Advances in Computational Research
ISSN: 0975-3273 & E-ISSN: 0975-9085, Volume 4, Issue 1, 2012, pp.-113-116.
Available online at http://www.bioinfo.in/contents.php?id=33

IPv6 - ADDRESSING GRID-INTEROPERABILITY PERSPECTIVE FOR PATIENTS IN MEDICAL FIELD

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Received: February 21, 2012; Accepted: March 06, 2012

Abstract- IPv6 is of considerable importance to businesses, consumers, and network access providers of all sizes. IPv6 is designed to improve upon IPv4's scalability, security, ease-of-configuration, and network management; these issues are central to the competitiveness and performance of all types of network-dependent businesses. IPv6 aims to preserve existing investment as much as possible. End users, industry executives, network administrators, protocol engineers, and many others will benefit from understanding the ways that IPv6 will affect future internetworking and distributed computing application like cloud computing ,Grid computing etc. Every individual is to be identified as the requirement of today's Science and Technology.
In this paper, we present a platform providing a problem solving environment for patients or persons among multiple application domains of Grid computing especially in medical and scientific study, using the collaborative relationship and also fostering interoperability in Grid infrastructure. The proposed work is based on IPv6 address scheme providing seamless, secure, and intuitive access to distributed Grid resources.
Keywords- IPv4, IPv6, Grid computing, Patients, scalability, Internet

Citation: Mahalle H.S., Manwar A.B. and Vinay Chavan (2012) IPv6 - Addressing Grid-Interoperability Perspective for Patients in Medical Field. Advances in Computational Research, ISSN: 0975-3273 & E-ISSN: 0975-9085, Volume 4, Issue 1, pp.-113-116.

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Introduction

In 1980, ARPA started converting systems to TCP/IP. In 1983, ARPANET was split into two different networks: MILNET for military research and ARPANET for continuing the current path of research. In 1983 it was also mandated by ARPA that all systems connected to ARPANET use TCP/IP.
The Internet Protocol (IP) has its roots in early research networks of the 1970s, but within the past decade has become the leading network-layer protocol. This means that IP is a primary vehicle for a vast number of client/server and peer-to-peer communications, and the current scale of deployment is straining many aspects of its twenty-year old design.
The Internet Engineering Task Force (IETF) has produced specifications that define the next-generation IP protocol known as "IPng," or "IPv6." IPv6 is both a near-term and long-range concern for network owners and service providers. IPv6 products have already come to market; on the other hand, IPv6 development work will likely continue well into the next decade. Though it is based on much-needed enhancements to IPv4 standards, IPv6 should be viewed as a new protocol that will provide a firmer base for the continued growth of today's internetworks.
Because it is intended to replace IPv4, IPv6 is of considerable importance to businesses, consumers, and network access providers of all sizes. IPv6 is designed to improve upon IPv4's scalability, security, ease-of-configuration, and network management; these issues are central to the competitiveness and performance

of all types of network-dependent businesses. IPv6 aims to preserve existing investment as much as possible. End users, industry executives, network administrators, protocol engineers, and many others will benefit from understanding the ways that IPv6 will affect future internetworking and distributed computing applications [1, 2, 3].
E-Science today, particularly scientific experiments and studies, involve distributed and heterogeneous resources. The scientific applications use different approaches with similar characteristics in a wide variety of scientific domains and typically require distributed, high-throughput and data intensive computing [5].
In recent years, a grid environment has been adopted in order to accomplish these necessities, which are motivated for several reasons, including technology reuse, computational performance and also, security system aspects [6].
One of the main current Public Key Infrastructures (PKI needs is interoperability, which makes possible the secure interconnection and co-operation between different PKI structures, thus enhancing their feasibility and applicability at regional, national, as well as international level. This is even more important in the healthcare sector, due to the increased demand for mobility of both patients and doctors and the criticality of the telemedicine data, which make the secure and interoperable information exchange, a basic element for high-level healthcare service provision [7].

Network Addressing in IPv6
Following are some of the points which glance at familiar attributes of address allocation, associated with IPv4 and compare them to similar attributes in IPv6 [1-4].

Address scheme

IPv4 Address Scheme
32 bits long (4 bytes). Address is composed of a network and a host portion, which depend on address class. Various address classes are defined: A, B, C, D, or E depending on initial few bits. The total number of IPv4 addresses is 4,294,967,296.
The text form of the IPv4 address is nnn.nnn.nnn.nnn, where 0<=nnn<=255, and each n is a decimal digit. Leading zeros may be omitted. Maximum number of print characters is 15, not counting a mask.

IPv6 Address Scheme
128 bits long (16 bytes). Basic architecture is 64 bits for the network number and 64 bits for the host number. Often, the host portion of an IPv6 address (or part of it) will be a MAC address or other interface identifier.
Depending on the subnet prefix, IPv6 has a more complicated architecture than IPv4.
The number of IPv6 addresses is 10^{28}
(79 228 162 514 264 337 593 543 950 336) times larger than the number of IPv4 addresses.
The text form of the IPv6 address is xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx, where each x is a hexadecimal digit, representing 4 bits. Leading zeros may be omitted. The double colon (::) may be used once in the text form of an address, to designate any number of 0 bits. For example, ::ffff:10.120.78.40 is an IPv6 IPv4-mapped address.

Address Allocation

IPv4 - Originally, addresses were allocated by network class. As address space is used up, smaller allocations using Classless Inter-Domain Routing (CIDR) are made. Allocation has not been balanced among institutions and nations.
IPv6 - Allocation is in the earliest stages. The Internet Engineering Task Force (IETF) and Internet Architecture Board (IAB) have recommended that essentially every organization, home, or entity be allocated a /48 subnet prefix length. This would leave 16 bits for the organization to do subnetting. The address space is large enough to give every person in the world their own /48 subnet prefix length.

Address Mask
In IPv4, network mask is used to designate network from host portion whereas, the mask does not exist in IPv6.

Address Resolution Protocol (ARP)
Address Resolution Protocol is used by IPv4 to find a physical address, such as the MAC or link address, associated with an IPv4 address.
IPv6 embeds these functions within IP itself as part of the algorithms for stateless auto configuration and neighbor discovery using Internet Control Message Protocol version 6 (ICMPv6). Hence, there is no such thing as ARP6.

Address Types
IPv4 supports Unicast, multicast, and broadcast, whereas IPv6 supports unicast, multicast, and anycast.

Network Address Configuration
In IPv4 Configuration must be done on a newly installed system before it can communicate; that is, IP addresses and routes must be assigned.
In IPv6, configuration is optional, depending on functions required. An appropriate Ethernet or tunnel interface must be designated as an IPv6 interface, using iSeries Navigator. Once that is done, IPv6 interfaces are self-configuring. So, the system will be able to communicate with other IPv6 systems that are local and remote, depending on the type of network and whether an IPv6 router exists.

Domain Name System (DNS)
Applications accept host names and then use DNS to get an IP address, using socket API gethostbyname(). Applications also accept IP addresses and then use DNS to get host names using gethostbyaddr(). For IPv4, the domain for reverse lookups is in-addr.arpa.
Same for IPv6. Support for IPv6 exists using AAAA (quad A) record type and reverse lookup (IP-to-name). An application may elect to accept IPv6 addresses from DNS (or not) and then use IPv6 to communicate (or not).
The socket API gethostbyname() is unchanged for IPv6 and the getaddrinfo() API can be used to obtain (at application choice) IPv6 only, or IPv4 and IPv6 addresses.

DHCP (Dynamic Host Configuration Protocol)
In IPv4, Dynamic Host configuration Protocol is used to dynami-

cally obtain an IP address and other configuration information. Currently, DHCP does not support IPv6.

Implementation and Transition to IPv6:

IPv6 implementation is an ongoing process. Some analysts make comparisons between the potential shortfall of IPv4 addresses and the potential problems like mismatch of addresses, viruses affecting the change in configuration etc.

The task of transitioning to IPv6 is full of challenges. Large-scale transitions require a high level of flexibility in the protocol, software and hardware supporting and using it. A successful migration to IPv6 requires all IPv4 nodes to communicate with IPv6 nodes during the migration period. It is also important that technology is in place to allow IPv6 nodes can communicate over the IPv4 Internet to other networks. To meet the needs of the various network topologies that are spread throughout the Internet, there are multiple methods for making this change [3].

The major transition mechanisms that are integral to the IPv6 design effort, these techniques include dual-stack IPv4 /IPv6 hosts and routers, tunneling of IPv6 via IPv4, and a number of IPv6 services, including IPv6 DNS, DHCP, MIBs, and so on [2].

Worldwide IPv6 testing and pre-production deployment network, called the 6BONE, had already reached approximately 40 countries. There are many IPv6 implementations completed or underway worldwide, and in test or production use on the 6BONE. The 6BONE has been built by an active population of protocol inventors, designers and programmers [2, 3].

Problem- Resource provision in a Grid

The IPv6 can be effectively used in Grid computing for various problems faced by the users in the Internet. It is the prime requirement of future scenario of the world to identify at every individual and every asset in the Internet so as to provide the service to every individual or every asset.

With the rapid progress of various technologies, there is a growing demand for integrating amount of domain information, including medical information, bioinformatics information, enterprise information and etc. Medical information system is well known in the world as one of the most complicated information systems, which main target is through the network to achieve medical resource sharing of each aspect of medical domain, for instance, hospital, medical research organizations, doctors and patients [8].

In this paper we have concentrated on providing every individual the medical facility being enrolled in the Grid of Doctors. As the number of patients is very large or every member of the family has a unique identity in the Internet so as to get the proper and required aid, it is not possible to address the every individual using the IPv4 address scheme. So, to address the millions of persons individually in the system it is required to have a addressing scheme which can addresses these millions of patients or persons in the system the only solution is to use the IPv6 addressing scheme.

The key factor for this project was generating and managing metadata. The Metadata has found to be the key in the ability to interoperate and co-relate heterogeneous data systems and available data bases in the distributed computing. The emphasis was given on data engineering to understand how to interpret and interrelate the local data dictionaries among the distributed systems.

The IPv6 as the perspective solution

The Internet is changing the face of medical research. The current world of isolated research and proprietary data encodings is evolving into a future of standardized medical databases and integrated medical applications, such as clinical decision support systems [9].

The every individual in the Internet is recognized by the IPv6 addressing scheme. The microchip is to be fitted with every individual for keeping the contact within the Grid of Doctors. The microchip records the every change in the body of the person and sends the information to the server in the Grid. Accordingly the server distributes the information to the related nodes in the Grid. The corresponding Doctor or the related person after seeing the information instructs the patient or if required can take the expert decision in the regard. Some special laboratories will also be involved in the investigation of the diseases or special equipment will also be shared in the Grid. The team of experts will after proper discussion and after proper investigation the expert's decision or the line of treatment will be sent back to the server and then it will be sent to the patient or needy person.

Model Data Architecture

The model data architecture focused on the deployment of a middleware component with the objective of interconnecting distributed heterogeneous data systems and also using microchips and Satellite for patients data communication.

The Data Architecture (Fig 1) uses the Servers in Grid environment varying from S1,S2,S3- - - - -S_N . The main focus of is the distributed patients, referred as P_1,P_2,P_3- - - - - -P_N. The computer systems from Grid environment contributing to project, referred as C_1,C_2,C_3- - - - - - C_N.

The Satellites covering the globe and thereby covering the global patients registered in the system provides ready information about the patients to the servers. These Satellites are referred as ST_1,ST_2,ST_3- - - - - - - - -ST_N.

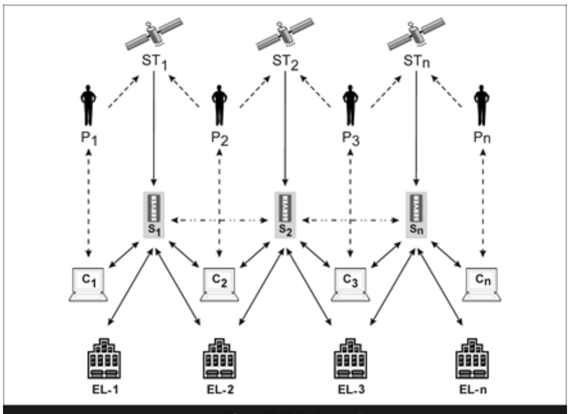

Fig. MMC Graph

Fig. 1- The model Data Architecture for Patients Grid-Interoperability developed by researcher (here in after called MMC Graph)

The Algorithm

The algorithm for "IPv6-Addressing Grid-Interoperability Perspective for Patients In Medical Field" here in after referred as MMC algorithm.

The MMC Algorithm

1. INITIALIZE THE SYSTEM WITH IPv6 ADDRESSING
2. SELECT SERVERS AS S_1,S_2,S_3,- - - - - - -S_N
3. SELECT PATIENTS AS P_1,P_2,P_3,- - - - - - -P_N
4. SELECT COMPUTERS AS C_1,C_2,C_3,- - - - -C_N
5. SELECT SATELLITE AS ST_1,ST_2,ST_3,- - - -ST_N
6. SELECT EQUIPMENT LABORATORY AS EL-1,EL-2,EL-3,- - - -EL-N
7. REQUEST FROM P_1,P_2,P_3- - - - - -P_N
   i. ACTIVATE SATELLITE
   ii. ACTIVATE SERVER
8. APPLY PROCESS IN SERVER
   i. IF Related Data-base found then sent information to related Doctors Team
      GOTO LOOP-1
   ii. ELSE IF Related Data-base not found then sent Information to Experts Team
      GOTO LOOP-2
   iii. ELSE IF Required specialized equipment help sent information to Equipment Lab.
      GOTO LOOP-3
   iv. OTHERWISE Sent back to SERVER
      EXECUTE LOOP-4
9. LOOP-1
   The Doctors Team verify the Data-bases and their opin ion along with Line of treatment sent back to SERVER.
   GOTO LOOP-5
10. LOOP-2
   The Experts Team study the new disease and sight a line of treatment or if required sent to Investigation Lab. For sophisticated Equipment help.
   GOTO LOOP-3
11. LOOP-3
   The results of Specialized Equipment Lab. Sent back to Experts Team.
   GOTO LOOP-6
12. LOOP-4
   For unknown Diseases or for which Data-bases not availa ble the Experts Team sent back Information to SERVER and Research Lab. For Investigation.
   GOTO LOOP-7
13. LOOP-5
   The SERVER sent the refined Information back to users Computer
   END OF LOOP
14. LOOP-6
   The Experts Team observes the results of Specialized Lab. Equipments and draws the line of treatment and sent the Information to SERVER.
   EXECUTE LOOP-5
15. LOOP-7
   The report of research Lab. Sent back to Experts Team, which then after discussion, sight a line of treatment and sent to SERVER.
   EXECUTE LOOP-5
16. END

Discussion

The MMC Algorithm should be very useful for future scenario because of huge population and the explosion of technology it is rather difficult to provide medical facilities. So as a solution to future problem the MMC Algorithm will play an important role. This model aims to settle the semantic relationship between heterogeneous medical information systems. It will support integration and Interoperability by sharing of heterogeneous medical data-bases available in the Grid. It will also support semantic-consistent data process schema to support the
information exchange between heterogeneous systems under Grid environment.

Our future work includes the actual creation and verification of the MMC model to integrate medical information systems.

Conclusion

Thus, from the facts of address allocation schemes in IPv6, it is indeed a great achievement that the quantity of IPv6 addresses is so vast that every individual can be recognized in the network. Definitely, this will lead to a future with almost every human being linked in the Internet and much better networking applications and services can be made available along with adequate security.

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