

Transpower – Transforming Electricity Operations Through Improved Telecommunications

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Introduction

The demands for a reliable communications network to ensure the optimum management of a modern power system are increasing.

In New Zealand, and worldwide, power systems are being run harder than ever before. This is due both to the difficulties in building new assets (through environmental issues either real or perceived) and the impact of emerging renewable generation technology such as wind.

Transpower's response to the challenge of running the New Zealand power system harder includes several important initiatives:

- Upgraded market systems and operational management requirements to:
 - Manage a power system which is being run harder; and
 - Maintain operator awareness of power system conditions.
- Improved monitoring of power system dynamic performance and stability to prevent failure triggered by excessive running of the system.
- Greater access to detailed information, to evaluate the condition and operation of important assets that make up part of New Zealand's National Grid.

These are typical of the changes being introduced into an industry that has historically worked in terms of decades when planning its networks. Such radical changes demand radical solutions, and these solutions require an up-to-date and future-aware telecommunications infrastructure.

Meeting the Challenges

Meeting the challenges of the system operator

Transpower, New Zealand's system operator, is commissioning a major upgrade of the market system software. This will allow the operating functions of Transpower to run the power system harder by automatically accounting for limits due to constraints. The proposal is to extend the new systems to provide more exchange of information between industry participants to generators. More accurate information within the electricity market allows for better decision-making, resulting in improvements such as increased efficiency and lower costs.

The system operator also operates a virtual control center comprised of two sites running together in parallel with staff working between the two locations. This novel arrangement creates a high need for communications bandwidth and route diversity, both to back up the mission-critical applications and to deliver an open video link between the centers so they operate as one virtual entity.



Meeting the challenges of the grid planner

With the need to build a reliable and secure power system that is being run close to its limits and incorporates new technologies, the grid planner needs to have a good understanding of the dynamics of this very complex system. This understanding is important as changes in the power system are being made to include substantial wind generation, an upgraded HVDC link and extensive reliance on reactive support equipment such as SVC's.

Transpower needs a robust communications network to:

- Access systems that measure the dynamic performance of the network in order to deliver on projects.
- Measure synchrophaser and small signal stability as part of the planning of new assets such as replacing part of New Zealand's inter-island network; i.e. – Pole 1 of the HVDC.

Meeting the challenges of grid maintenance

With aging assets being run almost to their capacity, Transpower has an ongoing need to better understand the utilization and condition of key assets in case of the need for replacement or maintenance. For some time, Transpower has been investigating the potential for a networked environment for equipment in the field using so called "substation servers".

The existing telecommunications network has been identified as a major obstacle in achieving the potential to access higher quality asset performance information.

The aging infrastructure

Utilities are naturally conservative organizations. They will not be found at the leading edge of technology and, considering the safety issues involved, will stay firmly with the tried and tested.

However, the telecommunications networks that support a utility's mission-critical grid services (such as tele-protection, telemetry, SCADA and operational voice) are aging rapidly. Indeed, electricity networks are often supported by communications technologies that have reached the end of their useful life. Furthermore, manufacturers and telecommunications operators are moving to an all IP environment, forcing electric systems operators to pay serious attention to their communications networks.



Transpower control room

Transpower – Transforming Electricity Operations Through Improved Telecommunications

Transpower is both the transmission owner and systems operator in New Zealand, owning and operating approximately 12,000 km of high-voltage power grid with some 193 substations, offices and switchyards. Earlier this year, Transpower awarded a contract to Alcatel-Lucent for the renewal and transformation of its legacy communications infrastructure to support an ongoing upgrade to the National Grid.

The need for change

Transpower's electricity network was first deployed in the 1920s, with the majority of the higher voltage 220 kV network being built during the 1950s and '60s. As with many utilities worldwide, it is essentially this infrastructure that is supporting New Zealand's energy needs today.

Given the challenges outlined, Transpower is undertaking a major investment program to improve energy reliability and availability and to optimize asset utilization. It became clear early in the process that a modern, advanced communications infrastructure would play a major role in this transformation program.

Current Communications Environment

Today's communications network has grown ad hoc. This is reflected in the broadly unstructured nature of the network and the combination of over 115 different types of equipment from 28 different vendors. Much of the equipment is currently at or drawing to its end of life.

Another key issue faced by system operators worldwide is the progressive withdrawal of TDM services by public service providers, which is a critical development for the electricity industry. For the foreseeable future, TDM will continue to be an essential technology supporting the most crucial safety mechanism: teleprotection.¹ Consequently, moves by service providers to all-IP networks mean that Transpower, like many others, needs to develop and retain its own carrier-grade communications capability independent of public service providers.

¹ The mechanism by which faults on high-voltage routes are rapidly isolated from the electricity network, preventing the failure from propagating further.

Evolving Requirements

The communications network must support in real time the full variety of operational services associated with an electricity transmission network, including:

- Teleprotection, which requires very low, deterministic network latency.
- SCADA, currently using analog technology, but which will evolve over time to IP-based solutions.
- Operational voice, which must be available independent of any incident on the public service providers.
- IT security, which requires a robust and reliable network.
- New substation features, such as IP CCTV.

The network has to be robust and available and therefore unaffected by events on the electricity or public telecommunications networks. This demands proactive management to neutralize any faults or incidents in real time.

Finally, the network must be future-proof, while using tried and tested technologies.

In brief, Transpower's key objective is to build, maintain and operate a National Grid that maintains a flexible and reliable electricity supply. This requires a changed approach to grid investment and a similar change in its telecommunications investment. The current telecommunications network requires an upgrade allowing it to underpin the grid investment planned over the next 10 years.

Telecommunications most important function is to be a fundamental enabler for Transpower to maintain prudent and efficient control of the power system and to maximize its grid utilization.

Alcatel-Lucent's Role

The challenges

At first glance, Transpower's requirements do not look stringent. Compared to the networks operated by service providers, this network is relatively simple and uses well known technologies. However, Alcatel-Lucent has to address some significant challenges:

- The criticality of the service provided by Alcatel-Lucent and its direct effect on New Zealand's electricity supply.
- The special requirements of teleprotection services demand a careful and thorough network design.
- Careful management of the safety issues related to working in high voltage environments.
- The issue of migrating services from the existing to the new communications network, while ensuring zero disruption to the electricity supply service.

One of the reasons Transpower chose Alcatel-Lucent was its experience in the utilities marketplace, which enables the company to address these issues effectively.

Meeting the technical criticality

The network solution that Alcatel-Lucent will roll out for Transpower is resolved around the multi-service optical transport services switch, which supports both TDM and Ethernet. Its TDM capability provides the necessary time-sensitive communications channels needed by teleprotection services, while offering a communications channel for legacy devices that still require TDM interfaces. Ethernet interfaces support less delay-critical applications.

Alcatel-Lucent's IP/MPLS router will support the progressive move of non-latency-sensitive services to IP, as and when dictated by Transpower's own substation and grid build program. It will also support the OmniPCX Enterprise IP PBX, which will provide operational voice services at each site, the deployment of mass IP CCTV and Transpower's IT security platform.

Careful network design is required to understand and minimize delays across the network for time-sensitive services and to assign the correct priorities and quality of service (QoS) to the different IP services. In turn, this will ensure the uninterrupted availability of operational-critical IP services (voice and SCADA).

Network implementation and service migration will also be managed by Alcatel-Lucent, drawing on its global experience of large-scale transformation projects.

Meeting mission-critical demands

Designing and implementing a structure that meets the mission-critical nature of Transpower's business is only one part of the challenge. The other equally important part is to keep it running reliably, day in and day out. Alcatel-Lucent will upgrade Transpower's existing network operations center (NOC) in Hamilton, to monitor and manage the Transpower network.

Using sophisticated tools developed for the Telco market, Alcatel-Lucent will be able to detect incidents or failures rapidly and reliably throughout the network, diagnose and prioritize them, and, in most cases, neutralize the problem remotely.

Service levels

Given the critical nature of Transpower's business, Alcatel-Lucent has to meet key performance indicators derived from Transpower's business needs. They cover a whole range of operations including service delivery, responsiveness to problems, neutralization of incidents and adherence to Transpower's on-site safety procedures.

Life-cycle management

Alcatel-Lucent's contract requires the company to manage the network's entire life cycle to avoid obsolescence, ensuring that the technology deployed will remain fit for purpose for many years to come.

Enterprise services

In addition to its operational services, the network will support Transpower's enterprise networking requirements. These include services such as dispatch, WAN / LAN connection, enterprise voice and video.

Quality of service was a key element in their design; however, the operational services always have priority and must receive the bandwidth they need to support mission-critical activities.

The Benefits for Transpower

Transpower's objectives in this project are to obtain a homogenous, simple and robust communications infrastructure. This will allow efficiencies to be improved and also support the services and applications needed for the renovation and enhancement of the National Grid.

As Dr. Ralph Craven, Transpower's CEO put it:

"The challenge we face in upgrading our communications network is how to merge multiple legacy and future technologies on a single, easily managed platform. Alcatel-Lucent is helping us meet that challenge with a highly reliable and achievable communications solution that will deliver operational savings and efficiencies in the future."

Conclusion

As power system assets are driven harder, dependence on the rapid transfer of significant volumes of operational information increases significantly. Aging communications infrastructure needs to be renewed if the gains from the introduction of critical initiatives such as real-time system stability monitoring and sub-station automation are to be realized. Telecommunications has become a vital element of the solution that these operators require.

Transpower has recognized this need and, with the help of Alcatel-Lucent, is deploying a network that will support its mission-critical services for the foreseeable future. Transpower's actions will also have to be carried out by many other transmission and distribution systems operators worldwide.

Utilities are naturally conservative organizations. However, the need for a change in communications is even more compelling – a change which must not compromise the excellent record of safety and reliability of these operators. Furthermore, without this change, the ability to maintain a good electricity supply becomes more and more challenging. Transpower, with the help of Alcatel-Lucent, is at the forefront of making these much-needed changes a reality. ☒

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