

Main Feature

PC/104 in the Military

Enabling Ruggedized IP Networking in Net-Centric Operations

The combination of PC/104 hardware with Cisco IOS software and the Mobile IP specification facilitate the creation of net-centric applications for military use, allowing mobile units to maintain consistent logical addresses for easy communications.

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The military trend toward net-centric operations—linking field resources together using Internet Protocol (IP)-based networking—requires that ruggedized IP nodes and servers be available for constructing the network. Further, these units must be portable and capable of utilizing many different communications channels. A commercial-grade solution to mobile networking that uses PC/104 is available that provides rugged IP networking elements for mobile applications.

The U.S. military sees net-centric operations as a compelling mechanism for coordinating diverse resources in field operations. Using IP-based communications, virtually every vehicle, plane and soldier becomes a node in the network and can share data. With this massive data

sharing, field and strategic commanders could obtain real-time situational awareness for tactical planning, deployed units and enemy movement could be tracked across an entire battlefield. It would also allow direct, secure voice-over-IP (VoIP) be-

tween any two members of the network despite differences in the communications platforms they utilize.

Mobile IP Networking Equipment

Networking equipment that can meet the demands of battlefield deployment must satisfy several criteria. It must be

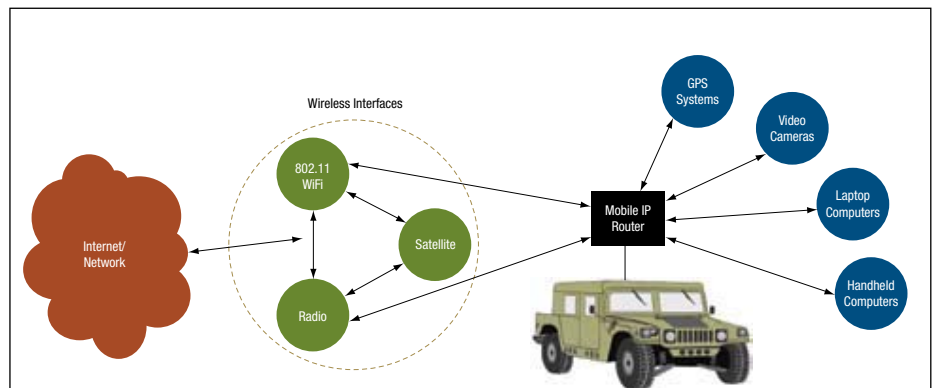


Figure 1

Mobile IP networking allows an entire vehicle network to stay connected by enabling transparent roaming and always-on connectivity across wireless coverage areas.

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rugged, that is, able to handle temperature extremes as well as severe mechanical shock and vibration. It must also be portable, since both space and weight are significant concerns in military equipment. The equipment must be compatible with a wide range of communications platforms, including wireline, spread-spectrum RF, optical and satellite links. Finally, to meet the modern military's budget constraints, the equipment must be based on commercial-grade technology.

As a result, the distinctive advantages of PC/104—compact size, PC compatibility, strong vendor support, stackable design, low-power requirements, environmental durability and simple maintenance—make it an ideal foundation for building Mobile IP networking solutions.

The beginnings of commercial solutions to net-centric applications arose with the introduction in 2002 of the Mobile IP specification (RFC 2002) by the Internet Engineering Task Force (IETF).

Before RFC 2002, when a mobile node moved from one local network into another, the node's IP communications channel with the wide area network terminated. The new network's server then had to establish its own communications channel and assign a new IP address to the node. This not only interrupted the mobile node's communications through the network, it changed the return path address so that other nodes on the wide network could no longer find the mobile node. All such links needed to be re-established each time the mobile node changed local networks.

The Mobile IP specification allows a mobile node to roam across multiple local networks while maintaining continual communications with, and a consistent IP address for, the wide area network (Figure 1). This attribute greatly facilitates communications among nodes by giving each node a unique address that does not change with movement and by preventing the continual breaking of, and need for re-connecting, links between nodes. The mobile node thus can roam seamlessly across networks, effectively behaving as though it were stationary.

The creation of the Mobile IP speci-

cation made it possible for Cisco Systems to develop the Cisco 3200 Series Wireless and Mobile Router. Cisco 3200 Series Routers run Cisco IOS software and enable the networking of multiple wireless devices running any variety of communications links. For instance, the routers can tie together nodes that use cellular telephony, WiFi (802.11 Ethernet) and satellite communications into a single network. Each node is free to roam anywhere these links provide coverage, switching links as needed, without losing its unique IP address.

Cisco originally developed the Series 3200 Router platform using VME hardware, and then redesigned it with PC/104 components to provide a rugged, more compact and lower cost system (Figure 2). These PC/104 components are well suited to the unique requirements of Mobile IP networking, where shock, vibration and other environmental extremes could destroy a system based on open desk-top technology.

Enabling Ruggedized Mobile IP

Another step in enabling ruggedized IP communications came when Parvus packaged Cisco's boards in a rugged enclosure designed for the hostile environment of transportation installations. This ruggedized Mobile IP access router, the

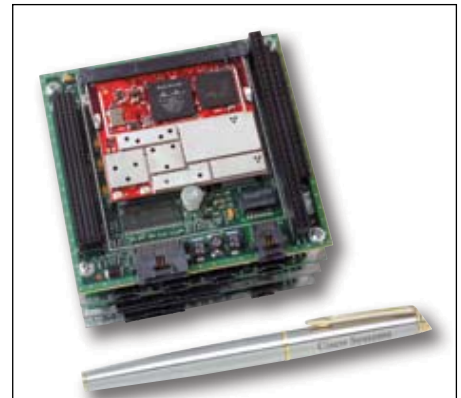


Figure 2

The Cisco 3200 Series Wireless and Mobile Router was the first step in enabling ruggedized Mobile IP, using PC/104 technology to achieve a compact size.

DuraMAR, includes a 150W power supply that accepts a wide range of input DC and provides isolation against voltage spikes and transients (Figure 3). It was created for use in transportation equipment such as buses and trains, but is equally applicable to use in military transport.

Because a router by itself is not enough to provide a network link, this ruggedized Mobile IP access router was designed with



Figure 3

The DuraMAR system from Parvus provides a rugged enclosure and robust power supply for the mobile router, and simplifies the connection of other equipment by supplying Power over Ethernet to peripherals.

Main Feature

a distributed architecture that enables the connection of peripheral devices, or nodes, to provide the radio and other communications links as well as end user nodes. The ruggedized router uses Power over Ethernet (PoE) and Power with Serial (PwS) to supply power to these peripherals, simplifying their installation and use in a variety of configurations. Nodes can be a long-range communications channel to the main network, a LAN controller for creating a local wireless network or peripheral equipment that needs a network connection.

Ruggedized, Mobile IP networking is a proven concept. The DuraMAR series, for instance, has been used in field trials with a major metropolitan transit authority for linking trains into a network. The systems replace a modem connection on the train and provide connections to sensors and monitoring systems in the train. This allows central dispatch to monitor the trains' conditions in real time as they move through the rail network, helping ensure passenger safety and providing early warnings of maintenance requirements.

Industry standard environmental tests have been conducted, including temperature, shock and vibration, as well as shallow immersion. Through the use of conductive cooling and elimination of all moving parts, not only will the ruggedized Mobile IP access router withstand these harsh environments, but its MTBF will be considerably higher than previous solutions.

Ruggedized Mobile IP for Net-Centric Operations

The availability of commercial-grade, ruggedized, Mobile IP networking opens up a wide range of possibilities for military applications. For example, the DuraMAR is being deployed aboard Black Hawk he-

licopters for equipment monitoring and secure communications using IPsec and other encryption modes. Shipboard applications are also being evaluated.

Several other applications are also possible. A vehicle such as a HUMVEE can be outfitted to provide a mobile WiFi hotspot for field communications. This capability gives human-transported field equipment the opportunity to use WiFi as its basic communications link and connect to the network through satellite or other long-range links that may be offered via the vehicle. Field equipment no longer must be burdened with multiple communications choices, or retrofitted as long-range links change.

Aircraft can use VoIP for voice communications with central command, utilizing whatever radio links it currently has available. The need to break communications to switch channels or to switch to another type of equipment is eliminated.

Central facilities can use the network to monitor the status of field equipment in order to provide just-in-time support, such as scheduling refueling for vehicles and aircraft.

Remotely piloted and autonomous surveillance vehicles can broadcast their data to the network, allowing field troops to access real-time intelligence about battlefield conditions, including live video, as they need it.

For all of these applications, PC/104's modular architecture enables the use of application-specific functionality—such as a wireless modem, Ethernet switch, WiFi interface or MIL-STD-1553 interface card—to create a distributed architecture for mobile networking that supports a wide variety of applications.

Because all equipment connects together over the IP network, it does not

have to be directly compatible. A WiFi laptop can thus serve as the communications instrument connecting command to field troops, regardless of the type of radio being used in the field, as long as each can connect to the network via its own method.

Eliminating the need for direct compatibility also allows ruggedized Mobile IP networking to support legacy systems by creating a bridge device. Systems using buses such as CAN, 1553 and LonWorks can then connect through the IP network, reducing the need for cabling and extending the system's useful lifetime. Connection through the Mobile IP network also extends the legacy system's flexibility in terms of its ability to provide data and to be controlled by remote operators and other, previously incompatible, information systems.

By providing IP-based equipment with seamless roaming across networks, the Mobile IP specification sets the stage for net-centric military operations. Using IP as the base protocol, any equipment that can connect to the network can then connect with any other equipment on the network. Ruggedized mobile routers, such as the Mobile IP access router, provide the nucleus for systems that can link that equipment to the network through any of multiple communications channels and maintain that connection while in motion. Both field and base units remain connected in a network that can flex and range across the battlefield, but which structurally remains intact and unchanged. ■■

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