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.
Industrial wireless communication products are becoming indispensable 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.

### 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.

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### 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.

### 1 Comparison of wireless technologies

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

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**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?
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.

(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.

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