

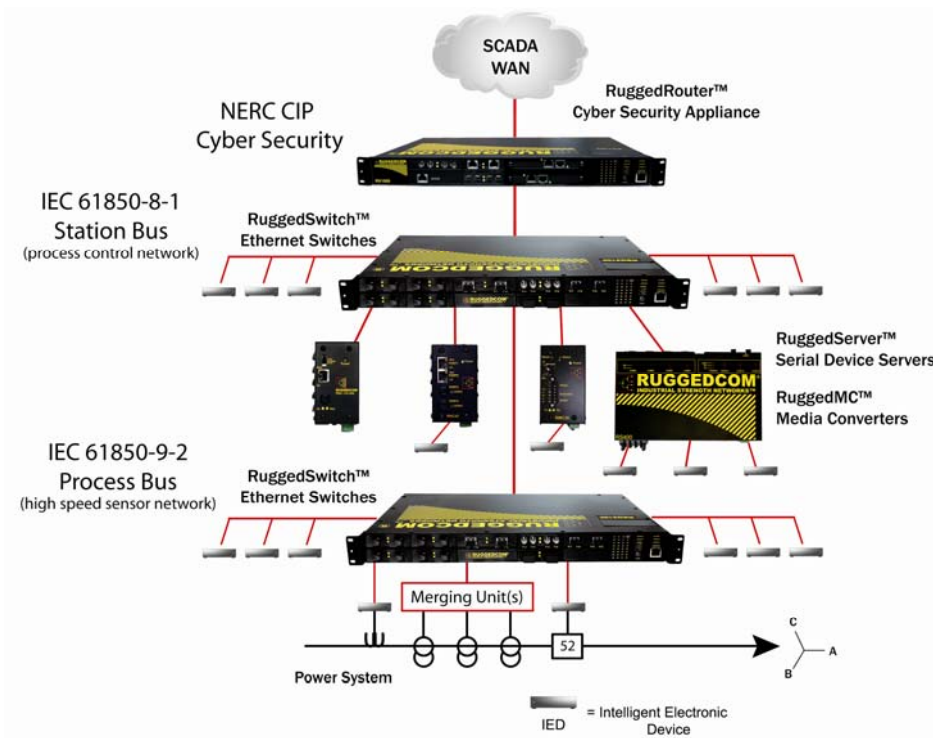
ARC BRIEF

By ARC Advisory Group

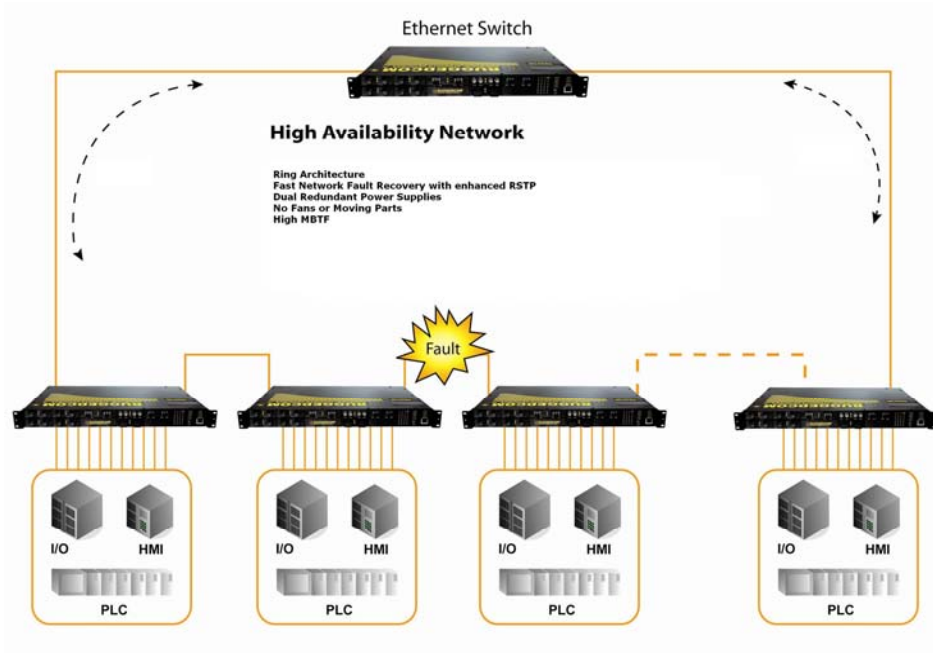
JANUARY 2007

RuggedCom: Growing from Electric Power to the Plant Floor





Ethernet Network for an IEC 61850 Electric Power Substation



High-Availability Industrial Ethernet Network Configuration

Executive Overview

The overall market for industrial Ethernet in automation is growing rapidly. Most Ethernet infrastructure suppliers in the industrial space have attempted to cover the largest possible portion of the market. By contrast, Canadian supplier RuggedCom has developed a strong following in a single vertical industry – Electric Power Transmission and Distribution. The

Most companies supplying industrial Ethernet infrastructure pursue many vertical industries. By contrast, Canadian supplier RuggedCom has grown by focusing on the electric power industry, but now finds that other industrial markets are becoming open to using its solutions.

company, which now has a major share of the power market, is now beginning to be felt in other vertical industries who find that some of the attributes of power industry equipment serve them well also.

Power transmission can involve harsh operating conditions, most especially including very strong electromagnetic fields created when the grid's giant circuit breakers operate. The power industry has collaborated globally to develop standards to automate

substation equipment using Ethernet, and RuggedCom has been in the thick of this multi-year effort. Besides successfully operating critical automation and protective functions, the Ethernet networks deployed in power need to be highly secure from cyber-intruders, since the world's power grids are a high-value target for hackers, including terrorists.

This report profiles RuggedCom, the reasons for their reputation within the electric power industry, and several of RuggedCom's recent customers in electric power and in process manufacturing.

Industrial Ethernet Today

Ethernet is the ascendant network in automation today. ARC Advisory Group forecasts that industrial Ethernet device shipments will grow by almost 50% per year through 2009. More and more industrial applications are migrating from proprietary or specialized networks to Ethernet. This share growth, combined with the very healthy business overall climate for automation, give industrial Ethernet devices and systems strong momentum in today's marketplace.

The rapid growth of industrial Ethernet has brought many suppliers into the market for industrial Ethernet infrastructure. Most of these suppliers have sought to broaden their target market as much as possible to include factory automation, process automation, transportation systems, and even building automation and security applications. All of these applications have some overlap in terms of their need for rugged and reliable networks and their growing use of Ethernet. The normal supplier behavior today is to market their product portfolio across as many of these vertical markets as can be managed.

A notable exception to this pattern is RuggedCom. Based in Woodbridge, Ontario, Canada, RuggedCom has become an established global leader in industrial Ethernet and communications technologies. But only recently has RuggedCom begun to serve multiple markets with its industrial Ethernet products. The company's historical strength has been in a single vertical – the electric power industry. Within the power industry RuggedCom equipment is most often used with the systems that transport and distribute electric power over large areas. This is called the “T&D” segment, for “transmission and distribution”. RuggedCom is now building on the product portfolio that brought it success in electric power T&D to expand into other markets with similar customer needs.

Succeeding in Power T&D

Electric power T&D is not the normal place to market state-of-the-art products. Utility company operations are notoriously risk-averse, and for very good reasons. Equipment put into service must work reliably for many years, so the industry is not one to jump at the latest technology. Instead, they generally opt for “proven technology” that has shown its reliability over a long period in similar service. Because of the long life of their systems, they look carefully into the reliability of every component they deploy. Network infrastructure, which is critical for both normal and emergency operation, is an especially important factor in the overall system reliability equation. Utilities often require daunting service and support requirements as well.

But some things have also changed in the electric utility industry. Customers and regulators are demanding more reliable service with lower overhead costs. During the past 5 years, a number of major blackouts in

North America and Europe have shown the importance of reliable power supply, and highlighted the hidden costs of operating power grids with outdated equipment. The result is that many power utility companies are investing in new network infrastructure that enables them to monitor and service grid equipment in real-time from remote locations. In addition, the electromechanical relays and breakers within substations are rapidly being upgraded to become Intelligent Electrical Devices (IEDs) that support remote diagnosis, configuration, and monitoring.

The need for higher reliability in the electric power industry is now driving utilities to replace many legacy T&D networks with industrial Ethernet.

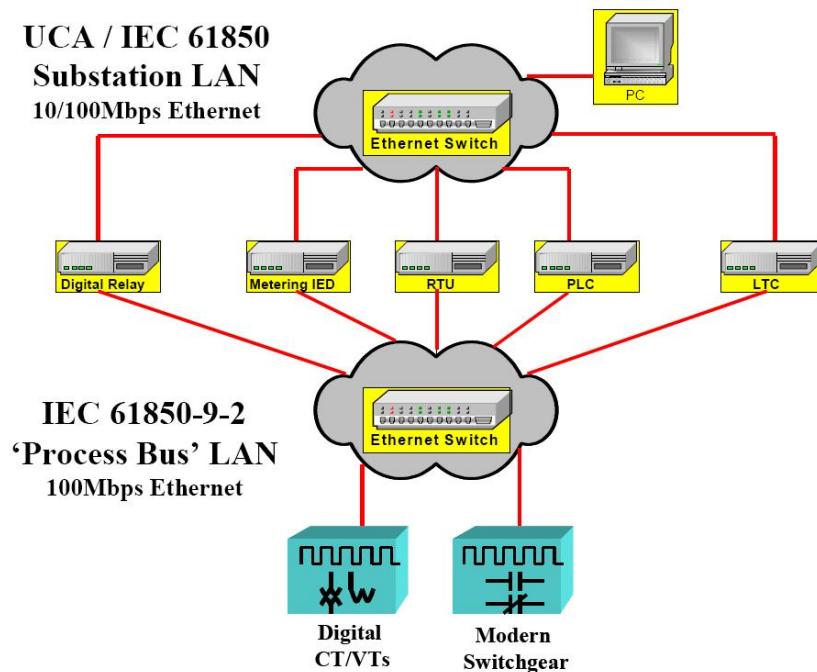
Furthermore, collaboration among utility companies and suppliers is resulting in new equipment, processes, and standards for the industry that are truly global. The most important global standard is IEC 61850. This is an international standard for automation of substation equipment. The model-driven approach of IEC 61850 requires new design and automation practices that yield major improvements in cost and performance. The equipment models defined in IEC61850 can be implemented using a number of protocols. These protocols can run over TCP/IP networks and/or substation LANs built of high speed switched Ethernet to achieve the 4 millisecond response times needed by protective relaying. In effect, IEC61850 brings industrial Ethernet to utility automation in the same way that high-level automation frameworks (such as Profinet and EtherNet/IP) have brought Ethernet into the factory automation mainstream.

Equipment Challenges of Power T&D

Ethernet equipment in Power T&D must work under quite challenging conditions. Though installed indoors in power substations, the environment is usually unheated and has no air conditioning, requiring a broad operating temperature range. Reliability requirements dictate that passive cooling rather than fans are used. Reliability also dictates that network redundancy must be provided and redundancy mechanisms must operate in milliseconds not seconds (similar to factory automation). Redundant equipment power is expected, with DC power preferred for the backup source, since substations usually include battery systems that provide backup power.

The most challenging aspect of substation automation applications, however, is the need for immunity to electromagnetic interference (EMI). When high voltage circuit breakers open or close they generate extremely strong electromagnetic fields in their vicinity. High voltages and very large currents are involved in these events. Not by coincidence, it is exactly at these moments when EMI is the strongest that the Ethernet network is most critical and must operate flawlessly to insure the protective relaying function.

The growing threat of global terrorism has also changed the electric utility industry. One major change is that the T&D networks need to be secure from disturbance by cyber-intruders. Utilities had only recently adopted public standards such as TCP/IP protocols for these networks. However as T&D networks became attached to corporate networks and the Internet, they became exposed to all varieties of intruders. A successful and simultaneous attack on just a few critical T&D components could cause a large cascading blackout event. The North American blackout of August 2003, while not caused by cyber-terrorists, showed how an extensive and prolonged blackout could result from just a few equipment failures that occurred simultaneously. This means that utility T&D networks must be secured or they can not be relied on.



IEC 61850 Includes Switchgear and Protective Equipment Controlled as Industrial Ethernet Devices

RuggedCom was always intimately familiar with the harsh conditions of substations because the company's founders had a background in designing IEDs for power substations. Thus RuggedCom's design approach for its network components was the same as for the IEDs that manage the grid. Rather than trying to add sufficient shielding to a commercial Ethernet switch for the huge EMI of the substation, RuggedCom used the substation EMI conditions as the design basis for its product lines. This resulted in some unique designs that made extensive use of fiber optics and electronic assemblies that were able to function in high EMI environments. Fully redundant power supplies supporting AC and DC were standard. The switches supported the STP and RSTP protocols for communication redundancy, but extended these standard protocols compatibly to achieve the higher performance that was needed for protective relaying. Likewise, IEEE 802.1x mechanisms were embedded to support inclusion of this equipment in enterprise-level network security services.

As word of this equipment got around the electric utility industry, RuggedCom acquired more and more of the substation Ethernet business. Many suppliers of IEDs have quietly recommended RuggedCom to their customers. Today RuggedCom remains the leader and very well known in this vertical, yet some other vertical industries have not even heard of the company. As its reputation spreads, industrial companies have picked up RuggedCom for use in their power utility plants, and now some are using RuggedCom equipment as an Ethernet backbone for their plant networks as well.

RuggedCom Networks in Manufacturing

Here are examples of each type of RuggedCom customer: a power utility, a manufacturer using RuggedCom in its own power operations, and one using RuggedCom for its plant floor networks.

Ethernet Substations for Tennessee Valley Authority – The giant Tennessee Valley Authority (TVA), a federal corporation, is the largest public power agency and one of the largest utility organizations in the United States. Formed during the Great Depression in the 1930s, TVA has developed a program for continuously upgrading its T&D infrastructure and managing the adoption of new technologies in its power service area.

Substation upgrades and new construction are a regular and scheduled activity at TVA, and for several years these projects have used RuggedCom. Critical in TVA's decision was the fact that RuggedCom engineers were involved in the global effort to develop and refine standards for both network equipment and the IEDs in these substations. Environmental suitability was a major part of these efforts, but RuggedCom personnel also took leadership in resolving communication issues that were discovered during the development process.

TVA has used RuggedCom to upgrade their T&D communications capabilities for several years. After a pilot project for the Tiptonville substation, TVA is implementing Ethernet-based automation in the 500 kV Bradley substation using IEC 61850. Bradley will become the "template" for all future automation projects at TVA. The architecture used is based on IEC 61850 and includes a multi-layer redundant Ethernet network built using RuggedCom equipment. The initial Bradley-class substation project will go into service during 2007.

Industrial Power SCADA at Dow Chemical – Dow Chemical's Freeport, Texas complex is one of the company's largest, and also includes one of the largest industrial power plants in the country. Freeport's multiple power generation complexes are coordinated and monitored using a new SCADA network built with RuggedCom equipment. The network includes both Ethernet switches and RuggedCom device servers for legacy device interface. The SCADA network is the nerve center for all power monitoring at Freeport and includes interfaces to thousands of plant sensors.

Dow Freeport used RuggedCom equipment throughout their SCADA applications due to good experience with it as their network was developed.

In 2004 Dow initially tested network equipment from different suppliers for this service. Another project at a different Dow plant had a successful track record with RuggedCom, and one major IED supplier also recommended them, so RuggedCom equipment was among those tested in service.

Dow's early experience convinced them that the RuggedCom equipment was more reliable than the other suppliers they tested. Loss of communication with even a single device server can cripple SCADA functions. Dow experienced several such incidents with some of the equipment they tested, but could not trace the faults to the harsh EMI environment or to other factors. However the higher reliability Dow experienced with RuggedCom device servers and Ethernet switches convinced them to build out their

SCADA system using RuggedCom and eventually migrate the entire SCADA infrastructure to RuggedCom.

Metal Processing at Aleris – Aleris International is one of the world’s largest recyclers of aluminum and zinc and one of North America’s leading manufacturers of recycled aluminum. Aleris has 24 U.S. production plants. Recently Aleris began upgrading obsolete Ethernet infrastructure at several of its US plants. The infrastructure supports PLCs and plant floor control systems critical to their operation.

Initially their plan was to use hardened commercial switches for this job, which had been their past company practice. Upon looking further at their options, Aleris discovered that they could rebuild their network with RuggedCom equipment at an installed cost that was lower than the hardened commercial switches. Both the process engineering and IT organizations agreed on a new network configuration that included RuggedCom equipment for the plant floors with fiber optic backbones where required and a fiber optic interface to the enterprise network. Aleris has migrated to this configuration already in several of their plants in Oklahoma, Kentucky, Arizona, and Tennessee.

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Acronym Reference: For a complete list of industry acronyms, refer to our web page at www.arcweb.com/C13/IndustryTerms/

API Application Program Interface	ERP Enterprise Resource Planning
APS Advanced Planning & Scheduling	HMI Human Machine Interface
B2B Business-to-Business	IT Information Technology
BPM Business Process Management	MIS Management Information System
CAGR Compound Annual Growth Rate	MRP Materials Resource Planning
CAS Collaborative Automation System	OpX Operational Excellence
CEM Collaborative Manufacturing Management	OEE Operational Equipment Effectiveness
CNC Computer Numeric Control	OLE Object Linking & Embedding
CPG Consumer Packaged Goods	OPC OLE for Process Control
CPAS Collaborative Process Automation System	PAS Process Automation System
CPM Collaborative Production Management	PLC Programmable Logic Controller
CRM Customer Relationship Management	PLM Product Lifecycle Management
DCS Distributed Control System	RFID Radio Frequency Identification
EAI Enterprise Application Integration	ROA Return on Assets
EAM Enterprise Asset Management	RPM Real-time Performance Management
	SCM Supply Chain Management
	WMS Warehouse Management System

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