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The future of the net: IPv6

Since it went commercial in mid-1990, the Internet has been arguably one of the fastest processes for world-wide adoption of new technology. However, as its global success unfolded, the engineers behind the technology, the Internet Engineering Task Force (IETF), soon realised that the technology, which in its current Internet protocol version 4 (IPv4) allows for only 4.2 billion unique addresses, would be insufficient for global demand. The use of technical fixes such as 'private' addresses and classless interdomain routing (CIDR) allowed continued expansion of the worldwide Internet, but they were only ever stopgap solutions.

If the current rate of allocation continues, the pool of IPv4 addresses is expected to run out by 2010 and further growth of the Internet will require the adoption of a new generation of Internet technology, Internet Protocol version 6 (IPv6).

The IETF developed the Internet Protocol as the standard by which computers all around the world could transfer data. The protocol provides for data to be separated into 'packets' composed of a payload and address information. By increasing the length of the address from 32 bits used in IPv4 to to 128 bits, IPv6 vastly expands the number of original addresses that can be used on the Internet to 3.4×10^{38} unique addresses. By way of analogy, if all the IPv4 addresses occupied a volume the size of a mobile phone, then you would need a phone the size of Planet Earth to contain all IPv6 addresses.

The imperative to adopt IPv6 will affect all major international economies including North America, Asia and Europe, a fact which was highlighted at the recent 2008 Australian IPv6 Summit* in Canberra.

IPv6 vastly increases the scale of networks that can be built using Internet technology. It also includes additional features, which were not originally included in the IPv4 version of Internet technology. IPv6 allows the elimination of network address translation (one of the stopgap solutions mentioned above) so that all addresses used are unique and can be reached from any other part of the Internet, in what is called an end-to-end architecture. Such an approach allows all computers on the Internet to become producers as well as consumers of information. Ultimately, this approach will support a shift from the 'Internet of desktops' to the 'Internet of devices', and support technologies such as large scale sensor networks, which could be used in environmental, energy or security monitoring. IPv6 includes enhancements such as autoconfiguration and mandatory support for the Internet security protocol (IPSEC).

There are, however, major challenges (and opportunities) in the transition for business and policy.

IPv6 is not backward compatible with IPv4. Both can coexist on the same network, and neither protocol will interfere with the other, but they cannot interwork. Therefore, a transition process is required to move all parts of the Internet onto IPv6, in the long term. As an interim step, the IETF has proposed that both protocols continue to operate in all parts of the Internet, under an arrangement called 'dual stack'.

A node of the Internet that uses IPv6 will be invisible to another node which uses IPv4, so one or both nodes must use both protocols, or some translation mechanism must be used. Most translation mechanisms have disadvantages of one sort or another, which is why dual stack is the transitional method of choice.

In this environment Australia needs to build capacity to develop IPv6 skills and requires services that help to adopt the technology.

As was pointed out at the IPv6 Summit by leading Internet authorities including Vint Cerf, the father of the Internet, and Paul Twomey, chief executive of ICANN, there is an urgent need to build skills and processes for adoption of IPv6.

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Responding to this challenge a group of people who have been leading Australia's discussion of IPv6 and representing Australia in international forums, founded a start up company in 2007, IPv6Now**, with the aim of providing support services for Australia's transition to IPv6:

- It has developed the skills and infrastructure to support all Australian organisations as they adopt IPv6.
- It has conducted policy analysis for Australian governments, including a policy analysis of the benefits of IPv6 to Victorian industry.
- It has also built its own infrastructure that allows Internet users anywhere to access the IPv6 Internet over their existing IPv4 infrastructure.

IPv6Now is now working with the Australian Industry Group to build an IPv6 testbed network for Victorian industry, in a project funded by Multimedia Victoria. The testbed will allow industry to gain experience with the use of IPv6 prior to implementation in production networks, so as to minimise disruption to industry in a transition to IPv6. The project will initially focus on developing proof of principle demonstrations for three target sectors: health, financial services and automotive manufacturing. Businesses and organisations from these sectors will be able to become members of the testbed project, allowing them to inject design requirements into the project and allowing their staff to gain direct access to the testbed network to carry out trials and develop capabilities, which in turn can be taken back to operate in production networks. The testbed project will support product and process innovation to help industry build greater efficiency and productivity based on adoption of IPv6.

As IPv4 address exhaustion looms, it is now time to implement the necessary steps to a prosperous IPv6 future.

* www.ipv6.org.au/summit; ** www.ipv6now.com.au