ATIS Internet Protocol version 6 (IPv6) Task Force Report on IPv6 Transition Challenges

July 2007

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ATIS Internet Protocol version 6 (IPv6) Report & Recommendation

This is an ***ATIS Report*** developed by the **IPv6 Task Force** for the **TOPS COUNCIL**.

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Published by
Alliance for Telecommunications Industry Solutions
1200 G Street, NW, Suite 500
Washington, DC 20005

TABLE OF CONTENTS

EXECUTIVE SUMMARY

In May 2006, the ATIS IPv6 Task Force (IPv6TF) issued a report and recommendation with respect to various aspects of IPv6 entitled "ATIS Internet Protocol version 6 (IPv6): Report & Recommendation, May 2006." Areas reviewed by the group included deployment, transition challenges and the market drivers behind deployment of IPv6. In response to that report, the ATIS Board of Directors requested that the ATIS Technical & Operations (TOPS) Council commission the extension of the IPv6TF to propose steps forward to the extent possible to address the numerous transition challenges identified. This second report of the IPv6TF attempts to address this objective.

Since the May 2006 IPv6TF report, work within the standards and policy arena (particularly the IETF and American Registry of Internet Numbers (ARIN)) has advanced to address several aspects of the challenges originally identified by the Task Force; however, additional work still remains. Of the items remaining to be resolved, most notable is the need for organizations to make key internal business decisions with respect to IPv6. More precisely, while IPv6 is unquestionably of importance to the industry, its wide-scale advancement has been preempted by more pressing technical and operational priorities demanding industry's focused attention. Given this reality in addition to the perception that market demands have yet to materialize to the point of driving IPv6 deployment beyond solutions presently available and supported today to enable IPv4-to-IPv6 interoperability (e.g., dual-stack with encapsulation), there is no sense of urgency to change this approach. However, as recently illustrated by ARIN's announcement with respect to the exhaustion of IPv4 address, certain market drivers for transitioning to IPv6 are starting to materialize.[1]

Notwithstanding the above, industry is keenly aware of the need to continue its efforts to address IPv6 to the extent possible. From the list of eighteen (18) transition challenges originally identified by the IPv6TF, Address Allocation Policies, Site Multi-homing, Quality of Service (QoS), Security, Interoperability between IPv4 and IPv6, Network Address Translators (NATs) and the impacts on existing network traffic and routing were quickly identified as high interest items when transitioning to IPv6.

Originally identified as an issue needing resolution shortly after the release of the IPv6TF report, ARIN approved a policy which granted service providers (SPs) the flexibility they requested in allocating addresses to their customers. This differs from the original policy whereby service providers were constrained by a fixed assignment standard and timeframe for allocating IPv6 addresses.

Conversely, site multi-homing continues to be a topic of high-interest and passionate debate. Every solution proposed to-date to address this gap has yet to advance to wide-scale deployment; with each option currently proposed having its advantages and disadvantages. Understanding the level of focus presently being placed on resolving

[1] http://www.arin.net/announcements/20070521.html

this gap and the resources allocated to this topic within the IETF, it should be expected that an agreement on an approach forward will eventually surface. In the interim, representation from the different interested organizations (IETF, Regional Internet Registers (RIRs), vendors and operators) should, to the extent possible, jointly compile the minimal and optimal technical and operational requirements to solve the problem and explore possible solutions forward.

A unified approach is also of value with respect to the interconnection and interoperability of IPv4 with IPv6 networks. The implementation of a dual-stack approach, which was recommended by the IPv6TF in its first report and reaffirmed within this report, effectively affords network providers the ability to minimize impacts on their existing core network by placing interoperability decisions on the edge devices (i.e., edge devices will decide which IP version is required to interoperate with the host). This approach however, as any approach to augment existing network-to-network interworkings, has known limitations, but steps towards mitigating any negative impacts can be properly dealt with through the development of acceptable operational best practices.

Many of the remaining items identified of high interest await internal business decisions before actionable steps forward can be proposed. For instance, the continued use of NATs in an IPv6 network is widely recognized as not the ideal approach. However, market realities mandate acceptance that NATs are deeply embedded within the communications networks today and will likely continue to be deployed. Consequently, NATs are here to stay for the foreseeable future and each organization must deal with these embedded devices in their own way; including their affects on network architectures when contemplating next generation topics such as wireline-wireless convergence, multicast and continuous media flows (i.e., VoIP).

Security issues --which seemingly change daily as IPv6 continues to be tested through laboratory evaluations and field trials -- as well as the impacts on existing traffic and routing tables as a result of transitioning to IPv6 will inherently call for industry caution and diligence for an extended period. Therefore, during this transition phase the support of standardization efforts and internal organizational decisions based on business needs and policy debates must continue.

In summary, findings contained in this report can be classified into three (3) categories:

- **Technical**: current standards activities, internal and external to ATIS affecting issues identified, are either available, under development or pending start-up (e.g., security, QoS, etc.)
- **Business Related**: internal company business decisions need to be made in order to build consensus for best practices, solutions or needs for solutions (e.g., site multi-homing, NATS, etc.)

- **Policy Related**: issues are outside the scope of the IPv6TF, but individual companies are actively addressing them in appropriate groups (e.g., privacy, numbering, etc.)

INTRODUCTION

ATIS, through its IPv6 Task Force (IPv6TF), has been actively reviewing and assessing various aspects of IPv6 for the past several years. Commissioned under the leadership of the *ATIS Technical & Operations (TOPS) Council* --a standing committee of the ATIS Board of Directors -- TOPS set forth the IPv6TF's objectives to include:

- review current standards activities internal and external to ATIS affecting those issues identified
- record consensus for best practices, solutions, or needs for solutions for those areas
- from the perspective of ATIS members, identify the areas in which ATIS committees or groups may contribute to, or anticipate activity in support of the deployment and ongoing management of IPv6 services
- to ascertain the readiness of IPv6 and identify technical and operational issues which must be brought to resolution; whereby "IPv6 readiness" is achieved when challenges identified in the ATIS IPv6 Report and Recommendation are addressed and IPv6 is minimally equal to current IPv4 offerings in the areas of security, Quality of Service (QoS) and operations management.

In May 2006, ATIS released its first report with respect to IPv6 entitled, "*ATIS Internet Protocol version 6 (IPv6) Report & Recommendation, May 2006*." In this report, the IPv6TF provided a survey of deployment drivers and challenges that service providers may face when considering their deployment of commercial IPv6 services. It also outlined transition strategies and challenges and recommended steps to mitigate deployment challenges.

On review of the challenges identified in the IPv6TF's report, the ATIS Board of Directors commissioned the extension of the IPv6TF to take a deeper dive into addressing the various challenges it identified in transitioning to IPv6. Of particular interest to the Board was attribution of the challenges to technical, operational or policy-related matters. The IPv6TF also was requested to ascertain the readiness of IPv6 and identify technical and operational issues which must be brought to resolution in order for the successful transition to and deployment of IPv6-based services. To the extent possible, this report attempts to addresses these objectives.

To initiate work, the IPv6TF prioritized the eighteen (18) identified challenges in its May 2006 report in order of importance to transitioning to IPv6.

Challenges identified as "HIGH" priority and selected to be addressed first included:

- Address Allocation Policies
- Site Multi-Homing
- Quality of Service
- Security
- Interoperability Between IPv4 & IPv6
- Network Address Translators (NATs)
- Impacts on Network Traffic & Routing

Challenges identified as "MEDIUM" priority and selected to be addressed secondly included:

- Impacts to Privacy/Legal Issues
- Management Tools (Dual-stack & IPv6 Networks)
- Impacts on Infrastructure Reliability
- Network Renumbering (Portability)
- Peering Evolution (Impacts to Settlements)
- Impacts to Access Networks

Challenges identified as "LOW" priority and selected to be addressed thirdly included:

- Separation of Locator & Identifier
- Vendor Availability
- Dual-Stack with Domain Name Server (DNS)
- Relationships with other Numbering Systems
- Cost

Other challenges were also identified during this exercise and are also included in this report.

1 ADDRESS ALLOCATION POLICIES

1.1 End Site Allocation Size

1.1.1 Issue

As outlined in the May 2006 IPv6TF report, the American Registry for Internet Numbers (ARIN) stated that within six (6) months of allocating IPv6 addresses, /32 must be announced to the global IPv6 networks and within five (5) years the Service Provider (SP) must have 200 /48 networks allocated to customers in order to retain its IPv6 allocation. As proposed by ARIN, service providers faced a major challenge in implementing this policy given that upon allocation of IPv6 address space, typically 6-12 months of internal testing is required prior to development of an implementation plan. Additionally, actual deployment of IPv6 services may take an additional two to three years.

The IPv6 allocation policy developed by ARIN stated the following for end-site allocations:

For fixed standard assignments:

a) /48 addresses should be assigned in the general case, except for very large subscribers
b) /64 addresses should be assigned when it is known that one and only one subnet is needed by design
c) /128 addresses should be assigned when it is absolutely known that one and only one device is connecting

A proposal to change the policy was submitted to ARIN in 2005 (2005-8). The proposal is as follows:

Flexible assignments between /64 and /48, with the following guidelines:

a) /64 addresses should be assigned when it is known that one and only one subnet is needed
b) /56 addresses should be assigned for small sites, those expected to need only a few subnets over the next 5 years
c) /48 addresses should be assigned for larger sites

1.1.2 Location of Work

ARIN is the body that sets IP addressing policies for the United States and Canada, and is where this policy and the proposal to change it reside.

1.1.3 Agreement

The main advantage of the proposal to allow for flexibility in assignments is that it would allow service providers flexibility in providing allocations to their customers,