Fine mesh

Mesh 802.11 wireless network connectivity

PETER BILL, MATHIAS KRANICH, NARASIMHA CHARI – As the number of intelligent devices used in industry mushrooms, so does the requirement to connect to them. Traditional, wired connections are often no longer appropriate and wireless is now frequently the only cost-effective, reliable and secure way to extend connectivity over wide areas to a large number of devices. With this in mind, ABB has recently acquired the Silicon-Valley-based company Tropos, the market leader in industrial-grade mesh 802.11 systems. Such systems provide many advantages over competing technologies – eg, narrowband private radio systems and cellular mobile data services – and are becoming more and more essential as power grids and other critical infrastructure become increasingly reliant on automation.

1 Comparison of wireless technologies

	Private narrowband radio	Public carrier cellular	Private 802.11 mesh
Latency	Hundreds to thousands of ms	Hundreds to thousands of ms	10-50 ms
Capacity	0.01-0.1 Mbps	0.1-10 Mbps	1-100 Mbps
Security	Medium	Medium-High	High
Reliability	Medium	Medium	High
QoS	Limited	Limited	Yes
Standards-based interoperability	Proprietary	Yes (eg, GPRS, HSPA, LTE)	Yes (IEEE 802.11 and IP)
Manageability	Limited	Very limited	Enterprise-class
Control	Private network	Owned and operated by mobile operator	Private network

Industrial wireless communication products are becoming indispensible for many applications and their use is growing dramatically. With its purchase of Tropos, ABB has acquired important 802.11 Wi-Fi-based mesh technology that has distinct advantages over competing approaches, such as narrowband private radio and cellular mobile data services. Just how do these technologies compare?

Narrowband private radio systems

Examples of narrowband radio systems include microwave radio links, neighborhood-area advanced metering infrastructure (AMI) meshes and licensed VHF/UHF radio systems. By and large, these use vendor-proprietary radio technology and generally offer lower performance (speeds up to hundreds of Kbps and latencies of hundreds of milliseconds and higher) and limited quality of service (QoS) and security functions.

Title picture
Large-scale and widespread wireless networks are proliferating. How is the ABB Tropos industrial-grade mesh 802.11 system superior to competing technologies in this area?

Cellular mobile data services

These offer a different economic model for endpoint connectivity that is based on recurring subscription costs for data services. Several generations of cellular technology have been deployed, including 2G (eg, GPRS) and 3G (eg, HSPA), and 4G LTE now being implemented. These networks are readily available and offer intermediate levels of performance – throughputs of up to a few Mbps and latencies in the range of hundreds of milliseconds. In general, these public networks do not provide the same level of availability, QoS, security and manageability for mission-critical applications that a privately-owned network can provide. Hence, industrial enterprises have always had concerns about their suitability.

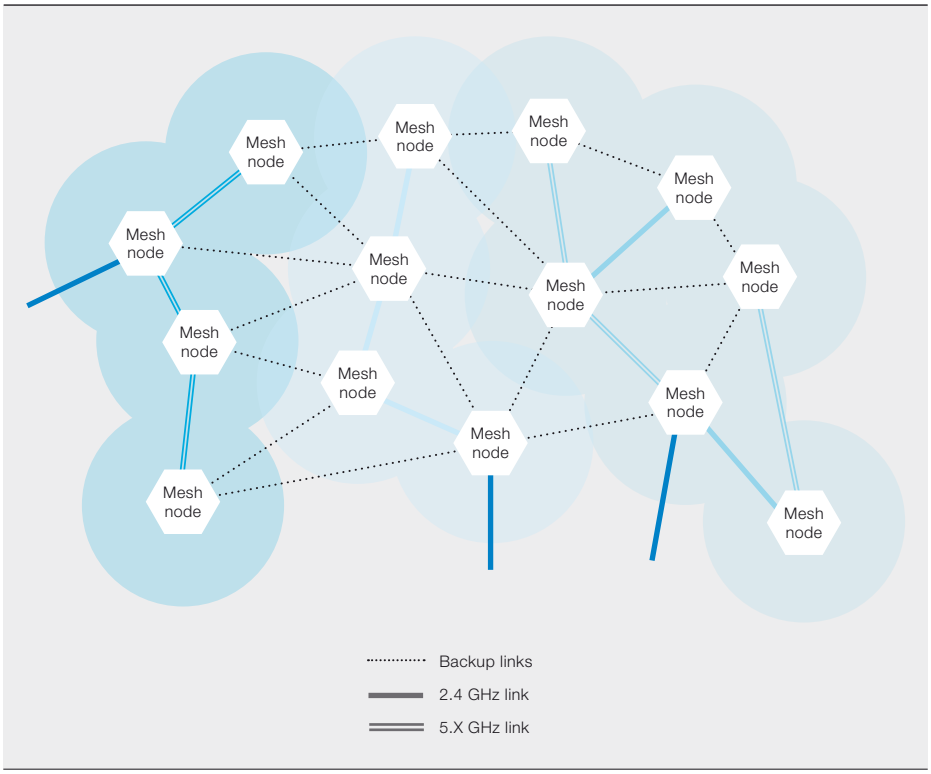
802.11 Wi-Fi-based mesh systems

Wi-Fi-based mesh systems are founded on open standards (IEEE 802.11 and IP) and support standards-based QoS and security mechanisms. Tropos offers the most advanced and market-leading industrial products in this category. They are differentiated from consumer-grade Wi-Fi systems by being hardened for harsh industrial and outdoor environments and by having patented software algorithms that enable a highly resilient and self-organizing mesh network architecture. Mesh routers are typically deployed outdoors on utility poles, streetlights or substations, as well as indoors in buildings and plants. These systems usually operate in an unlicensed spectrum (2.4 GHz and 5 GHz) though they can also be adapted to licensed frequency bands (such as 4.9 GHz). They offer significantly higher levels of performance

They are differentiated from consumer-grade Wi-Fi systems by being hardened for harsh industrial and outdoor environments and by having patented software algorithms.

The mesh structure is robust concerning broken links as there is often more than one path between a source and a destination in the network.

2 Tropos mesh network architecture



(multi-Mbps link speeds and latencies down to a few milliseconds per hop) than the other solutions, enabling implementation of multiservice networks including mission-critical applications ➔ 1.

Industrial applications for meshed Wi-Fi systems

In a mesh network, each node receives and sends its own data – but is also a relay station for other nodes, ie, it collaborates with the rest of the network to ensure data is transmitted successfully. The mesh structure is robust concerning broken links as there is often more than one path between a source and a destination in the network, allowing data to be quickly rerouted around a broken link.

The Tropos product line enables highly reliable industrial-grade mesh 802.11 systems that simultaneously support various applications over one unified network, eg, distribution automation (DA), mobile workforce automation and AMI ➔ 2. This optimizes capital expenditure as well as operational expenditure.

A further product is the Tropos Control software, which provides enterprise-class wireless network management, enabling easy and efficient management of even large-scale networks. Tropos systems have been successfully deployed by many industrial customers including electric utilities, municipal government agencies, public safety departments, transportation systems, oil and gas operators, mining companies, port authorities, etc. Detailed real-world case studies will be described in an upcoming edition of *ABB Review*.

Peter Bill
Mathias Kranich
ABB Power Systems
Baden, Switzerland
peter.bill@ch.abb.com
mathias.kranich@ch.abb.com

Narasimha Chari
ABB Tropos
Sunnyvale, CA, United States
chari@tropos.com