



IT Industry Innovation Council

CLOUD COMPUTING – OPPORTUNITIES AND CHALLENGES

Issue Date: 11 October 2011

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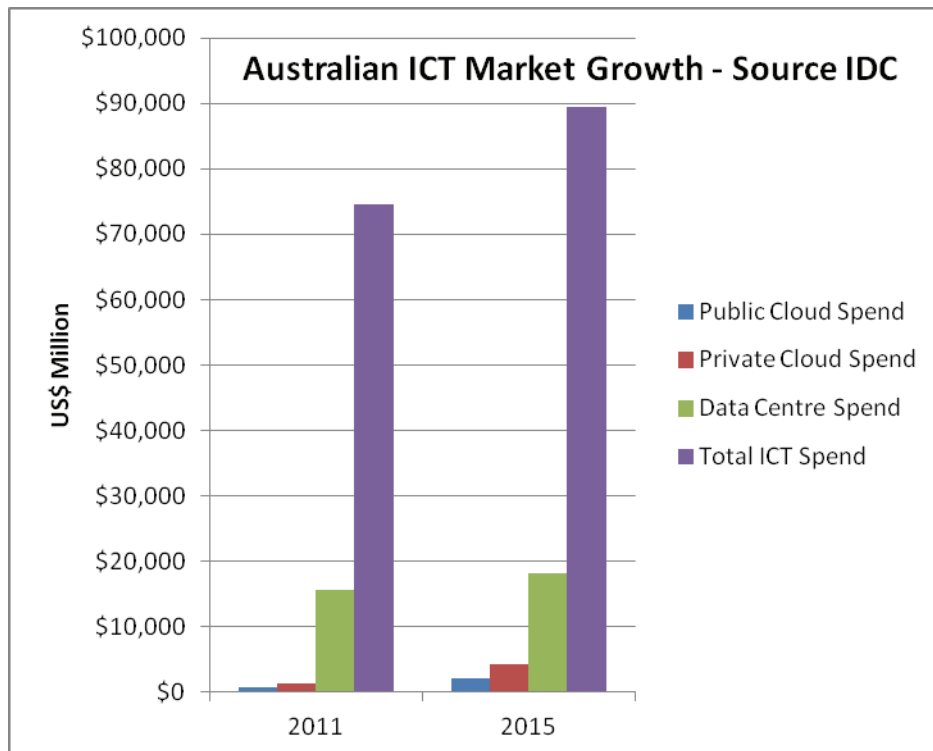
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Executive Summary

Cloud computing has emerged as the decade's biggest shift in the way organisations use Information Technology (IT). The following outlines a summary of advice to the Hon Kim Carr Minister for Innovation, Industry, Science and Research from the Information Technology Industry Innovation Council regarding the industry development opportunities and challenges presented by the growth of Cloud computing.

The 'Cloud' provides a new paradigm for delivering computing resources (for example, infrastructure, platform, software, etc.) to customers on demand, in a similar fashion as that provided by utilities (such as water, electricity, gas, etc.). Authoritative international market research from a number of different sources predicts that the global market for Cloud products and services will grow rapidly in the next few years. The global research firm IDC predicts a compound annual growth rate (CAGR) of 27.4 percent in public cloud services (including software as a service) up to 2014, rising to a total global market value of over US\$55 billion¹. The US-based research firm 451 Group predicts that core cloud platform and infrastructure services outside of software-as-a-service will grow at a CAGR of higher than 60 percent in the same period². All major IT research and advisory firms predict that Cloud related products and services will grow much faster than traditional IT services – typically at around four to five times a greater rate. This rapid growth dynamic provides a great opportunity for innovative Australian IT firms with leading-edge Cloud technologies to achieve increased revenues and also for related improvements in local IT employment.

It is worth noting that with the local Australian ICT (Information & Communication Technologies) marketplace having a reported value of over \$75 billion, and with the same fundamental dynamics regarding Cloud growth applying here to those playing out globally, there is also significant market revenue potential opening up specifically within Australia for Cloud providers. The following chart from IDC reflects that a projected 7.1 percent of total ICT spending in Australia in 2015 will be directly Cloud related, up from 2.8 percent in 2011. This will be a net increase in value of around \$4.3 billion. However with many Cloud services being able to be provided from any geographic location, it is important from a local industry development perspective to focus on maximising the related opportunities arising for local Australian ICT providers.



¹<http://www.techrepublic.com/blog/networking/cloud-computing-to-grow-at-5-times-rate-of-traditional-it-says-idc/3133>

²<http://www.prweb.com/releases/cloud/computing/prweb4771704.htm>

The key to maximising these relative opportunities lies in fuelling the level of demand for Cloud computing services and minimising current barriers to take-up. There needs to be a strong pull from the non-ICT sector in terms of understanding the fundamental business benefits of Cloud adoption, including operational efficiencies, greater reach into markets, cost reduction, reduced risk of IT investment with pay-as-you-go pricing, and greater flexibility to handle changes in business conditions.

A September 2011 IDC survey of enterprises in Australia found that 20.6 per cent of the respondents are already using Cloud computing, while 38.2 per cent are actively testing or planning to deploy Cloud services in the next six to 12 months. A further 41.2 per cent of companies are planning to implement Cloud services by 2013. These are positive indications that demand is growing rapidly.

We can conclude from the various expert insights that the local Australian Cloud market growth opportunities are real and provide a clearly addressable potential for local ICT providers. The extent of the Cloud market potential touches all of the segments of the broad ICT industry – including Software, Services, Hardware, Communications and Research.

Furthermore, we believe that there is an additional local industry development growth potential inherent in the proposition that Australia could be considered as a regional hub for the hosted provision and development of cloud computing services. This issue was canvassed by the recent Lateral Economics report, *“The potential for cloud computing services in Australia.”* The report was prepared on behalf of Macquarie Telecom, who are represented on the ITIIC, and also sit on the working group behind this report.

The Lateral Economics report notes that Australia’s geographic isolation provides a natural protection for Australian suppliers of cloud services to the domestic market and they argue that the Australian ICT sector should capitalise on this situation and build a strong domestic footprint, while along the way, positioning itself as a preferred supplier to nearby markets.

Importantly the report also highlights Australia’s low sovereign risk and stable political environment as providing an attractive basis for foreign investment. Furthermore it emphasises the benefits to consumers of existing laws such as the Privacy Act and the National Privacy Principles – benefits that would be further enhanced if the Exposure Draft on Australia’s Privacy Principles issued in June 2011 is enacted.

A further significant competitive advantage that Australia has over many other geographic locations in the Asia/Pacific region for the provision of hosted Cloud services relates to the wide potential availability of low-carbon energy resources to support a desirable “Green IT footprint” for data centres. With growing global awareness of Corporate Social Responsibility needs in the economic requirements of fast-growth companies this is important to note.

The ITIIC believe that taking positive steps to create new levels of consumer and business confidence in use of Cloud Computing solutions will have the additional benefit of helping position Australia as a national and regional Cloud leader – increasing the related industry development in software solutions and hosting centres, thereby boosting jobs and productivity whilst attracting global investment. Australia has strong fundamentals that are needed to make this a global reality; the leading-edge ICT skills, the legal, political and geographical certainties, as well as the assurance that data hosted here is secure. Powered and supported by transformative national initiatives such as the NBN, Australia increasingly has the infrastructure capacity and expert capability to plug into the world and reap the associated advantages.

Our overall assessment for the broad sector is that the Cloud computing market shift will impact parts of the existing Australian ICT industry in different ways,

Those elements of the ICT industry which focus on developing software solutions and software services will most likely need to rapidly transition their go-to-market models to take advantage of Cloud-based infrastructure and start providing their software solutions as a service from the Cloud. This may open up new markets for them and provide a springboard for growth, but given the increasing global competition dynamics in a Cloud world it is likely that the most innovative and nimble companies will prosper.

As covered by the Lateral Economics report, the provision of hosted Cloud solutions has significant potential both within Australia and in nearby markets.

While industry analysts are forecasting continued growth in 'core IT on-premise services and related computing infrastructure', those segments of the local ICT industry that currently focus on this area could find growth potentially more challenging over time. This segment will probably either have to enhance their offerings to become part of a cloud provider marketplace or face the possibility of gradually being forced to exit this market. Those that do stay in the market will over time have to compete more directly with the global cloud computing market providers, where to survive they will need to lower costs and find new local or operational efficiencies and increased productivity. In light of this, ITIIC believe there is a role for both industry associations and government in providing education and awareness for existing Australian ICT service provider organisations of the benefits and opportunities of Cloud, particularly in the areas of productivity and efficiency improvements, and how to make the transition to providing cloud based solutions.

We further note however, as with any new paradigm shift in market usage conditions, and thereby also change in related industry innovation, that there will be significant new opportunities for Australian ICT industry providers to develop leading solutions and services for Cloud usage globally. These opportunities will be best prosecuted if industry development of the ICT sector is seen as a key priority by the Australian Government.

The IT Industry Innovation Council recognises that Cloud computing in Australia has incredible growth potential, but is still in its infancy and the maturing of the market has a long way to go. As such it believes that a light touch in relation to government regulation of the market is the most appropriate approach. Outside of market regulation however, we believe that Government has a very key role to play in supporting the sector through some of its policy and procurement actions, and these dimensions are discussed directly in our Recommendations.

In terms of aligning the work of this paper with other key Government activities, the Council is aware that work is being done by the government on security and privacy issues, and on standards, and that there has been a significant body of work undertaken in the past 2 years looking at Cloud computing from a variety of aspects, not the least of which is the work of the GAP Taskforce on Cloud Computing whose report was released on 25 May 2011. The recommendations of that report represent a balanced approach to the issues, and we would encourage Senator Carr's consideration of these recommendations (included in Attachment A of this report).

Key recommendations

Recommendations Introduction

The IT IIC Working Group on Cloud Computing has met a number of times to review the nature of advice to the Minister regarding his questions raised. There are some overarching points to be made which “set the scene” for that advice, and these are:

- That the Council believes there is a current window of opportunity for Australia to be a global leader in the creation and adoption of Cloud computing innovation, both in the sense of being a leading ICT cloud computing solutions provider and in the more general sense of being a leading Cloud computing adopter. However Australian governments, Industry and the local ICT sector in particular must react promptly to this possibility with supportive actions (including the prioritising of the following recommendations) to support the achievement of wealth and prosperity arising from that opportunity;
- That Australian industry and government should focus their energies on the potential for the use of Cloud computing techniques to drive much-needed improvements in overall national productivity - noting that actions supporting this goal need to be accelerated faster than our international competitors;
- That there is a significant developing opportunity for local high-value ICT jobs creation by the development and use of smart Cloud computing applications to improve our global competitiveness and expand our export potential. The Australian Government should seek wherever practically possible to provide the right kind of stimulus actions in its approach to Cloud computing to encourage the development of a vibrant local ecosystem;
- The Council notes that there is a need to engender a sense of urgency and clear political leadership in this debate. Governments in other jurisdictions around the world are beginning to consider and take specific actions to encourage and promote their country as a leader in Cloud computing. One example of this in the procurement context is United States Government’s “Cloud First” policy which requires federal government agencies to first consider cloud as a mechanism to deliver any new IT initiatives. Another example from a consumer protection perspective is the discussion paper recently released by the Singapore Government’s Ministry of Information, Communications and the Arts for a Proposed Consumer Data Protection Regime for Singapore. The paper expressly notes:
“A general DP [data protection] law will also strengthen Singapore’s position as a trusted hub and create a conducive environment for the fast-growing global data management and data processing industries, such as cloud computing, to thrive in Singapore. Singapore has many competitive advantages as a data hosting location, such as its telecommunications infrastructure, geographical location, safety from natural disasters and power reliability. However the lack of a general DP law in Singapore may increasingly be seen as a significant disadvantage that could deter some companies from choosing to host their data here. The development of DP legislation would thus support Singapore’s future development as a global hub for data.”

Recommendations Summary

The ITIIC Working Group on Cloud Computing makes the following recommendations to Minister Carr:

1. The ITIIC recognises the valued work of the recent GAP Cloud Computing taskforce (coordinated by Department of Broadband, Communications & Digital Economy), and commends the GAP recommendations to the Minister.

The report’s recommendations focus on maximising the benefits of Cloud computing and minimising its risk. It calls for government to issue a statement of support for Cloud computing. Other recommendations advocate government adopting a position of leadership and vision, the establishment of a standing public/private Cloud Committee, domestic and international engagement, assessing Australia’s Cloud readiness, education and awareness, and co-regulation, including the possible development by industry of cloud computing trust-marks and a possible

industry self-regulatory code of conduct. The recommendations are included in full in Attachment A.

2. The ITIIC recognises the significant work undertaken also by the Australian Government in producing the Cloud Computing Strategic Directions Paper and the importance of the ongoing work being done to implement it. It is supportive of further accelerating many aspects of this work, as per Recommendation 5 below.
3. The ITIIC recommend that the following actions be undertaken to address industry development issues within the sector.
 - a) That the Australian Government should strongly support the development of an enhanced local Cloud computing industry, building on the inherent strengths that the stable Australian financial, policy and regulatory environment provides. This environment will be further strengthened by developing guidelines for Cloud Service Providers to publically demonstrate cyber-security, provable maintenance of privacy of customer data, and guaranteed unencumbered (trusted) operation (Security/Privacy/Trust).

This recommendation is proposed based on the fact that the IT Industry Innovation Council considers that Australia has a natural advantage in being a safe, secure destination for hosting of Cloud data and applications, particularly so given the regulatory environment of neighbouring countries and the geological stability of neighbouring countries in the Asia/pacific region. The recommendation is also based on the expectation that more and more users will move to a Cloud environment once Cloud services are considered to be trustworthy. The recommendation is further based on the natural advantage Australia has with abundant renewable energy sources, including solar and geothermal, which would offer Cloud Service Providers the opportunity to reduce operational costs and support ecological "green" objectives.

Specific proposed activities to be led by the Australian government under this recommendation include:

- i. Raise Australia's reputation as a safe and secure location for hosting cloud services with the goal of developing a compelling global brand that characterises Australia as the "Safe, Secure, Green Cloud" destination.
- ii. Work closely with government, commercial and research organisations to establish a set of well-informed and consistently applied accreditation guidelines for Cloud Service Providers to demonstrate Security/Privacy/Trust. The IT Industry Innovation Council would be pleased to be involved in this work and believe it would require:
 - a. A review and formulation a set of measures for Security/Privacy/Trust for Cloud Service Providers. It is extremely important that this be done in close co-operation with Australian Government bodies such as AGIMO and the Office of the Australian Information Commissioner. It is also important to obtain input from Cloud Service Providers in the formulation process.
 - b. Working with major Cloud Service Providers to establish an agreed common set of validation tests (standards) against which they can state that they meet appropriate measures.
 - c. Engagement with a standards bodies, such as W3C (World Wide Web Consortium - hosted by CSIRO in Australia), and the ACS (Australian Computer Society) to promote acceptance of such measures.
 - d. Establishment of a mechanism by which the measures and validation suite may be reviewed and refined/updated.
 - e. Establishment of a mechanism by which these measurements may be independently assessed.
 - f. Work closely with government, commercial and research organisations to establish a publically recognised set of marks which demonstrate levels of Security/Privacy/Trust, similar to the energy and water "Star-Ratings" for household goods.

- g. Development of associated and relevant underpinning themes, such as local clean energy capability and deep skills in the local industry to support the proposition.
 - h. Detailed consideration should be given to the value of making the ICT Industry (and its inherent linkage with both Cloud Computing and the Digital Economy) a key industry development priority area for the Australian Government, thereby raising its status in relation to the activities of associated agencies such as Austrade.
- b) Through engagement with the relevant industry association's focus on developing a plan to provide expertise and advice that will enable the local ICT industry to transition to the Cloud.
 - c) That the Minister use the Enterprise Connect program to educate Australian Business on the business agility, transformational opportunities, and efficiencies offered in a Cloud based environment, and investigate opportunities through other existing government programs (digitalbusiness.gov.au, the Digital enterprises initiative, Supplier Advocate programme, etc.) to improve awareness and drive faster take-up.
 - d) That Government, industry, CSIRO and NICTA collaborate and develop and execute a joint cloud computing research agenda. This agenda could include researching value and opportunities provided specifically for enhancing Australia's reputation and capability in a Cloud Computing global market including potential areas such as linkages of Cloud technologies with the NBN, leadership in applied usage of Cloud applications and innovative new Cloud software solutions for complex economic and community challenges.
4. The Department of IISR be included in the establishment of an ongoing Cloud Consultative Committee as proposed by the GAP Taskforce (see Attachment A), and that it use its involvement to address issues such as alignment between the Cloud computing agenda and its association with the NBN, the eight goals of the National Digital Economy Strategy, and other Government initiatives including environment and sustainability, health reform, public sector productivity improvements etc. and how they intersect with the wider industry development agenda .
5. In line with the GAP Taskforce, the ITIIC suggests that Government provide leadership and vision in the implementation of Cloud Computing. The ITIIC recognise that these issues are broader than the Innovation, Industry, Science & Research portfolio, however, would encourage Minister Carr, where possible to support their adoption, and as such the ITIIC recommends that:
- a) The Australian Government, as a major procurer of ICT products and services in Australia, assume a leadership position in promoting the adoption of Cloud computing and should encourage innovation by the Australian ICT industry by:
 - I. Rapidly increasing Government agency awareness of Cloud Computing solution dynamics, including the opportunities and benefits associated with cloud together with the technical, business and policy issues around acquisition, deployment and operation of cloud services. This work is currently being addressed under the auspices of the Australian Government's Cloud Computing Strategic Direction paper and needs to be prioritised as greater awareness of cloud within government agencies should dispel some current negative misconceptions about Cloud, and shorten the adoption timeframe.
 - II. The Australian Government, ICT industry and other stakeholders supporting and participating in the development and implementation of international, standardised frameworks for securing, assessing, certifying and/or accrediting cloud end-to-end solutions. The Government should investigate the requirement for a vendor "end-to-end" certification program and recognition of international certification programs, as outlined in the Australian Government's Cloud Computing Strategic Direction paper.
 - III. The Australian Government considering the faster adoption of cloud services by government agencies, where appropriate, with particular emphasis on non-sensitive public facing information and services being migrated to a public cloud environment. It is acknowledged that agencies must first undertake a risk assessment to ensure that the information or service is appropriate for placement in the cloud.

- IV. Developing a risk assessment methodology for agencies as part of the Australian Government's Cloud Framework with the goal of finalising it by the end of calendar year 2011.
- V. The Australian Government monitoring and tracking cloud services take-up within Government agencies so that related learnings arising can be shared, and progress assessed. Where possible, these learnings should be shared openly with industry.

Background

Charter of the IT Industry Innovation Council

The IT Industry Innovation Council was announced by Senator the Hon Kim Carr on 5 May 2009 in recognition of the leading role that IT plays across all sectors of our economy and its ability to enable innovation which can transform existing industries, create new ones and enhance Australia's productivity and competitiveness. The Council which primarily acts as an advisory body to the Minister is made up of 24 members drawn from across the IT spectrum, including representatives from industry, suppliers, users, education, research, government and unions. The Council also plays a strong advocacy role promoting the sector in its own right and as an enabler of innovation, productivity and sustainable development for the economy as a whole. It has defined two major areas of focus – *'Developing innovative technology - turning ideas into products and services of value'* and *'Applying innovative technology – creating competitive advantage for business and government'*.

The advice sought

On 18 April 2011, Senator Kim Carr wrote to the Council seeking advice on the potential benefits that cloud computing could bring to the further development of the ICT industry in Australia, any barriers to achieving those benefits and the role cloud computing could play as an enabler of innovation in the wider economy.

A working group was established to prepare this advice with the following membership; the make of the group was to ensure members brought a wide variety of perspectives to the development of the advice.

Mr Ian Birks (Chair of ITIIC)	Chief Executive Officer	Initially Australian Information Industry Association, then Skrib Pty Ltd.
Ms Suzanne Roche	Director	Smartnet Pty Ltd
Mr Glenn Wightwick	Director, IBM Global R&D Laboratory	IBM Australia & New Zealand
Mr Aidan Tudehope	Managing Director, Hosting	Macquarie Telecom
Mr Marty Gauvin	CEO/President	Virtual Ark - Cloud Technologies
Mr Paul Russell	Director, Digital Economy & Creative Industries	Department of Employment, Economic Development & Innovation, Queensland Govt.
Dr Ian Oppermann	Director	CSIRO ICT Centre
Dr Anna Liu	Principal Researcher & Research Leader	NICTA
Mr Keith Besgrove	First Assistant Secretary Digital Economy Services Division	Department of Broadband, Communications & the Digital Economy
Mr Glenn Archer	First Assistant Secretary Policy & Planning Division	Australian Government Information Management Office

The context for the advice

The ITIIC recognise the policy agenda surrounding any consideration of the role of Cloud Computing, noting in particular those policies relating to innovation and the digital economy, as outlined below. The ITIIC also note a number of other key activities in the cloud computing space, which are also outlined below.

The Government's policy agenda

The Government's innovation policy agenda is outlined in the document *Powering Ideas: An Innovation Agenda for the 21st Century* released in May 2009. This document is strategic in its message about building an effective innovation system and it includes priorities and actions to achieve targets. The agenda includes initiatives to

build innovation in business, to strengthen research and science, and to improve innovation in the public sector. Its key areas of focus are: building innovation skills, supporting research to create new knowledge, increasing business innovation and boosting collaboration. Information Technology (IT) will continue to be a vital transformational tool in driving innovation across these focus areas. The full document can be found at:

<http://www.innovation.gov.au/Innovation/Policy/Pages/PoweringIdeas.aspx>

The Government also has a commitment to position Australia as a leading digital economy by 2020. The National Digital Economy Strategy (NDES) sets out a vision for Australia to realise the benefits of the National Broadband Network (NBN) and to achieve this vision, the Strategy outlines eight Digital Economy Goals to:

1. increase Australian households' online participation
2. increase Australian business' and not-for-profit organisations' online engagement
3. smartly manage our environment
4. improve health and aged care
5. expand online education
6. increase teleworking
7. improved online government service delivery and engagement
8. increase digital engagement in regional Australia.

The strategy also outlines a Way Forward including Government and Industry Initiatives. The NDES can be downloaded here: <http://www.nbn.gov.au/the-vision/digitaleconomystrategy/>

There have also been a number of dedicated activities looking at Cloud Computing. The Australian Government's Cloud Computing Strategic Direction paper, released in April 2011 by the Australian Government Information Management Office (AGIMO)³ takes a principles and risk-based approach, to position agencies to take advantage of the benefits of cloud computing, while not compromising the security of their critical operations or people's private or sensitive information. As part of this work AGIMO will develop a broad risk assessment methodology for agencies in their consideration of cloud adoption.

On 12 April, the Defence Signals Directorate (DSD) also released a discussion paper to assist agencies to perform a risk assessment and make an informed decision as to whether cloud computing is currently suitable to meet their business goals with an acceptable level of risk. This approach to risk assessment focuses solely on security issues with cloud.

The GAP Task Force⁴ on Cloud Computing released a report on 25 May 2011, which notes that Cloud computing is important because it has the ability to significantly reduce the cost of establishing and operating computer and communications systems, while providing flexible scaling of services based on demand. The report also notes that the combination of Cloud services and high-speed broadband through the NBN will increase the scale, speed and complexity of both the opportunities and challenges which Australia must confront in moving towards a fully-fledged digital economy. The report's recommendations focus on maximising the benefits of Cloud computing and minimising its risk.

In September 2010 the Australian Academy of Technological Sciences and Engineering (ATSE) released a study conducted into the cloud computing opportunities and challenges for Australia. The report discusses cloud use by government, business and universities – both overseas and in Australia – and reveals there are valuable opportunities for Australia in cloud computing: for government, researchers and business. But the Australian Government needs to ensure that these opportunities are grasped and unnecessary barriers removed.

A summary of the four reports referenced above is provided at **Attachment A**. There are also various international activities in the Cloud computing environment and **Attachment B** outlines cloud computing initiatives from a number of key international jurisdictions, which could inform Australia's approach.

Attachment C outlines the CSIRO's work on cloud computing.

³ AGIMO is an agency of the Department of Finance & Deregulation

⁴ The GAP taskforce was chaired by DBCDE and comprised 20 people from Commonwealth and State government agencies, the private sector, consumer advocacy groups and the research community.

The advice

This paper recognises the plethora of information and discussion already in the public domain on Cloud computing and attempts to look at the related issues through the innovation and industry development lens.

Cloud Computing – a definition

For the purposes of this paper the following definition of Cloud computing as a delivery model for IT services as defined by the National Institute of Standards and Technology (NIST) is used. Specifically NIST defines cloud computing as “a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction”⁵. NIST specify five characteristics of cloud computing:

- 1) **On-demand self-service** involves customers using a web site or similar control panel interface to provision computing resources such as additional computers, network bandwidth or user email accounts, without requiring human interaction between customers and the vendor.
- 2) **Broad network access** enables customers to access computing resources over networks such as the Internet from a broad range of computing devices such as laptops and smart-phones.
- 3) **Resource pooling** involves vendors using shared computing resources to provide cloud services to multiple customers. Virtualisation and multi-tenancy mechanisms are typically used to both segregate and protect each customer and their data from other customers, and to make it appear to customers that they are the only user of a shared computer or software application.
- 4) **Rapid elasticity** enables the fast and automatic increase and decrease to the amount of available computer processing, storage and network bandwidth as required by customer demand.
- 5) **Pay-per-use measured service** involves customers only paying for the computing resources that they actually use, and being able to monitor their usage. This is analogous to household use of utilities such as electricity.

Cloud computing describes a broad movement to treat IT services as a commodity with the ability to dynamically increase or decrease capacity to match usage needs. By leveraging shared infrastructure and economies of scale, cloud computing presents governments and business with a compelling business model. It allows users to control the computing services they access, while sharing the investment in the underlying IT resources among consumers.

When the computing resources are provided by another organisation over a wide-area network, cloud computing is similar to an electric power utility. The providers benefit from economies of scale, which in turn enables them to lower individual usage costs and centralise infrastructure costs. Users pay for what they consume, can increase or decrease their usage, and leverage the shared underlying resources. With a cloud computing approach, a cloud customer can spend less time managing complex IT resources and more time investing in core business.

How is Cloud different from outsourcing, from Hosted services, from the Internet?

Cloud computing is a way of accessing IT infrastructure in a geographically independent, scale independent, pay-for-what-you-use way. It relates to infrastructure, or infrastructure and software.

- **Outsourcing** can be applied to cloud computing. It just adds a services layer on top.
- The **Internet** is a necessary precursor to Cloud Computing as it provides the network that cloud computing resources are accessed through.

⁵<http://csrc.nist.gov/groups/SNS/cloud-computing/cloud-def-v15.doc>

- Cloud computing can substitute for **hosted IT services** while the hosting model deploys dedicated hardware and software for a customer which is not 'elastic', the cloud model deploys elastic, 'virtual' infrastructure.

Types of clouds

Cloud type	Description
Private cloud	The cloud infrastructure is operated solely for an organisation. It may be managed by the organisation or a third party and may exist on premise or off premise.
Community cloud	The cloud infrastructure is shared by several organisations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organisations or a third party and may exist on premise or off premise.
Public cloud	The cloud infrastructure is made available to the general public or a large industry group and is owned by an organisation selling cloud services.
Hybrid cloud	The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardised or proprietary technology that enables data and application portability (e.g. cloud bursting for load-balancing between clouds).

Source: Wyld, 2010⁶

Principal drivers of the demand for cloud computing

The demand for cloud computing services is growing, for example a September 2011 IDC survey of enterprises in Australia found that 20.6 per cent of the respondents are already using Cloud computing, while 38.2 per cent are actively testing or planning to deploy Cloud services in the next six to 12 months. A further 41.2 per cent of companies are planning to implement Cloud services by 2013. These are positive indications that demand is growing. Some of the driving forces behind the growth in demand for cloud computing are:

- Significantly reduced Total Cost of Ownership (TCO) of the required IT infrastructure and software including (but not limited to) purchasing, operating, maintaining and updating costs and timeframes;
- Pay-As-You-Go (PAYG) based low prices;
- High Quality of Service (QoS) options provided by cloud service providers such as availability, reliability and dynamic resource scaling based on demand;
- Accessible - Easy access to organisational information and services anytime anywhere;
- Economic - Cost-shifting benefits with increased efficiencies; and
- Flexible - More business agility, providing "on-tap" IT capability for start-ups, spikes in workload, etc.

The role out of the National Broadband Network (NBN) in Australia will also provide a catalyst for increased demand for cloud computing services as the speed and capacity of the network is increased, the opportunities for what can be provided through cloud computing are also increased.

Cloud computing: Potential benefits to ICT industry development in Australia

The local Australian ICT (Information Communications & Technology) marketplace is measured by IDC with a reported value of over \$75 billion. Analysis from IDC reflects that a projected 7.1 percent of total ICT spending in Australia in 2015 will be directly Cloud related, up from 2.8 percent in 2011. This will be a net increase in value of around \$4.3 billion.

A September 2011 IDC survey of enterprises in Australia found that 20.6 per cent of the respondents are already using Cloud computing, while 38.2 per cent are actively testing or planning to deploy Cloud services in the next six to 12 months. A further 41.2 per cent of companies are planning to implement Cloud services by 2013. These are positive indications that demand is growing rapidly.

⁶ Wyld, D C, 2010, *The cloudy future of government IT: Cloud computing and the public sector around the world*, International Journal of Web & Semantic Technology (IJWesT), Vol 1, Num 1, January 2010, <http://airccse.org/journal/ijwest/papers/0101w1.pdf>

We can conclude from the various expert insights that the local Australian Cloud market growth opportunities are real and provide a clearly addressable potential for local ICT providers. The extent of the Cloud market potential touches all of the segments of the broad ICT industry – including Software, Services, Hardware, Communications and Research.

It should also be acknowledged that Cloud will impact parts of the existing ICT industry in different ways. Those elements of the ICT industry which focus on developing software solutions and software services will transition to providing software solutions as a service from an infrastructure cloud either owned and operated by them or by another public or community cloud provider. This transition will potentially lower computing infrastructure costs for this segment of the ICT industry, and also has the potential to increase business agility.

While analysts are forecasting continued growth in ‘core IT on-premise services and related computing infrastructure’, the impact of the cloud on this segment of the ICT industry will, over time, potentially be significant. This segment will probably either have to enhance their offerings to become part of a cloud provider marketplace or face the possibility of gradually being forced to exit this market. Those that do stay in the market will over time have to compete more directly with the global cloud computing market providers, where to survive they will need to lower costs and find new local or operational efficiencies and increased productivity.

A further issue with regard to industry development is whether Australia could really be considered as a regional hub for the provision of cloud computing services. This precise issue was canvassed by the recent Lateral Economics report, *“The potential for cloud computing services in Australia”*. The report was prepared on behalf of Macquarie Telecom, who are represented on the ITIIC, and also sit on the working group behind this advice. The report highlights some of the significant challenges Australia faces, including issues surrounding our remoteness and our undersea cabling capacity, which results in issues with capacity, congestion, cost and latency issues that disadvantage us against other locations closer to large markets⁷. While these congestion and latency issues present problems for Australia’s participation as global suppliers of cloud services, as Lateral Economics notes, these issues also provide a natural protection for Australian suppliers of cloud services to the domestic market, and they argue that the Australian ICT sector should capitalise on this situation and build a strong domestic sector, while along the way, positioning ourselves as a preferred supplier to nearby markets, at least in areas where latency is not an issue. The report also highlights Australia’s ‘intangible infrastructure’ – our governance – as a major asset, specifically noting our political stability and the stability, transparency and integrity of our institutions⁸.

The ITIIC would support this view further noting Australia has a natural advantage in being a safe, secure destination for hosting of Cloud data and applications, particularly so given the regulatory environment of neighbouring countries and the geological stability of neighbouring countries in the Asia/pacific region. Australia also has a natural advantage with regard to abundant renewable energy sources, including solar and geothermal, which would offer Cloud Service Providers the opportunity to reduce operational costs and support ecological “green” objectives. It is this strong regulatory and policy framework, geological environment, reliable and competitive energy supply, and our educated and skilled workforce, which all provide an attractive basis for investment.

Essentially, Cloud computing offers Australian’s accomplished ICT sector another niche in which to develop expertise. By selling the benefits of cloud computing to be reaped by consumers, and balancing these with the advantages of locally based Cloud computing providers the local ICT industry has a real opportunity for growth including through:

- Significant new business opportunities (translating directly to the potential for revenue and jobs growth) both locally and globally for the providers of Cloud based software and services solutions, and for the hosted provision of Cloud services in Australia, including usage both on-shore and off-shore; and
- A current window of innovation opportunity is opened due to the paradigm shift globally in the move to Cloud based solutions.

⁷ *The potential for cloud computing services in Australia: A Lateral Economics report to Macquarie Telecom*, pp. 3

⁸ *ibid* pp.4

For these potential benefits to be achieved to the fullest extent it is important that Australia be a fast-mover in both the development of Cloud solutions and the adoption of the same by Australian Government and commercial enterprises. Increased adoption lies in selling the benefits to consumers.

For example, for users of technology, Cloud computing has emerged as the decade's biggest shift in the way organisations use IT with implications that stretch well beyond IT operational efficiencies. Indeed cloud adoption can translate to substantial competitive advantage. However, the strategic business benefits of Cloud are often not broadly appreciated as cloud continues to be considered an IT operations issue, yet a consideration of the strategic benefits is vital for business leaders to make fully informed decisions about what they should consider moving to the Cloud and when.

The following outlines a wide range of critical business improvement opportunities that cloud computing offers Australian Industry and Governments. These include:

- Time to market in product and service development can be rapidly reduced
- Opportunity to sell across a broader geography without investing in infrastructure
- Opportunity to move IT systems forward more aggressively without waiting for investment cycles
- Reduced risk of IT investment due to reduced lock-in.
- *Pay as you go*. This model for computing infrastructure will allow industry to pay only for computing infrastructure that is fully utilised to develop and provide ICT services, resulting in lower ICT costs.
- *World-wide reach*. This is critical for expanding the market for software, services and IT solution developed by the Australian ICT industry.
- *Cost reduction*. World-wide competition between cloud providers will drive the ICT industry's computing costs down.
- *On-demand self-service*. This allow ICT industry to unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider.
- *Rapid elasticity*. Computing power and storage can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.
- *New markets*. Cloud will enable the developing of new markets involving smart phones, tablets, and intelligent transport. These opportunities will be amplified further with the introduction of ubiquitous high speed broadband such as that to be delivered by the NBN.
- *SME benefits*. The ability to look large while staying small and cost effective.

There is general consensus that the Cloud paradigm represents a significant shift. Despite all the attention, as a relatively recent innovation there remains little quantitative information on the benefits Cloud computing may deliver to the ICT industry, and to the Australian economy as a whole. For providers of Cloud services protracted business decisions, slowed by the lack of clarity, have translated to uncertainty over end user demand, making investment in Cloud infrastructure much more challenging. Bringing more clarity to these issues will facilitate more informed debate, decision-making and investments, so that all Australians may benefit. The IT IIC notes that KPMG is currently working in partnership with the Australian Information Industry Association (AIIA) on a detailed study that is intended to clearly quantify some of these benefits in economic terms and looks forward to the results of that study. Some of the currently perceived barriers to achieving those likely benefits are discussed further below.

Barriers and Risks to achieving those benefits

The barriers to the success of cloud computing as an alternative for the provision of computing services lie primarily in issues facing consumers of cloud. For example, when moving applications and/or data in the cloud, numerous challenges exist to leverage the full potential that cloud computing promises. These challenges are often related to cloud interoperability, security and trust, and contractual complexities. The following provides a summary of the key challenges that must be addressed:

- **Transitioning existing software and data to the cloud may be too expensive and technically challenging to undertake** - This is particularly true in situations that involve legacy or non-standard software systems and data stores. Transition to the cloud in some of these cases may require replacing the software with a modern cloud-ready design and extracting the data into a cloud based data store.
- **Lack of cloud Interoperability and contractual 'lock-in'** - Cloud interoperability issues arise when a software application and related data that are hosted in a cloud need to be moved to a different cloud provider (e.g., to reduce cost, improve service they provide, reduce security and availability risks). This is currently virtually impossible to do without incurring a significant cost and effort that will be required to port the software and its data. This typically will involve re-architecting existing software to comply with the interfaces and functionality of the new cloud provider. At this point this is a major task that will most likely result in locking the customer to the original service provider. Further, contractual complexities and inconsistencies (expensive exit clauses, data deletion etc) can lead to contractual 'lock-in' for consumers of the Cloud.
- **Data security and trust is a major concern** - Companies and consumers often do not want to store their data in the cloud due to a lack of trust and the risk of exposing their data in an un-trusted environment. In addition, companies and government agencies are often bound by data sovereignty concerns to host their application and/or data within specific geographic boundaries. This calls for *hybrid cloud environments* that can seamlessly work together, where parts of the application can be hosted in a public cloud and other parts such as data is hosted on premises. A key challenge is the provisioning of *secure and trusted data storage* that can be operated in such a hybrid cloud environment.
- **Quality of Service (QoS) is difficult to monitor and maintain** - Existing software systems typically consist of different parts and subsystems (such as Web frontend, rich client application, business services, workflows, database layer or message queuing). Such systems often have rigid *QoS requirements* in terms of performance, dependability, security and trust. *Monitoring and enforcing* those QoS requirements is a key challenge to fulfil Service Level Agreements (SLA) between the cloud application owner and the customer.
- **Frequent (re)assessment is required to keep maximising cloud benefits** - Different cloud providers offer similar services at different prices; also, often these prices are subject to frequent change. While one provider might be cheap for offering terabytes of storage, renting powerful VMs might be expensive. An important factor for customers to decide which the "right" cloud provider is the QoS that a cloud provider is offering and the cost that the provider is charging for the services. For cloud computing customers it will be increasingly difficult to decide which cloud provider can fulfil their QoS requirements. There will be a trade-off between cost vs. QoS of hosting a particular application that needs to be balanced, especially in hybrid cloud environments. Therefore, a key challenge will be to *optimise this trade-off* by maximising the SLA fulfilment while minimising the cost.

Today's fast telecommunications networks allow hosting and cloud computing providers to offer businesses and government data storage in domestic or offshore locations, the latter through global or regional clouds.

However, as noted above storing data offshore raises a raft of security and trust issues as in these circumstances data may move across multiple foreign jurisdictions, each with its own set of rules. In order for Australian customers to undertake an appropriate assessment of the Cost, Value and Risk dynamic for any proposed cloud solution, it is critical that they have visibility into the data management practices of cloud providers and how these may impact the solution's risk to them. Cloud computing will not totally displace existing IT solution options but rather complement existing technologies and offer customers an increased number of options. With this increased choice of alternatives, clarity not only of the risk, but also a deep understanding of the Cost and Value dimensions of the opportunity must be facilitated. This is particularly true when comparing the data-local benefits of an in-country cloud offering with the cost and scalability features inherent in the massive global scale offerings for the large IT operators. Customers must be able to understand and then evaluate the dynamics of cloud to obtain full value.

Macquarie Telecom commissioned international law firm Freshfields Bruckhaus Deringer to conduct independent research into issues associated with hosting data offshore. Key findings from the study include:

- Regulatory compliance risks need to be carefully and appropriately addressed.
- The disparities in the privacy regimes between for example Singapore, the US and Australia should be factored into any business case of off-shoring data (e.g. Singapore lacks unified and comprehensive data protection and does not constitutionally recognise a right to privacy, the US lacks a National privacy regime);
- Storing data in offshore markets such as Singapore or the US could give rise to a tax liability even if no business as such is transacted in those markets (for example hosting a transactional web site in the US could create a taxable presence in the US for both federal and state tax purposes);
- Data stored offshore is subject to the laws of the jurisdiction. Singapore for example has over 160 disparate, sector-specific laws regulating the use and disclosure of data in Singapore and failure to comply with these laws may prove costly in fines, revocation of operating licenses as well as reputation risks;
- Consideration needs to be made of the relevant government and law enforcement agency data access requirements if data is stored within the Cloud. The PATRIOT Act, for instance, applies to all data held by all US companies irrespective of the location of the data. Likewise, any Australian company with a presence in the US at all must comply with all US laws which includes the PATRIOT act. Further, aside from the specific example of the PATRIOT Act almost all countries have longstanding bi-lateral agreements and letters rogatory in place that facilitate the access of one government to information held within another countries borders under appropriate pre-agreed terms.

A statement made by the Hon Brendan O'Connor MP, Minister for Home Affairs and Justice, Minister for Privacy in April 2011 highlights the importance of storing data onshore and supports the need to be conscious of the above issues. He said, *"Businesses taking advantage of cloud computing must ensure their customers' information is secure, and that they are compliant with the Australian privacy regime. While some cloud providers are located in Australia, many more are located overseas. That of course gives rise to difficult jurisdictional issues, particularly where the laws of two or more countries could potentially apply"*⁹ Minister O'Connor recognised the fraught legal environment in which business will have to consciously address the existence of appropriate privacy protections.

The Australian Law Reform Commission, (ALRC) in its recent review of Australian Privacy laws also recommends that, if an *"agency or organisation in Australia or an external territory transfers personal information about an individual to a recipient (other than the agency, organisation or the individual) who is outside Australia or an external territory, the agency or organisation remains accountable for that personal information."*¹⁰ These concerns are also mirrored by the Defence Signals Directorate, as discussed in Attachment A. The ITIC understands that the Australian Government has now responded to the ALRC's recommendation and has accepted it with modifications. Fundamentally, the Government accepts the general principle that an agency or organisation should remain accountable for personal information that is transferred outside Australia.

Addressing security and privacy issues

Possible self-regulatory approach to provide confidence in the supply of cloud computing

To fully realise the benefits that cloud computing provide over traditional enterprise IT systems and applications potential security and privacy concerns need to be addressed. At the heart of the security concerns is the need for enterprises to meet regulatory compliance requirements and to be able to assess risk. Confidence, however is more than just "doing the right things", it is also demonstrating that you are doing the right things.

In addition to looking at the potential of regulatory devices to meet these demands one option would be to look at encouraging industry to take on a more self-regulatory approach to provide this "confidence". A grouping could be formed of those suppliers promoting best practices in the provision of cloud services to users in Australia such that users have confidence that their business critical and personally sensitive data will be handled appropriately and securely.

⁹[The Hon Brendon O'Connor MP, Minister for Home Affairs and Justice, Minister for Privacy FOI, April 2011](#)

¹⁰[Australian Law Reform Commission, Cross-border Data Flows](#)

The Council believes that a grouping of suppliers could sign onto a voluntary code for accreditation that could potentially encompass some or all of the following key principles:

- Commitment that business critical and/ or personally identifiable data will be hosted in Australia, and where it is not that appropriate and diverse back-up methods are used.
- Commitment to develop interoperability standards to lessen lock-in to contracts, and increase competition for the benefit of the consumer.
- Commitment that the data will be handled in accordance with all relevant Australian laws (especially privacy) and visibility provided of where data is at any point (accountability) and willingness to be subject to third party auditing
- That a voluntary breach notice regime will be adopted that ensures that the user of the service are advised within a set time of the fact a privacy/security breach has occurred and where there is reasonable belief that stolen or lost information can lead to identity theft.
- Commit to providing transparency around risk associated with provision of cloud computing
- Meet all relevant industry technical compliance arrangements
- Establish some mechanism for “putting it right” when instances of failure occur and the customer is not well placed to access any suitable remedy.

A similar self-regulatory approach was recommended by the Lateral Economics paper on Cloud Computing, and the European Union (EU) will also introduce new data protection laws along these lines in November this year. On 30 September it was reported in the press that the EU will use ‘the Binding Safe Processor Rules’ to ask cloud service providers working in the EU to agree to be legally liable for any data breaches or losses that occur at their data centres. It will affectively act as an accreditation scheme for cloud providers, meaning it will require suppliers to sign up to the initiative.¹¹ The ITIIC supports the consideration of the development of such a system.

The ITIIC notes and commends the self-regulatory approach taken by a number of leading data centre suppliers under the banner of OzHub to provide users with confidence around the security and privacy of data that is on-shored in Australia – on-shoring is particularly important in the case of highly sensitive data to avoid cross jurisdictional issues and the loss of control over data location.

Cloud computing as an enabler for SMEs in the wider economy

Cloud computing has the potential to impact both the economics and business models of Small to Medium Enterprises (SMEs). As discussed earlier cloud services facilitate new ways of working and collaborating and more flexible options for businesses through the ability to obtain the information and communication capacity they need, on demand. It provides a viable and affordable alternative to expensive and resource intensive in-house IT solutions and hardware and software investments, particularly where this is not core to the business. The benefits for consumers of cloud were discussed in detail on page 14, however, the gains offered by cloud computing hold particularly enormous potential for small businesses otherwise burdened by IT overheads which, in many cases, they find difficult to maintain and costly to keep up to date.

SMEs are a particularly important part of the business landscape in Australia and are an area of business that have been traditionally slow at adopting new and appropriate IT solutions. Anecdotal evidence collected by the ITIIC suggests many of the companies engaged with the DIISR’s Enterprise Connect program would welcome and benefit from a greater understanding of what IT and transformative technologies such as Cloud computing can do for their business. In this we regard Cloud technology offers five core benefits specifically for SMEs.

1. **Simplicity:** Cloud reduces to almost negligible the technical knowledge a business owner needs. Technical complexity related to set up, operations and maintenance – in fact any part of the ICT process

¹¹ <http://www.itnews.com.au/Tools/Print.aspx?CIID=275266>

- is taken care of by the cloud provider, enabling businesses to focus on their business rather than the technology that supports it.
2. **Accessibility:** The cloud provides small businesses accessibility to their business information irrespective of where it is stored and through a multitude of devices – limited only by access to the internet.
 3. **Flexibility:** In many respects cloud technology offers a greater value proposition to small businesses than larger enterprises when it comes to the flexibility it provides. Given the speed with which the business and technology landscape changes, small businesses need to be responsive, nimble and equipped to adapt their operations quickly. With cloud-based services priced per user or per subscription, small businesses can grow their technology capability in parallel with their business requirements and growth. Rather than being reliant on potentially risky forecasts and predictions – with cloud based solutions IT capability they can adapt and expand on an ad hoc, as needed basis. And given the cyclical nature of business, increase and reduce additional resource capability in line with actual business fluctuations. They also have flexibility in terms of how much of the cloud they use. While on the one hand they can base their entire IT systems in the cloud resulting in negligible IT hardware requirements onsite. On the other they can select only those components that suit them and their business, for example cloud driven email services, cloud based sales databases, or storage within the cloud.
 4. **Affordability:** Enterprise business applications like Customer Relationship Management (CRM) programs or Enterprise Resource Programs (ERP) are typically expensive to acquire, install and maintain. In a cloud computing model, these sorts of applications become much more affordable and thus accessible to the SME. Capital investment in infrastructure, including servers, storage and software is avoided. Hardware and software upgrades, software version control become obsolete, responsibility falling instead to the cloud service provider.
 5. **Improved Productivity:** With routine IT and network management tasks performed by the cloud service provider, SMEs can avoid the need to dedicate or redirect costly resources to maintain the systems they rely on to deliver their business. This directly improves business productivity and arguably enables SMEs to focus on a broader range of issues relevant to growing and improving the business overall and ensuring its continued competitiveness.

Notwithstanding unresolved issues in areas such as privacy and security, cloud technology offers SMEs the opportunity to leverage all the benefits of modern smart technology without the potentially costly and burdensome overheads that often accompany it. Given the potential offered by cloud to the SME sector, efforts by government and industry need to be made in promoting an awareness of these benefits alongside advice on how to circumvent any pitfalls. This is particularly important as noted by the GAP taskforce small business may be an especially vulnerable group to potential abuses by cloud computing service providers.

How the cloud can contribute to the Government's wider innovation agenda

The flexibility and elasticity of Cloud computing can reduce the cost and complexity of undertaking IT research and development as it allows for new application development projects to be conceived, developed, and tested with smaller initial investments than traditional IT investments. Rather than laboriously building in-house data centre capacity to support a new development environment, capacity can be provisioned in small increments through cloud computing technologies. After the small initial investment is made, the project can be evaluated for additional investment or cancellation. Projects that show promise can gain valuable insights through the evaluation process. Less promising projects can be cancelled with minimal losses. This “start small” approach collectively reduces the risk associated with new application development. Reducing the minimum required investment size will also provide a more experimental development environment in which innovation can flourish.

Cloud computing will also contribute to the Government innovation agenda as it will both benefit from and have a major impact on the National Broadband Network (NBN). The NBN will provide the bandwidth, connectivity, reliability and network QoS for the cloud. On the top of NBN, Cloud will provide cheap, on demand, elastic computing power (Infrastructure as a Service – IaaS), as well as a variety of applications for enterprises, homes, and mobile users that are maintained by the cloud provider (Software as a Service - SaaS). Finally the NBN will allow the consumer to deploy onto the cloud consumer-created or acquired applications (Platform as a Service - PaaS). These will enable the Australian ICT industry, the education sector, the health sector, the Australian

government, and the Australian Research Institutions to innovate in the areas of eLearning, eHealth, eGovernment and eResearch, and to significantly improve productivity in these sectors via the introduction of innovative ICT services. The DBCDE Digital regions initiative and National Digital Economy Strategy already include some initiatives to exploit the benefits of cloud computing in these sectors.

The ITIIC believe there is significant potential to further explore the potential possibilities for Cloud computing in these areas and recommends bringing these issues to bear in ongoing forums such as that being established by GAP.¹²

Industry capability to participate

In the private sector there are a range of prominent global vendors providing public cloud based services, the following list is an indication of some of the companies providing these services:

Amazon web services offer several different in-the-cloud services. The best known is Amazon Elastic Compute Cloud (EC2) which is a web service that offers resizable compute capacity in the cloud. Key features include: elasticity, control, and flexibility. Other Amazon services include Amazon Simple Storage Service (S3), Simple DB, Cloudfront, Simple Queue Service (SQS), and Elastic MapReduce.

Microsoft has positioned itself as an en-to-end platform company that provides an integrated platform and development model able to support SaaS offerings such as O365 Office and collaboration tools and Dynamics online CRM, through to the company's Azure Services Platform which is a Windows-like cloud computing architecture that offers remote computing power, storage and management services comprised in 4 key parts:

- Windows Azure: Windows-based environment for running applications and storing data on servers in Microsoft data centres
- Microsoft .Net Services: Distributed infrastructure services
- Microsoft SQL Services: Data services in the cloud based on SQL Server
- Live Services: Access data from Microsoft's Live applications and others and allow synchronising this data through Live Mesh.

In addition to supporting all three levels of Cloud the company supports both pure cloud-delivered offerings and hybrid, on-premises plus cloud scenarios which will become common options for customer.

VMware offers private as well as public cloud computing. The Private cloud computing has been designed to ensure security and compliance by deploying a private cloud infrastructure inside a business's firewall. The public cloud offers customers the freedom of open standards and interoperability of applications. It includes a common management and infrastructure platform.

Savvis offers two features: a web portal that allows customers to provision their own virtual computing and storage capabilities on either private or shared resources. Savvis offers scalability, flexibility and virtualised utility hosting on demand.

Google offers some of the best known cloud computing services available, including Gmail, Google Docs, Google Calendar, and Picasa. They also offer some lesser known cloud services targeted primarily at enterprises, such as Google Sites, Google Gadgets, Google Video, and most notable, the Google Apps Engine. Google Apps Engine is a free setup that allows the users to write and run their web applications on Google infrastructure. While it has been criticised for limited programming language support, the Apps Engine debuted Java and Ajax support in April 2010. A key advantage is scalability of the applications. GoogleApp Engine for business provides centralised administration, reliability, support and enterprise features.

There are also a number of Australian companies operating in this space. For example, Virtual Ark is offering cloud services to independent software vendors. Virtual Ark operates globally on a pay-per-use basis by using the cloud services of overseas providers, or private clouds in Australia as required. Macquarie Telecom also provides an Australian Enterprise Managed Cloud, with a focus on Australian hosted services. Australian based

¹² GAP Taskforce rec. 2 calls for the establishment of a standing committee on cloud computing, and we understand it will be chaired by DBCDE and meet for the first time in November 2011.

provide **Ninefold** also provides cloud computing hosting services including virtual server and online cloud storage solutions for start-ups, developers, digital agencies etc. Data is kept onshore in Australian based data centres.

The capabilities of the Australian IT sector to contribute in this area are being supported by the work of the CSIRO, and NICTA and their work is outlined further in Attachment C.

How and where the government can facilitate

Like the GAP Taskforce, ITIIC believe that Cloud computing can generate a range of major new business opportunities for Australia, but only if the regulatory environment succeeds in protecting consumers from abuse, while not constraining the introduction of innovative service solutions. In this regard ITIIC believe that consumer concerns about where their information is and what is happening to it can best be addressed by the adoption of common open standards by Cloud vendors to improve transparency, trust, data portability and interoperability. The GAP Taskforce endorsed greater government involvement in standards setting in this important emerging area, and the ITIIC would support this approach.

The ITIIC is aware that the Australian Government continues to monitor local and international trends on cloud services and has commenced working with standards making bodies to progress Cloud specific work in the international standards environment. This is primarily in recognition of a number of gaps in existing standards – including on gaps in privacy, and transparency for consumers about where cloud providers and data are actually located. It will be essential that Australia’s adoption of Cloud computing contributes to, and is consistent with, key global developments and avoids isolating Australia through special rules and standards. From a consumer protection perspective, Australia has the potential to position itself as a leading jurisdiction and authority on data protection and privacy issues concerning the Cloud.

Currently, the Joint Technical Committee 1 (JTC1) is the international standards development forum where stakeholders come together to explore, develop and agree upon information and communications technologies, including Cloud computing. Standards Australia is the National Member Body for JTC1 and operates eleven technical committees or ‘national mirror groups’ which correspond to selected JTC1 sub-committees and working groups.

DBCDE is currently working with AGIMO and Standards Australia to establish a Strategic Advisory Committee that will act as an umbrella group for the eleven mirror groups to improve and strategically align Australia’s involvement and contribution to international standards making activities. The Strategic Advisory Committee will interface between different government, industry and other stakeholders with a view to developing a more coherent and relevant position on standards, including those relating to Cloud computing.

The ITIIC also believe the Australian Government as a major procurer of ICT products and services in Australia, should show leadership by taking steps to encourage and support cloud computing and in turn the development of the Australian ICT Industry. The low latency and high bandwidth provided by the NBN will be essential for implementing cloud computing for the Australian government. Cloud computing will drive down computer ownership costs where government departments will pay for computing resources they actually use, and operational costs by powering down underutilised computing servers. In addition, cloud computing will provide instant elasticity allowing agencies to obtain and use computing resources they need on demand. Savings in operational costs will also translate to reduced energy use and a reduction in CO2 emissions.

Specifically ITIIC recognises the development of the Australian Government Cloud Computing Strategic Direction paper, and would like to see many of the issues raised in that paper given higher priority. Specifically in terms of Government agency awareness of the benefits of cloud computing, the development of international standards (as referenced above) and the faster adoption of cloud services by government agencies, using careful risk assessment methodology. The ITIIC also believe it would be beneficial to monitor and track cloud services take-up within Government agencies so that learnings can be shared and progress assessed. ITIIC views on the Government’s role are outlined further in the Recommendations section of this report.

Conclusion

There is no question that Cloud computing is a rapidly growing segment of the global ICT industry and that similarly it will continue to experience fast take-up here in Australia. This is inevitable because of the significant operational efficiencies it offers ICT users, many of whom may be able to transform their use of technology to improve their organisation's efficiency and effectiveness as a result. Inherently there is a significant Cloud computing related business opportunity for the Australian ICT industry to respond to, whether it is locally or in global markets.

For the Australian ICT sector to maximise the industry development opportunity offered by Cloud computing it is critical for timely supportive actions to take place (as outlined the Recommendations section of this report) by Australian Governments, Industry in general and the ICT sector in particular. We note that many other countries around the world are responding to the same dynamics and we cannot fall behind them in terms of capability and capacity if we want to reap the maximum related benefits for our future prosperity.

For the Australian Government we see great potential in leveraging off some of the fundamental strengths of our stable political, financial, legal and regulatory environment to help drive success for local industry and establish our ICT industry profile as a leading Cloud computing provider. Benefits arising from such success include the potential for significant foreign direct investment, high-value jobs creation and increased national productivity.

Further we strongly believe that the combination of Cloud services and high-speed broadband through the NBN will increase the scale, speed and complexity of both the opportunities which Australia must confront in moving towards a fully-fledged digital economy. We therefore urge the Minister to act in support of the Recommendations provided in this advice.

Attachment A

The following outlines a range of activity within government and elsewhere which is looking at the issues associated with cloud computing.

Australian Government Information Management Office: AGIMO¹³

The Australian Government Cloud Computing Strategic Direction paper, released in April 2011, states that “agencies may choose cloud based services if they demonstrate value for money and adequate security”. By taking a principles and risk-based approach, it positions agencies to take advantage of the benefits of cloud computing, while not compromising the security of their critical operations or people’s private or sensitive information. The implementation path to Government use of cloud services is through a three-phased strategic and tactical approach:

- Stream 1 to be completed in December 2011 is about preparing agencies to adopt the cloud. It includes the development of a Cloud framework that includes policy, principles, contract guidance and knowledge sharing.
- Stream 2 includes the adoption of public cloud by the Government as offerings mature.
- Stream 3 will take a more strategic approach to transitioning to private and government community clouds in conjunction with the Data Centre Strategy.

With the increase in availability of cloud-based services and high speed broadband, opportunities exist to improve delivery of government services and to reduce costs. The paper is available to download here:

<http://www.finance.gov.au/e-government/strategy-and-governance/cloud-computing.html>

Defence Signals Directorate

Cloud computing offers potential benefits including cost savings and improved business outcomes for Australian government agencies, however, there are a variety of information security risks that need to be carefully considered. On 12 April, the Defence Signals Directorate released a discussion paper to assist agencies to perform a risk assessment and make an informed decision as to whether cloud computing is currently suitable to meet their business goals with an acceptable level of risk. The document addresses the following topics:

- Availability of data and business functionality
- Protecting data from unauthorised access
- Handling security incidents

In this paper the DSD “*recommends against outsourcing information technology services and functions outside of Australia...[and] strongly encourages agencies to choose either a locally owned or foreign owned vendor that is located in Australia and stores, processes and manages sensitive data only within Australian border. A risk assessment should consider whether the agency is willing to trust their reputation, business continuity, and data to a vendor that may transmit, store and process the agency’s data offshore in a foreign country.*”¹⁴

http://www.dsd.gov.au/publications/Cloud_Computing_Security_Considerations.pdf

Australian Academy of Technological sciences and engineering (ATSE)

In September 2010 ATSE released a report of study conducted into the cloud computing opportunities and challenges for Australia. The report notes that discusses cloud use by government, business and universities – both overseas and in Australia – and reveals there are valuable opportunities for Australia in cloud computing: for government, researchers and business. But the Australian Government needs to ensure that these opportunities are grasped and unnecessary barriers removed.

¹³ AGIMO is an agency of the Department of Finance and Deregulation

¹⁴ [Department of Defence, Intelligence and Security, Cloud Computing Considerations, April 2011](#)

Global Access Partners (GAP) Task Force on Cloud Computing Final Report

The GAP Task Force on Cloud Computing was chaired by DBCDE and comprised 20 people from Commonwealth and State government agencies, the private sector, consumer advocacy groups and the research community. The taskforce released their report on 25 May 2011, which details the discussions from its meetings held between August 2010 and February 2011. Below are the recommendations made to Government which are supported by the ITIIC.

CENTRAL RECOMMENDATION - Statement of Support for Cloud Computing by the Australian Government

In recognition of the importance of Cloud computing to the positioning of Australia as a leader in the global digital economy, the Government should publicly acknowledge its support for Cloud computing. This should be issued by the highest levels of Government and should:

- Recognise the potential benefits of Cloud computing to Australia's digital economy
- Acknowledge the Australian Government's strategic direction paper, which recommends that "Agencies may choose Cloud-based services if they demonstrate value for money and adequate security." The paper's phased approach includes early trials and the appropriate adoption of Cloud computing solutions by government departments and agencies.
- Recognise the opportunity for national government agencies including the Department of Broadband, Communications and the Digital Economy and the Department of Finance and Deregulation to work co-operatively to drive the consideration and adoption of Cloud computing, both domestically and internationally.
- Recognises legitimate concerns of end users that they may lose control over their personal information unless Cloud-based service offerings are constructed appropriately and are covered by effective, enforceable, easy-to-access help and complaint resolution services that address the challenge of services operating in multijurisdictional circumstances.

RECOMMENDATION 1 - Leadership and Vision

This report finds that the cost savings offered by Cloud computing are already encouraging their adoption by a host of Australian domestic and business users, regardless of remaining regulatory challenges (page 12). The Australian Government should not lag behind business and consumers, but should adopt a leadership role in driving the uptake of Cloud computing solutions in Australia.

The Australian Government (through the Department of Broadband, Communications and the Digital Economy and the Department of Finance and Deregulation) should assume a joint leadership role in encouraging Australian Governments, business and consumers to harness the benefits offered by Cloud computing by:

- Recognising the ability of the Australian Government to stimulate the Australian digital economy by acting as an 'anchor tenant' to encourage the adoption of Cloud computing solutions in Australia.
- Recognising that the rate of adoption of Cloud computing by Australian Government agencies will be influenced by business requirements, risks to privacy and security in the public Cloud, maturity of the domestic Cloud services market, and the requirement for development of standards to support the portability of data/information held in public or private Clouds.
- Reviewing the recommendations of the report of the GAP Task Force on Cloud Computing _
- Setting forward-looking targets and timeframes to encourage the trial and (appropriate) adoption of Cloud computing solutions by appropriate Government departments and agencies. As indicated in the Australian Government's Cloud Computing Strategic Direction paper, proof of concept trials have already commenced and will commence through 2011 and onwards.
- Reviewing and adopting where appropriate policy instruments developed by other Australian Government agencies, e.g. DIISR, the Attorney-General's Department (AGD), the Office of the Australian Information Commissioner (AOIC), etc. This includes recognition in policy instruments of any guidance documents published by other agencies, for example security guidance published by the Defence Signals Directorate (DSD).

- Establishing processes and procedures for assessing the risks of adopting Cloud computing solutions and the allocation of those risks between Cloud computing platform providers, businesses built on those platforms and end consumers.
- Setting time frames for developing industry, regulatory or policy solutions to minimise these risks. These processes and procedures should actively seek input from both business and consumers. Particular attention needs to be paid to structuring of contracts and the way that they allocate risk, either by vigorous application of existing consumer protection law or specific amendment to it.

RECOMMENDATION 2 - Establishment of a Cloud Computing Task Force

The Department of Broadband, Communications and the Digital Economy should establish a standing Cloud Computing Task Force, with membership made up of relevant Government departments, regulators, industry and consumer representatives. The Task Force should perform an active role in assessing and communicating the results of Cloud computing trials, commissioning research, undertaking case studies and joint proof of concepts, and providing a thought leadership role to encourage the adoption of Cloud computing solutions in Australia.

This Task Force should work closely together with the Government-only Cloud Information Community (CLIC), which was established by the Department of Finance and Deregulation and the AIIA Cloud Taskforce.

RECOMMENDATION 3 - Engagement

The report recognises that widespread adoption of Cloud computing solutions will be facilitated by ensuring best practice privacy protection and security as well as the development of standards and protocols by Cloud computing vendors. It will be essential that Australia's approach contributes to and is consistent with global developments and avoids isolating Australia through special rules and standards.

The Australian Government should take a central role in the domestic and international fora developing these standards, protections and protocols, including:

- Working with relevant Australian Government agencies, industry, consumers and leading international authorities such as NIST, ENISA, ISO and internet standards bodies (such as W3C, OASIS etc.) to develop best practice guidance, standards and protocols for Cloud computing
- Engagement with leading jurisdictions and authorities internationally on data protection and privacy, clear rules for the allocation of jurisdiction, responsibility and liability, and consumer protection
- Engagement with the international dialogue already under way between leading US and EU authorities and global businesses on developing an efficient and effective multi-jurisdictional accountability process
- International work on trust marks for Cloud computing solutions
- Formulation of the APEC Cross Border Privacy Rules
- World Economic Forum work on developing security standards for and trust in Cloud computing solutions.
-

RECOMMENDATION 4 - Assessing Australia's Cloud Readiness

The report recognises that many major companies involved in Cloud computing do not yet have a presence in Australia Cloud. The Minister for Broadband, Communications and the Digital Economy should consider establishing an inquiry to investigate:

- The economic, geographic, market or regulatory reasons why this is the case and propose recommendations designed to encourage the increased availability of Cloud computing infrastructure and international data capacity in Australia.
- The appropriate regulatory framework for encouraging the adoption of Cloud computing to advance the Australian digital economy, including consideration of the appropriate industry and legislative structure to support a self or co-regulatory framework for Cloud computing.
- How best to increase consumer and business awareness of, and trust in, Cloud computing solutions.

This inquiry should take into consideration that Finance, in conjunction with DSD, is currently assessing the requirements for an accreditation program for Cloud computing services providers.

RECOMMENDATION 5 - Education and Awareness

The Department of Broadband, Communications and the Digital Economy should be given a specific role (and appropriate funding) to educate Australian business and consumers on how best to harness the benefits and manage the potential risks of adopting Cloud computing solutions. For example, the Government's Business Online website -<http://www.business.gov.au/BusinessTopics/Onlinebusiness/Pages/default.aspx> – could provide information for small business on adopting Cloud computing solutions.

RECOMMENDATION 6 - Development of self or co-regulatory approaches to Cloud Computing issues

There was widespread support within the Task Force for government to proceed cautiously before leaping into any regulatory responses to the range of issues of concern created or exacerbated by Cloud computing. This was in recognition of the rapidly changing nature of the technology, combined with a view that some issues could be addressed by a combination of education and awareness, development of trust marks and the further development of standards. Nevertheless, the Task Force also believes that there is the clear opportunity for industry to take the lead here and to work with government and consumer agencies to explore the scope for industry codes of practice to address many of the issues of potential concern to consumers and government.

The full taskforce report is accessible at: <http://www.globalaccesspartners.org/Cloud-Computing-GAP-Task-Force-Report-May-2011.pdf>

Since the reports publication, the issues raised have been discussed further at a workshop in June 2011 attended by approximately 100 people from the public & private sector. The workshop strongly endorsed the taskforces findings, including the emphasis on light touch regulatory approaches and the desirability of exploring development of trust-marks and industry codes of conduct.

Attachment B

Review of International Cloud Strategies/standards activity

United States

In December 2010, the *US Government's 25 Point Implementation Plan to Reform Federal Information Technology Management* was released requiring each agency CIO to identify three "must move" services that they would shift to the cloud. Agencies are required to create a project plan for migrating each service to cloud solutions and retiring the associated legacy systems. Of the three services, at least one must fully migrate to a cloud solution within 12 months and the remaining two within 18 months.

- The 5 most common services offered by agencies for migration include:
 - Email
 - Website hosting
 - Reports, document, Freedom of Information Act (FOIA) correspondence management
 - Collaboration services and/or information portals
 - Private cloud / data centre services

In February 2011, the *Federal Cloud Computing Strategy* was released. Taking a 3-prong approach, the "Cloud First" policy revolves around agencies using commercial cloud technologies where feasible, launching private government clouds, and utilising regional clouds with state and local governments where appropriate.

- When evaluating options for new IT deployments, it requires agencies to default to cloud-based solutions whenever a secure, reliable, cost-effective cloud option exists. To facilitate this shift, the US will be standing up secure government-wide cloud computing platforms.
 - A panel of 12 vendors has been established for IaaS – these vendors are currently completing certification requirements and the panel should be available for use within the next 6 months.
 - GSA is leading the Cloud SaaS Email Working Group to define and acquire SaaS email services for the US Federal Government through an RFI and RFQ process.
 - Platform-as-a-Service (PaaS) –Geospatial – GSA is working with government agencies in developing a geospatial platform pilot for sharing data and developing applications for geospatial purposes.
- NIST has been tasked with facilitating and leading the development of standards for security, interoperability, and portability.
- A Cloud Implementation Strategy is expected to be released by end September 2011.

Summary of cloud-related initiatives

Initiative	Details
Utilisation of existing Social Networking Public Cloud Services	Social networking services such as Facebook, Twitter, YouTube and blogs are being used across Government Agencies as part of a commitment to new "Open Government" initiatives.
Transparency initiatives	Government data is being made available to the public through established Dashboards and in raw form providing a first step to placing public data "in the Cloud". The initiative takes advantage of lack of copyright on Federal Government data in US.
Joint Authorisation Board	Provided a mechanism for granting government-wide approval for agency Cloud Computing applications that can then be adopted by other agencies.
Apps.gov	Gives Federal, State, Local and Tribal Governments access to Cloud-based IaaS and SaaS offerings through a Government Cloud storefront. The initiative takes advantage of existing surplus server infrastructure developed by individual agencies. It is expected to reduce infrastructure, software development and procurement costs.

Government Information Apps	Utilisation of Apps to improve awareness of government issues such as The White House app for iPhone.
GovLoop	A social networking site aimed at improving connections between agency employees. Currently has 25000 Government employees as members.
Increased Government Spending on Digital Security	Increase in spending on digital security to \$13 billion a year to assist with viability of Cloud options.
Public Media Forum	In the US Cloud Computing is getting significant levels of media attention due to the Government's commitment to addressing the new paradigm in a public forum. As a result public education about opportunities and challenges of this new technology has been improved.

United Kingdom

- The UK Government published its *ICT Strategy* in March 2011. This strategy noted that the Government would push ahead with its agenda for data centre, network, software and asset consolidation and the shift towards cloud computing.
 - There is conflicting press about whether the G-Cloud will continue as described in the Strategy released in 2010 by the previous Government.
 - Gartner states that there is currently a dichotomy between G-Cloud as a “thing” (ie an infrastructure owned by government or operated by vendors under tight government control) and G-Cloud as a way of buying IT services. However, Gartner feels that it appears that the UK Government may be leaning towards G-Cloud being a set of procurement vehicles similar to the United States.
 - The UK Ministry of Justice has been given the role of ICT strategy departmental owner for Data Centre Consolidation, Cloud, Apps Store and ICT Capability.
 - A Cloud Computing Implementation Strategy is expected to be released by end September 2011.

Summary of cloud-related initiatives

Initiative	Details
Government Agency shift to Cloud Solutions	Government agencies have chosen Composite's (sole specialised data virtualisation provider) proven data virtualisation platform to fulfil critical information needs, faster and with fewer resources. Establishment of the Cloud network is set to save up to 3.2 billion pounds a year.
DirectGov	As part of its commitment to Cloud the Government established the DirectGov Portal, hosting data for all Government departments and agencies. The Portal provides a one stop area for the public and businesses.
Establishment of major Data Centre	International Business Wales, the economic development arm of the Welsh Assembly Government, and Next Generation Data have established a \$326 million data centre. The centre is the largest of its kind in the UK, and one of the largest in Europe.
Intelligent Cost Reduction initiative	As part of the UK Government's commitment to lowering Britain's deficit, Cloud Computing has been officially adopted as a method of intelligent cost reduction.
Data.gov.uk	Allows authorised developers to find ways of making Government information available to the public. Effectively acts as App store for publicly developed apps based around released data. Provides significant aid to improving transparency.

European Union

- The European Union is expected to release its cloud strategy in 2012. It is currently progressing through a consultation phase.

Canada

- Canada has not released a Cloud Computing Strategy.

New Zealand

- NZ has not released a Cloud Computing Strategy. A representative from the New Zealand Government is participating in the Australian Government's Cloud Information Community.

Singapore

- The Singapore Government is expected to adopt a multi-pronged approach to cloud computing by leveraging on commercially available public cloud offerings where appropriate and implementing a secure private government cloud called Central G-Cloud for whole-of-government use. A tender is scheduled for late 2011.

Summary of cloud-related initiatives

Initiative	Details
Open Cirrus Cloud Computing Testbed	A research initiative implemented in 2008 comprising of the IDA and private stakeholders including Yahoo, Intel and HP. The initiative is aimed at a joint stakeholder evaluation of Cloud Computing opportunities.
Market Access Partnerships	Comprehensive market access partnerships with Singtel and trade promotion agency IE Singapore. Assists SMEs with forming consortiums that will then meet with partners in markets including Australia, India, Indonesia, the Philippines, and Thailand.
Commitment to increasing access to broadband	Significant public financial commitment to increasing access to broadband for all citizens. Has led to a 26% increase in access since 2005.
Collaboration with IBM	Collaboration with IBM to establish a Cloud Computing research lab in Singapore. Others already exist in other countries including the US, Vietnam and Ireland.
Regulatory commitment to facilitating Cloud	Singapore's government has embraced and facilitated Cloud technology development by avoiding stringent levels of regulation hindering development in other Asian nations. However, Privacy and Security issues still remain.

World Economic Forum

- In May 2011, the *World Economic Forum* released a report on Cloud Computing. This report included 8 action points for government and the cloud industry:
 1. Explore and facilitate the realisation of the benefits of cloud
 2. Advance understanding and management of cloud-related risks
 3. Promote service transparency
 4. Clarify and enhance accountability across all relevant parties
 5. Ensure data portability
 6. Facilitate interoperability
 7. Accelerate adaptation and harmonisation of regulatory frameworks related to cloud
 8. provide sufficient network connectivity to cloud services.

Attachment C

CSIRO Cloud capabilities

The CSIRO cloud capabilities and innovation are centred on the transition from traditional computing to a Cloud that not only optimizes computing costs but also increases user productivity and service quality. CSIRO is developing Hybrid Cloud (HyCloud) technology that can achieve these goals by flexibly combining private cloud resources with the capabilities and resources offered by one or more commercial Clouds. Specific areas of development include:

- Cloud Transitioning.
- Cloud interoperability.
- Privacy preservation, data protection and trust.
- QoS-based deployment, monitoring and management of Cloud-based applications.

By developing a HyCloud and pursuing research in this area, the CSIRO can provide major benefits in the following areas:

eLearning and eResearch: The benefits of developing a HyCloud for these areas are:

- *Achieve cost reduction and provide greater value* - A private CSIRO cloud is currently being developed to reduce the cost of computing for eResearch and eLearning.
- *Increased scientific productivity* - The introduction of HyCloud in CSIRO will provide for further increases in the productivity of scientists via (1) standardization of IaaS, PaaS, and SaaS services, (2) use of alternative Cloud infrastructure technologies that offer different cost, reliability, performance, and functionality capabilities, (3) seamless data and application portability that within the HyCloud environment, (4) automatic resource optimization and elasticity via HyCloud-wide QoS management, and (5) science-specific improvements in cloud computing technology developed via ICT Research.
- *Facilitate international collaboration* – Clouds resources provided by other organisations for use in international collaborations can be dynamically integrated to the HyCloud that serves a community of collaborators. This cloud solution will decrease collaboration cost and effort, and will further increase science productivity and international research collaborations.
- *Pave the way for developing leading Cloud ICT research* - Experience in implementing an effective eResearch Cloud will provide CSIRO ICT unique opportunities for the development of new Cloud and HyCloud technologies.
- *Pave the way for leading Cloud developments in Australia* – Experience in Developing the HyCloud and performing the related research for eResearch will provide necessary credibility that will enable CSIRO to become a key advisor to the Australian government in their efforts to develop private and Hybrid Clouds, and to fully utilise commercial Clouds when possible and it makes better economic sense. This is discussed further next.

Government: CSIRO advises the Australian government on how to transition to a private government Cloud and subsequently to a HyCloud with commercial/government components. To achieve this, CSIRO should:

- Utilise experience gained from the development of CSIRO's eResearchHyCloud.
- Open the eResearchHyCloud to government agencies for experimentation, studies and pilot hosting.
- Conduct research projects to assess results and solve problems encountered during government experimentation and pilots.
- Collect, improve and distribute best practices to government agencies and policy makers.

Commercial: CSIRO aims to develop partnerships with the Australian ICT industry, expanding HyCloud to include and integrate their Cloud computing and storage components, and licensing HyCloud research results aimed to advance commercial products and solutions.

ICT research: Engagements in eResearch and government will provide the ICT Centre key skills in creating, deploying, managing, and advancing a large HyCloud. CSIRO ICT will be in a unique position to perform world-leading Cloud computing research. The few other organisations that currently have such research opportunity

include a hand full of the world's major commercial vendors of Cloud computing software platforms and a few academic international cloud research consortia. Unlike the major commercial vendors that compete in the development of currently mutually exclusive Cloud platforms, CSIRO Cloud research should be focused on the *development, use, and advancement of HyCloud infrastructure and tools for eResearch/eLearning, government, and commercial partners.*

National ICT Australia (NICTA) Cloud capabilities

NICTA conducts world class research in cloud computing. The science results find valuable applications in the following areas:

Cost Effective Disaster Recovery solutions using cloud

NICTA cloud research has led to the development of a high integrity, high performance, low downtime and low cost solution to business continuity in the face of IT service disruptions due to disasters. Leveraging the inherently geographically distributed nature of the cloud computing environment, NICTA's Business Continuity technology enables organisations large and small to rapidly build disaster recovery solutions with minimal downtime and data loss, at fraction of the cost of traditional disaster recovery approaches.

Cost effort estimation techniques for managing cloud migration projects

Using its world leading empirical software engineering expertise, NICTA has developed the world's first Cost Effort Estimation methodology for managing cloud migration projects. The methodology quantitatively describes the various key elements that are major contributors towards cost and effort involved in any application migration projects to cloud. This enables organisations to more accurately determine migration efforts as part of a larger total cost of ownership calculation, and also in improving the project management of cloud migration projects.

Monitoring and management of hybrid cloud environments in enterprises

Enterprise organisations are increasing adopting various cloud computing models, whether it is Software as a service, Infrastructure as a service, public or private cloud etc. It is envisioned that enterprises will have to maintain a balance portfolio of application types running on a hybrid cloud environment. NICTA's Adaptive Cloud Technologies delivers a set of tools that provides an integrated monitoring and management solution for enterprise that on the one hand works well with traditional IT management process, as well as providing strong visibility into the application and infrastructure health status in a variety of clouds. This enhances an Enterprise's ability to forecast and diagnose any particular performance and Service Level Agreement (SLA) problems, and be in a position to assert desired control over the hybrid cloud environment.

Tools and technologies for processing/analysing extremely large datasets efficiently using cloud

NICTA has developed highly efficient data processing techniques for analysing extremely large scale datasets. Such large scale datasets exists in many important domains including health, transport and logistics, science endeavours, financial services, and many more. This added ability to very efficiently analyse large datasets, and using NICTA's world leading Machine Learning expertise combined with the highly parallel cloud computing model, organisations can more easily 'find the needle in the haystack'.

These innovation areas from NICTA will place Australia in a position to deliver better health, better education, more optimised transport and logistics for all citizens and more opportunities in the digital economy for all businesses large and small.