Final report for IDA

IPv6 readiness survey for Singapore

Final report for survey phase

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1 Executive summary

The Infocomm Development Authority of Singapore (IDA), in its role as national planner for ICT development of the nation, is leading a national effort to drive Internet Protocol version 6 (IPv6) adoption in Singapore and encourage efficient use of the remaining pool of IPv4 addresses to minimise the risks of depletion. Among other incentives, IPv6 is expected to foster a number of important new services in areas such as smart meters and intelligent buildings.

To meet this objective, IDA has appointed Analysys Mason and Tech Mahindra to carry out a focus-group survey to collect the data necessary to draw informed conclusions.

In line with these aims, this project has been split into two phases. This document is the final report for the first of the two phases.

- the **survey phase** has included face-to-face interviews with a range of stakeholders in the Singapore ICT ecosystem, as well as a web-based survey of small and medium-sized enterprises (SMEs). The output of this phase has been the identification of the following, for each category of stakeholders:
  - their infrastructure readiness
  - the dependency of their business on IP addresses
  - the progress they have made in planning for/implementing IPv6

- following the survey phase, the project will move to the **planning phase**, during which we will develop IPv6 adoption guides for each category of stakeholder, describing the key steps required during the transition to IPv6 and the technical options and approaches that are available to different stakeholder groups.

The face-to-face interviews were carried out between June 2010 and August 2010. All statements referring to future plans and timings are based on the information supplied at the time of the interviews. The web-based survey of SMEs was closed on 7 September 2010 and generated a total of 231 responses.

► *Face-to-face interviews*

In general, the face-to-face interviews have shown that vendors are the most prepared for IPv6, primarily driven by the recognition that they need to support the wider ecosystem and plan ahead for when IPv6 becomes more prevalent. In contrast, other stakeholders are less IPv6 ready and are typically adopting a 'wait and see' approach. ASP/web hosting and content providers are at various stages of IPv6 adoption and planning, depending on their own internal assessment of the business opportunity from IPv6 and its strategic fit with their business. Large domestic ISPs and mobile operators are replacing equipment as part of the standard refresh cycle and are seeing limited customer demand, but recognise the need to support IPv6 and have set broad timelines of

the end of 2011 for this. End users, and other stakeholders such as data centre operators, are delaying the move to IPv6 until they see a push from customers or service providers.

A common theme across all stakeholders during the face-to-face interviews was the difficulty seen in establishing a business case for IPv6, although most stakeholders recognise that they will have to support IPv6 at some point and are building IPv6 into their procurement processes and supporting the development of basic skills.

Our approach to the face-to-face interviews enabled us to assess the following five focus areas:

- **Planning**: the degree to which IPv6 is integrated into the organisation's overall plans and strategy, including, but not limited to, its roadmap, business plans/budgets, governance and business strategy.
- **Network**: the degree to which network infrastructure (core, edge and access) and its associated services (routing, DHCP, DNS, management, security) are ready and/or enabled for IPv6.
- **Applications**: the degree to which higher layers of the IT solutions (operating systems, web, email, proprietary applications) are ready and/or enabled for IPv6.
- **Skills**: how prevalent IPv6 skills and knowledge are across all levels of the organisation.
- **Services/products**: how IPv6 is being incorporated in services and products, and how this is being communicated to existing and potential customers.

Each of these factors covers a wide range of sub-elements: for example, the state of IPv6 readiness of 'applications' needs to take into account the state of IPv6 readiness of infrastructure services (DHCP, DNS), network management/OSS/BSS applications, operating systems, security applications, directory applications, web services, email services, unified communications, corporate applications and any proprietary applications within the organisation.

For each of the five focus areas listed above, we investigated four main aspects relevant to IPv6: current status; strategy; execution approach; and challenges. Prior to interviewing each organisation, we prepared a summary questionnaire for interviewees covering these four aspects. This questionnaire was circulated to individual organisations in advance of the interview and, along with preliminary discussions, was used to ensure that the proposed interviewee was the appropriate person to respond.

Following circulation of the summary questionnaire, we conducted a 60- to 90-minute interview with each interviewee and followed this up with clarification questions.

Following each interview, a panel of experts from Analysys Mason and Tech Mahindra[1] reviewed the findings from the discussions and allocated a score (typically 1 or 0) for each sub-element

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[1] The Analysys Mason and Tech Mahindra project team included the head of Analysys Mason's Network Practice, who has been a long-term advocate of IPv6 and has presented on IPv6 at numerous IET conferences. The lead technical consultant is the head of Tech Mahindra's IPv6 Centre of Excellence and has worked for a range of national governments, service providers and enterprises and is also contributing to India's national IPv6 programme and national IPv6 task force. The team also included an IT specialist with more than five years' experience at an IT infrastructure consultancy, while the overall project manager has more than ten years' experience in the TMT sector. Further details are provided in the annex to this document.

within the five focus areas. These scores were then aggregated and each stakeholder allocated a status for IPv6 readiness for each of the five main focus areas (planning, network, applications, skills, and services and products) against a set of pre-defined status options. Each status ranges from weak (denoted by ○○○○) to strong (denoted by ●●●●).

Our approach of breaking each focus area down in order to assess individual sub-elements ensured that stakeholders have been compared in a common fashion and minimised the need for subjective interpretation of the results. Nonetheless, the ranking of IPv6 status inevitably involved some degree of interpretation, given the need to consider such a broad spectrum of stakeholders, business models and technical architectures.

Given this, the aggregate scores were continually reviewed both across (and within) stakeholder groups over the course of the survey phase. The aim was to ensure that a consistent picture was being presented and that stakeholders that were allocated a particular status were at a comparable stage of IPv6 adoption and readiness.

The table below summarises the findings from the face-to-face interviews, which are discussed in more detail in the text underneath.

	Hardware vendors	Software vendors	Domestic large ISPs	Domestic small ISPs	International carriers	Mobile operators	Wireless operators	Data centre operators	ASP/web hosting providers	Content providers	Multinational companies
Planning	●●●●	●●●●	●●○○	●●●○	●○○○	●●○○	●○○○	○○○○	●●○○	●○○○	○○○○
Networks	n/a†	n/a†	●●○○	●●○○	●○○○	●○○○	○○○○	○○○○	●●○○	●○○○	○○○○
Applications	n/a†	n/a†	●○○○	●●○○	●○○○	●○○○	○○○○	○○○○	○○○○	○○○○	○○○○
Skills	●●●●	●●●●	●●○○	●●○○	●●○○	●●○○	●○○○	○○○○	●○○○	○○○○	○○○○
Services	●●●○	●●○○	○○○○	●○○○	○○○○	○○○○	○○○○	○○○○	●○○○	○○○○	n/a‡

Key: Weak ○○○○ ⇨ ●○○○ ⇨ ●●○○ ⇨ ●●●○ ⇨ ●●●● Strong

NB: The status shown in this table for a given stakeholder groups is the lowest of the statuses of the stakeholders interviewed during the survey phase, as activities to encourage IPv6 adoption should focus on bringing all stakeholders to the required level of IPv6 readiness (rather than focusing on the leading stakeholders).

† For hardware and software vendors, an assessment of IPv6 readiness of networks and applications is not relevant as their role in the ICT ecosystem is on the supply of equipment / systems to other stakeholders and the survey focus has therefore been on the IPv6 readiness of their products.

‡ The focus of the survey has been on assessing multinational companies as end users rather than as service providers. As such, an assessment of IPv6-enabled services and products for this category has not been conducted.

Figure 1.1: Overall summary table of survey findings [Source: Analysys Mason, Tech Mahindra]

The adoption of IPv6 across the ICT ecosystem is a function of a complex set of interactions and dependencies between the different stakeholders, as summarised below in Figure 1.2. While end users will drive demand for more IP addresses and IPv6-capable products and services, hardware and software vendors are key enablers of IPv6 adoption: without suitable products from these two stakeholders, the rest of the ecosystem will be unable to progress with the deployment of IPv6. Next, the inclusion of IPv6 support in commercial Internet services from Internet service providers and network providers is essential in further promoting IPv6 adoption, although the launch of such services will, at least in part, be driven by demand from service providers and end users. Service providers themselves are reliant on the availability of IPv6-enabled connectivity and also on evidence of customer demand; unsurprisingly, they have been tending to adopt a 'wait and see' stance unless they have identified a specific opportunity.
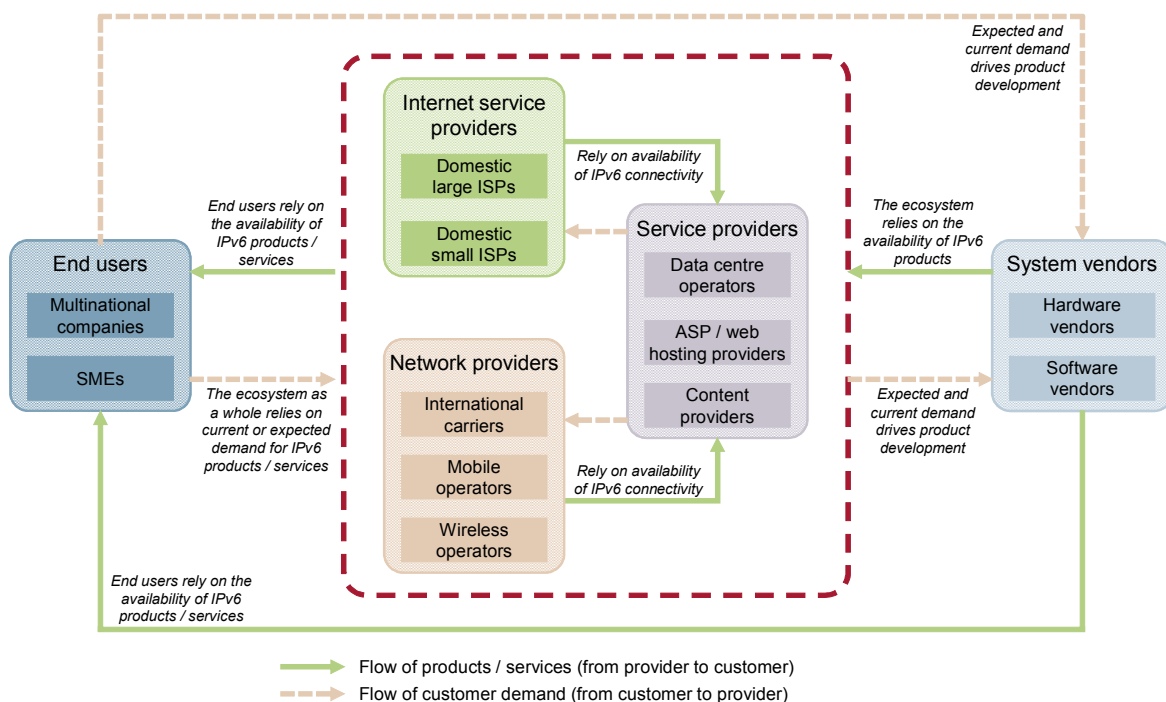

Figure 1.2:   Summary of IPv6 dependencies between stakeholder categories [Source: Analysys Mason]

Hardware and software vendors were found to be generally well developed in terms of IPv6 readiness. All vendors included in the survey had plans in place for IPv6 adoption across their product portfolio and had the required level of skills to develop and support these products. However, there are some areas of the product portfolio for both hardware and software vendors that are on roadmaps and are not currently IPv6 ready. Comments from other stakeholders during the survey phase suggested that this could impede the ability of a service provider or end user to transition fully to IPv6.

Domestic large ISPs were found to be at a preparatory stage: they have included IPv6 readiness in their procurement processes and have broad timelines (end of 2011) for IPv6 adoption. However,

they are not actively replacing equipment with IPv6-ready equipment in advance of the standard refresh cycle. This approach is in line with their business drivers (of business continuity and managing the risk of IPv4 exhaustion), and their view that IPv6 would neither enable sufficient new revenue streams in the near future to justify the expense of upgrading a complicated network architecture nor allow them to increase market share. They are currently seeing very limited demand from consumers.

In contrast, the **domestic small ISPs** covered during the survey phase were found to be relatively well advanced in terms of IPv6 readiness: networks and applications are IPv6 enabled (although the core network is still running on IPv4 – MPLS) and trial and commercial services are available, or the network and applications are IPv6 ready and will be enabled as business opportunities arise. The main business drivers for domestic small ISPs that offer commercial or trial IPv6 services have been to enable new services, improve market share or increase profits (through a niche player positioning) and to enhance their corporate image (as companies that are 'ahead of the technology curve'). Domestic small ISPs are willing to target markets that are currently small or niche as they run smaller, simpler and / or newer networks than domestic large ISPs which can be upgraded to support IPv6 at a lower relative cost and provide services that are not yet commercially attractive for larger ISPs. Domestic small ISPs that were IPv6 ready (but not yet providing commercial or trial IPv6 services) had the main business driver of being ready for future demand.

International carriers demonstrated a wide range of IPv6 readiness, with some of them already offering commercial IPv6 services and others yet to draw up plans for IPv6 in Singapore (although the international nature of the organisations means that they can draw on expertise in other parts of the world should they decide to move to IPv6). The business drivers mentioned by international carriers to deploy IPv6 covered the whole range, including business continuity and risk management, staying ahead of the technology demand curve or responding to a government mandate to support IPv6.

Mobile operators are at an early stage of IPv6 readiness and adoption. Broad timelines of the end of 2011 have been identified for IPv6 adoption, although design and roll-out plans have not yet been developed. Network solutions are being tested in the lab and, where the backhaul network is shared with domestic large ISPs, only the edge of the core network has been IPv6 enabled. A readiness assessment of applications for IPv6 has not yet been conducted and their IPv6 status is therefore unknown. Business drivers in this segment are the need to ensure business continuity and growth and managing the risk of IPv4 address exhaustion. While handset manufacturers are starting to launch mobile phones that support IPv6 on the cellular connection (rather than WLAN), these are yet to form a significant proportion of handsets currently in use by subscribers. This current lack of end-user devices deployed among subscribers, combined with the lack of IPv6 support in USB mobile broadband dongles deployed in Singapore, is seen as one of the major challenges associated with the mobile industry's move to IPv6. Another challenge cited by one of the mobile operators was the lack of clear guidelines and frameworks for international roaming on IPv6 from international bodies such as GSMA.

Wireless operators[2] in Singapore are at various stages of IPv6 readiness and adoption, from initial planning to the study of business impacts and required investment. Overall, limited technical effort has been invested in the area of readiness assessment, design and testing of IPv6 products. In general, timelines for IPv6 adoption have not yet been defined. Once again, the main business drivers stated for the adoption of IPv6 by one particular stakeholder were the need to ensure business continuity and growth and the wish to be ahead of the technology curve.

Data centre operators in Singapore generally do not see any business need for, or opportunity in, IPv6 adoption. Those that have begun the process at all are at an early stage of planning for IPv6. IPv6 readiness assessment and skill building are currently low on the list of priorities and there is no timeline for adopting IPv6.

ASP/web hosting providers interviewed during the survey phase are at various stages of IPv6 adoption: one is relatively well advanced in terms of IPv6 readiness and already has plans in place for the launch of various IPv6 services, including dates, milestones and roadmap as well as a business strategy for IPv6, while another is less advanced but recognises the need to support IPv6 and is aiming to develop an IPv6 adoption plan during Q4 2010. Where an adoption plan is in place, networks and applications are being assessed for IPv6 readiness and tested in labs and IPv6 trials are planned over the next six months. In all cases, IPv6 support has been included in the procurement process. The provider which has an IPv6 strategy in place has identified an opportunity to develop new business offers that leverage the lack of readiness for IPv6 across the rest of the industry and plans to facilitate the transition from IPv4 to IPv6 for content providers.

Most of the **content providers** included in the survey phase are relatively well advanced in terms of IPv6 readiness as they recognise their role in enabling and supporting the wider ecosystem. The majority have plans in place for IPv6 adoption (or have already started rolling out IPv6 services), and only one of the content providers interviewed does not have detailed plans in place.[3] For those content providers where plans are in place, network, applications and skills are generally well developed or IPv6 enabled, although IPv6 services have yet to be launched across the full portfolio and are being tested in the lab. Content providers interviewed are primarily relying on technology refresh to ensure that their network and applications are IPv6 ready. Where IPv6 has been included in plans, the main business drivers are primarily business continuity, the wish to manage the risk of IPv4 exhaustion, and a desire to be ahead of the technology demand curve.

Multinational companies are at various stages of IPv6 adoption, from initial planning to plans, milestones and roadmap in place. In most cases, IPv6 compliance has been included in the procurement guidelines for network equipment, but applications still need to be assessed for IPv6. All stakeholders have basic IPv6 skills in place. There is a common view across these stakeholder groups that the business case for IPv6 is weak, with no benefits from introducing this technology,

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[2]   A wireless operator runs a wireless network (e.g. a Wi-Fi network) and uses this to offer Internet services to end users. This is in contrast to a mobile operator, which runs a mobile (cellular) network and offers voice and broadband services over this network

[3]   This content provider's primary role is as a reseller / wholesaler of content from other providers and so it is dependent on the source content supporting IPv6 to enable its own end-user services for IPv6.

and that they have limited exposure to the risk of IPv4 address exhaustion as they commonly use private IPv4 addresses. Most players are consequently adopting a 'wait and see' strategy as they do not want to incur the cost of being an early adopter in the area of IPv6.

► *SME web-based survey*

The SME web-based survey generated 231 responses and gathered information from respondents about:

- their infrastructure readiness
- the dependency of their business on IP addresses
- the current use of IPv4 and IPv6 traffic
- the progress they have made in planning for / implementing IPv6.

The results showed that a relatively small number of SMEs are aware of IPv6 as a successor to IPv4 and the upcoming exhaustion of IPv4 addresses. Findings from the survey also demonstrated that there is a lack of understanding of the benefits and capabilities of IPv6. Also, very few respondents had a clear knowledge of their organisation's plans for adoption of IPv6: the findings suggest that very little is known about the resources (personnel and cost) and timelines required for IPv6 adoption. IT infrastructure readiness has largely not been assessed by the majority of the organisations that participated in the survey.

► *Comparison of Singapore's current IPv6 status with results from APNIC's 2009 survey*

The findings of the survey phase demonstrate that the current position in Singapore is not dissimilar from the findings of a survey conducted by Asia Pacific Network Information Centre (APNIC) in 2009, centred around gathering detailed information on member and stakeholder views, priorities and level of IPv6 readiness. This survey covered 56 economies in the Asia–Pacific region and received 601 valid responses.

- The majority of those interviewed in APNIC's survey had not deployed IPv6 and were not ready for IPv6 deployment.

- Most stakeholders did not have a formal plan in place for the adoption of IPv6.

- Future resources had not been budgeted for IPv6 adoption (although most stakeholders were aware of the potential risks and expected that they would have to act on IPv6 at some stage, although the timelines were uncertain).

- Most stakeholders did not view getting additional IPv6 skills / training into their organisation as essential, although there was a common view that the availability of more training courses and shared learning resources would be of interest to them.

The survey results suggest that Singapore is neither substantially ahead, nor substantially behind, the general position shown among APNIC members during the 2009 survey. It has to be noted, though, that the stakeholders with business drivers to adopt IPv6 (such as vendors, ISPs and

content providers) are generally more advanced in the process of adopting IPv6 than other stakeholders.