As with all smart grid applications, two-way communication is foundational to substation automation. To enable monitoring and control, substation computers, and computers in utility operations centers, must exchange information with intelligent electronic devices (IEDs) throughout the substation yard.

For new substations, both wired and wireless communications are options because the incremental cost of trenching to run cabling from the control house to IEDs in the yard is minimal. Construction equipment is already onsite and the grounding and surface of the yard has not yet been finalized.

However, adding new IEDs to existing substations is a different story. The cost of wired solutions is often prohibitive, due largely to the expense of trenching. Wireless communication, which requires no trenching, is almost always the more cost-effective way to install a network during a substation retrofit.

Substation automation: a key piece of grid modernization
Substation automation applications are a key element in a utility’s smart grid portfolio. Intelligent electronic devices (IEDs) – including breaker controllers, voltage regulators and remote terminal units (RTUs) – deployed throughout the substation yard can both gather data and take action to, for example, distribute power more efficiently or protect the power delivery infrastructure. Analyzing data and issuing commands is the responsibility of substation computers and/or computers (and their operators) located in the utility’s operations center. For the system to work, two-way communication between IEDs and substation computers as well

Benefits
- Improve reliability and efficiency of power delivery
- Lower operating costs by reducing truck rolls
- Improve response times and visibility through remote troubleshooting
- Leverage communication network for applications beyond automation, e.g., site security

Tropos Technology Differentiators
- Broadband networks provide a high bandwidth, low latency communication foundation for substation automation
- Wireless networks eliminate trenching costs associated with wired communications
- Wireless networks shorten deployment timelines and make them more predictable
- Tropos broadband wireless mesh networks provide high reliability, enterprise-class security and multi-use capability
- Tropos mesh routers are IEEE 1613 approved, support DNP3, Modbus and IEC 61850, and are NERC CIP 002-009 compliant

For new substations, both wired and wireless communications are options because the incremental cost of trenching to run cabling from the control house to IEDs in the yard is minimal. Construction equipment is already onsite and the grounding and surface of the yard has not yet been finalized.

However, adding new IEDs to existing substations is a different story. The cost of wired solutions is often prohibitive, due largely to the expense of trenching. Wireless communication, which requires no trenching, is almost always the more cost-effective way to install a network during a substation retrofit.

Substation automation: a key piece of grid modernization
Substation automation applications are a key element in a utility’s smart grid portfolio. Intelligent electronic devices (IEDs) – including breaker controllers, voltage regulators and remote terminal units (RTUs) – deployed throughout the substation yard can both gather data and take action to, for example, distribute power more efficiently or protect the power delivery infrastructure. Analyzing data and issuing commands is the responsibility of substation computers and/or computers (and their operators) located in the utility’s operations center. For the system to work, two-way communication between IEDs and substation computers as well
as data center computers is required. By automatically configuring substation systems for safe, efficient electricity delivery, substation automation saves money while improving grid reliability. And, since action can be taken remotely, truck rolls are reduced, further saving money while enhancing employee safety because field workers are dispatched to remote locations on fewer occasions.

**Wireless communication for substation automation**

For new substations, both wired and wireless communications are options. During construction, trenching equipment is already onsite and the surface of the yard has not yet been installed. Therefore, the incremental cost of trenching to run cabling from the control house to IEDs in the yard is minimal, removing the biggest obstacle to employing a wired network. While wireless still has advantages, e.g., enabling network access for laptops and handhelds used by field workers at the substation, wireless does not have a huge economic edge over wired options.

However, adding modernizing existing substations is a different story. The cost of wired solutions is often prohibitive, due largely to the expense of trenching. Wireless communication, which requires no trenching, is almost always the more cost-effective way to install a network during a substation retrofit and usually by a wide margin.

ABB civil engineers have estimated that trenching costs to retrofit an existing substation yard with wired communications are typically in the range of $40,000 to $45,000, with costs of $100,000 to $150,000 possible for larger or more challenging installations. The civil engineers may have been too conservative. One utility recently reported that it spent in excess of $250,000 digging trenches to wire three IEDs in an existing substation.

In addition, using wireless shortens deployment timelines and makes them more predictable. It is faster to deploy wireless than it is to engage a contractor to dig, lay conduit, run cables, etc. Removing trenching from the equation eliminates a dependency that could delay the project if, for example, the contractor’s previous job runs longer than expected.

Moreover, when a utility’s service territory crosses political or jurisdictional boundaries, different laws, regulations, contractors, union rules, etc., may be applicable to trenching. With wireless, none of this comes into play. Utilities will have fewer operational surprises, lower costs and automation projects will be deployed more smoothly.

Wireless also makes the substation future ready. Trenching and pulling cable provides wiring only to poles and assets in place or planned today. What if, in the future, additional poles, IEDs, etc., are required? Time to dig down to the conduit and go to work.

Tropos wireless mesh networks provide the high throughputs, low latency and reliability required to support virtually any substation automation application that can be supported by a wired network. (An important exception is protection applications that require ultra-low latency (<1 ms) and that cannot be supported by any form of packetized data network, whether wired or wireless.) Tropos mesh routers provide Ethernet and serial connections to attached IEDs without native wireless interfaces, support popular utility automation protocols including DNP3 and IEC 61850, conform to utility security requirements (NERC CIP 002-009), and are specially hardened for substation operation (IEEE 1613).

Enabling additional application using substation automation networks

Another advantage of Tropos wireless broadband mesh networks is that they can enable substation applications beyond automation. For example, substation security can be enhanced by leveraging the wireless network to support video surveillance cameras and intrusion sensors. Unscheduled maintenance can be reduced by using the wireless network to monitor smart transformers or gas sensors mounted near conventional transformers.

The productivity of mobile workers at substations is increased because they can use their laptops and handhelds to remotely access all of the information that would be available to them at the operations center, to file reports from the field and to access work orders in the field. In areas lacking cell phone coverage, worker safety is also enhanced by providing a voice over IP (VoIP) lifeline using a laptop or handheld.

In addition to performance, key features of Tropos wireless broadband mesh networks that make them well-suited to support multiple applications include virtual LANs (VLANs) and quality of service (QoS). Each application can be supported on a separate VLAN that is configured with appropriate QoS settings. Using these capabilities, a utility can ensure that latency-sensitive applications get network access priority over other applications with less stringent latency requirements.

**Substation automation building blocks**

The basic building blocks for substation automation include IEDs – breaker controllers, voltage regulators, RTUs, digital fault recorders (DFRs), programmable logic controllers (PLCs), load tap changers, recloser controllers, and the like – substation computers, data center computers, their associated software and a communication network. Additional substation applications can be enabled using smart transformers and/or transformer gas sensors, video cameras and digital video recorders, and intrusion sensors, as well as by equipping field workers with laptops, tablets or handhelds.

For the wireless communication network, key elements include Tropos mesh routers and the Tropos Control wireless network management system.

For more information regarding Tropos wireless mesh networks, visit abb.tropos.com. For more information about ABB’s substation automation offering, visit www.abb.com/substationautomation.

For more information please contact:

**ABB Inc.**

**Tropos Wireless Communication Systems**

555 Del Rey Avenue
Sunnyvale, CA 94085
Phone: +1 408.331.6800
E-Mail: tropos.sales@nam.abb.com

abb.tropos.com