CSL CS-461 EPC Class 1 Gen 2 RFID Fixed Reader User's Manual

Version 1.1C

CSL: The One-Stop-Shop for RFID Solutions

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2 FCC Statement

FCC NOTICE: To comply with FCC part 15 rules in the United States, the system must be professionally installed to ensure compliance with the Part 15 certification. It is the responsibility of the operator and professional installer to ensure that only certified systems are deployed in the United States. The use of the system in any other combination (such as co-located antennas transmitting the same information) is expressly forbidden.

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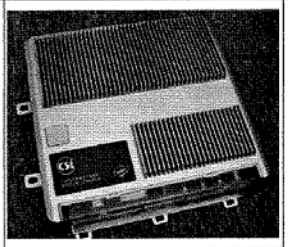
3 Introduction

3.1 CS-461 EPC Class 1 Gen 2 Fixed Reader

CSL is a One-Stop-Shop for RFID equipment that operates in the UHF (800/900 MHz) band. The CSL CS-461 RFID Reader is a EPCglobal Class 1 Gen 2 certified fixed reader product. This reader is powered by Impinj technology, with extremely high inventory rate, tag velocity and true dense reader mode.

This reader can connect to and control four UHF antennas from its 4 TNC duplex antenna ports. In addition to the reader, CSL also offers a mono-static UHF antenna, CS-771, that is designed for CS-461 reader to utilize the power of this reader. Other accessories, such as RF cables, are also available from CSL.

Products	Part Number	Photo
EPC Class 1 Gen 2 Fixed Reader (4 Ports)	CS-461	
Antenna (Mono-static area or zonal antenna, long range)	CS-771	

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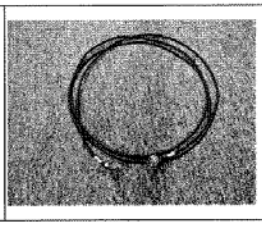
Cable (Custom lengths available)	CS-801-1-2-N, N straight male connector on one side, TNC reverse male connector on the other side. (N is length of cable)	

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3.2 How to Use this Manual

This manual provides a comprehensive introduction to the CSL CS-461 EPC Class1 Gen 2 RFID product (chapter 2), package information (chapter 3), hardware information (chapter 4), quick installation guide (chapter 5), detailed interfaces (chapter 6), RFID application guides (chapter 7) and the technical support information (chapter 8).

In addition to this user's manual, there are other programmer's manual for system integrators and software houses that develop their own software and would like to interface directly with this reader. Please refer to these manuals for the details of using the command sets.

There are two ways of accessing the reader, high level access (HTTP-based) and low level access (TCP/IP socket based).

The High level access method is described in the CSL High Level API Manual, and the Low level access method is described in the CSL Low Level API Manual.

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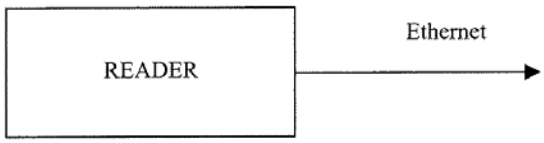
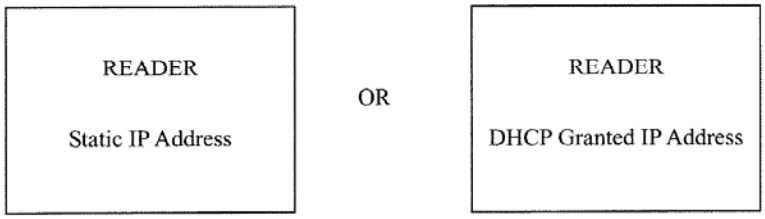
3.3 Connectivity Options

The CSL readers are connected to the network via Ethernet cable (RJ45 socket).
The reader can have a static IP address or can obtain an IP address using DHCP. Normally, a static IP address is more convenient to use because it does not change when the reader reboots, but the operator has to make sure there is no collision with other network devices in the network.





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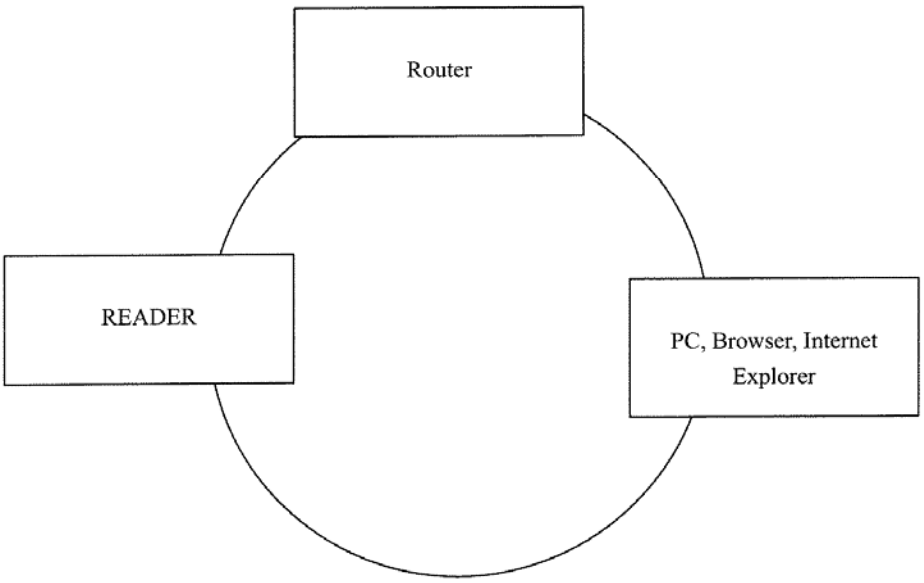
3.4 Browser Interface

The reader can be accessed from any PC via the Internet Explorer browser. The factory default setting of the reader is printed on the label of the reader. Just type in that IP address on the Internet Explorer and the web-based configuration interface of the reader will be shown.

If you encounter any problem in accessing the browser interface, please make sure that the following software packages are properly installed on your PC:

- Microsoft .NET framework 2.0 or above



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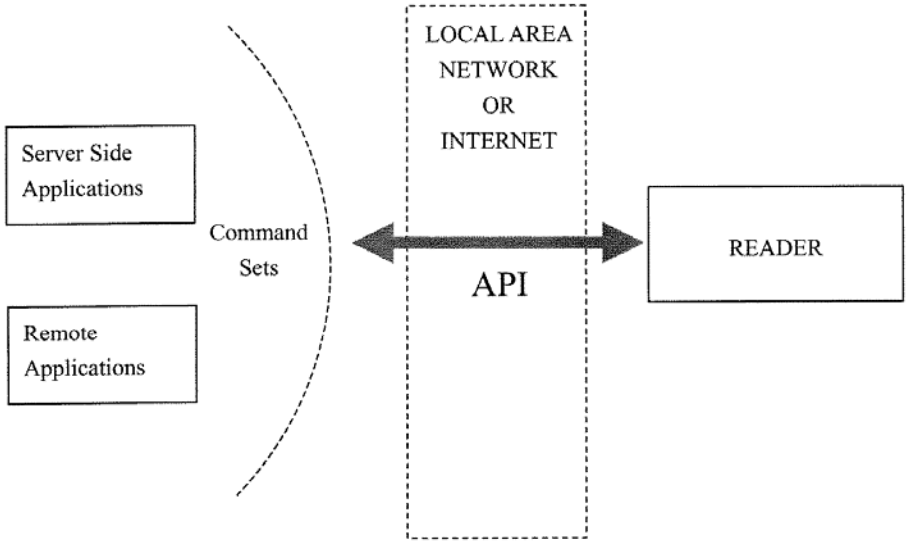
3.5 Programming Interfaces

The CSL CS-461 reader has a set of Application Programming Interfaces (API). Details of programming methods are described in the series of Command Set Manuals.



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3.6 Advanced Features

The CS-461 RFID reader is an EPC Class 1 Gen 2 certified product. As powered by the advance and intelligent technology from Impinj, CS-461 has the unique feature of Dense Reader mode. It allows multiple readers to be used in very close separation or area without jamming each other. Thus, a wide range of applications can be powered by CS-461.

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3.7 RFID Basic Principles

Passive tag RFID technology involves the reader, the antenna and the tag.

The reader sends out energy in the relevant frequency band to the antenna via RF cables, and the antenna radiates the energy out. This energy impinges on an RFID tag.

The RFID tag consists of an antenna coupled to an RFID IC. This IC converts the AC voltage it receives at the antenna port to DC voltage that in turn is used to empower the digital circuit inside.

The digital circuit then turns on and off some components connected to the antenna port, thereby changing its scattering behavior, in a pre-designed clock rate.

This changing of antenna port parameters then causes a "modulation" of the back-scattered RF energy.

This modulated back-scattered energy is detected by the reader and the modulation is captured and analyzed.

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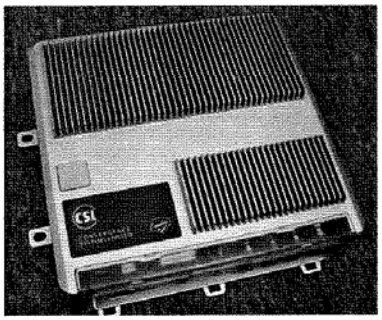
3.8 Product Specifications Briefs

3.8.1 CS-461



Features:

- Certified to the EPCglobal Class 1 Gen 2 UHF RFID protocol including dense reader mode
- Sophisticated data handling for efficient management of large streams of tag data on LAN resources
- Highly configurable buffering and tag filtering modes to eliminate the redundant tag data so as to reduce LAN traffic and server loading
- Compliant to the ISO 18000-6 type-C UHF RFID Standard
- 640 kbps tag-to-reader data rates
- Robust performance in dense-reader environments
- Excellent in transmit and receive mode – generates a different combination of unique reader-to-tag command rate, tag-to-reader backscatter rate, modulation format, and backscatter type
- Tremendous savings by using a single transmit/receive antenna for each of its four points ultra high inventory rate, read rate and tag velocity
- Settable and configurable parameters offer maximum throughput and optimal performance
- Supports all Gen 2 commands, including write, lock and kill

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Specifications:

Physical Characteristics:	Length: 29.5 cm; Width: 30 cm; Height: 8 cm; Weight: 3 Kg
Mounting	Vertical orientation
Environment:	Operating Temp: -20^{0}C to 55^{0}C Storage Temp: -40^{0}C to 85^{0}C Humidity: 10% to 95% non-condensing Enclosure: IP-53
Antenna:	4 TNC duplex antenna ports, each single unit antenna for transmit and receive per port
Power:	Power adaptor for 110-240VAC auto-ranging to DC24Volts, 60Watt
RFID Frequency Ranges:	800 or 900 MHz band
Interfaces	10/100 BASE-T Ethernet RJ45 connector Configurable to use fixed IP address or DHCP RS-232 (DB9 connector) HTTP web server Tag air interface: EPC Class 1 Gen 2
Networking Protocols:	High Level: CSL High Level API Low Level: CSL Low Level API
Hardware Platform:	Xscale
Operating System:	Monta Vista Linux 3.1
Maximum Tag Read Rate:	1000 tag/sec.
Maximum Speed of Tag:	660 ft/min
Accessories:	Power cord
Order Code:	CS-461-P (P=1: 865-869MHz; P=2: 902-929MHz; P=3: 950-956MHz)
Restrictions on Use:	Approvals, features and parameters may vary depending on country legislation and may change without notice

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4 Product Package

4.1 Basic Package Content

The reader package contains:

1 Reader
2 User Manual (in CD format)
3 Power Adapter
4 Power Cord
5 Plastic Cover

4.2 Unpacking Instructions

Unpacking of the reader is very simple. The only caution is that the RF connector sockets should be handled with care. The TNC reverse RF connectors come covered with plastic cap. They should remain covered when not in use to reduce chance of ESD entering the ports via the center conductors.

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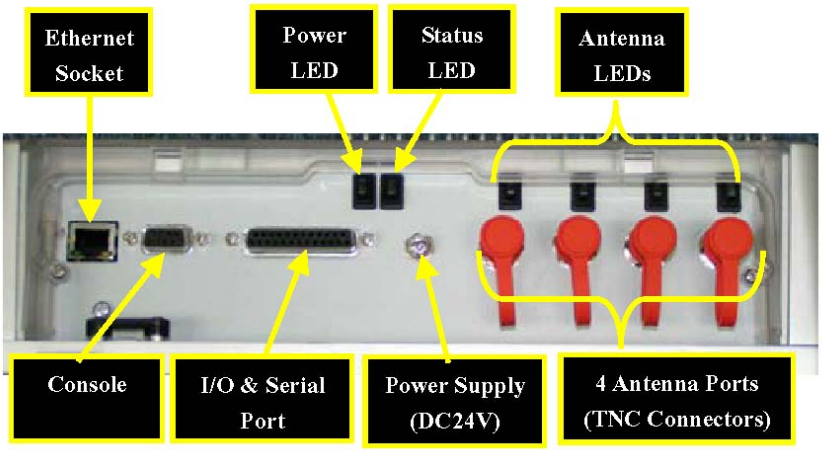
5 Hardware

5.1 Basic Hardware Information

5.1.1 Reader Cable Connection



Note: Minimum cable length is 1.5m for this reader.

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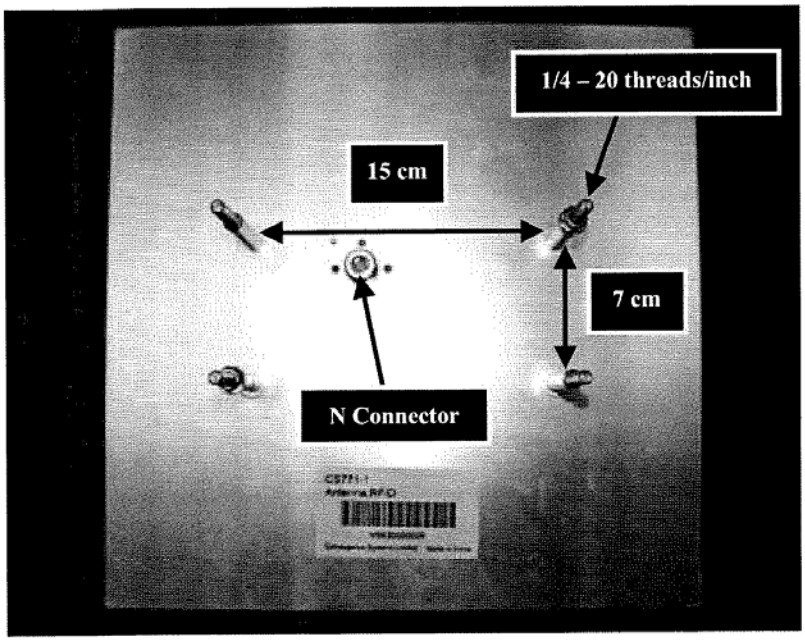
5.1.2 Antenna Cable Connection



CS-771 Mono-Static Antenna

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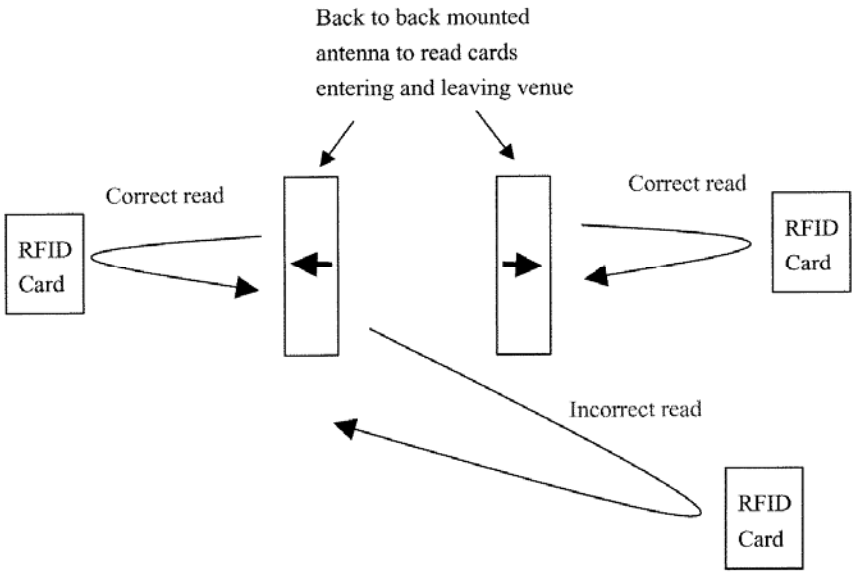
5.1.3 Antenna Installation

In antenna installation, especially when the reader is connected to multiple antennas, then the most important and immediate concern is spatial coupling between antenna, or, in other words, the isolation between antennas. If you mount antenna back to back, it is possible that the backlobe of the antenna will be able to transmit enough of the energy to turn on a tag that are on the opposite side and should have only been picked up by the antenna on that opposite side.



Back to back mounted antenna may erroneously read cards from back due to antenna backlobe

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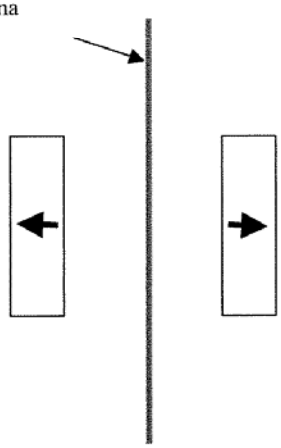
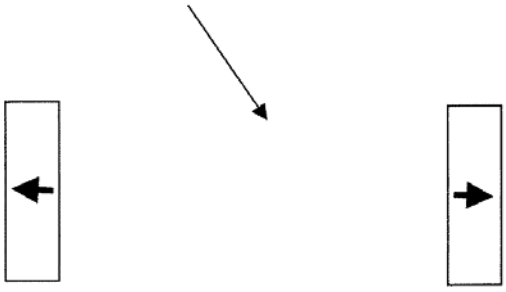
To prevent this erroneous read from happening, one can put spacer metal plate between the two back to back mounted antenna, or place the antenna farther apart, or a combination of the two methods:

Metal plate in between to isolate the two antennas, each dimension should be at least three times that of antenna



Increase the separation between the two antennas will increase the isolation between them.



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Note also that the isolation between the different ports on the readers are not all the same. There are pairs with better isolation than others. Port 1 has best isolation with port 3, port 2 has best isolation with port 4. If isolation between antennas is found to be a problem, put the problem antennas at these best isolated pairs, i.e. connect one to port 1 and the other to port 3, or connect one to port 2 and the other to port 4.

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5.2 Cautions

Since the reader comes out of factory with a default static IP setting, the installer needs to set a PC to that subnet in order to go in to the reader and change the IP address to whatever he wants.

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6 Quick Installation Guide

6.1 Hardware Installation

The reader can be setup easily as described below:

1. Connect the antenna(s) to the reader using the appropriate antenna cables (TNC reverse male connector to the reader side and N straight male connector to the antenna side).

2. Connect the reader to your network or computer using LAN cable on the LAN port. Please remember to use cross-over cable if it is direct reader-to-computer connection.

3. Plug in the power cord to the reader and switch on the power supply. Then the reader will boot up automatically. After the LEDs on the reader finished flashing and the Power LED remains in ON state, the reader has been boot up successfully. You can now use the web-based administration page of the reader to configure the reader.

4. In order to access the web-based administration interface of the reader, open a web browser (Internet Explorer) on your PC and enter the IP address of the reader on the URL field (the default IP address of the reader is printed on the label of the reader). Make sure that the PC is configured in the same subnet as the reader and they are properly connected on the LAN. Moreover, please set the option "Check for newer versions of stored page" to "Every visit to the page" on the IE. The steps for setting it is:
   - Select "Tools" pull-down menu of the IE
   - Select "Internet Option" dialog box
   - Select "General" section and click the "Settings" button inside "Temporary Internet Files"
   - Under "Check for newer versions of stored pages", select "Every vsit to the page".
   - Click "OK" twice to confirm the setting

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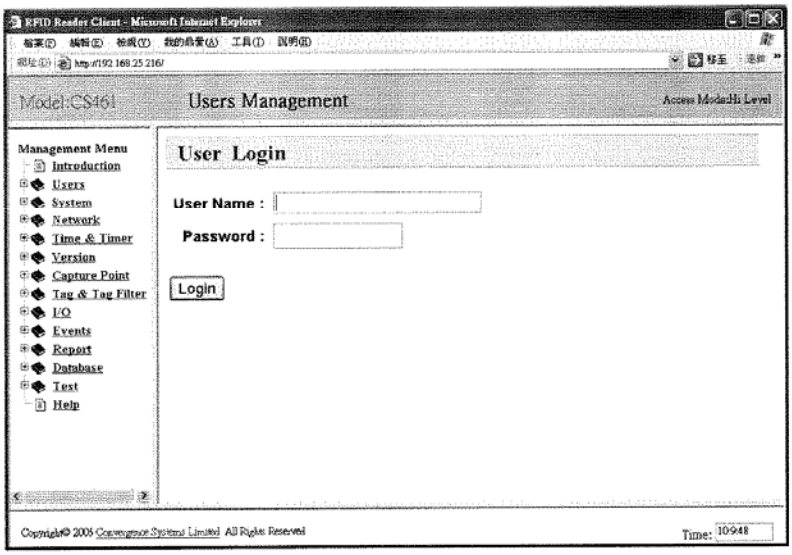
5. After that, the web-based administration page of the reader will be displayed on the web browser as follows:



You can now login the configuration tool. The default administrator login name and password are as follows:
Login: root
Password: root

Please refer to next chapter for the details of this configuration interface.

6. In addition to the web interface, a "Reader Demo Program" is also provided for your configuration and testing of the reader. Please refer to chapter 6 for the details.

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6.2 Verification & Validation

The reader should be verified to be functioning properly:

1. Hook up all four ports to four antennae.
2. Set up the reader to read all four ports alternately (time division).
3. Take the sample tags and read them from the four antennae. Make sure there is not any other reader operating nearby.
4. Take the read range of the tags and check them against the standard performance.

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7 Interface Details

This chapter describes the details of interface to the reader via three methods:

1. **Web Browser Interface**, interacting with the user via a web page using a web browser on a PC that is network connected to the reader. This is particularly useful for operators when configuring the reader. This interface operates when the reader is set as "High-level HTTP API Mode" in Access Mode.

2. **CSL Reader Demo Program**, interacting with the user via a Windows-based program on a PC that is network connected to the reader. This program can be used for controlling one or two readers simultaneously. It can help system integrators to test a single reader or two readers operating in dense reader mode quickly. This interface is particularly useful for site evaluation and installation. This interface can operate to control the reader when the reader is set as "Low-level Mach1 API Mode" in Access Mode.

3. **Programming Interface**, interacting with the user's program via an API library. This interface is particularly useful for connection to software resident on backend servers, such as ERP, SCM, and HR modules. It is fast – of course only up to the speed and latency of a LAN or Internet network. There are two APIs:
   i) the CSL High Level API, when the reader is set to "High-level HTTP API Mode" in Access Mode;
   ii) the CSL Low Level API, when the reader is set to "Low-level API Mode" in Access Mode.

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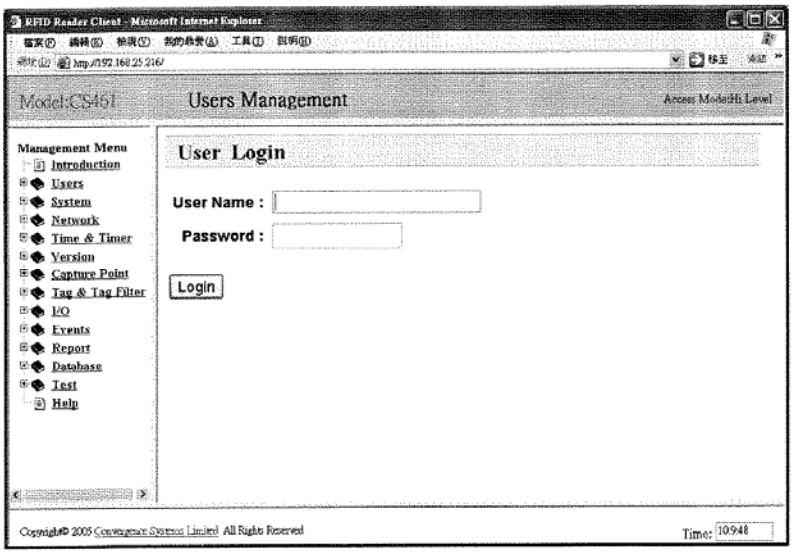
7.1 Web Browser Interface

7.1.1 Home Page

The home page of the web-based administration interface can be entered by just entering the IP address of the reader (default IP address is printed on the label) on the web browser (Internet Explorer is required).
For example, if the IP address of the reader is 192.168.25.173, you should enter:
http://192.168.25.173



Special Caution: Please set the Internet Explorer "Check for newer versions of stored page" option to "Every visit to the page".

To do that, On your browser, from the menu bar "Tools" pull down menu, select "Internet Options". The "Internet Option" dialog box will come out, select the "General" section, look in the "Temporary Internet Files" sub-section and click the "Settings" button. A dialog box will come out. In this dialog box, under "Check for newer versions of stored pages", select "Every visit to the page". Click OK twice. This will take you out of the Internet Options configuration screen.

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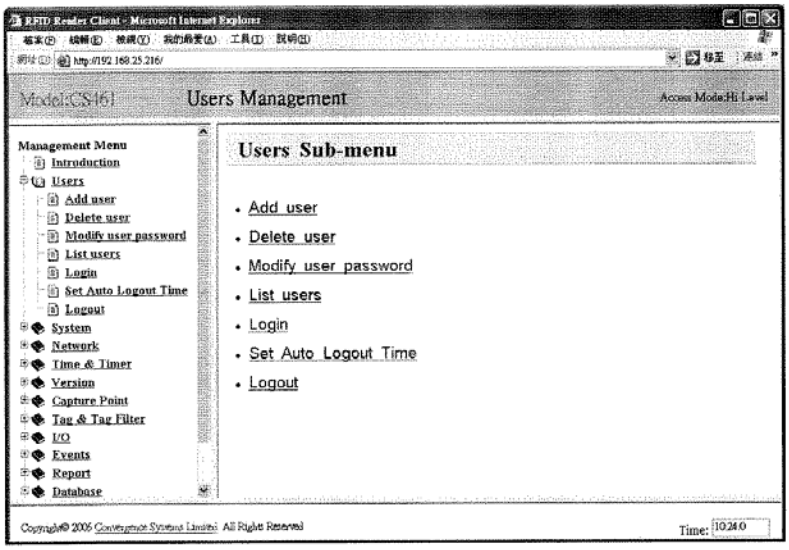
7.1.2 Users Management

The users management page contains sub-menu to add user, delete user, list users, login and logout.



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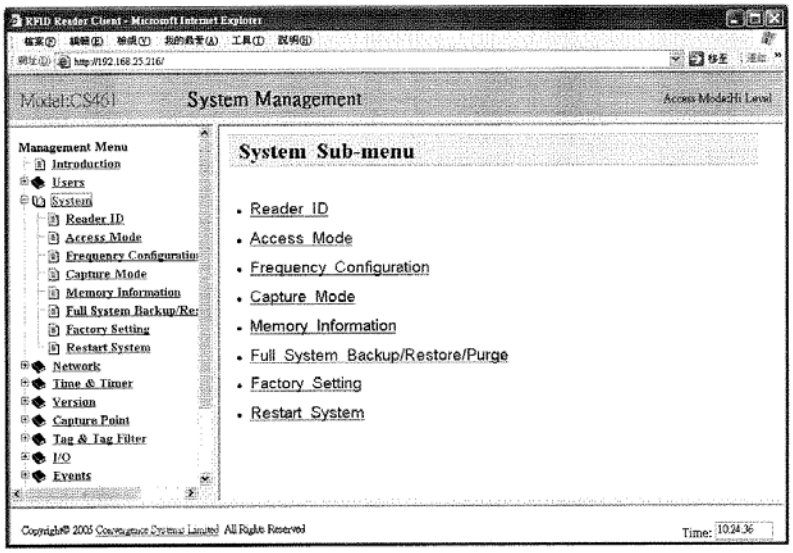
7.1.3 System Management

The system management page contains sub-menus to set reader ID, Access mode, list available fixed frequency channels, available hopping channels, hopping sequences, set tag baud rate, set capture mode, list memory information, restore factory setting and do system restart etc.



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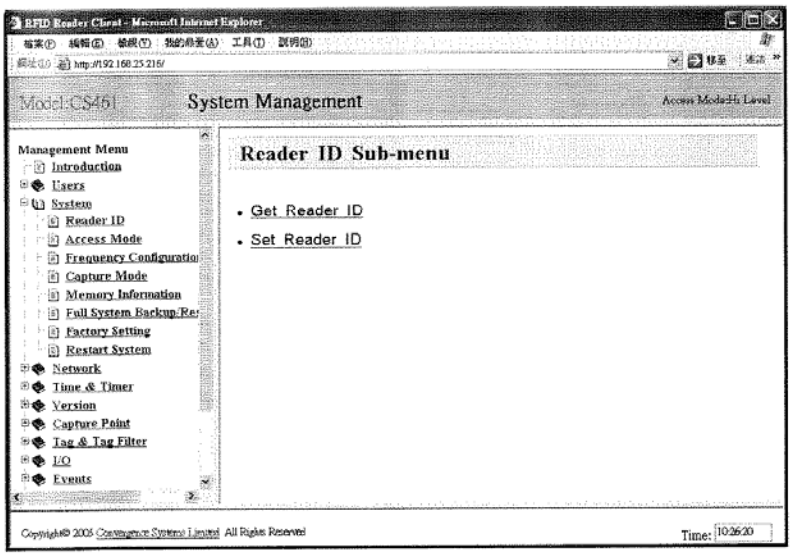
Here is the reader ID submenu:



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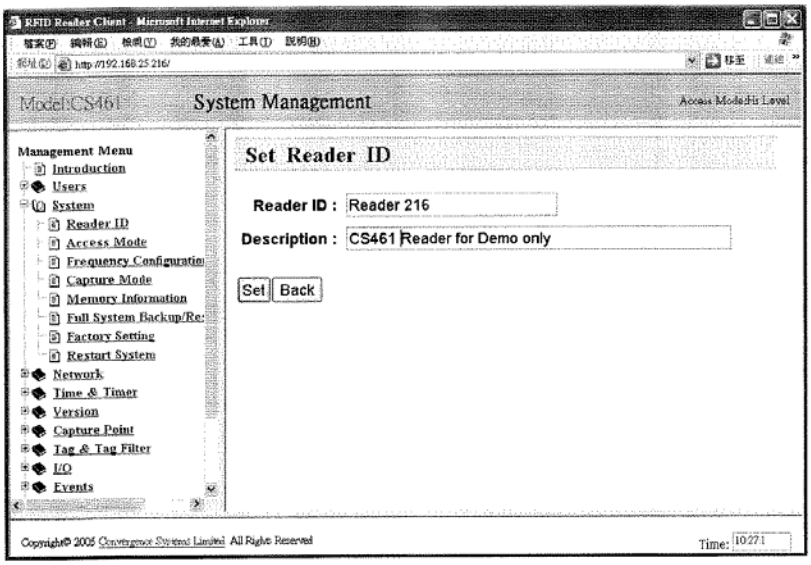
One can then set the unique ID for the reader. This is needed for easy future reference and programming access:



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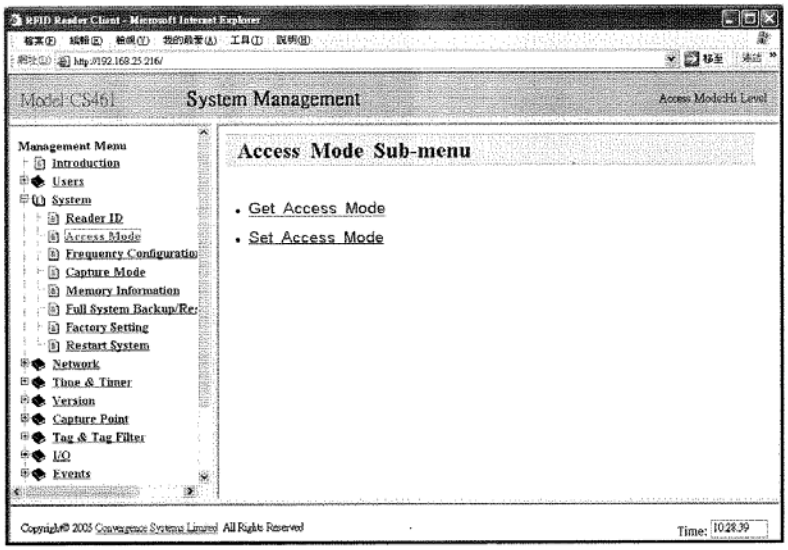
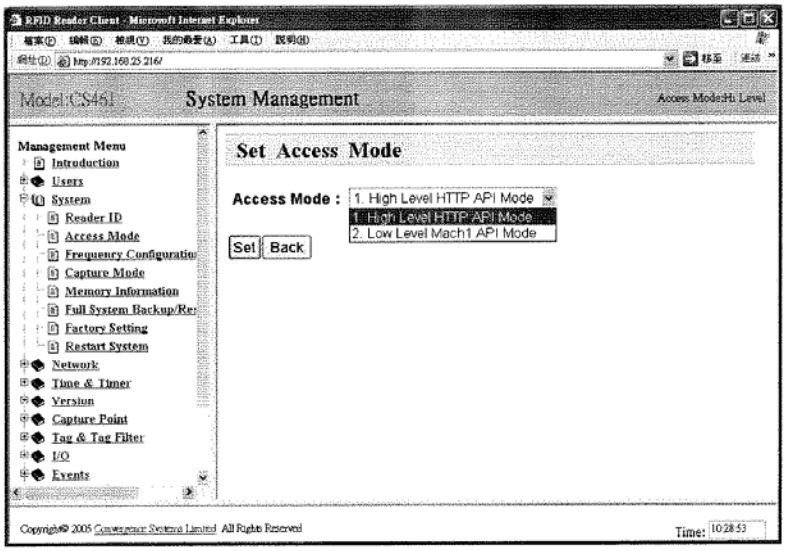
Here is the Access mode sub-menu:



User can configure whether to use the HTTP API (web-based admin tool) or the Mach1 API to control the reader on this page.



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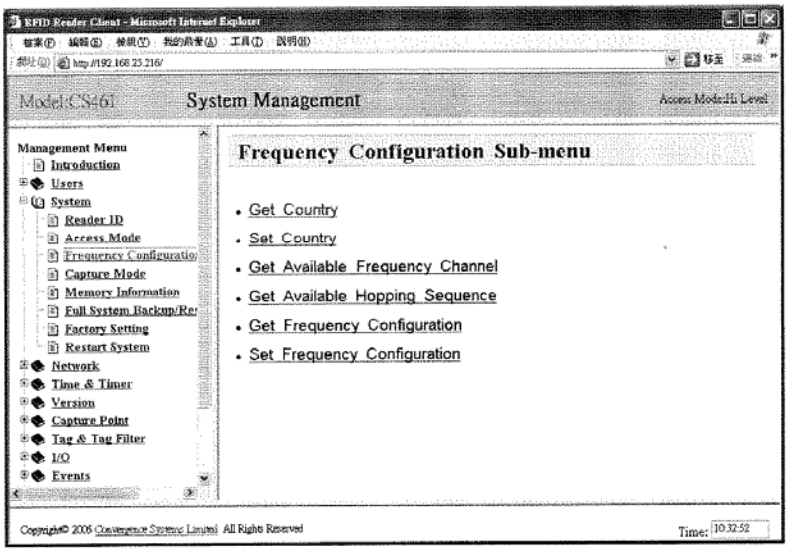
Here is the frequency configuration sub-menu:



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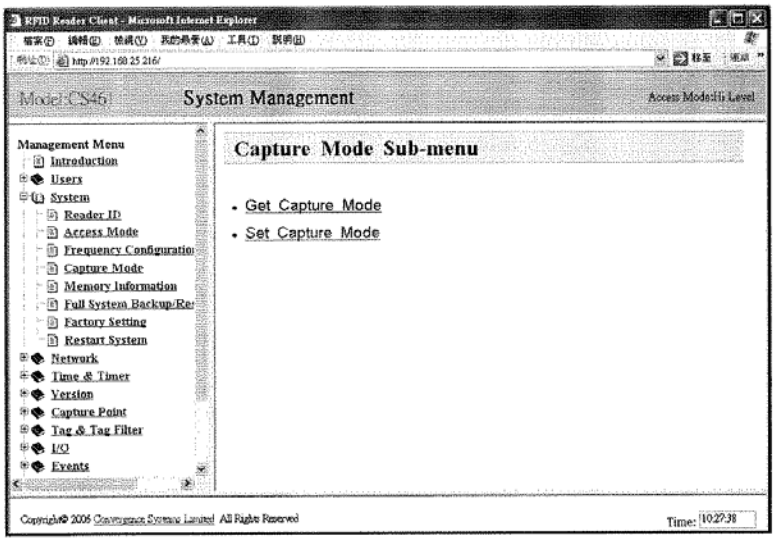
Here is the capture mode sub-menu:



This is the set capture mode page. One can set the system to one of three different capture modes:

1. Windowed Mode:
   In windowed mode the reader reads within a time window and collect all the tag IDs together. The **window time** is how long this time window is.
2. Total Visibility Mode:
   In total visibility mode the reader tracks each and every tag visible, and show them in the bin until they leave the area. The **expiration time** parameter controls how long it is that the tag is no longer visible that the reader considers the tag is gone.
3. Cumulative Mode:
   In cumulative mode the reader reads any tag entering its capturing area and record that occurrence in the bin. This record will stay. The **debouncing time** is the time that within this time if the tag is seen again it will not be considered another read.

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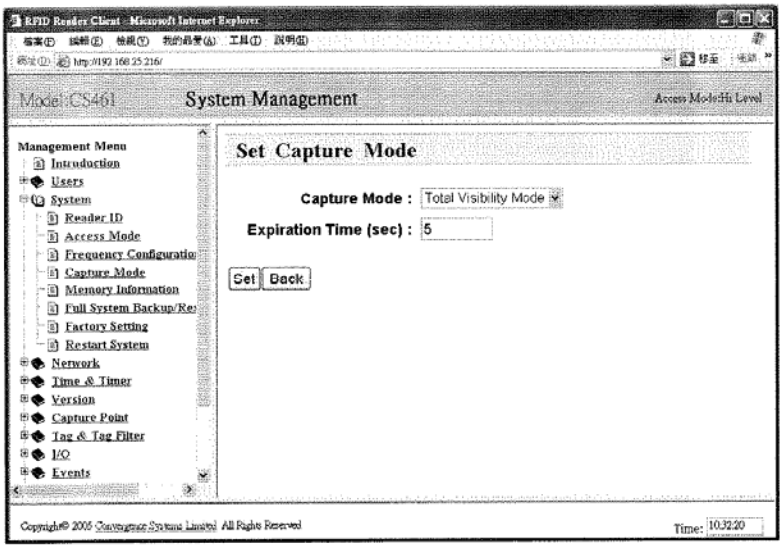

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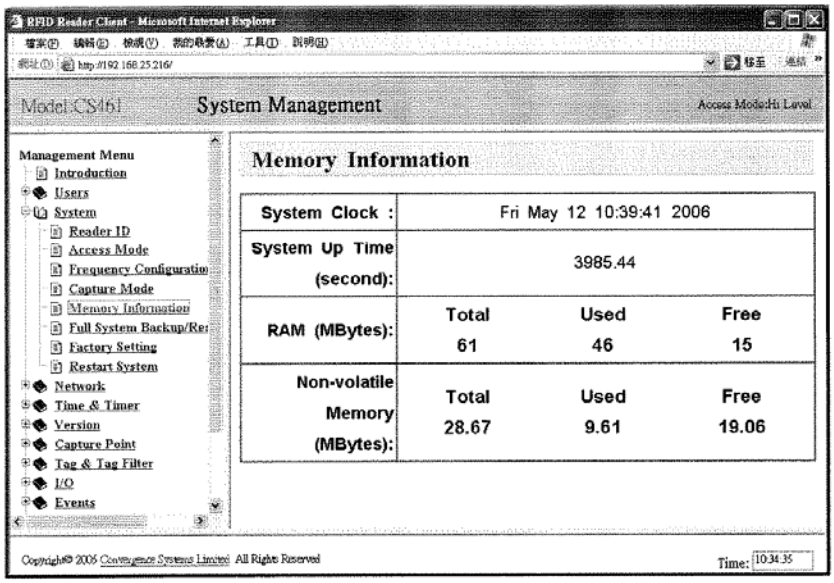
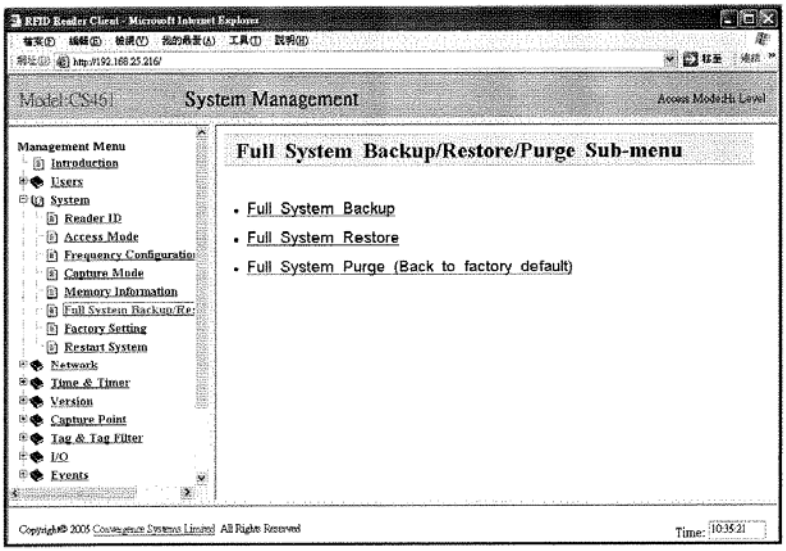
This is the Memory Information page that shows the memory status



User can perform system backup, restore or return to factory setting on the "Full System Backup/Restore/Purge" page.



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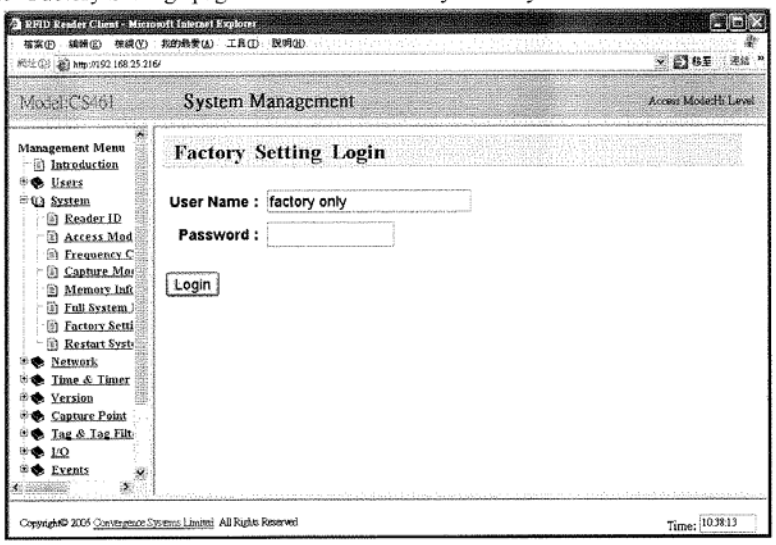
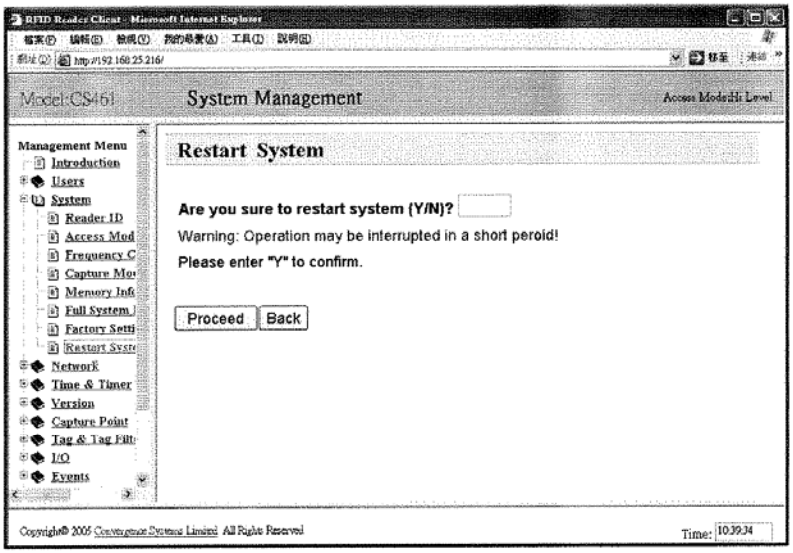
The "Factory Setting" page is reserved for factory use only.



User can restart the reader on the "Restart System" page.



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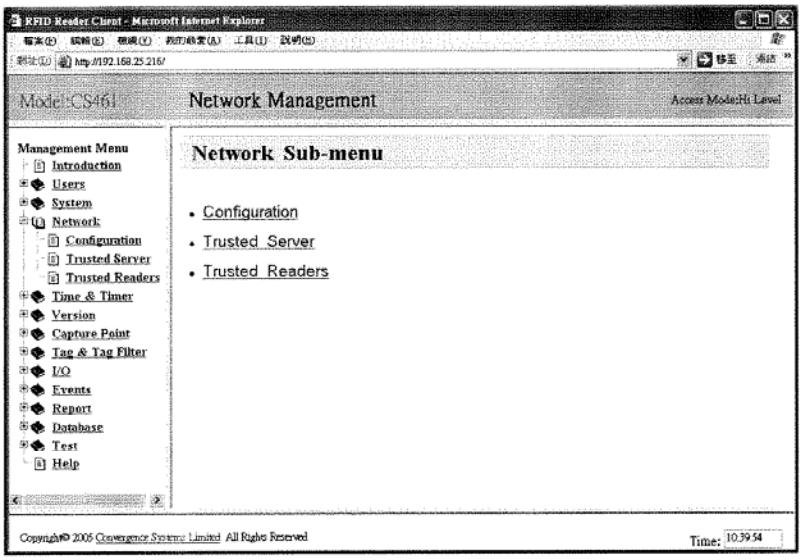
7.1.4 Network Management

Network management page allows the user to set the network parameters and trusted settings.



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