Proceedings published by International Journal of Computer Applications® (IJCA)
International Conference on Computer Communication and Networks CSI- COMNET-2011

Indian Readiness Towards Migration from IPV4 to IPV6

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ABSTRACT
IPv6 (Internet Protocol Version 6) is the next generation Internet Protocol designed for replacing the currently used IPv4(Internet Protocol Version 4). The migration to IPv6 from IPv4 is also one of the thrust areas of DIT, Government of India. The technical foundations of IPv6 have been built but deployment and capability to use it is the ensuing challenge. Further realizing, that the awareness on IPv6 is also quite low, the impact of this technological change needs to be deliberated and the technical know-how needs to be assembled.

This paper has the intention to present some of the issues that have forced others to restrain themselves from incorporating the new standard, IPv6, into their business plan and to present the advantages of implementing this standard and why Internet service providers (ISP) are taking their time to move on.

Keywords
IPv4, IPv6, Addressing, Tunneling

1. INTRODUCTION
The current generation of IP, version 4, (IPV4), is roughly 20 years old. Since its inception in the 80's, it has supported the Internet's rapid growth during that time. It has been proven to be robust, easily implemented and interoperable. This is a tribute to its initial design. IPv4 uses a 32-bit address space, in which can accommodate about 4 billion unique addresses. There are several problems such as impending exhaustion of the IPv4 address space, configuration and complexities and poor security at the IP level. To overcome these concerns, in the early 90's, IETF (Internet Engineering Task Force (IETF), began developing a new IP protocol namely IPv6 (other name, Next Generation IP, IPng). It will use a 128-bit address space. In the other hand, it would support unique addresses well beyond the trillions. It can support 340, 282, 366, 920, 938, 463, 374, 607, 431, 768, 211, 456 unique addresses! It will not only eliminate the shortcomings of IPv4, but also unlock new features and services.

2. NEED OF IPV6
Over the years we have seen the rapid surge in the field of number of user that are it savvy. In a estimate nearly 500 million internet users are there and there is ever increasing numbers of the gadgets to add for. The address space that IPv4 offers is not commensurate with the increasing demand for unique IP addresses. This demand for IP addresses will keep on growing; indeed with the current trend to use the Internet for sensors, telephones and other objects, there is no apparent limit to the demand. IPv6, which is version 6 of IP, offers a much large address space to meet the increasing demand.. In addition to , IPv6 offers other advantages over IPv4 namely in-built security, fast processing of data packets, better support for mobility, auto-configuration and Quality of Service, and plug and play feature. The major question is now to address when and how to manage the migration from IPv4 to IPv6 without affecting services.

With every passing moment Ipv4 address space is becoming depleted. It is affected by some basic issues like the available original allocation was inefficient and at the same time routing tables in the Internet core routers have become very large. The solution could be to create a successor with a much wider address space which could promote efficient route aggregation and eventually could Auto configuration, IP Security. It can also be notably added that there is Expectation of a resurgence of "always-on" technologies xDSL, cable, Ethernet-to-the-home, Cell-phones, etc. Expectation of millions of new networks.

IPv6 also implements additional features not present in IPv4. It simplifies aspects of address assignment (stateless address auto configuration), network renumbering and router announcements when changing Internet connectivity providers. The IPv6 subnet size has been standardized by fixing the size of the host identifier portion of an address to 64 bits to facilitate an automatic mechanism for forming the host identifier from link-layer media addressing information (MAC address). Network security is also integrated into the design of the IPv6 architecture, and the IPv6 specification mandates support for IPSec as a fundamental interoperability requirement.

The last top level (/8) block of free IPv4 addresses was assigned in February 2011 by IANA to the 5 RIRs, although many free addresses still remain in most assigned blocks and each RIR will continue with standard policy until it is at its last /8. After that, only 1024 addresses (a /22) are made available from the RIR for each LIR – currently, only APNIC has already reached this stage.

While IPv6 is supported on all major operating systems in use in commercial, business, and home consumer environments, IPv6 does not implement interoperability features with IPv4, and creates essentially a parallel, independent network. Exchanging traffic between the two networks requires special translator gateways, but modern computer operating systems implement dual-protocol software for transparent access to both networks either natively or using a tunneling protocol such as 6to4, 6in4, or Teredo. In December 2010, despite marking its 12th anniversary as a Standards Track protocol, IPv6 was only in its infancy in terms of general worldwide deployment. A 2008 study by Google Inc. indicated that penetration was still less than one percent of Internet-enabled hosts in any country at that time.

3. IPV6 TECHNOLOGY SCOPE

IP Service	IPv4 Solution	IPv6 Solution
Addressing Range	32-bit, Network Address Translation	128-bit, Multiple Scopes
Auto configuration	DHCP	Server less, Reconfiguration, DHCP
Security	IPSec	IPSec Mandated, works End-to-End
Mobility	Mobile IP	Mobile IP with Direct Routing
Quality-of-Service	Differentiated Service, Integrated Service	Differentiated Service, Integrated Service
IP Multicast	IGMP/PIM/Multi cast BGP	MLD/PIM/Multi cast BGP, Scope Identifier

4. MAJOR IMPROVEMENTS OF IPV6 HEADER

No option field:- Replaced by extension header. Result in a fixed length, 40-byte IP header.

No header checksum:- Result in fast processing.

No fragmentation at intermediate nodes:- Result in fast IP forwarding.

5. LIMITATIONS OF IPV4 AND IPV6 STRENGTHS & NEED

The Ipv4 addressing system uses 32-bit address space. These 32-bit address space allows for 4,294,967,296 Ipv4 addresses but these Ipv4 address allocation practices limit the number of available public IPv4 addresses. Many address which are allocated to many companies were not used and this created scarcity of IPv4 addresses. Security related Issues:-

Internet protocol security (IP Sec) is a protocol suit which enables network security by protecting the data being sent from viewed or modified.

IPSec provides security for IPv4 packets but it is not built-in and optional. Address configuration related issues have to be taken care of also. Networks and also Internet is expanding and many new computers and devices are using IP. The configuration of IP addresses (static or dynamic) should be simple.

Quality of service (Qos):-It is available in IPv4 and it relies on the 8-bits of the Ipv4 Types of Service(TOS) field and the identification of the payload. IPv4 Type of Service(TOS) field has limited functionality and payload identification (uses a TCP or UDP port) is not possible when the IPv4 packet payload is encrypted.The transition from IPv4 to IPv6 will mark a period of waiting for the Internet community – a time where a feeling of uncertainty over the adoption of IPv6 standards and implementation.

This transitional period will also be a time when Internet engineers will decide whether to deploy further weak fixes and/or add-ons to IPv4 or upgrade to the integrated and more powerful IPv6.Admittedly, the transition to IPv6 will not be effortless, but, by carefully coordinating IPv4 upgrades with

IPv6 deployments, networks can mature and evolve gracefully without experiencing costly growing pains, making tomorrow's 'next generation' networks more efficient to deploy, maintain and operate.

6. Tunneling

In the early phases of IPv6 development, an Internet service provider will allow access to isolated IPv6 users and communicate with IPv6 islands through an IPv4 network. The method used in this case will be tunneling, illustrated in Figure below.

In this diagram, two IPv6 islands are connected to an IPv4 core network. Router A and Router B are Dual-Stack routers. Let us review what happens to the

IPv6 packet as it moves across the IPv4 network destined for a host in an IPv6 network:

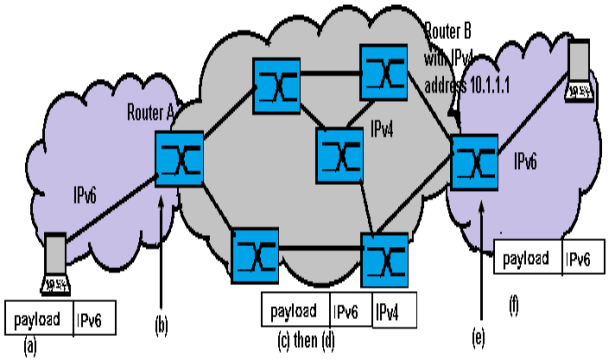

Fig :- Tunneling Mechanism

- packet with an IPv6 address arrives at Router A.
- Router A identifies its forwarding table and finds that it can route this IPv6 address by sending it to Router B . It finds that Router B's IPv4 address is 10.1.1.1.
- Router A encapsulates the IPv6 packet in an IPv4 packet and sends it into the IPv4 cloud.
- The IPv4 cloud routes the packet using the 10.1.1.1 destination address as if it were a normal IPv4 packet. The packet finally reaches Router B.
- Router B looks at the packet and realizes that it is carrying an IPv6 packet inside. It strips out the IPv4 header and uses the IPv6 header to identify its forwarding table. It finds that it can reach the IPv6 address destination in the IPv6 network to which it is connected.
- Router B sends the packet to its destination.

7. IPV6 NETWORKS OVER TIME

The following graph indicates the percentage of Autonomous Systems registered in each RIR that are IPv6 enabled. Click on the map to view a dynamic version and select individual countries or groups of countries.

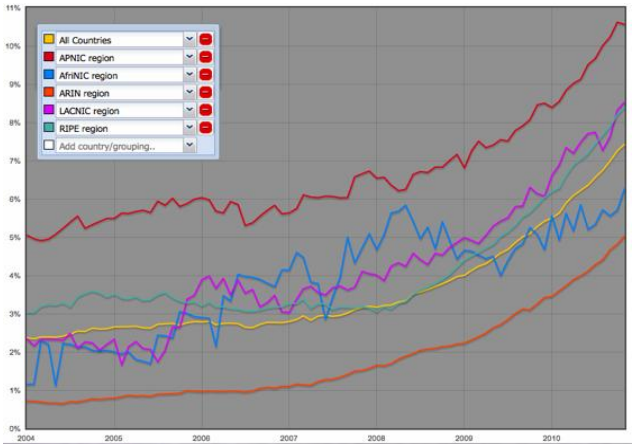

Fig:- IPv6 Network

8. THE ADVANTAGES OF IPV6

IPv6 have some basic advantages over the existing system. It had been able to overcome the known nuisances and have been able to provide a stable solution. Some of the known benefits that could be earmarked are asunder

- Increased address space:- IPv6 provides sufficient addresses for every device that needs to have a unique public IPv6 address. In addition, the 64-bit host portion (interface ID) of an IPv6 address can be automatically generated from the network adapter hardware.
- Automatic Address Configuration:- IPv6 deals with the need for simpler and more automatic address configuration by supporting both stateful and stateless address configuration.
- Network level security:- Communication over the internet requires encryption to protect data from being viewed or modified in transit. IPSec provides this facility and IPv6 makes IPSec mandatory.
- Real time data delivery:- Quality of service(QoS) exists in IPv4 and bandwidth can be guaranteed for real-time traffic over a network, but not when an IPv4 packet's payload is encrypted. Payload identification is included in the Flow label field of the IPv6 header, so payload encryption does not affect QoS operation.
- Routing table size:- On the IPv6 Internet, backbone routers have greatly reduced routing tables that use route aggregation, which permits a number of contiguous address blocks to be combined and summarized as a larger address block.
- Header size and extension headers:- IPv4 and IPv6 headers are not compatible, and a host or router must use both IPv4 and IPv6 implementations to recognize and process both header formats. Therefore, the IPv6 header was designed to be as small as was practical. Nonessential and optional fields are moved to extension headers placed after the IPv6 header.
- Removal of broadcast traffic:- IPv4 relies on ARP broadcasts to resolve the MAC addresses of the network adapters. The IPv6 Neighbor Discovery (ND) protocol uses a series of ICMPv6 messages. ND replaces ARP broadcasts, ICMPv4 Router Discovery, and ICMPv4 Redirect messages with efficient multicast and unicast ND messages.

9. Indian Perspective & World Scenario

India is a vast country with diverse cultures, languages and regions and boasts large Metros, Urban, suburban, towns, rural and remote areas. The multilinguistic culture do post a limitation of IT awareness and also majority of content is in English language and Western hemisphere centric Even content produced in India is vastly focused on Metro/Urban areas. Hence, India has need for Local and regional content, Content in local language text. Illiteracy ids high in India and to make a illiterate person It savvy is again a terse job so knowing that there is population with lack of education thus necessitating basic devices with simple controls. It should also be emphasized that along with text there should be audio/ video delivery. Content needs to be contextual hence generated within the region and remote areas and also Selective prioritization should be possible done. Another important thing that has to be taken care of is Scalability is very important as Content ecosystem needs to be low capacity keeping the cost in view keeping in mind the financial level of commoner.

10. Data center Potential in India

Data Centers have a huge potential in India and will be led by the emerging "Cloud Computing" paradigm. Gartner in a study predicts Data Center Space in India to grow at a CAGR of 31%. IDC predicts a 20-22% growth due to Government hosting.

('000s of Square feet)	2007	2008	2009	2010	2011	CAGR (2007-2012)
Captive	726	1,209	1,723	2,145	2,391	29%
Hosted	611	1,090	1,749	2,108	2,371	33%
Total Data Centre Space	1,337	2,299	3,472	4,252	4,762	31%

11. ACADEMIC NETWORK

ERNET is the NREN of India. ERNET

was made IPv6 ready in the year 2005. ERNET is running dual stack backbone supporting both IPv4 and IPv6 since 2005 onward. ERNET is ready to offer IPv6 service to its users.

12. COMMERCIAL ACTIVITIES

Sify is the commercial service provider

to deploy IPv6 in their network in the year 2005. Backbone of Tata Communications the biggest Internet service provider in the country is already dual stacked and they are offering IPv6 peering to their customer. Most of the

other big service provider in India either have migrated to dual stack or are in the process of migration. Small service providers are yet to migrate to IPv6. National InternetExchange of India (NIXI) is already dual stacked.

13. GOVERNMENT INITIATIVE

In India, government initiative to migrate to IPv6 began as early as 2004 when "Migration from IPv4 to IPv6 in India" was listed as one of the items in the Ten Point Agenda given by Hon'ble Minister of Communications & Information Technology, Government of India. Department of Information Technology, formed a committee to suggest measure to be taken for migration to IPv6. DOT had taken initiative to recommend a suitable Roadmap to achieve transition from IPv4 to IPv6, clearly bringing out the steps involved. The task of leading the country towards IPv6 was given to the Telecommunication Engineering Centre (TEC), a standardization body under the Department of Telecommunications (DoT) in 2009. TEC, after talking to all stakeholders, came up with "National IPv6 Deployment Roadmap", which examines the different issues related to the deployment of IPv6 in India. For timely implementation of IPv6 in the country government had approved following action plans. Creation of IPv6 Task Force consisting of Senior government officials, head of service providers, industry associations, educational institutions and eminent persons. The task force will oversee timely deployment of IPv6.

Transition Plan for Central and State Government Departments: All central and State government ministries and departments, including its PSUs, shall start using IPv6 services by March-2012. Transition Plan for all service providers: To start with all major service providers (having at least 10,000 internet customers or STM-1 bandwidth) will target to handle IPv6 traffic and offer IPv6 services by December-2011

14. PATH AHEAD

The governmental agencies are trying to seek formal cooperation agreements with other nations in Ipv6and is open to enhance cooperation in R&D, operational matters of IPv6 and knowledge sharing. The steps are already taken and much more is being done on the urgent bases .Few of the vital decision taken are as under Establishment of National Internet Registry of India, Through the National Task Force the Ministry seeks to investigate deployment of IPv6 in Union e-governance networks and begin steps to opertionalise the same .It is also being planned to create Massive internal awareness campaign to polarize government staff on importance of IPv6.Funds and assistance is being provided for massive awareness and educational campaign with ISP/NSPs all over India to significantly raise awareness levels in IPv6 operational matters and thus enable them to innovate, link them up together and with partner overseas.

The European Union (EU) and India had established extensive cooperation in the science and Technology sector. As part of it, EU and India had entered into an agreement for promotion of ICT between Europe and India. As part of this agreement high speed-broadband connectivity was established between pan-European research network GEANT and the Indian education and research network ERNET. The promotion of IPv6 technology and deployment of next generation Internet based on IPv6 is one of the goals of this cooperation. In this context, the 6CHOICE project promotes the IPv6 technology across India and Europe. IPv6 services have been in production for several years in the EU, at least for the Academic community. In India IPv6 is also in production in academic research network since the year 2005 onwards. The goal of this deliverable is to present the status of IPv6 deployment world-wide especially in Europe and India.

15. CONCLUSIONS

ISP's are already getting ready with the IPV6 deployment. Greatest boon to the deployment is that much of global Ipv6 R&D of multinational companies happens in India(as part of offshore R&D of companies for global customers) notable clients for the same are E.g.: HP, IBM, Sun, Microsoft, Cisco, Juniper, Samsung, LG, Huawei , Infineon, Wipro etc .

Long term solution still awaits for the permancy. Some of the Possible Remedies for ensuring better Internet/Broadband penetration include Increased number of Data Centers in smaller towns. Reducing dependence on and usage of international links reduced access costs &reduced latency better user experience more users. Increased use of new computing models like "Cloud Computing"

It could be made Mandatory to use NIXI for all ISPs and increase NIXI PoPs which shall result in better and more efficient routing and reduces unnecessary international hops. Other than this there is need of regulatory push as well as development of newer business models.

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