AN APPROACH FOR STABLE MIGRATION OF IPV4 TO IPV6 IN SRI LANKAN ISP NETWORKS

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ABSTRACT

In Computer networking IP addresses are being used to form the connectivity among devices. Current IP version which has 4294967296 address space is not enough to facilitate the high growth of internet users. Solution provided by Internet Engineering Task Force (IETF) is IPv6 which has 2^{128} IP addresses. Even IPv6 is capable of providing IP addresses to every inch of the world and it is not an extended version of IPv4. IPv6 is completely different from IPv4. As a result of that, IP addresses need be migrated from IPv4 to IPv6 in order to upgrade the newer version. It is an extremely difficult task for all Internet Services Providers (ISP) to migrate to IPv6 without losing the end-to-end connectivity to their clients. In this study we propose an elegant method to migration of IPv4 to IPv6 in Sri Lankan ISP Networks. Provided solution divided into three phases called Preparation phase, Transition phase and Post transition phase. Preparation phase was developed to overcome issues with unsystematic frameworks and uplift the interest and awareness towards IPv6 migration in the technical staff of Sri Lankan internet service providing industry. In transition phase millstones were defined for smooth transition without losing the connectivity between IPv4 and IPv6 networks. In post transition phase smoothing options are discussed to reduce operational overhead. Developed approach was implemented and successfully tested in IPv6 migration of an ISP backbone network.

Keywords: IPv6, migration, transition

1. INTRODUCTION

This project is a study of related theories and protocols to migrate from IPv4 to IPv6. Steps of this migration were developed through the project and result is an approach for Sri Lankan ISPs to migrate their backbone networks from IPv4 to IPv6. This migration is critical because IANA IPv4 pool ran out 3rd February 2001 and only RIR pool will be available for few more time. With the exhaustion of free IPv4 pool enterprise organizations will no longer be able to obtain IPv4 address space for new networks of expansions. [1] They will only be provided IPv6 addresses. IP version 6 is not an extended version of IP version 4. It is a completely different concept and IPv6 host cannot communicate with IPv4 host. In this paper the term “migration” is used instead of “upgrade”. Therefore all the Internet Service Providers (ISP) have to migrate their networks from IPv4 to IPv6 rather than upgrading to the newer version. In this paper it is considered as the initial state of the network is IPv4 only and throughout the migration process it will come to a combination of both IPv4 and IPv6. Then it comes to the ultimate level, the IPv6 only network after utilizing the IPv4-IPv6 network for some time.

There are number of technologies are available to support this migration and in the project they were used in relevant millstones of the migration process. They are dual stack (support of both IPv4 and IPv6 in a device interface), Tunneling (encapsulation of an IPv6 packet with an IPv4 packet to transmit IPv6 packet through an IPv4 network) and Translation (address or port translation of addresses such as via a gateway device or translation code in the TCP/IP code of the host or router). [2] Features, benefits and limitations are varying for each strategy and they are not equal in complexity, functionalities and cost. Using the survey, issues with Sri Lankan ISPs were identified to develop the framework of migration using these migration technologies.

2. METHODOLOGY

The methodology of this project consists of four phases which are preliminary study, literature survey, development of final framework and implementation.

2.1. Preliminary Study

To develop the migration framework it is necessary to identify the issues related to IPv6 migration process of Sri Lankan ISPs. As the first phase of the preliminary study data was collected

from Sri Lankan ISPs and they were analyzed in the second phase.

List of ISPs: LankaCom, Sri Lanaka Telicom, Dialog, Mobitel, Hutch, Airtel,

2.1.1. Data Gathering

The list of most recognized ISPs was obtained from Telecommunications Regulatory Commission of Sri Lanka (TRCSL) and a questioner was given to each ISP. To make sure the reliability of data and the process authorized personals who are handling IP addressing and routing of ISP backbone networks were personally interviewed. Data and information about their current situation of IP addressing, budgets for new purchasing, structure of the backbone network, down time schedules, awareness and knowledge about IPv6, expecting or currently using mechanism to migrate to IPv6 and issues for the migration, were collected throughout the survey carried out from 10 Sri Lankan ISPs who are register in TRCSL. Given questioner was prepared through a focused group discussion and it was finalized after an expert review.

2.1.2. Data Analyzing

A simple analysis was carried out to identify the most affected factors which are holding the migration process in ISP backbone networks. According to the factor analyses following issues were identified as common issues. High expenses for hardware upgrades, inability to reuse previous devices, lack of interest in technical personals for the new version, lack of training and knowledge in IPv6, cost and extra effort to run both IP versions together, high level of dependencies for backbone devices, lack of redundant paths to route data, difficulties to manage connectivity down times, lack of low cost and free network supporting services and software tools, the need for lots of planning, lack of defined pre preparation millstones and unsystematic frameworks for migration.

2.2. Literature Survey

Science 2008 the world has started IPv6 migration and in 2014, 8% of internet population has been using IPv6 to connect internet. In Sri Lank it is only 0.04% [3]. To date number of research, and studies have been carried out on IPv6 migration and there are number of publications available to refer on this migration process. These theories and algorithms which were published by relevant authorities were referred to develop the final output of the project. Simple Internet Transition (SIT) Theory [4], other approaches already developed, Requests For Commands (RFCs), books and other publications were the referred factors to develop the framework. According to the United State government roadmap towards IPv6 adoption it has mentioned; identification of transition priorities, transition criteria for legacy, upgrade and new capabilities and dependencies as the elements that transition strategy must include [5]. In Austrian IPv6 roadmap [6] they have defined four stages called launch, backbone, provider access and complete. Federal government agency [5] has introduced their consideration and they highlight network infrastructure, address planning, transition mechanisms the book; Running IPv6 [7] describes the architecture and features of IPv6. RFCs [8] [9] [10] were referred to study more details of transition mechanisms, addressing plans and IPv6 characteristics.

2.3. Development of Migration Framework

In this phase of methodology two tasks which are called applicability testing and framework development were done simultaneously. Sri Lankan ISP called Lanka Communication Services (pvt) Ltd (LankaCom) [11] was selected as the base environment for testing the applicability of framework millstones and literature survey findings were analysed to define steps and factors of the migration framework.

2.3.1. Applicability Testing

For better understanding about LankaCom backbone network information was collected about backbone links, hardware devices, IP allocation, and staff awareness about IPv6. Literature survey and preliminary study findings were applied to collect information in order to define the basic structure of migration framework. According to the analysis of the functionality of the backbone network complete process of migration was divided into three phases as preparation phase, transition phase and post-transition phase. During the development phase of the methodology each phase was defined with facts by testing the applicability of the fact to the base environment. To test the applicability of each fact for the ISP network likert scales of requirements were used.

2.3.2. Framework Development

Preparation phase was highly focused into the findings of preliminary study and cost effective methods were added to the framework. To define

the preparation phase; upgrade existing hardware, identify critical infrastructure, prioritize devices and applications, find out low cost solutions for upgrades and apply firmware solution instead of hardware solutions were the facts considered. To define transition phase a testing model of a network was used and steps of transition was defined to have end to end connectivity consistently. Network support service, load balancing and error logging were considered as post transition steps.

2.4. Implementation

Lanka Communication Service (pvt) Ltd is a well-known ISP in Sri Lanka who has an island wide backbone network and a customer tail. Framework development and IPv6 migration were carried out simultaneously in the real environment and millstones of the framework were followed during the migration process.

3. RESULTS AND DISCUSSION

Final result of the project is the IPv6 migration framework which gives an approach for stable migration of IPv4 to IPv6 in Sri Lankan ISP networks.

1. Preparation phase
   - 1.1. Gather network information
     - 1.1.1. Hardware and software IPv6 capability survey
     - 1.1.2. Downtimes and backup routing path survey
     - 1.1.3. IP allocation survey
     - 1.1.4. IPv6 support monitoring and other services survey
   - 1.2. Identify critical infrastructure
   - 1.3. Prioritize devices and applications
   - 1.4. Identify hardware and software dependencies
   - 1.5. IP address allocation structure
   - 1.6. Develop transition time plan
   - 1.7. Staff training
2. Transition phase
   - 2.1. Upgrade hardware and software to support IPv6
   - 2.2. Configure migration mechanism and IPv6 addresses
   - 2.3. Tunnels and dual stack gateway
   - 2.4. Configure AAAA records needed for DNS
   - 2.5. Configure address translation in both IPv6 only and IPv4 only customer networks
   - 2.6. Apply security configurations, access control lists and firewall rules
   - 2.7. Upgrade monitoring and supporting services (servers)
3. Post transition phase
   - 3.1. Apply smoothing options to reduce operational over head

In the preparation phase four surveys are introduced and hardware which supports IPv6, which needs to be replaced and available firmware upgrades are the facts to be searched in the first step. Network down time requirements will be listed and available backup routing paths will be identified. Further possibilities to build new backup paths for necessary situations can also be identified in that step. Core routers and switches of the backbone network and node routers which handle data of beneficial customers are considered as the critical hardware. Prioritizing the devices upgrades is important to maintain the end to end connectivity during the transition phase. Hierarchy of the backbone hardware and links represent the dependencies of the network. To prepare the IP allocation structure current IPv4 address can be embedded into the lower part of IPv6 address and use for the same interface. Available IPv6 address need to be categorized into divisions such as infrastructure IPs, customer IPs, future services and each division will be further divided into sub divisions according to the ISP infrastructure. Developed time plan will be used to perform the tasks in the transition phase which has three states called IPv4 only, IPv4/IPv6 dual mode and IPv6 only. Until completion of the transition phase the network will function in IPv4/IPv6 dual mode in order to maintain the connectivity.

4. CONCLUSION

Developed approach was implemented and successfully tested in IPv6 migration of Lanka Communication (Pvt) Ltd backbone network. By applying this migration approach, it was possible to upgrade LankaCom backbone network to provide services to any customer who request IPv6 only network. Cost for this migration was reduced due to identification of critical devices, firmware upgrades, prioritizing the upgrades and well organized millstones. By following defined millstones the migration was done without losing the end to end connectivity via the backbone network for both IPv4 and IPv6 networks. All the ISP backbone networks are based on a similar network structure and therefore this approach is applicable to any ISP network in Sri Lanka.

5. REFERENCES

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