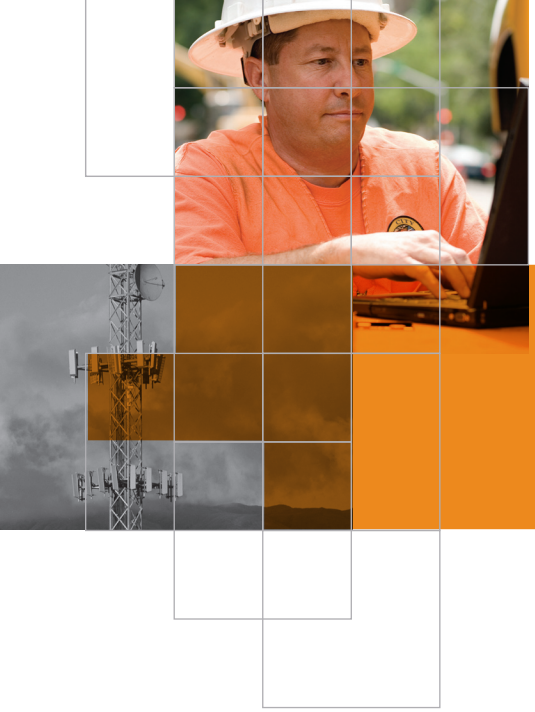

SUCCESS STORY

Cisco and IBM Provide High-Voltage Grid Operator with Increased Reliability and Manageability of its Telecommunication Infrastructure

Executive Summary

Customer Name

Terna—Rete Elettrica Nazionale SpA

Industry

Utilities

Business Challenges

- Eliminate grid blackout risks induced by possible telecommunications failures
- Improve quality of service and meet stringent target of Energy Not Supplied
- Replace ageing, expensive ATM network with faster, more reliable MPLS

Solution

- Back-up IP network over power lines supplements superior MPLS functionality
- Forward Error Control patch-panel solution with Asset Lifecycle Management
- Joint Cisco-IBM team covering development, implementation and maintenance

Business Results

- Improved safety and security across entire nationwide high-voltage network
- New equipment costs at field stations cut by 90 percent
- Low-maintenance costs
- Digital solution will allow central monitoring and control of electrical line failures

Business Challenges

Terna is the company in charge of electrical transmission and dispatching over high-voltage (HV) and extra high-voltage (EHV) lines for the whole of Italy. It owns 97 percent of the country's transmission infrastructure, and its main domestic role is to guarantee the balance between electricity supply and demand from a national control centre. Formerly in public ownership, as a wholly owned subsidiary of Enel, Italy's dominant electricity generator and distributor, Terna was privatized in 2004.

Along with 35 other European transmission operators, Terna is a member of the Union for the Coordination of the Transmission of Electricity (UCTE), sharing a wider responsibility for the safety and coordination of interconnected electrical networks across continental Europe. Terna is also pursuing new commercial opportunities abroad. It owns a controlling stake in Brazil's second-largest transmission network and is set to expand into new European markets.

In 2003, Italy experienced two major blackouts. The second, and more serious of these, was precipitated by damage to a high-power pylon in Switzerland, and the effects spread all over Italy. Terna established later that none of its transmission equipment had failed during the incident. The problem lay with a loss of telecommunications signaling in the leased lines used to monitor and manage its network. In order to improve the reliability of the network Terna needed a new and advanced back-up system to eliminate weak points and a centralized monitoring solution for effective remote operations.

Solutions

Terna's Italian national transmission network includes more than 300 field stations. Fluctuating demand for electricity must be kept in constant balance with supply, but the company's existing network management system which linked all its transmission assets to the national control centre, was based on a two layer network: the backbone based on an elderly Asynchronous Transfer Mode (ATM) network and an access network based on both Frame Relay technology and Power Line Carrier (PLC).

Cisco and IBM were ideally placed to create, test, and implement the new
an extended collaborative effort, working as strategic partners.

"In the energy sector, many of the technologies are very old and they are not open. We spotted the opportunity to create a way of dealing with our telecommunications that would get rid of a closed technology —a custom component—and instead integrate solutions on an open standard platform, like the Cisco MPLS network we are now deploying."

Carmine Auletta, CTO
Terna

In day-to-day operational mode, the ATM and Frame Relay network function over leased lines supplied by a leading Italian telecommunications operator. This is backed up by a proprietary, PLC solution, using military-grade broadband switches. It provides a maximum data transmission speed of 44 to 48 kbps, which is limited by the Forward Error Correction (FEC) algorithm used to eliminate electronic 'noise' on the lines.

In addition to being expensive to maintain or replace, the existing configuration offered minimal communication and control capabilities. Centralized monitoring of the power line communications network at any given moment was not possible. Engineers had to be sent out to each individual station to check for faults before any remedial action could be taken.

By 2004, Terna's management was already in discussions with Cisco on the design of a large new wide area network (WAN) in order to manage and control the grid more cheaply and effectively. The company chose a Multi Protocol Label Switching (MPLS) solution, with fibre optics, as the best option to combine improved monitoring and control with lower costs. In addition, the Italian company asked Cisco to carry out a feasibility study on a new data-over-power line solution, aimed at strengthening the capabilities of its back-up network.

At the time, IBM was already working with Terna, principally as a vendor. However, when IBM won the bid to become project manager for the new Terna MPLS network, including the integration, implementation, and maintenance, Cisco and IBM were well positioned to forge a close working partnership. The two companies already had a well-developed relationship after working together for three years at Enel, on another MPLS solution. In fact, Cisco and IBM were ideally placed to create, test and implement the new back-up power line solution for Terna through an extended collaborative effort, working throughout as strategic partners.

Terna wanted a back-up system that could operate independently of any outside telecommunications provider network. The most elegant and logical answer was to use its own power-line network to maintain continuity of grid network control and to safeguard against outside communications links going down. What began as a network renewal project thus switched focus to critical network outage management issues.

Carrying IP communications over power lines is not a new concept. There are various approaches to preventing the electronic 'noise' generated in power lines from disrupting IP traffic travelling over the same wires, so removing the

back-up power line solution through

need for data retransmission. Such techniques generally use the published FEC algorithm. In Terna's case, however, the proprietary nature of its existing solution blocked visibility of how FEC was functioning in its network. "There was no way to control the system remotely because we could not see from a central location whether each power line carrier was working properly," notes Auletta.

Terna's HV and EHV lines presented an additional challenge because they can create very high electronic noise levels—they are rated as 'very disturbed' (BER 10-3). IBM laboratories helped determine whether the standard FEC algorithm could be implemented on line-cards, to be inserted into Cisco routers, but for technical reasons this was not feasible. Cisco and IBM therefore had to look for an alternative solution.

Following extended discussions between Terna executives and Cisco technical experts, Cisco investigated the market in order to work on the software for an FEC 'patch panel'. It would have to be fully compatible with standard Cisco components and simple to connect. Cisco formed a joint team with IBM and third-party local consultant experts on telecommunications equipment, using Cisco Advanced Services extensively to support the development work, while IBM provided the high-level design.

After testing the concept in a small mock-up network in San Jose, the two companies presented the solution jointly to Terna. Cisco resold the third-party product to Terna as part of its overall solution package, while IBM retained responsibility as prime systems integrator, with an ongoing asset lifecycle maintenance responsibility for the FEC solution post-implementation to ensure optimum performance in the longer term.

Business Results

Field-tests of the prototype solution were conducted on two separate Terna high-voltage lines in Sicily and, by October 2007, the electricity company was poised to begin the roll-out by connecting 33 field stations in Sicily and Sardinia, joining up a network that will involve multiple jumps over interconnected PLC lines.

The national rollout to all Terna's 300-plus stations is scheduled to take place over three years, between 2008 and 2010. The company anticipates numerous benefits, including centralized control, improved network safety and security, and major cost savings.

From a technical viewpoint, the new system is expected to deliver an immediate 20 per cent increase in available bandwidth over PLC lines. The operational benefit is that whenever numerous lines register faults simultaneously under the existing system, restricted bandwidth becomes a bottleneck and processes slow down. In the future, this will no longer be the case, and the company foresees further bandwidth upgradeability by using progressively more sophisticated compression algorithms.

"Finding an innovative solution to handle the power line carrier network involved tight integration between IBM, as project manager, and Cisco, who carried out all the research and development. We were able to discuss any issues and problems face-to-face with Cisco, while IBM took responsibility for the testing and will now implement the full solution."

Carmine Auletta, CTO
Terna

"We now have the tools to adapt to each situation as it arises and can configure our solution to the specific case. With centralized management, it's not just a matter of making savings; it's a matter of network safety. Because we can monitor PLC lines form our central NOC and anticipate any trouble, we are making the system more secure."

Carmine Auletta, CTO
Terna

Moreover, Carmine Auletta anticipates that the switch to open standards will mean that power line data compression can be decoupled from use of FEC. It will no longer be necessary to keep FEC switched on at all times. Central monitoring will enable line controllers to switch FEC on and off as needed, so that it can be dispensed with at those times when electronic noise levels are low, thus further improving data speeds.

An additional operational benefit will be the ability to transition the separately controlled electrical network protection system, for back-up switching between stations, from analogue to digital. At present, this operates over an analogue network, and the only way to determine whether the network protection system is working is to send an engineer to test the lines manually on site. Here too, Terna expects to gain centralized monitoring and control, in the same way as it will have for PLC data.

The new solution also promises a dramatic reduction in Terna's costs. The cost per station to deploy the new FEC device has been cut by 90% compared to the former solution. The company will realize substantial savings on the costs of field monitoring and maintenance. Evidence of greater efficiency and significant cost savings should please its shareholders and help the company meet the demands of the disclosure obligations that have come in the wake of private ownership.

By increasing the reliability and the manageability of its telecommunication infrastructure Terna will also improve its capability to control the Italian power grid both during regular operations and more important in case of extraordinary events (e.g during black-outs) when public telecommunication infrastructures have showed their weaknesses.

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
www.cisco.com/go/ibm

International Business Machines Corporation
New Orchard Road
Armonk, New York 10504
www.ibm.com/cisco

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