IPv6 Background Information

In 2003, President Bush discussed his concerns about developing secure and robust Internet protocols to address the nation's growing dependence on cyberspace. One example of these dependencies is the work that that the Department of Defense is carrying out to implement a Global Information Grid (GIG) which will map out the globe with unique addresses. The GIG will enable the DoD to track the movements of vehicles and soldiers, collect status, and disseminate information in real time. In essence, the goal of the GIG is to support network-centric warfare which will enable the modern soldier to be in constant contact from the front line with command centers. For this to be successful, the lines of communication must be secure and should not require soldiers to have to configure complex networks at or near the front lines of war.

In order to support key initiatives like the GIG, the DoD has realized that the limitations of IPv4 networks are too great and they must start to adopt IPv6 technologies. Specifically, if they use IPv6, they will benefit from an increased address space, enhanced mobility features, enhanced configuration features, enhanced quality of service and enhanced security features.

Each device on the Internet is identified by a unique address. IPv4 is able to support ~4.3 billion addresses using a 32 bit addressing scheme. Given the proliferation of network devices throughout the world, the number of available addresses is quickly running out. IPv6 is able to support ~3.4 x 10^{35}addresses using a 128 bit addressing scheme. As a comparison, the surface area of the earth is 7.9 x 10^{17} inches. This means that there are trillions of addresses available for each square inch of the earth's surface. Using IPv6 addressing, it is predicted that any electronic device (i.e. mobile phones, unmanned sensors, mobile assets) can have its own address and we will still never run out of addresses. The DoD can use this to assign a unique address to each of the sensors that it uses when creating the GIG.

IPv6 networks benefit from enhanced mobility features and configuration capabilities to ease network administration. Using the increased address space, it will be possible to give each electronic device its own static interface ID which lets a device maintain a consistent identity regardless of where it is located in a network enabling greater end-to-end communication between devices. IPv6 also incorporates stateless automatic configuration and neighbor discovery enabling network devices to automatically identify themselves on a network and communicate with each other without the need for specialized servers. This is especially important for mobile military forces, especially first responders, who cannot afford to take time to configure an entire network before they can start communicating with remote command centers.

IPv6 headers include fields for traffic class and flow labels. These fields allow networks to prioritize certain packets which will enable improved streaming of video data. During times of crisis, networks experience unusually high volumes of traffic. As the DoD shifts to network-centric warfare tactics, it will be increasingly important for them to transmit data-rich content such as voice and video. These new features should enable defense and security transmissions to be prioritized higher than other types of data transmissions ensuring that these critical lines of communication are not blocked.

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IPv6 provides many new security features that IPv4 did not provide. IPv6 has integrated IPSec into its protocols making it easier to configure and use than it was in IPv4. Also, using the static interface IDs and end-to-end communications that the new addressing scheme enables, IPv6 users will be able to use host-based security models rather than perimeter-based security models that IPv4 networks must use. This means that network security can be better maintained even with mobile users. Combined, these security features improve authentication and confidentiality of information being transmitted. This is especially important for military applications where data security is of the utmost importance.

In order to make full use of the benefits that IPv6 provides, users must upgrade all of the devices in their network which can be a very costly undertaking. These costs can be minimized if users incorporate IPv6 features into all products that they buy as part of their normal equipment refresh cycles. By purchasing devices that contain a dual IPv4/IPv6 stack, users can make use of devices on their currently IPv4 networks now and then enable the IPv6 features at a later point in time when their network is able to support it. In essence, planning now for future needs can help users avoid costly upgrades later.

Information in this document was based on the following government reports:

- http://www.gao.gov/new.items/d05471.pdf
- http://www.ntia.doc.gov/ntiahome/ntiageneral/ipv6/final/ipv6final.pdf