



# SPEEDWAY™

## USER GUIDE

Speedway Reader IPJ-R1000 for UHF Gen 2 RFID

- EPCglobal™ certified for dense-reader operation
- High-performance software radio architecture for maximum flexibility
- Monostatic antennas for low-cost deployment
- Patented interference rejection combined with high sensitivity ensures highest possible read reliability
- Gen 2 certified for compliance and interoperability



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**Impinj®**

USER GUIDE

## Speedway Reader IPJ-R1000 for UHF Gen 2 RFID

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### Overview

The EPCglobal™-certified Speedway™ IPJ-R1000 reader is a stationary UHF Gen 2 RFID tag reader that provides network connectivity between tag data and enterprise system software.

A key element of Impinj's GrandPrix™ RFID system solution, the Speedway reader is the first high-performance reader designed from the ground up to support the EPCglobal Gen 2 standard in its entirety, including: the accommodation of 640 kbps tag-to-reader data rates, robust performance in dense-reader environments (without the requirement for network synchronization), the elimination of ghost reads, and more. Combined with an extensible architecture that supports seamless integration of field-upgradeable, third party application software, the Speedway reader is the most adaptable reader solution available today.

This user guide provides instructions on how to install, connect, configure, operate, upgrade, and troubleshoot Speedway readers. It assumes the user is familiar with appropriate networking facilities, the EPCglobal Gen 2 specification, and general principles of RFID system management.

**Important** The user guide only covers readers having part numbers in the following format:  
IPJ-R1000-USA-N-NN-NN-NNN, IPJ-R1000-EU1-N-NN-NN-NNN, and IPJ-R1000-AS1-N-NN-NN-NNN.





## Federal Communications Commission (FCC) Compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Consult the dealer or a qualified radio/TV technician for assistance

**Caution** Changes to this product will void the user's authority to operate per FCC Part 15.

## Industry Canada (IC) Compliance

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

This device has been designed to operate with the antenna(s) listed in section 2.5 and having a maximum gain of 6 dB. Antennas not included in this list or having a gain greater than 6 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication.

Note: The term "IC:" before the radio certification number only signifies that Industry of Canada technical specifications were met.



## CE Marking and European Economic Area (EEA)

RFID devices designed for use throughout the EEA must have a maximum radiated transmit power of 2W ERP in the frequency range of 865.6–867.6 MHz. For other EEA restrictions on RFID device use, please refer to the Impinj Declaration of Conformity (DoC) located at <http://fid-support.impinj.com>

## Before You Begin



**Warning** Please read this document in its entirety before operating the Speedway reader, as serious personal injury or equipment damage may result from improper use.

Unauthorized opening of the Speedway reader enclosure voids the warranty.

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## 1. Regions of Operation

The Speedway reader has been designed to work in various regions with differing frequency requirements. This document covers operation in North America, Europe, and Taiwan.

**Important** In each region, the reader is locked to only operate in the specific frequencies listed in the respective frequency plan tables (Table 1-1, Table 1-2, and Table 1-3).

### 1.1. Operation in North America

The FCC stipulates frequency hopping across the North American spectrum allocated to UHF RFID (902–928 MHz, with hopping occurring between 902.75–927.25 MHz in 500 KHz steps).

**Table 1-1 Frequency Plan for North America**

| Transmit Channel Number | Center Frequency (MHz) |
|-------------------------|------------------------|
| 1                       | 902.75                 |
| 2                       | 903.25                 |
| 3                       | 903.75                 |
| 4                       | 904.25                 |
| .                       | .                      |
| .                       | .                      |
| 49                      | 926.75                 |
| 50                      | 927.25                 |

### 1.2. Operation in Europe

For European operation, the Speedway reader operates under EN 302-208 using listen-before-talk (LBT). An optional setting allows use of a third-party controller for deployment where readers share channels. Consult the manufacturer of compatible controllers for details on how to setup and deploy.

**Table 1-2 Frequency Plan for Europe**

| Transmit Channel Number | Center Frequency (MHz) |
|-------------------------|------------------------|
| 4                       | 865.7                  |
| 7                       | 866.3                  |
| 10                      | 866.9                  |
| 13                      | 867.5                  |

### 1.3. Operation in Taiwan

The Speedway reader supports the frequency plan listed in Table 1-3 for operation in Taiwan. The NCC stipulates frequency hopping across the Taiwanese spectrum allocated to UHF RFID (922-928 MHz, with hopping occurring between 922.25–927.75 MHz in 500 KHz steps).

**Table 1-3 Frequency Plan for Taiwan**

| Transmit Channel Number | Center Frequency (MHz) |
|-------------------------|------------------------|
| 1                       | 922.25                 |
| 2                       | 922.75                 |
| .                       | .                      |
| .                       | .                      |
| 11                      | 927.25                 |
| 12                      | 927.75                 |

## 2. Setting Up the Speedway Reader

The Speedway reader unit requires a power supply module (CUI, Inc., P/N **DTS240250UC-P11P-DB** for North American operation or **DTS240250U-AC2-P11P-DB** for European Union operation) with 24 VDC output. See Appendix C for the power supply module specifications, or visit [www.cui.com](http://www.cui.com) for the latest information.



**Warning** The use of any other power supply module may cause damage to the reader.

### 2.1. System and Equipment Requirements

Table 2-1 summarizes the supported operating environments.

**Table 2-1 Operating Environments**

| Interface     | Protocol   | Recommended Tools  |               |           |
|---------------|------------|--|---------------|-----------|
|               |            | Windows  | Linux         | Mac/Other |
| Web Interface | HTTP       | Compatible with common browsers IE (6+), Firefox (1.5+), and Netscape (5.5+) |               |           |
| Remote Login  | SSH/Telnet | Putty  | SSH or Telnet | Terminal  |
| Serial        | RS-232     | Hyperterminal  | Minicom       | N/A       |

The components and accessories detailed below are required in order to ensure compliance with the Speedway reader. It is the responsibility of the user or professional installer to provide and properly use all these components and accessories:

- A computer running Windows 2000 (or higher), XP, or Linux PC, which has:
  - An available RS-232 serial port (required only if host system does not support DHCP)
  - An Ethernet port
- HTTP browser that includes the Java Runtime Environment (JRE), version 1.4.2 or later. Note that the Windows 2000 JRE default is version 1.3.1. The latest version of JRE can be downloaded from:  
<http://www.java.com/en/download/manual.jsp> (to determine/verify your version, go to <http://www.java.com/en/download/installed.jsp>)
- TCP/IP network equipment, as required to connect the reader to a PC, Mac, or other network terminal
- An Ethernet port
- Standard Ethernet cable(s)
- Impinj-approved UHF RFID antenna(s), including associated RF cable with RP-TNC male connector interface
- Standard, grounded DB9 serial cable (required only if system does not support IP provisioning)

## 2.2. Speedway Reader I/O Ports & Status

Refer to Figure 2-1 for the Speedway reader's major ports, connectors, and status indicators, which are clearly indicated on the unit. The Speedway reader is equipped with the following ports:

- RJ-45 Ethernet port (labeled 10/100 BASE-T)
- Four female RP-TNC RF antenna connectors (ANT1 – ANT4)
- Female DB-9 connector for serial communication (SERIAL)
- Female DB-25 connector with user I/O capability (GPIO) The GPIO contains: RS-232 serial interface, four 3.3/5V logic inputs, and eight 3.3V logic outputs. See Table 2-2 for the pin-out, Table 2-3 for the GPIO electrical specifications, and Figure 2-2 for the physical pin view.

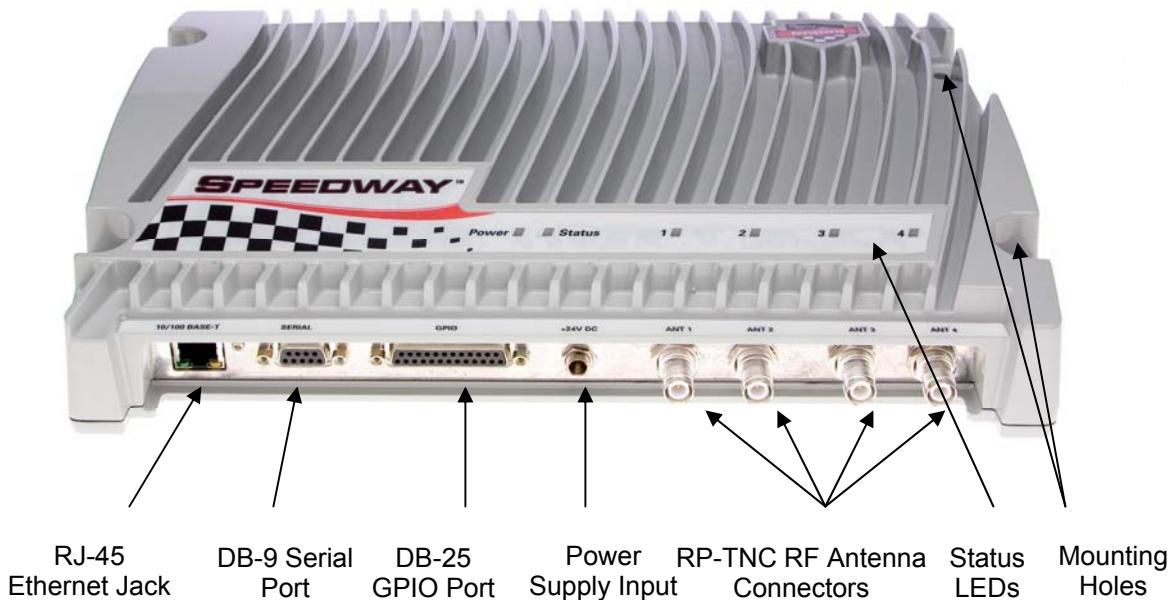


Figure 2-1 Impinj Speedway Reader Port Connections

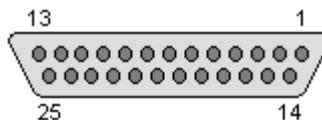
Table 2-2 DB-25 Connector Pin-Out

| Pin | I/O           | Pin | I/O   | Pin | I/O        |
|-----|---------------|-----|-------|-----|------------|
| 1   | No connect    | 10  | GPIN3 | 19  | GPIO5      |
| 2   | RS-232 RXD    | 11  | GPIN2 | 20  | No connect |
| 3   | RS-232 TXD    | 12  | GPIN1 | 21  | GPIO6      |
| 4   | RS-232 CTS    | 13  | GPIN0 | 22  | No connect |
| 5   | RS-232 RTS    | 14  | GPIO0 | 23  | GPIO7      |
| 6   | No connect    | 15  | GPIO1 | 24  | No connect |
| 7   | Signal Ground | 16  | GPIO2 | 25  | No connect |
| 8   | No connect    | 17  | GPIO3 |     |            |
| 9   | No connect    | 18  | GPIO4 |     |            |

**Caution** Pins listed in Table 1-2 as “No connect” must be left unconnected.

**Table 2-3 GPIO Interface Electrical Specifications**

| Pin        | Parameter | Description               | Minimum | Maximum | Unit    | Conditions             |
|------------|-----------|---------------------------|---------|---------|---------|------------------------|
| GPIN[3:0]  | $V_{IH}$  | HIGH-level input voltage  | 2       | 5       | V       |                        |
| GPIN[3:0]  | $V_{IL}$  | LOW-level input voltage   | 0       | 0.8     | V       |                        |
| GPIN[3:0]  | $I_{LI}$  | Input Leakage Current     | -5      | 5       | $\mu A$ | $V_{in}=0-5V$          |
| GPIN[3:0]  | $V_I$     | Input Voltage Range       | -5      | 5       | V       | No damage              |
| GPOUT[7:0] | $V_{OH}$  | HIGH-level output voltage | 3       | 3.3     | V       | $I_{out} = 100 \mu A$  |
| GPOUT[7:0] | $V_{OL}$  | LOW-level output voltage  | 0       | 0.25    | V       | $I_{out} = -100 \mu A$ |
| GPOUT[7:0] | $V_I$     | Input voltage range       | -5      | 5       | V       | No damage              |


**Figure 2-2 DB-25 Female Connector**

The labeled LEDs indicate **Power**, **Status**, and antenna activity. The LEDs that correspond to the connected antenna(s) (labeled **1**, **2**, **3**, and **4**), only light green when active (transmitting). A description of the status LED states appears in Table 2-4.

**Table 2-4 LED Status Indicators**

| Reader Operation  | LED Action                            |
|---|---------------------------------------|
| Startup   | Continuous Red                        |
| Power-on Start Test (POST) Failure  | Flashing Red (~2 Hz)                  |
| Bootloader Running  | Off                                   |
| File System Mounting Operation<br>(May also occur in certain upgrade scenarios to indicate the unit is functional but in a file system operation that will take some time to complete.) | Alternately Flashing Red/Green (1 Hz) |
| Speedway Reader able to Accept Mach1™ Connection  | Continuous Green                      |
| Speedway Reader in Active Mach1™ Connection   | Flashing Green (1 Hz)                 |
| Inventory in Progress with Tags in Field  | Flashing Orange (1 Hz)                |
| Inventory in Progress with no Tags in Field (for 3 sec)   | Flashing Orange (1/3 Hz)              |

**Note** Mach1™ denotes the Speedway RFID Command Interface, used by the reader to communicate with EPCglobal™ Generation 2 (Gen 2) RFID tags.

### 2.3. Mounting the Speedway Reader

When securing the unit with #10 screws via the four mounting holes, the Speedway reader may be mounted horizontally or vertically on a stable surface where it will be safe from disturbance. Keep the unit away from direct sunlight, high humidity, extreme temperatures, vibration, and sources of electromagnetic interference, as any combination of these conditions may degrade performance or shorten the life of the unit.

### 2.4. Connecting Power

Connect the AC power plug into a suitable 100-240 VAC, 50-60 Hz power outlet. The reader's green **Power** LED will light when power is on. The reader will then begin its boot sequence (the normal boot time for the reader's operating system is ~50 seconds). The reader will not accept commands until the boot sequence is complete.

### 2.5. Connecting the Antenna(s)

The Speedway reader is equipped with four (4) independent, bidirectional, full duplex TX/RX ports (monostatic).

**Caution** Unused antenna ports must be left unconnected; they should not be terminated.

#### 2.5.1. FCC and Industry Canada

Reader power has been factory preset to 30 dBm to accommodate an antenna with up to 6 dBi composite gain (inclusive of cabling). The Speedway reader may only be operated with Impinj-approved antennas and can radiate no more than 36 dBm EIRP (Equivalent Isotropically Radiated Power) per FCC Part 15.247 regulations. To obtain the maximum allowable reader power setting, the following expression should be used:

$$\text{Maximum power setting (in dBm)} = 36 - \text{Antenna Gain (in dBi)}$$

where the antenna gain includes the loss of the associated cable from the reader to the antenna.

Approved antenna vendors, model numbers, gain characteristics, and associated RF cable/connector include:

- Cushcraft Model Number S9028PCL/R (left- or right-hand CP); 6 dBi gain, with integrated pigtail to RP-TNC female connector
- Sensormatic Electronics Corp. model number IDANT20TNA25 with 25 foot Belden 7806A RG-58 coaxial cable (0.1 dB per foot loss); 5.5 dBi composite gain
- Sensormatic Electronics Corp. model number IDANT10CNA25 with 25 foot Belden 7806A coaxial cable (0.1 dB per foot loss); 3.5 dBi composite gain
- Sensormatic Electronics Corp. model number IDANT10CNA25 with 6 foot Belden 7806A coaxial cable (0.1 dB per foot loss); 5.4 dBi composite gain
- Impinj Model Number IPJ-A0301-USA (Mini-Guardrail); -15 dBi gain
- Impinj Model Number IPJ-A0400-USA, CSL CS-777-2 (Brickyard) with 5 foot integrated pigtail to RP-TNC female connector; 2 dBi composite gain
- Impinj Model Number IPJ-A0401-USA (Guardwall) with 6 foot integrated pigtail to RP-TNC female connector; 6 dBi composite gain



**Warning** The use of any other antenna may damage the reader or adversely affect performance.

#### 2.5.2. European Economic Area

European regulations allow a maximum radiated power of 33 dBm ERP (Effective Radiated Power) for high power RFID systems. The maximum Speedway output power is determined by the following equation:

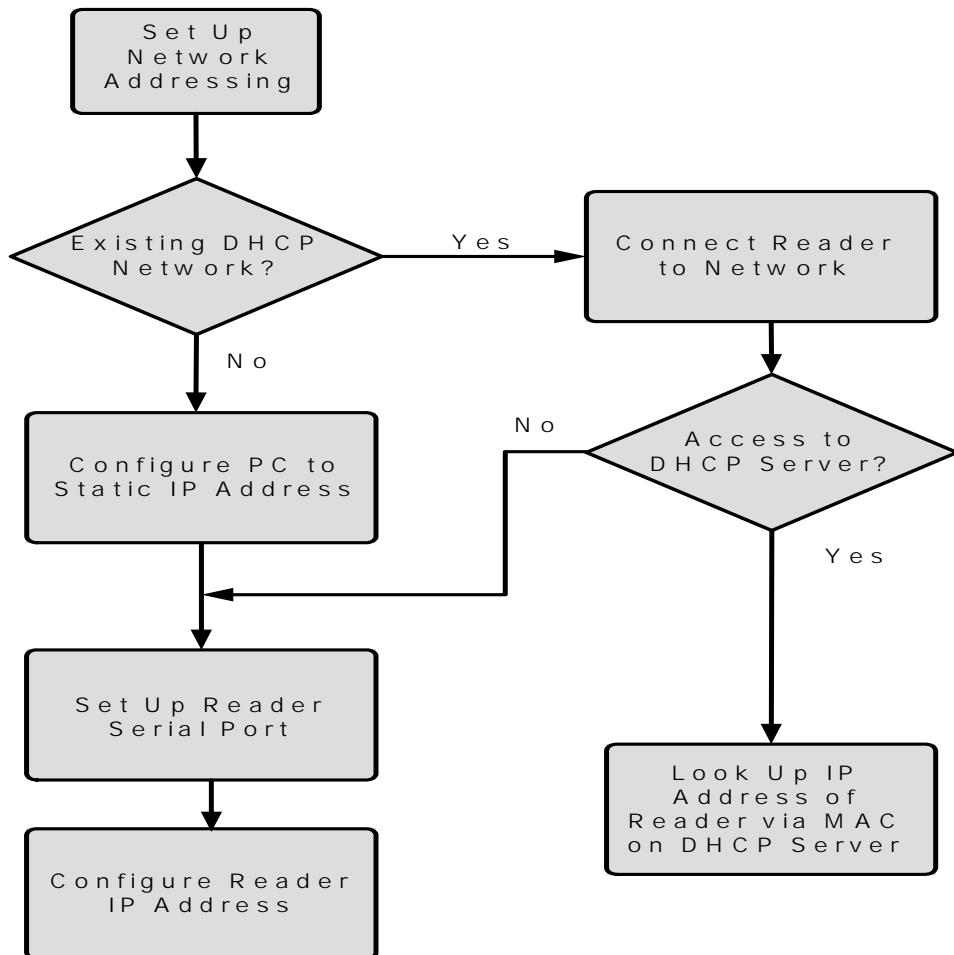
**Maximum power setting (in dBm) = 33 – Antenna Gain (in dBd) + Cable loss (in dB)**

For example, for an application with an antenna gain of 6 dBd and cable loss of 2 dB, the reader output power can be set no higher than  $33 - 6 + 2 = 29$  dBm. Note that it is important to apply the antenna gain expressed in dBd (dB with respect to a dipole), which is equivalent to the isotropic antenna gain (in dBi) minus 2.15 dB. Additionally, the antenna gain used to set the output power must be the maximum linear gain of the applicable antenna.

### 3. Communicating with the Speedway Reader

Reader connectivity and control is accomplished via either network (Ethernet, TCP/IP) or serial (RS-232) interfaces on the Speedway unit (see Figure 3-1).

If connecting via Ethernet, see Section 3.2. If your network equipment is not compatible with the default network configuration of the reader (DHCP), connecting via the serial interface will be necessary to establish initial command line-level communications with the Speedway reader. If making a direct serial connection, see Section 3.1.



**Figure 3-1 Configuration Options**

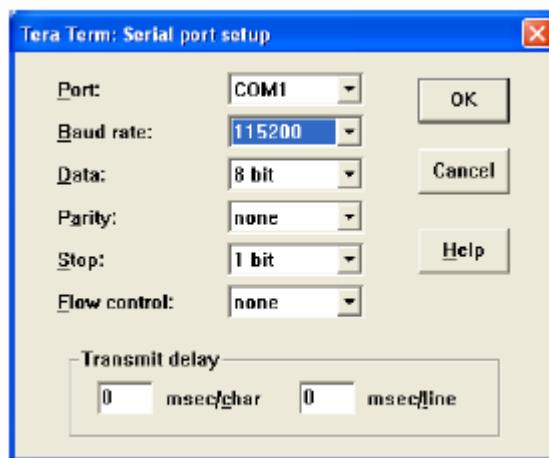
### 3.1. Preparing Serial Connectivity

Serial communication with the reader can be used at any time in conjunction with, or in lieu of, Ethernet connectivity in order to configure the reader. The serial interface may be necessary to establish initial communications with the Speedway reader (via the command line interface) if your network equipment is not compatible with the default network configuration of the reader (DHCP). In this case, the reader's network connection can be configured using the serial port; Ethernet connectivity can then be used for control thereafter.

Launch HyperTerminal (supplied with Microsoft Windows) or a similar communication program (such as Tera Term for Windows or Minicom for Linux) to establish serial reader communication. Configuration settings are entered via the command line interface (see section 4), accessed via your preferred terminal emulator, the prompt for which appears when the reader is connected to the PC via the serial port and booted.

After connecting the Speedway reader's serial port to the host PC's valid/active COM port, plug the reader's AC power unit into a suitable 100-240 VAC, 50-60 Hz power outlet. The Power LED will illuminate when power is applied. The reader will then begin its boot sequence. (Normal boot time for the reader's operating system is ~50 seconds. The reader will not accept commands until the boot sequence is complete.)

Set the communication parameters of the terminal software per Figure 3-2 (Tera Term screenshot shown).



**Figure 3-2 Serial Port Configuration**

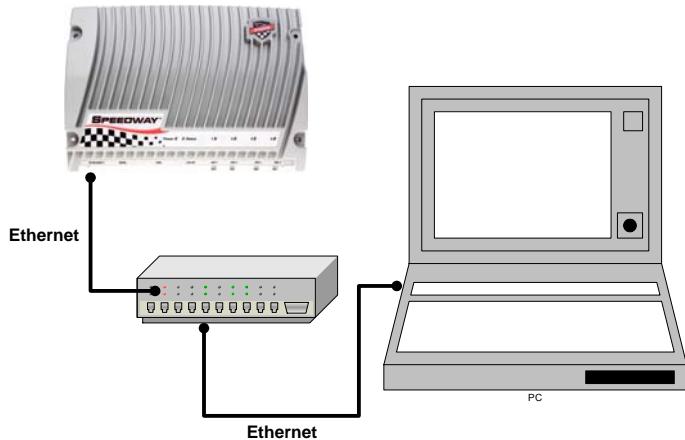
Once the terminal window opens, log onto the reader by entering the established user name and password. The default login (case-sensitive) is:

User Name: root  
Password: impinj

The Speedway reader is now ready to accept command line instructions (see section 4).

### 3.2. Preparing Ethernet (TCP/IP) Connectivity

Connect the reader to your network via the Ethernet port (see Figure 3-3). If your network is capable of communicating to the reader in its default IP configuration (DHCP), then complete and verify connectivity as described below. Note that the host computer must be on the same subnet as the reader.



**Figure 3-3 Ethernet Connectivity**

Connect the computer's Ethernet port to the Speedway reader using one of the following two methods:

- Use an Ethernet router or switch with either PC IP address set to a static address within the subnet of the reader (switch) or router's DHCP set to provide the PC with an IP address within the reader's subnet.
- Use a single Ethernet crossover cable to connect directly to your PC with the PC IP address set to a static value within the subnet of the reader.

To verify correct TCP/IP connectivity ping (using the “ping” command) or traceroute (using the “traceroute” command in a Linux environment, or the “tracert” command in a Windows environment) the reader’s IP address using the PC’s command line interface. Once connectivity is established, open the computer’s web browser application and connect to the Speedway reader’s hosted webpage (see Section 4), and login to complete the Speedway reader configuration. The default login (case-sensitive) is:

User Name: root  
Password: impinj

Proceed to section 4 to configure the network.

### 3.3. Mach1 Interface

The Speedway reader has a comprehensive RFID Command Interface, the Mach1, used by the reader to communicate with EPCglobal™ Generation 2 (Gen 2) RFID tags. Many application providers offer software that is compatible with Mach1. Consult your solutions provider or applications software vendor for additional information.

## 4. Network Configuration

The network may be configured for the Speedway reader using the Rshell command line interface (CLI), accessed via the serial port (see section 3.1) if your system does not support DHCP.

To complete the host name, concatenate the last three bytes of the unit's MAC address (printed on the Speedway reader enclosure and expressed in hexadecimal, e.g., MAC 00:16:25:**00:41:0C**) to the word "speedway" separated by "-" (e.g., speedway-**00-41-0C**).

Shown here are the essential configuration commands; for complete information on this interface, see section 8). To view the reader's current configuration settings, enter the following command at the prompt:

```
> show network summary
```

The reader will respond with the following (sample only; actual data will differ):

```
> show network summary
Status=0, 'success'
ipAddressMode=dynamic
ipAddress=192.168.20.121
ipMask=255.255.255.0
gatewayAddress=192.168.20.1
broadcastAddress=192.168.20.255
hostname=speedway-00-41-0C
>
```

At this point, the TCP/IP configuration parameters, such as its IP status (static or dynamic) and hostname, may be changed via the following command examples:

- To set **hostname**, at the prompt, enter the command:

```
config network hostname <HOSTNAME>
```

- To set **static IP address**, at the prompt, enter the command:

```
config network ip static <IP ADDRESS> <NETMASK> <GATEWAY> <BROADCAST>
```

- Alternatively, either of the following two versions of the **config network ip static** command may be used, in which case the reader will use default values for the unspecified parameters:

```
config network ip static <IP ADDRESS>
config network ip static <IP ADDRESS> <GATEWAY>
```

- To set **DHCP**, at the prompt, enter the command:

```
config network ip dynamic
```

You may now continue to use the Speedway reader in serial mode or connect to the network via the Speedway reader's Ethernet port.

## 5. Speedway Reader Settings

Navigate to the Speedway reader's hosted webpage. If using DHCP with DNS hostname registration enabled, connect via the default host name by navigating the browser to <http://speedway-nn-nn-nn>, where **nn-nn-nn** represents the host name suffix.

To complete the host name entry, concatenate the last three bytes of the unit's MAC address (printed on the Speedway reader enclosure and expressed in hexadecimal, e.g., MAC 00:16:25:00:41:0C) to the word "speedway" separated by "-" (e.g., speedway-00-41-0C).

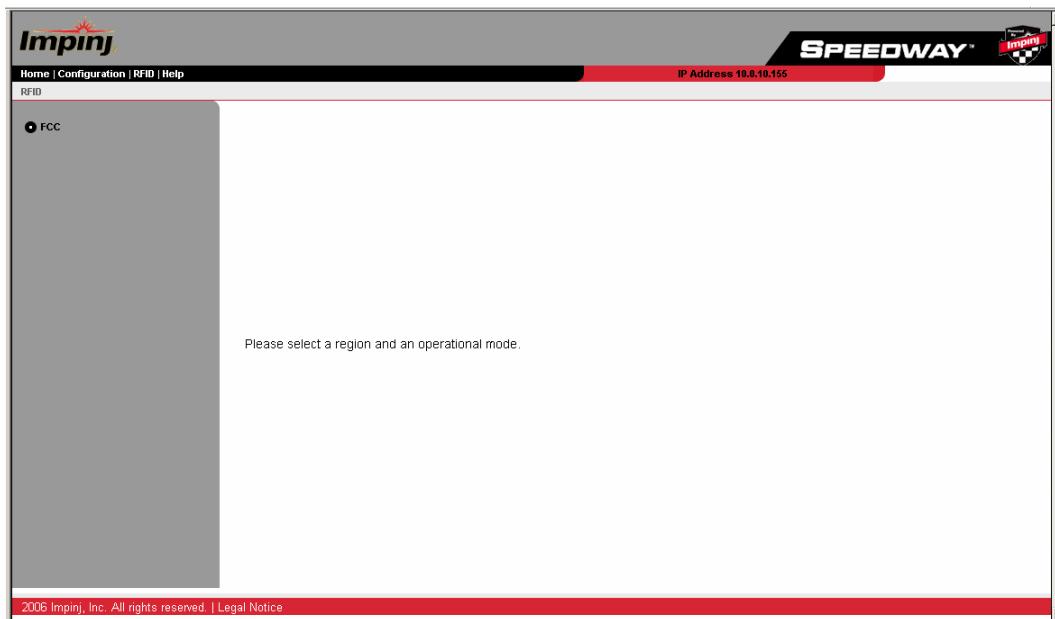
If your DHCP server does not support DNS hostname registration, the option has been turned off in Rshell, or you are using a static IP address, navigate to the IP address assigned (e.g., <http://xxx.xxx.xxx.xxx>) or the host name manually specified in your DNS server (e.g., <http://hostname>). You'll then be directed to the specific Speedway unit's homepage (see Figure 5-1), which details the hostname, IP address, serial number, hardware revision, and system statistics information. Note that the actual GUI appearance may vary from that shown in this User's Guide.



**Figure 5-1 Speedway Reader Homepage**

The Speedway reader applet is a Java program that runs from within a web browser. The Speedway reader requires Java Runtime Environment (JRE), version 1.4.2 or later. Note that the Windows 2000 default of JRE is 1.3.1. The latest version of JRE can be downloaded from: <http://java.com/en/download/manual.jsp>

The Speedway reader applet is accessed via the RFID menu tab in the navigation bar at the top of this page. (If the applet is opened, no other external software may connect to the reader via Mach1™.) Clicking this tab will bring up a region selection page (see Figure 5-2).



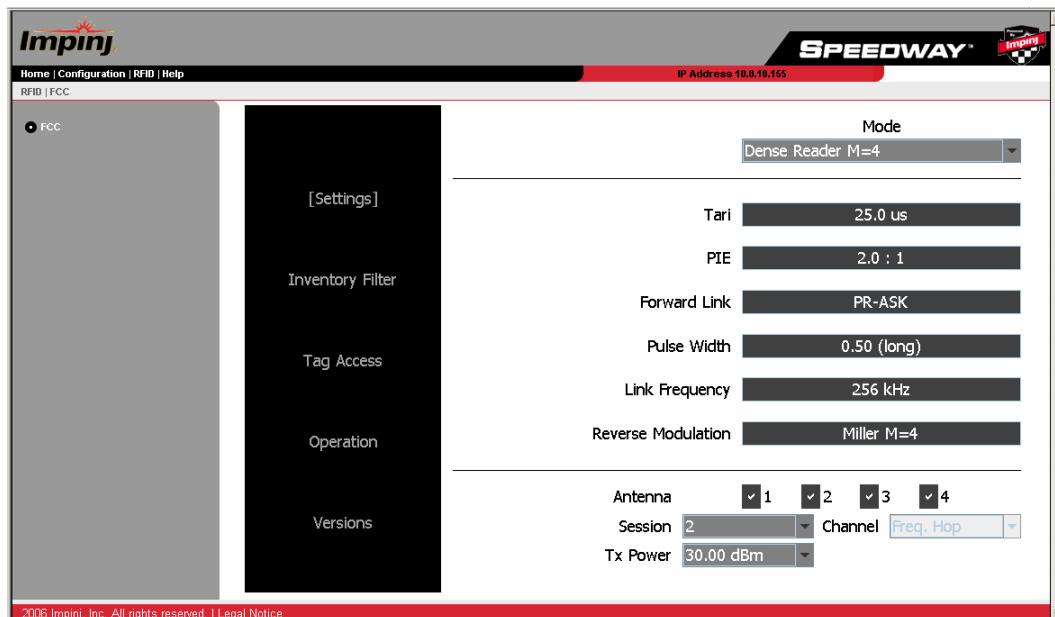
**Figure 5-2 Region Selection Page**

Selecting a region will bring up a dialog box prompting the user to enter a login ID and password, the default for which is:

User name: root  
Password: impinj

The Java applet will load and open the **Settings** page (see Figure 5-3).

The five user-selected fields on the Settings page include Mode, Antenna, Session, Transmit Power, and Channel, each of which are described below.



**Figure 5-3 Speedway Reader Settings Page**

### Mode

The reader mode is established via the Mode pull-down menu. Mode profile is a factory preset that configures the reader according to the respective default settings of that mode. For specific usage applications of the various modes, see Table 5-1.

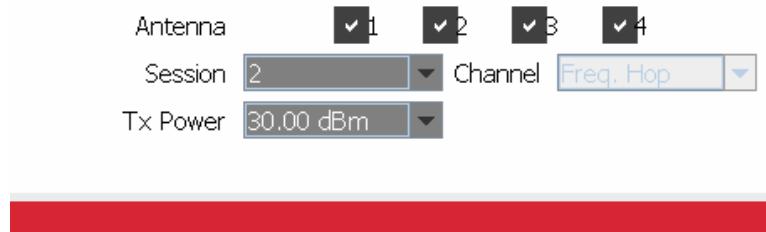
## Speedway Reader IPJ-R1000 for UHF Gen 2 RFID

**Table 5-1 Mode Usage**

| Mode | Mode Description   | Usage  |
|------|--------------------|--|
| 0    | Maximum Throughput | Very fast read rate<br>Very wide spectral occupancy<br>Used for low interference environments where speed matters                        |
| 1    | Hybrid             | Fast read rate<br>Intermediate spectral occupancy<br>Tolerant of some interference   |
| 2    | Dense reader M=4   | Intermediate read rate<br>Minimal spectral occupancy<br>Very robust to interference  |
| 3    | Dense reader M=8   | Half the data rate of Mode 2<br>Miller (M=8) may be used in extreme interference environments where tags are stationary or moving slowly |

### Antenna

The Speedway reader supports four (4) independent, bidirectional, full duplex TX/RX ports. Each antenna port is labeled (ANT1–ANT4) on the Speedway unit and these designations correspond to the Antenna selection buttons that appear on the lower third of the screen. Only those antennas activated by clicking the appropriate button(s) will be operational. (See Figure 5-4.)



**Figure 5-4 Closeup of Variable Selections**

### Session

The reader may be assigned to one of three sessions (1–3), selectable via the Sessions pull-down menu. A function of dense-reader mode, the use of sessions allows as many as three different readers to access the same population of tags through a time-interleaved process. In this mode, a shelf-mounted reader in the midst of a counting operation (assigned to Session 1, for example) may be interrupted by another reader entering the field—possibly a handheld reader—to perform its own inventory operation (in Session 2, for example). A dock door or forklift reader (assigned to Session 3, for example) might also initiate an inventory round. Because Gen 2 tags maintain a separate "inventoried" flag to keep track of each of these various random and independent sessions, they're able to seamlessly resume their participation.

### Transmit Power

The reader power setting is selected from the Tx Power pull-down menu. The output power ranges from 15 dBm to a maximum of 30 dBm (in .25 dB increments), measured at the Speedway reader's antenna ports.

### Channel

North America: The FCC stipulates frequency hopping across the North American spectrum allocated to UHF RFID (902–928 MHz, with hopping occurring between 902.75–927.25 MHz in 500 kHz steps). As such, the Speedway reader does not allow the setting of a static frequency for North American operation and the Channel is factory-set and fixed to frequency hop.

Europe: A pulldown menu supports channel selection.

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## Speedway Reader IPJ-R1000 for UHF Gen 2 RFID

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Taiwan: The NCC stipulates frequency hopping across the Taiwanese spectrum allocated to UHF RFID (922-928 MHz, with hopping occurring between 922.25–927.75 MHz in 500 kHz steps). As such, the Speedway reader does not allow the setting of a static frequency for North American operation and the Channel is factory-set and fixed to frequency hop.

# 6. Using the Speedway Reader

Once the Speedway reader settings have been established, the user may proceed directly to the **Operation** screen by clicking its menu navigation button.

## 6.1. Operation Screen—Monitoring Inventory Results

From the Operation page, simply click the Start/Stop toggle button to begin reading tags within range of the reader. The Clear button clears the results of the inventory operation that commenced with Start.

Tags being read are displayed in white fields, which fade to blue after not being seen by the reader within the last ~10 seconds. To see all tags and their status, simply scroll the screen.

As tags are read, their EPC numbers appear in the primary window of the Operation screen. If the Read TID button on the Operation screen has been enabled, the logo of the tag silicon manufacturer corresponding to the TID will also be displayed.

In addition to the EPC and TID, the results displayed include: Read Rate (expressed as tags/sec), Running Time (in hh:mm:ss from last Start), Total Tags (total number of tags read), and Total Active Tags (number of tags currently in the reader's field of view).

For more sophisticated inventory operations, the **Inventory Filter** and **Tag Access** pages allow the selection of tags according to user-specified criteria and rules. To access the Inventory Filter, Tag Access or protocol setup menus, any currently executing operation must be stopped.

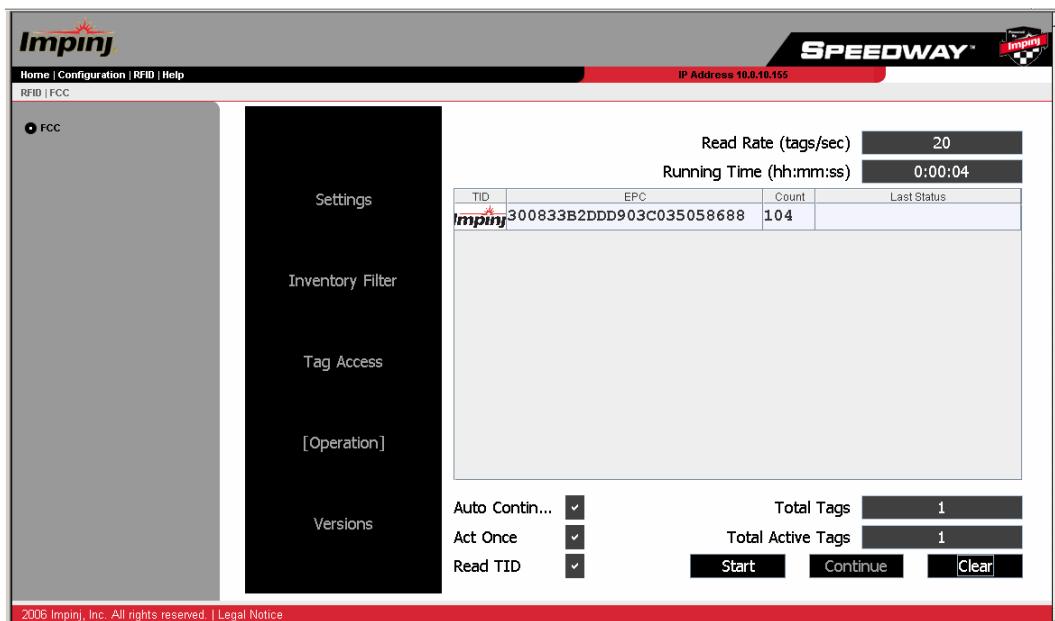


Figure 6-1 Operation Screen

## 6.2. Operation Screen—Filters

If the Inventory Filter has been activated (see Section 6.3), this status will be indicated in the Operation screen view (see Figure 6-2) with the text **\*\*Inventory Filter\*\*** appearing at the top of the screen. Likewise, if the Halt Filter has been activated (see Section 6.4), the text **\*\*Halt Filter\*\*** will appear.

### Auto Continue

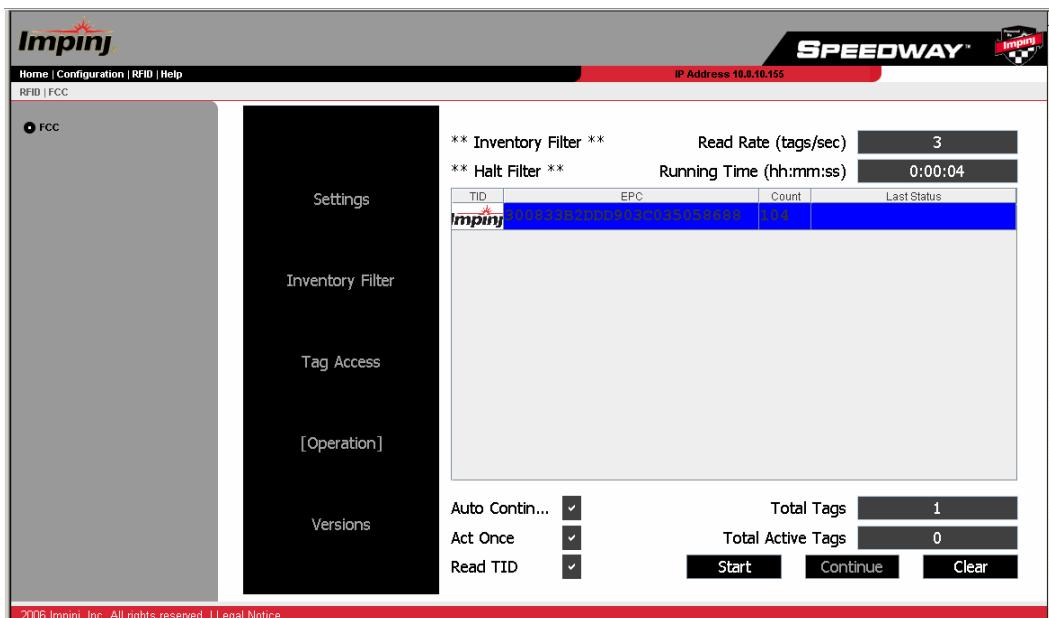
Referring to the set buttons in the lower-left portion of the Operation screen, Auto Continue directs the reader to continue singulation after a halt condition has been met. Otherwise, if the Halt Filter has been set, the reader will stop reading and return control to the user, resuming operation only when the Continue button has been clicked by the user. Note also that Halt does not require any subsequent action.

### Act Once

The Act Once button, if enabled, directs the reader to execute the action indicated in the Tag Access Action setting (read, write, lock, kill, etc.) only one time (see section 6.4). If the operation is successful (see Last Status column in the primary read window), the reader will continue the inventory or halt operation, depending on the status of the Auto Continue setting. If the Act Once setting is not enabled, and the action indicated is a write, the reader will write the tag over and over in a continuous loop. If both Act Once and Auto Continue are enabled, the reader will write the tag once and then continue the inventory operation, responding in accordance with the Inventory Filter settings that have been established.

To change settings from Operation mode:

- a. Stop continuous singulation using the Start/Stop button
- b. Configure the reader to the desired new mode using the Settings, Inventory Filter and Tag Access pages
- c. Return to the Operation page and re-start continuous singulation



**Figure 6-2 Operation Screen with Filters Enabled**

### 6.3. Inventory Filter Screen

The **Inventory Filter** screen (see Figure 6-3) is the user interface to the Select command, which the reader may apply successively to sort a particular tag population based on user-defined criteria that may include union, intersection, and negation-based tag partitioning (union and intersection operations are performed by issuing successive Select commands).

Select commands apply to a single memory bank; the Mem Bank field specifies if the criteria applies to the TID, EPC, or User memory of the tag (see Figure 6-4), as follows:

- Mem Bank 00 (0): Reserved (cannot select filter on this bank)
- Mem Bank 01 (1): EPC
- Mem Bank 10 (2): TID

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### Mem Bank 11 (3): User

Successive Selects may apply to different memory banks. The Bit Offset and Bit Length fields are used to target a specific portion of the tag memory on which to perform the filtering, while the Pattern field contains the comparison bits of interest. Note that the Bit Length must be non-zero. As tags are read, the Pattern is evaluated against the Select criteria, which includes Equal and Not Equal options in the Comparison field.

The Inventory Filter allows the use of two sets of criteria (defined by primary filter A and secondary filter B) that may be used separately, jointly, or not at all (the pull-down options include No Filter, A ONLY, A AND B, A OR B). When applied to an inventory round, only those tags that match the Select criteria will be displayed.

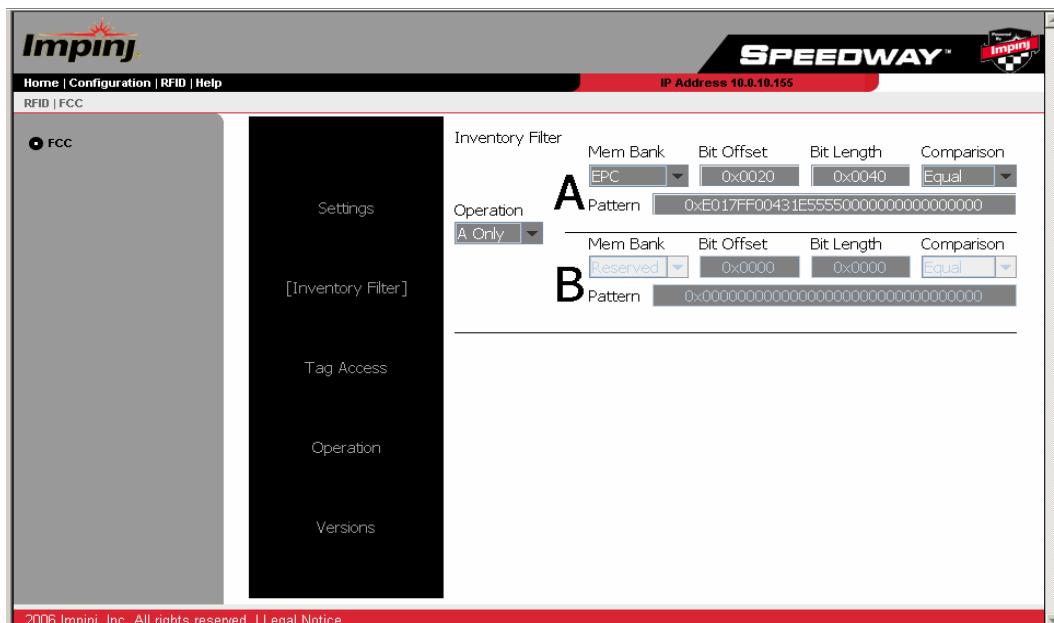


Figure 6-3 Inventory Filter

In Figure 6-3, the Pattern written is “`0xE017FF00431E55550000000000000000`”, the bit offset is “`0x0020`”, and the bit length is “`0x0040`.” The bit offset for an EPC code must be nonzero because the first 32 bits in the memory map (see Figure 6-4) are taken up by the CRC and PC codes. Figure 6-5 provides an example of how this pattern would be stored into the tag memory.

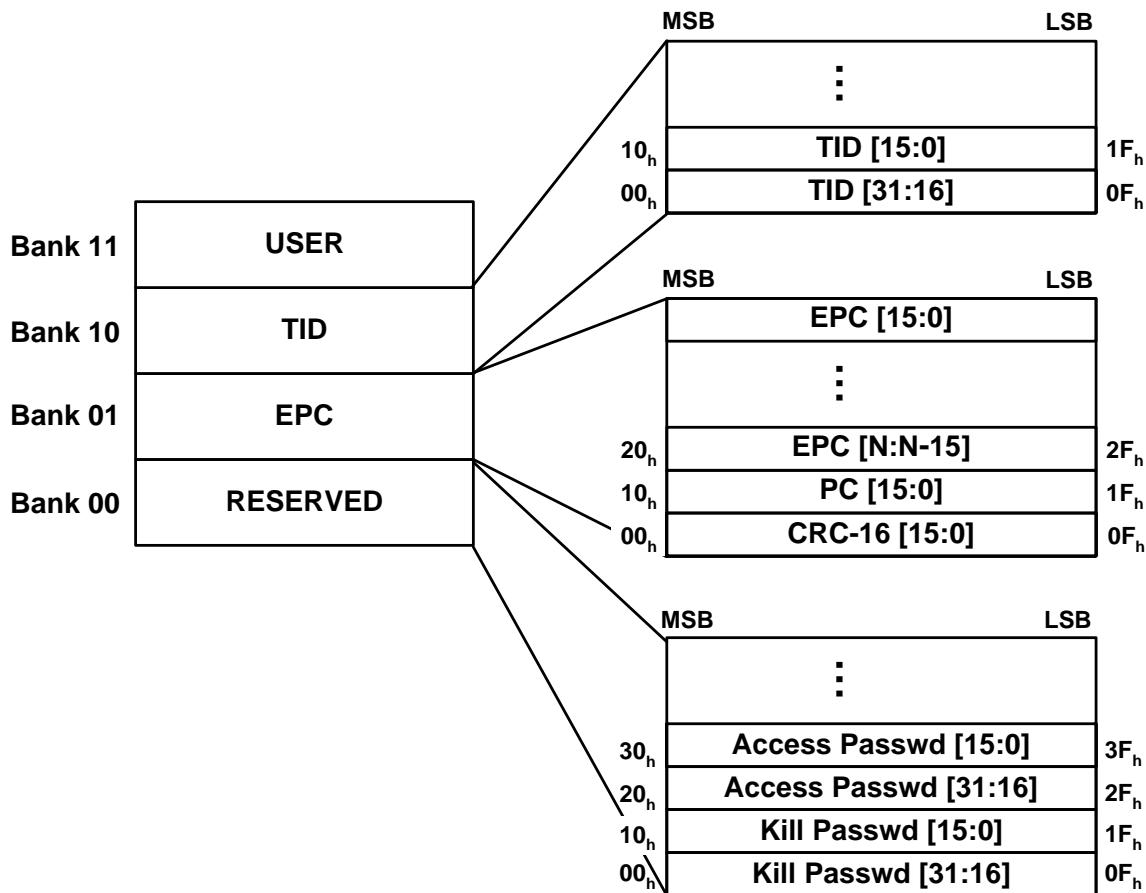


Figure 6-4 Tag Memory Map

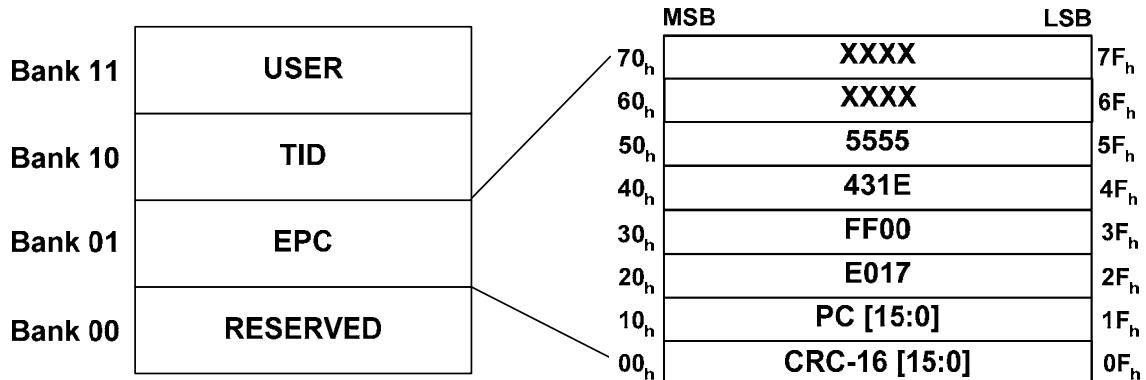


Figure 6-5 Writing EPC Example

## 6.4. Tag Access Screen

After acknowledging a tag, the Speedway reader may choose to access it. Under the **Tag Access** menu, a pull down menu provides five command Actions: Read, Write, BlockWrite, Lock, and Kill.

The menu item Tag Access (see Figure 6-6) adds a Mask field to the filtering operation, which allows the user to mask individual "don't care" bits or segments of the matching pattern, where "1" identifies a bit of interest and "0" represents a masked bit.

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Tag Access differs from the Inventory Filter operations in several respects. First, rather than performing a continuous inventory of a tag population, Tag Access allows the user to automatically halt the inventory process upon finding a tag of interest (e.g., a tag that meets the Halt Filter criteria). At this point, the tag can be automatically read, written, locked, or killed, according to the action selected in the Action pull-down menu. Note that the Halt criteria memory bank is independent of the write memory bank. For example, in Figure 6-6, the halt criteria is based on the EPC but the write action will happen on the TID.

The action is applied only to the selected Mem Bank and within it, the desired memory rows (00–07), the rows being made up of 16-bit words. If Action calls for a write, the specific bit pattern to be written must be entered (in hex format) in the corresponding field(s) below the selected row number(s). Multiple selected rows must be contiguous. For example, if only data in rows 1 and 3 must be changed, the data for row 2 must still be entered. The row number will change color to orange to indicate the valid rows for each memory bank. In the example of Figure 6-6, the TID only encompasses two sixteen bit rows so only rows 0 and 1 change color to orange to indicate valid selections. For the EPC, row 0 may not be overwritten (this is the CRC field, see Figure 6-4).

For Tag Access, the comparison criteria supports Greater Than and Less Than in addition to the Equal and Not Equal options available in the Inventory Filter page.

The Tag Access view is consistent with the Operation view (described in sections 6.1 and 6.2) in that settings input into one screen are valid for the other.

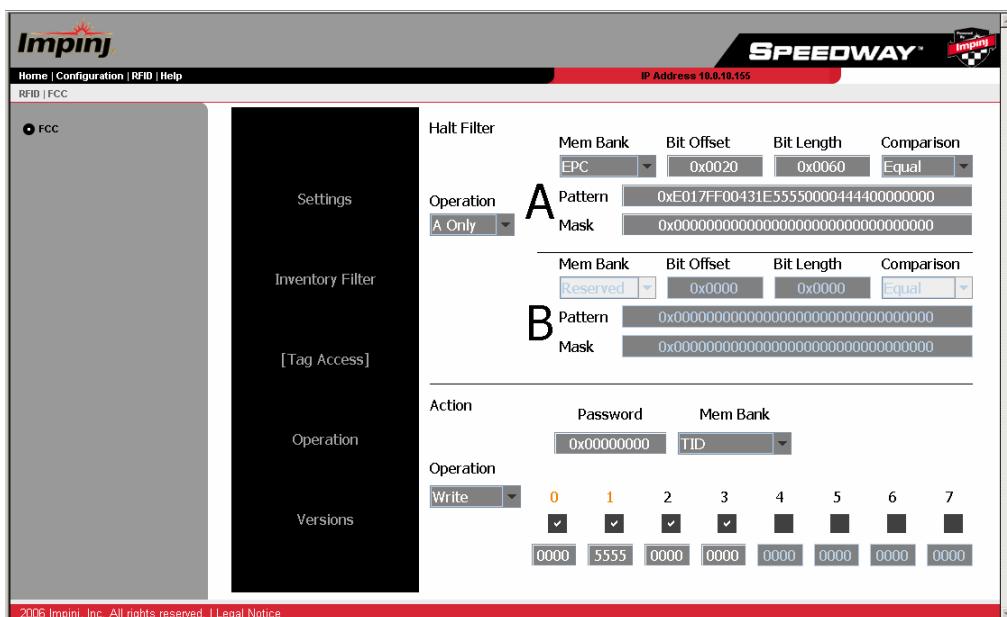
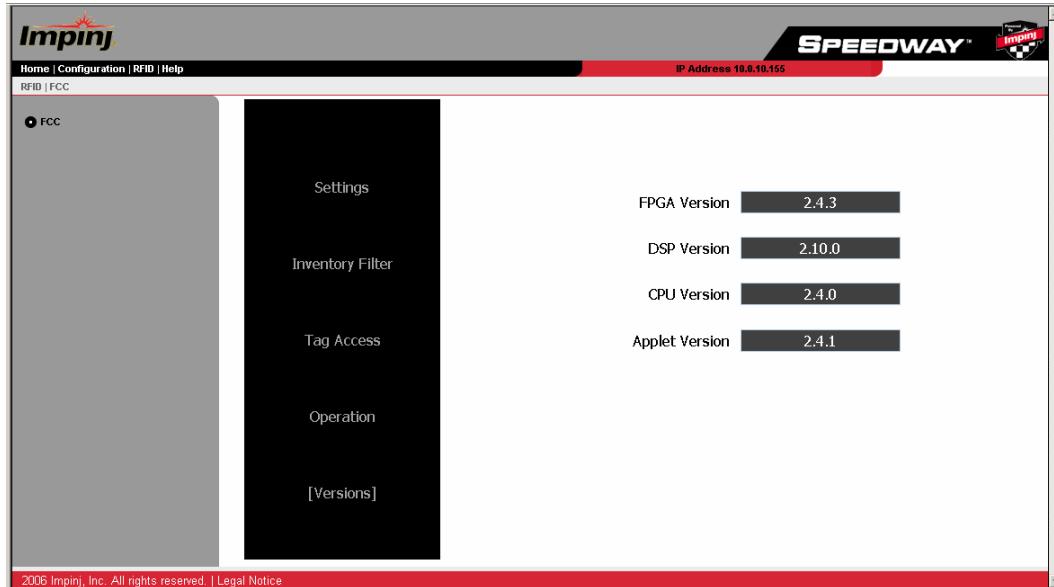


Figure 6-6 Tag Access

## 6.5. Version Screen

The **Version** screen (see Figure 6-7) simply reports the versions of the four primary components of the Speedway reader.



**Figure 6-7 Version**

# 7. Firmware Upgrade

The Speedway reader provides methods for managing the firmware image which include:

- Upgrade to a new image
- Fallback to a previous valid image
- Restore to factory default settings

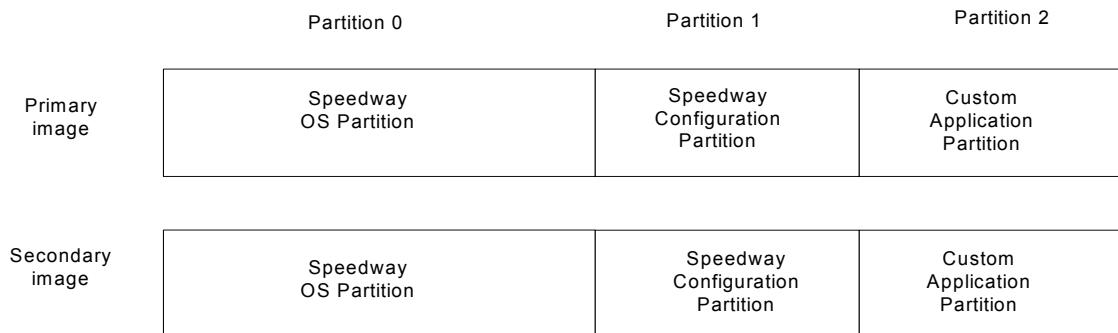
These can be done without disturbing the current operation of the reader. The user may manage the upgrade process through the steps described in this section. The upgrade may be performed via the command line interface or via the GUI Configuration Menu tab.

## Terms and Acronyms

- Client: the user program that uses the upgrade management service
- Primary image: the image that is currently running
- Secondary image: the image that is not running and may be the target of upgrading or fallback
- Upgrade Configuration: the information for determining the upgrading procedure
- Upgrade Image File: file that contains the Speedway reader image used for upgrade—stored on a file server and retrieved by the Speedway reader
- Metafile: data file that resides on a file server and contains the Upgrade Configuration information
- Metafile-URI: Universal Resource Identifier of the metafile
- URI: Universal Resource Identifier as defined in RFC3986

## Dual Image Model

The flash layout can be viewed as consisting of primary and secondary images, each of which contains three partitions, as shown in Figure 7-1. The primary image is the image that the reader is currently running and the secondary image is used for upgrade to a new image or fallback to a previous image.



**Figure 7-1 Dual Image Model**

The three partitions in each image are:

- Partition 0, the Speedway OS Partition (SOP). This partition contains the Linux OS image, file system, and Impinj reader application.
- Partition 1, the Speedway Configuration Partition (SCP). This partition contains the Impinj reader application configuration and other general configuration data.
- Partition 2, the Custom Application Partition (CAP). This partition may contain a custom application.

Partitions 0 and 2 can be individually upgraded, while Partition 1 can be upgraded only when Partition 0 is upgraded.

Upgrade is performed in the background, so that the current operation of the reader is not disturbed until the activation of the new image. The time of activation is also controlled by the user.

### Image Versioning Scheme

Each partition has a four-part version number associated with it. In the upgrade configuration file (see section 7.3), the version number is represented by a string consisting of four fields separated by ‘.’ (dot):

*ddd.ddd.ddd.ddd*

where each field is a decimal number ranging from 0 to 255. The left-most field is the most significant part of the version number with sub-versions provided to the right. For the purpose of upgrades, when two version numbers are compared, the one with the largest leftmost number is considered a higher version and therefore a newer image. For example, if two versions being compared are 2.3.4.9 and 2.4.4.1, 2.4.4.1 is considered newer because the second number from the left is larger (in this case 4 versus 3). Other than this comparison, the upgrade mechanism assumes no additional meaning for the version string.

## 7.1. Upgrade Methods

Speedway provides two methods to support software upgrade: push and pull. Push mode is a manual technique to perform an upgrade on an individual reader. Pull mode is an upgrade method that allows simultaneous upgrade of multiple readers through a single Upgrade Configuration file called a metafile. The default configuration of the reader is “push” mode.

In push mode, the user can trigger a one-time upgrade of the Speedway image. When triggering the upgrade, the user must specify the location of the Upgrade Image File as a URI. The upgrade will be performed if any of the partitions within the new image are different than those contained in the primary image. Once the download and programming have completed, the reader will remain in push mode and will perform no further upgrades until a new client request is issued. In push mode, the reader will not reboot automatically to activate the new image. The user must issue a reboot command (see section 8.3.1) to complete the activation.

In pull mode, the user creates a custom Upgrade Configuration Metafile (or metafile for short). This metafile is stored on a remote server. The user configures the location of the metafile as a URI. The reader downloads the data contained in the metafile at periodic intervals (called the retrieve period) and uses that data to make automatic upgrade decisions. The reader remembers the retrieve mode, retrieve period, and URI across power-cycles so that it can resume the pull method after a system reboot. Typically, when the reader retrieves the metafile at a scheduled time (or when it reboots), it will find that no upgrade is needed because, in the absence of any change in the metafile on the server, the image version the reader is running is the same as that specified in the metafile.

## 7.2. Preparing the Upgrade Image

The path and permission of the image file on the server should be set properly to allow file retrieval via the method as specified by the **upgrade-file-uri** field of the metafile or by the image URI.

## 7.3. The Upgrade Configuration Metafile

The Upgrade Configuration metafile is at the core of the pull upgrade mechanism. The user prepares this file based on upgrade requirements and saves it on a file server accessible from the reader. The file contains instructions to the Speedway reader as to how to perform the upgrade as a list of text-based entries. Each data entry consists of a single line data field and may be qualified with one or more parameters separated with a semi-colon. Table 7-1 lists the data entries in the metafile. All data fields and parameters are mandatory unless marked as optional. The format of a data entry is as follows:

```
field-name:field-value{;parameter-name=parameter-value} <EOL>
```

**Important** The metafile must not contain any Unicode characters.

Table 7-1 Upgrade Configuration Definition

| Field Name       | Field Value  | Param Name  | Param Value | Description  |  |
|------------------|--|---|-------------|--|--|
| retrieve-mode    | This field indicates how the metafile is to be retrieved.  |   |             |  |  |
|                  | push   | This field tells the reader to wait to be given upgrade information directly  |             |  |  |
|                  | pull   | retrieve-period   | <int>       | This field tells the reader to periodically retrieve the metafile. The mandatory parameter specifies how often (in minutes) the reader downloads the metafile  |  |
| upgrade-mode     | This field indicates how the reader determines the need for upgrade.                                   |   |             |  |  |
|                  | auto   | The reader determines if an upgrade is necessary based on its knowledge of the local image version compared to the upgrade file. Upgrade is needed if the local image has at least one partition that has a lower version than the corresponding partition in the upgrade image file. |             |  |  |
|                  | forced   | The reader should upgrade as long as the current image has at least one partition that has a different version from the corresponding partition in the upgrade image file.  |             |  |  |
| commit-mode      | This field indicates how the image should be activated.  |   |             |  |  |
|                  | immediate  | The image should be activated immediately after the upgrade is complete, causing an immediate reboot after programming is complete.   |             |  |  |
|                  | wait-4-cmd   | The image should be activated by a reboot command from the user.  |             |  |  |
|                  | scheduled  | time  | <string>    | Reboot is scheduled at the time indicated by the mandatory parameter <b>time</b> . The value of <b>time</b> is a string that takes the format of "<time-zone>:yyyy:mm:dd:hh:mm:ss" where <time-zone> is <b>gmt</b> . |  |
|                  |  | early-act-ok (optional)   | {no, yes}   | It's OK to activate the upgraded image before its scheduled activation time due to an early reboot. Default value is <b>no</b> when this parameter is absent.  |  |
| dl-retries       | <int>  | Number of times to retry if download fails due to timeout.  |             |  |  |
| dl-retry-period  | <int>  | Time to wait (seconds) before retrying a download.  |             |  |  |
| upgrade-file     | <int>  | This field is used as a delimiter. It means all data fields after this one, up to the next delimiter or end of metafile apply to the upgrade file indexed by the number in the field value <int>.   |             |  |  |
| img-type         | <int>  | This field indicates the image type of the upgrade file specified by the <b>file</b> field. The type is the enumeration number <int>. Refer to release notes for specific image type.   |             |  |  |
| upgrade-file-uri | <string>   | This field is the URI of the upgrade image file from which the upgrade image is downloaded.   |             |  |  |
| partition        | This field is the partition descriptor in an upgrade file. Refer to release notes for specific values. |   |             |  |  |
|                  | <int>  | version   | <string>    | Version of the partition, consisting of 4 fields of decimal numbers separated by a dot '.'. The number in each field must be in the range of 0 to 255.   |  |

## 7.4. Preparing the Upgrade Configuration Metafile

The upgrade configuration metafile is prepared on the server as pointed to by the reader's metafile URI. The data entries in the metafile should follow the format and definition given in section 7.3. Missing mandatory data entries and bad syntax will cause the reader to reject the metafile.

The upgrade image file pointed to by the **upgrade-file-uri** field must contain the same partitions, image types, and versions as described by the **partition** fields in the metafile. Disagreement between the metafile and the upgrade image file will cause the reader to reject the downloaded image file.

The path and permission of the metafile on the server should be set properly to allow file retrieval via the method specified by the **URI** parameter in the **config image metafile** command as explained in Section 8.4.2.3.

## 7.5. Image Management Command

### 7.5.1. Command Line Interface Upgrade

An upgrade can be triggered via the Command Line Interface in any one of the following scenarios:

- The user can invoke the Rshell command **config image upgrade** to instruct the reader to enter push mode, directly download the upgrade image file from the specified URI, and perform an upgrade with the image downloaded. See section 8.4.2.5 for details.
- The user can invoke the Rshell command **config image metafile** to instruct the reader to enter pull mode, download a metafile from the specified URI, and perform an upgrade based on the metafile. Regardless of the upgrade status, the reader remembers the URI for future use. See section 8.4.2.3 for details.
- The user can invoke the Rshell command **config image retrievemode** to manually set the retrieve mode of the reader. If the retrieve mode is set to pull via this command and the reader has a valid metafile URI, the reader will immediately attempt to retrieve the metafile via the URI. If metafile retrieval fails, the reader will retry periodically based on the retrieve period specified in the command. See section 8.4.2.4 for details.

### 7.5.2. GUI Upgrade

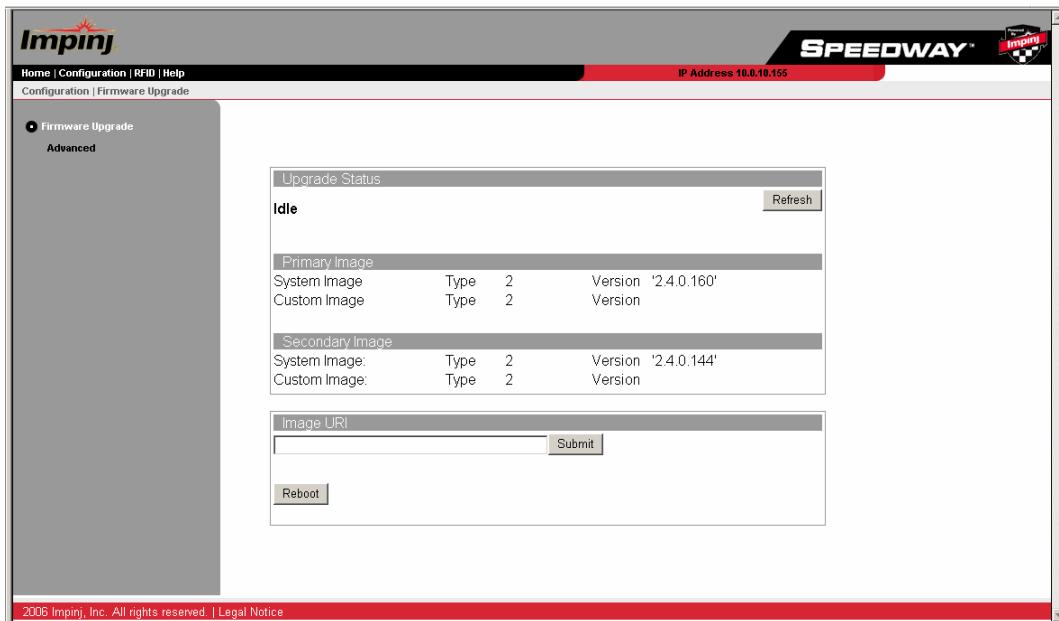
To use the GUI to execute push mode, click on the Configuration menu tab and select Firmware Upgrade (see Figure 7-2). The user must specify the location of the Upgrade Image File as a URI, enter it into the dialog box and click Submit. The upgrade will be performed if any of the partitions within the new image are different than those contained in the primary image. The Upgrade Status window will display the current image summary (similar to the upgrade status field in the **show image summary command**, see section 8.5.2.2). Once download and programming have completed, the reader will remain in push mode and will perform no further upgrades until a new request is issued.

In push mode, the reader will not reboot automatically to activate the new image. The user must issue a reboot command by clicking on the reboot button in the firmware upgrade GUI screen to complete the activation. The reader will not accept the reboot command until the image downloading and programming has completed, indicated by a “Done” status in the Upgrade Status dialog box. In other words, the reboot command issued to the reader by selecting the reboot button on the GUI interface does not have the **force** option (see section 8.3.1).

If the user enters a file into the Image URI dialog box illustrated in Figure 7-2 and performs a reboot, the reader will revert to push mode, even if it had previously been in pull mode.

**Important** The filename must be specified in the format described in section 7.8 (TFTP, FTP, or HTTP). As with any remote file retrieval, the servers should be properly configured such that the files are accessible either anonymously or by the specified user from the client (the reader).

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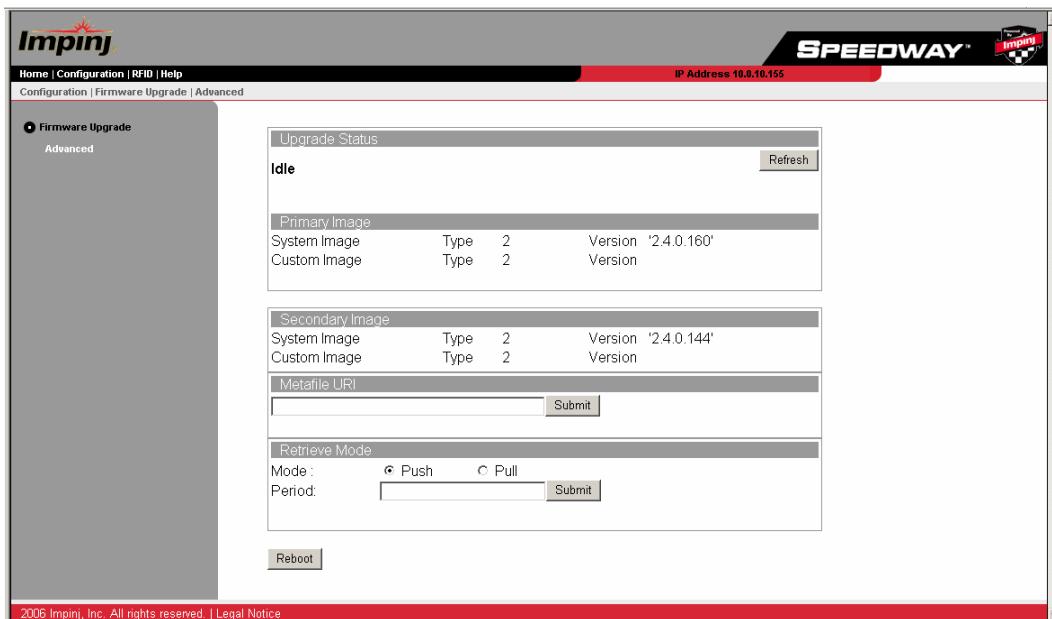


**Figure 7-2 Push Mode Upgrade GUI Screen**

To use the GUI to enter pull mode, click on the Configuration menu tab, select Firmware Upgrade, and then select Advanced (see Figure 7-3). The user must create a custom Upgrade Configuration Metafile (or metafile for short), store it on a remote server, and configure the location of the metafile as a URI. This URI may be entered into the dialog box labeled Metafile URI and submitted to the reader via the Submit button. The reader downloads the data contained in the metafile at periodic intervals, called the retrieve period. The retrieve period is a mandatory parameter in the metafile (see section 7.3) but it may be changed by entering a new retrieve period into the dialog box labeled Period in the Retrieve Mode section and clicking the Submit button. The user may also select the Pull option under Retrieve Mode by clicking on the Pull radio button; however, without a valid metafile, the software will issue an error. This can be resolved by entering a valid metafile.

The reader remembers the retrieve mode, retrieve period and URI across power-cycles so that it can resume the pull method after a system reboot. This will be reflected in the GUI by the darkened Pull radio button and a retrieve period value indicated in the dialog box.

The user may halt the automatic periodic updates and revert to Push mode by selecting the Push radio button under the Advanced screen.



**Figure 7-3 Pull Mode Upgrade GUI Screen**

### 7.5.3. Factory Default Restoration

The following command can be used to restore the Speedway reader's factory default configuration settings associated with the currently running image:

- The user can use the Rshell command **config image factory** to return the reader to a factory default configuration. The command retains the current primary SOP, but defaults the reader's configuration and erases any custom application. See section 8.4.2.1 for details.

### 7.5.4. Fallback to Previous Image

The following command can be used to fallback or restore the reader's previous image in case something was adversely affected by the upgrade procedure:

- The user can invoke the Rshell command **config image fallback** to restore the reader to its previous image. See section 8.4.2.2 for details.

### 7.5.5. Query the Upgrade Status

The following commands are used to query the status of upgrades including factory default and fallback:

- The user can invoke the Rshell command **show image summary** to view the details of the current primary and secondary images. This command also shows the status of pending and completed upgrades as well as error codes indicating the reasons for upgrade failures. See section 8.5.2.2 for details.
- The user can invoke the Rshell command **show image metafile** to view the details of the current retrieve mode and metafile data. See section 8.5.2.1 for details.

### 7.5.6. Background Execution of Image Management Commands

Some image management commands are executed in the background and are not finished right away. If a previous image management command is still being processed, a subsequent image management command will be rejected with a command response code of "Previous-Command-In-Progress". The following image management commands have this behavior:

```
config image metafile
config image upgrade
```

```
config image factory
```

During the execution of these image management commands, the **reboot** command will also be rejected with the “Previous-Command-In-Progress” error unless the force option is applied. All other **config image** and **show image** commands are completed immediately and can be immediately followed by any other image management command.

## 7.6. Upgrade Examples

Shown below is an example of command line activity demonstrating a successful upgrade, using the **push** method. The text entries after the # sign are comments.

```
# Issue a command to upgrade using FTP. The file path is only an example.
>
> config image upgrade ftp://username:password@server1.mydomain.com/binaries/sop-
2_4_0.upg
Status=0,'Success'      # command accepted
>
> show image summary    # Query status
Status=0,'Success'
UpgradeStatus=Downloading # Reader determines upgrade is needed and starts download
# Current image info
primaryImageType=2
primaryImageSystemVersion='2.4.0.144'
primaryImageConfigVersion='255.255.255.255'
secondaryImageType=2
secondaryImageSystemVersion='2.4.0.128'
secondaryImageConfigVersion='255.255.255.255'>
> show image summary
Status=0,'Success'
UpgradeStatus=Erasing # Download OK. Erasing secondary flash
primaryImageType=2
primaryImageSystemVersion='2.4.0.144'
primaryImageConfigVersion='255.255.255.255'
secondaryImageType=2
secondaryImageSystemVersion='2.4.0.128'

secondaryImageConfigVersion='255.255.255.255'
>
> show image summary
Status=0,'Success'
UpgradeStatus=Programming # Now programming new image
primaryImageType=2
primaryImageSystemVersion='2.4.0.144'
primaryImageConfigVersion='255.255.255.255'
secondaryImageType=2
secondaryImageSystemVersion='2.4.0.128'
secondaryImageConfigVersion='255.255.255.255'
>
> show image summary
Status=0,'Success'
UpgradeStatus=Done # programming done successfully
primaryImageType=2
primaryImageSystemVersion='2.4.0.144'
primaryImageConfigVersion='255.255.255.255'
secondaryImageType=2
secondaryImageSystemVersion='2.4.0.128'
```

```
secondaryImageConfigVersion='255.255.255.255'
>
# Reader is waiting for reboot to activate the new image. All other activities are
#not affected.
>
> reboot
Status=0, 'Success'
>
# when status LED comes back on as solid green, the reader will be running from
# the new image
```

## 7.7. Metafile Example

Below is an example of a complete metafile (note that the metafile may contain comment lines that start with a pound sign #):

```
## This is an example upgrade config metafile.
## Lines commented out with single # are alternative values or additional fields
## Lines commented out with double ## are explanations
##
## retrieve-period is in minutes
retrieve-mode:pull;retrieve-period=60
#retrieve-mode:push
upgrade-mode:auto
#upgrade-mode:forced
## reboot at a scheduled time yyyy:mm:dd:hh:mm:ss
commit-mode:scheduled;time="local.2006:05:08:04:12:32";early-act-ok=yes
#commit-mode:wait-4-cmd
#commit-mode:immediate
## dl-retries defaults to no-retry if not present. retry only if failed due to
timeout
#dl-retries:3
## dl-retry-period is in seconds
#dl-retry-period:60
upgrade-file:0
img-type:2
upgrade-file-uri:"tftp://fileserver.store.com/impinj-reader-image.upg"
## partitions and their versions must agree with what's in the image
partition:0;version="2.0.1.240"
#partition:1;version="255.255.255.255"
#partition:2;version="1.0.0.3"
```

## 7.8. Other URI Examples

The Speedway reader supports three URI schemes for upgrade: TFTP, FTP, and HTTP. Other examples of URIs:

[http://httpserver.mydomain.com/impinj/reader-images/upgrade\\_metafile](http://httpserver.mydomain.com/impinj/reader-images/upgrade_metafile)  
<tftp://tftpserver.mydomain.com/image-sop-scp-cap-2.1.1.upg>  
<ftp://user:password@ftpserver.mydomain.com/speedway/images/image-sop-scp-cap-2.1.1.upg>

As with any remote file retrieval, the servers should be properly configured such that the files are accessible either anonymously or by the specified user from the client (the reader).

## 7.9. Detailed Upgrade Behavior

### 7.9.1. Upgrade file validity check

The reader always checks the following for the validity of the upgrade file:

- Upgrade file format
- Upgrade file CRC
- Hardware compatibility with the reader
- Agreement between the upgrade metafile and the upgrade image in terms of version number, image type and partitions present.

If the check fails, the upgrade is aborted and the status is reported via the **show image summary** command as explained in section 8.5.2.2.

### 7.9.2. Rapid Polling Intervals

If the reader is configured to update automatically (pull mode) and the user attempts to send the reader into push mode by sending a **config image update** command, it is possible that the user will receive the message, “Command-in-Progress” because the automatic update just happened to occur at the same time as the manual command. This situation will most likely occur if the user’s network is slow or heavily loaded and the retrieve period (polling interval) is short.

### 7.9.3. Upgrade decision

Not all upgrade attempts will result in an actual upgrade, even if the upgrade file is valid. The reader’s upgrade decision is based on the following factors:

- The image versions of the SOP and CAP partitions of the primary image.
- The image version(s) of the partition(s) in the upgrade metafile and the upgrade image files downloaded, as well as the number of partitions present.
- The image type of the primary image, as well as the type indicated by the image metafile and upgrade file.
- The upgrade mode, **forced** or **auto**, as indicated in the upgrade metafile.

In **auto** upgrade mode, the upgrade will happen only when either one of the following is true:

- The upgrade image has the same type as the primary image and at least one partition in the upgrade image has a version higher than the corresponding version in primary image. In this case the partition in the upgrade file that has a lower version number than the one in the primary image will not be used, instead the current primary partition will be kept.
- The upgrade image has different image type from the primary and SOP is present in the upgrade file.

In the **forced** upgrade mode, an upgrade will happen as long as at least one partition in the upgrade file has a different version from the primary image. If the **config image upgrade** command is used, the upgrade is always performed regardless of version numbers or image type.

### 7.9.4. Partition copy-over

The upgrade image file does not necessarily contain all the partitions. The missing partition(s) will be copied over to the secondary image from the primary image upon reboot after upgrade whenever applicable. The behavior is as follows:

If the upgrade file has the same image type as the primary image, then

- If the upgrade file contains the SOP only, the primary SCP and the CAP (if present) are copied over.
- If the upgrade file contains the SOP and the CAP, the primary SCP is copied over.
- If the upgrade file contains the CAP, the primary SOP and the SCP are copied over.
- If the upgrade file contains the SOP and the SCP, the primary CAP, if present, is copied over.

Otherwise, if the upgrade file has a different image type from the primary image, no partition is copied over. The new image will use the factory default configuration if there is no SCP in the upgrade file. Such behavior allows the current configuration and custom application to be carried over to the new image after an upgrade.

### 7.9.5. Image partitions already programmed

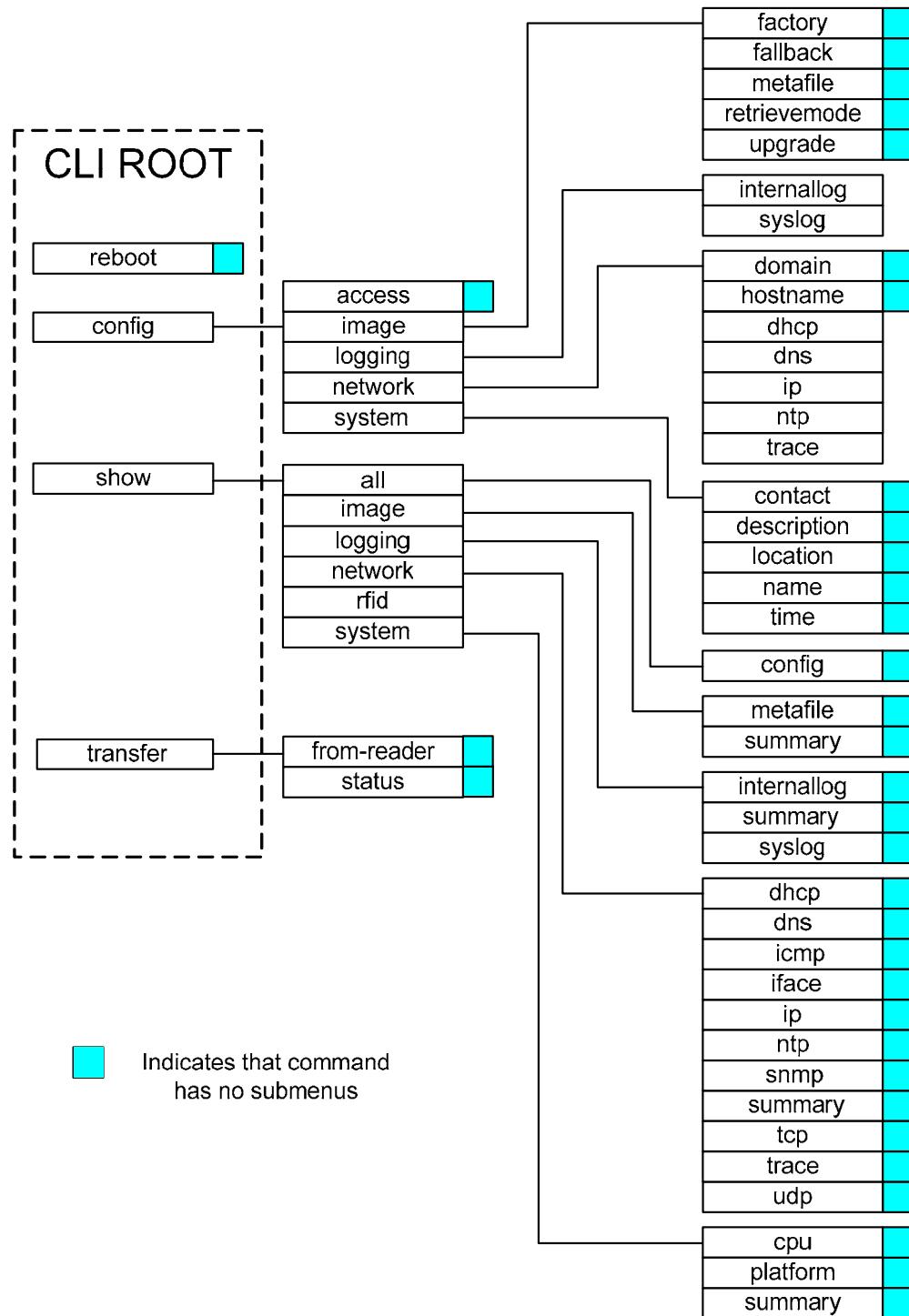
There are cases when the partitions in the upgrade file are already on the secondary image. For example, when a reboot is scheduled in ten hours following a successful upgrade and the reader is pulling the metafile every ten minutes, it will find that the same partitions in the metafile already programmed on the secondary image. The partitions are stored in flash memory which by its nature has a limited number of programming cycles. To avoid unnecessary programming of this flash memory, the reader checks if any or all of the intended partitions are already programmed and the behavior in these cases is as follows:

- If the upgrade file contains the SOP only and it is already on the secondary image, there is no reprogramming of the flash memory except for marking the primary SCP and the CAP, if present, to be copied over upon reboot after upgrade. (See section 7.9.4)
- If the upgrade file contains the SOP and the CAP and both are already on the secondary image, there is no reprogramming of the flash memory except for marking the primary SCP to be copied over upon reboot after upgrade.
- If the upgrade file contains the CAP only and it is already on the secondary image, the primary SOP is copied to the secondary image and the primary SCP is marked as to-be-copied over upon reboot after upgrade.

These behaviors only apply to automatic upgrades performed via the periodic pull method with auto or forced upgrade mode. When the upgrade is manually commanded (pushed) with the **config image upgrade** command, the flash memory is always programmed with the upgrade image regardless of the versions on the primary and secondary images.

## 8. Rshell Command Line Interface

The Speedway reader's Rshell Command Line Interface (CLI) is accessed via serial, Telnet, or SSH connectivity. A graphical representation of the command structure is shown in Figure 8-1.



 Indicates that command has no submenus

Figure 8-1 Command Line Interface Tree

### 8.1. Rshell Overview

Users may navigate to any of the menus simply by entering the menu name at the Rshell prompt, as shown below:

```
> show network
show network >
```

At all menus, the **help** command (or simply **?**) will list all the commands available from the active menu, as well as the submenus that can be accessed from the active menu.

```
> help

Commands:
osshell - Starts an OS shell for direct access to reader.
reboot - Reboots the system.
exit - Exit this submenu and return to the parent menu.
help - Displays this help message.
? - Displays this help message.

Sub-menus:
config - Submenu of configuration commands.
show - Submenu of elements that may have their configuration or
       status shown.
transfer - Submenu of transfer commands.
```

Menu navigation and the help keyword (or **?**) can be combined on the same line to list all the commands available for that menu. For example:

```
> config ?

Commands:
access - Changes the password for a given access level.
CLI - Not handled yet.
rfid - Not handled yet.
exit - Exit this submenu and return to the parent menu.
help - Displays this help message.
. - Exit this submenu and return to the parent menu.
? - Displays this help message.

Sub-menus:
image - Submenu of image and upgrade configuration commands.
logging - Submenu of logging configuration commands.
network - Submenu of network configuration commands.
system - Submenu of system info configuration commands
>
```

At all menus, entering the help command or **?** prior to a command or menu, will return the syntax for its usage. For example:

```
> ? config

config - Submenu of configuration commands.
Usage: config [<subcommand> ...]

>
```

or

```
> ? config access

config - Submenu of configuration commands.
Usage: config [<subcommand> ...]

access - Changes the password for a given access level.
Usage: config access <level> <password>
<level> is one of: root readonly readwrite (currently only
root is supported)
<password> is any text, please use at least six characters.

>
```

Entering the **?** between a menu and sub-menu/command will return the usage for all items following the **?**. In the example below, **image** is a menu that contains commands of its own.

```
> config ? image factory

image - Submenu of image and upgrade configuration commands.
Usage: image [<subcommand> ...]

factory - Revert to factory defaults.
Usage: image factory

>
```

Required parameters are indicated by angle brackets (e.g., **<parameter>**), while optional parameters are indicated by square brackets (e.g., **[parameter]**). At all menus, the **exit** command or simply **.'** will return the user to the previous menu context. To exit Rshell and terminate the user session (serial, telnet, or SSH), the exit command must be executed from the root menu:

```
show network> exit
show>
```

For machine execution, all commands can be called from the root menu. For example:

```
> show network
show network> dns
```

is equivalent to:

```
> show network dns
```

All commands return data in machine/human readable format.

## 8.2. Error Codes

The first line of every response has the following format:

```
Status=errorCode, 'error string'
```

Where **errorCode** is a numeric value and **'error string'** is a single-quoted human-readable error code. The error codes are defined in Table 8-1.

**Table 8-1 Error Codes**

| Error Code | Error String                 | Description  |
|------------|------------------------------|--|
| 0          | Success                      |  |
| 1          | Invalid-Command              | Command could not be parsed and identified as one of the commands supported by the interface   |
| 2          | Invalid-Command-Parameter    | One or more parameter types was unrecognized for this command  |
| 3          | Invalid-Parameter-Value      | One or more parameter values was illegal or out-of-range for this command  |
| 4          | Parameter-Dependency-Error   | Parameter value or combination was invalid in combination with other parameters or values  |
| 5          | Incomplete-Parameter-List    | The parameter list was incompletely specified and the command cannot be executed   |
| 6          | System-Resource-Limit        | Command could not be executed because of a resource limit on the box (e.g., could not add a fourth trap receiver because the device only supports three) |
| 7          | Unsupported-Command          | Reserved for Future commands   |
| 8          | Permission-Denied            | User does not have permission to access this command   |
| 9          | Previous-Command-In-Progress | The command was rejected because a previous command is still in progress such that this one could not be processed                                       |
| 10         | Command-Being-Processed      | The command cannot be finished right away; it is being processed.  |

A sample error parameter string is shown below:

```
> config
Status=1, 'Invalid-Command'
```

When a command's action requires return parameters, they follow the error status, one parameter per line, and in the following format:

```
parameterName=value0
parameterName=value1
...
parameterName=value9
```

The specific response parameters are detailed in the sections that follow.

## 8.3. Root Menu

Referring to Figure 8-1, the root menu contains the **reboot** command, and links to the **config**, **show**, and **transfer** sub-menus.

### 8.3.1. reboot Command

The **reboot** command instructs the reader to reboot. This may be used after a manual upgrade of the reader's firmware or application software. The reboot command may also contain an optional argument **force** that will cause the reader to reboot even if a current operation is pending (such as a firmware download). If the force argument is absent, the reader will reject the command if a current download is in progress. A help command entered at the command line interface will return the following usage instruction:

```
> help reboot
reboot  - Reboots the system.
Usage: reboot [force]
```

### 8.3.2. config Command

The **config** command leads to a submenu of configuration commands described further in section 8.4.

### 8.3.3. show Command

The **show** command leads to a submenu of elements that may have their configuration or status shown. See section 8.5.

### 8.3.4. transfer Command

The **transfer** command leads to a submenu of transfer commands described further in section 8.6.

## 8.4. Config Command

If a **help config** command is entered at the command line interface, the system will respond as follows to indicate the need to enter subcommands:

```
> help config
config      - Submenu of configuration commands.
Usage: config [<subcommand> ...]
```

Entering the **config** command, followed by help (or ?), brings up a submenu of configuration commands.

```
> config
config > ?

Commands:
access      - Changes the password for a given access level.
CLI         - Not handled yet.
rfid        - Not handled yet.
exit        - Exit this submenu and return to the parent menu.
Help        - Displays this help message.
.           - Exit this submenu and return to the parent menu.
?           - Displays this help message.

Sub-menus:
image       - Submenu of image and upgrade configuration commands.
logging     - Submenu of logging configuration commands.
network     - Submenu of network configuration commands.
system      - Submenu of system info configuration commands.
```

### 8.4.1. config access Command

The **config access** command changes the password for a given access level. Only root is supported at present. Password changes made via this command also change the user's web password to the same value. The command parameters are shown in Table 8-2.

**Table 8-2 "config access" Command Parameters**

| Arguments | Options | Format | Description   |
|-----------|---------|--------|---|
| Level     | Root    | STRING | Level of user to change (only root is supported)                        |
| Password  |         | STRING | Password to set account's active password to (at least six characters). |

The command usage is shown below:

```
Usage: access <level> <password>
```

A sample of the command and response is shown below:

```
> config access root MyPassword
Status=0, 'success'
```

### 8.4.2. config image Command

The **config image** commands provide configuration options for image and upgrade configurations. It contains no sub-menus. The commands are described below:

Commands:

|              |  |
|--------------|--|
| factory      | - Revert to factory defaults.                      |
| fallback     | - Fallback to the previous image (if valid).       |
| metafile     | - Perform an upgrade with a given metadata URI.    |
| retrievemode | - Perform an upgrade with a given URI.             |
| upgrade      | - Perform an upgrade with a given URI.             |
| exit         | - Exit this submenu and return to the parent menu. |
| help         | - Displays this help message.                      |
| .            | - Exit this submenu and return to the parent menu. |
| ?            | - Displays this help message.                      |

Sub-menus:

None

These commands will not take effect until the reader is rebooted. Detailed explanation of how to upgrade images is given in section 7.

#### 8.4.2.1. config image factory Command

This command, followed by a reboot, returns the reader to the factory default configuration associated with the current running image and at the same time, removes the custom application partition. Once complete, the factory defaults do not take effect until the system is rebooted. This command takes no parameter. Example command usage is shown below:

```
Usage: config image factory
```

During factory default, the **show image summary** (section 8.5.2.2) command reports the **UpgradeStatus** as Erasing, Programming, or Done. After this command is processed, the reader will continue its operation with the current configuration until a reboot command is issued. In the mean time, the metafile retrieve-mode is set to push (i.e., the factory default restore command cancels a previously scheduled periodic upgrade). When the reader comes up from the reboot, it will run the same SOP image version as the one from which it performed the factory default restore, with factory default configuration and no custom application.

If the reader is in pull mode during the execution of this command, it is possible that the reader is currently retrieving the metafile or performing an upgrade. In these instances, this command may return “Previous-Command-In-Progress”.

#### 8.4.2.2. config image fallback Command

The successful processing of this command, followed by a reboot, returns the reader to the previous valid image. This command takes no parameter.

```
Usage: config image fallback
```

If there is no valid previous image to fallback to, the command response will be “failure” with a reason “No Fallback Image Available”, as listed in Table 8-14. After this command is successfully processed, the reader waits for a reboot command to fallback to the previous image. In the mean time, the reader operates normally except that all the **config image** commands will

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be rejected with a reason “Current Image Invalidated”. Also the metafile retrieve-mode is set to push, i.e., the fallback command cancels a previously scheduled periodic upgrade. When the reader is rebooted, the previous image will be activated.

If the reader is in pull mode during the execution of this command, it is possible that the reader is currently retrieving the metafile or performing an upgrade. In these instances, this command may return “Previous-Command-In-Progress”.

**Important** A fallback will utilize all the old configuration settings, including the upgrade metafile settings as if the upgrade to the newer image was never performed—which may trigger an immediate upgrade. If the URI of the old metafile is known and an immediate upgrade is not desired, the user should remove or rename the old metafile before performing a fallback.

### 8.4.2.3. config image metafile Command

This command takes the Universal Resource Identifier (URI) of the upgrade configuration metafile as the parameter. It commands the reader to perform an upgrade using the metafile identified by the URI.

Usage: config image metafile <URI>

Upon receiving this command, the reader updates its local upgrade configuration URI, retrieves the upgrade configuration metafile, and performs the upgrade in accordance with the metafile. If the upgrade is successful, how the new image is activated depends on the commit-mode specified in the metafile (see Section 7.3, Table 7-1).

If the reader is in pull mode during the execution of this command, it is possible that the reader is currently retrieving the metafile or performing an upgrade. In these instances, this command may return “Previous-Command-In-Progress”.

### 8.4.2.4. config image retrievemode Command

This command sets the reader’s metafile retrieve mode and (if applicable) the retrieve period (see Table 8-3). When the retrieve-mode is set to push, the reader will take no upgrade action. To perform an upgrade in this mode the user must issue a **config image upgrade** command to directly download an upgrade image (see section 8.4.2.5).

Usage: config image retrievemode push  
config image retrievemode pull <period-minutes>  
<period-minutes> is how often the reader pulls the metafile  
from the most recently specified <URI>.

**Table 8-3 “config image retrievemode” Command Parameters**

| Argument        | Options       | Format | Description   |
|-----------------|---------------|--------|---|
| mode            | <pull   push> | STRING | When the mode is pull, the reader periodically retrieves the metafile from the most recent metafile URI at the rate specified by the retrieve-period. In push mode the user must manually specify a new metafile URI or manually upgrade the file to perform the upgrade. |
| retrieve-period |               | INT    | Interval of pull in minutes—only applicable when mode is pull. This retrieve period is used only until the reader retrieves a valid metafile, at which point the retrieve period from the metafile is adopted.  |

If this command results in a change from push to pull, or a change of **retrieve-period** while the current mode is pull, the reader immediately attempts to download a new UConf metafile using its current metafile URI.

### 8.4.2.5. config image upgrade Command

This command is used to instruct the Speedway reader to directly download an upgrade image file and perform an immediate upgrade. Upgrade image files are stored on a file server and retrieved by the Speedway reader from the location identified by the URI.

Usage: config image upgrade <URI>

Upon receiving this command, the Speedway reader downloads the image file and, if the file is valid and eligible, performs the upgrade. When this command is used, the upgrade will always be performed even if the version matches the current one.

If the upgrade is successful, the new image is not activated until the user reboots the system.

If the reader is in pull mode during the execution of this command, it is possible that the reader is currently retrieving the metafile or performing an upgrade. In these instances, this command may return “Previous-Command-In-Progress”.

Note that this command does not change the reader’s upgrade configuration URI, but it sets the retrieve-mode to push, meaning that the reader will not periodically retrieve upgrade configuration metafile until the retrieve-mode is set to pull again. See section 8.4.2.4.

### 8.4.3. config logging Command

The **config logging** commands provide configuration options for remote syslog capture as well as internal Impinj log capture via sub-menus. The internal log is stored in the RAM file system only, is capable of high-speed, real-time logging of internal events, and is routed to the syslog based on the severity level (described below). The syslog is stored in the local Flash memory file system, is the standard Unix logging system, and is forwarded to a remote syslog server.

Logging levels may be set to one of eight options (in decreasing order from most severe to least): emergency, alert, critical, error, warning, notice, info, and debug. Which data are forwarded from the internal Impinj (**internallog**) log capture to the remote system logging (**syslog**) depends on the relative level settings. For example, if the **internallog** is set to the level of “critical”, and the **syslog** level is set to “debug”, then all internal log data will be sent to the remote system capture because the severity level of the internal Impinj log data will always be greater than the remote system log. Conversely, if the **internallog** is set to “info” and the **syslog** is set to “alert”, then only internal log data with severity level of “alert” and higher will be forwarded. The **internallog** data is still accessible via Rshell but it will not be stored in the **syslog**. See Figure 8-2.

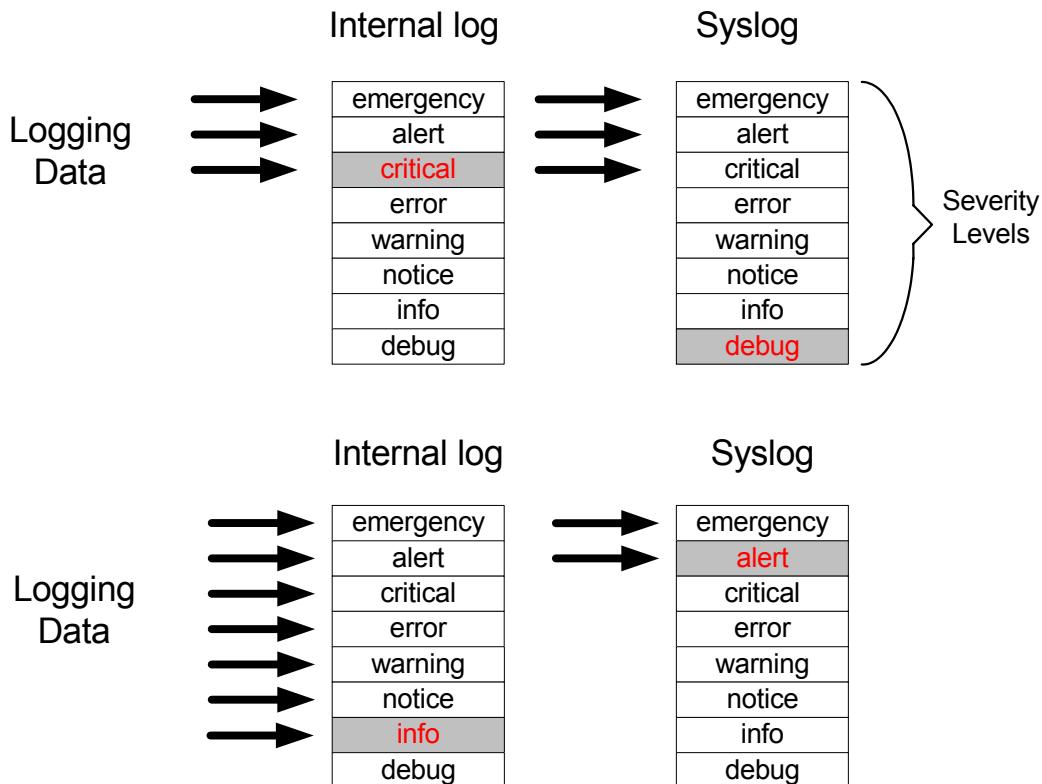
The commands are described below:

Commands:

|      |  |
|------|--|
| exit | - Exit this submenu and return to the parent menu. |
| help | - Displays this help message.                      |
| .    | - Exit this submenu and return to the parent menu. |
| ?    | - Displays this help message.                      |

Sub-menus:

|             |  |
|-------------|--|
| internallog | - Submenu of internal logging specific commands. |
| syslog      | - Submenu of syslog specific commands.           |



**Figure 8-2 Relative Severity Level Logging Transfer**

#### 8.4.3.1. config logging internallog Commands

The **config logging internallog** commands set the internal logging level for reader log events. These events can be viewed via the **show logging** command or transferred off the reader via the **transfer** command. The command parameters are shown in Table 8-4. The **set** command sets the logging level for a log class to one of a set of pre-defined values.

**Commands:**

```

set   - Configures internal logs.
exit  - Exit this submenu and return to the parent menu.
help  - Displays this help message.
.     - Exit this submenu and return to the parent menu.
?     - Displays this help message.

```

**Sub-menus:**

None

**Table 8-4 "config logging internallog" Command Parameters**

| Arguments          | Options  | Format | Description  |
|--------------------|--|--------|--|
| ApplicationLevel   | <Emergency   Alert   Critical   Error   Warning   Notice   Info   Debug> | STRING | Configures the level at and above which ApplicationLevel logs are sent to the log database. Listing in decreasing order of severity. |
| ConfigurationLevel | ...  | STRING | ...  |
| MgmtLevel          | ...  | STRING | ...  |
| NetworkLevel       | ...  | STRING | ...  |
| RFIDParameters     | ...  | STRING | ...  |
| RFIDSingulation    | ...  | STRING | ...  |
| RFIDAccess         | ...  | STRING | ...  |
| System             | ...  | STRING | ...  |

Usage for the **config logging internallog set** command is shown below:

```
Usage: config logging internallog set <className> <level>
<className> is (ApplicationLevel | ConfigurationLevel | MgmtLevel |
NetworkLevel | RFIDParameters | RFIDSingulation | RFIDAccess | System)
<level> is (emergency|alert|critical|error|warning|notice|info|debug)
```

A sample command that sets the RFID Access logging is shown below:

```
> config logging internallog set RFIDAccess emergency
Status=0, 'Success'
```

#### 8.4.3.2. config logging syslog Commands

The **config logging syslog** menu provides the configuration interface for the syslog module on the reader. If all remote syslog servers are removed, the reader will begin to log in its internal memory. The command parameters are shown in Table 8-5.

```
Commands:
add   - Add a server to the list of current syslog servers.
del   - Delete a server from the list of current syslog servers.
delall- Delete all current servers.
level - Change the severity level of the messages to log via syslog.
reset - Removes all archived syslog messages.
exit  - Exit this submenu and return to the parent menu.
help  - Displays this help message.
.     - Exit this submenu and return to the parent menu.
?     - Displays this help message.
```

Sub-menus:

None

**Table 8-5 "config logging syslog" Command Parameters**

| Arguments | Options  | Format | Description  |
|-----------|--|--------|--|
| add       | <IpAddress hostname>   | STRING | Add a new syslog server with the following address   |
| del       | <IpAddress hostname>   | STRING | Delete a syslog server with the following address  |
| delall    |  |        | Delete all syslog servers  |
| level     | <Emergency   Alert   Critical   Error   Warning   Notice   Info   Debug> | STRING | Set the syslog security level. Only logs at or greater in severity than this level will be forwarded to syslog. Levels listed in order of decreasing severity. |
| reset     |  |        | Removes all archived syslog messages.  |

Usage of the commands is shown below:

```

Usage: config logging syslog add <server-name>
Usage: config logging syslog del <server-name>
Usage: config logging syslog delall
Usage: config logging syslog level <level>
Usage: config logging syslog reset

```

Sample commands are shown below:

```

> config logging syslog add 10.0.10.37
Status=0,'Success'

> config logging syslog del 10.0.10.37
Status=0,'Success'

> config logging syslog level warning
Status=0,'Success'

> config logging syslog reset
Status=0,'Success'

```

#### 8.4.4. config network Command

The **config network** menu allows the user to administer and manually provision the network settings for the reader. This menu provides the following commands:

```

Commands:
domain      - Set the domain of the reader.
hostname    - Set the reader hostname.
snmp        - Not handled yet.
exit        - Exit this submenu and return to the parent menu.
help        - Displays this help message.
.           - Exit this submenu and return to the parent menu.
?           - Displays this help message.

```

```

Sub-menus:
dhcp        - Submenu of DHCP specific commands.

```

|       |   |
|-------|---|
| dns   | - Submenu of DNS specific commands.                 |
| ip    | - Submenu of IP address and configuration commands. |
| ntp   | - Submenu of NTP specific commands.                 |
| trace | - Submenu of network trace specific commands.       |

#### 8.4.4.1. config network domain Command

The **config network domain** command configures a search domain on the reader device. This domain will be used if the DHCP network does not provide a search domain to the device or the IP address mode is static. The command parameters are shown in Table 8-6.

**Table 8-6 "config network domain" Command Parameters**

| Command | Options | Format | Description  |
|---------|---------|--------|--|
| domain  |         | STRING | Configures a static search domain for the reader. If DHCP is used, this static domain is not used. If the IP address mode is turned to static, this domain will be put to use. If the STRING is absent, this command deletes the static search domain. |

The command usage is shown below:

```
Usage: config network domain <domain-name>
```

A sample of the command and response is shown below:

```
> config network domain bar.com
Status=0, 'success'
```

#### 8.4.4.2. config network hostname Command

The **config network hostname** command configures a hostname on the reader device—the hostname to be used if the DHCP network does not provide a hostname to the device. The command parameters are shown in Table 8-7.

**Table 8-7 "config network hostname" Command Parameters**

| Command  | Options | Format | Description   |
|----------|---------|--------|---|
| hostname |         | STRING | Configures the current hostname for the reader. Parameters returned from DHCP will override this value. |

The command usage is shown below:

```
Usage: config network hostname <host-name>
```

A sample of the command and response is shown below:

```
> config network hostname speedwayc11
Status=0, 'success'
```

#### 8.4.4.3. config network dhcp Command

The **config network dhcp** command allows the user to modify the DHCP client configuration. The commands are described below.

Commands:

|              |  |
|--------------|--|
| sendhostname | - Turn on/off send-hostname in DHCP client config. |
| userclass    | - Set the user class option of DHCP client config. |
| exit         | - Exit this submenu and return to the parent menu. |
| help         | - Displays this help message.                      |
| .            | - Exit this submenu and return to the parent menu. |
| ?            | - Displays this help message.                      |

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Sub-menus:  
None

Command parameters are shown in Table 8-8.

**Table 8-8 "config network dhcp" Command Parameters**

| Commands     | Arguments  | Format | Description   |
|--------------|------------|--------|---|
| Sendhostname | <on   off> | STRING | Turn the “send hostname” on/off option in the DHCP client configuration   |
| Userclass    |            | STRING | Sets the value for the “send user-class” option of the DHCP client configuration. Issuing this command without giving a userclass string turns this option off. |

The command usage is shown below:

```
Usage: config network dhcp sendhostname <on|off>
Usage: config network dhcp userclass [<string>]
```

The result of issuing this command is:

- If the sendhostname DHCP option is currently off and the command turns it on, the network interface is “refreshed”, i.e., the DHCP client is restarted and the DHCP request is resent to get an IP address.
- If the userclass option is turned on or its value is changed, the network interface is refreshed.

### 8.4.4.4. config network dns Command

The **config network dns** command allows the user to statically configure DNS servers. These servers are in addition to any provisioned through DHCP. The commands are described below.

Commands:

|        |   |
|--------|---|
| add    | - Add a static server to the list of current DNS servers.                     |
| del    | - Delete a statically configured server from the list of current DNS servers. |
| delall | - Delete all statically configured DNS servers.                               |
| exit   | - Exit this submenu and return to the parent menu.                            |
| help   | - Displays this help message.   |
| .      | - Exit this submenu and return to the parent menu.                            |
| ?      | - Displays this help message.   |

Sub-menus:  
None

Command parameters are shown in Table 8-9:

**Table 8-9 "config network dns" Command Parameters**

| Command | Arguments | Format    | Description  |
|---------|-----------|-----------|--|
| add     | IpAddress | IpAddress | Add a static DNS server with the following address. Manually configured DNS servers will be utilized after searching DNS servers returned by DHCP. |
| del     | IpAddress | IpAddress | Delete a statically configured DNS server with the following address. Servers obtained through DHCP are not available for delete.                  |
| delall  |           |           | Delete all statically configured DNS servers added with the add command.   |

The command usage is shown below:

```
Usage: config network dns add <server-ip-address>
Usage: config network dns del <server-ip-address>
Usage: config network dns delall
```

A sample command and response is shown below:

```
>config network dns add 1.2.3.4
Status=0, 'success'
```

### 8.4.4.5. config network ip Command

The **config network ip** command allows the user to statically configure IP settings, or configure the reader to use DHCP. The commands are described below.

Commands:

```
dynamic - Set the reader to DHCP for IP address parameters.
static  - Set the reader to static IP address parameters.
exit    - Exit this submenu and return to the parent menu.
help    - Displays this help message.
.       - Exit this submenu and return to the parent menu.
?       - Displays this help message.
```

Sub-menus:

None

Command parameters are shown in Table 8-10:

**Table 8-10 "config network ip" Command Parameters**

| Commands   | Arguments         | Format | Description  |
|--|-------------------|--------|--|
| static   | IpAddress         |        | Configure the network for static address resolution. The following combinations of parameters are valid: |
|  | netmask           |        | <IpAddress>  |
|  | gateway-address   |        | <Ip Address> <gateway-address>   |
|  | broadcast-address |        | <Ip_Address> <netmask> <gateway-address> <broadcast-address>   |
| For parameters not specified the reader will use default values. |                   |        |  |
| dynamic  |                   |        | Configures the network for dynamic address resolution using the DHCP protocol.                           |

The usage for this command is shown below:

```
Usage: config network ip static <ip-address>
Usage: config network ip static <ip-address> <gateway-address>
Usage: config network ip static <ip-address> <netmask> <gateway-address>
<broadcast-address>
Usage: config network ip dynamic
```

---

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A sample of the command and response is shown below:

```
> config network ip dynamic
Status=0,'success'

> config network ip static 192.168.20.116
Status=0,'Success'
> show network summary
Status=0,'Success'
ipAddressMode=static
ipAddress=192.168.20.116
ipMask=255.255.255.0
gatewayAddress=192.168.20.1
broadcastAddress=192.168.20.255
hostname=speedwayc11

> config network ip static 192.168.20.116 255.255.255.0 192.168.20.1
192.168.20.255
Status=0,'success'
> show network summary
Status=0,'success'
ipAddressMode=static
ipAddress=192.168.20.116
ipMask=255.255.255.0
broadcastAddress=192.168.20.255
gatewayAddress=192.168.20.1
hostname=speedwayc11
>
```

### 8.4.4.6. config network ntp Command

The **config network ntp** command allows the user to statically configure NTP servers. These servers are in addition to any provisioned through DHCP. The commands are shown below:

Commands:

|        |   |
|--------|---|
| add    | - Add a static server to the list of current NTP servers.                     |
| del    | - Delete a statically configured server from the list of current NTP servers. |
| delall | - Delete all statically configured NTP servers.                               |
| exit   | - Exit this submenu and return to the parent menu.                            |
| help   | - Displays this help message.   |
| .      | - Exit this submenu and return to the parent menu.                            |
| ?      | - Displays this help message.   |

Sub-menus:

None

The command parameters are shown in Table 8-11:

**Table 8-11 "config network ntp" Command Parameters**

| Command | Arguments            | Format | Description   |
|---------|----------------------|--------|---|
| Add     | <IpAddress hostname> | STRING | Add a static server to the list of current NTP servers.                     |
| Del     | <IpAddress hostname> | STRING | Delete a statically configured server from the list of current NTP servers. |
| Delall  |                      |        | Delete all the statically configured NTP servers.                           |

The command usage is shown below:

```
Usage: config network ntp add <server-name>
Usage: config network ntp del <server-name>
Usage: config network ntp delall
```

A sample of the command and response is shown below:

```
> config network ntp add yourservername.com
> Status=0, 'success'
>
```

### 8.4.4.7. config network trace Command

The **config network trace** command sets up a remote network trace utility to redirect all traffic from the <source> to a remote system. For example, it is possible to redirect all data transmitted and received on the external network connection to a remote computer for analysis. When the trace is active, the data is transmitted in “libpcap” format to the remote system via a TCP/IP connection. Since TCP/IP requires acknowledgement of packet data, an application (such as “netcat” in Linux/Unix) must be running on the remote computer (on the desired port) to save all the data transmitted, otherwise the data will be dropped and the trace will end. The commands are shown below:

Commands:

```
start  - Start the remote network trace utility.
stop   - Stops the remote network trace utility.
exit   - Exit this submenu and return to the parent menu.
help   - Displays this help message.
.      - Exit this submenu and return to the parent menu.
?      - Displays this help message.
```

Sub-menus:

None

The command usage is shown below:

```
Usage: config network trace start <source> <destination address>
       <destination TCP port>
       config network trace stop
```

A sample of the command and response is shown below:

```
> config network trace start external my_pc 2002
> Status=0, 'success'
>
```

This command would start redirecting all external network traffic to <my\_pc> port 2002 for analysis. Note that <my\_pc> must have a TCP/IP listener waiting on port 2002 to accept and store the data. For example, if my\_pc is running Linux/Unix, it is possible to use the “netcat” utility to listen on port 2002 and redirect the data to a file. Since this file is in “libpcap” format, it may be directly opened with standard networking monitoring tools such as “tcpdump,” “ethereal,” or “wireshark.”

To stop an active redirection, enter:

```
> config network trace stop
> Status=0, 'success'
>
```

### 8.4.5. config system Command

This menu allows configuration of the system identification parameters. Commands are shown below:

Commands:

|             |  |
|-------------|--|
| contact     | - Configure the system contact.                    |
| description | - Configure the system description.                |
| location    | - Configure the system location.                   |
| name        | - Configure the system name.                       |
| time        | - Configure the system time.                       |
| exit        | - Exit this submenu and return to the parent menu. |
| help        | - Displays this help message.                      |
| .           | - Exit this submenu and return to the parent menu. |
| ?           | - Displays this help message.                      |

Sub-menus:

None

All system parameters are entered as strings except for **time**. Place single quotes around strings that have white space. **Time** must be entered in one of the following formats:

MMDDhhmmCCYY  
MM.DD hh:mm:ss  
CCYY.MM.DD hh:mm:ss  
CCYY.MM.DD hh:mm  
hh:mm:ss  
hh:mm

Usage for the **config system** commands is shown below:

```
Usage: config system contact <contact-string>
Usage: config system description <description-string>
Usage: config system location <location-string>
Usage: config system name <system-name-string>
Usage: config system time <correctly formatted time>
```

A sample **config system** command is shown below:

```
config system > location 'a specific location identifier'
Status=0,'Success'
sysDesc="Impinj Speedway"
sysContact="http://www.supplier.com/techsupport"
sysName="speedway-00-00-06"
sysLocation="a specific location identifier"
time="Tue Apr 25 03:59:00 UTC 2006"
```

A sample command that sets **time** is shown below: (Time is set to April, 27<sup>th</sup> 1:11:00 p.m. 2006.)

```
> config system time 042713112006

Status=0,'Success'
sysDesc="Impinj Speedway"
sysContact="http://www.supplier.com/techsupport"
sysName="speedway-00-00-06"
sysLocation="a specific location identifier"
time="Thu Apr 27 13:11:00 UTC 2006"
```

## 8.5. Show Command

If a **help show** command is entered at the command line interface, the system will respond as follows to indicate the need to enter subcommands:

```
> help show
show  - Submenu of elements that may have their configuration or status
      shown
Usage: show [<subcommand> ...]
```

The **show** command brings up a submenu of configuration commands.

```
Commands:
CLI      - Not handled yet.
exit     - Exit this submenu and return to the parent menu.
help     - Displays this help message.
.        - Exit this submenu and return to the parent menu.
?        - Displays this help message.

Sub-menus:
all      - Submenu of multi-category info display commands.
image    - Submenu of image status commands.
logging  - Submenu of logging status commands.
network  - Submenu of network status commands.
rfid     - Submenu of RFID status commands.
system   - Submenu of system status commands.
```

### 8.5.1. show all Command

The **show all** menu has the commands listed below.

```
Commands:
config   - Summary of reader configuration.
exit     - Exit this submenu and return to the parent menu.
help     - Displays this help message.
.        - Exit this submenu and return to the parent menu.
?        - Displays this help message.

Sub-menus:
None
```

#### 8.5.1.1. show all config Command

**show all config** is a summary of the static configuration entries of all categories. The static configuration entries are those that are manually set via CLI commands. The entries that are obtained via such protocols as DHCP are considered dynamic and are not displayed. The response of the command is the concatenation of all the static entries from the following four categories: network, system information, upgrade agent, and logging. Each category is preceded with a delimiter field. The entire collection of possible parameters is listed in Table 8-12. Note that some parameters are present only when set and applicable. The command usage for **show all config** is shown below:

```
Usage: show all config
```

**Table 8-12 "show all config" Response Parameters**

| Parameter Name          | Format     | Description  |
|-------------------------|------------|--|
| ConfigCategory          | Network    | Delimits the network category                                      |
| DomainStatic            | STRING     | The statically set domain  |
| NnsServerAddress<n>Stat | IP Address | The <i>n</i> th static DNS server address. <i>n</i> starts with 1. |

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| Parameter Name          | Format   | Description  |
|-------------------------|--|--|
| NtpServerAddress<n>Stat | IP Address   | The <i>n</i> th static NTP server address, <i>n</i> starts with 1.   |
| IpAddressMode           | <dynamic   static>   | The IP address mode. Dynamic means DHCP is used to obtain IP address.  |
| IpAddress               | IP Address   | The IP address of the reader's Ethernet interface. Present only if ipAddressMode is static.                        |
| IpMask                  | IP Address   | The IP subnet mask of the Ethernet interface. Present only if ipAddressMode is static.                             |
| GatewayAddress          | IP Address   | The default gateway IP address of the Ethernet interface. Present only if the ipAddressMode is static.             |
| BroadcastAddress        | IP Address   | The broadcast address of the Ethernet interface. Present only if the ipAddressMode is static.                      |
| Hostname                | STRING   | The hostname of the reader   |
| DhcpSendHostname        | <on   off>   | Indicates if the "send hostname" option of DHCP client configuration is turned on                                  |
| DhcpUserclass           | DisplayString  | Displays the user-class option of the DHCP client configuration. DisplayString is empty if this option is not set. |
| ConfigCategory          | SystemInfo   | Delimits the system info category  |
| SysDesc                 | DisplayString  | The system description   |
| SysContact              | DisplayString  | The system contact   |
| SysName                 | DisplayString  | The system name  |
| SysLocation             | DisplayString  | The system location  |
| ConfigCategory          | UpgradeAgent   | Delimits the upgrade agent category  |
| MetafileUri             | DisplayString  | The URI of the upgrade metafile  |
| RetrieveMode            | <pull   push>  | The upgrade agent's metafile retrieve mode   |
| RetrievePeriod          | INTEGER  | The retrieve-period in minutes. Present only if the RetrieveMode is pull.  |
| ConfigCategory          | Logging  | Delimits the logging category  |
| ApplicationLevel        | <Emergency   Alert   Critical   Warning   Notice   Info   Debug> | The individual component's syslog logging level, as returned by the "show logging summary" command.                |
| ConfigurationLevel      |  |  |
| MgmtLevel               |  |  |
| NetworkLevel            |  |  |
| RFIDParameters          |  |  |
| RFIDSimulation          |  |  |
| RFIDAccess              |  |  |
| System                  |  |  |
| SeverityLevel           | Same as above  | The syslog logging severity level as set by the "config logging syslog level" command                              |
| SyslogServerAddress1    | IP Address or STRING   | The first syslog server as set by the "config logging syslog add" command.   |
| ...                     | ...  | ...  |
| SyslogServerAddress<N>  | IP Address or STRING   | The last syslog server as set by the "config logging syslog add" command.  |

```
show all > config
Status=0, 'success'
ConfigCategory=Network
domainStatic=
```

```
ipAddressMode=dynamic
hostname=speedway-00-02-01
sendHostname=on
userClass=''

ConfigCategory=SystemInfo
sysDesc='Impinj Speedway'
sysContact='unknown'
sysName='speedway-00-02-01'
sysLocation='unknown'
sysTime='Mon Aug 14 20:38:00 UTC 2006'

ConfigCategory=UpgradeAgent
MetafileUri=' '
RetrieveMode=push

ConfigCategory=Logging
ApplicationLevel=emergency
ConfigurationLevel=emergency
MgmtLevel=emergency
NetworkLevel=emergency
RFIDParameters=emergency
RFIDSingulation=emergency
RFIDAccess=emergency
System=emergency
```

### 8.5.2. show image Command

The **show image** sub-menus commands are shown below:

Commands:

```
metafile - Command to display upgrade metafile info.
summary - Command to display current image status.
exit     - Exit this submenu and return to the parent menu.
help     - Displays this help message.
.        - Exit this submenu and return to the parent menu.
?        - Displays this help message.
```

Sub-menus:

None

#### 8.5.2.1. show image metafile Command

The **show image metafile** command displays the information for the current upgrade metafile. If no metafile has ever been successfully downloaded, only the first two fields are available. The command parameters are shown in Table 8-13. The command usage is shown below:

Usage: show image metafile

**Table 8-13 "show image metafile" Response Parameters**

| Parameter Name  | Format                                | Description  |
|-----------------|---------------------------------------|--|
| MetafileUri     | STRING                                | The current upgrade metafile URI   |
| RetrieveMode    | <pull   push>                         | The current retrieve mode  |
| RetrievePeriod  | INTEGER                               | The current retrieve period, present only if retrieve mode is pull. This is specified in seconds.  |
| UpgradeMode     | <auto   force>                        | The upgrade mode if metafile is currently available  |
| CommitMode      | < immediate   scheduled   wait-4-cmd> | The commit mode if metafile is currently available   |
| CommitTime      | DisplayString                         | The schedule commit time, present only if commit mode is scheduled. Its format is <timezone-yyyymmddhhmmss>, where time zone is the readers time which is gmt. |
| EarlyActivateOk | <yes   no>                            | Indicates whether an early activation of the upgrade image is valid when the commit is scheduled. Present only if the metafile has the early-act-ok field.     |
| UpgFileUri      | DisplayString                         | The upgrade file URI, present if the current metafile is available and has the upgrade-file-uri field.   |

#### 8.5.2.2. show image summary Command

The **show image summary** command specifies the image summary information. The command usage is shown below:

Usage: show image summary

The command returns the following (with all response parameters defined in Table 8-14):

```
> show image summary
Status=0, 'Success'
UpgradeStatus=Download Failed
Reason=File Not Found
DownloadFile=Upgrade Image
primaryImageType=2
primaryImageSystemVersion='2.0.1.240'
primaryImageConfigVersion='255.255.255.255'
secondaryImageType=2
secondaryImageSystemVersion='2.0.1.48'
secondaryImageConfigVersion='255.255.255.255'
```

**Table 8-14 "show image" Response Parameters**

| Parameter Name | Format                              | Description   |
|----------------|-------------------------------------|---|
| UpgradeStatus  |                                     | The upgrade status of the last executed upgrade   |
|                | <Idle                               | The reader is idle in terms of upgrade.   |
|                | Contacting Server                   | Reader is contacting server for file download.  |
|                | Downloading                         | File is being downloaded.   |
|                | Download Failed                     | Failed to download either the metafile or the upgrade image.  |
|                | Bad Config                          | The upgrade configuration metafile is invalid.  |
|                | Bad Image                           | The image downloaded is invalid.  |
|                | No Upgrade                          | No need to upgrade  |
|                | Erasing                             | Reader is erasing flash memory before writing new image.  |
|                | Programming                         | Reader is programming new image into flash memory.  |
|                | Done                                | Upgrade is complete.  |
|                | Set Metafile Failed                 | The configureUri command failed.  |
|                | Set Upgrade Failed                  | The updateUri command failed.   |
|                | FDR Failed                          | The factory command failed.   |
|                | Set RetrieveMode Failed             | The retrievemode command failed.  |
|                | Failed >                            | Any other failures not covered above. Usually explained by Reason field   |
| Reason         |                                     | This supplements the upgradeStatus field to give a reason for the status  |
|                | <Unknown Host                       | Download failed because of an unknown host.   |
|                | Unsupported Scheme                  | Download failed because of unsupported URI scheme (only FTP, HTTP and TFTP are supported).                        |
|                | Syntax Error                        | Metafile has a syntax error.  |
|                | Timeout                             | Download timed out.   |
|                | File Not Found                      | Download file not found.  |
|                | Access Denied                       | Download failed because of access denied by server, e.g., bad password.   |
|                | Not Matching Metafile               | Bad upgrade image because of its not matching the metafile.   |
|                | Bad File Format                     | Bad upgrade image file format.  |
|                | Bad CRC                             | Bad image CRC.  |
|                | Bad Hw Version                      | Image Hw version does not match the reader.   |
|                | No Newer Version                    | Upgrade not needed because no newer version in the metafile or upgrade image.                                     |
|                | File Mismatch                       | Metafile has mismatched partition image types.  |
|                | No File                             | Metafile does not contain upgrade file information.   |
|                | Missing SOP                         | Metafile does not contain SOP partition while SCP is present.   |
|                | Duplicated Partition                | Upgrade failed because either the metafile or the upgrade file has a duplicated partition in it.                  |
|                | Incompatible Upgrade/Downgrade Path | Upgrade failed because upgrading/downgrading to the intended SOP version or type is not allowed by current image. |

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| Parameter Name              | Format                      | Description  |
|-----------------------------|-----------------------------|--|
|                             | Flash Programming Failed    | Failed to write the flash memory.  |
|                             | Flash Programming Failed    | Failed to burn the flash.  |
|                             | Current Image Invalidated   | The current image has been invalidated by a previous “fallback” command.                   |
|                             | No Fallback Image Available | This reason applies to the rejection of multiple commands following a “fallback” commands. |
|                             | Generic Error >             | Download error other than those specified above.   |
| PrimaryImageType            | STRING                      | The type of image stored in the primary (currently defaults to Linux)                      |
| PrimaryImageSystemVersion   | STRING                      | The version string of the primary image system partition                                   |
| PrimaryImageConfigVersion   | STRING                      | The version string of the primary image configuration partition                            |
| SecondaryImageType          | STRING                      | The type of image stored in the secondary (currently defaults to Linux)                    |
| secondaryImageSystemVersion | STRING                      | The version string of the secondary image system partition                                 |
| secondaryImageConfigVersion | STRING                      | The version string of the secondary image configuration partition                          |

Following an upgrade command, the **UpgradeStatus** can take any of the values shown in Table 8-14. For each abnormal status, a Reason parameter is given to indicate the reason for the status. The reason values are also given in Table 8-14.

### 8.5.3. show logging Command

The **show logging** commands are used to display the logging parameters for the system and for displaying the log information in text form. The commands are described below.

Commands:

```
internallog - Displays the last internal log entries.
summary      - Displays the current logging levels of the internal logs.
syslog       - Displays the last syslog log entries.
exit         - Exit this submenu and return to the parent menu.
help         - Displays this help message.
.            - Exit this submenu and return to the parent menu.
?            - Displays this help message.
```

Sub-menus:

None

#### 8.5.3.1. show logging internallog Command

Format for the **show logging internallog** command takes an integer argument to specify how many of the last internal log entries to display. The command usage is shown below:

```
Usage: show logging internallog <eventcount>
```

An example command is shown below:

```
> show logging internallog 1
Status=0,'Success'
Event1=1156073965.245217 -- UpgradeAgent          LAPI
Logging service started at: Sun Aug 20 11:39:25 2006
>
```

Log entries are reported from most recent to oldest. Response parameters for the **show logging <syslog|internallog>** are shown in Table 8-15.

**Table 8-15 "show logging <syslog | internallog>" Response Parameters**

| Parameter Name | Format | Description                              |
|----------------|--------|--|
| EventN         | STRING | The string responses from the log events |
| EventN-1       | STRING |  |
| ...            | ...    | ...                                      |
| Event1         | STRING |  |

#### 8.5.3.2. show logging summary Command

The **show logging summary** command displays the current logging configuration for syslog and for the internal log. The command usage is shown below:

```
Usage: show logging summary
```

Response parameters for the logging summary command are shown in Table 8-16.

**Table 8-16 "show logging summary" Response Parameters**

| Parameter Name     | Format   | Description  |
|--------------------|--|--|
| ApplicationLevel   | <Emergency <br>Alert  <br>Critical  <br>Error  <br>Warning  <br>Notice  <br>Info  <br>Debug> | The level at and above which application-level logs are sent to the log database         |
| ConfigurationLevel |  | Log level for configuration  |
| MgmtLevel          |  | Log level for management   |
| NetworkLevel       |  | Log level for networking   |
| RFIDParameters     |  | Log level for RFID parameters  |
| RFIDSingulation    |  | Log level for RFID singulation   |
| RFIDAccess         |  | Log level for RFID access  |
| System             |  | Log level for system   |
| severityLevel      |  | The syslog security level. Only logs at or above this level will be forwarded to syslog. |

A sample of the command is shown below:

```
> show logging summary
Status=0,'Success'
ApplicationLevel=critical
ConfigurationLevel=emergency
MgmtLevel=emergency
NetworkLevel=emergency
RFIDParameters=emergency
RFIDSingulation=emergency
RFIDAccess=emergency
System=emergency
severityLevel=warning
>
```

### 8.5.3.3. show logging syslog Command

Format for the **show logging syslog** command takes an integer argument to specify how many log entries to display. The command usage is shown below:

```
Usage: show logging syslog <eventcount>
```

An example command is shown below:

```
> show logging syslog 3
Status=0,'Success'
Event3=Aug 20 11:39:25 (none) ntpd[625]: bind() fd 4, family 2, port 123,
addr 10.0.10.231, in_classd=0 flags=1 fails: Address already in use
Event2=Aug 20 11:39:26 (none) thttpd[631]: socket :: - Address family not
supported by protocol
Event1=Aug 20 11:39:54 (none) dhclient: receive_packet failed on ixp0:
Network is down
```

### 8.5.4. show network Command

The **show network** menu contains commands to display networking parameters and statistics. All commands are single word commands and take no arguments. Commands with their usage format are shown below, while the response parameters are shown in Table 8-17 through Table 8-26.

**Commands:**

dhcp - Summary of DHCP Client configuration.  
dns - Summary of DNS settings.  
icmp - ICMP statistics.  
iface - Interface status.  
ip - IP statistics.  
ntp - Summary of NTP settings.  
snmp - Not handled yet.  
summary - Summary of network settings.  
tcp - TCP statistics.  
trace - Status of current net trace activity.  
udp - UDP statistics.  
exit - Exit this submenu and return to the parent menu.  
help - Displays this help message.  
. - Exit this submenu and return to the parent menu.  
? - Displays this help message.

**Sub-menus:**

None

The command usage for **show network dhcp** is shown below:

Usage: show network dhcp

**Table 8-17 "show network dhcp" Response Parameters**

| Parameter Name | Format | Description  |
|----------------|--------|--|
| sendHostname   | on off | Indicates the current setting for sending the hostname during DHCP negotiation.  |
| UserClass      | STRING | Displays the current setting for the user class DHCP option. If this is an empty string the user class option is not sent via DHCP. Otherwise the value indicates the string that is sent. |

The command usage for **show network dns** is shown below:

Usage: show network dns

**Table 8-18 "show network dns" Response Parameters**

| Parameter Name          | Format    | Description   |
|-------------------------|-----------|---|
| DomainStatic            | STRING    | Statically configured domain, if available                    |
| domainDynamic           | STRING    | DNS domain obtained from DHCP, if available                   |
| dnsServerAddress1Stat   | IpAddress | Address of first static DNS server                            |
| dnsServerAddress2Stat   | IpAddress | Address of second statically added DNS server                 |
| ...                     | ...       | ...   |
| dnsServerAddress<N>Stat | IpAddress | Address of last statically added DNS server                   |
| dnsServerAddress1Dyn    | IPAdress  | Address of first dynamic DNS server obtained from DHCP server |
| ...                     | ...       | ...   |
| dnsServerAddress<N>Dyn  | IPAdress  | Address of last dynamic DNS server obtained from DHCP server  |

The command usage for **show network icmp** is shown below:

Usage: show network icmp

**Table 8-19 "show network icmp" Response Parameters**

| Parameter Name       | Format  | Description        |
|----------------------|---------|--------------------|
| icmpInMsgs           | Counter | See MIB-2 RFC 1213 |
| icmpInErrors         | Counter |                    |
| icmpInTimeExcds      | Counter |                    |
| icmpInParmProbs      | Counter |                    |
| icmpInSrcQuenches    | Counter |                    |
| icmpInRedirects      | Counter |                    |
| icmpInEchos          | Counter |                    |
| icmpInEchoReps       | Counter |                    |
| icmpInTimestamps     | Counter |                    |
| icmpInTimestampReps  | Counter |                    |
| icmpInAddrMasks      | Counter |                    |
| icmpInAddrMaskReps   | Counter |                    |
| icmpOutMsgs          | Counter |                    |
| icmpOutErrors        | Counter |                    |
| icmpOutDestUnreachs  | Counter |                    |
| icmpOutTimeExcds     | Counter |                    |
| icmpOutParmProbs     | Counter |                    |
| icmpOutSrcQuenches   | Counter |                    |
| icmpOutRedirects     | Counter |                    |
| icmpOutEchos         | Counter |                    |
| icmpOutEchoReps      | Counter |                    |
| icmpOutTimestamps    | Counter |                    |
| icmpOutTimestampReps | Counter |                    |
| icmpOutAddrMasks     | Counter |                    |
| icmpOutAddrMaskReps  | Counter |                    |

A sample command is show below:

```
> show network icmp
Status=0, 'Success'
icmpInMsgs=0
icmpInErrors=0
icmpInTimeExclds=0
icmpInParmProbs=0
icmpInSrcQuenches=0
icmpInRedirects=0
icmpInEchos=0
icmpInEchoReps=0
icmpInTimestamps=0
icmpInTimestampReps=0
icmpInAddrMasks=0
icmpInAddrMaskReps=0
icmpOutMsgs=0
icmpOutErrors=0
icmpOutDestUnreachs=0
icmpOutTimeExclds=0
icmpOutParmProbs=0
icmpOutSrcQuenches=0
icmpOutRedirects=0
icmpOutEchos=0
icmpOutEchoReps=0
icmpOutTimestamps=0
icmpOutTimestampReps=0
icmpOutAddrMasks=0
icmpOutAddrMaskReps=0
```

The command usage for **show network iface** is shown below:

Usage: show network iface

**Table 8-20 "show network iface" Response Parameters**

| Parameter Name | format        | Description  |
|----------------|---------------|--|
| IfIface        | DisplayString | Interface Name   |
| IfMTU          | integer       | Maximum Transfer Unit Size   |
| IfMet          | integer       | Interface Metric   |
| ifRx-OK        | integer       | Successful Receive Frames  |
| ifRX-ERR       | integer       | Errored Receive Frames   |
| ifRF-DRP       | integer       | Dropped Receive Frames   |
| ifRF-OVR       | integer       | Receiver Overruns  |
| ifTX-OK        | integer       | Successful Transmit Frames   |
| ifTx-ERR       | integer       | Errored Transmit Frames  |
| ifTx-DRP       | integer       | Dropped Transmit Frames  |
| ifTx-OVR       | integer       | Transmitter Overruns   |
| IfFlg          | DisplayString | B -- broadcast address has been set.<br>L --This interface is a loopback device.<br>M --All packets are received (promiscuous mode).<br>O --ARP is turned off for this interface.<br>P --This is a point-to-point connection.<br>R --Interface is running.<br>U --Interface is up. |

---

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A sample command is shown below:

```
show network > iface
Status=0,'Success'
ifIface=ixp0
ifMTU=1500
ifMet=0
ifRX-OK=31921
ifRX-ERR=0
ifRX-DRP=0
ifRX-OVR=0
ifTX-OK=24338
ifTX-ERR=0
ifTX-DRP=0
ifTX-OVR=0
ifFlg=BMRU
```

The command usage for **show network ip** is shown below:

```
Usage: show network ip
```

**Table 8-21 "show network ip" Response Parameters**

| Parameter Name    | Format  | Description        |
|-------------------|---------|--------------------|
| ipForwarding      | INTEGER | See MIB-2 RFC 1213 |
| ipDefaultTTL      | INTEGER |                    |
| ipInReceives      | Counter |                    |
| ipInHdrErrors     | Counter |                    |
| ipInAddrErrors    | Counter |                    |
| ipForwDatagrams   | Counter |                    |
| ipInUnknownProtos | Counter |                    |
| ipInDiscards      | Counter |                    |
| ipInDelivers      | Counter |                    |
| ipOutRequests     | Counter |                    |
| ipOutDiscards     | Counter |                    |
| ipOutNoRoutes     | Counter |                    |
| ipReasmTimeout    | INTEGER |                    |
| ipReasmReqds      | Counter |                    |
| ipReasmOKs        | Counter |                    |
| ipReasmFails      | Counter |                    |
| ipFragOKs         | Counter |                    |
| ipFragFails       | Counter |                    |
| ipFragCreates     | Counter |                    |
| ipRoutingDiscards | Counter |                    |

A sample command is shown below:

```
> show network ip
Status=0,'Success'
ipForwarding=2
ipDefaultTTL=64
ipInReceives=22028
ipInHdrErrors=0
ipInAddrErrors=0
ipForwDatagrams=0
```

```
ipInUnknownProtos=0
ipInDiscards=0
ipInDelivers=22001
ipOutRequests=23126
ipOutDiscards=0
ipOutNoRoutes=0
ipReasmTimeout=0
ipReasmReqds=0
ipReasmOKs=0
ipReasmFails=0
ipFragOKs=0
ipFragFails=0
ipFragCreates=0
ipRoutingDiscards=0
```

The command usage for **show network ntp** is shown below:

```
Usage: show network ntp
```

**Table 8-22 "show network ntp" Response Parameters**

| Parameter Name          | Format | Description  |
|-------------------------|--------|--|
| NtpServerAddress1Stat   | STRING | Address of the first statically added NTP server                   |
| NtpServerAddress2Stat   | STRING | Address of the second statically added NTP server                  |
| ...                     | ...    | ...  |
| NtpServerAddress<N>Stat | STRING | Address of the last NTP server                                     |
| NtpServerAddress1Dyn    | STRING | Address of the first NTP server obtained from DHCP server          |
| NtpServerAddress2Stat   | STRING | Address of the second dynamic NTP server obtained from DHCP server |
| ...                     | ...    | ...  |
| NtpServerAddress<N>Dyn  | STRING | Address of the last NTP server obtained from DHCP server           |

A sample command is shown below:

```
> show network ntp
Status=0,'success'
NtpServerAddress1Stat=140.142.16.34
```

The command usage for **show network summary** is shown below:

```
Usage: show network summary
```

**Table 8-23 "show network summary" Response Parameters**

| Parameter Name   | Format    | Description  |
|------------------|-----------|--|
| ipAddressMode    | STRING    | If configuration is currently dynamic, the dynamic values returned by DHCP are given |
| ipAddress        | ipAddress |  |
| IpMask           | ipAddress |  |
| gatewayAddress   | ipAddress |  |
| broadcastAddress | ipAddress |  |
| hostname         | STRING    |  |

A sample command is shown below:

```
> show network summary
Status=0,'success'
ipAddressMode=dynamic
ipAddress=192.168.8.98
ipMask=255.255.252.0
gatewayAddress=192.168.8.1
broadcastAddress=192.168.11.255
hostname=rdr-100-64
```

The command usage for **show network tcp** is shown below:

Usage: show network tcp

**Table 8-24 "show network tcp" Response Parameters**

| Parameter Name  | Format  | Description        |
|-----------------|---------|--------------------|
| tcpRtoAlgorithm | INTEGER | See MIB-2 RFC 1213 |
| tcpRtoMin       | INTEGER |                    |
| tcpRtoMax       | INTEGER |                    |
| tcpMaxConn      | INTEGER |                    |
| tcpActiveOpens  | Counter |                    |
| tcpPassiveOpens | Counter |                    |
| tcpAttemptFails | Counter |                    |
| tcpEstabResets  | Counter |                    |
| tcpCurrEstab    | Gauge   |                    |
| tcpInSegs       | Counter |                    |
| tcpOutSegs      | Counter |                    |
| tcpRetransSegs  | Counter |                    |
| tcpInErrs       | Counter |                    |
| tcpOutRsts      | Counter |                    |

A sample command is shown below:

```
> show network tcp
Status=0,'Success'
tcpRtoAlgorithm=0
tcpRtoMin=0
tcpRtoMax=0
tcpMaxConn=0
tcpActiveOpens=4
tcpPassiveOpens=33
tcpAttemptFails=0
```

```

tcpEstabResets=0
tcpCurrEstab=2
tcpInSegs=14269
tcpOutSegs=22171
tcpRetransSegs=0
tcpInErrs=0
tcpOutRsts=2

```

The command usage for **show network udp** is shown below:

```
Usage: show network udp
```

**Table 8-25 "show network udp" Response Parameters**

| Parameter Name  | Format  | Description        |
|-----------------|---------|--------------------|
| udpInDatagrams  | Counter | See MIB-2 RFC 1213 |
| udpNoPorts      | Counter |                    |
| udpInErrors     | Counter |                    |
| udpOutDatagrams | Counter |                    |

A sample command is shown below:

```

> show network udp
Status=0, 'Success'
udpInDatagrams=917
udpNoPorts=0
udpInErrors=0
udpOutDatagrams=976

```

The command usage for **show network trace** is shown below:

```
Usage: show network trace
```

**Table 8-26 "show network trace" Response Parameters**

| Parameter Name | Format | Description  |
|----------------|--------|--|
| Active         | STRING | "Yes" or "No" indicating if a net trace is currently active. |

A sample command is shown below:

```

show network > trace
Status=0, 'Success'
Active=No
>

```

### 8.5.5. show system Command

The **show system** menu displays information on the system state of the reader. Command usage for each subcommand is shown below and Table 8-27 through Table 8-29 summarize the respective response parameters. Examples for each follow.

Commands:

```

cpu      - Platform memory usage and available application space
          statistics.
platform - Displays generic platform statistics.
summary  - Displays system information

```

---

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```
exit      - Exit this submenu and return to the parent menu.  
help      - Displays this help message.  
.       - Exit this submenu and return to the parent menu.  
?       - Displays this help message.
```

Sub-menus:  
None

The command usage for **show system cpu** is shown below:

```
Usage: show system cpu
```

**Table 8-27 "show system cpu" Response Parameters**

| Parameter Name                 | Format     | Description                                  |
|--------------------------------|------------|--|
| TotalMemory                    | Unsigned32 | Total available RAM in bytes                 |
| FreeMemory                     | Unsigned32 | Total free RAM in bytes                      |
| CpuUtilization                 | Unsigned32 | CPU utilization in percent                   |
| TotalConfigurationStorageSpace | Unsigned32 | Total Configuration partition space in bytes |
| FreeConfigurationStorageSpace  | Unsigned32 | Free Configuration partition space in bytes  |
| TotalApplicationStorageSpace   | Unsigned32 | Total Application partition space in bytes   |
| FreeApplicationStorageSpace    | Unsigned32 | Free Application partition space in bytes    |

```
> Show system cpu  
Status=0, 'success'  
TotalMemory=64606208  
FreeMemory=45469696  
CpuUtilization=3  
TotalConfigurationStorageSpace=2097152  
FreeConfigurationStorageSpace=1335296  
TotalApplicationStorageSpace=2097152  
FreeApplicationStorageSpace=1437696
```

The command usage for **show system platform** is shown below:

```
Usage: show system platform
```

**Table 8-28 "show system platform" Response Parameters**

| Parameter Name  | Format         | Description   |
|-----------------|----------------|---|
| hardwareVersion | Display String | Returns the current hardware version information    |
| serialNumber    | Display String | Returns the hardware serial number                  |
| bIOSVersion     | Display String | Returns the version information for the reader BIOS |
| MacAddress      | Display String | MAC Address of unit's Ethernet port                 |
| UptimeSeconds   | <Time ticks>   | Time since last reboot in seconds                   |

```
> show system platform  
Status=0, 'success'  
hardwareVersion=010-000.027255  
serialNumber=00-06-02-00022  
biosVersion=1.1.0 RC 2  
macAddress=00:16:25:00:01:18  
uptimeSeconds=5836
```

The command usage for **show system summary** is shown below:

```
Usage: show system summary
```

**Table 8-29 “show system summary” Response Parameters**

| Parameter Name | Format        | Description  |
|----------------|---------------|--|
| SysDesc        | DisplayString | A system description; defaults to make and model number of reader  |
| SysContact     | DisplayString | The system contact information – defaults to unknown   |
| SysName        | DisplayString | A system name – defaults to speedway-nn-nn-nn where nn-nn-nn are the last three octets of the MAC address. |
| SysLocation    | DisplayString | A system location – defaults to ‘unknown’  |
| SysTime        | DisplayString | A time in UTC  |

```
> show system summary
Status=0, 'Success'
sysDesc='Impinj Speedway'
sysContact='unknown'
sysName='speedway-00-00-08'
sysLocation='unknown'
sysTime='Tue Apr 25 16:04:59 UTC 2006'
```

## 8.6. Transfer Command

If a **help transfer** command is entered at the command line interface, the system will respond as follows to indicate the need to enter subcommands:

```
> help transfer
transfer - Submenu of transfer commands.
Usage: transfer [<subcommand> ...]
```

The **transfer** menu contains commands for transferring files from the reader. Syslog and internal log files stored on the reader can be offloaded to remote servers. The transfer commands have the following format:

```
Commands:
from-reader - Transfer a file from the reader to a remote URI.
status      - Display status of any currently active transfer.
exit        - Exit this submenu and return to the parent menu.
help        - Displays this help message.
.           - Exit this submenu and return to the parent menu.
?           - Displays this help message.

Sub-menus:
None
```

### 8.6.1. transfer from-reader Command

The **transfer from-reader** command uploads files from the reader. The command requires two arguments: the first specifies the file to upload, the second specifies the URI destination for the file. The file upload options are **internallog** or **syslog**. The **internallog** and **syslog** options upload the internal log and syslog, respectively, to a file specified by the URI that must end in .txt.gz. The command usage is shown below:

```
Usage: from-reader <internallog|syslog> <URI>
```

The following URI formats are accepted by this command:

```
tftp://<servername>/<directory>/<file>.txt.gz
ftp://<user>:<password>@<servername>/<directory>/<file>.txt.gz
```

A sample command is shown below:

```
> transfer from-reader syslog tftp://10.0.10.37/syslog.txt.gz
Status=0, 'Success'
>
```

### 8.6.2. transfer status Command

The **transfer status** command displays the current status of the transfer sub-system. The command usage is shown below. The command response parameters are given in Table 8-30. This command takes no arguments.

Usage: transfer status

**Table 8-30 “transfer status“ Command Response**

| Parameter Name | Format  | Description  |
|----------------|---|--|
| TransferStatus | <Unknown   Contacting Server   Transferring   Transfer Failed   Done>   | The status of the transfer. Unknown means there is no outstanding transfer command.  |
| Reason         | < Unknown Host   Access Denied   File Not Found   Timeout   Invalid URI Format   Invalid URI Format (username:password@host)> | Reason for failure of transfer.<br>Note that when using TFTP to upload, the remote file may have to be already on the server with the right permission, otherwise transfer fails with reason “File Not Found” or “Access Denied”.<br>If the remote URI is invalid, transfer fails with reason “Invalid URI Format” and if FTP is used, the correct form is given in the Reason string. |

An example of a failed transfer has the following status response:

```
> transfer status
Status=0, 'Success'
TransferStatus=Transfer Failed
Reason=Unknown Host
>
```

## 9. Troubleshooting

Refer to Table 9-1 for resolution of common problems. For additional technical support, go to <http://rfid-support.impinj.com>. For units not purchased directly from Impinj, please contact your VAR directly.

**Table 9-1 Troubleshooting**

| Problem   | Solution   |
|---|--|
| The reader's default page does not load.                            | Most likely the reader operating system is still booting or TCP/IP connectivity has been lost. Retry or "ping" the reader to verify connectivity. If more than 50 seconds have elapsed since power was applied, disconnect and reconnect power, then re-attempt to ping the unit after 50 seconds. |
| Java applet does not load after selecting "RFID" from default page. | Verify that the PC's web browser has Java Runtime Environment (JRE) of version 1.4.2 or later. The latest version of JRE may be installed from: <a href="http://java.com/en/download/manual.jsp">http://java.com/en/download/manual.jsp</a>  |
| "Initializing" or "Calibrating" dialog boxes do not disappear.      | The reader has likely locked up. Power cycle the reader.   |
| Tags/sec rate varies when configuration settings are changed.       | This is normal. Currently, the Maximum Throughput mode should have >200 tags/sec, while Dense-Reader or Initialization modes are ~100 tags/sec. Some transmit frequencies will be better than others (no interference or less noise). Best rates will be achieved with 10 to 30 tags within range. |
| None of the recommend actions fixes the problem.                    | Power-cycle the reader   |

## 10. References

| Reference      | Description   |
|----------------|---|
| MIB-2 RFC 1213 | Management Information Base for Network Management of TCP/IP-based internets: MIB-II. K. McCloghrie, M. Rose. March 1991. |
| RFC 3986       | Uniform Resource Identifier (URI): Generic Syntax. T. Berners-Lee, R. Fielding, L. Masinter. January 2005.                |

### Appendix A Impinj Factory Default Configuration

Detailed below are the factory default configuration settings for the Speedway reader. Except for the username and password, all entries are shown when the “show all config” command is issued on a Speedway reader in its factory default configuration.

Username: root

Password: impinj

#### **Networking Category**

Static domain: None

IpAddressMode: dynamic # (using DHCP to obtain IP address)

hostname: speedway-nn-nn-nn, # where nn-nn-nn are the last three bytes of the reader's MAC address (in hex)

SendHostname: on

Userclass: None

Static DNS server: None

Static NTP server: None

System Info category:

system Description: 'Impinj Speedway'

system Contact: 'http://www.supplier.com/techsupport'

system name: 'speedway-nn-nn-nn' # same as default hostname

system Location: 'unknown'

#### **Upgrade Agent Category**

MetafileUri: Empty

RetrieveMode: push

#### **Logging Category**

ApplicationLevel: emergency

ConfigurationLevel: emergency

MgmtLevel: emergency

NetworkLevel: emergency

RFIDParameters Level : emergency

RFIDSingulation Level: emergency

RFIDAccess Level: emergency

System Level: emergency

syslog severityLevel: error

static syslog server: none

## Appendix B Command Line Editing in Rshell

| Key            | Sequence             | Action   |
|----------------|----------------------|--|
| Printable char |                      | Insert character at cursor position then move cursor right one.  |
| KEY_LEFT       | Control-B, \033[D    | Move cursor left one. Sticks at begin-of-line.   |
| KEY_RIGHT      | Control-F, \033[C    | Move cursor right one. Sticks at end-of-line.  |
| KEY_HOME       | Control-A, \033[1~   | Move cursor to begin-of-line.  |
| KEY_END        | Control-E, \033[4~   | Move cursor to end-of-line   |
| KEY_DELETE     | Control-D, \033[3~   | Delete character at cursor position. Leave cursor at same position.  |
| KEY_BACKSPACE  | Control-H            | Move cursor left one then same as KEY_DELETE. Does nothing at begin-of-line.   |
| KEY_ERASELINE  | Control-U            | Erase entire line, place cursor at begin-of-line   |
| KEY_ENTER      | Control-J, Control-M | Move cursor to end-of-line. Return the line to the caller for processing.  |
| KEY_UP         | Control-P, \033[A    | Move up (earlier) the history list. Erases current line, copies in and displays history entry, places cursor at end-of-line. |
| KEY_DOWN       | Control-N, \033[B    | Move down (later) the history list. Erases current line, copies in and displays history entry, places cursor at end-of-line. |
| anything else  |                      | Ignored  |

## Appendix C Power Supply Specifications<sup>1</sup>

| Parameter                       | Specification   |  |
|---------------------------------|---|--|
| <b>Input</b>                    |   |  |
| Rated input voltage             | 100 V ~ 240 V ac  |  |
| Input voltage range             | 90 V ~ 264 V ac   |  |
| Rated frequency                 | 50~60 Hz  |  |
| Frequency range                 | 47~63 Hz  |  |
| Rated input current             | 1.5 A at 115 / 0.75 A at 230 V ac (full load)   |  |
| Inrush current                  | nominal ac input voltage at full load, 25°C, cold start<br>(no damage will occur and the input fuse will not blow)  |  |
| <b>Output</b>                   |   |  |
| Output voltage                  | 24 V dc at 2.5 A  |  |
| Output min. current             | 0 A   |  |
| Line regulation                 | ± 2%  |  |
| Load regulation                 | ± 5%  |  |
| Over voltage protection         | ≤ 31 V dc max. with zener clamp   |  |
| Over current protection         | ≤ 5 A (with auto-recovery function)   |  |
| Short circuit protection        | a short circuit at the dc output to ground will cause no damage   |  |
| Ripple voltage                  | 240 mV (p-p) (at 20 MHz and output parallel with 0.1 µF and 10 µF capacitors to ground.)  |  |
| Efficiency                      | 80% min. (at nominal input voltage and full load)   |  |
| <b>Safety and EMI</b>           |   |  |
| HI-POT                          | input to output   | 1500 V ac or 2121 V dc at 10 mA for 1 min. |
|                                 | primary to ground   | 1500 V ac or 2121 V dc at 10 mA for 1 min. |
| Safety approvals                | UL/cUL (UL60950-1), TUV/GS (EN60950-1), T-license (EN60950-1), SAA (AS/NZS60950)  |  |
| EMI standard                    | FCC part 15 class B, C-Tick, CE (EN55022)   |  |
| RoHS compliant                  | yes   |  |
| Leakage current                 | 0.25 mA   |  |
| <b>Environmental</b>            |   |  |
| Cooling                         | by natural convection   |  |
| Storage temperature             | -20°C ~ +60° C  |  |
| Operating temperature           | 0°C ~ +40° C  |  |
| Storage humidity                | 5~95% RH (non-condensing)   |  |
| Operating humidity              | 20~85% RH (non-condensing)  |  |
| <b>Reliability</b>              |   |  |
| Mean time before failure (MTBF) | the power supply is designed and produced to have a mean time between failures (MTBF) of 50,000 hours while operating under the following conditions: 80% max. load at 25°C, nominal input voltage. |  |
| Burn-in test                    | 4 hours at 40°C max., nominal input voltage, 80% of max. load   |  |

<sup>1</sup> Valid data as of December 2006

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