Management System Document – SSA Smart Network Vision

Summary

This document details TransGrid's Smart Network Vision of 2040.

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Executive Summary

The landscape of substation secondary systems is changing. New technologies are constantly emerging that can provide clear long term benefits for electricity grid management, and offer opportunities to propel the secondary systems network into a smarter more agile and integrated future. The deployment of such technologies onto the ageing TransGrid network would not be without inherent challenges though, and as they mature unprecedented demand will be placed onto secondary system supporting architecture.

This Smart Network Vision details TransGrid's intended tactic moving into the future and how new technologies will be deployed onto the transmission network. The vision is in direct alignment with the business change initiatives and overarching TransGrid Network Vision. This document is supported by a high-level roadmap indicating key milestones out to the year 2040.

TransGrid envisages that the Smart Network of the future will be one of real-time monitoring with integrated sets of interoperable sensors, monitoring devices and management systems supported by a high capacity fast and reliable telecommunications network. The ideals of this vision are centred on the concept of a converged Operations and Information Technology platform.

The vision was developed such that TransGrid would be better poised to take advantage of future non-prescribed opportunities in both traditional and renewable energy sectors, as well as abilities to securely grow the telecommunication business arm through integration of third party services with operations infrastructure.

Based on this TransGrid has identified five key levers with which this vision is dependent on:

- Major enhancement of the communications network
- Full digitisation of substations
- Interoperability of systems
- Convergence of grid systems
- Adoption of site-wide replacement strategies

Proceeding sections of this document outline the above levers, how they link to both the corporate business plan and overall network vision, and how they can be realistically accomplished in reference to the supporting roadmap.

Contents

1. Purpose

This document presents a high level vision of the TransGrid Smart Network beyond year 2040 and a roadmap defining the pathways for achieving that vision.

The document considers TransGrid's current technology platforms, existing policies and frameworks linking the overall corporate plan, existing strategies concerning renewal and maintenance, and both current and future initiatives supporting the proposed 2040 technological vision.

TransGrid is an industry leader in the field of high voltage energy transmission, and is committed to maintaining this status moving forward. TransGrid's vision is *Excellence in all we do*[1] with a supporting business mission to *Create value by providing safe, reliable and efficient transmission services*[1]. However, with an ever changing energy environment increasingly driven by consumer behaviour and advancements in technology, achieving this mission into the medium to long term future will require a flexible and adaptive approach. Such an approach will need to be underpinned by the deployment of more innovative, smarter, interdependent and cost effective technologies. This document attempts to illustrate such an approach within an execution timeframe that is realistic and to inform our investments decisions today.

In defining this roadmap to year 2040 and beyond the primary focus surrounded supporting the Australian Energy Regulators (AER) existing electricity rules and energy policy goals in a technically and feasibly compliant manner. Cost benefit analyses of this roadmap are beyond the scope of this document and shall be conducted as appropriate through the network investment process.

[1] TransGrid Corporate Plan 2014-2019, http://thewire/Documents/Corporate Plan 2014-2019.pdf

2. Positioning within the Asset Management Framework

The *Smart Network Vision* document is one of several that comprise the Network Vision/Development Strategies within TransGrid's Asset Management Framework. This document serves as an input to the Asset Management Strategy and Objectives document as shown in Figure 1.

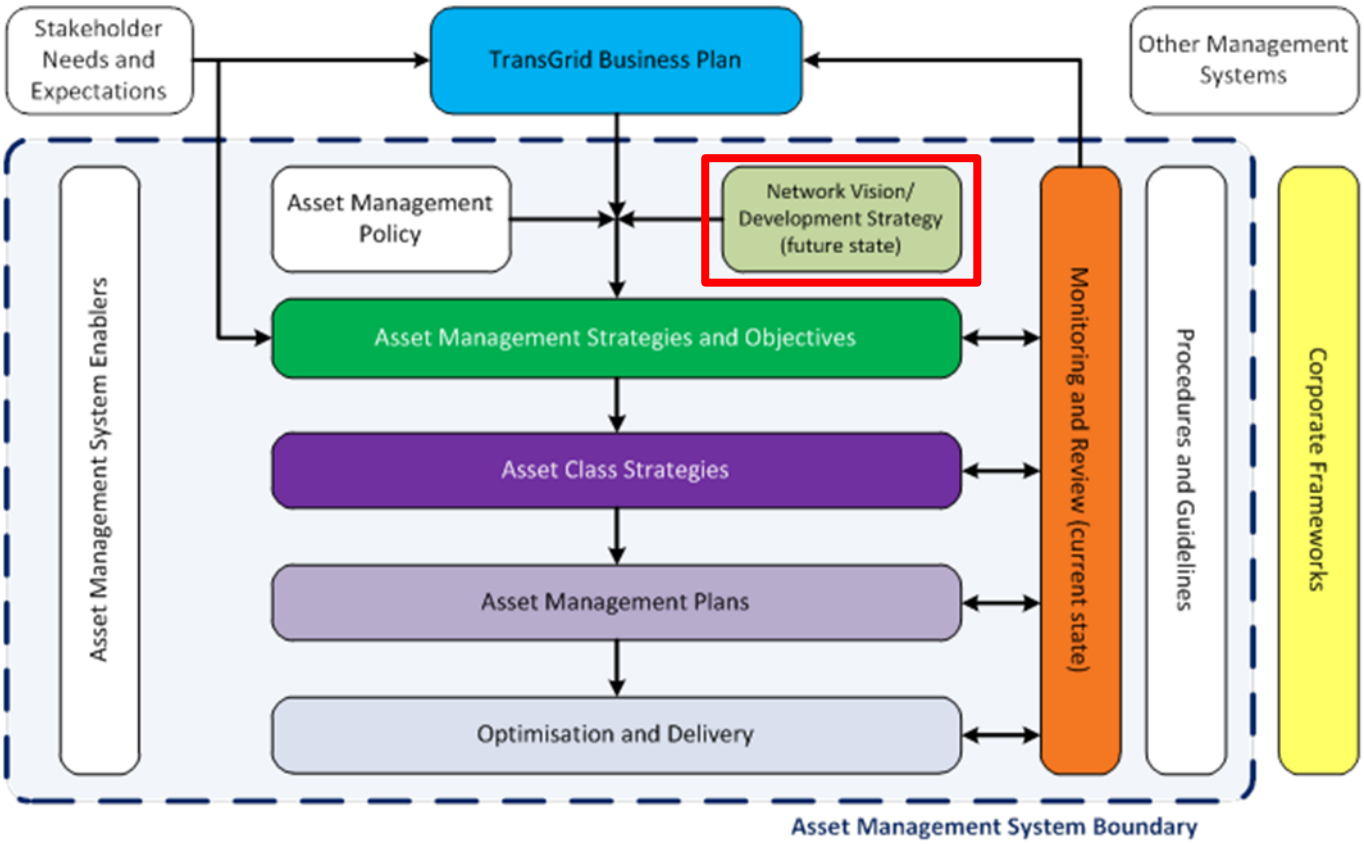

Figure 1: Asset Management System Document Hierarchy

3. Definitions

Term	Definition
AER	Australian Energy Regulator
AEMO	Australian Energy Market Operator
Asset Management	Systematic and co-ordinated activities through which TransGrid effectively manages its assets and their associated performance, risks and expenditures over their lifecycle for the purpose of achieving the Corporate Plan and objectives.
Asset Management System	TransGrid's processes, procedures and organizational structures necessary for the development, implementation and continual improvement of the asset management policy, asset management objectives, asset management strategy, and asset management plans.
Asset Manager	Asset Management business unit is responsible for strategic asset management in TransGrid.

Asset Management Policy	Principles and direction consistent with TransGrid's Corporate Plan and objectives for the setting of the asset management objectives and the development of the asset management strategy.
Asset Management Objectives	• Specific and measurable outcomes required of the assets in order to achieve the Corporate Plan and objectives; and/or • Specific and measurable level of performance required of the assets; and/or • Specific and measurable level of the health or condition required of the assets; and/or • Specific and measurable outcomes or achievement required of the asset management system.
Asset Management Strategy	Documents setting out the long term and short term approach to: • Management of the assets to achieve the required asset management objectives. • Balancing the cost, risk and performance of the assets over the complete asset lifecycle. • Making better asset management decisions. • Continual improvement of the asset management system to support the achievement of the asset management objectives. • Continual improvement of asset management.
Asset Management Plans	Documents specifying activities, resources, responsibilities and timescales for implementing the asset management strategy and delivering the asset management objectives.
CAPEX	Capital Expenditure
DRM	Demand Response Management
DWDM	Dense Wavelength Division Multiplexing
EMS	Energy Management System
ERP	Enterprise Resource Planning
HV	High Voltage
IED	Intelligent Electronic Device
IT	Information Technology
MWFM	Mobile Workforce Management
NCIT	Non-Conventional Instrument Transformer
NER	National Electricity Rules
OLCM	Online Condition Monitoring
OPEX	Operational Expenditure
OPGW	Optical Fibre Ground Wire
OT	Operations Technology

PSDCS	Power Systems Data Communications Standard
RET	Renewable Energy Target
SDH	Synchronous Digital Hierarchy
Secondary Systems Site Installation	Refers to the complete installation of secondary systems at a site and is inclusive of infrastructure, cabling, equipment, functional methodologies and generational standards.
SCADA	Supervisory Control and Data Acquisition

Figure 2: Definitions

4. Business Drivers

This section details the specific business drivers supporting the case for further investigation, research and development, and evolutionary long-term deployment of a future Smart Network.

These business drivers are as follows:

- TransGrid Business Plan 2016-2021[2]
- Network Vision 2056[3]
- Regulatory Requirements
- Commercial Opportunities

4.1 TransGrid Business Plan 2016-2021

TransGrid has identified the following three strategic themes to improve operational and financial performance:

- **Operational Excellence**: Driving improvement across our business, including health, safety and environment outcomes, outperformance in terms of operations and efficiency while meeting our reliability outcomes.

- **Customer Orientated Growth**: Improve our competitiveness for new business, drive costs down, promote strong customer service and support renewable energy.

- **Develop Our People**: Promote high productivity, agility and innovation in our employees, building a culture of performance through strong leadership

4.2 Network Vision

The TransGrid Network Vision 2056 is the organisations long term forecast on our electricity industry and how the business will need to adapt to effectively operate. The Network Vision essentially is broken down into the following key areas: current energy industry trends and how the consumer landscape is predicted to change; the business response to such change; and guiding principles to deliver the network of the future.

In order to meet the needs of the future, the network must be flexible, scalable and efficient. The Network Vision has identified the following four principals required to deliver such a network:

- Engage to understand
- Move from assets to services
- Invest for value
- Innovate through people, data and technology.

The proposed Smart Network Vision directly supports a number of key actions identified in the Network Vision 2056 document in both the near and long term future, some of which are as below:

[2] TransGrid Business Plan 2016-2021, http://thewire/dc/pr/cp/Documents/Our Business Plan 2016 2021 final.pdf

[3] TransGrid Network Vision 2056, http://thewire/OO/bu/AM/Documents/TransGrid_ Network_Vision_2056.pdf

- Supporting the development of more flexible reliability standards
- More flexible approach to connection designs and processes
- Piloting integration of local generation, storage and Automated Demand Response
- Using new tools and channels to pursue broader non-network opportunities
- Using automated substation secondary systems design (IEC61850)
- New technologies enabling field services at lower operating costs
- Develop more sophisticated services and service levels

4.3 Regulatory Requirements

A number of regulatory requirements are related to proceeding with the development of a Smart Network:

- Australian Energy Regulator (AER) Regulatory Framework
- Renewable Energy Target (RET)
- Australian Electricity Market Operator (AEMO) requirements

4.3.1 Australian Energy Regulator (AER) Regulatory Framework

All Smart Network development will be required to conform to the regulatory framework established by the AER. This involves justification of all investment based on a sound business case and clear identification of the need for development. This need shall then be supported by various technical solutions, corresponding economic analysis for assessing feasibility, development timing and associated risk assessments.

4.3.2 Renewable Energy Target (RET)

In 2015 the Australian Government amended the Renewable Energy Target scheme for large-scale generation to 33,000 GWh in 2020 which will represent approximately 23.5% of Australia's electricity generation.

The NSW government in September 2013 released the NSW Renewable Energy Action Plan[4] to guide NSW's renewable energy development and to support the national direction on renewal energy, and committed to achieving approximately 20% of actual electricity demand. The following goals and actions were set in this plan:

- Attract renewable investment
- Build community support
- Attract and grow renewable energy expertise

The Smart Network Vision will enable TransGrid to poise itself to take further advantage of significant amounts of renewable energy investment forecasted within NSW. For example the NSW government has recently provided support for 17 large-scale renewable energy projects, totalling a potential 4,500 MW of new capacity and $6 billion of investment[5]. This investment includes large-scale projects in solar farms, wind farms, and battery energy storage.

Developing the Smart Network would enable a more reliable, diverse and flexible transmission network for renewable energy customers to enter the NSW market.

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[4] NSW Renewable Energy Action Plan , http://www.resourcesandenergy.nsw.gov.au/energy-consumers/sustainable-energy/renewable-energy-action-plan

[5] NSW Renewable Energy Action Plan Annual Report 2015 (http://www.resourcesandenergy.nsw.gov.au/energy-consumers/sustainable-energy/renewable-energy-action-plan)

4.3.3 Australian Electricity Market Operator (AEMO) requirements

As per requirements within Chapter 4 of the NER, TransGrid, as a service provider, is to comply with various requirements surrounding the transmission of control, indication and operational metering data from all substations and connected power stations.

To implement these requirements AEMO developed the Power Systems Data Communications Standard (PSDCS) which defines performance requirements for SCADA data being provided to AEMO.

TransGrid's HV network will become more complex as demand for new services, such as renewables, increases. The demand for more real-time system data for these services (and existing services) is highly likely into the foreseeable future and will exert increasing levels of strain on telecommunications network infrastructure, and will be further compounded by the desire to connect third party services to the telecommunications network.

The Smart Network vision addresses such constraints and endeavours to ensure TransGrid compliance with AEMO requirements into the long term future.

4.4 Commercial Opportunities

There are numerous commercial opportunities within NSW that TransGrid are currently targeting. Of significance relating to the Smart Network vision include HV grid connection opportunities for new and diverse energy sources, and third-party telecommunication connections into the telecommunications network.

Developing the Smart Network will enable TransGrid to more seamlessly integrate a diverse range of energy source types including solar, wind and storage solutions, and importantly be seen by customers as the preferred choice to conduct business with. The implementation of a flexible more agile future network will also lower market barriers for customer connections by facilitating a negotiated alignment of risk profiles.

A key objective within the development of the Smart Network is boosting existing telecommunication services. Aside from enhancing TransGrid's overall reliability and compliance with the NER, a high speed high capacity telecommunications network will enable the on-selling of future spare capacity and access to third parties.

5. The Smart Network Vision

This section outlines TransGrid's proposed Smart Network vision for 2040, and the key levers ensuring such a vision is brought to fruition. TransGrid's vision is centred on the ideal of a singular integrated platform combining both Operations and Information Technologies. Figure 3 below illustrates this vision.

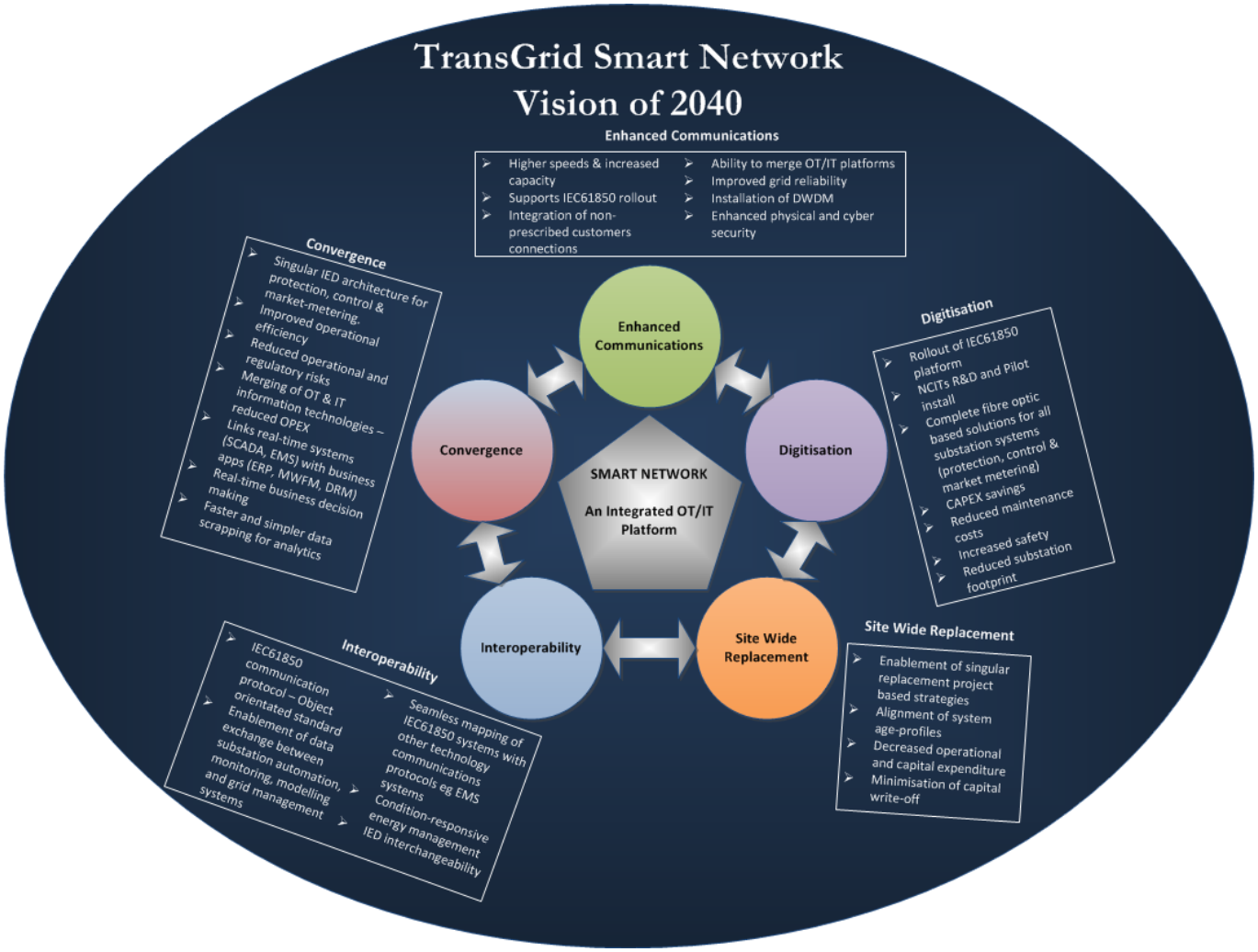


Figure 3: TransGrid Smart Network Vision for 2040

Five levers have been identified that are crucial to transforming the existing TransGrid secondary system landscape into the vision for 2040. These are as follows:

- **Enhanced Communications**: Communication infrastructure shall be capable of serving future big data demands in a fast efficient and secure manner
- **Digitisation**: Secondary systems substation design will move to fully integrate digital interfaces with the HV network
- **Site Wide Replacements**: Enhancing asset management outcomes through more cost effective processes and utilisation of modern digital technologies
- **Interoperability**: Barriers of traditionally siloed network stakeholders are eliminated through development of an interoperable network where meaningful information is readily exchanged and acted on

- **Convergence**: Methodical evolutionary process of vertically aligning operations and information technologies to enhance automation and grid intelligence

5.1 Line of Sight with Technology Strategy

The TransGrid Technology Strategy[6] outlines a strategic plan for organisational technology and defines both the evolution process and how new technologies will be best integrated to achieve the business goals. Figure 4 below illustrates line of sight between the Smart Network Vision and TransGrid's technology strategy.

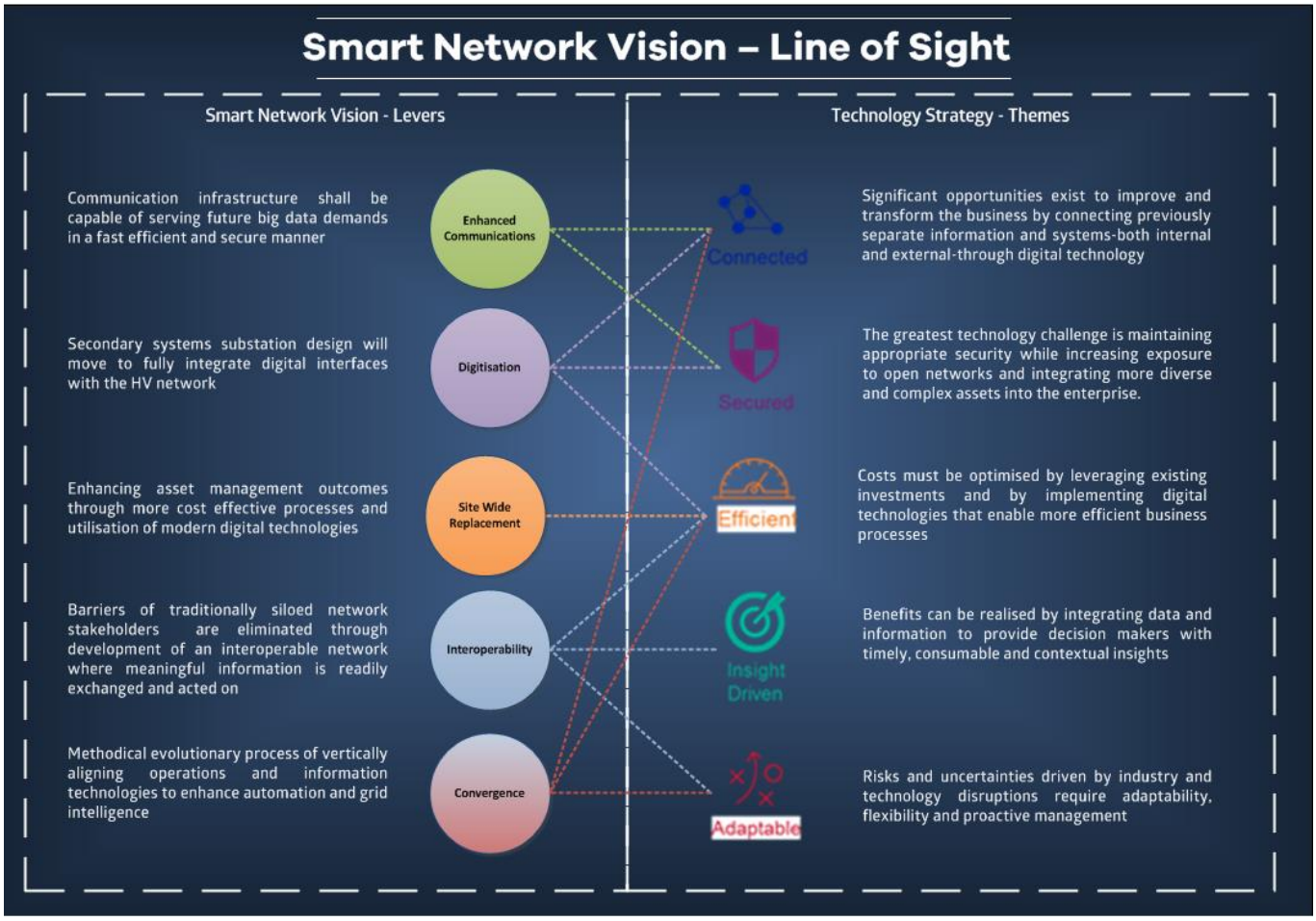
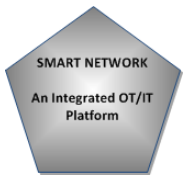


Figure 4: Network Vision Line of Sight

5.2 Roadmap

The Smart Network roadmap is illustrated in Appendix A and details all key regulatory periods until vision fruition. Importantly it illustrates how key milestones are linked between regulatory periods and how the vision realisation has been phased. The regulatory periods covered within this roadmap are as follows:

- RP1 (2014 – 2018)
- RP2 (2019 – 2023)
- RP3 & RP4 (2024 – 2028, 2029 - 2033)
- RP5 (2034 – 2038)



[6] TransGrid Technology Strategy 2017-2023, http://thewire/projects/ICTTeam/SS/ITPS/Strategic Planning/TransGrid Technology Strategy 2017-2023 22 Nov.docx

- RP6+ (2040+)

The vision milestones can be broadly broken down into their relevant secondary system disciplines being SCADA/Operations Technology (OT), Telecommunications, Substations, Metering, and Protection & Control.

A number of key projects have been identified within each regulatory period that are of particular significance to the overall Smart Network development vision and are the keys to assist driving projects forward into subsequent regulatory periods. Those projects which have been identified in periods RP1 and RP2 carry their relevant Need ID references, and if initiated their project status.

5.3 Lever 1 - Enhanced Communications

TransGrid's current telecommunications capability will require reinforcement in order to adequately service data and communications demands of the future. As such existing technology and infrastructure will need to be boosted to ensure adequate bandwidth is available to accommodate the following identified future needs:

1. IEC61850 rollout to TransGrid substations
2. Demand for energy connections types relying on advanced network communications
3. Integration of third party services onto the TransGrid telecommunications network
4. Integration and alignment of operations and information infrastructure
5. Asset information 'Big Data' strategy
6. Real-time predictive analytics
7. Network Operations Centre (NOC)

The enhancement of telecommunication services across the grid supports numerous key actions within the Network Vision such as a more flexible connection approach, use of new tools and channels, and development of more sophisticated services. Enhancing telecommunication infrastructure within the context of a smart network will drive strategic achievements in operational excellence, customer orientated growth and developing our people.

5.3.1 Path to Enhanced Communications

Program of Works	Description / Strategic Rationale
Upgrade existing SCADA/EMS systems, SDH communications network and SSZ network	> Toward the later end of RP2 a new SCADA/EMS system will be required based on the end of life condition of existing systems. This replacement will likely also be required due to technical incompatibilities as more modern telecommunications are deployed onto the TransGrid network. > TransGrid utilises SDH technology across the optical fibre and microwave telecommunications networks as the main backbone for data transmissions between substations, offices and depots, network control rooms and data centres. The existing equipment has reached end of life condition however can be managed into the RP2 regulatory cycle before requiring a full system upgrade. > The existing substation Security Zone (SSZ) infrastructure will reach end of life during RP2. It will be upgraded to take advantage of additional capacity to the communications network and future proof the system for increased demand as use of online condition monitoring, client-server based applications and IEC61850 become more prevalent. The upgrade will also enable more sophisticated cyber-security features to be integrated and therefore mitigating

Program of Works	Description / Strategic Rationale
	the increasing levels of cyber threats forecasted in the near future.
Increase capacity demands	Fibre optic network will be expanded to reach all 500kV and 330kV substations, and connected strategically as required to various 220kV and 132kV substations.
Establishment of high capacity protected telecommunication ring topology	Achieved by installing high capacity telecommunication bearers to close the network rings at key sites throughout NSW.
Rollout of DWDM terminal equipment	Aid in the replacement of microwave trunk systems throughout TransGrid's telecommunication network and will be essential for the deployment of future Operations and Information Technology (OT/IT) services

The telecommunications reinforcement strategy is expected to be completed within RP3 by 2028. The completion of this strategy will signify a major step-change within the TransGrid telecommunications network, with a now ultra-modern high speed, high capacity and flexible system. This system will break down the technological barriers limiting more advanced deployments in the areas of IP networking solutions, operations and corporate information systems, advanced substation security and mobility solutions.

The system shall have vastly superior cyber-security architecture compared to existing technology and will be more aligned with telecommunication standards used in modern IT systems.

5.4 Lever 2 - Digitisation

A digital substation is one where digital interfaces are fully integrated with the HV network, and as such there is no requirement to convert analogue signals to digital. This lever will cultivate employee innovation and directly supports the strategic theme of developing our people.

The TransGrid digital journey has been time-lined in Figure 5 below. At the end of this timeline are the proposed methods TransGrid will adopt moving forward in order to achieve full digitisation within the network.

A smart, digital, substation provides significant improvements in electrical safety, reliability and availability. The improvements are in alignment with driving operational excellence. Such intelligent systems will allow the operation of assets to be optimised and run closer to designed ratings, have lower overall maintenance costs, and reduce CAPEX expenditure. A digital system also introduces the interoperability factor not only within the local substation level (between IEDs), but more significantly at the wider area level allowing direct data exchange between substations.

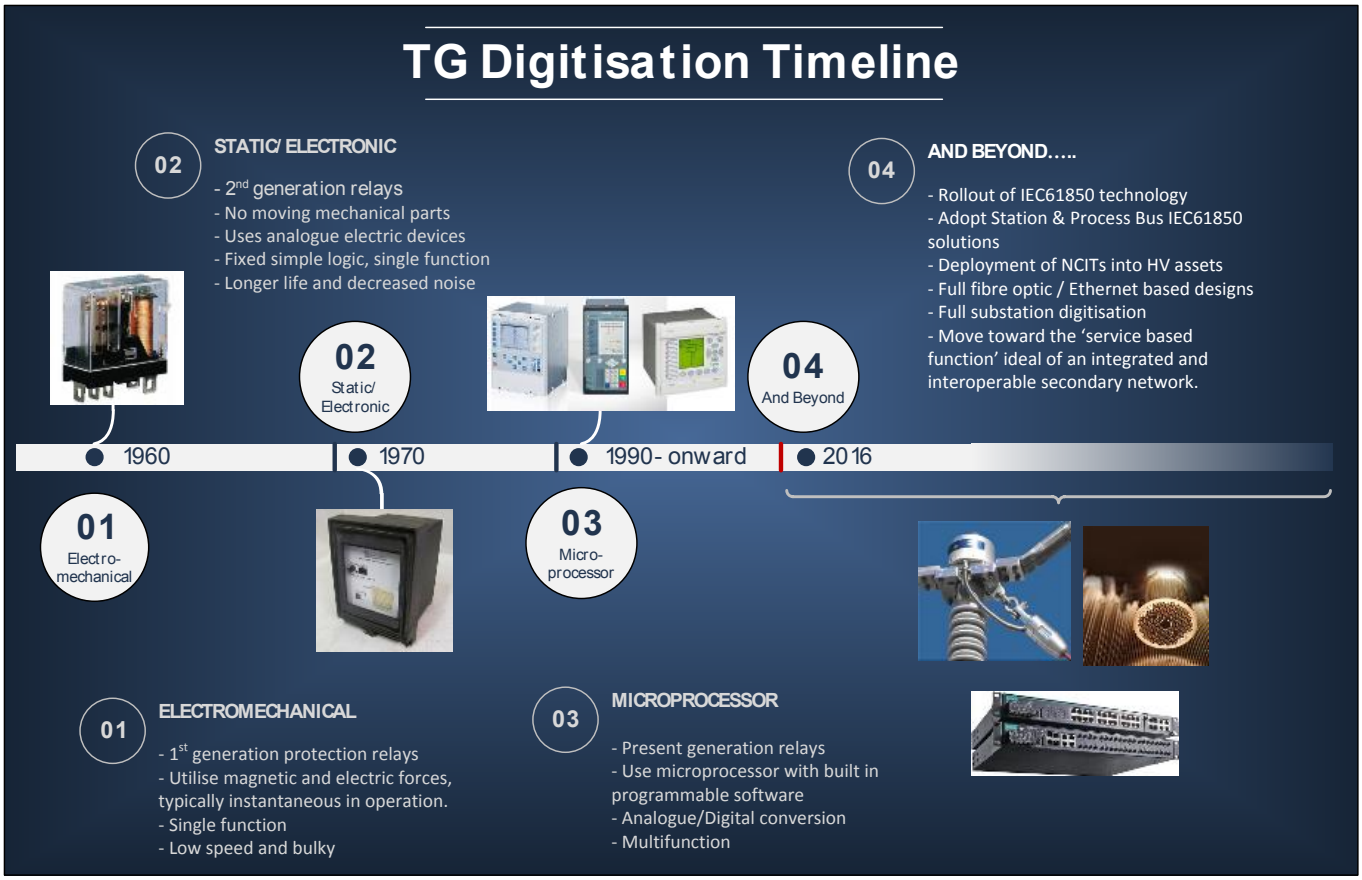


Figure 5: Digitisation Timeline

Adoption of the digital substation concept will require evolving our existing traditional copper cable substation solutions to ones centred on Ethernet and fibre optic based connections. The deployments of IEC61850 and fibre optic sensing units are key enablers in the path to digitising TransGrid substations.

5.4.1 Path to Digitisation

Program of Works	Description / Strategic Rationale
IEC61850 R&D, Vendor Selection & Pilot Installation	> An IEC61850 R&D development and deployment initiative commenced in 2014 in order to investigate the design and implementation of such technologies into the TransGrid network. > Prior to the end of RP1 it is expected that preliminary design methodologies, testing and the vendor selection processes is complete. It is also expected that the first pilot IEC61850 installation, at Avon 330kV Substation, is completed. This pilot installation is a key milestone in the vision roadmap and paves the way as a significant driver for future IEC61850 deployments, and the required business supporting technology and skillsets. > During the RP1 IEC61850 pilot installation phase it will be imperative to test the capabilities of IEC61850 compliant market meters within a live substation environment. This will initially be completed at Avon 330kV Substation which does not have market meter installations. Proving meter accuracy against existing standard requirements is a key milestone in this period and will allow subsequent testing at a marketed metering installation at a location determined during RP2.

Program of Works	Description / Strategic Rationale
	> The ramp-up of IEC61850 onto the TransGrid network is expected to begin within RP2. This will mark the commencement of a green field deployment phase and integration of IEC61850 technologies into more mainstream TransGrid substations. This deployment phase is expected to ramp-up toward the end of RP2. > As the rollout of IEC61850 technologies increases across the network, so too will learning and development programs aimed at up-skilling TransGrid staff on specific aspects of design, testing and maintenance knowledge in order to meet the demands required of new design philosophies.
Non-Conventional Instrument Transformer (NCIT) R&D and Pilot Installation	> The utilisation of Non-Conventional Instrument Transformers (NCITs) goes a step further in the digitisation transformation, and provides the ability to measure HV analogue signals via optic sensors. > An R&D project into the utilisation of Non-Conventional Instrument Transformers and a subsequent pilot installation shall be completed within RP2. The pilot NCITs will be installed in parallel with an existing bay in order to be directly compared with current in-service equipment. The following outcomes are expected: ▪ Successful accuracy testing against in-service protection, control and market-metering equipment ▪ Determination of best practice installation methods (including physical erection/retro-fit and cabling options) ▪ Determination of maintenance routines > Upon completion of the NCIT R&D and testing phases within RP2, it is expected that NCITs shall be a proven technology within TransGrid and a wider more standard deployment shall commence in RP3 and RP4. This is expected to enhance the drivers for IEC61850 by exploiting synergies and seamless integration between the two technologies. > As new NCITs are rolled out onto the TransGrid network various supporting Online Condition Monitoring methods (OLCM) shall be integrated into existing substation monitoring systems.

5.5 Lever 3 - Interoperability

The ability of two or more networks, systems or devices to freely exchange and utilise meaningful information is a necessary trait for any smart network. The TransGrid information network will transition from a historically siloed interconnection of grid stakeholders to a network of interoperable systems. That is, different systems will be able to exchange meaningful, actionable information between two or more systems across organisational boundaries. The systems will have a shared meaning of the exchanged information, and an agreed expectation for the response to information exchanged.[7]

[7] GridWise Architecture Council, Interoperability Path Forward Whitepaper, November 30, 2005 (v1.0)

The development of an interoperable network directly supports TransGrid's strategic theme of customer orientated growth. Significant improvements across the business are envisaged through the use of readily available holistic grid information. Such information will allow the business to become more competitive when targeting new business and more agile for the connection of renewable energy generation.

Figure 6 below depicts the interoperability evolution process illustrating historical, present and future methods of how various grid stakeholders have interworked.

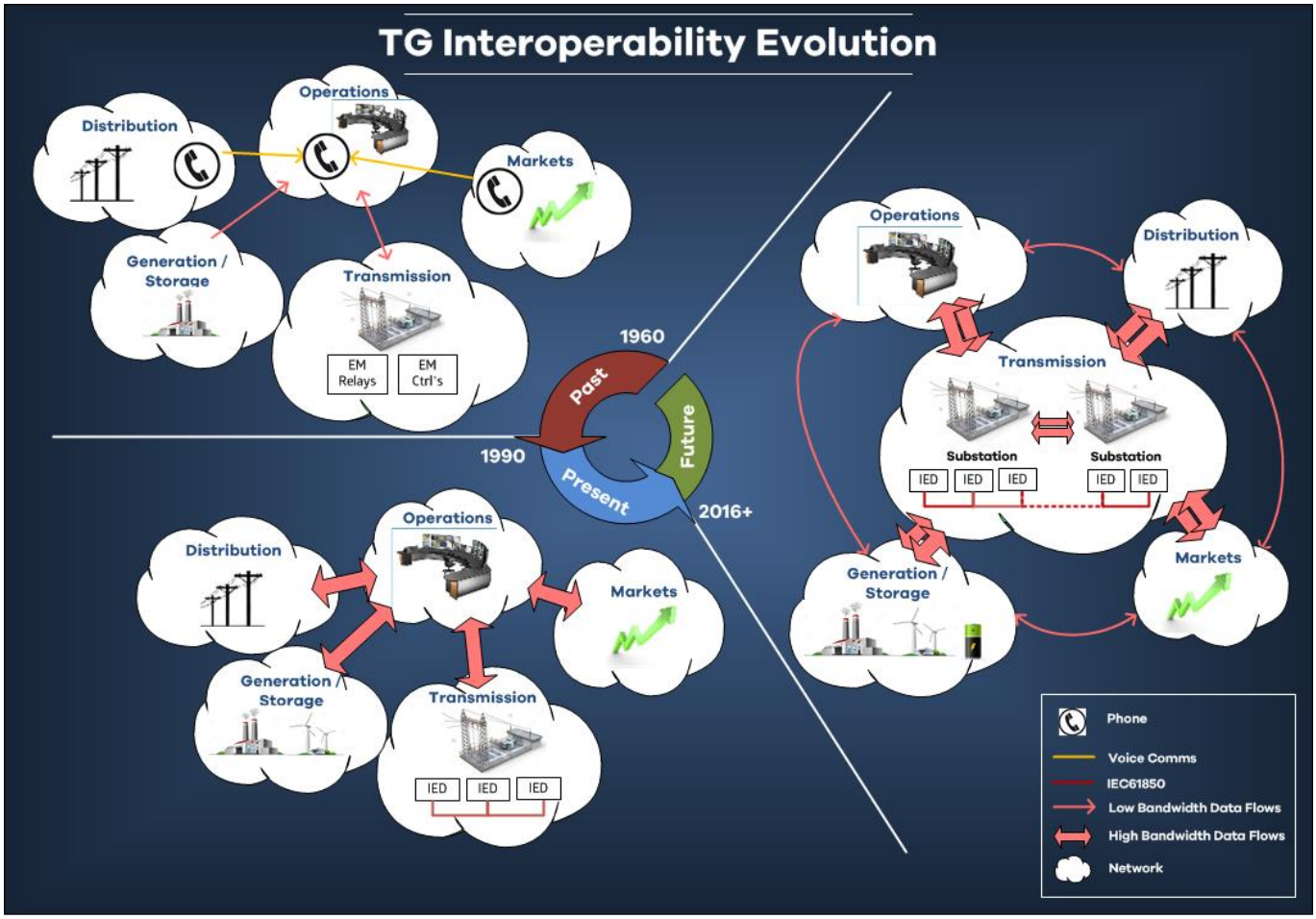


Figure 6: TG Interoperability Evolution

The vision of TransGrid's future Smart Network is one that features open, scalable and interoperable systems supporting seamless exchanging of information. It is expected that developing interoperable systems into future network designs will have many advantages including:

- Improved utility and Grid reliability through enhanced data flows between generation and transmission stakeholders likely reducing the need to customer load shedding and risks of blackout events.
- Allowance of more autonomous grid operations based on deductions gathered from shared information, therefore reducing switching decision times in contingency/emergency situations, and as autonomy increases possibly even the prevention of such cases arising.
- Lower Grid capital costs through the effective use of an information rich smart network
- Enablement of data exchange between substation automation, monitoring, modelling and grid management systems
- Seamless mapping of substation devices with other grid systems (eg EMS)
- Enhanced condition-responsive energy management decision making

- Enablement of data exchange between IEDs from different manufacturers
- Interchangeability of substation IEDs between manufacturers

5.5.1 Path to Interoperability

At the substation level deployment of IEC61850 based devices and systems will drive the ability to freely exchange information between individual IEDs and higher level control services. The evolution of interoperability is predicted to begin within the substation and occur as a natural consequence of IEC61850 technologies being deployed. At this level interoperability is linked to the Digitisation lever and therefore resulting advantages are expected to be seen from RP3 onwards.

Entering the realm of interoperable systems with other major grid stakeholders including operations, generator and storage plants, distributors and market operators requires significant steps forward. In order for this ideal to reach fruition, all stakeholders within the future grid sphere need to be identified and engaged to develop a common understanding of interoperability and specific information needs. This will be a complex engagement task intrinsically linked with the willingness of stakeholders to accept grid-wide change and take the necessary steps to implement interoperable systems. This process of engagement will likely begin sometime within the RP3/RP4 periods.

5.6 Lever 4 - Convergence

Convergence of technologies is a central theme of TransGrid's Smart Network of 2040, and is in direct support of all three long term TransGrid change initiatives. At this point the grid vision will be one of real-time monitoring with integrated sets of interoperable sensors, monitoring devices and management systems supported by a fast and reliable telecommunications network

At an overall grid level, the key concept of convergence is a vertical alignment of both operations and information technologies and linking systems that have traditionally operated in isolation. At a lower substation IED level, this concept will drive the need for deploying a suite of new generation IEC61850 compliant IEDs allowing the convergence of protection, automation and market-meter capabilities.

A transition toward this vision is required in order to enhance the automation and intelligence of grid operations, and begin addressing a copious number of concerns such as reducing operational and capital expenditure to meet new AER regulatory requirements. This transition process is illustrated in Figure 7 below.

The following advantages have been identified as a result of convergence:

- Singular IED architecture for protection, control & market-metering
- Improved operational efficiency
- Reduced operational and regulatory risks
- Reduced OPEX from a merged OT/IT system
- Links real-time systems such as SCADA and EMS with business applications such as ERP, MWFM, and DRM
- Enablement of real-time business decision making based on grid conditions
- Faster and simpler data scraping for analytics using a singular shared service communication network

5.6.1 Path to Convergence

The path to system convergence will be a methodical evolutionary process premised on the success of all other identified levers in realising the smart network vision. As per the roadmap in Appendix A this process is expected to yield a converged OT/IT platform within the RP6 regulatory period. The convergence of substation functions into IEDs has already begun within RP1 and will continue to develop toward the ideal of a 'service' based function approach as referenced by the supporting action within the Network Vision.

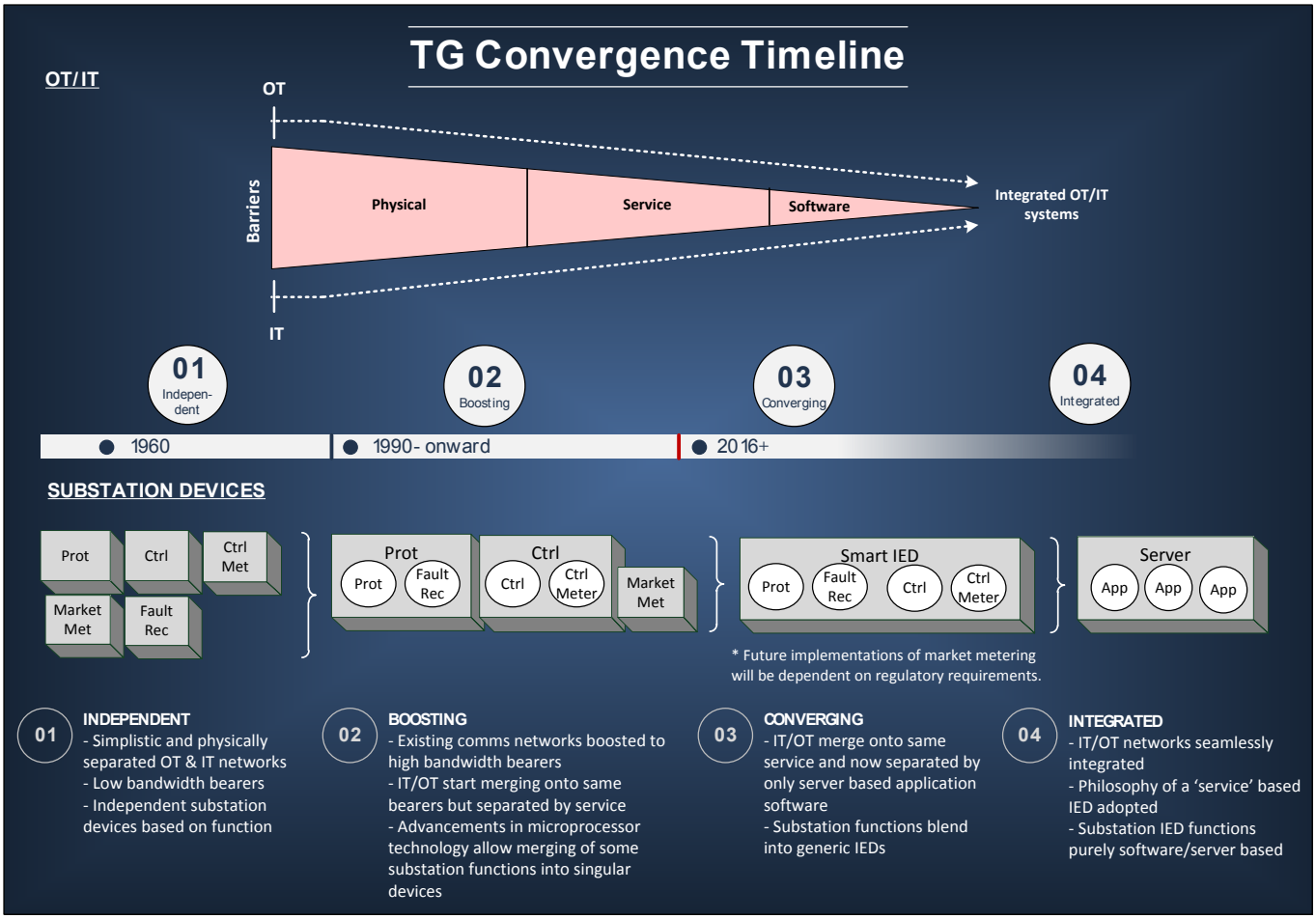


Figure 7: TG Convergence Timeline

5.7 Lever 5 - Site Wide Replacement

The execution of an effective site wide only replacement strategy is a key lever in achieving the Smart Network vision. Such a strategy will allow the unification of entire secondary systems at a particular site, at a particular point in time, with modern technology enabling the facilitation of integrated OT/IT platforms. This lever is particularly linked with the operational excellence strategic theme as will drive efficiencies not only across asset management but also the business in general.

Details of the site wide only replacement initiative are covered within the Secondary System Site Installations Renewal and Maintenance Strategy[8].

A successful site wide replacement strategy is expected to provide the following additional benefits:

- Streamlining of the asset management process with more cost effective strategies utilising modern technology
- Enablement of singular replacement project based strategies
- Normalisation of system age-profiles
- Decreased operational and capital expenditure
- Minimisation of capital write-off

[8] SSA Strategy - Renewal and Maintenance -Secondary Systems Site Installations

- Platform commonality
- Enhanced features
- Reduction in overall asset base count

5.7.1 Path to Side Wide Replacement

From RP5 onward individual asset replacements will cease and the adoption of site wide only secondary system replacement projects will commence. This initiative marks an evolutionary transition away from current risk based approaches on individual secondary assets, and toward a strategic focus on substation level assets.

As illustrated in the Appendix A Roadmap the path to effective site wide only replacements is heavily reliant on:

- Matured IEC61850 and NCIT designs and their employment in brown-field applications
- Substation analytics to determine substations that are feasible to replace and when
- Formulation of a robust and tangible asset management site-wide replacement strategy
- Available capital to finance a site wide based replacement strategy
- Sufficient business resources to successfully execute a heavy replacement program of works

6. Change from previous version

Revision no	Approved by	Amendment

7. References

Nil

8. Attachments

Appendix A – TransGrid Smart Network Roadmap

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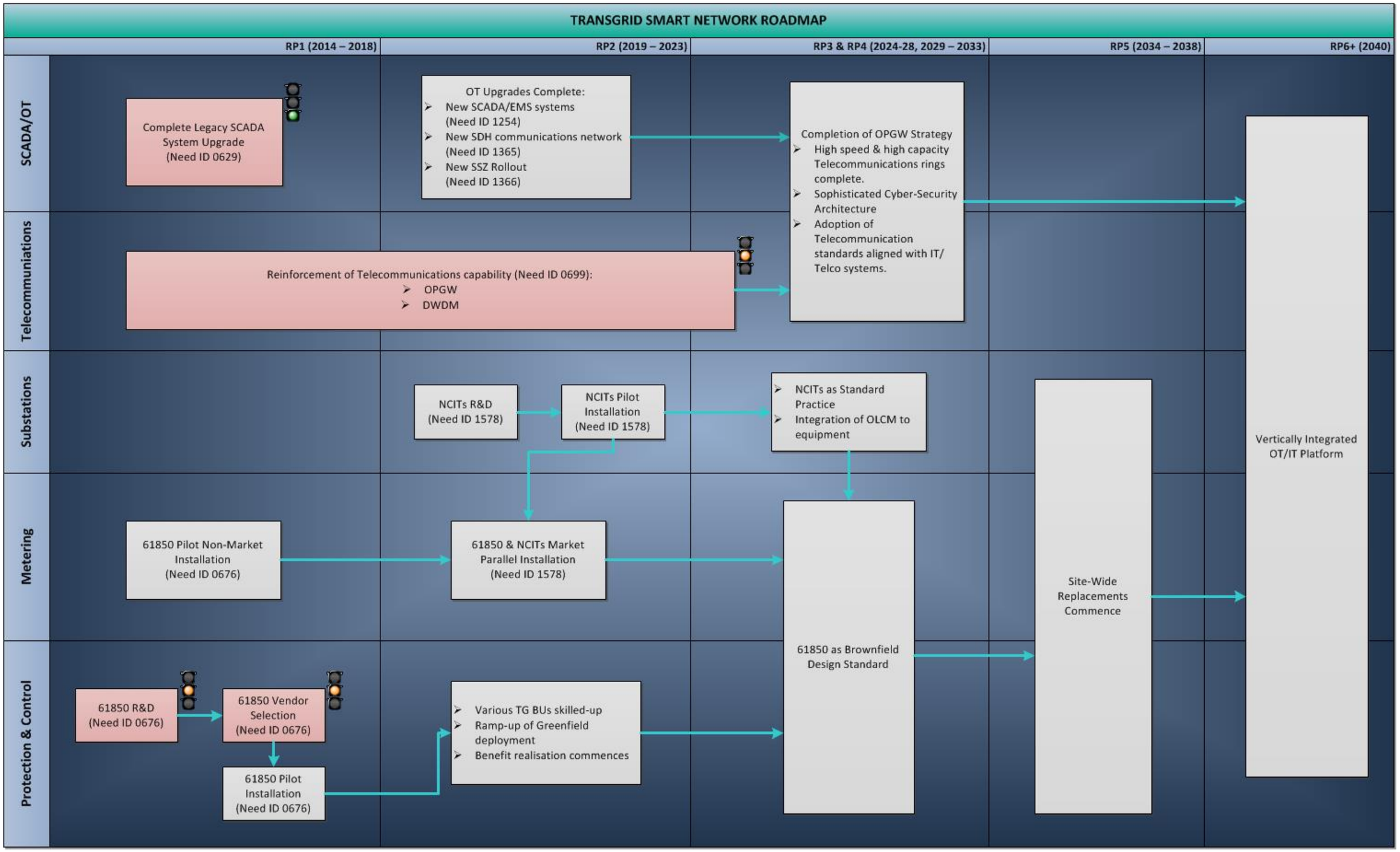

Figure 8: TransGrid Smart Network Roadmap