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Real World Connected Systems Magazine. Produced by Intelligent Systems Source

Vol 17 / No 7 / JULY 2016

# The Great Industrial Internet-of-Things (IIoT) Gold Rush



An RTC Group Publication



# Mobile Communications Are Key to Network Edge Design

Mobile networking needs solutions tailored for their operating environments, yet most mobile applications have severe space and power limitations. These can pose design challenges for even the best enclosure suppliers. This article discusses ways to overcome them.

by Steve Gudknecht, Elma Electronic Inc.

As the Internet-of-Things (IoT) continues to expand to all aspects of life, it becomes apparent that many functions normally required at the core of the network are now necessary at the outer edges of the network. When the requirement of mobility at the end points is added, it becomes necessary to use networking solutions that address key areas of network traffic management. This is especially true for mobile users who operate beyond the reach of a fixed network infrastructure, but still need the ability to share information at the local level, and to do so knowing that data security is tantamount.

It is equally necessary to work with solutions partners who provide a strong mechanical foundation to build products for

use in often rugged environments found at the network edge. First responder's communications gear in disaster recovery, mining and transportation equipment are a few examples of applications that need communication capabilities that can survive in severe conditions.

So where does one start in evaluating the building blocks for these mobile networking solutions?

### Two Top Level Keys to Success

The first key is to include underlying networking protocol solutions from a supplier who leads the industry in not only the basic networking capabilities that all IT professionals look for, but who also understands the critical demands of mobile, secure

networking and is a proven leader in the fast-emerging IoT arena. One such supplier is Cisco, with their Embedded Services Routers (ESRs). All ESR products run Cisco IOS software and support Cisco's Mobile Ready Net platform of protocols used for secure and seamless information sharing between mobile users.

The second key to success is in packaging these networking functions in a chassis built to survive the environmental rigors found in demanding applications where edge equipment may be deployed. Extreme environmental factors such as high shock, vibration, temperature and ingress protection are important considerations in computer designs. Size, weight and power are common considerations for mobile products, so working with packaging designers with proven experience is a must. Cisco partners like Elma Electronic design computing platforms for use in mobile environments. This effort requires unique skills beyond simply mounting a board in a box and wiring the connectors. The CISCO ESR board requires a dedicated, custom designed module to bring out the I/O, so integrators must be capable of supporting this in addition to having the ability to package for the end environment. For post-sale support of the system, the integrator must offer a method to handle reported issues. This includes the ability to duplicate a reported issue on Cisco qualified platforms custom-built for troubleshooting and simulation.

### Mobility with Guaranteed Connectivity

Expanding on some of the protocols supported by Cisco's Mobile Ready Net platform, helps better understand and highlight its capabilities: mobile ad hoc networks (MANET), Cisco® Radio Aware Routing (RAR) and Dynamic Link Exchange Protocol (DLEP).

MANET is a key protocol required for mobile devices that need to join self-forming, self-healing clusters, made up of mobile routers and nodes communicating over wireless links. A node is generally anything that moves – ground vehicles,

aircraft, watercraft, even humans on foot. In disaster recovery operations, mining operations and other applications with mobile assets, networks frequently need to be set up on the fly. Such network nodes move randomly and form arbitrary topologies that can change rapidly and often need to operate outside of a fixed network infrastructure. Cisco's twist on MANET includes enhancements to the Open Shortest Path First Protocol version 3 (OSPFv3) standard. Those enhancements improve performance and reduce protocol overhead resulting in faster, more efficient and seamless network changes and link exchanges.

### Radio Aware Routing

To ensure effective integration of router and radio networks, this protocol enables routers and radios to share link-quality metrics and neighbor status. Based on the industry's first router implementation of RFC 4938bis, it defines a cross-layer signaling mechanism between routers and radios. The overarching goal of RAR is to deliver sensitive network traffic to high priority users as quickly and as efficiently as possible without delay or signal breakup. A subset of RAR is another protocol called **Dynamic Link Exchange Protocol** or DLEP. This provides seamless real-time link exchange or changeover where link speed or link quality makes it necessary to switch data paths to use the fastest, most reliable link available. DLEP monitors 5 metrics: maximum and current link speed, link quality, latency and battery power.

### Mobility with Security

Critical communications means there's no shortage of security protocols. IOS provides encryption support including Suite-B-GCM-128, Suite-B-GCM-256, Suite-B-GMAC-128, and Suite-B-GMAC-256. Secure collaborative communications and threat control are included in Cisco's IOS Suite. Managed endpoint identity plus a host of additional security protocols supported by



Figure 1: Expandable package designs and tailored I/O integration enable a wide range of quick turn solutions.

## 4.1 MOBILE COMMUNICATIONS ARE KEY TO NETWORK EDGE DESIGN

Cisco IOS round out one of the best such suites available.

### Toughness and Size

#### *Targeted packaging for the end environment*

Mobile routing equipment needs to operate in environmentally hostile installations - no longer is networking equipment confined to the central office or a server / router farms where +5°C to +40°C is the norm and where shock and vibration mitigation is handled at the rack or room level. Rack-mounted equipment in the central office has comparatively generous amounts space for powerful airflow systems and air conditioning that provide optimized environments. Mobile networking needs solutions tailored for their operating environments yet has severe space limitations and scarce available power along with harsh operating environments. These limitations can pose design challenges for enclosure suppliers, yet a few are up to the task. System designers can satisfy these often conflicting requirements by designing computer platforms that use the latest thermal design / imaging techniques.

The “Big Five” environmental considerations include shock, vibration, thermal, altitude and humidity. Depending on the application, systems may be required to operate over a -40°C to +75°C temp range with operating shock that exceeds 40Gs. IP65 or higher levels for ingress protection against dust and water are commonly required. Not all applications used in the IoT revolution require such packaging. Cisco packaging partners offer custom and off-the-shelf enclosure solutions that span a wide range of designs from lite industrial to ultra-rugged.

### Built to Fit the Space Allowed

Sometimes applications can use an off-the-shelf solution; others need to fill a specific space and therefore need a custom enclosure. Yet others need to add their own applications into the solution – perhaps adding more computing or I/O alongside the router function. Such additions may necessitate future expansion. Packaging designs that conquer size, weight and power constraints that are modular and expandable with multiple mounting options can be cost savers when it comes time to upgrade or reconfigure as an application evolves. Elma Electronic has developed a line of PCI/104 based Cisco routing chassis which address a wide range of environmental demands while offering an expandable design to easily add features needed for specific applications. Figure 1.

Cisco offers its partners hardware and software options for packaging mobile routing. These enable a wide range of packaging designs. Cisco’s 5915 is PCI/104 based and provides three switching and two IP routing ports. Several manufacturers have developed PCI/104 systems around the 5915. Others take advantage of the stackable architecture of PCI/104 and add computing and additional Ethernet ports or storage for more full-featured systems. Cisco and other suppliers offer PCI/104 Ethernet products that can add 26 or more ports to a system. Most PCI/104 SBCs are used for the computing power.

Ultimate flexibility in packaging however is achieved via software implementation of the routing features. Cisco’s 5921



**Figure 1:** Cisco's Linux-based software router opens the door to custom packaging designs suitable for any deployed space.

is intended to run IOS software on Linux-based platforms and is form factor agnostic. The 5921 requires a minimum of three Gigabit Ethernet ports plus at least a dual core CPU to handle the protocol stack. Figure 2 shows a full-featured system incorporating software based Cisco Mobile IP routing in a small box intended for rugged industrial vehicular applications. The system adds Wi-Fi and CANbus features with Core i5 / i7 CPU options. Figure 2.

### Conclusion

Predictions of vast efficiency and reliability improvements in disaster recovery, homeland security, energy exploration, manufacturing, transportation, and health cares are driving demand for connectivity of “things”. Mobile assets make up a large list of things requiring guaranteed network access, especially in challenging situations. To meet these demands, suppliers must work together to create end products that reflect the best of their individual capabilities in order to meet the needs of the various target markets regardless of the end use environment. Successful products in the new IoT and IoE world order will be the result of a combination of the right functionality supported by partners like Elma with tailored packaging designed to bring that functionality to the places where it’s needed most.

### About the author:

*Steve Gudknecht is product marketing manager at Elma Electronic. He has held positions in field application engineering, product management and technical marketing in the embedded computing and semiconductor equipment industries. Steve has an associate's degree in business administration. His responsibilities include product development, product marketing, training and sales support.*

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