Internet of Things

IoT

Control networking for the Industrial Internet of Things (IIoT): Gaining the advantages of IP enablement without starting over

By Echelon Corporation

Within the burgeoning Internet of Things (IoT), the largest segment in the near future will be made up of industrial and commercial applications, spanning things such as building automation, industrial automation, lighting, commercial transportation and fleet management, enterprise asset management, smart cards, test and measurement, and the energy grid.

To date, however, most discussion of the IoT has focused on what can be termed the "Human IoT," or HIoT, in which human users are integral to the interaction. Personal fitness devices and home automation systems are the most frequently cited examples of this HIoT, or consumer IoT.

This article will focus on the Industrial Internet of Things (IIoT), including its distinct requirements (why the same approaches that work for the HIoT can't necessarily be applied to the IIoT), the importance of "IP-all-the-way" to end devices, and how to allow legacy industrial devices to participate in the opportunities presented by the IIoT. We will introduce Echelon's IzoT™ Platform for the IIoT, which represents an important practical step toward bridging today's world of siloed networks and incompatible protocols with the future world of the IIoT.

Why the IIoT isn't the same as the HIoT

IIoT requirements differ from those of the HIoT in a number of important ways, including:

- **Autonomous control.** The HIoT consists of cloud- or server-mediated communications involving human users. In contrast, the IIoT is characterized by Peer-to-Peer (P2P) control and the ability to operate without human intervention – either because the industrial environment is too harsh for people or because actions need to take place too quickly or frequently for people to handle over long durations.
- **Industrial-strength reliability.** Reliability is non-negotiable in many industrial settings. If your networked home thermostat stops working for a while, it's inconvenient. If an automated train switching system fails, it could literally be a life-or-death moment.
- **Brownfield vs. greenfield.** Most HIoT applications involve recently introduced devices. Because industrial automation has been around for so long, there are billions of legacy devices out there, not to mention multiple protocols that have evolved to meet the needs of specific environments and do not intercommunicate. IIoT solutions need to enable existing devices and applications to evolve and to coexist with new ones.
- **Wired as well as wireless connectivity.** The HIoT depends primarily on wireless communications. Industrial environments are frequently not conducive to wireless links. Dust, smoke, extremely hot or cold temperatures, loud noise levels, vibration, and locations below ground or surrounded by thick concrete structures all diminish the reliability of wireless communications, making it a risky proposition for many IIoT applications. For that reason, wired links must coexist with wireless connectivity for the IIoT.

Think of the IIoT as control networking 2.0

Control networking is nothing new. In fact, there are more than a billion networked industrial devices, but they operate on many separate islands of networks. For instance, in the realm of building automation, air conditioning systems cannot communicate with lighting systems, even within the same building, and security systems speak yet another language on another island.

If the IIoT is really the next generation, or version 2.0, of traditional control networking, then what's the difference? It comes down to two fundamental technical issues:

- Increasing use of Internet Protocol (IP) in the fieldbus so that field devices have IP addresses rather than just gateways
- Decreasing use of gateways and a greater use of routers to connect networks

Today, some end points on the fieldbus have IP, but not every device or controller out there is IP-enabled. In a few years IP will be driven into many more individual end points, while at the same time static gateways used to connect distinct control networks with the IT network will give way to native IP connectivity all the way to the end device. In essence, *gateways* will be replaced by *routers*.

These shifts make sense when you look at three main drivers:

1. The analytics enabled by Big Data are how the world will run in the future, however you can't have Big Data without first collecting a whole bunch of "small data." Because it's impossible to know ahead of time what small data will be important for Big Data insights, every possible bit of data sensed or generated will need to be collected. Static gateways aren't good at this widespread data aggregation, but native IP devices are well suited to a Big Data analytics framework. Extending IP-all-the-way to end points means that more devices can contribute small data to inform the Big Data picture.
2. Soon, automation networks will cease to be the sole domain of facilities managers and control administrators. IT organizations are going to become more involved in automation networks, and IP is familiar territory for IT. Most of IT's tools are built on the IP protocol, and IT has established operational frameworks that allow them to manage assets based on IP addresses. This involvement of IT in automation networks will encourage greater use of IP for devices on the fieldbus.
3. Original Equipment Manufacturers (OEMs) will need to support more links and protocols than they do today. For instance, building automation OEMs working exclusively for many years with LonWorks® systems can't compete on BACnet® opportunities, and vice versa. Similarly, OEMs with only wired products are unable to support customers that want wireless extensions. IP can act as an integrating technology that allows multiple protocols to run on the same device on the fieldbus, and that also supports a rich set of communications links, both wired and wireless.

Within an IP-centric application development framework, developers of industrial products now can leverage a single development effort in multiple ways. With relatively simple tweaks, any given device can be repurposed into versions that run on different hardware links and transports.

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As a result, extending IP to the endpoint will change the market dynamics for application developers. In the IIoT, the implications include making it cost-effective to include both wireless and wired (Ethernet, Powerline, RS-485, Free Topology (FT), and the like) support within a single device development effort.

The key is to have an application development environment that can easily facilitate the creation of multiprotocol, multimedia devices. The architecture should be fully backward-compatible with legacy systems, but should also be forward looking and use IP-based communications all-the-way to the end devices to enable the same device to be brought to market with support for multiple protocols and providing a much broader set of connectivity options.

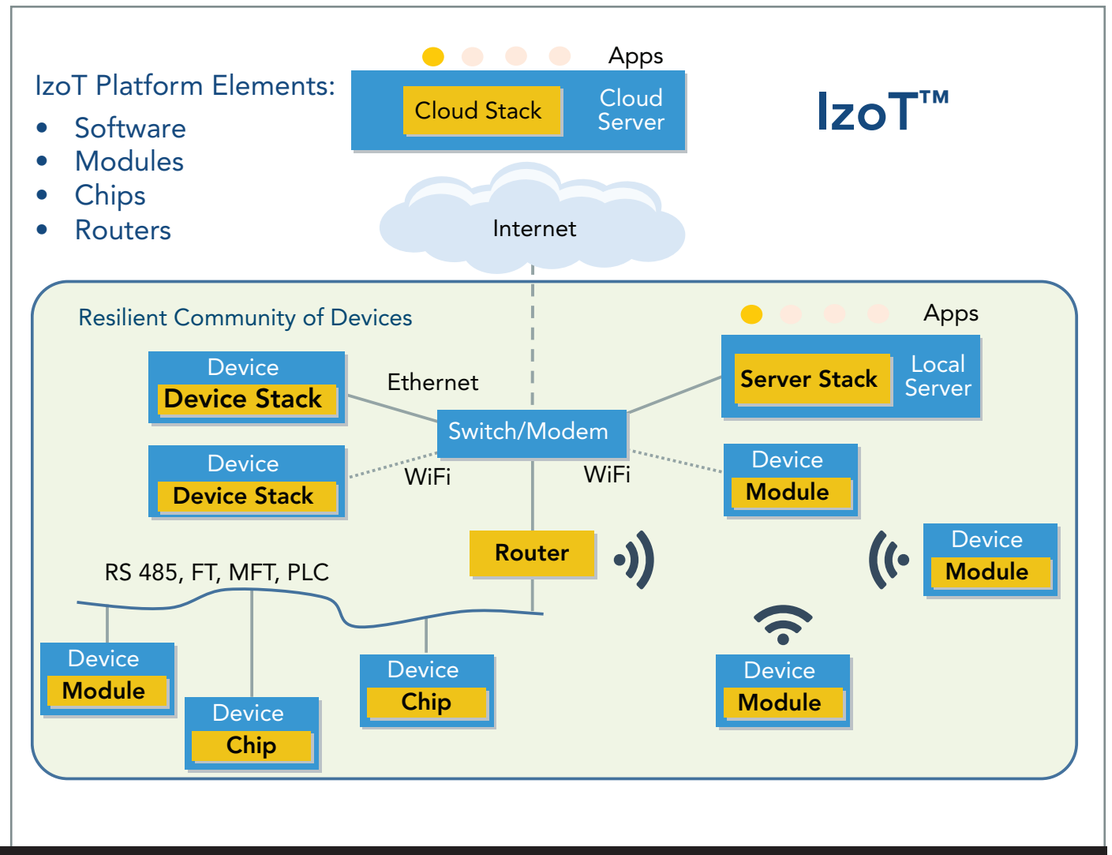
The IzoT platform: Making the IIoT practical, now

The IIoT, or Control Networking 2.0, is a big and inevitable trend, and from an embedded design perspective it represents the single largest economic opportunity in the next 10 years. There might be some debate about when the transition to IP will happen, but the transition is inevitable.

Echelon's IzoT platform for the IIoT allows control networking to be done using IP-all-the-way to the end device, and is delivered in the form of software, chips, modules, routers, configuration, and management tools.

For example, Echelon has already launched the next generation of our popular FT System-on-Chip (SoC). The IzoT-enabled multiprotocol FT 6050 SoC is a single-chip solution for providing reliable, cost-effective, and flexible wired IP connectivity for communities of devices in the IIoT. The FT 6050 has built-in control services along with the IP layer already ported onto it, and uses the FT channel for communications.

The FT 6050 SoC makes possible the scenario outlined in Figure 1, which shows a P2P LonWorks community of devices for building automation that uses a variety of IP-based communications options, such as Ethernet, Wi-Fi, IEEE 802.15.4, FT, and RS-485.



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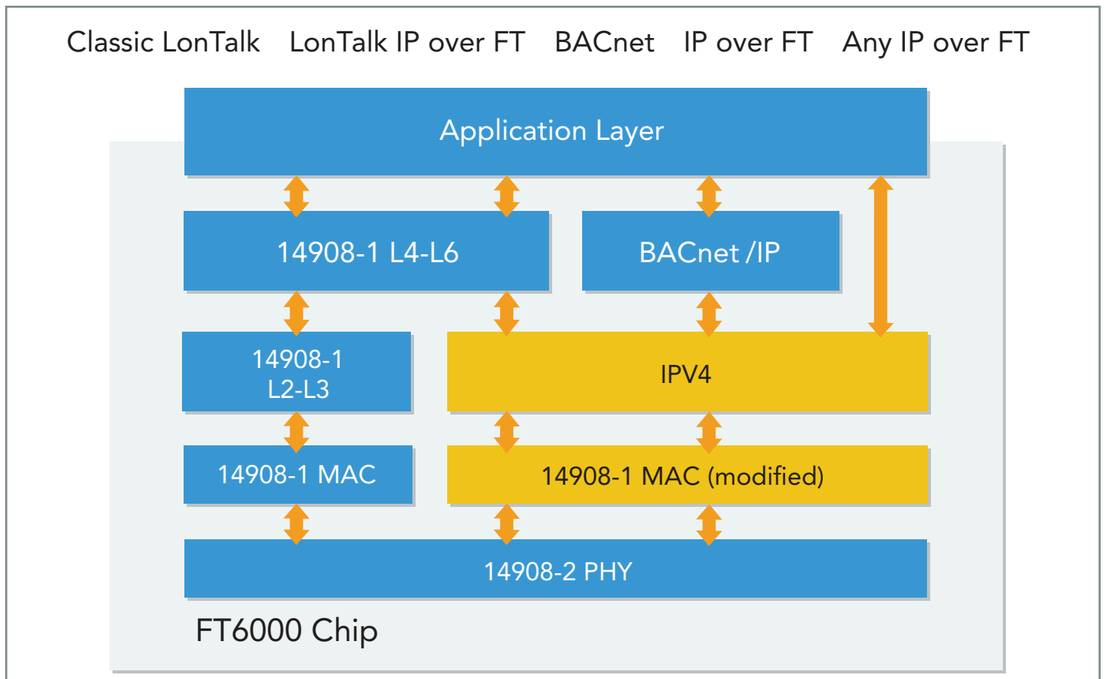
The FT 6050 System-on-Chip (SoC), part of Echelon's IzoT platform, enables the Industrial Internet of Things (IIoT) by providing IP-all-the-way connectivity that supports a variety of wired and wireless protocols.

Sticking with the building automation example, Figure 2 outlines how a device developed using the IP-enabled FT 6050 SoC can act as both a LonWorks and BACnet device within the same application. The application on top of the ISO 14908-1 L4-L6 services can present itself as a traditional LonWorks node (using LonTalk ISO 14908-1 L2-L3 addressing), or as a LonTalk/IP (using IP addressing instead of 14908-1 L2-L3 addressing). Additionally, the same application can present itself as a "BACnet-over-IP" node because of a unique BACnet mapping layer that is built into the FT 6050 SoC. The advantage is that BACnet/IP is available over the FT channel, which is far superior to the less-reliable RS-485 channel, and more flexible at a lower price point than Ethernet for BACnet/IP.



··· Figure 2

Echelon's FT 6050 System-on-Chip (SoC) has the flexibility to operate as both a LonWorks and BACnet device within the same application, providing an element of adaptability even after devices are deployed.

In this way, it is possible for the same application to be delivered as a LonWorks or BACnet node, and over a range of communications options.

IIoT reality, beginning now

The IIoT is not some fanciful mirage. It's a trend that's happening now and growing fast, and it holds tremendous promise for embedded computing and control networking.

By using IP as common ground among the various control networking protocols and building on proven LonWorks concepts, Echelon's IzoT platform promises to drive success for developers of all kinds in the expanding IIoT market.

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