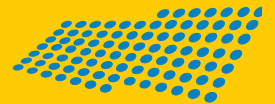


Delivering an Intelligent
Electricity Network for
Future Generations



EnergyAustralia[®]
We're on it



EnergyAustralia is one of the largest energy suppliers in Australia with over 100 years experience. We are a leader in providing broad-based energy solutions and supply more than 1.5 million customers from our electricity network, which is the country's biggest.

As part of our plans to invest over \$4.8 billion in our electricity infrastructure over the next five years we are also taking the opportunity to utilise the latest in communications and IT technology to build a state-of-the-art 'intelligent' network.

Called 'Electric Thinking', our transformation program will deliver an active, automated network that will provide a complete understanding of network-customer interaction, real-time pricing, and customer choice in load management.

We are already realising cost benefits from our transformed communications network. Having a single network reduces complexities and, coupled with smart monitoring tools, makes the electricity network easier to manage and maintain.

The applications running now - and in the future - will deliver real productivity gains and allow us to use our assets more efficiently by providing a better understanding of what's happening on our network. With increased real-time system monitoring enabled by the new communications network, responsiveness can be improved, increasing network reliability for our customers.

In the future, the integration of new information and communications technologies into our existing electricity supply networks will open up a realm of possibilities to deliver even more operational benefits and control for our customers.

George Maltabarow
Managing Director
EnergyAustralia





Telecommunications Strategy

As part of EnergyAustralia's long-term strategy to build an intelligent electricity network, we have embarked on a project to transform the communications capabilities linking our major sites. Successful management of a modern power system is largely dependent on reliable communications. Taking the opportunity to refresh telecommunications assets with modern technologies as older equipment is retired is an important step to cost-effectively realising EnergyAustralia's intelligent electricity network vision.

As part of this communications transformation, EnergyAustralia is deploying Alcatel-Lucent's carrier-grade Internet protocol (IP) solutions to eventually connect 200 major electricity substations and network operations centres via a single, reliable and cost-effective communications network.

At the core of EnergyAustralia's new IP communications network is multi-protocol label switching (MPLS) technology. MPLS ensures that a range of applications critical to the reliable supply of electricity, such as alarm monitoring, fault information and security video remains reliable and protected while using the same underlying network infrastructure.

EnergyAustralia will also leverage this new IP/MPLS network to deliver productivity gains by allowing EnergyAustralia staff to access greater information in the field using high-security wireless access points deployed at substations. Field staff working in substations will be able to use devices such as laptops and mobile phones to wirelessly connect to EnergyAustralia's IT applications including equipment mapping systems, voice-over-IP and video conferencing.

Typically power utilities have relied on multiple legacy networks to deliver critical services such as SCADA, security and operational IT applications. However, the cost of building and maintaining multiple networks is uneconomic and a large burden on resources. The key to transforming EnergyAustralia's electricity network was to replace our legacy networks with a single, reliable network infrastructure that allows mission-critical data to be prioritised.

To ensure the new communications network meets EnergyAustralia's mission-critical requirements, a meshed network was designed to protect against single element failures, fibre cuts or substation power outages. While IP networks are traditionally architected to recover from failure, EnergyAustralia's new carrier-grade network has been built with reliability at its core. Providing alternate paths through the meshed network enables an 'always on' service which is easy to manage and in turn enables deployment of service levels to support a reliable, safe and cost-effective energy network.

The network is designed to handle traffic at Layer 2 so that voice, video, SCADA and GOOSE (generic object oriented substation equipment) messaging can all be delivered over a common infrastructure but separated and prioritised. Priority can be given to the most mission-critical services, with strict quality of service rules, should bandwidth be limited.

Alcatel-Lucent and EnergyAustralia have worked closely together to ensure the IP/MPLS network meets the requirements of today and can scale easily to accommodate new services in the future. Designed from the ground up, reliability is built in covering not only systems and hardware, but also processes. Carrier-grade equipment was chosen because the mission-critical nature of EnergyAustralia's operations require communications solutions capable of delivering the highest levels of performance and reliability.





Transmission Enhancement

EnergyAustralia is developing more intelligent zone substations that take advantage of new communication and data standards such as IP/MPLS telecommunications networks and IEC61850 control devices to simplify substation secondary systems, reduce commissioning and maintenance costs, and make greater levels of information available to our staff.

Adopting a smart substation design enables future rationalisation of SCADA, protection and associated design and wiring requirements within the substation. Enabling future automation capabilities will help to optimise network performance, asset utilisation and distribute intelligence across different asset classes.

The transformation to open communication standards based on the IEC 16850 framework is driving the requirement for mission-critical communication not only within the substation but also between substations and ultimately the network control centres. The underlying transport framework for this evolution is Ethernet. The challenge is how to provide a connection-oriented, robust and reliable communications path across what is essentially a Local Area Network protocol.

What has EnergyAustralia already done?

EnergyAustralia has implemented a best of breed telecommunications network that is being rolled out to all major zone substations creating a very flexible wide area Ethernet-based connectivity infrastructure that is 'always on'.

This network is capable of delivering mission-critical communications infrastructure utilising the advanced Ethernet

technologies of Virtual Private LAN Services (VPLS) on a diverse and fault tolerant MPLS network. It is also well suited to the requirements of modern substation protocols such as IEC61850 and DNP3, enabling SCADA and protection messaging to be delivered in a secure manner, at the least possible cost and with guaranteed levels of service delivery.

To demonstrate the functionality of EnergyAustralia's network, GOOSE messaging trials have been performed in conjunction with Siemens and Alcatel-Lucent. As part of these world-leading trials, GOOSE messaging was successfully sent between two EnergyAustralia substations 300km apart. The testing showed that with the priority assigned to GOOSE messages, the recorded impact on the latency was 0.0002 milliseconds, highlighting the benefit of the quality of service prioritisation capability of EnergyAustralia's communications network.

Future Vision

EnergyAustralia's vision is to create seamless information flow between our zone substations and backend IT systems to improve the way we manage our network. We strongly believe in a future network that is based on the harmonization of IEC61850 and Common Information Model (CIM) data standards and the emergence of a secure substation workstation environment. The development of this environment will enable our field staff to make more informed decisions and bridge the knowledge gap created by key staff retiring.

Distribution Automation

Automating the monitoring and control capabilities on our 11kV and low voltage network will have a major impact on the availability of timely load data for planning, maintenance and operational decision making and provide the platform for improvement in customer reliability performance.

It will enable us to proactively manage asset utilization and provide more dynamic rating calculations. We will also be able to respond more quickly to customer requests and improve our management of power-quality related complaints.

There is a general expectation that the level of distributed generation (smaller power generation plants located throughout the electricity network) being fed into the 11kV and low voltage network will increase significantly in the future. Relying on peak demand indicators or manual load surveys is not going to be sufficient for a grid with increasing levels of two-way electricity flows and it is crucial that EnergyAustralia has better load data to describe our network.

EnergyAustralia's key objectives are to:

- reduce time taken, and the cost of, fault repairs using remote, real-time data to assist in locating faults and providing network status;
- reduce the impact of network outages by reducing the number of customers affected;
- improve network planning and network operations by providing better information for decision making.

What has EnergyAustralia already done?

EnergyAustralia has undertaken a pilot program of over 100 distribution substations, both pole and pad mounted, to verify the benefits of near real-time access to load data and the reliability improvements that come from distribution automation.

This program has utilised two-way smart metering technology to demonstrate a cost effective solution and inform the broader investigation of customer based smart metering technologies.



Future Vision

EnergyAustralia is looking towards a future 11kV and low voltage network that has widespread sensing, monitoring and control capabilities that will enable smarter management of the network. These capabilities will make localised control automation possible, significantly enhance preventive maintenance programs and dramatically improve the time taken to respond to and rectify outages on the lower voltage network.

Mobilising the Energy Workforce

EnergyAustralia's vision is to provide information on an anywhere, anytime, anyhow basis. The benefits of this approach will increase as the intelligent network is deployed so that the information-rich environment becomes a core part of how we operate our business.

To achieve this, EnergyAustralia is deploying wireless access points in substations to give field staff the flexibility to collect data, make accurate diagnoses based on information from the field and from databases and feed the information back centrally. The use of EnergyAustralia's own private network to carry voice, data and video traffic will enable the company to provide next-generation wireless communications to remote locations, including those beyond the coverage of public communications networks.

What has EnergyAustralia done?

EnergyAustralia is deploying Alcatel-Lucent's military-grade secure wireless access points at substations as part of our major communications refurbishment program. This capability has also been extended through field trials of a common communications connectivity platform to enable seamless data roaming between any wireless network, including public mobile broadband networks. In addition, widespread IP video services between major locations are being deployed as standard solutions.

EnergyAustralia operates not only in the metropolitan areas of Sydney and Newcastle, but rural environments where it is most difficult to provide communications coverage. In some areas in the remote Upper Hunter region, traditional carrier services do not exist and even satellite coverage is limited. As a consequence EnergyAustralia is implementing a private data-over-wireless solution to ensure that all our network areas benefit from our push towards an intelligent network.



Future Vision

EnergyAustralia is planning a future where new applications will take advantage of this mobile environment. There are two 'killer applications' that EnergyAustralia is planning to make available in the future. One is the creation of a substation portal to provide field staff with a greater view of what is happening in the substation. The second is being able to extend access to wireless voice, video and data applications in a simplified manner, making these services available to all and importantly simple to use.





Customer Enablement

EnergyAustralia has been active in implementing time-of-use (ToU) tariffs and trialling two-way smart metering (also known as advanced metering infrastructure or AMI) for several years. Based on EnergyAustralia's experience, a key focus in building our intelligent network is to provide customers with a more interactive and flexible electricity experience.

As a network business we see the opportunity from smart devices at the customer premise to transition our existing hot water load control to a new solution, to monitor power quality at the edge of the network and to improve response time to faults.

EnergyAustralia believes there is an opportunity to provide value-added services to our customers, improve interaction and provide faster billing, make it easier to value and switch to alternative tariff schemes and deliver a more personalised customer service based on the latest technology solutions.

What has EnergyAustralia already done?

EnergyAustralia has installed over 350,000 interval meters that enable time-of-use (ToU) tariffs. Approximately half of the customers with these meters are now on time based tariffs. We have also undertaken a strategic pricing study based to better understand customer responsiveness to peak pricing.

EnergyAustralia has undertaken one of the largest trials of two-way smart metering in Australia with over 6,000 meters deployed on the network to date. These meters have been installed using different 'last mile' communications technologies and using meters from a range of vendors. These trials have utilised

communications solutions such as narrow-band powerline carrier communications, broadband powerline communications and GSM mobile communications. EnergyAustralia is taking this investigation further with a pilot evaluation of the new WiMAX Rev E wireless technology standard, with a base-station deployed in one of our zone substation areas.

These trials have informed EnergyAustralia about the challenges, maturity of products and necessary processes required to undertake a wide scale AMI deployment.

Future Vision

Our experience with smart metering, communications and meter data management technology suggests there is still some way to go before technologies have matured to a point where wide-scale deployments can be undertaken with confidence.

EnergyAustralia is actively involved in the Ministerial Council on Energy smart metering process and is preparing itself for the consequences of the current policy initiatives.

EnergyAustralia expects to replace the off-peak hot water load control systems with a more flexible platform, which allows not just the transition of hot water load but the increase of alternative direct load control capabilities. It is likely that this will be part of an AMI solution that can also be used to provide additional services to electricity retailers.



Enhanced Operating Environment

Increasingly, traditional control room capabilities that switch the high voltage network are being supplemented by two emerging operational environments, the evaluation and switching decisions made on the low voltage network and the emerging requirement to manage the health and functionality of smart devices. The environment that we are preparing for extends beyond normal communications monitoring and decision making to include smart devices on our transmission and distribution networks and at customer premises.

EnergyAustralia is investing in each of these operating environments to ensure that appropriate IT systems are available to assist in carrying out their functions. At the transmission level we are implementing a new distribution management system and at the low voltage network level an outage management system is being developed. At the same time, EnergyAustralia is developing engineering analysis tools and creating a new network operations centre (NOC).

What has EnergyAustralia already done?

The NOC has been built to address the communications network but built in such a way that it can be easily expanded to manage IEC61850 devices installed at zone substations and devices at customer premises. By taking advantage of standard protocols such as SNMP and IP networking interrogation techniques, smart devices on our network will be proactively monitored to ensure both appropriate maintenance and a high level of customer service is maintained at low cost.

Future Vision

The operating environments described above are likely to integrate in the future to provide a next-generation control room environment to meet the requirements of the intelligent network. These tools will allow for consistent management across all voltage levels with IT systems enabling a 'virtual' environment or more distributed decision making organisation. In particular the functions of the NOC will be extended as greater and greater numbers of smart devices are deployed.

The Last Mile Opportunity

There are a number of intelligent network applications that could leverage a common access or 'last mile' communications solution, including smart metering, load control, distribution automation and field computing.

As the most important consideration is to satisfy these requirements with a standardised approach, EnergyAustralia is considering access solutions based on Internet Protocol (IP) and Ethernet standards.

EnergyAustralia intends to leverage investments we have already made in building a IP/MPLS communications network linking all our major substations. There are a number of 'last mile' options under consideration including the latest revision of the WiMAX wireless standard. Initial analysis suggests that WiMAX is a cost-effective utility solution that is scalable to meet all the requirements of EnergyAustralia's 'last mile' requirements.

WiMAX (IEEE 802.16e) is building momentum as a broadband access technology of choice not only in the telecoms market but also for electricity utilities. It is a technology that is founded on global standards, provides flexibility, scalability and is future proof. Today WiMAX leads other emerging broadband wireless technologies in maturity by at least five years. Intelligent

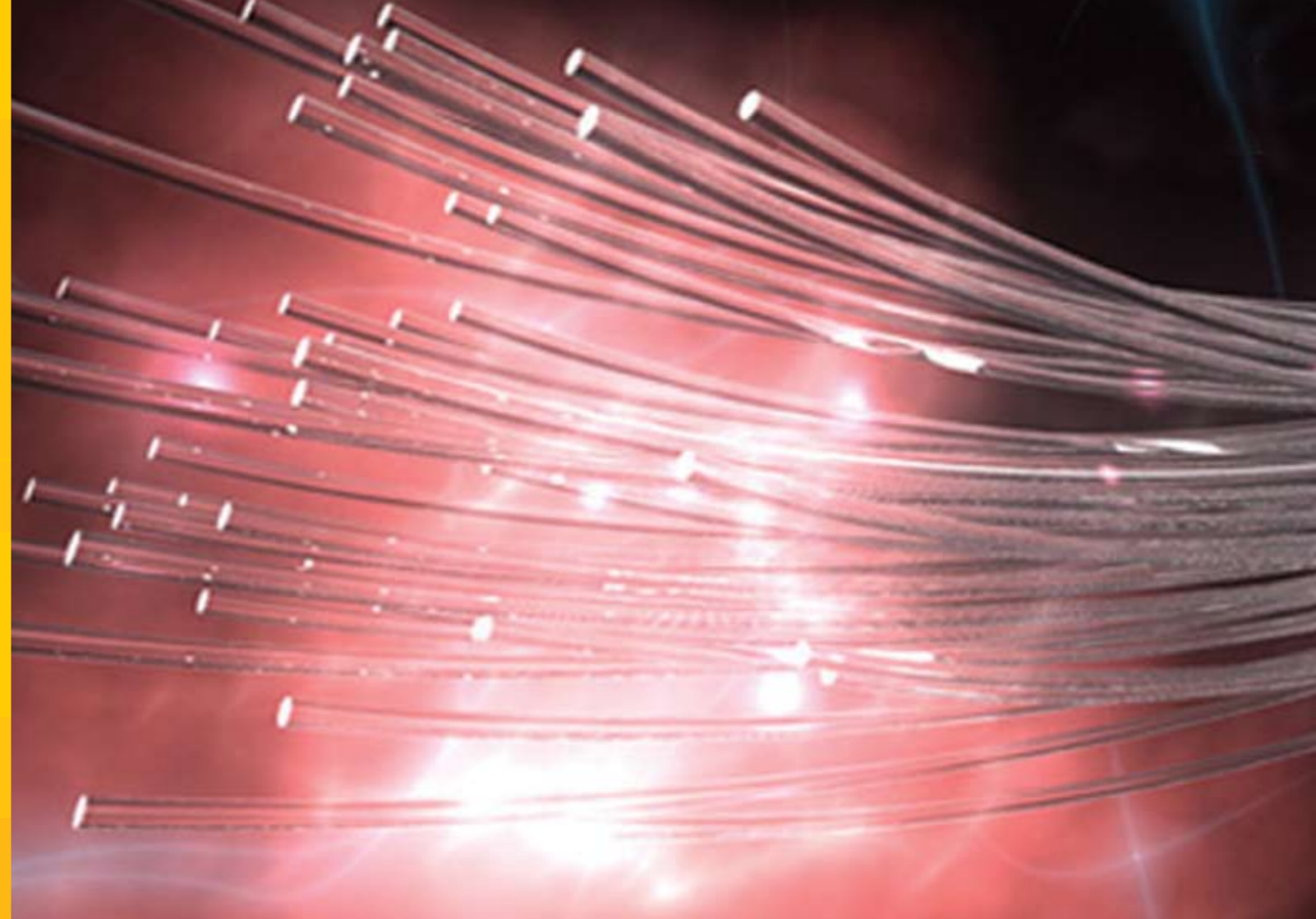
electronic device manufacturers are already incorporating WiMAX chipset technology from Intel (a major supporter of WiMAX technology) into devices.

What has EnergyAustralia Already Done?

EnergyAustralia is currently undertaking a technical pilot of the latest WiMAX base station technology for use as an electricity 'last mile' communications solution.

Future Vision

EnergyAustralia believes that a 'last mile' solution should be available at low cost and be scalable to deliver our requirements to customers, network devices and field staff. Whatever the underpinning technology, the operating environment and communications routing layers will all use similar technology to that being considered by telecommunications carriers for 'last mile' access. To this extent an emerging wireless IP technology such as WiMAX may just fill the gap that electricity utilities have in 'last mile' communications.



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