Radio Internet-Protocol Communications Module (RIC-M)

RIC-M Setup Details

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Christine Wireless, Inc.

- Based in Ellicott City Maryland
- Consulting on Standards-based Wireless Technology especially APCO Project 25
  - AES and DES Encryption implementation and testing
  - FIPS 140-2 Product Certifications
  - Cryptographic Key Fill Devices
  - Over-the-Air Rekey (OTAR) Implementations
  - Voice-Over IP Conventional Fixed Station Interface design and implementation
- Richard Brockway: President, Owner

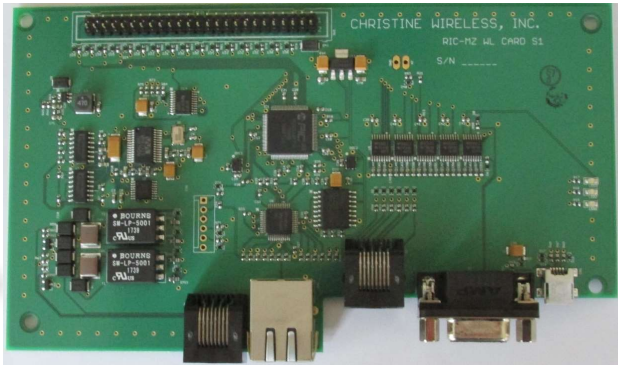
Christine Wireless - Background

- Started and ran Racal/Thales Communications Public Safety Radio Business, 1993-2003 (Racal/Thales 25 radio)
- 2003: Started Nexus Wireless, Inc. (radio designs) Sold IPR/Name in 2005- changed company name to Christine Wireless, Inc.
- Active Participant in Project 25 since 1993: Chaired TIA Encryption Committee for 4 years
- 2003-present: Engaged in Project 25 Consulting/Technology Hardware/Firmware

The Benefits of Migrating to an Internet-Protocol Based System

RIC-M

RIC-Mz



RIC-Mz Wireline

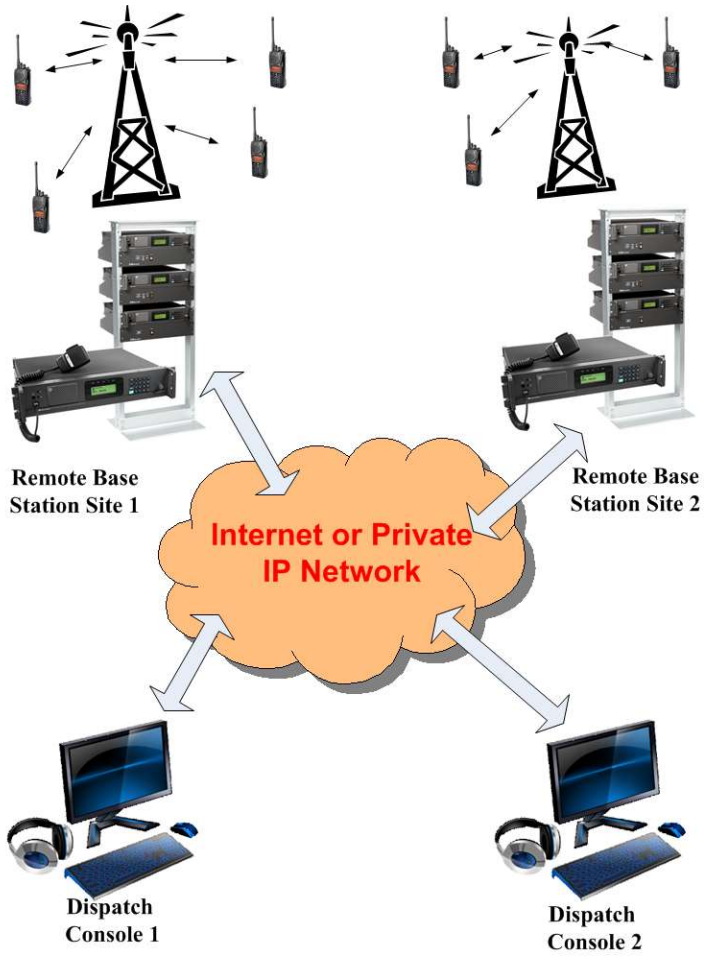
Christine Wireless, Inc.

RIC-M

Radio Internet-Protocol Communications Module

Developed by DHS Science and Technology Directorate

Internet-Protocol Connected System



Benefits of Standards Based IP Systems

- Interoperability (frequency bands, manufacturers, technologies)
- Scalability-Very small through very large systems
- Flexibility/Rapid re-configurability (Incident response)
- Cover a wide geographic region
- Economy (low cost IP circuits)
- Enhanced security
- Enhanced reliability

Difficulties in Migrating to an IP-Based System

- Most currently installed legacy equipment is not IP-capable or upgradable to IP-*total replacement required*
- Most current IP-Based solutions are manufacturer proprietary-*once you pick the proprietary solution you can only buy from that manufacturer*
- Most current IP-Based solutions are expensive

Solution: Radio Internet-Protocol Communications Module (RIC-M)

RIC-M Features/Benefits

- RIC-M provides an IP gateway for currently installed legacy Motorola Astro™ Conventional and analog equipment-*reuse current equipment, not replace it*
- RIC-M uses TIA-standard IP and interoperates with equipment from multiple Dispatch Console and Base Station manufacturers-*freedom on vendor selection for future equipment*
- RIC-M supports phased migration to IP while maintaining interoperability with installed legacy systems
- Installed legacy equipment has several more years of useful life:

  defer equipment replacement while enjoying the benefits of IP based communications

RIC-M puts the radio system owner back in control of the migration process

RIC-M Overview

- RIC-M is an after-market protocol converter: Converts Motorola Conventional ASTRO™ V.24 serial communications into Project 25 standard Internet-Protocol.
- RIC-M interoperates with multi-vendor Project 25-capable Dispatch Consoles.
- RIC-M can also connect with another RIC-M over IP without a Dispatch Console (autonomous mode).
- RIC-M handles analog, digital voice (encrypted and unencrypted), Packet Data, TSBKs as well as remote control commands.
- RIC-M is configured via a web browser over IP and firmware can be updated remotely over IP.

RIC-M History

- Concept addresses a requirement identified by the Department of Interior Radio Laboratory in Denver Colorado in early 2011.
- Department of Homeland Security Science and Technology Directorate funded development effort in November 2011.
- First demonstration of concept at DOI Radio Lab in August 2012.
- DHS Operational Field Assessment test at DOI Radio Lab in November 2013.
- Final Delivery of design (Tier 1 IPR) to DHS in December 2013-Intellectual Property Rights (IPR) owned by DHS.
- March 2015 Christine Wireless, Inc. receives license agreement under a CRADA for manufacture and sale of RIC-M from DHS.
- DHS RIC-M demonstration at IWCE in March 2015.
- DHS RIC-M demonstration at APCO in August 2015.

RIC-M Applications

- Elimination of expensive and hard to get copper telephone circuits to interconnect Conventional Motorola ASTRO™ system elements.
- Allow addition of non-Motorola base stations (e.g. Codan, ICOM) and other equipment into a Conventional Motorola ASTRO™ system.
- Use non-Motorola Dispatch Consoles with a Conventional Motorola ASTRO™ system. Dispatch consoles from Avtec, Catalyst, Telex-Bosch, Moducom and Zetron
- Facilitates the transition to modern IP-Base connectivity while retaining installer equipment.
- Re-location of elements of a Conventional Motorola ASTRO™ system to diverse locations using IP connections.
- Applicable Products: Quantar™, GTR-8000™, PDR-3500™, ASTRO-TAC 3000™, DIU-3000™and TXM 2000™.

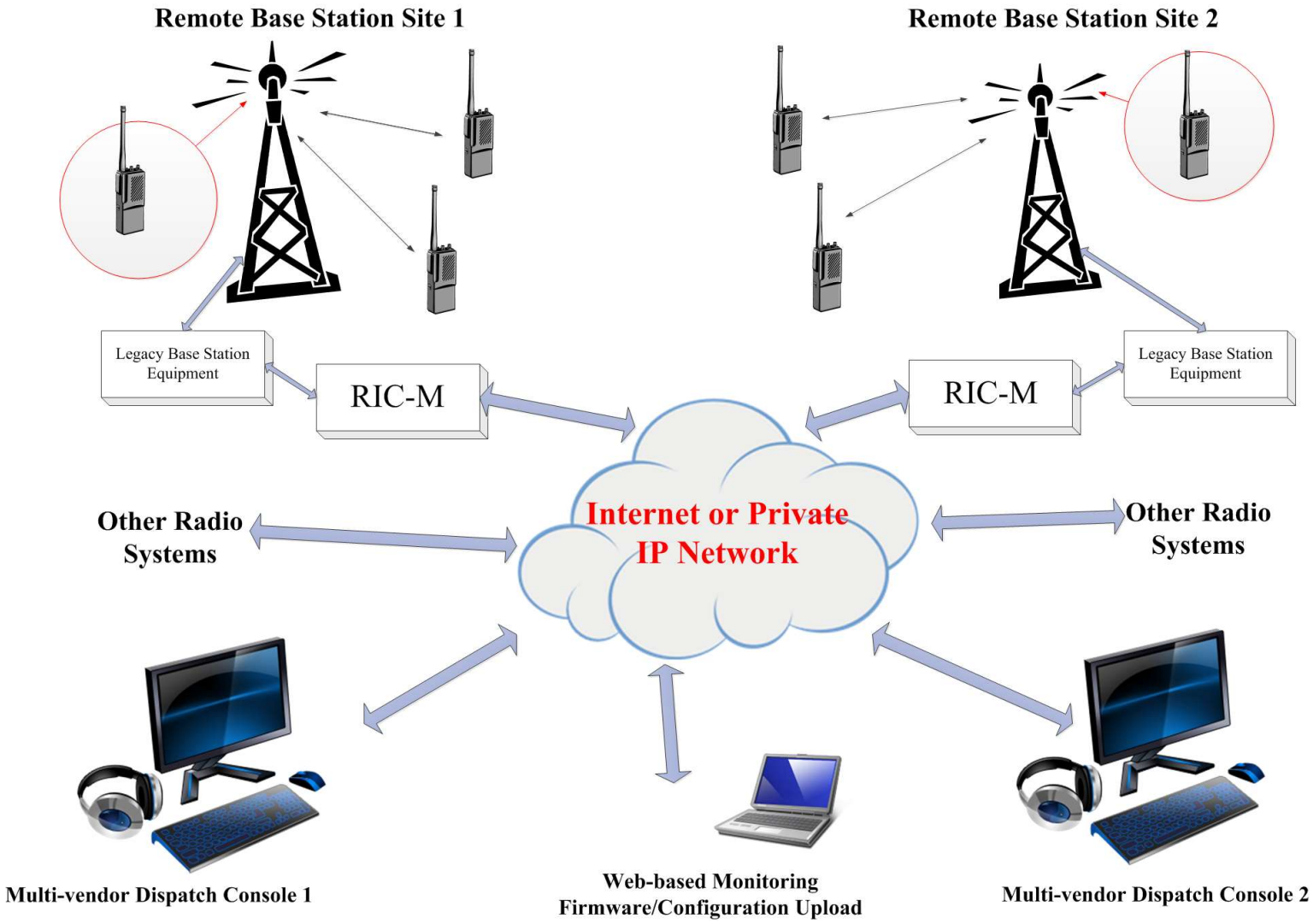
RIC-M Capabilities

- Digital Project 25 voice (Encrypted and unencrypted)
- Analog Voice (4 wire E&M)
- Confirmed and Unconfirmed Project 25 data including Over-the-Air-Rekey (OTAR) messages
- Virtual Com port for remote Radio Service Software (RSS) application via Internet-Protocol
- Remote Control of connected Base Station equipment
- Conventional Control and Signaling (TSBKs)
- Authenticated Remote Firmware Update via Internet-Protocol
- Connects to Conventional Motorola ASTRO™ system elements with and without V.24 board.
- Interconnects via Internet, private intranet, satellite, cellular and Virtual Private Networks (VPN).
- Web-based (browser) setup and monitoring

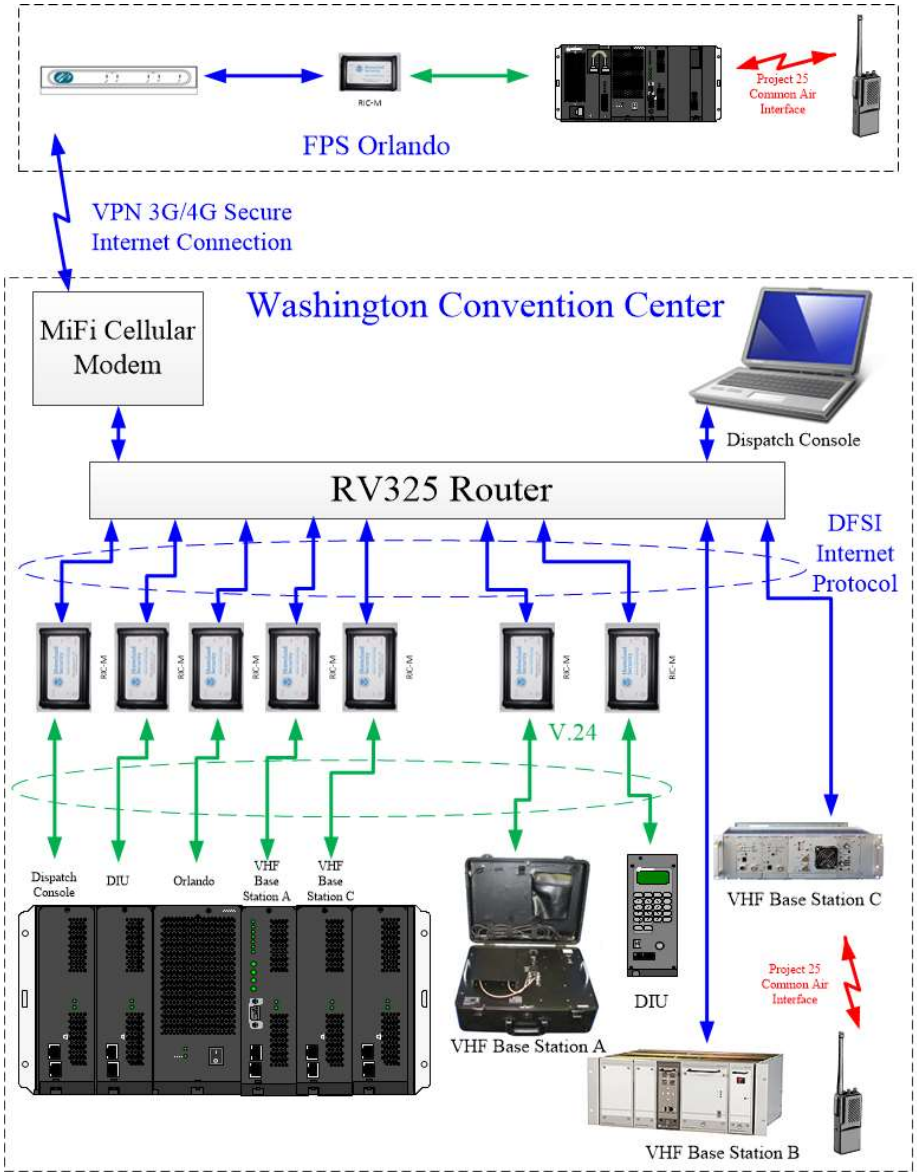
Project 25 TIA Standards

- RIC-M is compliant with the Project 25 TIA-102.BAHA published standard.
- RIC-M also incorporates Project 25 TIA Standards for:
  - Packet Data
  - TIA-102.BAHA-A

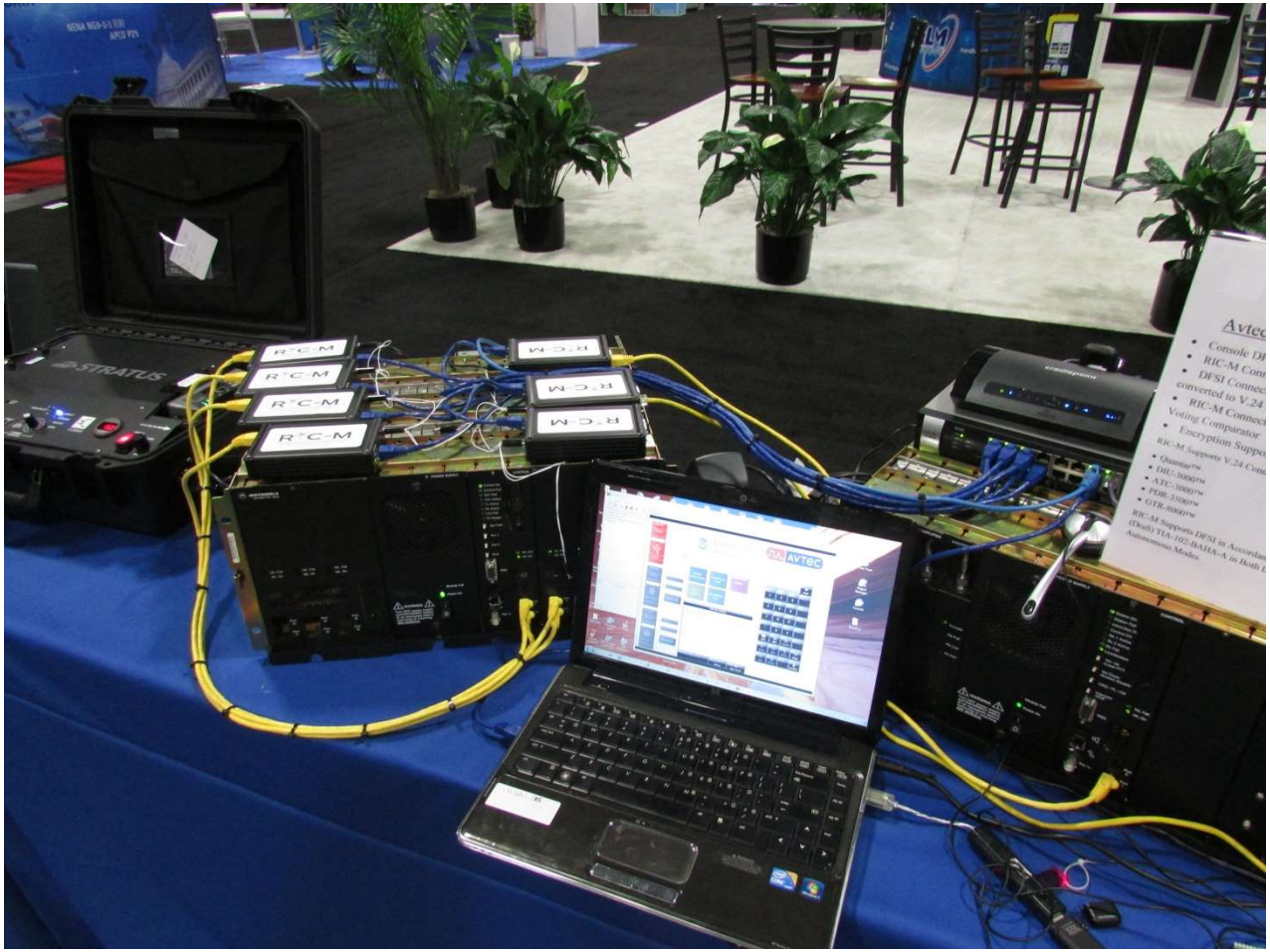
RIC-M Network Application



APCO 2015 Main Demonstration Table



APCO 2015 Main Demonstration Table



RIC-M Testing

- Federal Agencies: US Marshals Service, FBI, FPS, CBP, etc.
- Department of Interior Radio Laboratory
- Dispatch Console Manufacturers
- DHS Test Report November 2013

Ongoing Research, Development, Test, and Evaluation

- 29 RIC-Ms currently deployed in a multi-state private radio network for daily live operational testing 24/7
- Radio system operated by a Christine Wireless partner organization
  - Simulates a true “real world” environment
  - Separate from critical Public Safety radio systems
- Multi-site, multi-band, multi-frequency radio network
  - Repeaters located in MD (2), VA (2), TN (3), and FL (1)
- CradlePoint router / firewall / modems used at the repeater sites
  - RIC-Ms use HDLC Client Tunnel Mode
  - AES-256 SHA2 256 IPsec VPN Tunnels for enhanced security
- Operates using multiple wired and wireless carriers
  - Comcast, Spectrum, Verizon, AT&T, and US Cellular
  - Repeaters backhauled over IP to a central ATAC-3000™ comparator
  - RIC-Ms use HDLC Server Tunnel Mode with 4 times repeat of voice packets
- Multi-vendor subscriber radios used for testing
  - utilize AES-256 encryption full-time
- Repeaters use the RIC-M Virtual COM Port to enable remote management and diagnostics

Web Resources

- www.christinewireless.com
- https://www.acgsys.com/product/ric-m-radio-ipcommunications-module/
- http://www.firstresponder.gov/TechnologyDocuments/Conventional%20Fixed%20Station%20Interface%20Operational%20Field%20Assessment.pdf
- http://www.dhs.gov/science-and-technology/can-you-hear-me-now

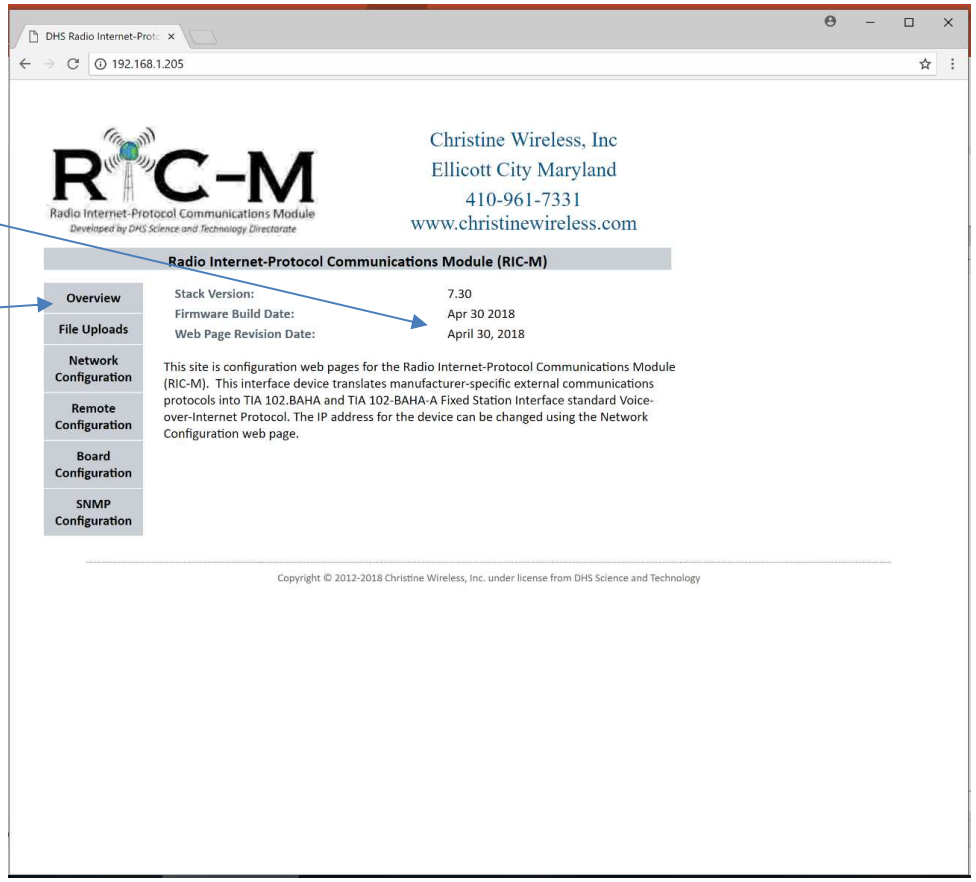
RIC-M Setup

- Web Browser Setup (Edge, Explorer, Mozilla, Chrome, Safari)-Chrome recommended
- Homepage accessible without user name and password
- Other pages require user name and password
- User name and password can be set by user
- Reset mechanism (entering “shift z” on RS-232 during startup) restores factory defaults
- Factory defaults:
  - User Name: admin
  - Password: dhsricm
  - IP Address 192.168.1.204 (https://192.168.1.204 for RIC-Mz)
  - IP gateway 192.168.1.1

RIC-Mx Home Web Page

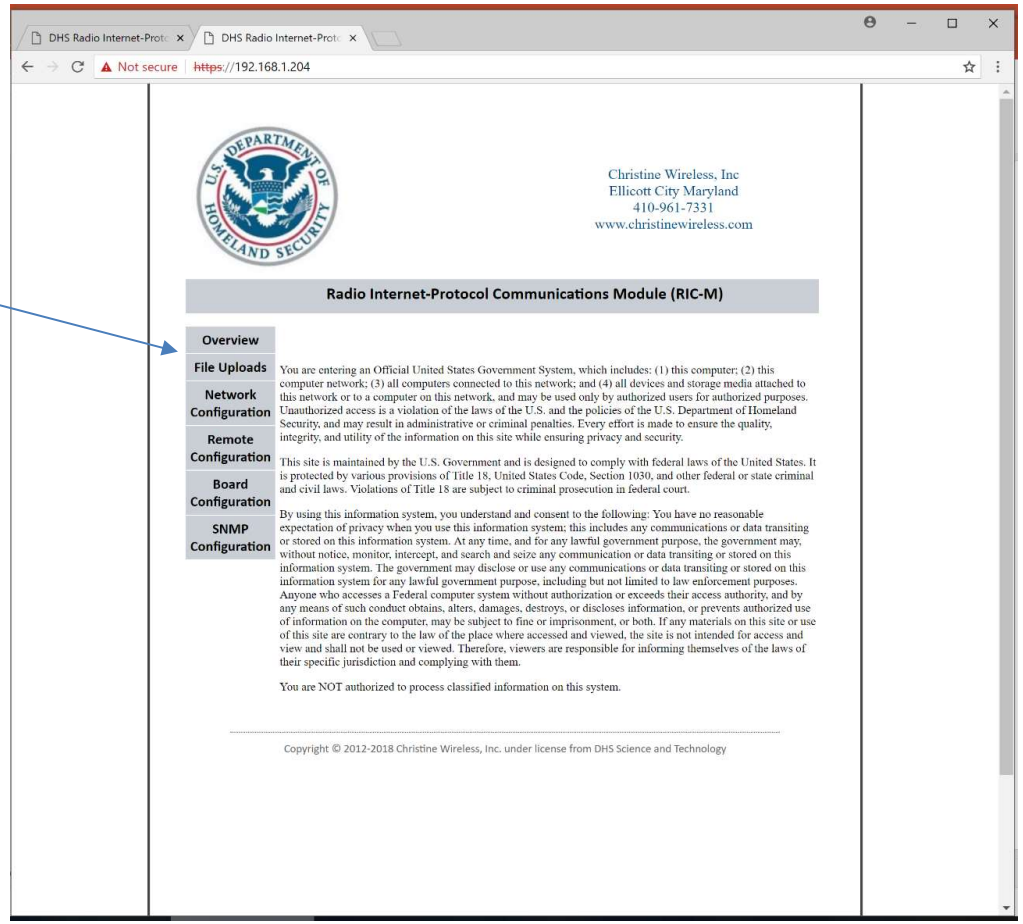
Firmware Build Date

- Navigate to other pages using these buttons
- Password and User Name required to access other pages
- Default User Name: admin
- Default Password: dhsricm

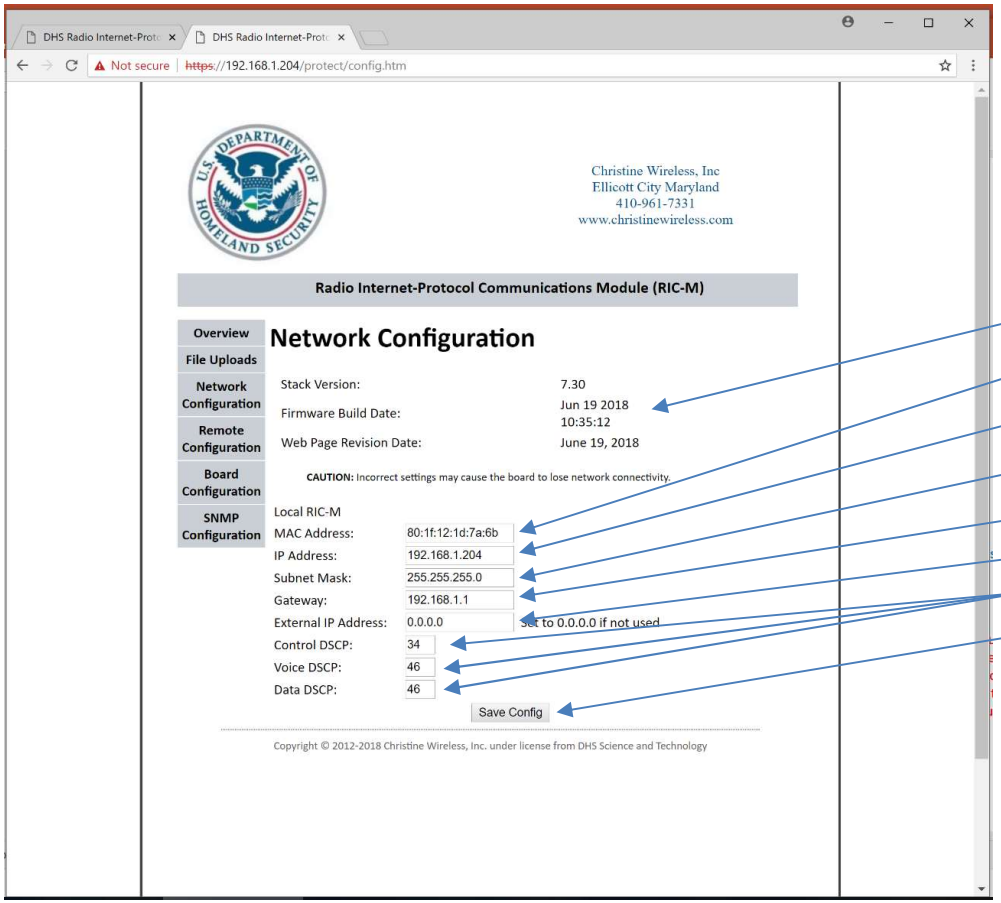


RIC-Mz Home Web Page (https)

- Navigate to other pages using these buttons
- Password and User Name required to access other pages
- Default User Name: admin
- Default Password: dhsricm
- Browser may warn on security due to self-signed X.509 certificates. Go to browser Advanced/go to site anyway or create a security exception. Web pages are secure, but the browser cannot authenticate the X.509 certificates.



Network Configuration Web Page



Revision Information (RIC-Mz only)

Board MAC Address

Board IP Address Setting

IPV4 Subnet Mask

Gateway

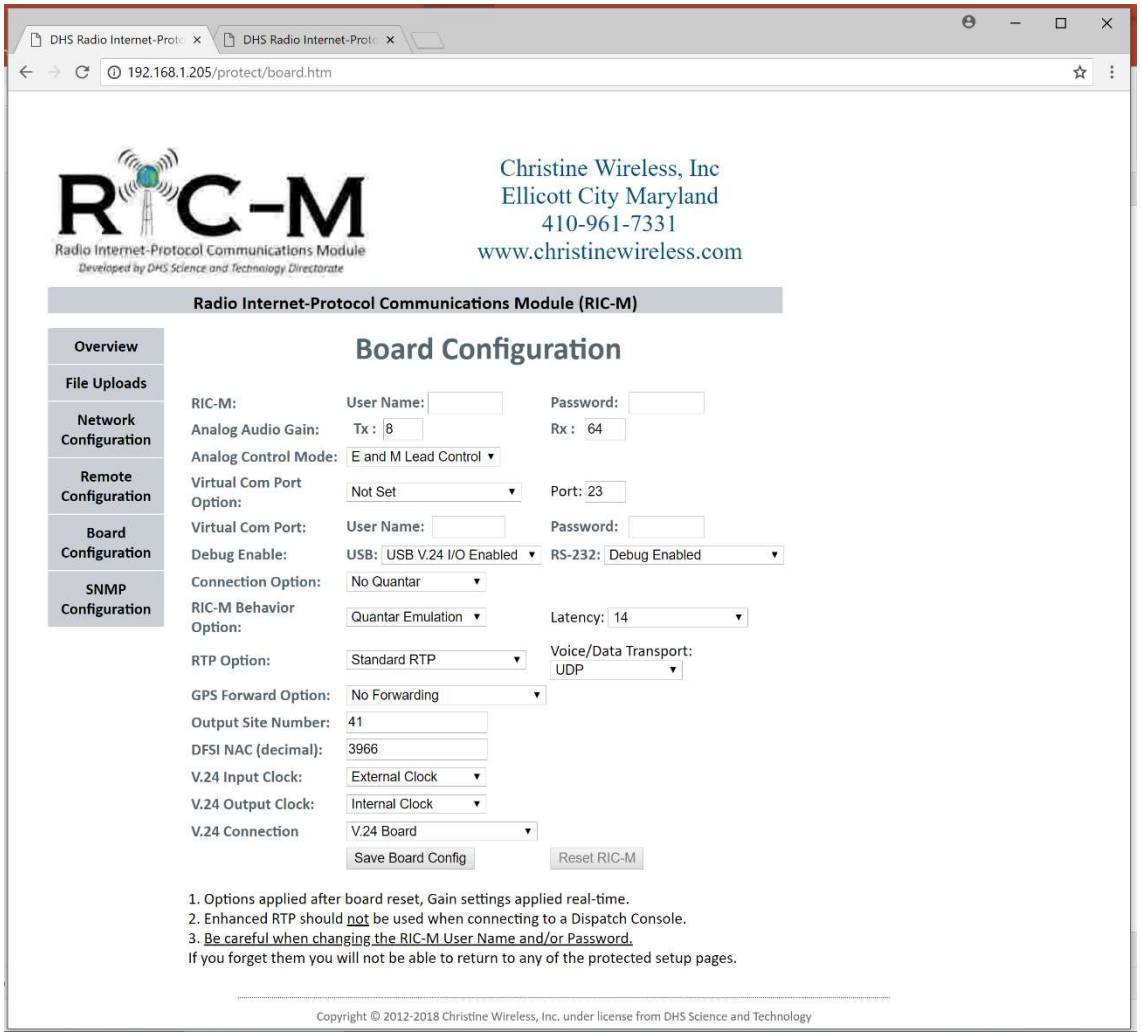
External IP Address if port forwarding is used

Quality of Service Settings

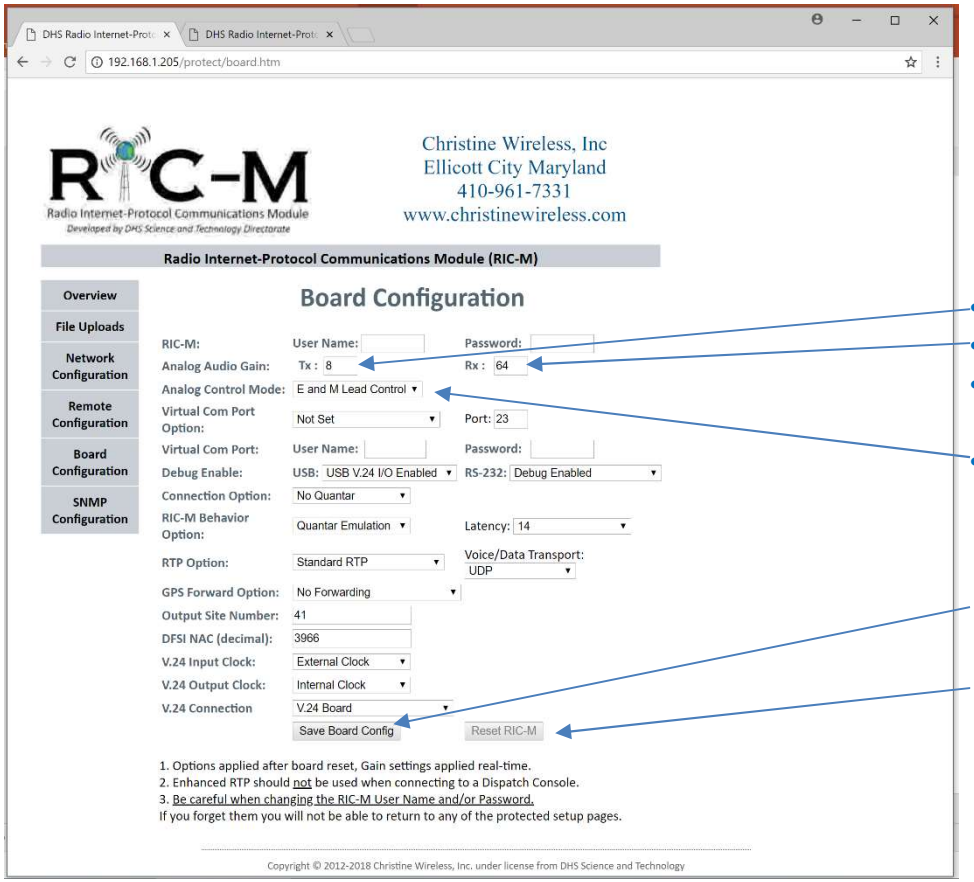
Enter Button to Save/Apply Changes

Note: The IP Address and Gateway must be within the IP Mask. Entries will be rejected if they do not comply with this rule. If you want to make changes, all changes must be entered at the same time and comply with this rule.

Board Configuration Web Page



Board Configuration: Analog Setup



- Tx Gain Adjustment (0-255)
- Rx Gain Adjustment (0-255)
- Gain adjustments are applied when entered without resetting RIC-M
- E and M Lead Control must be enabled here to be active

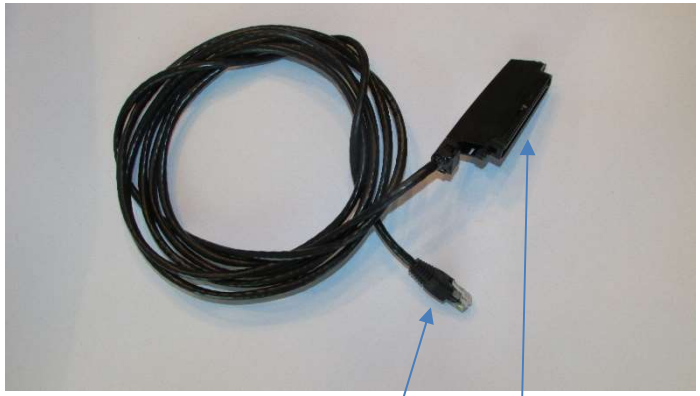
- Save Board Config saves the changes and applies gain settings
- Reset RIC-M required to apply non-gain changes. Causes a power up reset of RIC-M

Analog Connection to Quantar™

- Cable from 50 pin “telco” connector on back of Quantar™ to RJ-45 Wireline connector on RIC-M

Wireline Connections The connections for the 8 pin RJ-45 Wireline Connector are as follows:

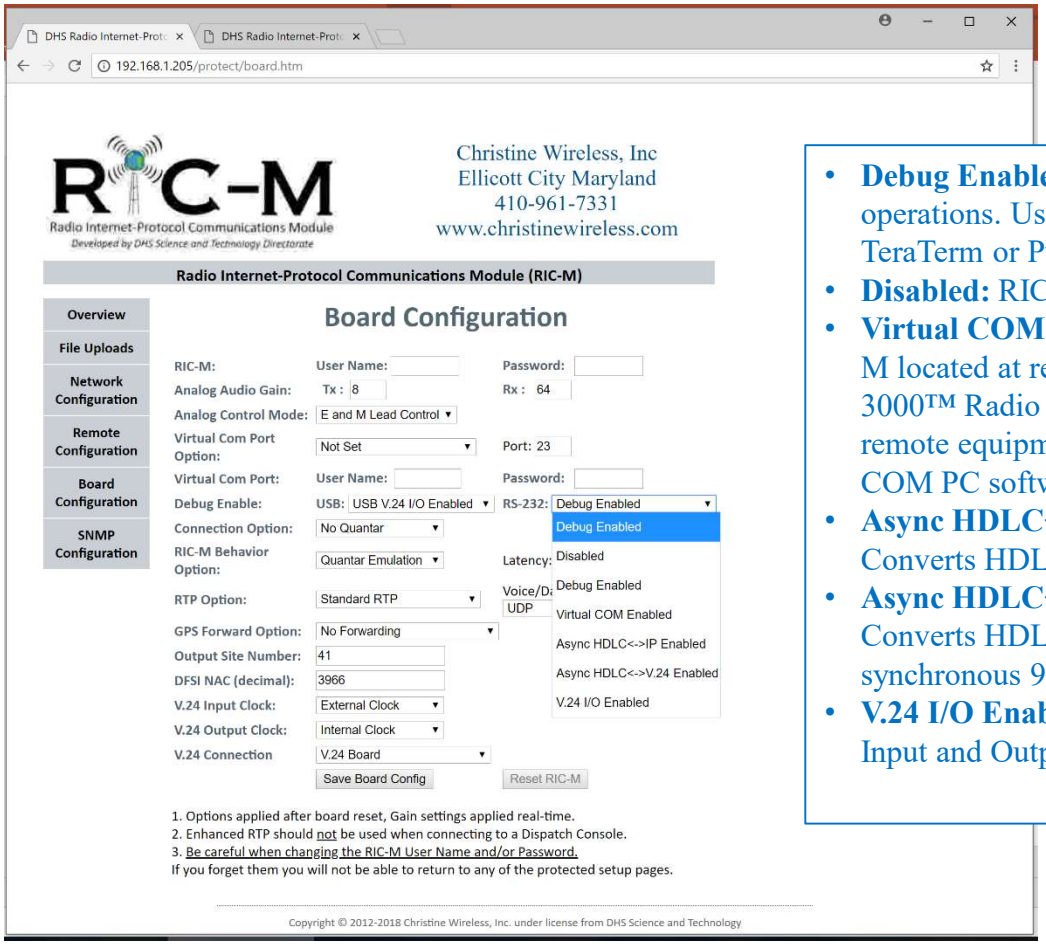
RJ-45 Pin	Function	RJ-45 Wire Color	Quantar™ Telco Connection Pin	Cable Color
1	Ground	Orange/White	7	Blue
2	M-Lead to RIC-M	Orange	18	Gray/Red
3	Analog Input to RIC-M+	Green/White	2	Brown
4	Analog Output from RIC-M+	Blue	1	Black
5	Analog Output from RIC-M-	Blue/White	26	Black/White
6	Analog Input to RIC-M-	Green	27	Brown/White
7	E-Lead to Quantar™	Brown/White	47	LT Yellow/Red
8	Pullup Voltage for M Lead	Brown	N/C	
	The following are jumpered together			
Jumper	+5VDC		8	Purple
Jumper	Ext PTT In +		22	LT Yellow/Black
Jumper	Rx Stat Out +		43	Gray/Green



RJ-45

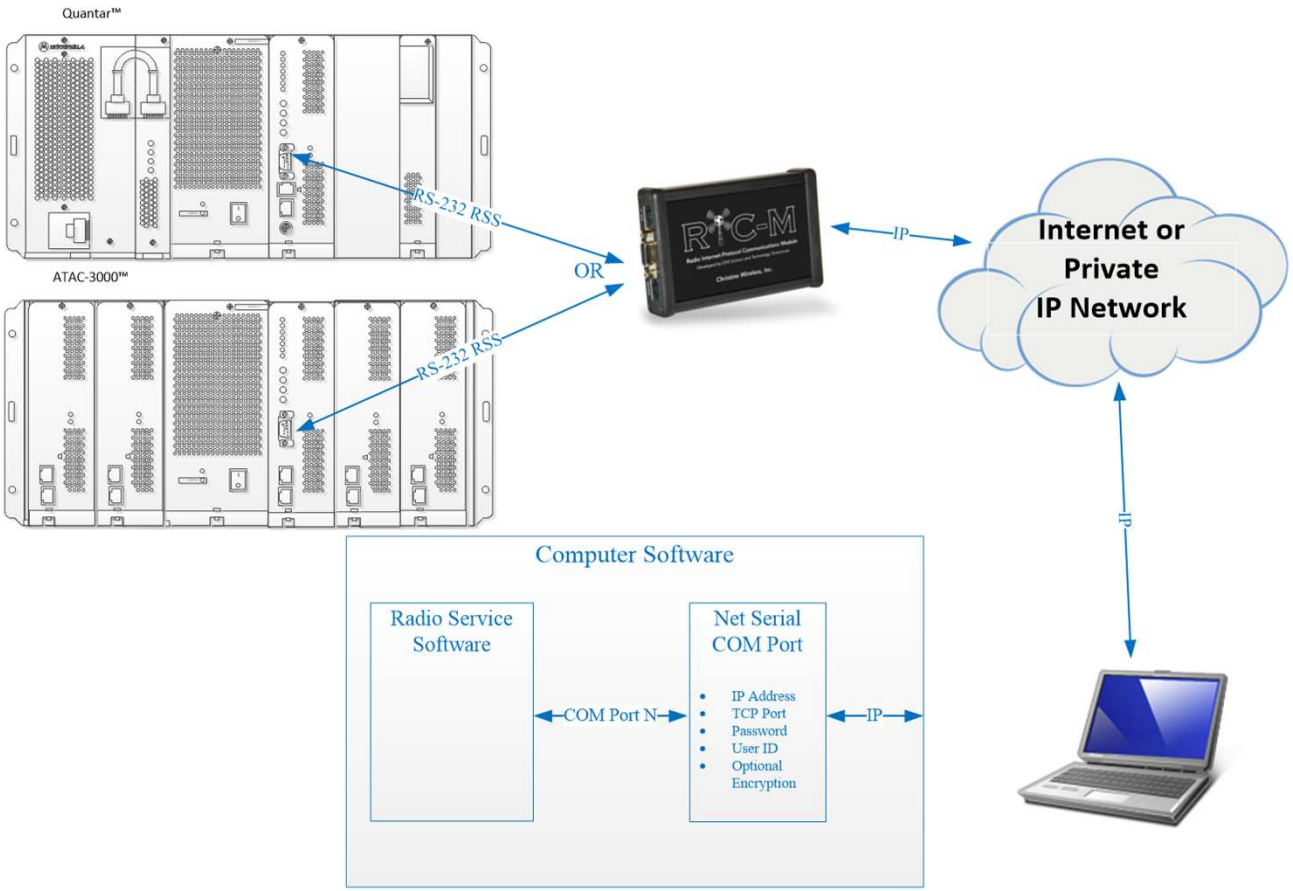
50 Pin “Telco” Connector

Board Configuration: RS-232 Options



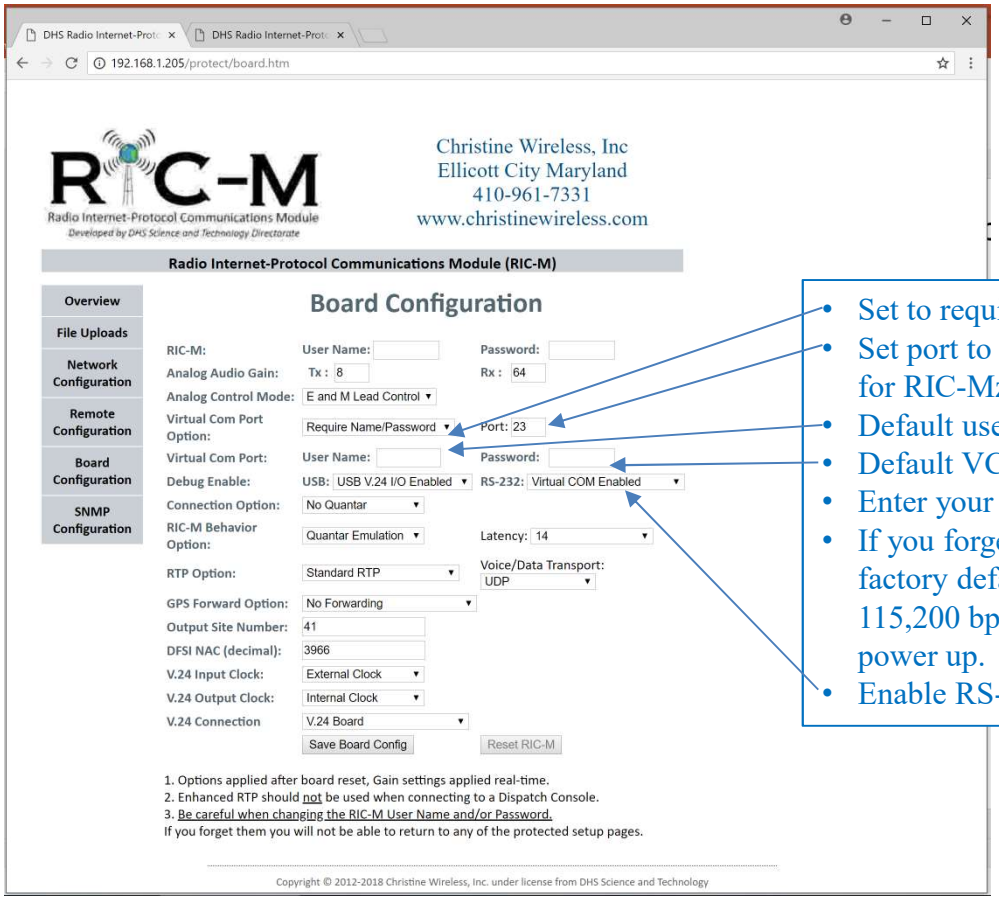
- **Debug Enabled:** RS-232 provides detailed insight into RIC-M operations. Use a terminal emulation program such as TeraTerm or Putty and settings 115,200 bps, 8N1.
- **Disabled:** RIC-M RS-232 port inactive
- **Virtual COM Enabled:** RS-232 9 pin D connector on a RIC-M located at remote site can be connected to Quantar™/ATC-3000™ Radio Service Software port. RSS software can access remote equipment over IP through an intermediate Virtual COM PC software application such as NetSerial.
- **Async HDLC<->IP Enabled:** Special mode for TXM-2000™. Converts HDLC asynchronous at 19,200 bps to IP for transport
- **Async HDLC<->V.24:** Special mode for TXM-2000™. Converts HDLC asynchronous at 19,200 bps to V.24 HDLC synchronous 9600 bps.
- **V.24 I/O Enabled** Provides a formatted output of the V.24 Input and Output messages

Virtual COM Port



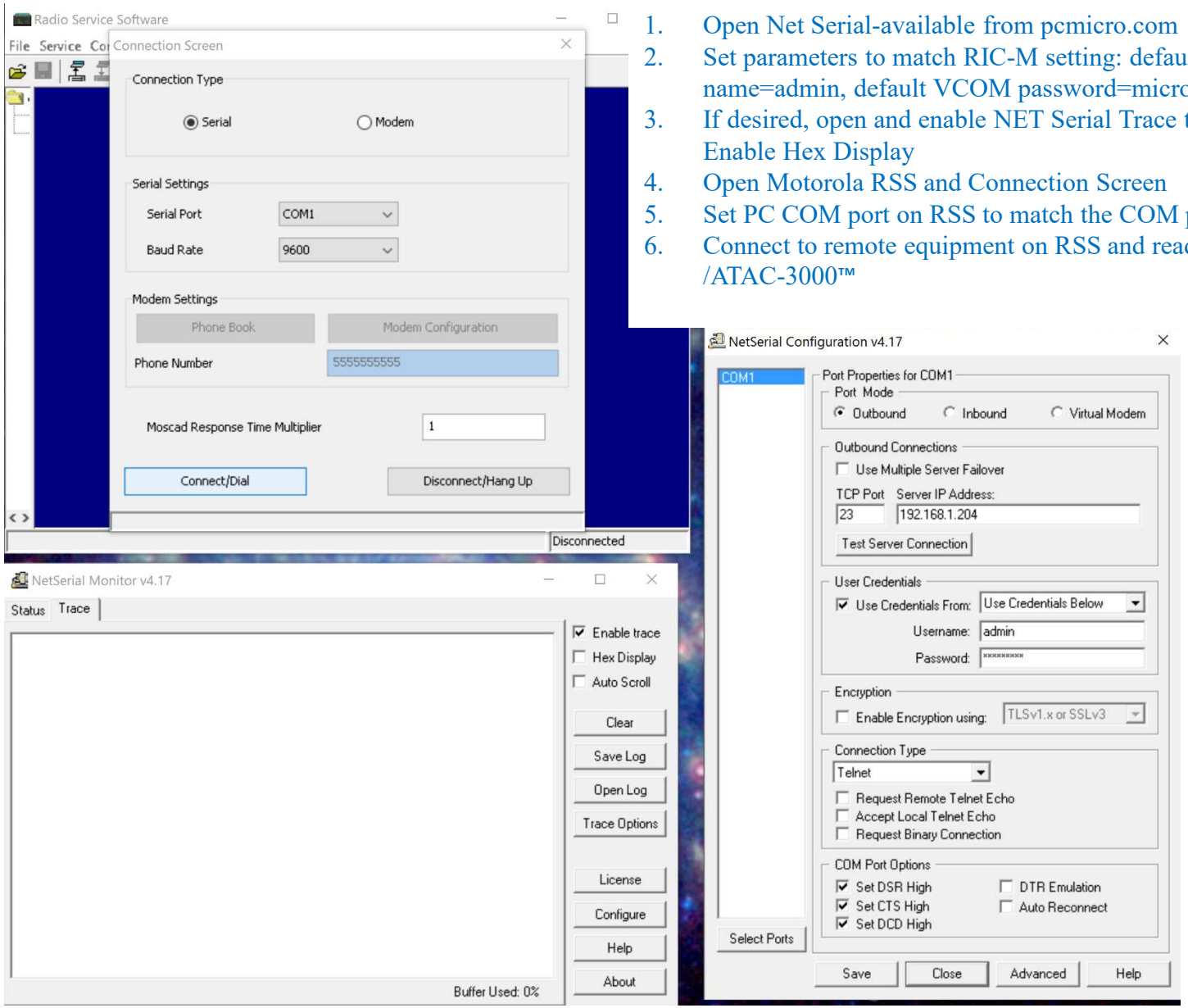
- Virtual COM Port allows operation of Radio Service Software (RSS) from a remote computer.
- Works with Quantar™ or ATAC-3000™ RSS ports.
- Multiple remote units can be managed from a single computer by setting multiple virtual COM ports in NetSerial.
- Encryption requires a RIC-Mz with TLS.

Board Configuration: Virtual COM Port Setup



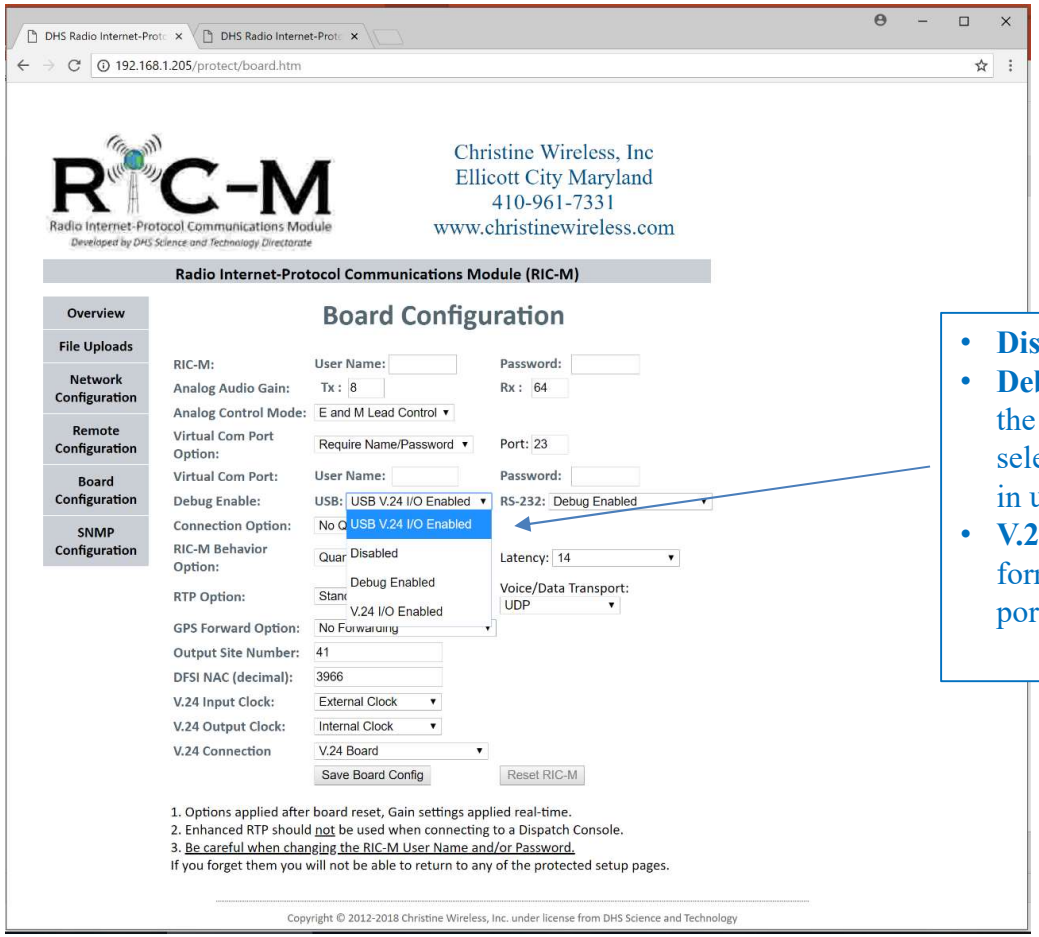
- Set to require user name/password
- Set port to match Net Serial. Does not have to be 23 Must be 992 for RIC-Mz Secure Operation
- Default user VCOM user name: admin
- Default VCOM password: microchip
- Enter your own user name/password if desired
- If you forget your credentials, the RIC-M can be restored to factory defaults by connecting to the RS-232 connector at 115,200 bps and holding down the “shift z” keys during initial power up. Erases all user parameters including IP address
- Enable RS-232 for Virtual COM

Virtual COM Port Setup-PC



1. Open Net Serial-available from pcmicro.com
2. Set parameters to match RIC-M setting: default VCOM user name=admin, default VCOM password=microchip
3. If desired, open and enable NET Serial Trace to monitor session. Enable Hex Display
4. Open Motorola RSS and Connection Screen
5. Set PC COM port on RSS to match the COM port selected on NetSerial
6. Connect to remote equipment on RSS and read remote Quantar™ /ATAC-3000™

Board Configuration: USB Debug Port



- **Disabled:** No use of USB other than System Console
- **Debug Enabled:** The debug text normally output on the RS-232 will be output on the USB port. Cannot select debug on both. For use when the RS-232 port is in use for non-debug purposes.
- **V.24 I/O Enabled:** Selecting this option will provide a formatted display of the input and output on the V.24 port.

USB Debug Output

- Use of USB set in Board Configuration
- Most useful function is V.24 I/O
- Driver required for PC - Installation tool location: http://www.microchip.com/Developmenttools/ProductDetails.aspx?PartNO=MCP2200EV-VCP

USB V.24 I/O

COM33:9600baud - Tera Term VT

File Edit Setup Control Window Help

```
Q* 07036002040C0B1B661A220000000000000000000000000000000800000000000204FF  069.855 34 Q+
Q* 0703613F3F1F202708013400 3A0B0311381800150026 0E02D9A3  069.879 26 Q+
Q* 07036202040C0B1B661A2280CCFFF9BE82D70002A4ED70027D3E  069.906 26 Q+
Q* 070363CCF9DAD01108000C5A128100BED109  069.923 18 Q+
Q* 07036400000400C43CC27AD3E800057421C002B308  069.943 21 Q+
Q* 07036500 0FFF00CC359E0628690009BF8171028529  069.962 21 Q+
Q* 0703660004D500CC711F586127000752EE9802505F  069.981 21 Q+
Q* 070367DB5DBB00A87C605A8FEF0006CA9F31022E73  070.001 21 Q+
Q* 070368D0CECB00A864FDE4DE22000663E340025B24  070.020 21 Q+
Q* 0703697A21CF00CC7115747772000 75A9B29028E43  070.039 21 Q+
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Q* 07036D00000000985C3395A6DE00049A6A8D02E5B2  070.845 21 Q+
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Q* 07036F00000000CC711E147AEC00071EF60102DC34  070.884 21 Q+
Q* 0703708000000 0CC78D1E4A77B000431086802 70C0  070.903 21 Q+
Q* 070371ACB8A400C4718EAD3A270007F1C35902 0DE8  070.922 21 Q+
Q* 0703729BDC7500CC709E71F9EC00061A7D9002C2E8  070.942 21 Q+
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Q* 07036202040C0B1B671A2180CC710D3C72760007 9C0C6802CC34  070.988 26 Q+
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Q* 07036500 0FFF00CC35DF0262A600073AD161020244  071.044 21 Q+
Q* 0703660004D500CC7901F71B570004BA52B8023FEA  071.063 21 Q+
Q* 070367DB5DBB00CC3DD8AA7195000705DAD10286D2  071.082 21 Q+
```
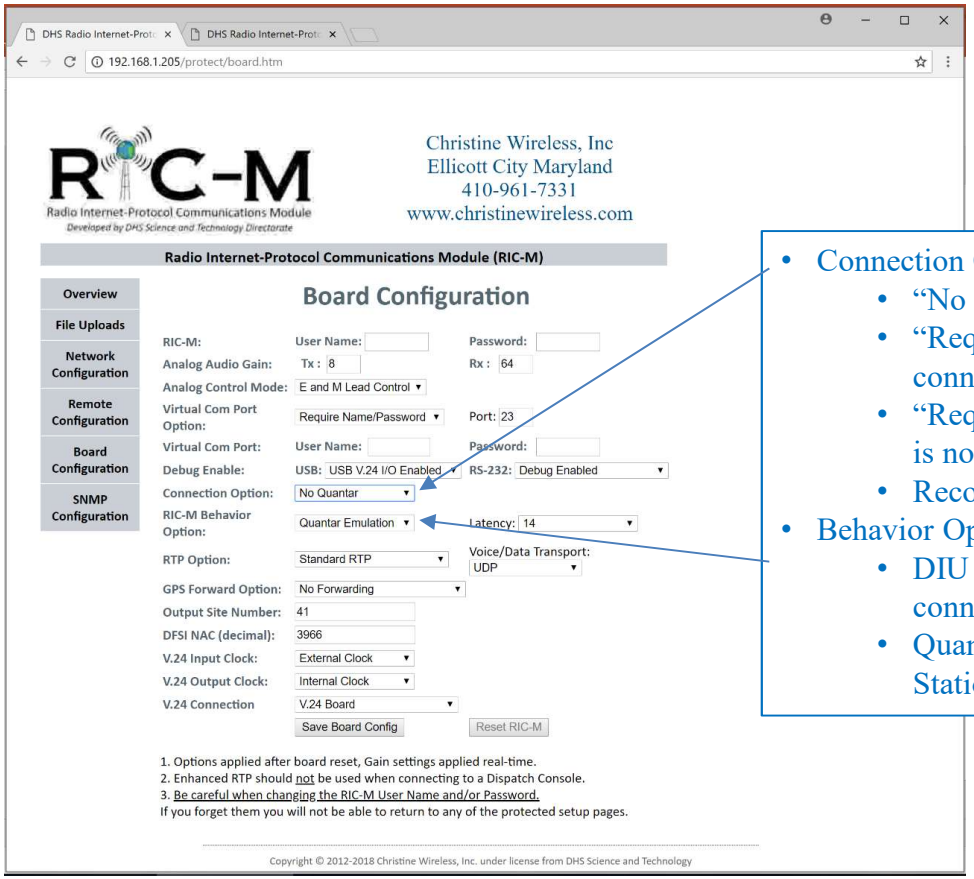

USB V.24 I/O Decoded

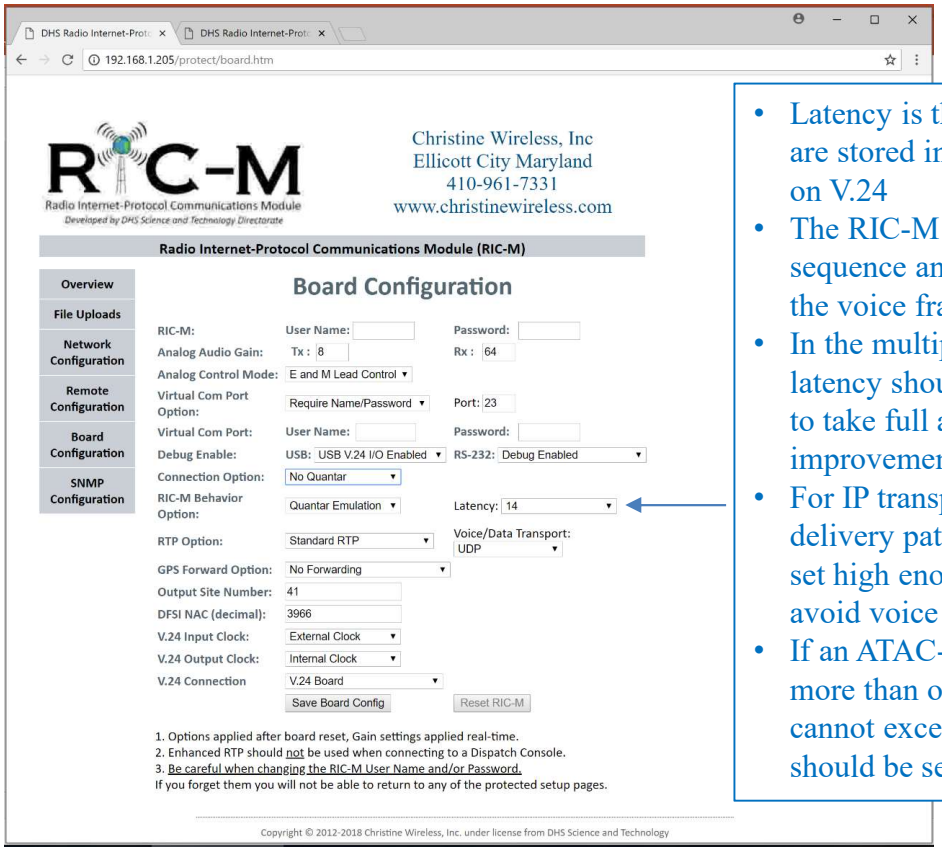
```
Q* 0703 60 02040C0B1B531A350000000000000000000000000000080000000000 02 B5EE  997.938 34 Q+ Header Data Unit 1
Q* 0703 61 000117142A10333100392A22042312110A00030C 02 C8A8  997.961 26 Q+                Header Data Unit 2
Q* 0703 62 02040C0B1B531A3580 CCFFFBFE82C6000E74AF78 02   A1B2  997.993 26 Q+            Voice Frame 1
Q* 0703 63                   CD799880331900088B5081 02FE 1C4B  998.010 18 Q+
Q* 0703 64 00000400          CC38DB5A92C3000B0B89B8 02   35B3  998.029 21 Q+            Third Voice Frame
Q* 0703 65 00000100          745E619E20ACC00A1B09FF 02   92C6  998.048 21 Q+
Q* 0703 66 0004D300          7448D742DA36000554B34E 02   F2B1  998.068 21 Q+
Q* 0703 67 D7051D00          5869F4213AF200150DC445 02   CAA6  998.087 21 Q+
Q* 0703 68 FB35F500          5C47FAC01CCC00120F76F6 02   BE6F  998.107 21 Q+
Q* 0703 69 909F4000          6461919E7871000E5177A3 02   9D56  998.126 21 Q+
Q* 0703 6A 000002            6436FEC29B46C00C7B08CC 02   421C  998.144 20 Q+
Q* 0703 6B 02040C0B1B531A3584 644B033F6E9600034A143D 02   5260  998.173 26 Q+
Q* 0703 6C                   CC3C996FB9D10007ACEF08 023E 74EA  998.190 18 Q+
Q* 0703 6D 00000000          6462796D033600086F0883 02   C4C7  998.209 21 Q+
Q* 0703 6E 00000000          6435CCA34F4C000BCE24E2 02   6F8D  998.228 21 Q+
Q* 0703 6F 00000000          5869840FAFA7001718E587 02   7ECE  998.248 21 Q+
Q* 0703 70 80000000          5825F9E0F80A0004CE5EFE 02   8E53  998.267 21 Q+
Q* 0703 71 ACB8A400          6066BC58DFA5C00FA52E1F 02   E5E7  998.287 21 Q+
Q* 0703 72 9BDC7500          603045E33216000F9B5966 02   416C  998.306 21 Q+
Q* 0703 73 000008            4836A392A3BB003FAAF101 02   B307  998.325 20 Q+          Eighteenth Voice Frame
LEGEND:  Header    Frame Number    IMBE Vocoder Data    CRC-16    Time Stamp    Byte Count
Low Speed Data    Link Control    Encryption Sync
```

Board Configuration: Additional Options



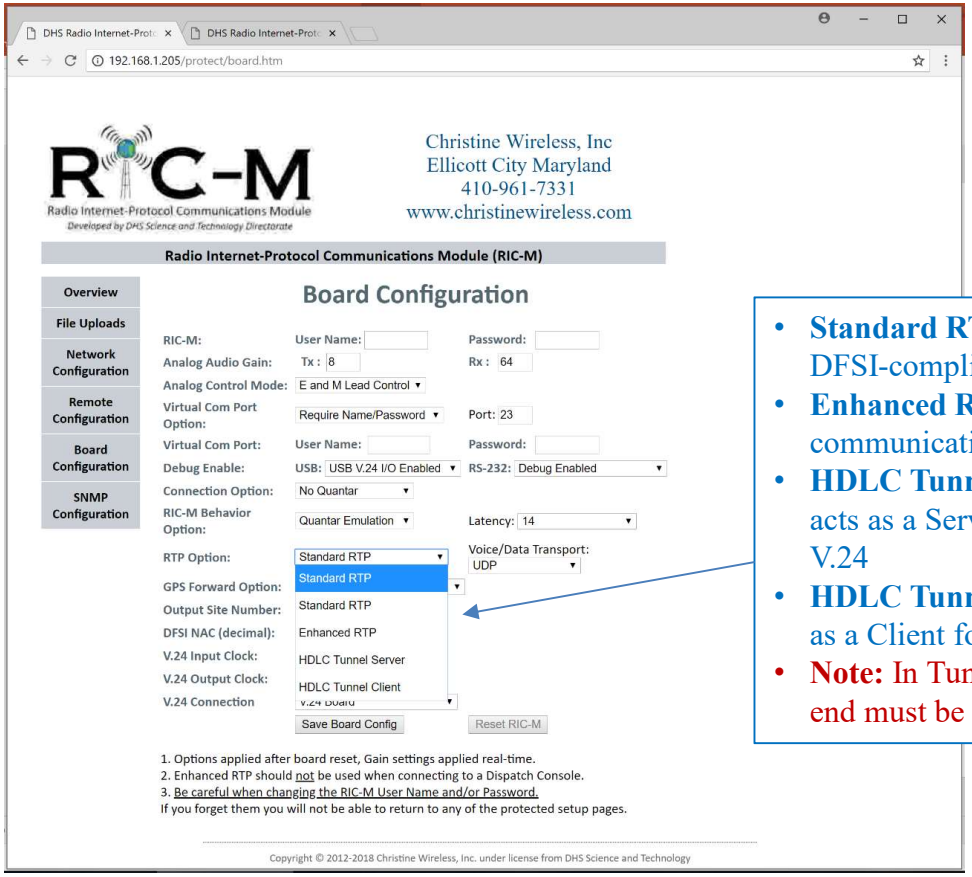
- Connection Option:
  - "No Quantar" makes IP and V.24 connections independent
  - "Require Quantar" inhibits IP connection if a V.24 connection is not present
  - "Require IP" prevents V.24 connection if an IP connection is not present
  - Recommendation: use No Quantar to prevent confusion
- Behavior Option:
  - DIU Emulation is to connect to a Quantar etc. or to connect to an ATC DIU port
  - Quantar Emulation is to connect to a DIU or an ATC Station port

Board Configuration: Latency



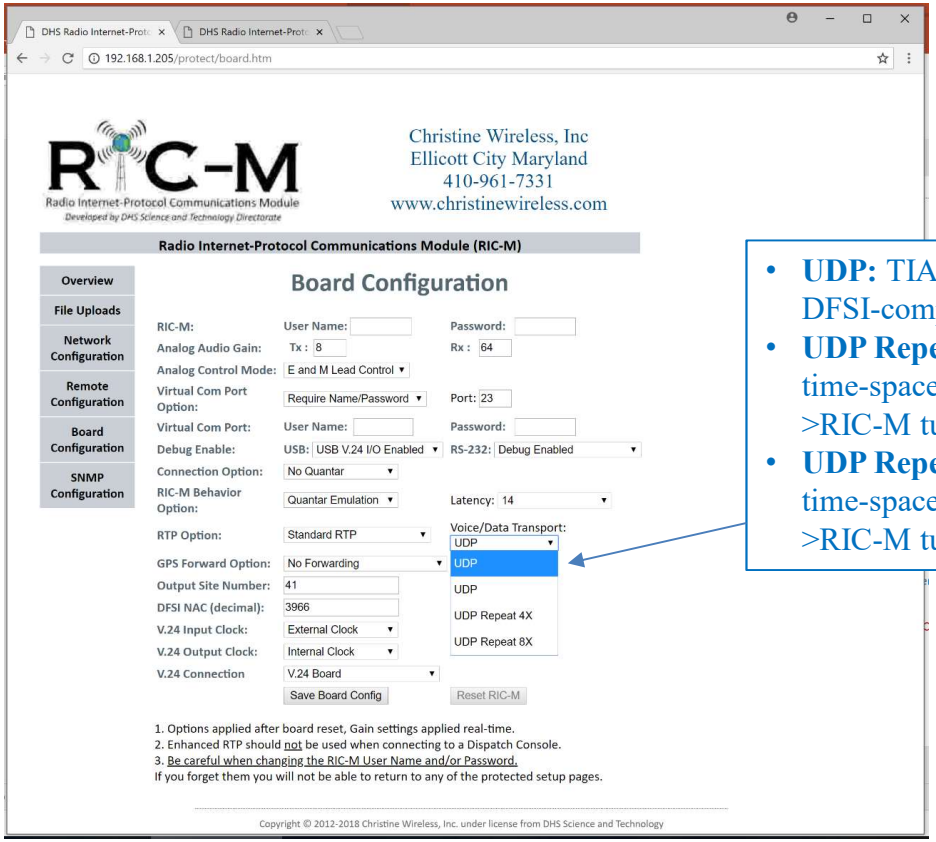
- Latency is the number of voice frames (20 milliseconds each) that are stored in the RIC-M before it starts outputting the voice frames on V.24
- The RIC-M will attempt to reorder voice frames arriving out-of-sequence and buffer them to eliminate any timing irregularities in the voice frame arrival times over IP.
- In the multiple send modes (primarily UDP tunnel modes) the latency should be set to a higher number than the number of repeats to take full advantage of the repeat voice frame reliability improvement.
- For IP transport with highly irregular arrival times or “clumping” delivery patterns (e.g. LTE in late afternoon) the latency should be set high enough to overcome the IP arrival time irregularities and avoid voice breaks on the V.24.
- If an ATAC-3000™ is used in a true voting mode (same source on more than one input), the latency difference between the inputs cannot exceed 100 milliseconds and the RIC-M latency setting should be set to a low number.

Board Configuration: RTP Options-1



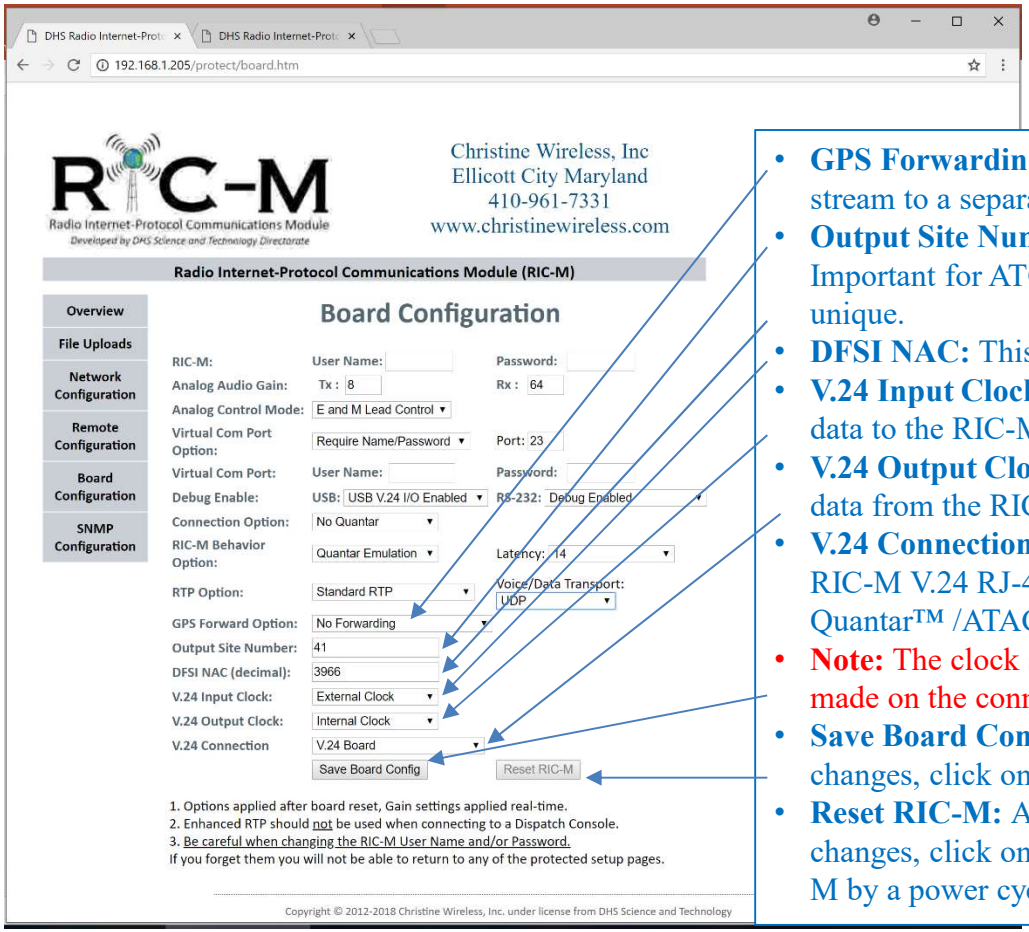
- **Standard RTP:** TIA standard Real Time Protocol. For use with other DFSI-compliant equipment
- **Enhanced RTP:** Non-standard RTP for use in two RIC-Ms communication. Provides additional V.24 fidelity
- **HDLC Tunnel Server:** Establishes a tunnel to another RIC-M and acts as a Server for encapsulated V.24. Provides 100% fidelity for V.24
- **HDLC Tunnel Client:** Establishes a tunnel to another RIC-M and acts as a Client for encapsulated V.24. Provides 100% fidelity for V.24
- **Note:** In Tunnel operation one end must be set to Client and the other end must be set to Server

Board Configuration: RTP Options-2



- **UDP:** TIA standard Real Time Protocol. For use with other DFSI-compliant equipment
- **UDP Repeat 4X** Each UDP voice packet is sent 4 times on a time-spaced interleaved basis. Primarily for use in RIC-M<->RIC-M tunnel operations on unreliable IP connections
- **UDP Repeat 8X** Each UDP voice packet is sent 8 times on a time-spaced interleaved basis. Primarily for use in RIC-M<->RIC-M tunnel operations on unreliable IP connections

Board Configuration: Final Options



- **GPS Forwarding:** Option to forward GPS data embedded in a voice stream to a separate Data IP address
- **Output Site Number:** This is the Quantar™ Site Number. Important for ATC connection where every site number must be unique.
- **DFSI NAC:** This is the NAC the will be reported to the Console
- **V.24 Input Clock:** Selects the source of the clock used to input V.24 data to the RIC-M
- **V.24 Output Clock:** Selects the source of clock used to output V.24 data from the RIC-M.
- **V.24 Connection:** Selects whether the V.24 connection is via the RIC-M V.24 RJ-45 connector of via a 50 Pin ribbon cable from the Quantar™ /ATAC Wireline board.
- **Note:** The clock selections must be compatible with the selections made on the connected equipment.
- **Save Board Configuration:** After entering Board Configuration changes, click on Save Board Configuration to store the changes.
- **Reset RIC-M:** After entering and saving the Board Configuration changes, click on Reset RIC-M to apply the new settings to the RIC-M by a power cycle.

GPS Forwarding

- APX (and other?) radios have a “peer-to-peer” GPS reporting mode
- GPS data is sent on alternate P25 voice superframes (once every 720 milliseconds)
- Transport is in voice with alternate Link Control data being repurposed for GPS
- RIC-M can extract normal and GPS Link Control information and send an unconfirmed data message to a designated IP address
- Longitude, Latitude, Unit ID and Emergency status reported >1 per second while active
- Functionality can be enabled for input, output or both voice directions.
- Frame decoding information available from Christine Wireless, Inc.
- External application will be available from:
  - GCS Electronics & Communications
    200 Sellers St
    Martinsville, VA 24112

Remote Configuration Web Page

DHS Radio Internet-Prot | DHS Radio Internet-Prot

192.168.1.205/protect/remoteconfig.htm

RIC-M
Radio Internet-Protocol Communications Module
Developed by DHS Science and Technology Directorate

Christine Wireless, Inc
Ellicott City Maryland
410-961-7331
www.christinewireless.com

Radio Internet-Protocol Communications Module (RIC-M)

- Overview
- File Uploads
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- Remote Configuration
- Board Configuration
- SNMP Configuration

Remote Configuration

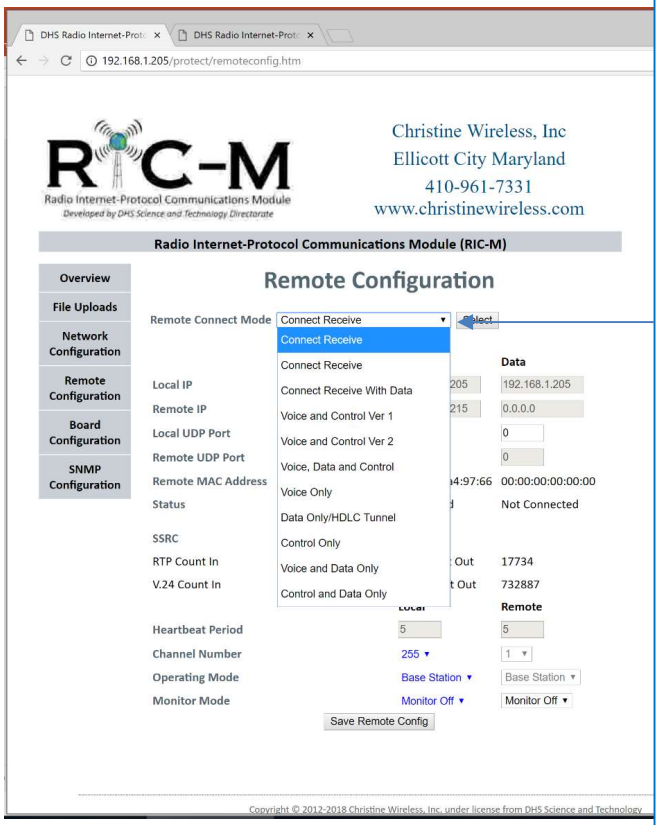
Remote Connect Mode: Connect Receive [Select]

	Control	Voice	Data
Local IP	192.168.1.205	192.168.1.205	192.168.1.205
Remote IP	192.168.1.215	192.168.1.215	0.0.0.0
Local UDP Port	7000	2000	0
Remote UDP Port	53706	50020	0
Remote MAC Address	70:5a:b6:a4:97:66	70:5a:b6:a4:97:66	00:00:00:00:00:00
Status	Connected	Connected	Not Connected
SSRC	0x18400000		
RTP Count In	97	RTP Count Out	17734
V.24 Count In	723770	V.24 Count Out	732887

	Local	Remote
Heartbeat Period	5	5
Channel Number	255	1
Operating Mode	Base Station	Base Station
Monitor Mode	Monitor Off	Monitor Off

[Save Remote Config]

Remote Configuration Web Page
Remote Connect Modes



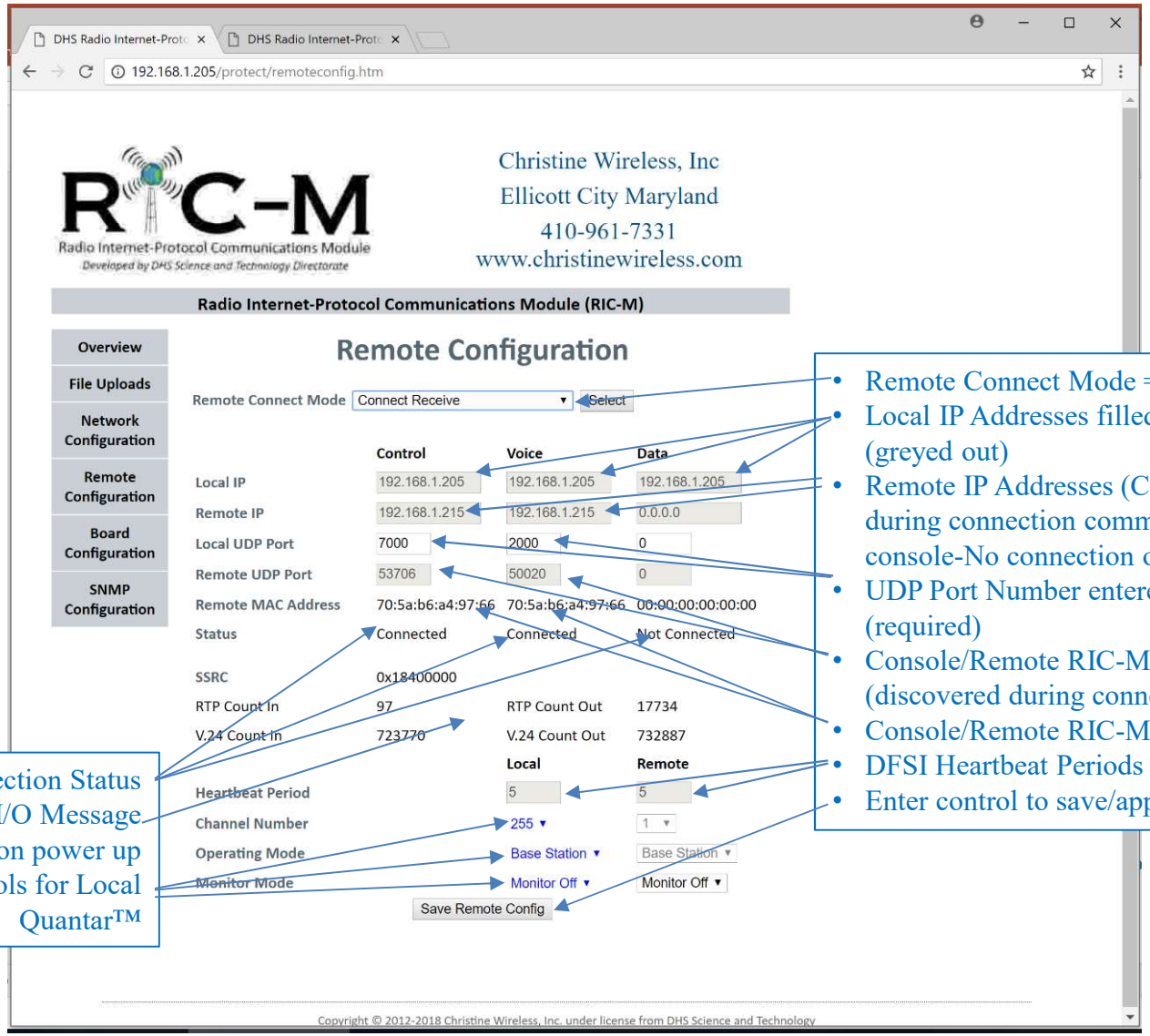
Fixed Station Modes:

- **Connect Receive:** RIC-M responds to Version 1 (TIA 102.BAHA) or Version 2 (TIA 102.BAHA-A) connection commands for Voice, Data and Control.
- **Connect Receive with Data:** RIC-M responds to Version 1 Control and Voice connect commands and establishes a Version 2 data connection. Mode is for backward compatibility to existing DFSI consoles while still supporting Data to another location such as GPS forwarding.

Host Modes:

- **Voice and Control Ver 1:** RIC-M acts like a Version 1 console and connects to DFSI Version 1 external devices.
- **Voice and Control Ver 2:** RIC_M acts like a Version 2 console and connects to DFSI Version 2 external devices for Voice and Control.
- **Voice, Data and Control:** RIC_M acts like a Version 2 console and connects to DFSI Version 2 external devices for Voice, Data and Control.
- **Voice Only:** RIC-M establishes a Voice RTP connection to an external device using Version 2.
- **Data Only/HDLC Tunnel:** RIC-M establishes a Version 2 Data Connection to an external device. This mode is also used for a HDLC (V.24) tunnel for Voice, Data and TSBK messages.
- **Control Only:** RIC-M establishes connections for other devices using Version 2.
- **Voice and Data Only:** RIC-M establishes Version 2 Voice and Data connections to an external device
- **Control and Data Only:** RIC-M established Version 2 Control and Data connections to an external device.

Remote Configuration Web Page



- Remote Connect Mode = Connect Receive
- Local IP Addresses filled in by RIC-M (greyed out)
- Remote IP Addresses (Console) determined during connection command process from console-No connection on Data
- UDP Port Number entered by User (required)
- Console/Remote RIC-M UDP Port (discovered during connect command)
- Console/Remote RIC-M MAC Address
- DFSI Heartbeat Periods (set by console)
- Enter control to save/apply changes

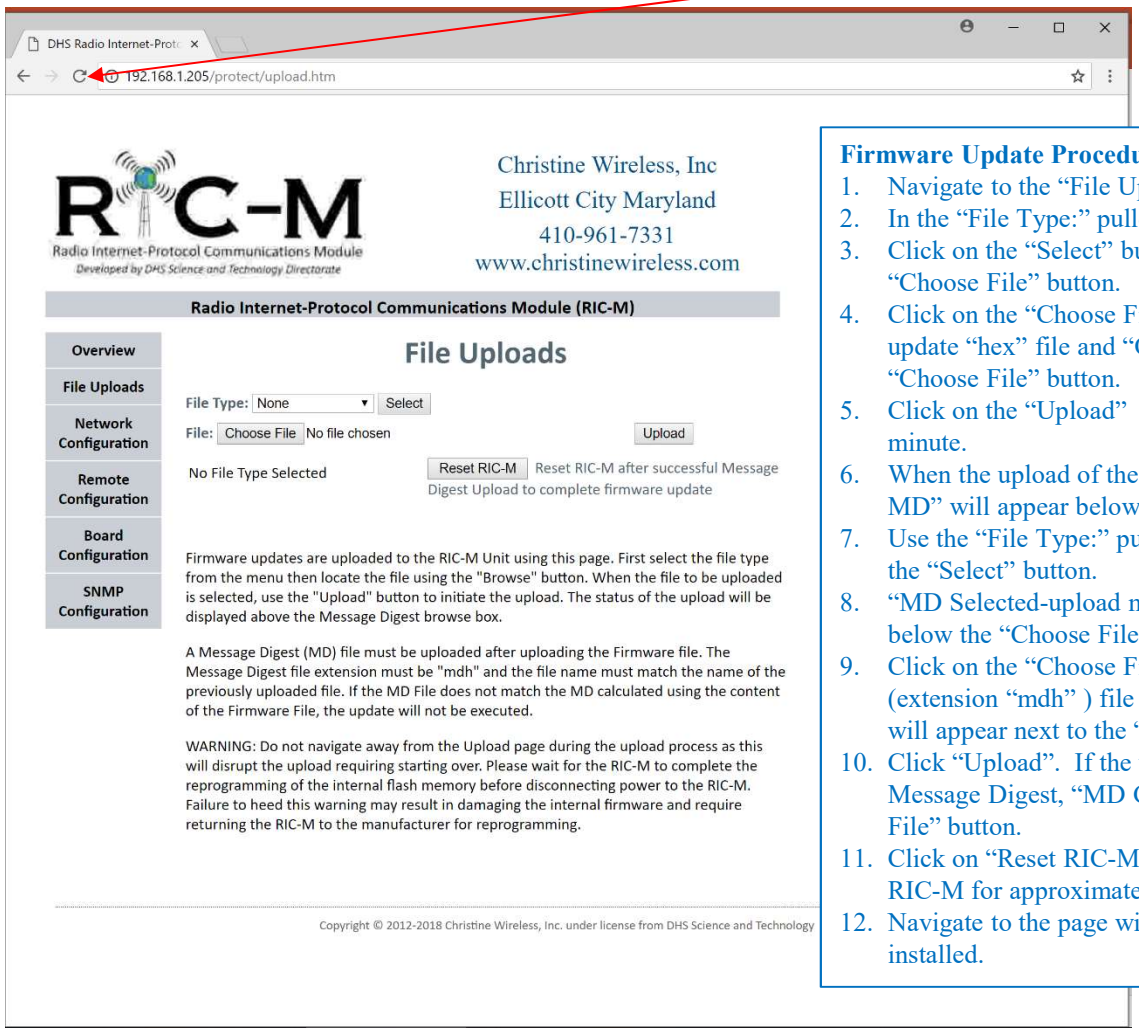
Current Connection Status
V.24/RTP I/O Message Counters-Reset on power up
Controls for Local Quantar™

RIC-M Remote Firmware Update

- Firmware for RIC-M can be updated remotely via an Internet Protocol http connection. RIC-Mz uses https.
- Two files are supplied, a “hex” file with the new firmware and a “mdh” file with the Message Digest for the new firmware.
- The Message Digest is a cryptographic sum of the entire “hex” firmware file calculated with a private key. The Message Digest is used to ensure that the new firmware is intact (uncorrupted) and also to authenticate the source of the firmware (Christine Wireless, Inc.)
- During the upload process, the RIC-M calculates the Message Digest value (256 bits) for the newly uploaded firmware.
- The User must upload the supplied Message Digest “mdh” file to complete the upload process and to enable application of the new firmware.
- If the two Message Digests do not match, the newly uploaded firmware is discarded.

Firmware Update Procedure

Special Note for RIC-Mz:
If at step 7 or 11, the web page returns a “501 not found” message, click on the browser clockwise circular icon to continue. This is a known anomality with the RIC-Mz.



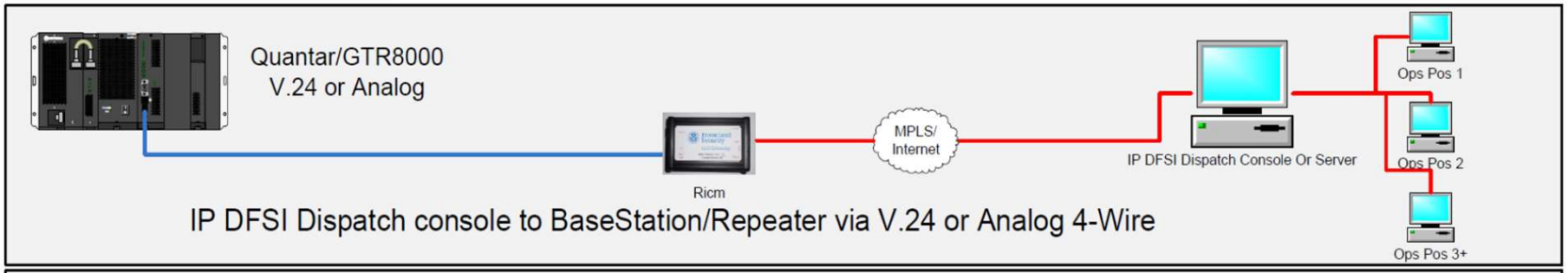
Firmware Update Procedure (Chrome recommended as browser)

1. Navigate to the “File Upload” web page.
2. In the “File Type:” pulldown menu click on “RIC-M Firmware”.
3. Click on the “Select” button- “File Type Selected” will appear below the “Choose File” button.
4. Click on the “Choose File” button and navigate to the location of the firmware update “hex” file and “Open” it. The “hex” file name will appear next to the “Choose File” button.
5. Click on the “Upload” button. Be patient, the upload will take less than a minute.
6. When the upload of the “hex” file is complete, “MD Calculated-Enter Correct MD” will appear below the “Choose File” button.
7. Use the “File Type:” pulldown menu and click on “Message Digest” and click the “Select” button.
8. “MD Selected-upload matching name file with .mhd extension” will appear below the “Choose File” button.
9. Click on the “Choose File” button and navigate to the Message Digest (extension “mdh”) file and “Open” it. The name of the Message Digest file will appear next to the “Choose File” button.
10. Click “Upload”. If the uploaded Message Digest matches the calculated Message Digest, “MD Checks-Update Enabled” will appear below the “Choose File” button.
11. Click on “Reset RIC-M” to apply the update. Do not disrupt the power on the RIC-M for approximately 90 seconds while the update is taking place.
12. Navigate to the page with the Firmware Date to verify that the new Firmware is installed.

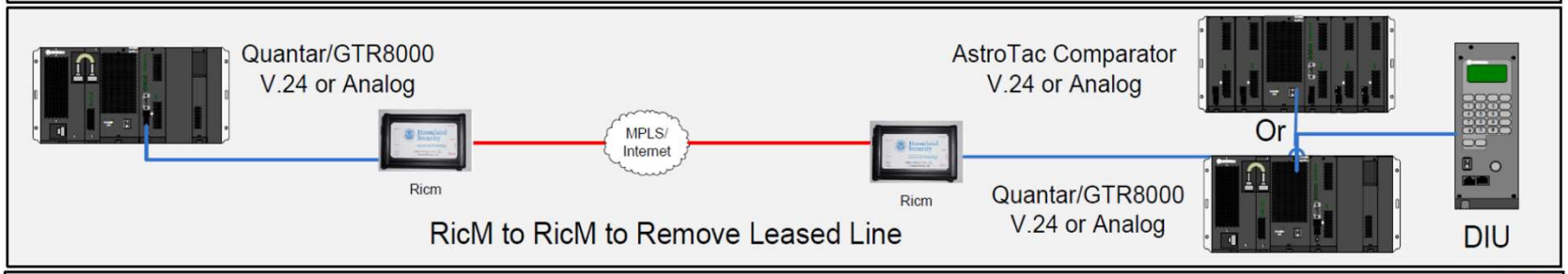
Setup Scenarios

- Analog Connection to a Quantar™ /GTR/PDR
- Digital Connection to a Quantar™ /GTR/PDR/DIU
  - V.24 RJ-45
  - 50 pin header/cable to wireline board
- Avtec and Other DFSI Console Connection
- ATAC-3000™ DIU port V.24
- ATAC-3000™ Station port V.24
- Copper POTS line replacement
- HDLC Tunnel option
- Paradyne modem/STUN connection
- DFSI/RIC-M Base Station replacement for Quantar™ /GTR/PDR
- Connection to Motorola “Core” via GGM8000
- OTAR Considerations
- Embedded GPS Forwarding
- IP Transport Options/VPN

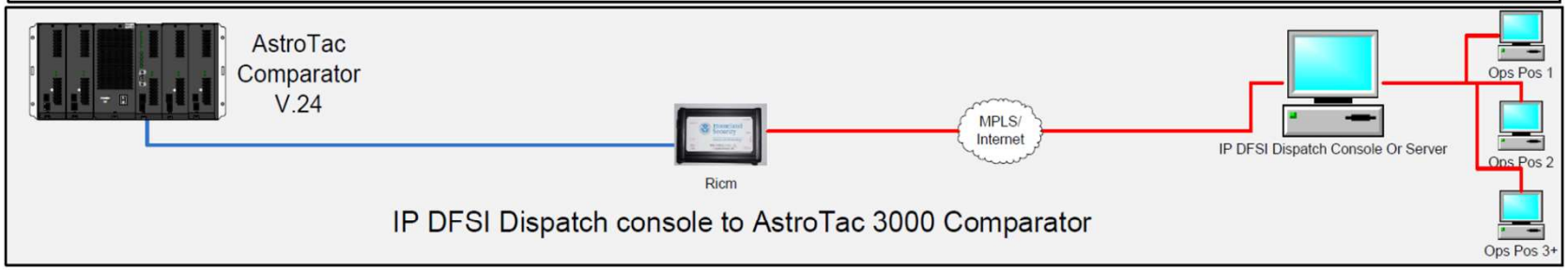
RIC-M Set Up Scenarios



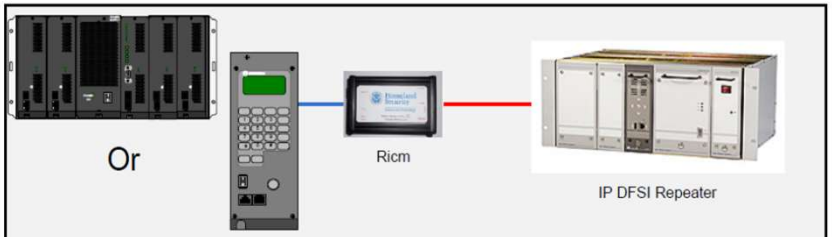
IP DFSI Dispatch console to BaseStation/Repeater via V.24 or Analog 4-Wire



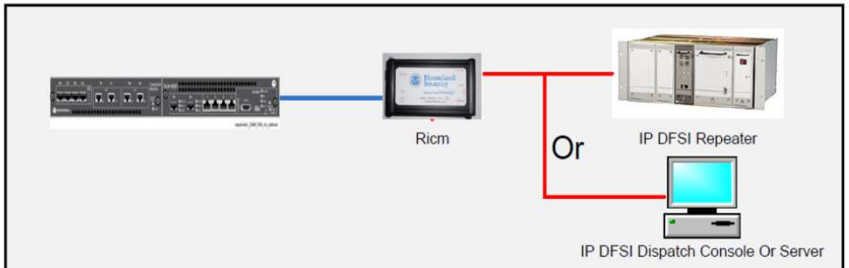
RicM to RicM to Remove Leased Line



IP DFSI Dispatch console to AstroTac 3000 Comparator

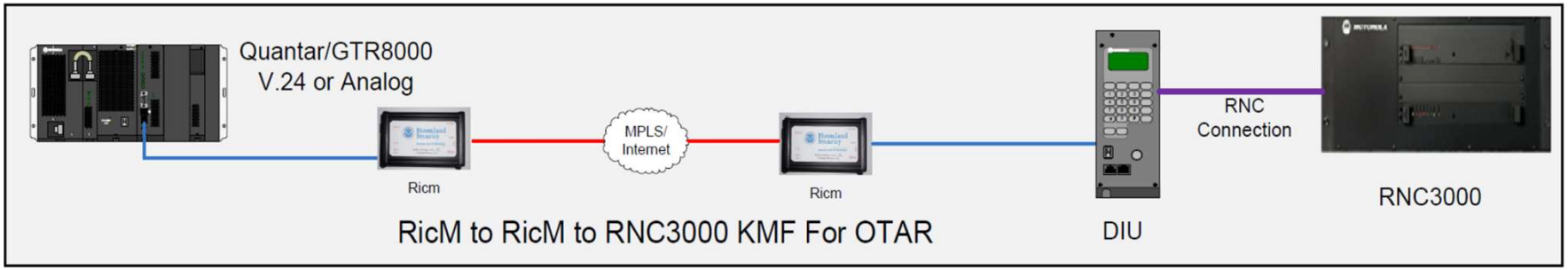


RicM to convert IP DFSI to Quantar V.24 Emulation replacing old Quantar connected to AstroTac or DIU

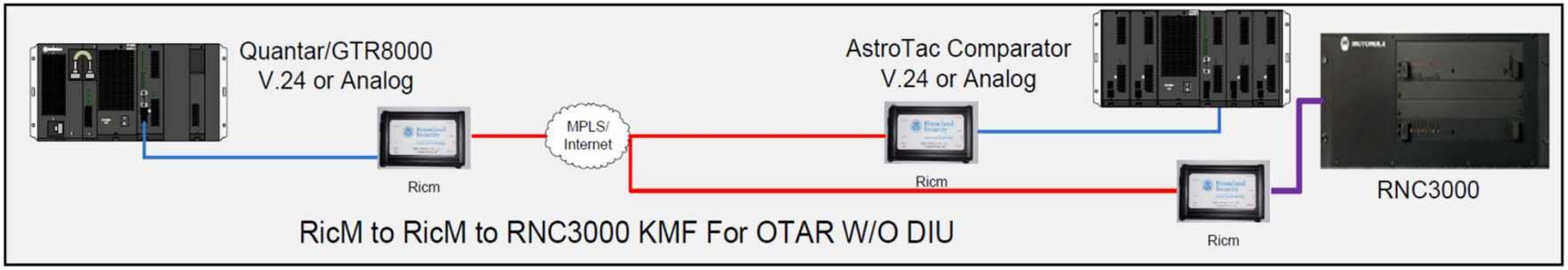


DFSI IP Repeater or Console RicM To V.24 Motorola GGM8000 providing gateway in Motorola IP CORE

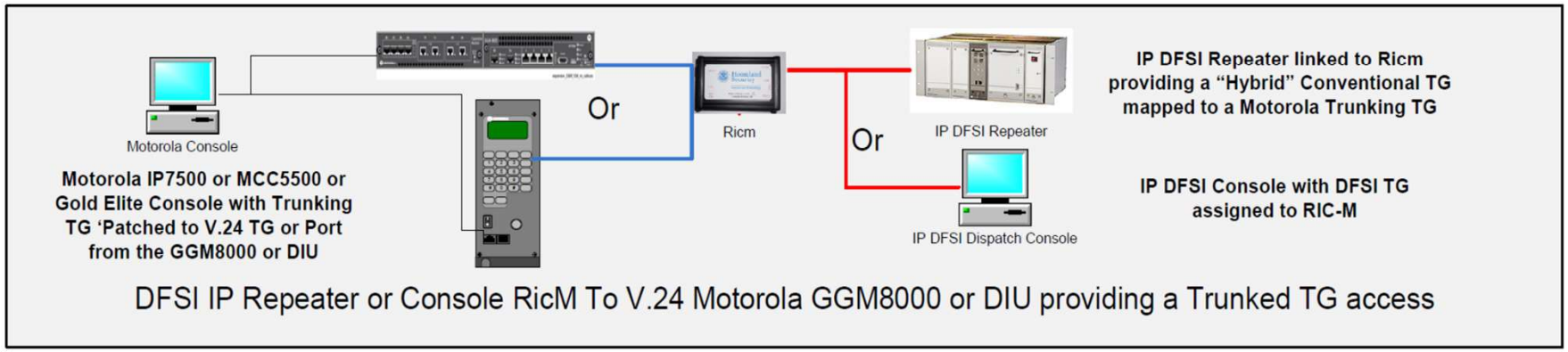
RIC-M Set Up Scenarios-Continued



RicM to RicM to RNC3000 KMF For OTAR



RicM to RicM to RNC3000 KMF For OTAR W/O DIU



DFSI IP Repeater or Console RicM To V.24 Motorola GGM8000 or DIU providing a Trunked TG access

RIC-M use with DFSI Dispatch Console

- Consoles Supported:
  - Avtec
  - Telex-Bosch
  - Zetron
  - Moducom
  - Catalyst
  - Consoles work on TIA-102.BAHA (version 1)
- Example shown is a connection to an ATAC-3000™ on a V.24 DIU port

DFSI Console Board Configuration

DHS Radio Internet-Pro

192.168.1.204/protect/board.htm

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Developed by DHS Science and Technology Directorate

Christine Wireless, Inc
Ellicott City Maryland
410-961-7331

Radio Internet-Protocol Communications Module (RIC-M)

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- Remote Configuration
- Board Configuration
- SNMP Configuration

Board Configuration

RIC-M:	User Name:	Password:
Analog Audio Gain:	Tx : 8	Rx : 64
Analog Control Mode:	Disabled	
RS-232 Enable:	Debug Enabled	
Virtual Com Port:	23	
Virtual Com Port Option:	Not Set	
Virtual Com Port:	User Name:	Password:
USB Debug Enable:	USB V.24 I/O Enabled	
Connection Option:	No Quantar	
RIC-M Behavior Option:	DIU Emulation	
RTP Option:	Standard RTP	Voice/Data Transport: UDP
GPS Forward Option:	No Forwarding	
Output Site Number:	2	
DFSI NAC (decimal):	3966	
V.24 Input Clock:	External Clock	
V.24 Output Clock:	Internal Clock	
V.24 Connection	V.24 Board	

1. Options applied after board reset, Gain settings applied real-time.
2. Enhanced RTP should not be used when connecting to a Dispatch Console.
3. Be careful when changing the RIC-M User Name and/or Password. If you forget them you will not be able to return to any of the protected setup pages.

Save Board Config | Reset RIC-M

DFSI Remote Configuration Web Page

DHS Radio Internet-Pro

192.168.1.204/protect/remoteconfig.htm

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Remote Configuration

Remote Connect Mode: Connect Receive [Select]

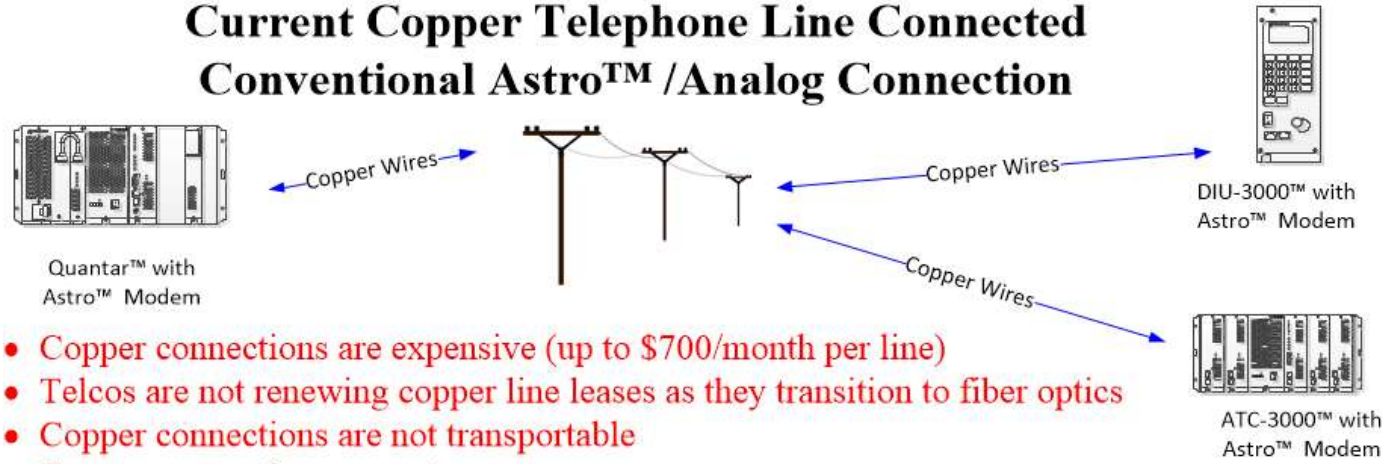
	Control	Voice	Data
Local IP	192.168.1.204	192.168.1.204	192.168.1.204
Remote IP	192.168.1.215	192.168.1.215	0.0.0.0
Local UDP Port	7000	2000	0
Remote UDP Port	57287	57288	0
Remote MAC Address	70:5a:b6:a4:97:66	70:5a:b6:a4:97:66	00:00:00:00:00:00
Status	Connected	Connected	Not Connected
SSRC	0xdf610000		

	Local	Remote
Heartbeat Period	5	5
Channel Number	0	0
Operating Mode	Base Station	Base Station
Monitor Mode	Monitor Off	Monitor Off

[Save Remote Config]

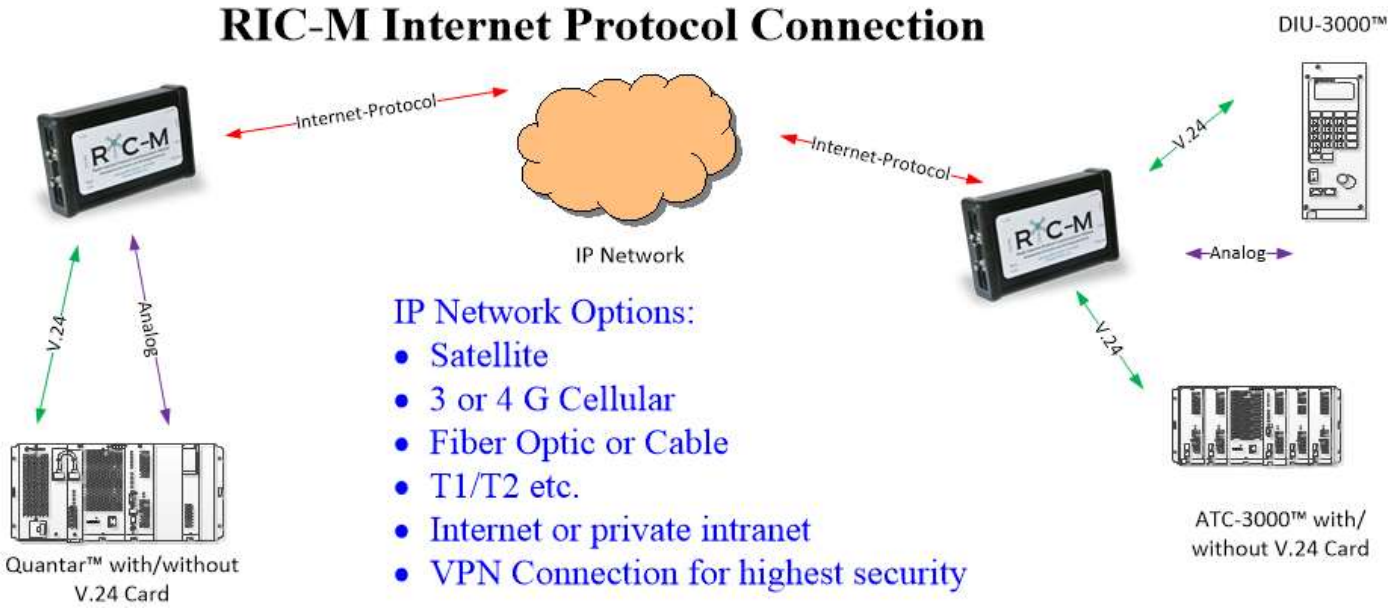
Replace Copper Connections

Current Copper Telephone Line Connected Conventional Astro™ /Analog Connection



- Copper connections are expensive (up to $700/month per line)
- Telcos are not renewing copper line leases as they transition to fiber optics
- Copper connections are not transportable
- Copper connections are not secure

RIC-M Internet Protocol Connection



IP Network Options:

- Satellite
- 3 or 4 G Cellular
- Fiber Optic or Cable
- T1/T2 etc.
- Internet or private intranet
- VPN Connection for highest security

HDLC (V.24) Tunnel

- RIC-M converts HDLC to/from TIA-102.BAHA and TIA-102.BAHA-A standards. Conversions result in some loss of information embedded in the HDLC stream.
- Tunnel mode encapsulates all HDLC messages “as is” with time stamp/sequence number and sends it on UDP. Input HDLC can be synchronous (V.24) or asynchronous (TXM-2000™).
- Receive RIC-M strips off time stamp/sequence number, checks the CRC of the HDLC, saves only one correct copy of each voice packet and sends out the exact HDLC input to the connected equipment. Reorder of packets if necessary. HDLC can be synchronous or asynchronous.
- UDP Server set on one end and UDP Client set on other
- No separate UDP Control or Voice connections: Voice and Data sent as a UDP HDLC data message.
- Also supports 4 and 8 times voice packet send/receive- packets are time-spaced and interleaved. Intended for use with unreliable IP transport.
- Only applicable to Christine Wireless, Inc. RIC-M to RIC-M connections.

Tunnel Server Setup – Remote Configuration

DHS Radio Internet-Protocc | DHS Radio Internet-Pro

192.168.1.209/protect/remoteconfig

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Christine Wireless, Inc
Ellicott City Maryland
410-961-7331

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Remote Configuration

Remote Connect Mode: Data Only/HDLC Tunnel [Select]

	Control	Voice	Data
Local IP	255.255.255.255	0.0.0.0	192.168.1.209
Remote IP	0.0.0.0	0.0.0.0	174.205.26.122
Local UDP Port	0	0	3000
Remote UDP Port	0	0	3000
Remote MAC Address	00:00:00:00:00:00	00:00:00:00:00:00	00:00:00:00:00:00
Status	Not Connected	Not Connected	Connected
SSRC	0x00000000		

	Local	Remote
Heartbeat Period	0	0
Channel Number	255	255
Operating Mode	Base Station	Base Station
Monitor Mode	Monitor Off	Monitor Off

[Save Remote Config]

http://192.168.1.209/protect/remoteconfig.htm

Tunnel Server Setup – Board Configuration

DHS Radio Internet-Protocc | DHS Radio Internet-Pro

192.168.1.209/protect/board.htm

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Board Configuration

RIC-M:	User Name:	Password:
Analog Audio Gain:	Tx : 8	Rx : 64
Analog Control Mode:	Disabled	
RS-232 Enable:	Debug Enabled	
Virtual Com Port:	23	
Virtual Com Port Option:	Not Set	
Virtual Com Port:	User Name:	Password:
USB Debug Enable:	USB V.24 I/O Enabled	
Connection Option:	No Quantar	
RIC-M Behavior Option:	DIU Emulation	
RTP Option:	HDLC Server Tunnel	Voice/Data Transport: UDP
GPS Forward Option:	Not Set	
Output Site Number:	default	
DFSI NAC (decimal):	3966	
V.24 Input Clock:	External Clock	
V.24 Output Clock:	Internal Clock	
V.24 Connection	V.24	

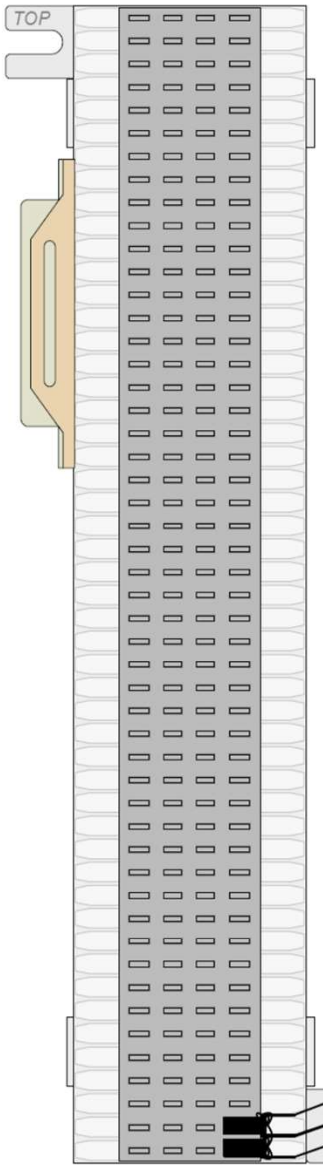
1. Options applied after board reset, Gain settings applied real-time.
2. Enhanced RTP should not be used when connecting to a Dispatch Console.
3. Be careful when changing the RIC-M User Name and/or Password. If you forget them you will not be able to return to any of the protected setup pages.

Save Board Config | Reset RIC-M

Paradyne Modem/STUN™ Connection

- Paradyne modem and STUN™ provide V.24 remote connectivity for several Federal Agencies
- Paradyne works over POTS
- STUN™ works over IP – supports multiple V.24 connections
- Both require a V.24 “crossover” cable to work with RIC-M
- Both clocks on RIC-M must be set for “External”
- RIC-M has been extensively tested with both Paradyne Modem and STUN™ including OTAR operation
- RIC-M Tunnel Mode is a built-in alternative for both Paradyne Modem and STUN™

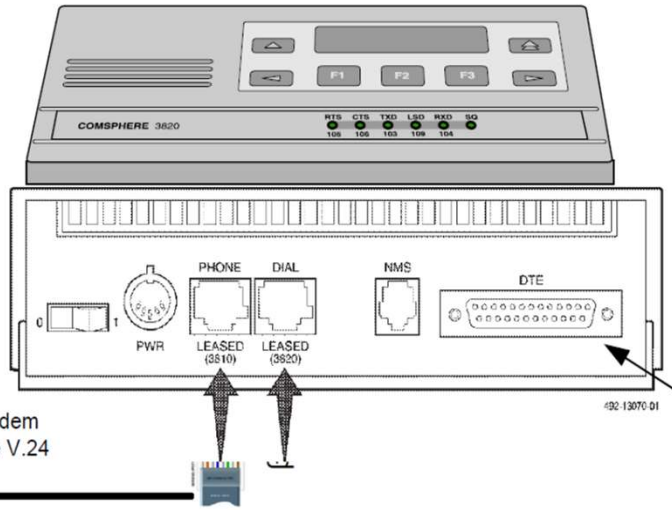
Interface to Paradyne V.35 Modem



RJ-45
1-DTE TX
2-CD
3-DCE-RX
4-GND
5-TX Data
6-RX-Data
7-RTS
8-CTS

Serial Monitor/RSS
V.24 4-wire E&M

Null Cable

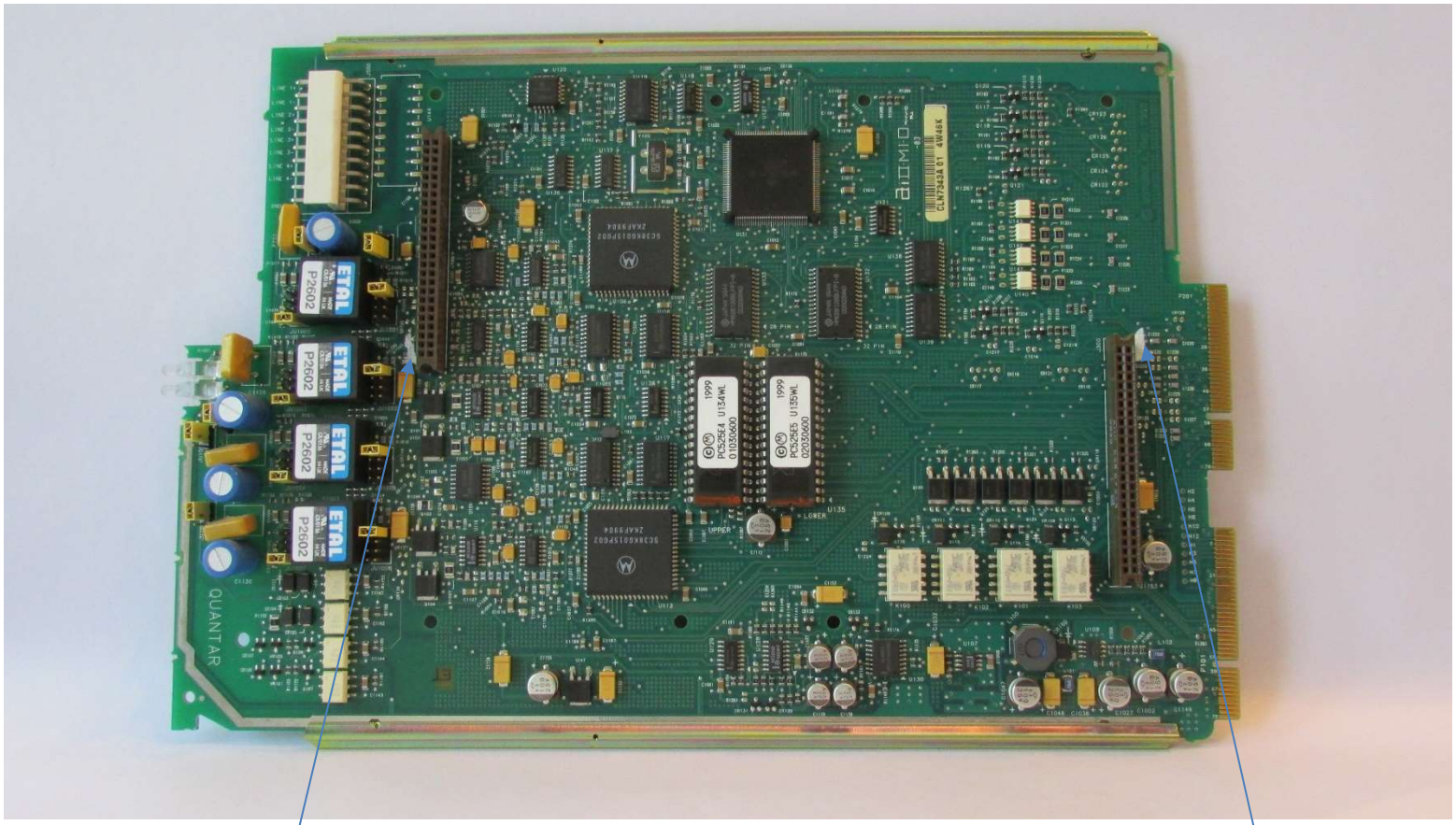


To another Modem plugged into the V.24 Port

RJ45 Pin 1 and 2 for 2-Wire

FUNCTION:	DB25M	RJ-45F
RX TIMING (DCE)	17	1
CARRIER DETECT	8	2
TX TIMING (DTE)	15	3
GROUND	7	4
RX DATA	3	5
TX DATA	2	6
CTS	5	7
RTS	4	8

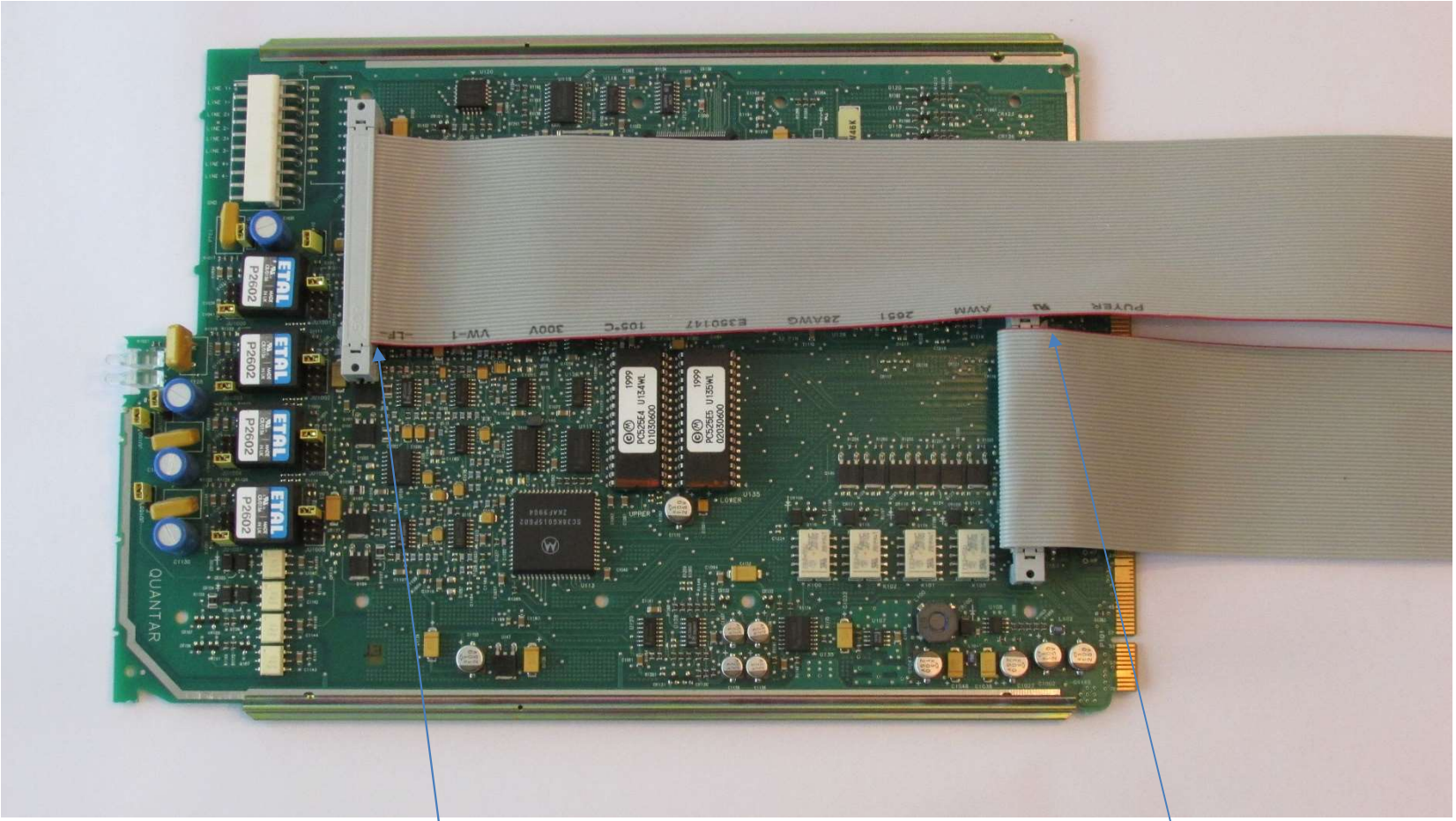
Quantar™/ATAC-3000™ Wireline Board



50 Pin Header Pin 1 (Port 2)

50 Pin Header Pin 1 (Port 1)

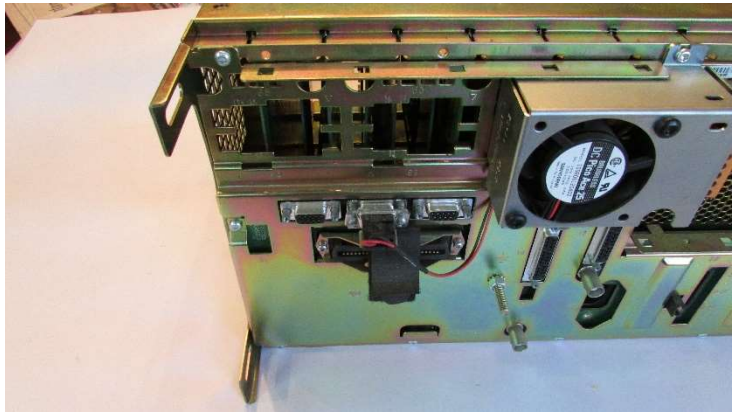
Ribbon Cable Connection to Wireline Board

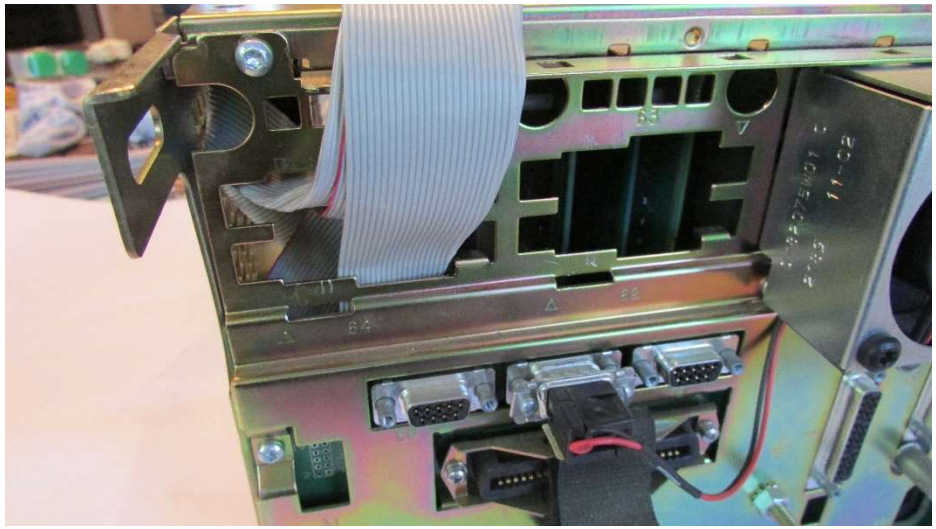


Pin 1 Marking (Port 2 – ATC Only)

Pin 1 Marking (Port 1)
Cable folded over connector

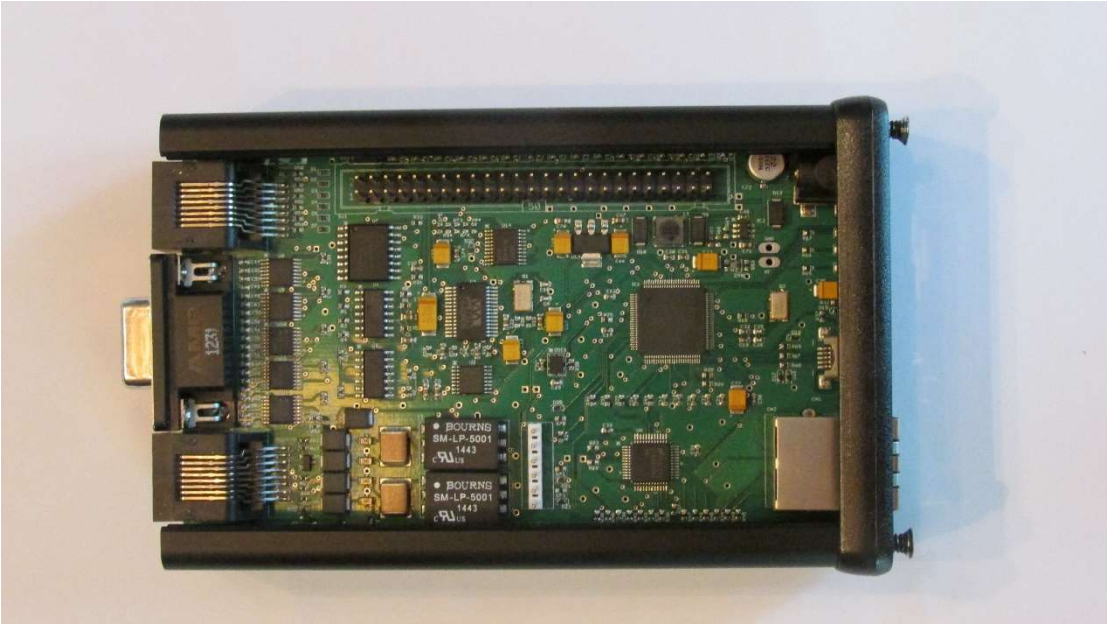
Ribbon Cable Routing for ATAC





1. Remove analog connectors/cables
2. Fold ribbon cables
3. Protect folded cables with tape
4. Feed folded ribbon cables through holes in rear of ATAC
5. Slide in Wireline card while pulling ribbon cables through holes in ATAC
6. RIC-Ms can be mounted on shelf above ATAC
7. Alternative ribbon cable routing from front of ATAC w/o face plate

RIC-M Ribbon Cable Installation



1. Remove left endplate and plastic end plate carrier
2. Loosen top two screws on right end plate
3. Remove top cover (slide to left)

RIC-M Ribbon Cable Installation

1. Fold the ribbon cable over the top of the 50 pin female connector.
2. Push the 50 pin female connector onto the 50 pin male header on the RIC-M board
3. Make sure that the red ribbon cable pin 1 indicator is to the left
4. Ensure that the 50 pin female ribbon connector is fully seated on the 50 pin RIC-M male header.

RIC-M Ribbon Cable Installation

1. Fold the ribbon cable on a 45 degree bend toward the left end of the RIC-M
2. Slide the plastic endplate carrier over the ribbon cable as shown above
3. Slide the left end plate over the ribbon cable with the end plate markings out and down as shown above.

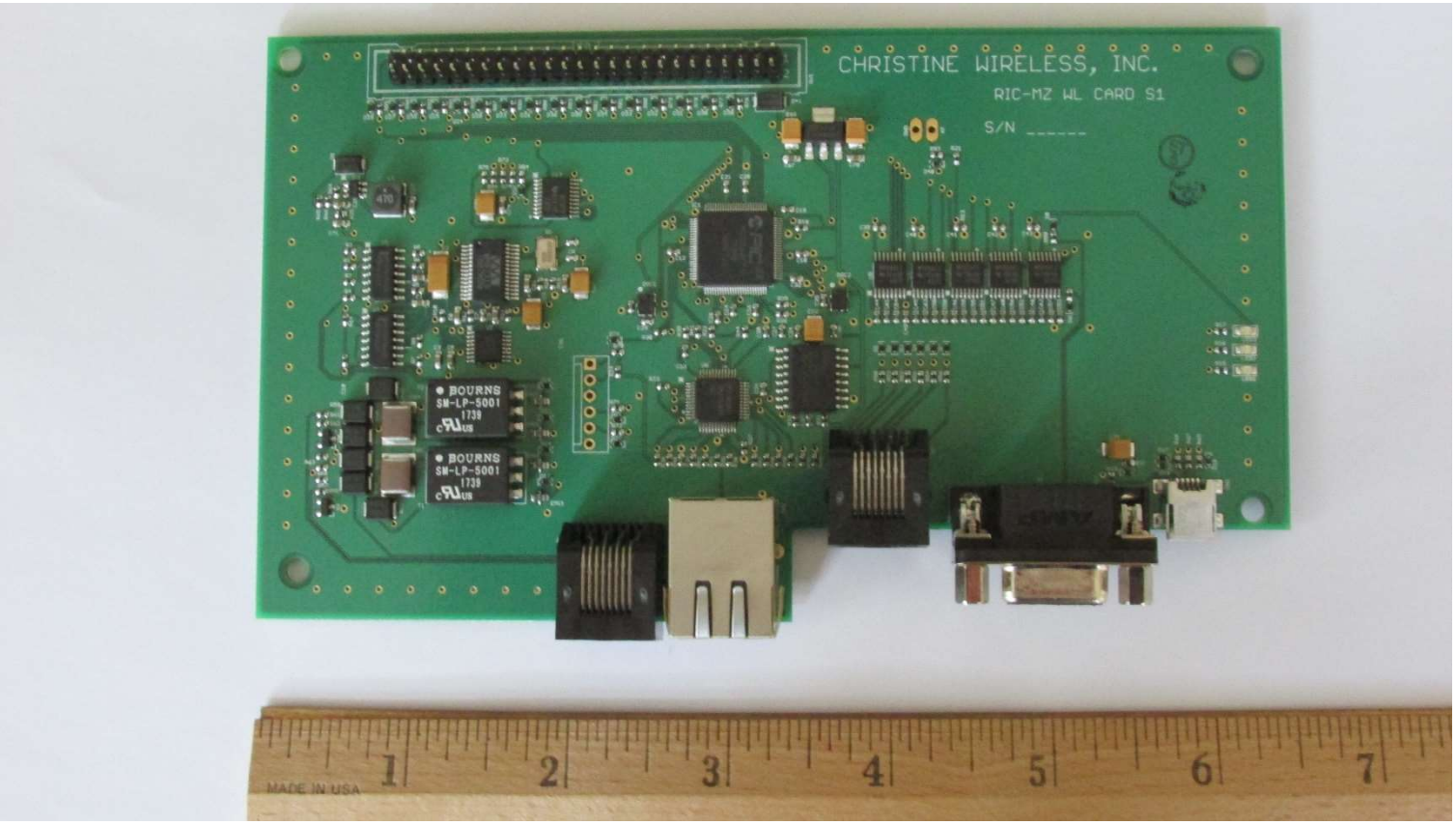
RIC-M Ribbon Cable Installation

1. Slide the top cover into the slots on the RIC-M housing
2. Push the ribbon cable while carefully sliding the top cover to the right.
3. Make sure the edge of the top cover does not damage the ribbon cable insulation

RIC-M Ribbon Cable Installation

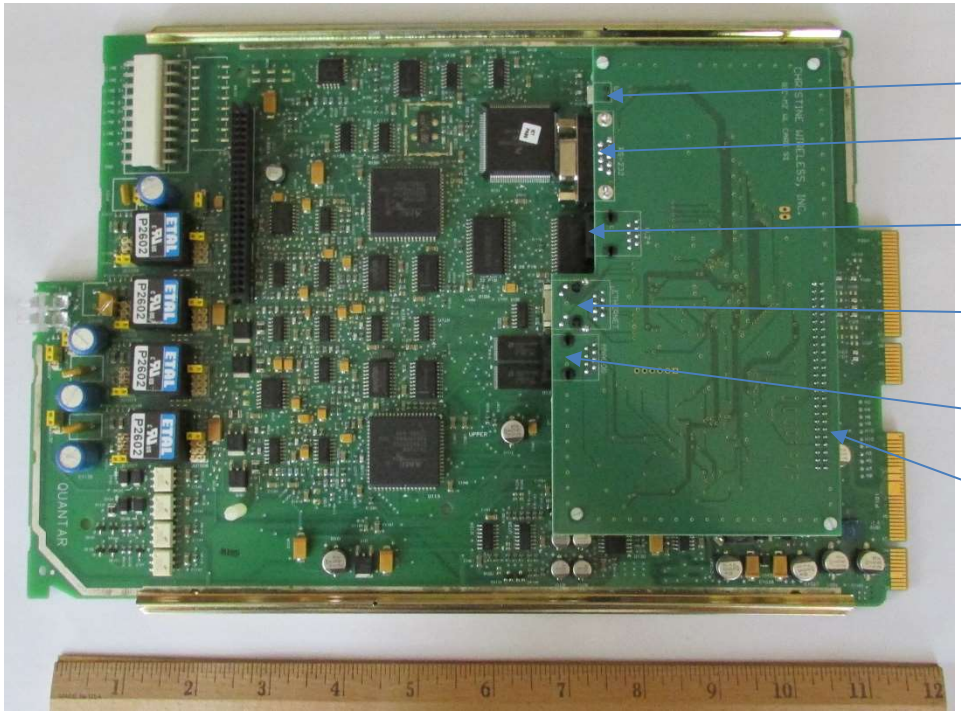
1. Replace the left plastic end cover holder.
2. Replace the left end cover and insert and tighten the 4 screws.
3. Tighten the 2 right end cover screws
4. The completed installation should look like the above.

RIC-M Wireline Board Alternative



- The new Wireline format for RIC-Mz eliminates the case and power supply
- The RIC-Mz Wireline board plugs into the Quantar™ or ATAC-3000™ wireline 50 pin header connector
- The RIC-Mz is powered from the Quantar™ or ATAC-3000™

RIC-M Wireline Board Alternative Packaging



- The new Wireline format for RIC-Mz installed on a Quantar™ Wireline board
- The RIC-Mz Wireline board plugs into the Quantar™ or ATAC-3000™ wireline 50 pin header connector
- The RIC-Mz is powered from the Quantar™ or ATAC-3000™

RIC-Mz TLSv1.2 HTTPS

Christine WIRELESS

Details | DHS Documents | Purchase | Support | Contact

The RIC-M is an external after-market protocol converter allowing Conventional Motorola ASTRO™ base stations and other related equipment to be interconnected using Internet Protocol.

The **new RIC-Mz** features TLS 1.2 key exchange encryption advanced security and is designed to the DHS 4300 policy standards for the protection of sensitive information.

Designed for use in State, Local and Federal First Responder, Public Safety and Law Enforcement radio systems.

Developed by Christine Wireless, Inc. under contract to and licensed by the Department of Homeland Security Science and Technology Directorate.

APPLICATIONS

- Elimination of expensive and hard to get copper telephone circuits to interconnect Conventional Motorola ASTRO™ system elements.
- Allow addition of non-Motorola base stations and other equipment into a Conventional Motorola ASTRO™ system
- Location of elements of a Conventional Motorola ASTRO™ system to diverse locations
- Use-Motorola Dispatch Consoles with a Conventional Motorola ASTRO™ system
- Applicable Products: Quantar™, GTR-8000™, PDR-3500™, ASTRO-TAC 3000™ and DIU-3000™

CAPABILITY

- Digital Project 25 voice (Encrypted and unencrypted)
- Analog Voice (4 wire E&M)
- Confirmed and Unconfirmed Project 25 data including Over-the-Air-Rekey (OTAR)
- Virtual Com port for remote Radio Service Software (RSS) application via Internet Protocol
- Remote Control of connected equipment
- Conventional Control and Signaling (TSBKs)
- Authenticated Remote Firmware Update via Internet Protocol
- Connects to Conventional Motorola ASTRO™ system elements with and without V.24 board.
- Interconnects via Internet, private intranet, satellite, cellular and Virtual Private Networks.
- Web-based (browser) setup and monitoring

STANDARDS-BASED

The RIC-M utilizes Project 25/APCO/TIA published and draft standards.

- GENERAL INFORMATION
- SETUP AND CONFIGURATION
- MissionCritical WEBINAR: THE BENEFITS OF MIGRATING TO AN IP-BASED SYSTEM

Bringing IP Interconnectivity to First Responder Radio Communications.