MAGNUM 6K SWITCHES NETWORK SUBSTATIONS HIGH IN ANDES MOUNTAINS

A Power Utility Application Note

ABOUT THE EBSA SUBSTATION NETWORKING PROJECT

EBSA = Empresa de Energia de Boyaca S.A. E.S.P. EBSA is headquartered in Tunja, a city in the state of Boyaca in Colombia S.A., very high (2782 meters above sea level) in the Andes Mountains. The EBSA project was developed in order to get SCADA data from the electrical substations into a new Central Control Room. Siemens, responsible for the overall network, turned to ANDESwireless Ltda. (www.andeswireless.com) to provide the necessary networking switches and consulting for the project.

THE CHALLENGE

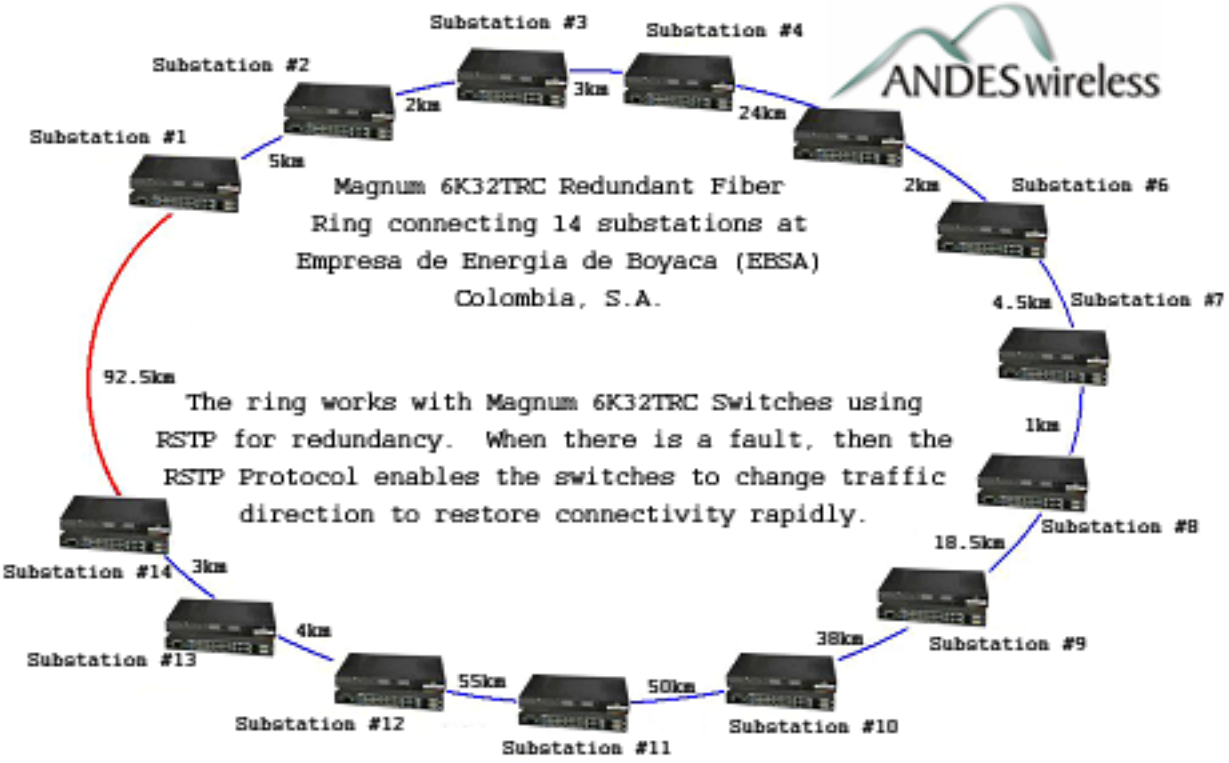
ANDESwireless' challenge was to create a substation-hardened network that offered redundancy in the event of a fault. The overall networking area consisted of fourteen substations spread throughout EBSA. As shown in the diagram below, most of the substations were many kilometers apart--with the greatest networking distance between any two substations at 92.5 kilometers. Additionally, the fourteen substations were subject to harsh electrical, thermal, and environmental conditions.

THE SOLUTION

ANDESwireless implemented a network with 14 substations linked together with fiber and wireless media. The switches chosen were GarrettCom Magnum 6K32TRC Managed Switches. The 6K32TRC Switches were networked in a ring topology that inter-connected the substations. Using industry standard RSTP (Rapid Spanning Tree Protocol) and IEEE 802.1d, the switches can quickly restore connectivity in the event of a network fault by changing one of the ring control ports from a blocking port to a forwarding port, and restoring full connectivity.

The configurability of the Magnum 6K32TRC was key. The network ring included various fiber optic cabling types, including multi-mode fiber, single-mode fiber, and long-haul single-mode fiber. In the initial design, the ring was not closed between substations 1 and 14 (below diagram). Then, a very long 92.5km fiber optic cable between two long-haul 6K32TRC fiber ports closed the ring.

Seven of the main substations are connected with an additional wireless (WiFi) TCP/IP network in order to enhance system availability to meet the operations requirements.



Substation Networking in Andes Mtns

NETWORK FAULT_RECOVERY FEATURES

- The fault-tolerant network operation is based on RSTP (Rapid Spanning Tree Protocol) and IEEE 802.1d industrial standards.
- The redundant ring covers a distance of 300 km and includes 14 electrical substations.
- It meets IEC 61850 and IEEE1613 Environmental Standards for Electric Power Substations
- Normal operation of the switches is in daisy-chain configuration that uses two fiber optic ring control ports per switch. One fiber port in the ring is in stand-by mode (blocked by RSTP) while all Ethernet traffic flows by means of the other ring port in that switch (non-blocked) without interruption.
- There is a regular flow of status-checking multi-cast packets (called BPDUs, or Bridge Protocol Data Units) sent out by RSTP that move around the ring to insure normal functioning.
- The normal status is designated as RING_CLOSED. Operations will continue this way indefinitely until a fault occurs.
- A fault anywhere in the ring will interrupt the flow of standard IEEE 802.1d status-checking BPDU packets, and will signal to RSTP that a fault has occurred. Then all ports are reconfigured automatically so that all LAN traffic is restored.

ABOUT MAGNUM PRODUCTS

Magnum 6K Managed Switches are highly configurable switches, providing modular slots for user selection of 100Mb, 10Mb, or Gigabit Ethernet fiber or copper ports, and are substation hardened with "no-fans" or fan-based cooling. Power input choices include AC, 125VDC, -48VDC, 24VDC, and dual DC input for redundancy.

MNS-6K Managed Network Software provides the latest technology for switch management, network management and security. Based on network standards, it is easily integrated into existing networks, and features standards-based redundancy functionality and Secure Web Management (SWM) GUI. MNS-6K offers standards-based cyber security tools for supporting NERC CIP network and systems compliance for power utilities and other critical industrial operations. MNS-6K-SECURE is available for those customers demanding *extra* security in their networks.

ABOUT GARRETTCOM

GarrettCom, Inc. is the leading manufacturer of industrial and power utility networking products. GarrettCom offers a comprehensive line of industrial switches, routers and converters for use in power utility, factory floor, telecommunications, and outdoor environments. The company's management software features resiliency and security for complex local and remote networks. GarrettCom markets its products through a network of resellers, OEMs, system integrators, and distributors worldwide. For more information on GarrettCom and its products, visit **www.GarrettCom.com**.

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