Juniper Networks, Inc.

Response to

Request for Comment (RFC)

U.S. Department of Commerce

Deployment of Internet Protocol, Version 6

Docket No. 040107006-4006-01

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Office of Policy Analysis and Development
National Telecommunications and Information Administration
Room 4725
Attention: Internet Protocol, Version 6 Proceeding
1401 Constitution Ave., N.W.
Washington, DC 20230

To Whom It May Concern:

Juniper Networks, Inc. is pleased to respond to the Request For Comments circulated by the Department of Commerce. Since the company's inception in 1996, Juniper Networks has been focused on building equipment for the networks and protocols of the future

Successful deployment of a new protocol such as IPv6 into a production environment requires support for a router architecture designed to deliver IPv6 features and best-in-class performance. Juniper Networks Internet Processor II ASIC was designed from day one to support IPv6 and does so naturally in hardware. The vision was to prepare for IPv6 deployments without the requirement of expensive upgrades to routers and without adding significant operational overhead. Recent deployments in research and academic networks have shown that coexistence of IPv4 and IPv6 in a single network can be done without interruption of services as long as the routers in the network support transition solutions like dual stack and tunneling.

Many network vendors already incorporate support for IPv6 in their products. The Federal Government should encourage industry and research to explore innovations that have a requirement for globally, unique addresses. An application, service or appliance that requires globally, unique addresses will trigger more rapid adoption of IPv6. It is difficult to predict what forms these innovations may take, but it is easy to imagine how without IPv6 capable networks, the United States may be placed at a competitive disadvantage. The adoption and deployment of IPv6 is a step toward the modern network and those yet to be realized applications and services. Juniper Networks is proud to be one of the vendors that have invested in development of IPv6 capable equipment helping to lay the foundation for the future.

Sincerely,

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Juniper Networks Comments

I. Summary

Juniper Networks comments regarding IPv6 deployment worldwide, and the U.S. government's role in it, can be best summed up by the following points:

- A growing number of telecommunications companies require global connectivity and have expanded their footprint to many regions of the world
- Growing numbers of large enterprises are based internationally with worldwide offices
- Market forces and government encouragement in Asia and Europe have driven demand for IPv6 in those parts of the world
- U.S. providers will need, and in some cases already need, to provide support for IPv6 connectivity in regions of the world where they do business
- Support for IPv6 is widespread in most hardware platforms deployed in service provider networks today
- The appropriate role for Government is as a consumer of IPv6 products and services thereby promoting IPv6 development and adoption within the United States

II. Potential Benefits and Uses

As the DoC states: "One potential benefit of IPv6 it that its increased address space may further an original vision of the Internet." It is Juniper Networks view that peer-to-peer (P2P) networking was a fundamental characteristic of the Internet as it was originally envisioned: A shared resource of equally connected and equally accessible hosts. But over the years technical limitations and business influences have driven Internet usage to a primarily client/server model. Recently, new applications have demonstrated the possibilities of P2P and have sparked interest in reintroducing this fundamental Internet concept.

Global addresses for all Internet-connected devices encourages development of new services and applications without the impediment of NAT. Without NAT, the door is open to an increasing number of P2P systems and to expanded addressing of appliances and other devices.

Online Gaming

Juniper Networks believes that online gaming is a P2P application that will be a major driver of IPv6. And unlike more traditional purveyors of entertainment, major game system producers such as Sony, Nintendo, Sega, and Microsoft see P2P not as a threat to be stopped but an opportunity to be pursued. Microsoft, for example, recently announced that it is investing $2 billion in its new XBox Live online system. South Korean gaming developer NCSoft predicts that online gaming revenue in the United States will grow from the present $210 million to $1.8 billion by 2005, an increase of more than 100% per year. In Japan, the industry accounted for ¥35 billion in 2001 and is expected to grow to ¥271 billion ($2.2 billion) by 2006. Entertainment market research firm DFC Intelligence predicts 114 million online gamers worldwide by 2006.

Smart Appliances

As the reality of the digital home inches closer, "smart" appliances continue to play an important role. Smart appliances are those devices that access the Internet directly to enhance their core functions. Smart appliances cover a diverse range of products, and although many of these products have not done as well as hoped in the last year, there are still many companies interested in the industry, which could drive the need for the increased address space IPv6 will bring. Some of these smart appliances include:

- Refrigerators (e.g. Electrolux Screenfridge, LG Internet Refrigerator, Samsung Digital Network Refrigerator)
- Security / Fire Alarm systems
- Internet-enabled ATM machines (e.g. Fujitsu Series 8000, Infonox)
- Internet-enabled luxury cars

Other P2P Applications

The following are examples of other P2P applications that drive requirements for IPv6:

- Content sharing (Napster, Kazaa, Morpheus, etc.)
- Distributed data processing (grid computing)
  - SETI@home
  - Folding@home
  - Popular Power
  - United Devices
- Business collaboration systems
  - Serverless groupware
  - Multimedia conferencing

  The history of the Internet includes several instances of disruptive technologies that have changed the status quo and disproved prevailing assumptions on growth and usage. Long-term predictions of IP address usage are unreliable since those predictions are based only on what we know and cannot factor in new applications and services.

  The availability of globally unique addresses will encourage experimentation and may lead to innovations that will yet again lead to an unforeseen evolution of the Internet.

III. Status of Domestic and International Deployment

It is Juniper Networks view that the majority of IPv6 network deployment efforts have been focused internationally (Asia and Europe), while the United States' service providers have had less incentive to deploy IPv6. The following are some of the reasons for this as well as some examples of IPv6 deployments worldwide.

Domestic Efforts

IPv6 adoption in the United States has been much slower than in Europe and Asia. Some of the reasons for this include:

- Less IPv4 address depletion
- Wireless has less penetration
- Lack of market drivers
- Few government initiatives translating to market incentives

As Wired.com put it: "Compounding the problem, carriers have cut spending amid a weak U.S. economy and tight capital supply. North America, which has 74 percent of the world's Internet Protocol addresses, has little incentive to make the change. Europe has 17 percent of the addresses while Asia has 9 percent."

However, Juniper Networks believes that the Department of Defense (DoD) initiative to adopt IPv6 products and services will quickly change the U.S. "laggard" reputation. This initiative is already inspiring interest in other government agencies, both in the U.S. (DoC) and the world (Japan's SDF). Some of the DoD IPv6 initiatives include:

- As of October 2003, all network equipment purchased by the DoD must be IPv6 capable
- Moonv6 testbed in operation
- Minimizing future transition costs by adding IPv6 capabilities now

Paramount to these efforts are network vendors, such as Juniper Networks, being able to provide IPv6-ready equipment off the shelf. For instance, the major Research and Academic networks in the US, such as Internet2, StarTap, Abilene and TeraGrid, are fully IPv6 capable today due to existing capabilities of production ready routers from major vendors. Several US network providers, such as MCI VBNS and Qwest, already deploy IPv6 capable routing equipment from Juniper and other vendors. As the government continues to define its requirements for IPv6 products and services that will promote and accelerate the innovation and development of more IPv6 applications and services.

International Efforts (Asia and Europe)

As mentioned above, the most rapid deployment of IPv6 has taken place in Asia and Europe. In March 2000, NTT Communications announced commercial Internet service supporting IPv6. Six months later in September 2000, IIJ launched a national IPv6 commercial service in Japan.

Asia

In Asia, government directives have promoted IPv6 deployment. For example, the Japanese government continues to support IPv6 deployments through the eJapan Initiative. Some of the programs implemented through this initiative include:

- eJapan II (May 2003)
  - Refocus on applications
  - Medical, Food, Finance, Homelife, Intelligence, Labor, Government Services
- IPv6 Promotion Council of Japan

- ¥8B (US$70M) for IPv6 R&D

- 2002-2003 Tax Incentive Program
  - ISPs can get reduced corporate and fixed property tax for newly acquired IPv6 ready routers

China's Next Generation Internet (CNGI) initiative was announced in December 2003 and will be funded with 1.4B RMB (US$170M). The network will consist of nationwide, interconnected IPv6 backbones and is being built by 5 major carriers (China Telecom, China Unicom, China Netcom, China Mobile, China RailCom).

Europe

In Europe, there are over 40 IPv6 research projects supported by the European Union. One of those, the Pan-European Dual Stack Géant Backbone now provides native IPv6 and IPv4 services to 9 Research and Academic networks. The networks that receive native IPv6 service from Géant include:

- Rediris (ES)
- Renater (FR)
- Surfnet (NL)
- Garr (IT)
- Heanet (IE)
- PSCN (PL)
- EEnet (EE)
- Roedunet (RO)
- Abilene (US)

The Géant network was first commissioned as a dual stack network in February 2003, began early, IPv6 customer pilots in April 2003, and declared the IPv6 service in full production in January 2004. Juniper Networks worked very closely with the European team during the design, planning and testing phase. Many of the network requirements were modeled in Juniper's network laboratory prior to deployment. The migration from an IPv4 network to the dual stack network was non-service impacting.

Other commercial pilots in Europe include:

- France Telecom
- Telecom Italia
- Telefonica Data
- Swisscom
- Deutsche Telekom
- British Telecom
- Telia

IV. Conclusion

Given the more advanced deployment status of IPv6, commercial networks in other parts of the world, slower deployment of IPv6 by the United States may one day place it at a competitive disadvantage. The IPv6 standards bodies have required co-existence of IPv4 and Ipv6 since the outset of the specification for IPv6. Thus the standards for IPv6 are complete enough to enable widespread commercial deployment as noted in the examples above. More details on IPv6 deployments are documented more thoroughly at he website www.ipv6forum.org.

Many vendors already support co-existence of both protocol families: IPv4 and IPv6. Clear definitions of customer requirements for applications and security trust models would benefit the community at large by prompting development in those areas. The United States government can play a key role in promoting research and development in these areas. It is Juniper Networks view that the best way for the U.S. government to be involved in IPv6 adoption is as an interested consumer of Internet products.