RoIP

Radio over Internet Protocol for Land Mobile Radio Systems

via the Digital Ethernet Universal Interface Card (UIC)

DANIELS™ ELECTRONICS LTD.
www.danelec.com Radio System Manufacturer

P25 DIGITAL • DIGITAL WIRELESS • SANS FIL NUMÉRIQUE • INALÁMBRICO DIGITAL

Digital Interoperability in a Land Mobile Radio (LMR) Network

The need for Interoperability is well known in the Land Mobile Radio (LMR) industry. One means of implementing interoperability is the Common Air Interface (CAI) defined by the P25 standard that allows handsets from multiple agencies to communicate in the same area. Interoperability however is a much larger issue than simply having fire and police staff communicating between their handsets at the same incident scene. True interoperability requires all members of an agency to be capable of communicating within their organization and across organizations at a local level or a national level. That type of interoperability currently only exists in the telephone network.

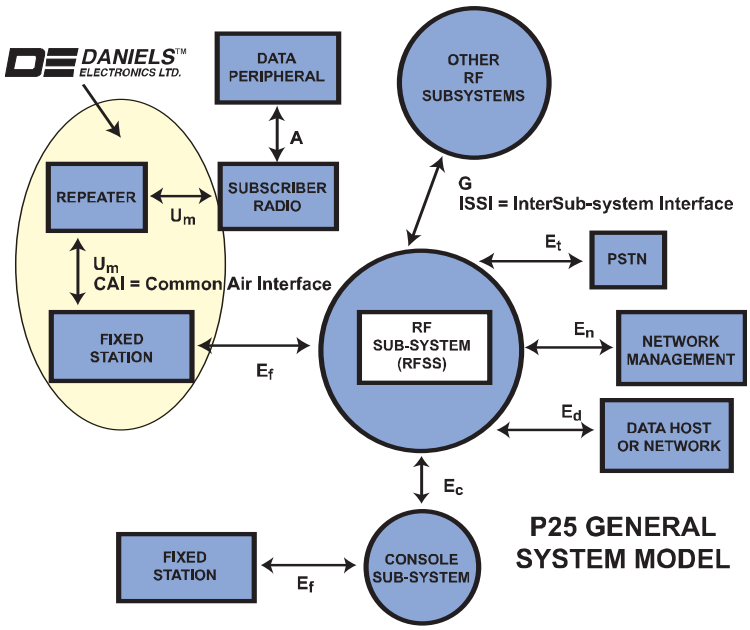
A second technology being used to achieve interoperability is IP (Internet Protocol). IP technology allows multiple communications devices (telephone, LMR radio, cell phone, PC) to be interconnected since they are all communicating in the common format of digital IP packets. Voice over IP (VoIP) is the most familiar form of this type of communication allowing a standard telephone to talk to a PC based telephone. That same technology is now being used in LMR networks to achieve true interoperability.

RoIP (Radio over IP) Networks

Radio over IP (RoIP) is an expanded version of VoIP, transmitting the radio control signals such as PTT and COR in digital format in addition to the digital voice packets. With RoIP it is possible to offer end to end digital signaling from a handset to any other communications device in the world. RoIP technology eliminates the leased lines previously used to remotely control base stations by tones and, in a true RoIP digital implementation there are no conversions from E&M to IP limiting the controls signals available or delaying the speed of signaling. Of course true end to end digital signaling and communications also facilities end to end encryption for secure communications.

Daniels Electronics radios now support true end to end digital RoIP communications with the digital Ethernet interface provided by the new Universal Interface Card (UIC). As shown in the APCO P25 general system diagram to the right, the UIC interface interconnects the Fixed Station (Daniels Radio) with a Console, IP switch or RF subsystem at the E_f connection. This interface provides new features and greater connectivity between P25 subsystems in lieu of the Fixed Station and Console sub-system interfaces evolving at the TIA standards committee.

The new Universal Interface Card (UIC) creates a powerful interface from the RF world into the IP world that allows Daniels to provide Best in Class digital connectivity from the radio world into the IP centric world of all other communications networks.



Daniels Electronics - Universal Interface Card (UIC)

The Daniels Universal Interface Card (UIC) provides digital Ethernet connectivity from the Daniels MT-3 analog or MT-4 digital radio system to other LMR subsystems in a P25 network. The UIC provides Daniels customers with access to the base station's signals in order to interface with other RF subsystems and console equipment, thus enabling third parties access to a wide range of signals, controls and functionalities that already exist on the Daniels radio modules. The Universal Interface Card enables:

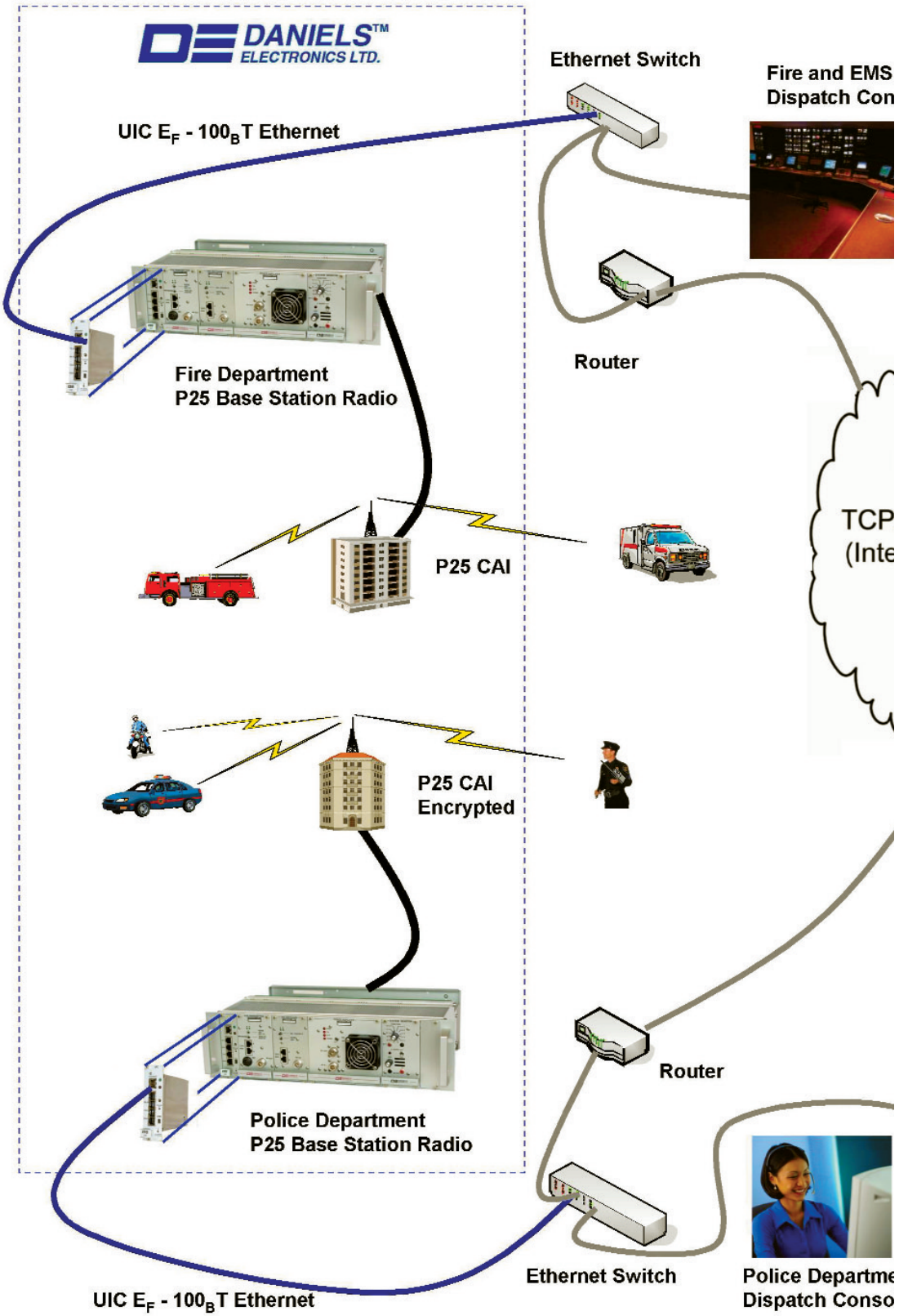
- End to End digital Encrypted communications for secure applications
- Interoperability between agencies in the same jurisdiction and between jurisdictions.
- An opportunity to select Best in Class Plug and Play Base Stations
- Realization of a RoIP network that is truly integrated
- Reduced interconnection costs
- Simplified setup and configuration

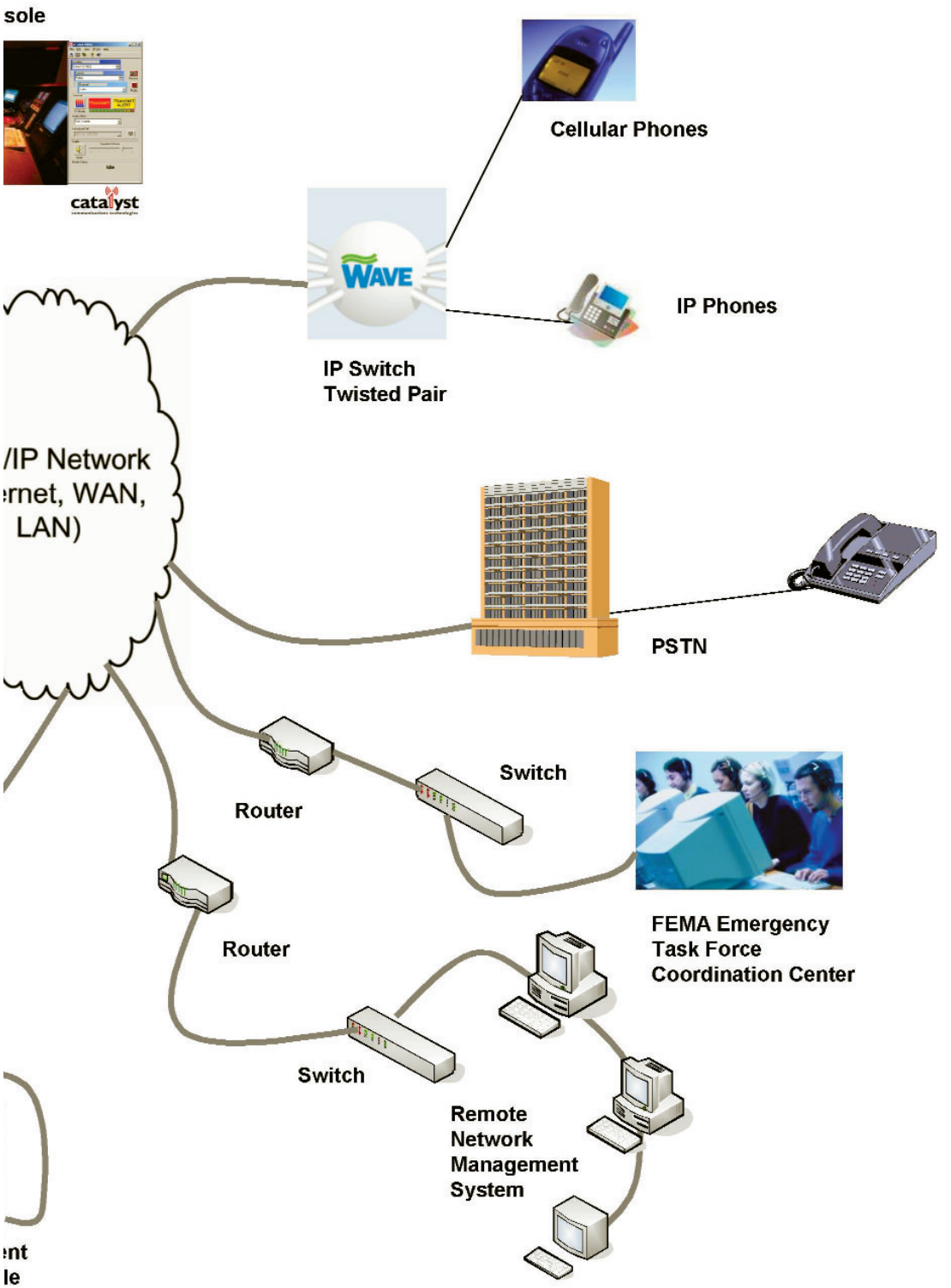
The UIC board incorporates one RJ-45 connector for the (Ethernet 10/100 Base-T) connection to the outside world and four RJ-45 connectors, for supporting two Receivers and two Transmitters stationed in the subrack. The USB connection is for connection to a maintenance / programming PC, allowing firmware updates via flashing. (In the future, updates will be downloadable from the Daniels Electronics website.)

The Universal Interface Card (UIC) in a P25 Base Station

The Universal interface card provides Daniels customers with access to all of the MT-3 and MT-4 base station's backplane signals, as well, the front panel connections between the Transmitter and the Receiver are extended externally out of the radio via the UIC Ethernet connection. This provides additional functionality compared with the analog offering currently supported on Daniels radios via the Aux interface. The goal of this interface is to allow companies to interconnect Daniels radios to their other communications systems for interoperability applications.

LMR Networks interconnected with the Digital Ethernet Interfaces (UIC)

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Initial Software release (1.0) of the Universal Interface Card (UIC)

The first commercial release of the UIC provides PCM based audio, encryption over the air and a suite of control signals to the console.

- Receive/transmit baseband PCM audio via UDP protocol over Ethernet.
- Control of A side Rx/Tx.
- Channel changing (control of channel select and bank A/B select lines).
- Squelch override control.
- Encryption control (secure/clear control and indication, clear keys control).
- Reading NACs in the P25 transmissions.
- Battery voltage power monitoring.
- Programmability through the front panel LVDS data port(s) (setting IP address, etc.)
- Ability to interface with Catalyst, Telex/Vega and Twisted Pair. (application products for console/web functions.)
- The ability to connect to multiple consoles at a time.

Software Releases Planned

The goal of the Universal interface Card is to allow companies to interconnect Daniels radios to their systems for interoperability applications. From the first commercial release it is our intention to expand the UIC capabilities to offer access to all 103 internal signals, and increase the number of partners supported. The UIC will be capable of interfacing from either the MT-4 digital or MT-3 analog radio systems. Daniels envisions a half dozen software releases leading to compliance with the still to be defined P25 standard for Fixed Station interface – E_f. The following major releases are proposed to reach that destination.

Release #	Release Date	Functionality
1	August 2005	1st commercial release of UIC supporting encryption over the air from the Base Station and providing PCM based audio as well as a suite of signals to the console.
2	1st Quarter 2006	IMBE vocoding and Encryption support from the console. Basic MT-3 analog radio support.
3	3rd Quarter 2006	Radio Management using the RSS capabilities remotely programmed via the UIC.
4	1st Quarter 2007	Trunked to conventional radio conversion as well as repeater and two transmitter / receivers in a subrack support. Scanning will also be provided.
5	2007	Digital P25 voting using BER and RSSI.
6	2008	TIA E_f standard compliant interface.

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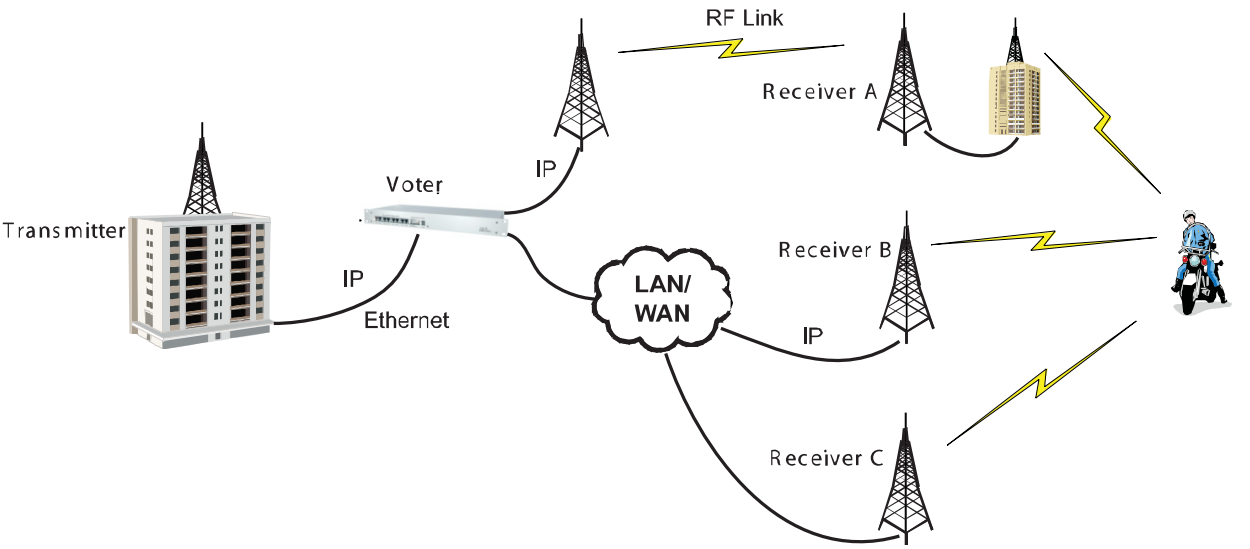
Future P25 Voter based on BER and RSSI

Voting systems are commonly used to extend the operational range of low power subscriber units by providing receivers in small inbound cells to segment the larger area covered by the transmitter. The receivers are strategically distributed across the geographical area covered by the base station / repeater, as show in the diagram below.



Multiple receivers will receive the same signal from the subscriber unit as illustrated above. To select the best signal a voter is required to “vote”. Analog voting systems have used the Signal to Noise (S/N) ratio as the voting means to determine the best signal. In a digital world voting can be done either by priority, by Bit Error Rate (BER) or Received Signal Strength Indication (RSSI).

Daniels is planning to utilize the signals contained with the UIC protocol to provide a means of offering digital voting based on Bit Error Rate (BER) and Received Signal Strength Indication (RSSI).

Future P25 Trunked to Conventional Radio Interfaces

The demand for true interoperability will ultimately require a means of interfacing trunked P25 systems with conventional P25 systems, such as conventional radios in rural areas with trunked radios in urban areas.

Daniels is exploring means to utilize the signals contained with the UIC protocol to provide a P25 trunked to P25 conventional radio conversion based on the signaling contained within the P25 CAI. Such a converter would allow the Daniels P25 conventional radio to communicate with a trunked handheld or repeater and in turn relay the communications to conventional handhelds and repeaters.

Daniels Electronics - UIC Partners

The following companies have been founding partners in the development of the Universal Interface Card. Their software products communicate with Daniels radios via the UIC. Additional details on their products are available on their websites.

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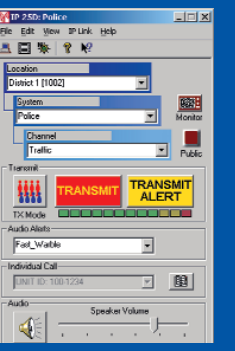
www.catcomtec.com

Catalyst Communications Technologies is a leading provider of Radio over IP Interoperability and Desktop Dispatch solutions to the LMR marketplace. Catalyst IP25D software solution can be combined with our other products that provide advanced control of radios, allowing a graceful migration from legacy radio systems to new digital P25 capabilities.



www.twistpair.com

Twisted Pair Solutions develops IP-based software that enables interoperable group communications. The WAVE for LMR product provides interoperability to any radio or device, on any system, at any time, and includes a powerful software dispatch console. Twisted Pair is a dedicated team, committed to providing our customers and communities with unprecedented day-to-day and emergency communications capabilities.

www.telex.com

Telex and Vega have been making professional radio communications more effective for cities, utilities, and Government agencies across the country for over 25 years. They specialize in IP-based radio dispatch consoles, portable and installed interoperability solutions as well as dispatch accessories.

To learn more about the UIC, our partners or how you can become a development partner contact Daniels at the address below.

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