
device_id	The ID assigned to the reporting Intel® RFID Sensor Platform.
facility_id	The ID assigned to the facility where the reporting Intel® RFID Sensor Platform is located.
status	The reported status of the Intel® RFID Sensor Platform. The possible values are “ready", “in_reset", “shutting_down", "firmware_update" and “lost".

```
{
   "jsonrpc":"2.0",
   "method":"status_update",
   "params":{
      "sent_on":1424976117309,
      "device_id":"RSP-abcdef",
      "facility_id":"CH11",
      "status":"ready"
   }
}
```

The “lost" status message originates from the MQTT Broker. It is registered during power-on as the “Last Will and Testament".

4.4.29 Inventory Data Indication

The Intel® RFID Sensor Platform sends inventory data indications to the Gateway during the execution of each inventory round. The data indication follows the JSON schema shown below. The example contains three unique tag records.

Table 37 Inventory Data Indication Parameters

Parameter	Definition
sent_on	The millisecond timestamp of this indication.
period	The period in milliseconds over which these tag reads were collected.
device_id	The ID assigned to the reporting Intel® RFID Sensor Platform.
facility_id	The ID assigned to the facility where the reporting Intel® RFID Sensor Platform is located.
location	*deprecated*
motion_detected	A Boolean field that represents whether or not the Intel® RSP was detecting motion during the period specified above.
data	An array of RFID tag records.

Each Data record contains the following fields.

epc	The EPC of the tag associated with this record.
tid	The TID of the tag associated with this record. This field is null when the inventory_mode is EPConly.
antenna_id	The physical antenna port used to discover this tag.
last_read_on	The millisecond timestamp of the last measurement.
rssi	A signed value representing the receive signal strength in units of 0.1 dBm of the backscatter signal from the RFID tag.
phase	The signed 7-bit phase offset of the received backscatter signal from the RFID tag. Valid range is from -64 to 63.
frequency	The frequency in kHz of the received backscatter signal from the RFID tag.

```
{
   "jsonrpc":"2.0",
   "method":"inventory_data",
   "params":{
      "sent_on":1424976117309,
      "period":500,
      "device_id":"RSP-abcdef",
      "facility_id":"MainStore",
      "location":{},
      "motion_detected":true,
      "data":[
         {
            "epc":"100000000000000000000002A1",
            "tid":"E28011606000020BCEC36DC1",
            "antenna_id":0,
            "last_read_on":1424976117295,
            "rssi":-582,
            "phase":63,
            "frequency":902750
         },
         {
            "epc":"100000000000000000000002A2",
            "tid":"E28011606000020BCEC36DD1",
            "antenna_id":1,
            "last_read_on":1424976117345,
            "rssi":-531,
            "phase":63,
            "frequency":902750
         },
         {
            "epc":"100000000000000000000002A3",
            "tid":"E28011606000020BCEC36DE1",
            "antenna_id":0,
            "last_read_on":1424976117486,
            "rssi":-649,
            "phase":46,
            "frequency":902750
         }
      ]
   }
}
```

4.4.30 Inventory Complete Indication

When the Gateway initiates a scan using either the "start_inventory" command or the "filter_inventory" command and the "auto_repeat" parameter is set to "No", the Intel® RFID Sensor Platform (Intel® RSP) will send an Inventory Complete Indication upon completion of the single inventory round according to the following JSON schema.

Table 38 Inventory Complete Indication Parameters

Parameter	Definition
sent_on	The millisecond timestamp of this indication.
device_id	The ID assigned to the reporting Intel® RFID Sensor Platform (Intel® RSP).
facility_id	The ID assigned to the facility where the reporting Intel® RFID Sensor Platform (Intel® RSP) is located.

```
{
   "jsonrpc":"2.0",
   "method":"inventory_complete",
   "params":{
      "sent_on":1424976117309,
      "device_id":"RSP-abcdef",
      "facility_id":"CH11"
   }
}
```

4.4.31 Gateway Status Indication

The Gateway may announce a status update to the population of Intel® RFID Sensor Platform Platforms by sending the following JSON schema.

Table 39 Gateway Status Indication Parameters

Parameter	Definition
sent_on	The millisecond timestamp of this indication. When reporting a status of "lost", this field is optional.
device_id	The ID assigned to the reporting device.
status	The reported status of the Gateway. The possible values are “ready", “in_reset", “shutting_down", "firmware_update" and “lost".

```
{
   "jsonrpc":"2.0",
   "method":"gw_status_update",
   "params":{

      "sent_on":1424976117309,
      "device_id":"RSDGW11",

      "status":"ready"

   }
}
```

The “lost" status message originates from the MQTT Broker. Its contents are registered during power-on as the “Last Will and Testament".