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SMART GRIDS FOR SMART CITIES

STRATEGIC OPTIONS FOR SMART GRID COMMUNICATION NETWORKS

To meet the goals of a smart city in supporting a sustainable high-quality lifestyle for citizens, a smart city needs a smart grid. To build smart cities of the future, Information and Communications Technology infrastructure will be a key enabler, and strategic choices made by utilities today have the power to transform society tomorrow.

THE FUTURE BELONGS TO THOSE WHO PREPARE FOR IT TODAY

To meet the goals of a smart city in supporting a sustainable high-quality lifestyle for citizens, a smart city needs a smart grid. To build smart cities of the future, Information and Communications Technology (ICT) infrastructure will be a key enabler. In this way, the ICT infrastructure choices made by utilities today have the power to transform society tomorrow.

Utilities are currently discussing opportunities and challenges associated with a wide range of issues when contemplating the future demands for smart grid communication networks, which include:

- Technology choices
- Private/public network sharing possibilities
- Mass deployment of cheap wireless sensors
- Electric vehicle charging
- Home energy management solutions
- The rise of the 'Prosumer' (i.e. consumers who are also producers and participate in the energy market)
- New "smart" communications requirements from water and gas utilities; and
- How to handle large scale data analysis.

Clearly, smart grid technology alone is not the answer. Also required is a new way of thinking about the underpinning ICT business models and supporting industry structures necessary to realise the investment and drive innovation to ultimately benefit society.

So, what are the strategic options available to a utility when considering their evolving smart grid communications network requirements? Specifically, how do they plan for the expected changes and challenges in the near future?

The following paper discusses some of these considerations and explores the strategic options available. Effective strategic planning will help to future-proof investments and enable new business models to assist in meeting business case hurdles, whilst providing flexibility for tomorrow's smart city requirements.

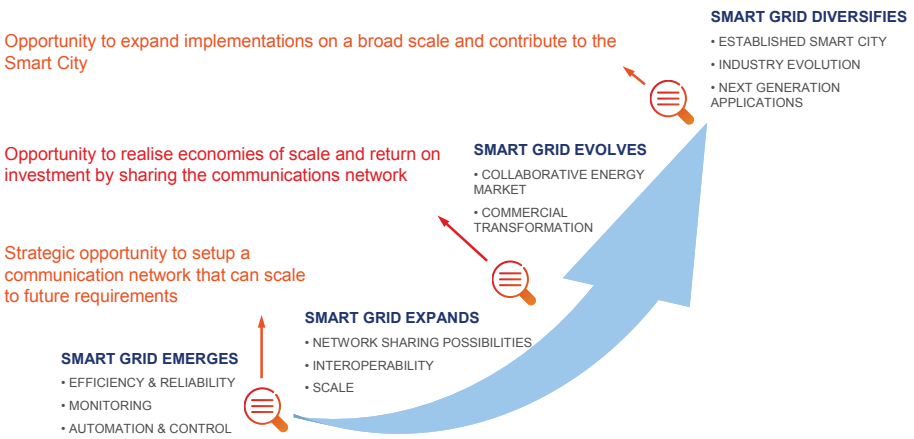

Figure 1 - The smart grid evolution

As depicted in Figure 1, smart grids of the future will evolve through multiple stages. No one can predict the future, however it *is* possible to plan for it.

When considering evolving IT and communications network requirements, it is useful to employ a structured approached which identifies the key strategic considerations at various stages of evolution. These considerations may include:

- Today's business and operational requirements
- Possible network sharing opportunities
- Government regulations and reforms
- Global industry developments and standards
- Electricity grid and ICT technology evolution
- End consumer demands and requirements; and
- Future smart city requirements and opportunities.

The methodology shown in Figure 2 aims to ensure the utility communications network can evolve to meet immediate business and operational needs, whilst positioning the utility to take advantage of the opportunities presented by a smart city future.

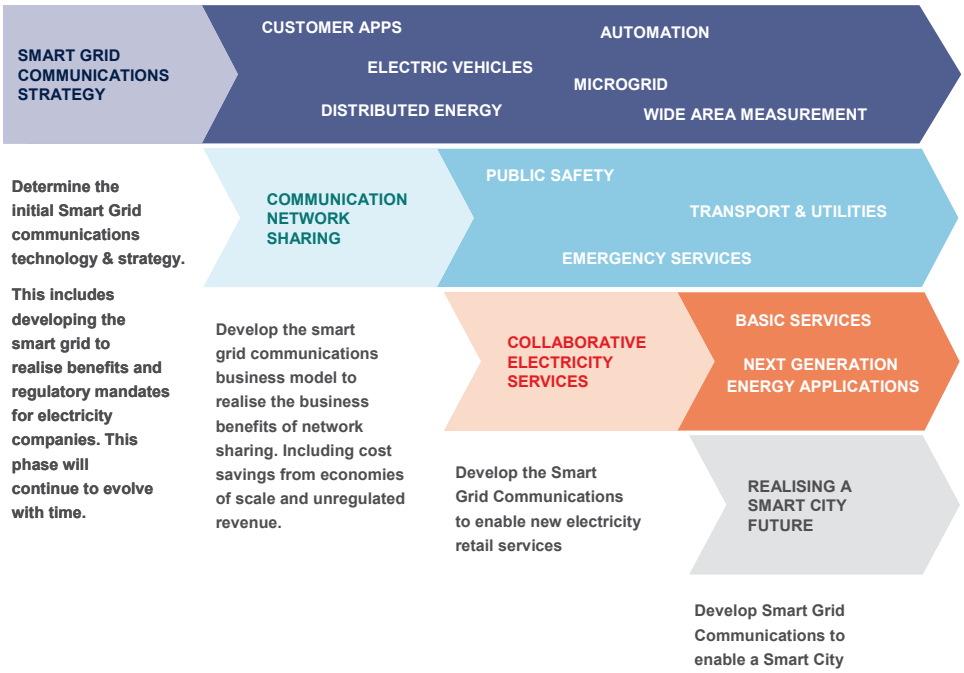

Figure 2 – Future-proofing a utility's communications network investment

This document expands on the four elements to be addressed within the structure of Figure 2, including:

- Smart grid communications strategy – how to integrate existing communication elements into a future-proof roadmap
- Communications network sharing possibilities – how to maximise the potential benefits of shared infrastructure
- Collaborative electricity services - how to support an increasing range of value-added energy services; and
- Realising a smart city future – how to leverage synergies through collaboration with others to position for the smart city future.

In order to future-proof a utility's communication network investment, all elements must be considered upfront as part of a comprehensive strategic plan.

The pressing challenge today for utilities is to select and deploy new communications infrastructure, as well as determine how to integrate to existing infrastructure to meet immediate regulated expectations. However, it is also evident that to achieve the vision of smart cities, the utilities, the broader industry, the regulator and government will inevitably be drawn to realise a more holistic and far-reaching plan. Considerations for this more complete planning approach are discussed as further sections in this document and require not so much technology solutions, as new business models, partnerships and industry structures.

SMART GRID COMMUNICATIONS STRATEGY

ICT decisions are made given today's business, regulatory and operational needs, as well as with a view towards future requirements.

When evaluating the various technology choices, many communication specific aspects must be taken into account, such as:

- Total Cost of Ownership and Return on Investment analysis for each applicable technology
- Evaluation of the life cycle of each technology and its impact on costs and business
- Capability of the technology to support short term smart grid communications requirements, as well as the potential to scale to meet future long term requirements and to operate with other communications networks; and
- Long term evaluation of network and device price forecasts for each technology.

A capability assessment of the various technology options is required in order to understand if they will adequately support the immediate and future requirements of the smart grid.

For technologies that are in place, for example Power Line Carrier (PLC), strategies can be devised to integrate them with newer technologies, potentially incorporating technology migration strategies.

Where new communications technologies are to be selected, a future-proof choice will invariably prefer standards-based communication offerings with a well-developed manufacturer eco-system. The benefits of such an eco-system are mass-market adoption, network and device availability and economies of scale. An example of a well-developed eco-system is the 3GPP (3rd Generation Partnership Project) technology family, which has an industry delivering millions of interworking devices to billions of users, and offers a guaranteed future evolution path and certainty of support for past, present and future technologies as they continue to evolve. See Figure 3.

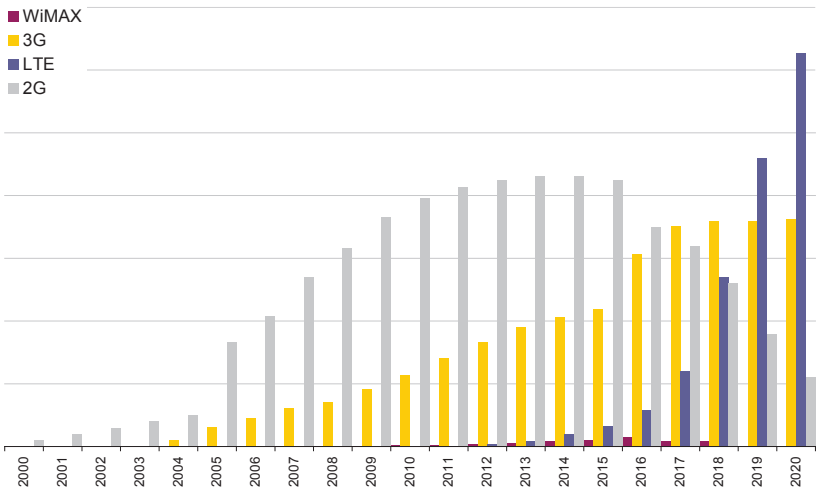

Figure 3 – Global number of wireless devices

In the case of wireless communications, a standards-based technology selection also provides licensed spectrum certainty. A particular aspect of planning wireless communications infrastructure is a comprehensive understanding of the implications of choice of spectrum, as this will underpin the performance and future capabilities of a smart grid communications network.

For existing utilities and regions, it is probable that a range of technology types will be integrated to make up the fabric of the future smart grid and smart city infrastructure, including fixed, cellular and other wireless communications technologies. Figure 4 illustrates the multi-purpose and multi-technology aspects of smart grid communications.

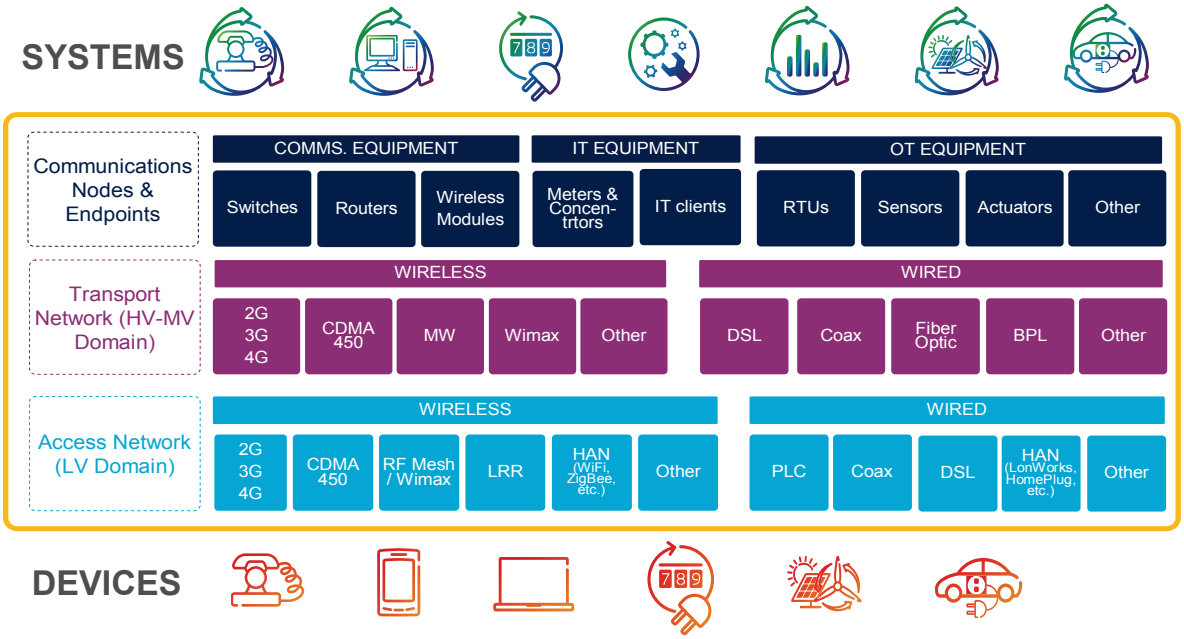

Figure 4 – Multi-purpose and multi-technology smart grid communications

THE IMMEDIATE CHALLENGE FOR UTILITIES IS TO INTEGRATE EXISTING COMMUNICATION ELEMENTS WITH NEW, MORE FUTURE-PROOF TECHNOLOGIES

COMMUNICATIONS NETWORK SHARING POSSIBILITIES

How does a utility ensure that it's specific communication Service Level Agreements (SLAs) are met, whilst having access to the latest ICT communications specialists and technology?

As utilities build smart grids, they may choose whether or not to constrain their communications network to meet their own needs, or to grow in such a way that they can share their communications network with other organisations and potentially other sectors such as public safety organisations.

Network sharing can open many possibilities for evolving smart grid requirements, whilst at the same time allowing business case hurdles regarding CAPEX and OPEX to be met. Differentiation of smart grid services from conventional broadband services can be achieved through SLA-based agreements and new network models.

Communications network sharing creates possibilities that not only bring financial benefits to the utility, but by supporting other industry sectors may justify particular regulatory support. Indeed, by planning at the regional or national level, an industry-based approach allows for more powerful and effective influencing of government and regulators on industry-specific issues, such as spectrum access and energy-specific smart city requirements.

A business model where the costs and benefits inherent to network sharing can be realised is dependent on having a communications technology that is inherently suitable for network sharing.

In order to assure the best investment returns, analysis of the following will determine the optimal timing of deployment:

- **Investment case** including capital and operational communications network expected future cash flows; and
- **Strategic analysis** of network sharing opportunities and other organisations capability to do so; including strategic positioning that could affect regulatory and budgetary approval.

Network sharing not only allows utilities to collaborate, it also provides the flexibility to benefit from accessing public (telco operated) networks where needed, for example in order to address coverage black-spots or introduce additional redundancy.

Naturally, each network sharing opportunity requires specific analysis to determine the potential impact on communications network coverage, capacity, billing systems and interoperability.

NETWORK SHARING CAN BE ABOUT A UTILITY OFFERING USE OF IT'S COMMS INFRASTRUCTURE TO OTHERS, OR THE UTILITY MAKING USE OF OTHER ORGANISATIONS' COMMS INFRASTRUCTURE - OR A COMBINATION OF BOTH

COLLABORATIVE ELECTRICITY SERVICES

A smart grid will be instrumental in enabling value-added smart city services – and the possibilities are endless.

For example, electric vehicles today are emerging as a revolutionary automotive reality that requires leadership and ICT transformation from the energy sector. Charging the vehicle is merely one requirement for ICT solutions. The car of the future smart city will have multiple applications requiring connectivity, served by multiple providers. An integrated communications network architecture is the only way to efficiently deliver this outcome.

Another example of a value-added service is the control, monitoring and remote diagnosis of home appliances, including white-goods, consumer electronics, pool pumps and heating / cooling systems, all of which contribute to peak-load and directly affect end user expectations on energy companies.

Preparing for these exciting and emerging opportunities is no small task. It requires planning today for a relevant smart grid communications network strategy, including:

- Choice of technologies and the necessary architecture to enable integration of multiple solutions and services, including capabilities and future migration paths
- Service provisioning, operations support, data collection and integration into charging and billing systems
- Security considerations; and
- Monitoring / control modules and associated capabilities.

Co-operation today between the electricity distributors and retailers and potentially new value-adding retailers is required in order to plan for the likely collaborative energy services to be delivered tomorrow. This will ensure that relevant service delivery architectures and appropriate communication networks are considered today in preparation for a smart city future.

The business models and communications infrastructure must consider the entire energy value chain, including efficient energy generation, transmission, distribution, billing and revenue management from a growing number of distributed energy sources, as shown in Figure 5.

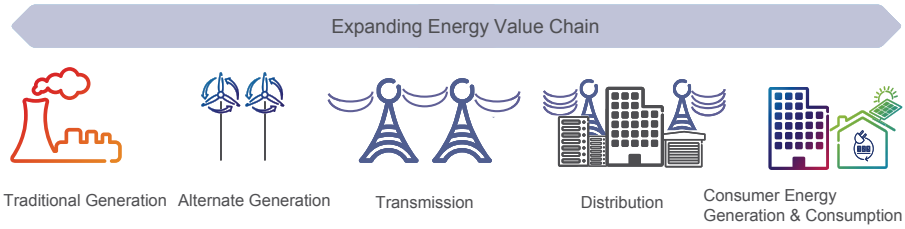

Figure 5 – The expanding energy value chain

UTILITIES IN A SMART CITY MUST PROVIDE GRID AND COMMUNICATIONS CAPABILITIES TO SUPPORT THE FUNCTIONING OF A WIDE RANGE OF VALUE-ADDED ENERGY SERVICES

REALISING A SMART CITY FUTURE

Holistic scenario planning can help to identify which specific investments being considered today by the utility can be leveraged by other industry sectors in order to help justify business case and regulatory approvals.

Globally, Ericsson envisions there will be 50 billion (mainly machine-to-machine) connected devices by 2020, including devices such as grid switches and sensors, smart meters and connected in-home appliances. These devices in their own right will generate vast quantities of data which must be analysed, interpreted and acted upon. This presents both challenges and opportunities to utilities and to those organisations that would benefit from access to this data, and the subsequent services that may be offered.

As depicted in Figure 6, in a smart city this data is likely to be partly carried by the smart grid communications infrastructure and partly on broadband communication services. In a smart city there will be much higher value placed on the synergies that arise by combining data derived from multiple sources. A real world example is the forecasting of energy demand hours in advance, by combining data from broadband connected weather sensors and smart grid load sensors.

Ericsson is working with key global industry and academic researchers to measure, report and forecast the global implications and developments of smart cities – including the global industry adoption of communication technology, global smart grid evolution and regulatory reforms.

Incorporating these developments into a utility's communications requirements today will equip the organisation to take advantage of the exciting possibilities of the future.

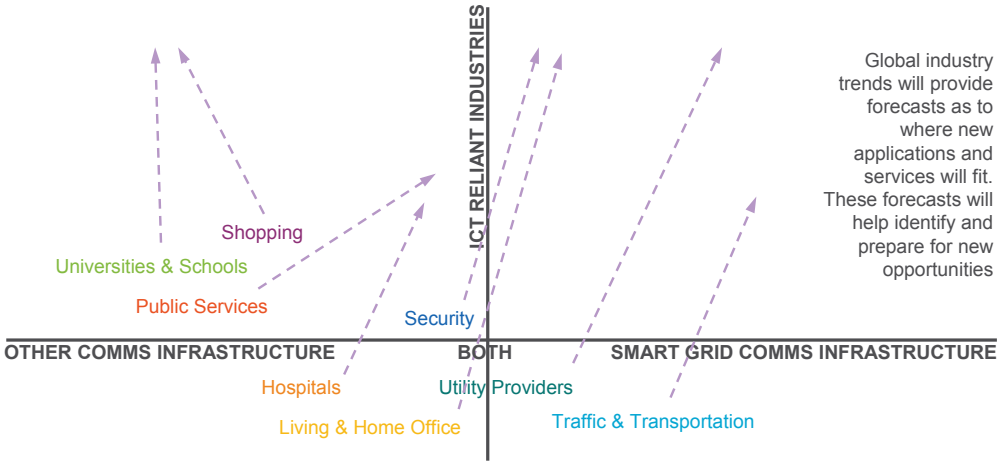

Figure 6 – Multi-sector synergies over communications infrastructure

IN THE SMART CITY OF THE FUTURE, EXTENSIVE DATA FLOWS FROM NUMEROUS SOURCES WILL BE CARRIED OVER MANY COMMUNICATIONS NETWORKS TO BE ANALYSED, INTEGRATED AND ACTED UPON TO THE BENEFIT OF ALL

ENVISIONING A SMART FUTURE

Ericsson calls the new emerging society that will be inherently transformed by ICT, the Networked Society. Based on Ericsson's Networked Society City Index , there is a strong correlation between ICT maturity in the world's largest cities and their 'triple-bottom-line' (social, economic and environmental) development.

There is a role for utilities to play in driving innovation to create integrated energy and ICT solutions, helping us all to prosper in a resource constrained world through provision of the enabling infrastructure for society to live 'smarter'.

While utilities have a long history of leveraging IT systems and data communications, notably for electricity transmission networks, the new smart grids will require considerably more investment in time, skills and capital into ICT than was ever required previously. The level and complexity of the task requires a different order of strategic planning than was previously the case.

A robust evaluation of a utility's strategic options will help to assure the right communications technology strategy is devised to meet immediate smart grid requirements, and to future-proof long term investments for tomorrow's smart cities.

Employing a structured approach, consideration must be given from the outset to a number of key areas, including:

- The utility's over-arching strategy for smart grid communications and how to integrate both existing and new communication elements into a future-proof roadmap
- Possibilities for communications network sharing to optimise the potential technical, commercial and strategic benefits of shared infrastructure for the utility and its customers
- New business opportunities arising from supporting an increasing range of value-added energy services; and
- Opportunities for collaboration and innovation to position for a smart city future.

Ericsson is today the world's largest provider of communications technology and services. Working with telecoms, utilities as well as other industries, we are committed to helping to unlock the 'smart possibilities' of the emerging Networked Society.

Talk to us about what Smart Grids for Smart Cities can mean for you.

SMART POSSIBILITIES

ABOUT ERICSSON

Ericsson is the world's leading provider of communications technology and services. We are enabling the Networked Society with efficient real-time solutions that allow us all to study, work and live our lives more freely, in sustainable societies around the world.

Our offering comprises services, software and infrastructure within Information and Communications Technology for telecom operators and other industries. Today more than 40 percent of the world's mobile traffic goes through Ericsson networks and we support customers' networks servicing more than 2 billion subscribers.

We operate in 180 countries and employ more than 100,000 people. Founded in 1876, Ericsson is headquartered in Stockholm, Sweden. In 2011 the company had revenues of SEK 226,9 billion (USD 35,0 billion). Ericsson is listed on NASDAQ OMX, Stockholm and NASDAQ, New York stock exchanges.

Visit www.ericsson.com/yourbusiness/utilities to learn more about Ericsson's offerings for the utilities industry and the work we're doing with our existing utilities customers around the world, including Ausgrid (Australia), Acea (Italy) and Hydro-Quebec (Canada).

Ericsson – innovating to empower people, business and society.

ERICSSON PROFILES

YOCHAI GLICK is a Senior Utilities Subject Matter Expert at Ericsson Australia & New Zealand with responsibility for defining AMI, smart grid and M2M solutions and the their integration with ICT systems for local utilities customers. Yochai represents Ericsson as part of a number of industry bodies and is also involved in smart grid research collaboration between academia, utilities and industry.

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