

# VMware Comments on IPv6 for NTIA

## Benefits:

1. What are the benefits of implementing IPv6? For example, what are the direct performance benefits of implementing IPv6 for end users, or for enhanced network security, as compared to IPv4?

***[VMware] The most apparent benefit of implementing IPv6 is more address space. The total number of possible IPv6 addresses is more than  $7.9 \times 10^{28}$  times as many as IPv4 addresses. With every single virtual machine and every single device (desktop, laptop, mobile, etc.) needing its own IP address – and as the number of VMs and devices increases exponentially – IP address depletion is an imminent event. Many organizations in Asia and Europe have already depleted their supply of IPv4 addresses.***

### ***Benefits to end users:***

***One of the challenges of virtualized environments and consolidated networks is that local clusters can become large. It's not uncommon to have thousands of virtual machine instances on a single local network. With IPv4 networks, broadcast traffic can become intensive and consume valuable bandwidth which affects the performance of network critical applications. In IPv6 networks, multicast helps to minimize this type of traffic.***

***At the application level, the consistent, intelligent design and organization of IPv6 packets simplifies the handling of headers and options.***

2. What are the expected or unexpected benefits of implementing IPv6?

***[VMware] In addition to greater address space, IPv6 is a globally unique IP address and provides benefits such as zero-configuration, which enables a simpler configuration and deployment process. IPv6 also provides more intelligent, direct, and efficient routing, leading to reduced networking time and latency.***

***Another expected benefit is lower costs: NAT (Network Address Translation) and Carrier Grade NAT devices are increasingly expensive, and they were established largely for the purpose of extending the pool of available IPv4 addresses through forwarding and increasing communication time. CGNs are also stateful, and for that reason they introduce issues with security, performance, and quality of service.***

***With the abundant supply of globally unique IPv6 addresses, there is no such need for NAT.***

***One of the unexpected benefits of IPv6 was that the large address space allowed us to develop a global IPAM (IP address management) strategy. With IPv4, this needed to be done manually either lab by lab or rack by rack. Another unexpected benefit for vendors is providing support only for implementations where IPv6 is turned on. Testing only with IPv6 enabled reduces the testing matrix for solutions vendors and more vendors may cease to support configurations without any IPv6 enabled.***

## Obstacles:

1. What are the biggest obstacles related to IPv6 implementation? For example, is it difficult to access adequate vendor support for IPv6 hardware and/or software? Does successful implementation depend directly on another service provider?

***[VMware] From a business perspective, the biggest obstacle is the lack of enterprise customer demand for deploying IPv6, due to general lack of knowledge and perceived difficulty of migrating to IPv6. There are also organizations within certain industries and regions that have more IP addresses allocated and believe that they do not need to implement IPv6. The “if it ain’t broke, don’t fix it” mindset is preventing IPv6 implementation.***

***Inconsistent vendor support for IPv6, particularly for older equipment claiming IPv6 support, is another obstacle. The speed at which new solutions and features (such as DHCPv6 support) are rolled out makes obsolete the physical networking equipment that’s still under a maintenance contract.***

2. How does an organization overcome those obstacles? Incentives: 1 <http://www.igf2016.mx/>. 1. What factors contribute to an organization’s decision to implement IPv6?

***[VMware] The largest incentive is demand from an organization’s customers. The most apparent example is service providers whose end customers are in regions where IPv4 addresses have been depleted or soon will be. Service providers have consistently been the top requesters for IPv6 support from VMware.***

***Other incentives include vendors whose applications are latency sensitive, e.g. applications that involve multi-player interactions or demand high performance (e.g. news feeds or information on financial markets).***

3. What additional incentives would be helpful in a decision to implement IPv6?

***[VMware] Top-down mandates, such as from a Federal Government, would be helpful in dictating implementation. Unfortunately, VMware has seen that many organizations are more reactive rather than proactive due to the perceived high cost of implementation.***

4. If one factor made the crucial difference in deciding to implement IPv6, as opposed to not implementing IPv6, what is that factor?

***[VMware] An organization’s customer demand (for better performance, quality, availability of Internet services) / ability to sell to customers***

## Motivation:

1. What is typically the driving motivation behind an organization’s decision to implement IPv6?

***[VMware] Reacting to lost customers and market opportunities and falling behind competition***

2. What are the job titles and/or roles of the people within an organization typically involved in a decision to implement IPv6? What are those individuals' primary motivations when it comes to implementing IPv6?

***[VMware] Vice President or General Manager: ensure product can sell into all sectors and maintain competitive advantage.***

***Product Management can drive business decisions, determine specific requirements for each component of the product (e.g. by network if there are multiple networks involved), and plan the roadmap of capturing their product's market with IPv6 enablement.***

***Networking architects need to drive the engineering conversation on the implementation side (and need to be well informed about IPv6 to want to drive the conversation for an IPv6 overhaul). The dependencies on other products' support of IPv6 should also be noted.***

### Return on Investment:

1. What is the anticipated return on an IPv6-related investment? How quickly is a return on investment expected?

***[VMware] One of the top reason for IPv6 implementation being delayed is the perceived long horizon for its return on investment. Even organizations with an IPv6 mandate have not been moving quickly to enforce using only products that support IPv6. Each company needs to consider the costs of maintaining NAT and legacy equipment that does not support IPv4 against the benefits of more intelligent and direct / dynamic routing and time reclaimed from higher performance, but it can be challenging to predict costs given changing organizational budgets, spending plans, acquisitions, etc.***

2. Is return on investment a reason to implement IPv6, or is implementation considered a cost of doing business?

***[VMware] From what we have seen, our customers view implementing IPv6 as a cost of doing business. They need to be more informed on why it is also a positive return on investment in the medium to longer term. When companies find that they are no longer able to access services on the Web without switching to IPv6 due to legacy routers reaching their maximum memory capacity with a larger number of Internet routes, they will need to scramble to implement what can take multiple years to plan, design, and implement.***

<http://blog.allstream.com/ipv6-economics-the-cost-of-avoiding-it-may-be-getting-worse/>

### Implementation:

1. How long does the planning process for IPv6 implementation take?

***[VMware] Depending on the size of an organization, IPv6 will take multiple years. For example, it took Microsoft more than eight years to plan and implement IPv6 on their systems and products. VMware added IPv6 support to its vCenter Server management product in about a year, but there are***

*more remaining configurations to support. There also need to be architects with the knowledge to help design and inform other engineering and IT teams on doing an IPv6 rollout for the company.*

2. How long does actual implementation of IPv6 typically take? Is implementation a single event or evolutionary?

**[VMware]** *This depends on the size of the organization (especially those with multiple products and interactions), but implementation is most likely evolutionary. Certain steps that need to be in place: global IT backbone within the organization where IPv6 can be externally routable, IPv6-capable routing equipment and testbeds, etc. The development side of IPv6 tends to be less time-intensive than the testing side.*

### Cost of Implementation:

1. What are the different types of costs involved in implementing IPv6? What are the typical magnitudes of each type of cost?

**[VMware]** *Time and education, as well as replacing older equipment that are not compatible with IPv6 such as legacy BIOS, NAT devices, and older IPv4-only routers.*

2. How does an organization cover those costs?
3. How does an organization justify those costs?

**[VMware]** *Replacing NAT and legacy equipment are among the largest of costs. Comparing today's cost with the future scenario of no purchasing of NAT equipment and higher quality of service to customers would help justify the costs.*

4. What considerations are there for cost-saving?
5. What implication does the size of an organization implementing IPv6 have on cost?

**[VMware]** *Size and revenue of an organization can help justify implementing IPv6, but one of the key reasons is where the organization's customers are (in terms of available IPv4 address left), and how sensitive these customers are to limited IP addresses, lower latency / better performance.*

### Promotional Efforts:

1. What promotional efforts, if any, should NTIA take? What would have the most impact?

**[VMware]** *Continued education in how to implement IPv6 and that IPv4-only strategies and NAT'ing are prolonging the inevitable. Encourage organizations to think longer term rather than accumulate technical debt by trying to squeeze the last out of IPv4. The runway is only getting shorter.*

*The benefits of IPv6 should also be underscored – better security and performance in addition to never worrying about address space again.*

2. What promotional efforts, if any, are being led by the private sector? Have they been effective?

***[VMware] We have interacted with the California IPv6 task force to work with our IT team, but as with any organization, IT has many other priorities and IPv6 is too often seen as a “cost of doing business” rather than a proactive one-time migration toward better security, performance, and resolving the address space issue once and for all. The task force led by Groupware Technology presents at IT conferences such as Interop, and they are helpful in disseminating information on IPv6, but it needs to reach a broader audience who has tendencies to be risk-averse.***

3. Which additional stakeholders should NTIA target? What is the most effective forum?

***[VMware] Encourage Internet Service Providers to work with their vendors and put a monetary amount on performance and productivity lost due to NAT, extra security measures, and IPv4 complexity.***

4. Should NTIA partner with any particular stakeholder group?

***[VMware] Try starting with Groupware Technology if you have not yet already.***  
<https://www.linkedin.com/in/ehorley>

*Additional Issues: NTIA invites commenters to provide any additional information on other issues not identified in this RFC that could contribute to NTIA’s understanding of the considerations that organizations take into account when deciding to proceed with IPv6 implementation, as well as future IPv6 promotional efforts that NTIA may undertake.*