NOKIA

The Digital Economy: Opening up the Conversation

A response to the Australian Government's Consultation

Foreword

Nokia is a global company investing significantly in the human possibilities of digital technologies. These technologies are driving an accelerating transformation of whole economies and societies. There is much to gain but also much to lose if a country is not prepared. Nokia applauds the Federal Government in its leadership of a strategy for Australia's Digital Economy. In response to the Government's invitation, Nokia offers its perspectives on practicalities for a successful Digital Economy.

Introduction

Nokia welcomes the opportunity to respond to the Australian Government's consultation, *The Digital Economy: Opening up the Conversation*. The consultation is considered timely as the world is accelerating into an exciting digital future. Australia's ongoing economic prosperity and social well being will depend upon securing competitive and social advantages in this future. As the Consultation paper acknowledges, *"the rest of the world will not wait for us."*

As recently as June 2017, the United Nations Broadband Commission published a report examining policies and regulations which can help governments advance national digitalisation. Nokia has long been a voice advocating the benefits of this future and Nokia's CEO, Rajeev Suri, was appointed to chair the global Working Group. Under his stewardship a team of leaders from across industry, government and academia produced a report highlighting the very different basis for future economic and social development. They made specific recommendations to all governments on aspects including the need for national strategies, collegiate working, data sharing, seed funding, education and awareness. They also raised a similar warning, there is no room for complacency.

Underpinning the digital economy is a historically unprecedented level of hyper-connectedness across the globe. Hyper-connectedness is a phenomenon and describes our world evolving from billions of digitally connected people to tens of billions of connected people and "things." This is a new commodity world of massive scale connectivity, extreme automation and mass customisation. It demands visionary leadership and open mindedness to significant possibilities for innovation.

Innovation leverages the new scale of device connectivity and the prolific volumes of collected data being fed into ever-more sophisticated analytics-based applications. Inevitably, traditional sector operations will be disrupted or dislodged. This is because value chains are being simplified or shortened. New emerging technologies such as Blockchain will perpetuate the trend.

Countries which thrive in this era will be the ones that both harness innovative digital ecosystems and embrace new market dynamics. Markets will rise and fall with greater frequency. Markets will no longer be uniquely defined within national boundaries or in sector isolation. Increasingly markets will redefine themselves around streamlined consumption. In agriculture for example there is the concept of paddock to the fridge. This ties a farm directly to a served household. More than ever before this is a likelihood.

Australia has many attributes to succeed in the digital economic era. However, it will need to better enable the new digital ecosystems and actively cultivate the new market dynamics. A suggestion and practical way forward might be to recast the role of every Australian city as engine rooms of the digital economy to experiment more deliberately.

Responses

1. How are advances in digital technology changing the way you work, your industry, and your community?

   Nokia response- Digital Technology is driving unprecedented network automation to reduce costs, elevate functional quality, increase service performance and improve customer service satisfaction. Examples of automation include use of drones for infrastructure installations, autonomous performance optimisation of networks in response to service types and traffic volumes, automatic proactive problem identification and resolution, service configuration on demand and agile development of new network services. The automation is enabled by extensive investments in infrastructure and operational software systems, 360-degree data collection, embedded end to end cyber security, artificial intelligence engines, innovation platforms and innovation ecosystems.

2. What is your vision for an Australia that thrives in a digital economy? Where would you like to see Australia in five, 10 and 20 years' time?

   Nokia response – Australia might target a future where it is a global maker of new markets, drawing on a transformational culture and digital innovation prowess.
   5 years – *Australia's cities should be fully integrated into the digital economic development of Australia, underpinned by a City Digital Platform to standardise deployment and innovation practices.*

   10 years - *Australia's digital innovation ranking is within top 10 in the world, enabled because of its vibrant digital markets and the most productive innovation ecosystems across business, academia and government.*

   20 years – *Australia is celebrated for its sustained economic and social development and distinctive global leadership in at least four key digital market areas. Nominal digital market development suggestions:*

   1. Consumable Cities
   2. Consumable Agriculture
   3. Consumable Disaster Management and Public Safety
   4. Consumable Health

3. What is the role of government in achieving that vision?

Nokia response – It is important that Australia consider all three tiers of government to enable our digital economy.

Federal Government *should set strategy for digital economic development, cultivate national digital innovation, facilitate making of new digital markets and incentivise horizontal enablers*[Note 1] *to build Australia's digital foundation.*

State/Territory Governments *should cultivate economic agglomeration, integrate cities as platforms for digital economic development, facilitate ecosystem based collaboration, promote PPP financing*

Local Government *should be recast to become agents of the digital economy to localise economic agglomeration and champion the types of digital markets and innovation that will make a difference to Australia's economic base.*

Note 1: Horizontal enablers

Horizontal enablers will establish a digital foundation for Australia. They include digital leadership, digital skills, cybersecurity, data protection, cloud services and digital finance. New digital markets and verticals can be built on top of the enablers. The two areas not well covered in the current conversation are Cloud services and Digital finance.

Digital Leadership: *provide clarity of vision and go beyond National Broadband Strategies. Link together with National Digital Economy Strategy, National Cyber-Security Strategy, and National Smart Cities policies.*

Digital Skills: *cultivate digital literacy and champion ecosystem-based innovation.*

Cybersecurity: *implement a national cybersecurity strategy and platform.*

Data Protection: *implement national and/or sector-specific data protection laws.*

Cloud Services: *implement a cloud policy framework to provide transparency about liability issues and to establish a nationally harmonised digital platform (integrated device, network and data-centre platforms for services and innovation).*

Digital Finance: *reinforce digital financial inclusion through modern consumer protection regulations governing electronic payment processing.*

Derived from the outcomes of International Working Group (ITU, UNESCO) on the Digitalization Scorecard, chaired by Nokia.

Advancing Digitalization of Verticals with Enabling Policies and Regulations

"Which policies and regulations can help advance digitalization, June 2017"

The Working Group on Digitalization Scorecard addressed 'the policy and regulatory fit' for vertical sectors to digitalize, especially beyond the traditional telecom environment. The work on the new scorecard includes analysing key sector specific policy/regulatory barriers and accelerators to digitalization for selected verticals (health, transportation, energy, etc.) in different countries.

For further information, visit the website of the Digitalization scorecard project:

http://www.broadbandcommission.org/workinggroups/Pages/digiscorecard.aspx

4. What are the key disruptive technologies or business models that you are seeing? What do you predict is on the horizon in five, 10, 20 years' time?

Nokia response – Key disruptive technologies all relate to hyper-connectedness, new mass market places, massive ICT scaling, prolific digital innovation, collaborative ecosystems and PPP financing.

5 years
Technology *– ubiquitous 1Gbps access, 10msecond latency, 4*9 reliability, classified miniaturised devices built fit for purpose, ubiquitous broadband and narrowband (NB-IOT/LPWA) mobile access (incl 5G), deep cloud processing, end to end cyber security, software controlled network and data centre infrastructures, artificial intelligence platforms for autonomy, integrated operations management and industry accessible innovation platforms, Augmented Reality, 4k video*
Business Model *– shared economy, ecosystem development, data brokering, PPP risk sharing, emergence of private-public ICT infrastructure, intellectual property rights licensing., utility based pricing, local service guarantees, national and international services by order placement, limited tiers of service quality*

10 years
Technology – *ubiquitous 10Gbps access, 5msecond latency, 5*9 reliability, service centricity, dominance of wireless access, horizontal ICT platforms, critical machine communications and processing, network slicing, ubiquitous edge computing, XaaS, critical video analytics, blockchain, cognitive analytics, ubiquitous UAV, Virtual Reality, 8k video/audio*
Business Model – *shared economy, ecosystem development, data brokering, PPP risk sharing, private-public ICT infrastructure, intellectual property rights licensing value based pricing, global service guarantees, nationally ubiquitous on-demand services, sliding scale of service quality*

20 years
Technology –*ubiquitous 100 Gbps, 1msecond latency, 6*9 reliability, customer/user centricity, dominance of wireless access, mission critical communications and processing, dynamically consumable ICT resources (network and data centre), XaaS, blockchain, cognitive analytics, ubiquitous UAV, 3D Virtual Reality, 16k video/audio*
Business Model - *shared economy, ecosystem development, data brokering, PPP risk sharing, private-public ICT infrastructure, intellectual property rights licensing value based pricing, internationally ubiquitous on-demand services with service based performance guarantees*

5. What communication services, and underlying data, platforms and protocols, does Australia need to maximise the opportunities of the digital economy?

Nokia response – the basic technology model required for the digital economy is end to end and composed of devices, connectivity, core networks, data compute & storage, dynamic security, operational & security management, innovation enablement and digital application runtime. There are 100's of technical standards applicable. Some of these standards are industry based, others are telecoms based or compute based. There are many standards still evolving.

The future state is to serve mass market critical and non-critical applications requiring selective performance per application or service type (capacity, latency, security, reliability). The top end performance is typically required for critical data driven applications which far exceeds the capabilities of today's mass market networks and data centres.

Six principal technical requirements:
a. Wireless private networks interoperating seamlessly with mobile public networks
b. Public Clouds dynamically interconnecting with many private/public networks
c. Embedded design of end to end cyber security (device to application)
d. Device classification for function, performance and security
e. Open data environment for ease of discovery and use in software development
f. Robust operations and security management across layers of devices, infrastructure, services and applications

6. What opportunities do we have to accelerate the development of technologies that will underpin Australia's digital economy?

Nokia response – the future of automation serving society and the economy is based on the collection and clever processing of abundant data. The more data

collected the greater the quality of autonomous decision making. This requires a combination of specialist quality hardware and software development. It also typically requires intellectual problem solving using advanced mathematics and science. These are aspects that Australia can excel at a global level and is already achieving but on a smaller scale than might be possible.

- *Australia is already strong in areas of specialist technology platform design and build. In some cases, these manufacturing companies have their strongest markets off-shore. By promoting Australia's market development to utilise quality device assets there is potentially a stronger export market and new job opportunities.*
- *Australia is already leading the world in areas of specialist analytical systems. An example might be disaster management and public safety. Much of this intellectual capital is the domain of Universities looking for application. With greater impetus, Australia may have the opportunity to better stimulate the development of digital markets to effectively leverage the intellectual capital from our universities.*
- *Australia has the opportunity to use its cities as crucibles for mainstream diversification into the digital economy. A city is a complex operational entity which underpins economic agglomeration. The role of cities will need to be redefined more specifically as engine rooms for the digital economy. Cities in Australia are fragmented operational entities. A city is not generally responsible for its own operation which today is made-up of many siloes of operation. E.g. Energy, Transport, Health, Education.*
- *Australia can use its cities as platforms for massive scale digital innovation. Cities are natural for the new digital markets needed to absorb digital innovation. Cities can establish standardised digital platforms for ease of collecting data and programming applications, for applying intellectual capital to problem solving and for creating opportunities for export.*

7. What opportunities do we have in standards development and regulation to:
   - enable digital entrepreneurship, innovation and trade?
   - mitigate the risks associated with digital disruption?

   Nokia response – standards development and regulation only makes sense if done in context of a national strategy. Hence the importance of articulating Australia's Digital Economic Strategy. In the world today, there are so many varieties of standards to anticipate whether they be industrial sector based or international community based or community of interest based. The Strategy should be used to

articulate the focus priorities of Australia, to bring alignment of purpose across ecosystems of partners and to cultivate innovation capabilities of Australia.

Digital disruption needs to be turned into a national advantage. This requires deliberate acceptance there will be new digital markets and they will create a chaotic environment. The core value to espouse in this chaos is the importance of growing, attracting and retaining talented people to fill the inevitable surge of jobs requiring new skill types and behavioural attitudes.

8. What digital standards do we need to enable Australian businesses to participate in global supply chains and maximise the opportunities of the digital economy?

Nokia response – standards are essential for functional interoperability across end to end systems and there are hundreds of standards. It will be important for Australia to prioritise the most impacting standards to build momentum behind the digital economy.

The digital economy is underpinned by abundant multi-point data collection and advanced algorithmically programmed automation. Gaining momentum in the digital economy is heavily dependent on standardisation. The standardisation required is multi-dimensional ranging across standards for the likes of

- *architecture and design for devices, systems and applications*
- *physical device connection into networks*
- *network services function, platform and performance standards*
- *security function, platform and performance standards*
- *data collection, storage, discovery and accessibility*
- *application programming function, platform and performance standards*
- *operational lifecycle management for devices and applications*
- *system integration management*
- *operational management for infrastructure, services, applications, security*
- *ecosystem partnering management and Service Level Agreements*
- *runtime operations and Operating Level Agreements*

Top three priorities to build momentum are:

1. *security function, platform and performance standards*
2. *data collection, storage, discovery and accessibility*
3. *ecosystem partnering management and Service Level Agreements*

The remaining standards have their own momentum across industry.

9. What opportunities do we have to build trust and community confidence through resilience to cyber threats, online safety and privacy?

   Nokia response – Australia is culturally aligned and well positioned to lead globally in cyber based Trust Models. Trust Models also underpin Personalisation Models which themselves are critical to the future of efficient and effective city and sectoral operations. Australia is also culturally aligned and well positioned to lead globally in Personalisation Models. Given Australia's natural affinity we should carve out Trust and Personalisation Models as Centres of Excellence applied in Australia and established as a solid export market under the Digital Economic Strategy.

   Cyber Security and Privacy principles, practices and platforms specifically underpin Trust. There is a significant shift underway toward dynamic security management as opposed to historical static security management. Privacy practices and awareness are well established in Australia. IOT Alliance Australia is advocating Security and Privacy as essential for IOT success and has published reference documents. Universities are already working on Cyber Security and Privacy. Australia could converge Trust and Personalisation with a single Centre of Excellence also embracing Cyber Security and Privacy. The Centre of Excellence would inevitably be an ecosystem of partners.

10. What roles should government, business and individuals play in protecting the community in a digital economy?

    Nokia response – the digital economy will fail if trust is lost. All stakeholders have a role to play to ensure this trust is not lost. The challenge today is the lack of clarity in the trust requirements for a hyperconnected world. This is leading to confusion and lack of alignment across multiple parties. The Centre of Excellence mentioned in point 9 could have a two-fold charter to address today's shortcomings. The first is to provide clarity and the second is to cultivate alignment across multiple parties that inevitably form under ecosystems and market opportunities.

11. What integrity and privacy measures do we need to ensure consumers can protect their data?

    Nokia response – consumers will lose trust in the digital economy if their personal data is lost, misused or misrepresented. Generally, today there is a lack of transparency on treatment of personal data, accountability for accuracy and security and ownership of the data. The most important measures going forward seem to be aligned to government intent around transparency, accountability and ownership. Transparency should become a norm and Accountability should rest with every party to act in the interests of the consumer. The consumer should be

seen as the ultimate owner of their record with entitlements to reasonably amend or manage to their discretion.

12. What are barriers for business, particularly small business, in adopting cyber security and privacy practices?

    Nokia response – Businesses are generally sensitised to the need for security and privacy. However, the lack of clarity of a cyber trust framework in Australia leads to ambiguities in understanding the role of the business versus the multiple service providers involved in a digital value chain. The ambiguity is amplified because a number of value chains include offshore entities. The Centre of Excellence mentioned in point 9 would assist to address the ambiguities and the requirements for a business.

13. What integrity measures do the Australian Government and the private sector need to take to ensure business-consumer transactions are secure?

    Nokia response – preserving the integrity of transactions is essential to success of the digital economy. Managing integrity has both functional and process requirements.

    At a functional level, there is a need to trust devices, to properly authenticate the transactional parties and to secure the end to end communication for the duration of the transaction. Devices need to be classified to a security standard. Authentication needs to be non-refutable. Transactions require fit for purpose encryption and fail-safe completion. There will be differing degrees of security depending on the sensitivity of the data or transaction. A nationally graded classification system for standard of security would help understanding and set expectations.

    At a process level there is a need for transparent traceability and auditability coupled to sensible restitution frameworks in case of disputes. Especially the case in Public Cloud examples.

14. What is holding Australian businesses back in terms of benefiting from digital technologies?

    Nokia response – most businesses have already benefitted from digital technologies. Over the last 20 years of the internet this was largely because of improved internal business efficiencies together with more responsive customer services. The hyperconnected future goes well beyond cost savings and customer satisfaction. It challenges new business models, new customer opportunities and

new markets. While today it is still possible for businesses to achieve gainshare using more contemporary ICT technologies, the step function benefit is more likely going to come with a corresponding expansion of the customer base or new markets. Generally speaking if there is conservatism and risk aversion it is unlikely to result in significant further investment. The opportunities for new customers and new markets should be obvious in the Digital Economic Strategy. Businesses should be encouraged to think very differently about their future opportunities.

15. What would help Australian businesses to embrace digital technologies?

    Nokia response – see response to point 14.

16. What efforts are you or your organisation making to respond to digital transformation? Why?

    Nokia response – Nokia is a global technology company and already actioning the shift toward the digital economy. Nokia has a corporate strategy and investment program in its own transformation toward new markets, customer/user centricity, process automation, critical digital infrastructures and innovation ecosystems.

17. What opportunities do we have to use digital technologies to improve linkages into export markets and global supply chains?

    Nokia response – the digital economy is a global phenomenon and Hyperconnectedness naturally extends beyond national borders. As mentioned in previous points, it would make sense for the Digital Economic Strategy to implicitly incorporate an export focus. Increasingly it is important to link into ecosystems of partners based on high degrees of specialisation. There are Australian technology companies successful in international markets because of these linkages.

18. What opportunities do small and medium-sized businesses have to embrace digital innovation to drive customer value, improve their services and unlock their potential?

    Nokia response – as mentioned previously success will be driven by imagination and leadership with appreciation of the new customer and market opportunities.

19. What are the key new growth industries that Australia should be tapping into? In what technologies and sectors should Australian businesses take the lead, and where should we be a 'fast follower' of international trends?

Nokia response – There are a number of growth possibilities that Australia might pursue. The digital economy is composed of four fundamental elements.

1. *knowledge driven*
2. *draws its value from across sectors*
3. *is dependent on the exploitation of digital technologies*
4. *is built upon a trusted operating model*

Each of these elements presents an opportunity for Australia and its industries.

Knowledge Driven

There are three cases which might be considered.

1. *Hyperconnectedness is unprecedented and exploiting it requires a significant mind-shift view of customer segmentation and markets.*
   - *Building transformational practices opens opportunities for professional services*
   - *Building supporting software toolsets creates products that the world needs*
2. *There are "big thinking" problems to be solved within and across sectoral domains.*
   - *Linking into the University system to bridge with industry deliberately underpinning the digital economy opens opportunities for Australia to lead on intellectual problem solving*
   - *Bridging into the University system provides depth to attract international students because of the career relevance of the programs and the practical experience they can gain in Australia*
3. *Prolific innovation is also characteristic of the digital economy.*
   - *A positive and somewhat unique cultural attribute of Australians is to team effectively. The digital economy relies on ecosystem and team based innovation. Through cultivating this form of innovation Australia has the opportunity to attract investment for innovation and develop its skill base as an economic differentiator.*
   - *Innovation needs to be proved in real markets. Australia has the opportunity to lead with new markets to launch innovations and therefore provide a synergistic benefit to future developments.*

Cross-sectoral value

There are two cases which might be considered.

1. *The definition and collection of quality data which is useful both within a sector and across sectors as a basis for operational and transformational opportunities.*
   - *Data is at the heart of innovation. Professional Services, standards (e.g. Hypercat BSI standard advocated by IOTAA) and toolsets driving the effective instantiation of data models, the collection of data and the qualification of data are economic opportunities.*
2. *The effective orchestration, processing and presentation of large volumes of data for analysis and interpretation is a science and requires a range of specialist capabilities.*
   - *Analytical views of data are the basis for high value application developments. Professional Services, standards and toolsets for process orchestration, algorithmic application development and data presentation are economic opportunities.*

Digital Technologies

There are two case which might be considered.

1. *Hardware*
   - *Fabrication and customisation of hardware for industrial and consumer applications in accordance with national standards. Would carry a credential into many markets lacking the quality and discipline for the digital economy.*
2. *Software*
   - *Advanced analytics based applications proven locally and launched globally. Would carry a credential into many markets of deep research and insights from practical application.*

20. What opportunities do we have to equip Australians with the skills they need for the digital economy, today's jobs, and jobs of the future?

Nokia response – There are studies which highlight the prospect of new job types following a strong commitment to a digital economic strategy. These jobs are expected to be high value and to pull through new opportunities for jobs displaced because of automation. However, this is not a passive participant model. The digital

economy is globally competitive and it seeks to create its own opportunities. Australians already receive quality education. The shift in requirement is for Australians to be demanding to learn the skills needed for the digital economy. This will come through clear proof of value from working in the digital economy. Australia can use its cities to exemplify this working by clearly positioning them as economic growth engines.

21. What opportunities do we have to bridge the 'digital divide' and make the most of the benefits that digital technologies present for social inclusion?

Nokia response – bridging the digital divide is best dealt with through a pull strategy. A starting point is that every city is chartered with growth objectives toward the digital economy. This empowers people in a city to take control of their destiny. Individuals can make a choice to contribute or not but at least they have the option. If their choice is to contribute then a collective voice will be demanding the learning and investments which will progressively close the digital divide.

22. What opportunities do we have to ensure digital technology has a positive impact on the cultural practices and social relationships of Australians?

Nokia response – There are two aspects which might be considered.

1. *Hyperconnectedness has its own value proposition for economic development and social inclusion. Digital technologies underpin Hyperconnectedness and its benefits should be self-evident to the point that people themselves adopt the best aspects to self-improve cultural practices and social relationships. The Digital Economic strategy should build out from the concept of Hyperconnectedness rather than emphasise the digital technology.*
2. *The innovation possibilities in a hyperconnected world are open ended and almost infinite. There are already advanced analytics driven applications facilitating improved lifestyle and health of people. The required framing is Hyperconnectedness and not just the technology. The Digital Economic strategy should articulate the value to people, businesses and the economy of Hyperconnectedness rather than emphasising the digital technology.*

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ATTACHMENT 1

Nokia White Paper: *Securing Australia's future with emergence of the Digital Economy*

Securing Australia's future with emergence of the Digital Economy

Australia's continuing economic prosperity and social well being will depend upon securing competitive advantage in the technology-driven future where disruptive automation and innovation will transform every aspect of life and business.

Abstract

Australia's continuing economic prosperity and social well being will depend upon securing competitive advantage in our technology-driven future. Disruptive automation and innovation will transform every aspect of life and business. Effective leadership will be critical to success.

Underpinning the digital economy is an unprecedented hyper-connectedness, enabled by extreme automation and prolific innovation. Automation and innovation utilise data collected on a massive scale feeding into ever more sophisticated and autonomous analytics-based applications. The applications are fundamentally disrupting traditional industry and sectoral boundaries. The prolific innovation is either improving or displacing traditional markets and rampantly creating new markets. Countries which thrive in this digital era will be the ones that fully harness innovative digital ecosystems and embrace the new market dynamics. Australia has many attributes to succeed in the digital economic era. However, it will need to better enable new digital ecosystems and cultivate opportunities for new markets. A practical way forward might be to recast every Australian city as an engine room of the digital economy.

About Nokia

Nokia serves global markets of communication service providers, governments, large enterprises and consumers. It invests substantial Research & Development into an end-to-end portfolio of digital network infrastructure products, services and licensing. The world is moving at a fast pace and network infrastructures are evolving with 5G and the Internet of Things. 5G is a mobile technology that goes way further than current 4G networks today. It is being designed for the digital economic era to meet the needs of IOT applications dependent not only on connectivity but also bandwidth, latency, ultra-reliability and effective cyber security. Nokia is pushing boundaries to shape the future of technology to positively transform the human experience. Through Nokia's Bell Labs Research, Nokia is developing cognitive, self-learning networks that will fluidly respond to how we all live and work. These will enable next generation IOT applications for a profoundly better world.

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Executive Summary

The world transitioned significantly during the first 20-years of the internet. A uniquely new transition took hold in 2015. This was a transition into the digital economic era which has taken over the world's growth mantle. In this new era, national economies are being commoditised and traditional markets are being disrupted. This era is being driven by revolutionary possibilities from innovative digital technologies. Nations and businesses which take advantage of the transition will benefit most. A race of nations is already underway to implement Industry 4.0.

The Digital Economy encapsulates Industry 4.0 but more broadly the scale of mass market digital automation. Key principle behind automation is collection of measurement data and the use of advanced data analytics to augment human decision making. Automation is not new and has been used by industry for decades to manage output quality and production. The difference now is that automation can cost-effectively scale to benefit all of humanity and not just some sectoral industries. This scale is unprecedented in world history, enabled by discrete technologies which have emerged and converged over the last 10 years. These are device, network and cloud processing technologies.

Devices have been miniaturised and can be easily deployed with batteries that might last 10 years. Networks can connect tens of billions of devices, each with a unique service type. Cloud processing can cost effectively serve massive volumes of data and applications out of data-centres. Increasingly there is a requirement for real-time or near real-time data and applications. Evolutionary examples include autonomous vehicles, remote robotic medical surgery and drone aerial goods delivery. Automation promises substantial benefits because digital technologies are improving inter-connectedness of people and objects and facilitating deep connectedness to the environment around them. This vast multi-dimensional connectedness can be described by the term "hyper-connectedness".

Hyper-connectedness is a phenomenon and describes our world evolving from billions of digitally connected people to tens of billions of connected people and "things." This is the new commodity world of mass customisation. It is the world driven by sophisticated intelligence and extreme levels of automation. Hyper-connectedness demands an open mind to the almost infinite number of possible new innovative applications and markets. Joshua Ramo, in his book titled [1]The Seventh Sense describes hyper-connectedness and the constant state of market shock we can expect. Success will come from multi-sourcing innovation from anybody in any context. There is a need to actualise hyper-connectedness.

Economies and businesses which cultivate hyper-connectedness will derive competitive advantage in a highly-commoditised world. Although still challenging, Australia's investment in education and multi-culturalism means it can relatively easily shift gears to utilise the knowledge capital and creative energy of its people. The bigger challenge for Australia is the comfort we find in our current economic success built on the back of a long-term commodities boom and fast following adoption of technology. In broad terms, it was a conveniently exploited

economic situation. However, in context of the Digital Economy the future requires more purposeful creation and shaping. This will come from cultivating invention through people and technology and the rapid assimilation of newly spawned market places into the economy.

A significant course correction for Australia is to recognise that abundant technology based innovation is a fundamental for sustaining wealth. The traditional fast-following adoption of technology and a constrained view of market structures miss the mark completely. Fast following only makes sense if the life-cycle of technology is five or more years. Digital innovation is now measured in months and weeks. Australia needs to stake out a leadership position in both digital innovation and new market places. The new markets are a consequence of innovation and the absolute winning formula is to be first to every market. Also, innovation is no longer just in the realm of large corporations. Innovation has most potential if multi-sourced from anybody and in any context. It is ripe for proliferating the number of small businesses which are at the heart of a healthy economy. Given this is a pioneering period it is also ripe for creating new opportunities for Australia's universities and colleges at a world level.

There is an urgency for Australia to set a course and take a leadership position in the hyper-connected world. Australia has many essential attributes for success but is currently lacking a definitive approach to proliferating technology based innovation and openly assimilating new market places. This paper argues that cities are a natural starting point for the enabling innovation and new markets.

National competitiveness reshaped by technology

Modern digital technologies are driving significantly disruptive changes into societies and economies around the world. These changes were first substantially experienced in the decade starting 2005. New levels of digital connectedness enabled the likes of online banking, online customer services, online entertainment, social networking and social commerce. Classic examples highlighting the value of connectedness include Facebook, iTunes, eBay, Amazon, LinkedIn, and Airbnb. However, in the decade ahead the underlying the change impacts will be characterised by hyper-connectedness and highly-responsive control systems utilising sophisticated data analytics.

Hyper-connectedness is a term describing our world as it evolves from billions of digitally connected people to tens of billions of connected "things". This is a commodity world of mass customisation. It is a world driven by sophisticated intelligence processing and extreme levels of automation. In his book *The Seventh Sense*, Joshua Ramo explains hyper-connectedness as an unprecedented phenomenon in world history. He describes a constant state of market shock as digital technologies continuously disrupt. His 'Seventh Sense' concept expresses a fundamental shift in human attitude and insight needed when thinking about the nature of markets and competition. A hyper-connected world underlies rapid innovation and there is an almost infinite number of new market opportunities.

Economies which cultivate this 'Seventh Sense' will derive a fundamental competitive advantage. To be ready for this hyper-connected world and to cultivate the Seventh Sense, a country like Australia needs to mobilise its population around digital enablement and innovation. Australia can gain competitive advantage in its own right through its investment in community digital assets. The digital asset will help empower any community across Australia to build their own future. It will better connect communities into the growing digital economy, energise creativity, evolve more inclusive communities, pull through new jobs and open dynamic export market opportunities.

Digital assets and innovation vital for growth

Digital assets describe the totality of skills, structures and technology platforms. These assets are essential in a commoditised economy where prolific innovation is the basis for creating wealth. However, digital assets are not only a platform for invention but also essential for communities to be effective. Further, a process of innovation to constantly improve the community is a basis for new export markets.

Australia's tradition of being a "fast follower" will not work in this digital age. Digital America Report by McKinsey Global Institute in December 2015 highlighted three areas of innovation important to communities, namely; labour market efficiency, capital efficiency, and multifactor productivity. Improvements in these areas could positively lift GDP 6 to 8 percent above baseline projections. This does not account for the broader growth from new markets.

Labour market efficiency – innovative talent platforms can cultivate effective agglomeration and enhance social inclusion.

Capital efficiency – Internet of Things (IoT) platforms can improve asset utilisation and be used to proactively influence positive experiences.

Multifactor productivity – digital platforms can optimise cost structures and elevate performance of the community.

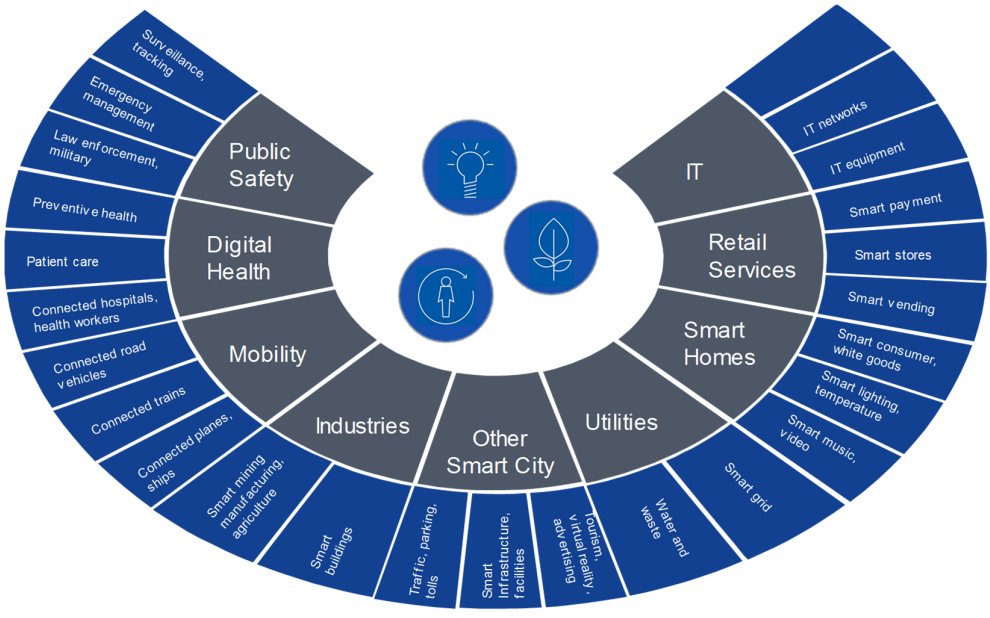
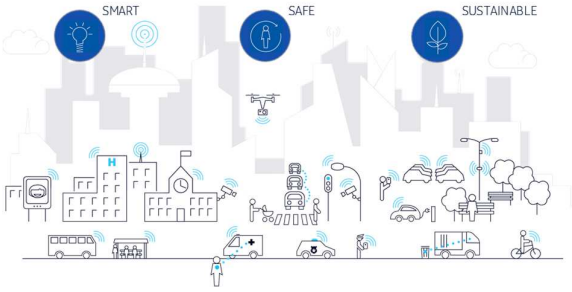


Figure 1 - Many new and yet to be discovered sectoral automation opportunities

Communities are crucibles for digital innovation

Communities can be defined as any shared common interest across a group of people. There are no constraints on what constitutes an interest and the groups of people can be geographically or virtually connected. A clear and distinctive advantage of people living in a city is the ease they can be both geographically and virtually connected. The most vibrant communities are known to be the most connected. In economic terms this connection leads to high rates of quality innovation and productivity. It is called economic agglomeration and makes cities a natural vehicle to create wealth in the digital economic era. In fact, cities have become the primary growth engines for national economies.



Consequently, national governments are intervening ever more in the social and economic evolution of their cities. Great examples of blending social (urban) and economic development can be found in the United Kingdom. After more than 20 years of experimentation with city models, the UK has fathomed the importance of creating urban envrionments which both attract talent and are highly connected. Digital automation of urban environments has been found to be key and it is essential to have a city connected seamlessly across its total assets. This seamlessness is derived from collecting an abundance of data across the whole of the city. This enables clever analytics and prolific innovation across all facets of city life and operations. It integrates life and productivity experiences across people, buildings, public spaces, infrastructure and commerce. It reinforces both the brand of a city and its international reputation.

Cities are crucibles for digital innovation and importantly are essential economic growth engines. Cities have become incubators of innovation and also make the consumer markets for the innovators. It is important to have local markets to provide a basis for expanding globally.

In Australia it is essential that expectations are properly set about the role of cities in the digital economic era. Today there is a misplaced interpretation that cities are equipping themselves for their new role. The reality is that Australia's cities and their administratiors only exist to service rate payers using local taxes raised. They do not have the skills nor resources to scale and respond to the heightened demands of innovation in the digital economy.

Australia's cities need to be equipped for social and economic development for this era of dramatic social and economic transformation. This includes investments to implement capabilities for digital innovation readily accessible by communities. These platforms do not exist today and they require coordinated and standardised approach to design and implementation. Nokia advocates government leadership in this area.

Communities and City Digital Platform

Cities and communities will only substantially benefit from City Digital Platform if it is secure, trusted and operationally reliable. City Digital Platform is mission critical and requires high availability. It utilises an ICT technology architecture incorporating sensors, security, networks, data-centres, databases, application development and end-to-end operations management.

The necessary scale of such a platform is significant and requires professional, technical and operational ICT skills. Any one community or city will find it challenging to independently deploy and operate City Digital Platform. Core network/data-centre infrastructure, end-end operations management and cyber security are probably best performed across a whole state/territory geography. A city or community can then implement local networks and establish their own innovation ecosystems.

City Digital Platform enables a community to solve local problems and importantly shape and create their future. A community can become a better partner to businesses and universities and therefore attract investment. A community might decide to become a net exporter of energy. A community might perfect multi-mode transport and optimise travel times. The possibilities are boundless and any one innovation can potentially lead in the world.

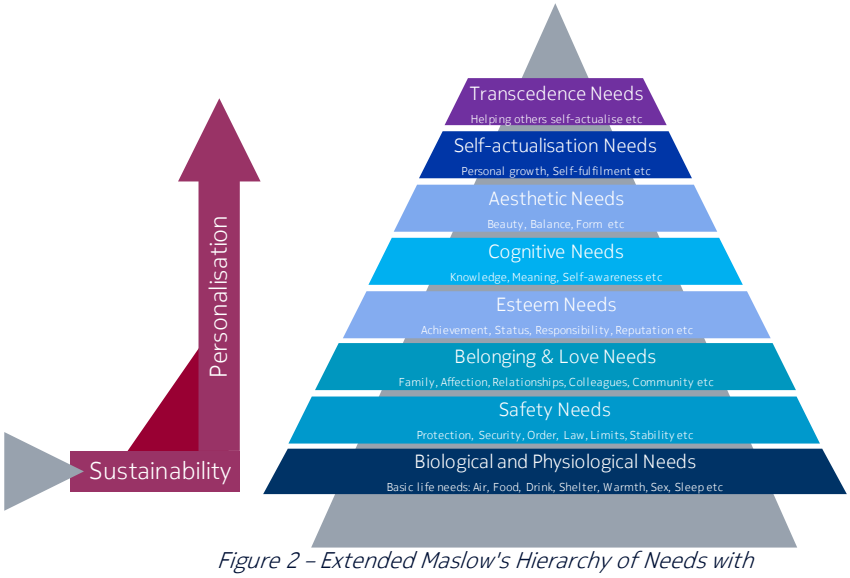


Figure 2 – Extended Maslow's Hierarchy of Needs with mapping of Sustainability and Personalisation Measures

Importantly, cities and communities must integrate people within their urban fabric. This is a broad topic but there are two high level measures describing this integration. Sustainability is the most commonly identified urban measure. In terms of Maslow's five level "hierarchy of needs" this largely addresses the lowest three tiers of his pyramid. It basically measures the quality of life when people are living together in an urban environment. Personalisation is the

second measure but is not often mentioned in literature related to cities because it can easily be assumed to be a by-product of sustainability.

Personalisation needs to be called-out. It is probably the most important measure because it focuses on individuals and their emotional feelings. Personalisation strides across the layers to the top of Maslow's Hierarchy which (Figure 2) but has been extended to eight layers for contemporary relevance. In the digital economic era the attractiveness of a city for talent and doing collaborative business is paramount. With sustainability alone, a city is efficient. With personalisation added, a city is effective because it becomes a place where people want to live, work and play.

Personalisation aligns well with the Australian architype around personal freedom and inter-personal relationships. Personalisation is potentially an economic differentiator and a key theme to be developed for all of Australia's cities and communities.

Describing City Digital Platform

City Digital Platform is essentially a tightly performing distributed Cloud architecture which dynamically connects millions of sensors and devices to data centres running applications in hosted environments. It is designed for critical applications and multi-tenancy use. It supports innovation ecosystems of partners across people, businesses, academia and governments. It also implicitly secures and protects consumer rights and information because appropriate information sharing is fundamentally important.

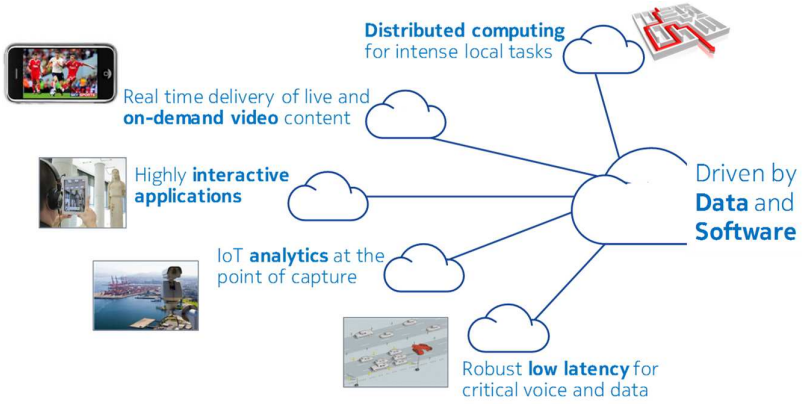


Figure 3 - City Digital Platform is Cloud-based

City Digital Platform does not exist in Australia today. If it is considered to exist at all, it exists as a piece-meal patchwork of disparate enterprise oriented ICT systems with no long-term foundation. There is no standardisation, is labour intensive and detracts from the focus cities need about solving local problems and building their future.

Possibly underestimated are the needs to support an expansive range of device types and an almost limitless number of possible applications. Applications will range from simple binary decision making controls through to being complex and driven by sophisticated data analytics. Most complex applications are life or business impacting systems and require high

performance and high availability. Enterprise networks are not designed for this range of application types nor to be mission critical. A trap for cities is they forget about the important need to upgrade their enterprise networks. This is often because in the early stages of smarter city initiatives they only deploy sensors to gather new information about city assets. These sensors are invariably connected to an existing enterprise or internet network. However, as the city matures it tends to use new collected data for more critical applications and deploy new sensors but continues to use the same network.

To help visualise the meaning of mission critical consider 50 city services that might all be delivered every day of a year. Given nominal enterprise performance levels the failure rate will likely mean any one service will be unavailable at least one full day in a year. This level of performance is counter to the needs of modern cities. The only way to address this is to design and deploy City Digital Platform at scale and with high performance and resilience. A community cannot achieve this on its own, but it can be achieved and indeed optimised across a state/territory.

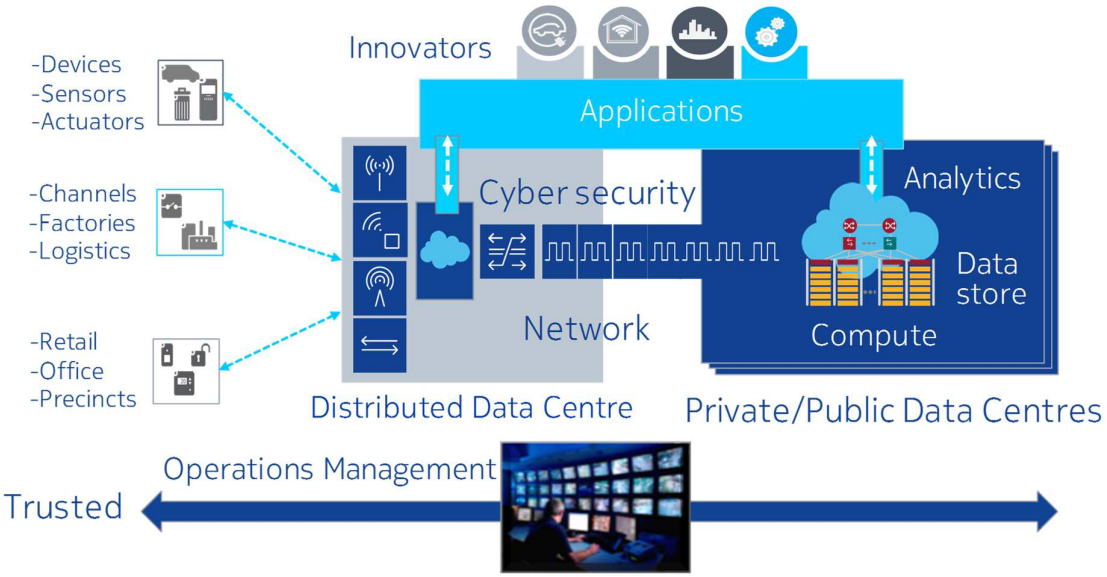


Figure 4 - City Digital Platform is defined by an ICT infrastructure, operations and innovation architecture

A distinctive advantage of City Digital Platform is that it sits at the intersection between data and innovative business models. The more data that is collected and processed the more possibilities arise for innovation. Data is the basis for some of the most disruptive business models today. Consider Uber disrupting the taxi industry because it correlates passenger location with driver location and personalises the trip. Consider Airbnb which correlates travel data with property data and personalises the experience for great stays. Data will increasingly be processed from both public and private sources. The scale of the collection and processing of data will be immense but achievable with City Digital Platform.

Another advantage of City Digital Platform is that privacy and security is part of the end-to-end design and can be managed centrally. Increasingly the risk of security breaches and hostile attacks mandates dynamic security controls and effective device management across the millions of personal devices, sensors and actuators. It is essential to be connected into global security frameworks, to utilise both remote device management and sophisticated attack analytics. The design of City Digital Platform will allow the network to automatically quarantine problem devices, isolate compromised infrastructure and maintain integrity of services and personal data.

Nokia's engineering of City Digital Platform

City Digital Platform is an engineered system of integrated functional building blocks. It is a non-proprietary ICT resource which can delegate defined functions to cities and communities. It can also wholely exist in a single city or community context but would ideally be implemented at a state or territory level for use by multiple cities and communities.

Figure 5 outlines Nokia's defined fifteen building blocks underpinning City Digital Platform.

In a city context the building blocks each require their own deployment and ongoing support structure. Consequently each building block needs to be assigned to a responsible operating entity. The total cost of ownership for each building block can be used to determine assignment of responsibility. Ongoing cost structures will largely be determined by scale of operation. However, scale will need to be balanced against the need to localise accountabilities for achievable outcomes. Therefore it makes sense for some building blocks to be implemented at the level of state/territory whilst others are implemented at a city/community level.

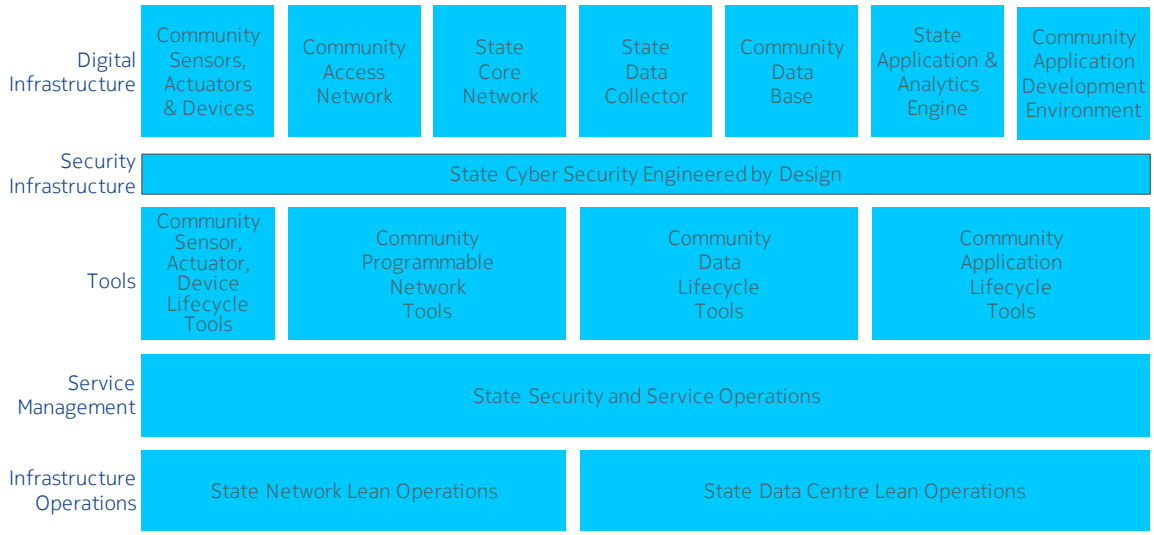


Figure 5 - City Digital Platform is a state/territory ICT resource which delegates defined functions to cities and communities

Figure 5 suggests a possible mapping of building blocks between state/territory and cities/communities. For example cyber security is a complex, end-to-end practice requiring significant skills and integration into global security frameworks. It is therefore probably best the responsibility of a state or territory linked to national policy and enforcement. Otherwise for a city/community it may be sensible to delegate responsibility for access network functions for connecting thousands of sensors. Similarly it may be sensible to delegate responsibility to city/community for deploying tools, with a potential additional benefit for local innovation ecosystems.

Building blocks are designed using modern technologies suited to the era of hyper-connectedness and the massive scale of programmable applications. Nokia recommends that governments use the building block approach to establish an end-to-end design and to assemble their own preferred ecosystems of partners.

The technical architecture must be 'plug and play' to allow choice from the many functional products available from innovation leaders like Nokia and other suppliers across the technology market. Nokia is already working with many of these other suppliers and also has its own ecosystem of preferred partners.

Key attributes of City Digital Platform

Digital Infrastructure – must be considered Mission Critical Infrastructure and provides the foundations for robust, application relevant performance and operation. It needs to be kept in mind that all city utilities and agencies including transport, water, energy will depend on this digital infrastructure for safety, productivity and efficiency requirements.

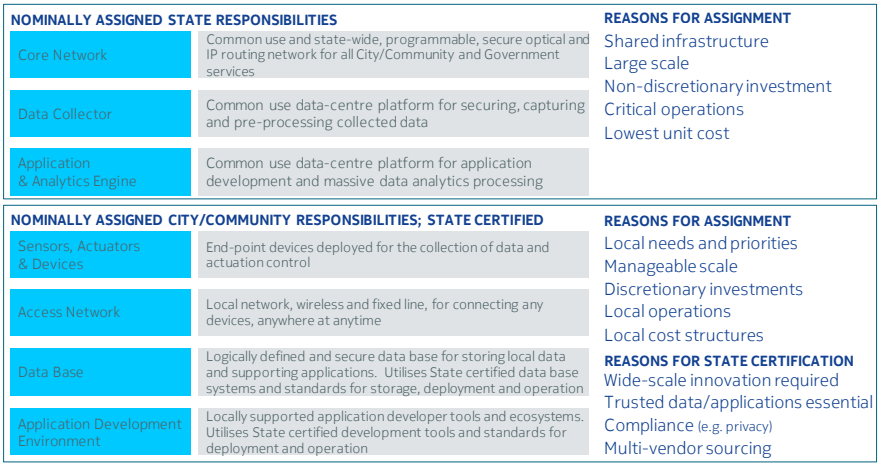


Figure 6 - Nominal assignment of responsibilities between state/territory and city/community for digital infrastructure

The seven building blocks shown in Figure 6 describe the underlying digital infrastructure and capabilities of City Digital Platform. Each block has been assigned a nominal responsible owner

between state/territory and city/community. There is also an assigned state certification to allow a region or city to adopt and implement a state or territory standard.

Security Infrastructure – must ensure a trusted customer environment and be designed into the end-to-end technical architecture and is a combination of physical and virtual embedded technologies including Artificial Intelligence.

Figure 7 - Nominal assignment of responsibilities to State or Territory for Cyber Security Management

Tools – must support local operational productivity, compliance management and security operations and should take full advantage of Software Defined Networking (SDN) and Virtualisation technologies for programmability as well as sophisticated development and management.

Figure 8 - Nominal assignment of responsibilities to communities using state/territory certified tools

Service Management – must be end-to-end across all services delivered on top of the digital infrastructures and include security management.

NOMINALLY ASSIGNED STATE RESPONSIBILITIES; WITH DELEGATED FUNCTIONS		REASONS FOR ASSIGNMENT
Security and Service Operations	End to end operational management encompasses all device end-points through networks to data centres and applications. Operational management covers deployment functions, provisioning functions, assurance functions and security. Deployment and provisioning includes delegated functions to local operations in Cities/Communities. Assurance also includes delegated functions to local operations in Cities/Communities as well as incorporates change management controls. Security is fully integrated into global security operations centres. All management should be based on Lean Operations systems and practices to ensure the maximum extent of automation and a need for only a small number of highly skilled operators running 7/24 operations.	Highly specialised skill domain State scale of operation Non-discretionary investment Critical standards & operations Lowest unit cost **DELEGATED FUNCTIONS** Delegated local operations centre Local workforce, including field Locally prioritised response Standard practices used Full visibility of operational status

Figure 9 - Nominal assignment of responsibilities to State with delegated function to Cities/Communities

Infrastructure Operations – must utilise Lean Operations practices and methods to affordably scale for the hundreds of millions of sensors and devices to be operated in various networking configurations across cities and local communities.

NOMINALLY ASSIGNED STATE RESPONSIBILITIES; WITH DELEGATED FUNCTIONS		REASONS FOR ASSIGNMENT
Network Lean Operations Data Centre Lean Operations	Lean Operations is based on Lean Manufacturing principles, already well established by automotive manufacturers. It is a closed-loop model for processing operations data and using advanced analytics to automate responses to operational problems. Historically, assurance responses have been based on manual tickets being launched per problem. Modern network and data centre design enables massive collection and processing of operational data together with massive analytics based decision making for fully automated corrective actions. Inevitably there will be a fall-out of problems requiring manual intervention. The objective is to minimise the number of these but even then the problems are automatically assigned. This manual effort may be assigned locally. Otherwise, the State Infrastructure Management Centre should only need small numbers of staff. A typical benchmark is 3 people per shift.	Specialised systems domain State scale of operation Non-discretionary investment Critical standards & operations Lowest unit cost **DELEGATED FUNCTIONS** Work order assigned local fixes Local field workforce State prioritised response target Standard practices used Full visibility of fix status

Figure 10 - Nominal assignment of responsibilities to state/territory for infrastructure operations management

Capital and expense funding options for City Digital Platform

City Digital Platform has components of shared common infrastructure (state/territory) and purpose built infrastructure (cities/communities). The Platform provides an important foundation for wide-spread innovation, productivity and efficiency improvements across the state/territory, and cities/communities.

The Platform will be used for many applications serving many different purposes including the likes of utilities (eg. energy) and sectoral (eg. transport) groups. Some of these purposes are even yet to be invented. No matter what, it will:

- Advance economic well-being across all metro and regional areas,
- Enhance social cohesion across the state/territory and its cities/communities,
- Enable vibrant and collaborative innovation, ensuring the state/territory remains competitive, and
- Step up the state/territory-wide and global connectedness of people, businesses, academia and governments.

An initial requirement will be the establishment funding for baseline state/territory and cities/communities infrastructure and operations. A follow-up requirement will be the funding to expand and evolve the baseline infrastructure over time. In most cases around the world, start-up funding is provided as a government grant, supported by a business case. A long-term business case should be developed assuming the multi-faceted benefits expected from the Platform. The likely most long-term funding model would involve commercial Public-Private-Partnership (PPP, Figure 11) entities.

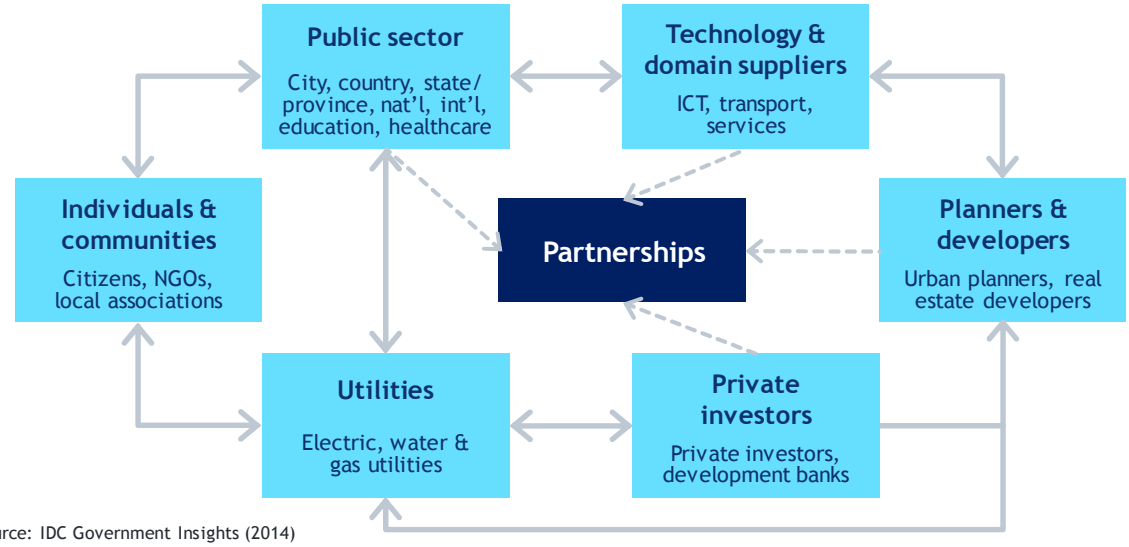


Figure 11 - Example Public-Private-Partnership framework

Once the Platform is established, its operational expenses (OPEX) might be funded on a usage basis. In most cases usage is directly paid by users and beneficiaries. Increasingly, OPEX funding can be obtained indirectly using creative revenue models based on revenue share, sponsorship, advertising or share gain business models for example (Figure 12).

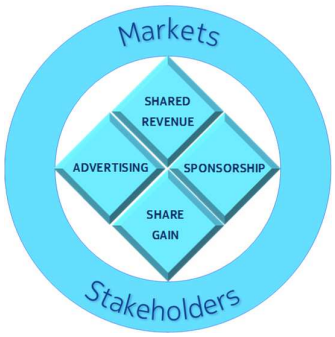


Figure 12 - Example of alternative funding models for OPEX

Nokia's six imperatives for economic leadership

Nokia advocates six imperatives to take a leadership position in the hyper-connected era:

1. Eliminate device, data and applications stovepipes –provides a community the ability to take control of itself and offer sustainability and personalisation services holistically to become an effective partner to business and people. Communities must have single jurisdiction controls (health, transport, utility….) and an abundant data repository that is readily accessible by any software developer. This may require using special vehicle bodies beyond the local council and also defined standards such as for shared/interoperable data.

2. Establish a standard state/territory-wide City Digital Platform – the current ten year cycle (from 2015) can be defined as a period of massive scale automation. This is a hyper-connected and data-driven period requiring high integrity digital infrastructure to tap any data from across a city (simple telemetry data through to intense video data) and process this data for augmented city response, often in real-time. This requires scaled and secure digital infrastructures which cities do not have today. City Digital Platform defines the digital infrastructure and operations.

3. Unleash a state/territory level movement around digital innovation – fully recognise the extent of impact of digital disruption and the emergence of the Digital Economy. Reverse Australia's current backward trending on key metrics – such as technology readiness, business sophistication and innovation - important to succeed in the digital era. Raise awareness of the impact of digital disruption and the need for innovation to create the next generation work force structure for jobs.

4. Establish a collaborative dynamic across Australia – the digital economy is massively disruptive across traditional sectoral boundaries and is driven by new concepts and new technologies. To identify new market opportunities or to survive market disruption requires advanced problem solving and sharing of knowledge and ideas. This is not a norm across Australia and must be called out as a cause for survival and future prosperity. Communities can make a big difference by emphasising collaboration. Universities must be party to the collaboration.

5. Lead the world on a new personalisation measure – in the context of cities, personalisation is a measure which has unique possibilities when digital data and analytics are abundantly available. In thinking about communities or cities and the possibilities from a hyper-connected world, personalisation will set an underpinning and differentiating theme for Australia as it plays on the global stage.

6. Facilitate dynamic Public-Private Partnerships for city innovation – financing for success in the digital economic era will depend much more on entrepreneurial shared risk and reward models than ever before. This is largely because of the emergence of unbounded new digital markets and the chaotic nature of disruption. Most evidence points to dynamic PPP being the only agile way to adapt in what is a high stakes game. More traditional PPP's are functional consortiums and have not resulted in the improved innovation which must be more characteristic of successful PPP's in the future.

Conclusion

Australia is faced with the inevitability of a chaotic world and commoditised economy. Our current standard of living is in jeopardy and it faces a declining future. Australia has a second chance because it has key ingredients for success in the digital economy. The most significant exceptions are technology sophistication needed to empower the country and the ready assimilation of dynamic new market places. Fast following technology will no longer suffice and economic growth is about prolific new mass markets.

There is an urgency for Australia to set a course to take a leading position in the hyper-connected world. This paper argues that in the context of a federally directed digital economic strategy, states and territories are the natural starting point for enabling wide scale digital innovation. Each state and territory has the opportunity to grab control of its future by deploying a City Digital Platform. The Platform will help unleash the creative energy of cities and communities which can better solve their own problems and invent new market opportunities. This will add significant momentum to transitioning the workforce into the new digital economic era. Most importantly it will underpin an essential market basis for sustained economic prosperity and employment.

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