



Reference

Industrial Communication

A WiMAX network from Siemens masters the harsh conditions of the Baltic Sea

Siemens WiMAX solution delivers 4G broadband wireless network for transmission system SCADA along with improved reliability and capacity for future functionalities to island archipelago in the Baltic Sea

The Åland archipelago comprises 6500 named islands scattered across the northern Baltic Sea between Finland and Sweden. In summer, the archipelago's sunny beaches attract vacationers on holiday, though severe thunderstorms are frequent. In winter, the environment is forbidding, with temperatures dipping to -25 degrees Celsius (-13 degrees Fahrenheit) and winds whipping salty sea spray at nearly 25 meters per second (more than 50 miles per hour).

The archipelago's isolation, hilly, wooded topography and sometimes extreme weather creates a challenge for Kraftnät Åland, the transmission utility that serves several local power distribution companies.

Kraftnät Åland chose RUGGEDCOM product line from Siemens – designed for use in harsh environments – to help them solve their unique challenges.

Kraftnät Åland's SCADA system depended on legacy technology that combined a fiber network on the main island with wireless GPRS modems for more remote substations that depended on a local telecom operator. Power failures inevitably led to a loss of visibility into the transmission system and the utility needed to improve the reliability of its SCADA network for monitoring and control of the transmission system, while significantly reducing its reliance on local telecom networks. The utility found that its legacy equipment would be difficult, if not impossible, to upgrade to achieve a high degree of reliability. "We wanted control of the whole communications network, from our

SCADA system in our control center all the way out to the substations," explained Jan Mörn, IT manager for Kraftnät Åland. "We have to have reliable, wireless communication with substations on the islands as it is physically difficult to get there. At certain times of the year, we need to reach some sites by helicopter, which means that a reliable communication network is very important to us. On the main island, we cannot restore the grid without good communications to the substations – so as you can see, communications reliability is of paramount importance to us."

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The challenge

Kraftnät Åland sought a reliable, resilient and cost-effective communication solution to provide robust, secure SCADA monitoring and control between its central and/or remote office(s) and its substations on a remote island archipelago.

Discussions with the utility's SCADA vendor, Netcontrol OY, revealed that a utility-owned WiMAX communications solution could provide the desired SCADA reliability and resilience, while providing the capacity for future upgrades. The transmission utility's SCADA system is integrated with the SCADA system for local distribution system operators, who were looking to automate aspects of their system.

Meanwhile, the Finnish frequency office was making the 1.35 Gigahertz (GHz) spectrum available for utility communications in Finland. Further, because radio signal propagation improves at lower frequencies, this frequency would be ideally suited to the hilly, wooded terrain of the Åland archipelago.

Kraftnät Åland also needed a solution with reliable back-up power, as power failures had revealed that the utility's internet service provider (ISP) had weak battery back-up for its communication stations. These weak communication links were invisible to the utility, which hampered its ability to prioritize power restoration efforts.

"We have fish farms across the archipelago," Mörn said, indicating the need for grid reliability. "Further, we have highly engineered, high-grade medical plastic manufacturing with a worldwide market. These industries are important to the local economy."

With this as background information, it was quite clear that Kraftnät Åland needed to invest in a robust, secure, scalable, cost-effective and future-oriented solution to address its unique needs in the archipelago.

"It would be unrealistic to try to run fiber from island to island," Mörn said. "So wireless is the cost-effective solution." But, according to Mörn, creating a 3G wireless network that depended on a telecom operator would be too expensive and not necessarily more reliable. "Also, we were thinking of running the IEC 61850 protocol in our substations and we needed a solution that could support it," Mörn added. "Netcontrol OY, our SCADA supplier, recommended a Siemens solution as Siemens RUGGEDCOM could run on 1.35 GHz, handle the IEC 61850 protocol and be cost effective."

The solution

Kraftnät Åland, supported by Siemens and Netcontrol OY, designed a reliable, cost-effective communication solution that provides SCADA monitoring and control over a utility-owned WiMAX network for an improved level of reliability and resilience.

Prior to the Finnish government's official approval for the utility's use of 1.35 GHz spectrum, Siemens made RUGGEDCOM WIN base stations and subscriber units running at 3.5 GHz available to Mörn and his colleagues to test proof-of-concept on Fasta Åland.

"We had Siemens support for our testing, but the RUGGEDCOM units are quite straightforward and easy to work with and they functioned very well," Mörn said. "So we decided to go with Siemens."

Mörn and his colleagues discovered that three RUGGEDCOM WIN7014 base stations strategically placed on towers on high ground around the main island provided full coverage, with redundancy for substations located on low ground.

When designing the complete SCADA data network, from the remote terminal units (RTUs) in substations up to Kraftnät Åland's and its distribution partners' control centers, the utilities had to work closely with companies with the appropriate experience.

"Both the transmission and distribution companies use Netcontrol brand substations, so getting data securely from the RTU to the control center required our assistance when it came to designing the network," explained Kim Malmberg, CTO and technology manager at Netcontrol OY. "It was not a simple network to configure, and many features on the network needed support from Siemens as well."

RUGGEDCOM WIN7014 high power base stations provide the foundation for a robust and secure, utility owned 4G WiMAX network for SCADA that serves both transmission and distribution utilities. The Åland archipelago's environment demanded the most robust solution. All WIN7000 family base stations are certified to operate from -40 degrees to +65 degrees Celsius (-40 degrees to +150 degrees Fahrenheit).

"As you can imagine, it's not a good environment for electronic equipment," Mörn said. "The robustness of the RUGGEDCOM equipment is notable. These units have managed to stay in service, despite the thunderstorms that we regularly experience."

Of critical importance to Kraftnät Åland's specific needs, RUGGEDCOM WIN7000 base stations are available to operate in other frequency bands using the same management system.

"This [compatibility with 1.35 GHz] made our investment future proof," Mörn said. The WIN 7000's Quality-of-Service (QoS) options also met the utility's needs. "We can prioritize SCADA data over other streams because SCADA always has the highest network priority," Mörn added.

RUGGEDCOM WIN5200 outdoor subscriber units provide robust transmitter/receivers that perform in non-line-of-sight (NLOS) conditions, and can be deployed incrementally to scale a solution. The WIN5200s, just like the WIN7000 base stations, are reliable in the Åland archipelago's sometimes harsh environment.

Where necessary to improve network performance, Kraftnät Åland has positioned its several dozen WIN5200s outdoors on poles or short towers. According to Mörn, the utility has experienced no communication outages since installing the Siemens solution. The scalability of the solution, partly achieved by adding additional WIN5200 subscriber units, is important to the utility. "We started work on a small scale and we did the work ourselves," Mörn explained. "But we can already see that in the future we can expand it across our service territory."

In one instance, Mörn and his colleagues placed a WIN5200 subscriber unit on top of a local wind turbine, where a WIN7000 base station was also located without a fiber connection.

"That didn't work," Mörn recalled. "We requested a solution from Siemens to securely access and manage the base station from the subscriber unit side. Siemens responded with a 'Management CPE' solution. This function allows us to run up from our fiber system to the first base station on Fasta Åland for SCADA commands, and then establish a connection to the base station by going through the subscriber unit. Once we installed this new functionality, the system worked very well."

RUGGEDCOM i802 compact Ethernet switches serve as interfaces between the WIN5200 subscriber units and a substation's internal RTUs and IEDs, and the RUGGEDCOM RP100 provides Power-over-Ethernet (PoE) to the subscriber units. According to Netcontrol OY's Malmberg, the i802's multiple ports allow the utility to plug in original, copper-based, serial RTUs while adding newer, fiber-based IEDs. This approach allowed them to maintain the usefulness of legacy equipment, while upgrading their system at the same time. The i802's high immunity to electromagnetic interference (EMI) and heavy electrical surges make them reliable in the harsh environment of a transmission substation.

RUGGEDCOM RX1500 routers direct myriad data streams each to their own discreet channels to maintain secure, authorized-only access. The RX1500's integrated virtual private network (VPN) and virtual local area network (VLAN) functions enable Kraftnät Åland to segregate its data traffic from, for instance, the distribution system operators' traffic, which shares the WiMAX network. "Because the traffic is Internet Protocol (IP)-based, this is like a 'closed Internet,'" Malmberg explained.

The RX1500's features also enable the utility to use them to monitor and control substations on remote islands in the archipelago by routing SCADA data over a backup GSM-based cellular network, according to Mörn. "Being able to monitor remote substations in this way helps us to prioritize maintenance visits that require using a boat or helicopter – a costly and time-consuming affair."

The results

The Siemens solution has provided the transmission system operator with a more reliable, secure SCADA network for monitoring and controlling its far-flung substations, while providing the means to scale and add future functionalities.

"Today we have improved connections with our most distant substations, which once had only a wireless modem connection," Mörn said. "Since we installed the system last summer we haven't experienced any communication network failures. However, in the year before we implemented RUGGEDCOM, we had several communication failures. We can see that the system has become more stable." The Siemens WiMAX broadband solution provides greater data traffic capacity than is currently needed, which means headroom for expanding the use of the new communication network. That means the ability to add future functionalities, such as adding connectivity to substations on other islands in the archipelago and enabling distribution automation for local distribution system operators.

"We installed and configured this system by ourselves," Mörn explained. "We're very familiar with the system and have high confidence in it. However, having said that, Siemens has provided us with a lot of valuable support in getting our system operational, and that gives us a good feeling."



Åland Islands rugged terrain



RUGGEDCOM WIN installation

Case study at-a-glance

Customer: Kraftnät Åland is a transmission system operator responsible for providing reliable power in a remote island archipelago in the northern part of the Baltic Sea under Finnish jurisdiction.

Challenge: the utility was looking for a more reliable, resilient, cost-effective communication solution for secure SCADA monitoring and control between its central and/or remote office(s) and its substations on a remote island archipelago.

Solution: Kraftnät Åland, aided by Siemens and Netcontrol OY, designed a reliable, cost-effective communication solution that provides SCADA monitoring and control over a utility-owned WiMAX network for improved reliability and resilience.

Results: The Siemens solution has provided the transmission system operator with a more reliable, secure SCADA network for monitoring and control of its far-flung substations, while enabling future scale-up and upgrades.

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