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IPv6 Readiness for CWPRS Network – A steps towards Migration from IPv4 to IPv6

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Abstract - Internet Protocol Version 4 (IPv4) is the most popular addressing protocol used in Internet Technology since many year but with the advancement of the technology and development of Network friendly devices, these IPv4 protocol are not able to suffice the predicted long-term demand for network addresses. IPv4 uses 32 bit addressing system and can make 4.3 billion addresses only. The evolution of the Internet has effectively exhausted all unique addresses offered by the current IPv4 protocol. The solution of this problem is to new IPv6 protocol which provides 4 times more network address as compare to IPv4. IPv6 is 128 bit addressing system and offers 2^{128} or 3.4 X 10^{38} addresses .This research paper presents a case study about the migration from IPv4 to IPv6 of a Campus Network.

Keywords - *IPv4 to IPv6 Migration, Network Security, IPv6,CWPRS Network,IPv6 Readiness.*

1. Introduction

Communication technology is changing dynamically and Internet is becoming accessible to everyone, anywhere, anytime. As per Wikipedia, 7.3 billion are world population and worldwide 47% people are Internet users. India is having 2nd highest Internet users which is 26% people of total Indian Population [1]. The vehicle of the Internet is the "Internet Protocol" which assigns any router, server, host or simple internet devices so that it can communicate with other similar internet devices. The Internet Protocol is evolving as the Global Standard for communication across a range of devices, platforms and networks across the world. Fast development of Internet Technology and limited IPv4 addresses is the main reason to see the new Internet Addressing system to fulfill the future demands. IPv6 is a new version of Internet protocol which has more addresses as compare to IPv4. IPv6 has many new features, such as massive addresses, multicast, neighbor discovery, auto-configuration, service quality, removable and so on. It is imperative that the current IPv4 is migrated to IPv6 [2].

2. IPv4 to IPv6

The "Internet Protocol" (IP) is one specific element of the Internet architecture. Most parts of the Internet today run using Internet Protocol Version 4 (IPv4) addresses. An IPv4 address has a 32-bit addressing space, which can theoretically cater to 232 = 4.3 billion devices. If every person on this planet is associated with at least one internet access device, it is evident that we don't have enough IPv4 addresses. This was foreseen in the early 1990s itself and therefore the Internet Protocol Version 6 (IPv6) was developed. Apart from increasing the address space to 128 bits, many new and advanced features were also introduced in IPv6, which are not present in IPv4. IP backward compatible with IPv4. The current version of the IPv4 was first developed in the 1970s, and the main protocol standard RFC 791 that governs IPv4 functionality was published in 1981[3]. IPv6 also known as Next Generation Internet Protocol was developed by IETF and IPv6 was first published in 1995 and became a standard in 1998 (*RFC 2460*) [4].

Features of IPv6 : IPv6 has many features which address the issues being faced in IPv4. Some of the key features are:

- It has 128 bit address space which will allow many trillion addresses to be allocated to every individual on the Earth. This will ensure that

there will never be a shortage of addresses in future.

- It also supports stateless Auto-configuration for easier address allocation and plug and play operations i.e. no manual configuration of IP address is required. Out of 128 bits, the least significant 64 bits are used as host identifier in a subnet and is constructed from the MAC address and the most significant 64 bits are used as network identifier. A host connected to an IPv6 network will automatically get an IPv6 address in which the host identifier is constructed from the MAC address and the network prefix announced by the subnet router is appended to construct the complete 128 bit address. This allows plug and play IP configuration and the IP address assignment is done in such a way that it is automatically routable. If the machine moves to a new subnet, the IP address is automatically renumbered; the host identifier remains the same, but the network identifier changes.
- It has better support for routing. The address assignment in IPv6 is based on geography (address block assignment based on geographical location of the network) and hierarchy (hierarchical sub-netting within a network) in contrast to IPv4 where the IP address assignment was largely random. This allows route aggregation and faster routing.
- It has better support for mobility with fast handover, better route optimization and hierarchical mobility. This will be a key advantage as the future generation of mobile voice services like 4G will be based on IP.
- It has better support for Security as IPSec features are inbuilt in the IPv6 packet header using the AH authentication header and the ESP extension header.
- It has better support for Quality of Service (QoS) as the IPv6 packet header contains Traffic Class and Flow Label fields, which identifies packet flow for QoS handling by routers.
- It has better support for Multicast as it has larger multicast address space.

National IPv6 Deployment Roadmap : In India, efforts 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. The task of leading the country towards IPv6 was given to Telecommunication Engineering Centre (TEC), a standardization body under the Department of Telecommunications (DoT) in 2009. Keeping all the issues in mind deliberations were initiated with industry members and service providers, and it is emerged from all these discussions that there is a need to crystallize and firm up the transition strategy from IPv4 to IPv6 by involving all stakeholders. Since then TEC has conducted with CMAI a number of activities, like workshops, seminars, training programmes etc. throughout the country to interact with different stakeholders like service providers, central and state government departments, educational institutions, industry associations, equipment manufacturers, content developers etc. Based upon the inputs received from different stakeholders TEC has prepared the "**National IPv6 Deployment Roadmap**", which examines the different issues related to the deployment of IPv6 in India [5].

Problem Statement: The current CWPRS Network is not enabled for providing IPv6 services to the users. Currently users use Private IPv4 addresses or proxies to access Internet services. Similarly, the CWPRS website is accessible over the Internet on IPv4 only. As per the directives of DoT, CWPRS is required to conduct an audit of its setup to assess the IPv6 readiness and accordingly prepare a transition plan to support IPv6.

About CWPRS Local Area Network (LAN): Under the IX Plan Scheme of Information Technology development in CWPRS, a 230-Node Campus- wide Local Area Network (LAN) had been set up in CWPRS. The Local Area Network has been playing very vital role in CWPRS. The LAN nodes in various offices/Divisions share and exchange information over the fibre optic backbone network through Windows Servers installed in the Data Centre. CWPRS has also acquired 50 Mbps leased line connection from BSNL for fast Internet connectivity. The LAN in CWPRS is extensively being used by various divisions for their Research Work, Mathematical Modeling & Remote Sensing Application, Accessing the Research Journal, e-mail, Internet, Intranet PFMS, e-HRMS, Aadhar Enabled Biometric Attendance System (AEBAS), Government e-Market Place (GeM) Procurement, e-governance activities, MIS Network etc. The LAN consists of various electronic active and passive devices like Layer2/Layer3 switches, Servers, Uninterrupted power supply, Router, Wi-Fi Router, Biometric Devices, Optical Fiber Cables, Unshielded

Twisted Pair cables and other devices. Most of these devices are continuously on for 24 hours.

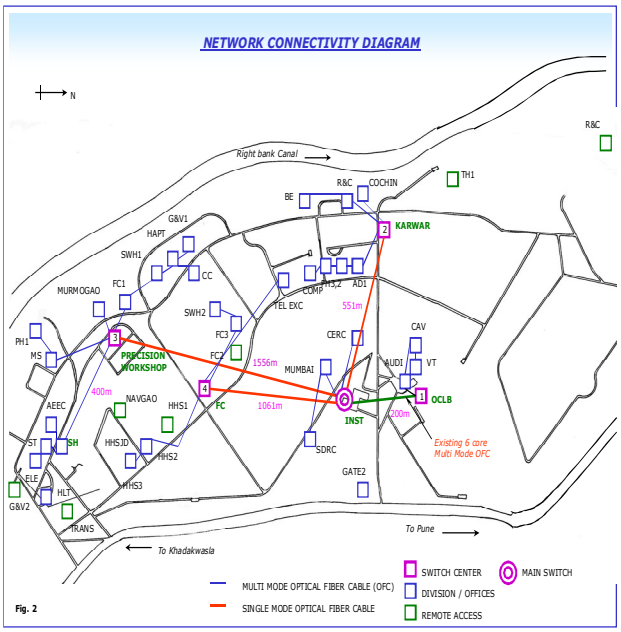

Figure 1.1 : CWPRS LAN Connectivity Diagram

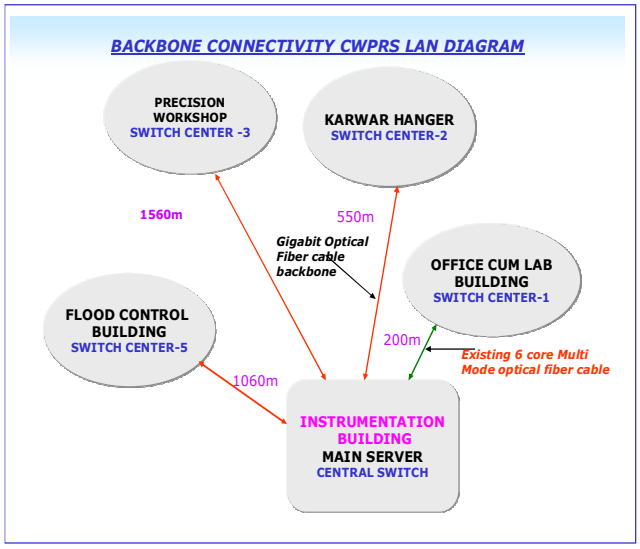

Figure 1.2 : CWPRS LAN Backbone Connectivity

Case Study: CWPRS Network is using IPv4 protocol addresses system to access Network/Internet services. As per the directives of DoT, CWPRS is required to conduct an audit of its IT setup to assess the IPv6 readiness and accordingly prepare a transition plan to support IPv6. The CWPRS Network was audited by BITCOE (BSNL IIT Kanpur Telecom Centre of Excellence) for IPv6 Readiness with the aim to identifying the requirements for enabling IPv6 in CWPRS network and suggesting a transition plan to achieve the same. Followings recommendations has been made to upgrade the equipments and devices for IPV6 support.

1. 3COM/HP should be contacted for providing necessary software/firmware upgrade of the Core Switch and Distribution Switch. If the upgrade is not possible, then they may be replaced with new switches.

2. BSNL should be requested to allocate /48 or /56 IPv6 address block to CWPRS and route the same address space through the edge router.

3. NIC should be requested to support Dual Stack on the web and mail servers which host the CWPRS website and mails.

4. The network equipment should be configured to support and route IPv6 traffic.

5. A new IPv6 compliant SNMP Management Software should be installed to monitor and manage the network.

6. IPv6 should be enabled in all the hosts. They should work as Dual Stack hosts.

7. IPv6 should be enabled in all the Intranet servers. They should work as Dual Stack servers.

8. All applications should be tested on IPv6.

9. The IPv6 feature list should also be included in the specifications for all future purchases.

10. All the new purchase of Hardware/Software/Application Software/Network Security Devices etc. should be IPv6 enabled/support.

3. Results

AS per the BITCOE recommendation, CWPRS initiated/ implemented the following action towards smooth migration from IPv4 to IPv6.

- The Core Network Switch and Distribution Switches are replaced with IPv6 compliant switches. These switches are installed and successfully working in CWPRS network. The

Network Switches were procured through DGS&D rate contract.

- All new procured Desktop Computers / Servers/Workstation are now IPv6 compatible and having dual stack features.

- CWPRS is making sure while purchasing new ICT devices Viz. Desktop Computers/Server/Workstation/Operating System/Network elements/Application Software/Database etc. should be IPv6 compatibles/Support.
- The Edge Router is fully IPv6 compliant. It only needs to be configured for IPv6 and BSNL will take the action for the same.
- Firewall Cyberroam UTM is IPv6 compliant. It is IPv6 Ready Logo certified. It only needs to be configured for IPv6.
- CWPRS web server and mail server are maintained by NIC. CWPRS will request to NIC enable Dual Stack and make them IPv6 compliant.
- CWPRS is in process to have the SNMP Software to monitor and manage the network.

4. Conclusion

As per Govt. of India guidelines and BITCOE recommendation, CWPRS phase wise took the action to migrate from IPv4 to IPv6 and successfully replaced/up-graded all the Network devices for IPv6 readiness and now made ready all the Network Infrastructure Device IPv6 compliance. Presently, CWPRS Network is configured using IPv4 protocol and once the BSNL (Internet Leased Line, Router) and NIC (CWPRS Website Hosting) make the provision/configuration for IPv6 for CWPRS Network, CWPRS will configure all the devices using IPv6 protocol.

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