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Enhancing OSPF Routing Protocol in Dual-Stack Enterprise Networks

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ABSTRACT: With the growth of IPv6, various IPv6-IPv4 translation systems for communication between IPv4 networks and IPv6 networks have been introduced. The paper showed an IPv4-IPv6 translation technique by utilizing network Address and simulated based on Petri nets that improve the OSPF routing Protocol using IPv4-Pv6 translation system. The paper introduces a translation scheme, which is based on determining two public addresses (IPv4 and IPv6) for every communicating session, understanding the obtained datagram, fetching and identifying the header, transformation of the datagram to the destination atmosphere, converting the header, and then transferring the datagram to the destination address. This mechanism is motivated by the fact that a host only utilize a small amount of port no. to link with others (Some mainstream operating systems also restrict the maximum no. of concurrent TCP links of a host). Additionally, the translation technique deals with the bi-directional operation that converts the obtained packet into the destination atmosphere based on identifying two public addresses for the two different atmospheres (IPv6 and IPv4 atmosphere).

KEYWORDS: Modeling, IPv6, IPv4, Translation, Petri nets

I. INTRODUCTION

The recent concerns about IPv4 address space exhaustion increased the attention provided to IPv6 deployment. Existed globally-addressable space on the IPv4 Internet is reducing. It is hard to evaluate the rate of reduction, and even one or two very large-scale applications that need global address space could exhaust most of the space that can be assigned without interruption to available subscribers and applications. Even an expansion of dedicated Internet links in several countries, if performed utilizing IPv4, could considerably exhaust the left IPv4 address space. IPv6 (Internet protocol, version 6) was formulated by the Internet Engineering Task Force (IETF), initiated in 1993, in reply to a series of perceived issues, mainly regarding current exhaustion, IP version 4 (IPv4)
address space. It arose out of an evaluation and design procedure that started in 1990 and assumed a no. of alternatives and a range of several protocol alternatives. Every entity on the network requires IP address to be utilized as a basic and unique identifier. IPv4 [1] was the first version of the IP that was broadly deployed for providing unique global computer addressing to ensure that two computers (or any two network devices) can uniquely identify each other. Because of the fast development of the network, a large no. of unique addresses is required; the available IPv4 Protocol exposes critical well-known problems. The almost-exhausted IPv4 address with greater than three-quarters of the 4 billion addresses engaged [2]. Hence, a novel version of the IP has been designed by the Internet Engineering Task Force (IETF), called IPv6 [3]. The primary objective for developing the new Internet Protocol (IPv6) is to increase the no. of IP addresses (address spaces). The IPv6 address was developed with a 128-bit (16- bytes) address technique rather than the 32-bit (4-bytes) address technique in IPv4, which means IPv6 can represent over 3.4x1038 possible unique addresses [4]. IPv6 will have sufficient unique address every device (e.g. cell phone, telephone, automobile, mp3 player etc) on the earth surface with full end to end connectivity (approx. 32 addresses per square inch of dry land). Additionally, IPv6 is developed to support scalability, security (IPSec), and multimedia transmissions. Overall, IPv6 was seriously thought out and was performed with future applications in mind.Many countries have prepared a schedule for new Internet Protocol (IPv6) implementation to satisfy their future deployment requirements. Since, IPv6 is not backward-compatible with the IPv4. The replacement of IPv4 by IPv6 is a fairly long procedure. So it is not possible to throw away the available IPv4 network and to follow IPv6 quickly. It is realized that the transition will

occur in phases with a few IPv6 nodes proposed into an IPv4 network and the no. slowly increasing over time till sometime in the future when the whole network becomes IPv6 [5,6,7]. Hence, it is essential to resolve IPv4/IPv6 address translation.

II. RELATED WORKS AND RESEARCH MOTIVATION

IPv4 was broadly deployed and utilizes 32-bit for both source and target IP addresses which restrict the address space to 4.3x109 possible unique addresses. Some of these addresses are reserved for particular tasks (in multicast addresses or private networks). IPv4 has some drawbacks with a lack of IP address spaces, the needs for security at the Internet layer, and the increment on quality of services (QoS) requirements. The enhancement from IPv4 to IPv6 offers a platform for new Internet service that will be needed in the coming future in addition to header format and size simplification [8]. Additionally, IPv6 addresses come in three different kinds: Unicast, Multicast, and Any cast; where every address type is utilized to determine if the forwarded packets are targeted for one or many machines [9,12]. Hence, IPv6 has many characteristics i.e. the novel header format with least header overhead, huge address spaces, better support for QoS, built-in security, and improved support for Mobile IP. The issue of porting available applications to IPv6 has been so far addressed by various researchers, involving companies and academic institutes. A white paper by Microsoft [13] concentrates on Windows applications, but simultaneously provides some basic guidelines that use any application for any operating system. IPv6 offers several advantages over IPv4 technique, but IPv6 deployment needs co-existence with IPv4 for some time period for enabling IPv4 network subscribers to interact with their old applications [11,12]. A no. of techniques have been developed for maintaining the transition from IPv6 to IPv4 and vice versa. There are three significant techniques that have already evolved; Tunnelling, Dual-Stack, and Translation. The Dual-Stack Method introduces to utilize the dual stack IP scheme based on IPv4 addresses allocated dynamically only when required, and the usage of IPv4 over IPv6 tunnelling for crossing the local IPv6 network before accessing the outer IPv4 network. But this technique has a drawback that all the edge nodes require edge nodes advanced to run IPv4 as well as IPv6 protocols [10,11]. These edge nodes require to be able to support dual addressing techniques, dual management routing protocols as well as having enough memory for both IPv6 and IPv4 routing tables. The tunnelling scheme can be utilized when two hosts that are positioned in two different IPv6-only zones wish to interact with one another by passing their packets via an IPv4-only zone, in this case the IPv6 packet will be encapsulated in an IPv4 packet to be passed via the IPv4-only zone. The tunnelling technique endures from the increment of the network traffic overhead (as a result of encapsulating IPv6 packets in IPv4 packets).
Several translation techniques are introduced i.e. Network Address Translation Protocol Translation (NAT-PT), Stateless IP/ICMP Translation (SIIT), and Network Address and Port Translation Protocol Translation (NAPT-PT) [12].The translation technique has many drawbacks i.e. the no. of simultaneous links and the translator capacity. Additionally, some security protocols i.e. IPSec are not compatible with the translation device [13].

III. THE IPV4-IPV6 TRANSLATION SYSTEM

The transition phase from IPv4 to IPv6 has introduced some discussions among the Internet community, as many companies and network administrators are reluctant, facing what they perceive as a great challenge with high costs. Apart from the hardware and network part of the issue, a very significant aspect is the modification (porting) of available applications so that they become IPv6 enabled. It is an essential phase in the broader adoption of IPv6, not only because without them the new infrastructure becomes waste for the subscriber, but also because applications have the capability to clearly implements the benefits of IPv6. The majority of network applications in presence today assume the usage of the IPv4 protocol, so the transition to IPv6 has to be achieved by new applications development and/or the change of the available ones, so that they can be utilized in IPv6 atmosphere. It has usually been established that the complexity of changing available applications changes significantly from one case to another.

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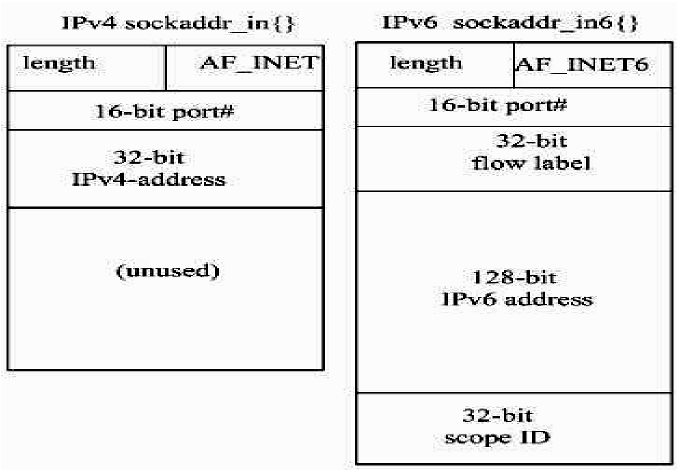

Fig. 1: IPv4 and IPv6 address structures

The principle rule of address translation is to set up the mapping technique between receiver and sender, which can map message sequence on a specific protocol to another protocol sequences. Protocol conversion is a procedure of the mapping from one sequence to another. The fundamental operation of IPv4-IPv6 translation is the mapping of the IP header between the two protocols, substituting the header from sender to recipient; whether the higher layer of the two protocols carries out the similar substitution based on differences among them [13,14,15]. In RFC6052 [15], a basic framework of stateless address translation is described. The IPv4 and IPv6 address structures are shown by Figure 1.

The IPv6 address header is simplified by neglecting or setting default for some information fields in the IPv4 protocol. Generally, the header of the two protocols is quite same as that some fields can be directly copied between two protocols. Of course, others require to carry out translation. If the IPv6 data packets are needed to address the neighbour discovery protocol, it is addressed; else, IPv4 packets and IPv6 packets continue along the similar way to determine the translation. Then according to the several translation direction, packets are transferred to the corresponding translation processing module. The translation processing module processes modified data packets and produces new packets. At last, the processed data packets are directly forwarded to the network interface. Table I is IPv4-IPv6 Transition Mapping. The system work flow can clearly define the work flow of the IPv6 and IPv4 translation mechanism (as illustrated in Figure 2).

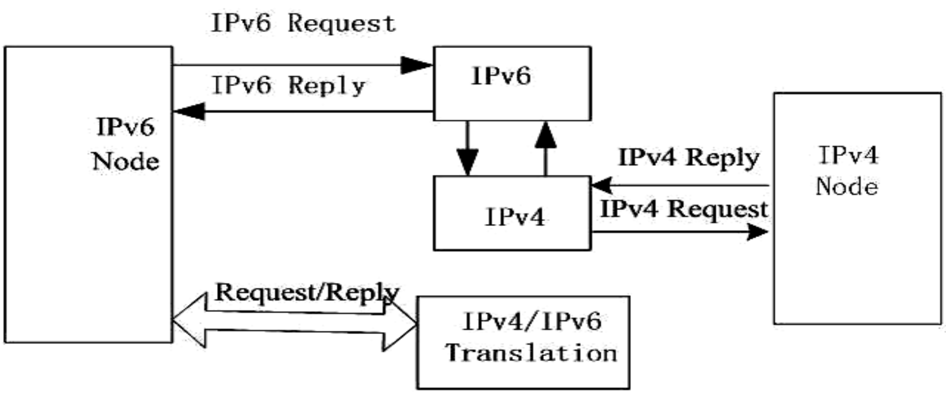

Fig. 2: the IPv4-IPv6 address translation System

First, the system hears on the network interface to get a data frame, and then reads the data frame header, and finds the protocol type according to the header field type. If the value of packet type is equal to 0x0800, it is an IPv4 packet, which can utilize to find the way of the IPv4 packet's translation and to process according to the configuration as follow. If the value of packet type is equal to 0x0806, it is an ARP packet. The packet is transferred to the ARP module

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to convert ARP request and reply and to manage the ARP table. If the value of packet type is equal to 0x08DD, it is an IPv6 packet [16].

IPv4 to IPv6 transition detailed procedure defines the IPv4 and IPv6 translation details, as illustrated in Figure3. These steps as follow:

(1)To evaluate whether the value of IPv4 packet TTL field is equal to 1. If the value is equal to 1, the lifetime of data packets has been used up. The packet will be dropped. The system will wait to achieve next data packet.

(2)According to the address mapping table, the IPv4's source address and destination address are translated into IPv6's address, and a novel IPv6 packet source address and a new destination address are created. If there is no address mapping table to determine the corresponding IPv6 address during translation, an error return: the address is not existed.

(3)According to translation algorithm, the IPv4 packet is transformed into an IPv6 data packet one by one field in accordance with each.

(4)According to the higher-layer protocol type, call suitable functions to deal with UDP, TCP, or ICMP packets, and a new checksum is computed.

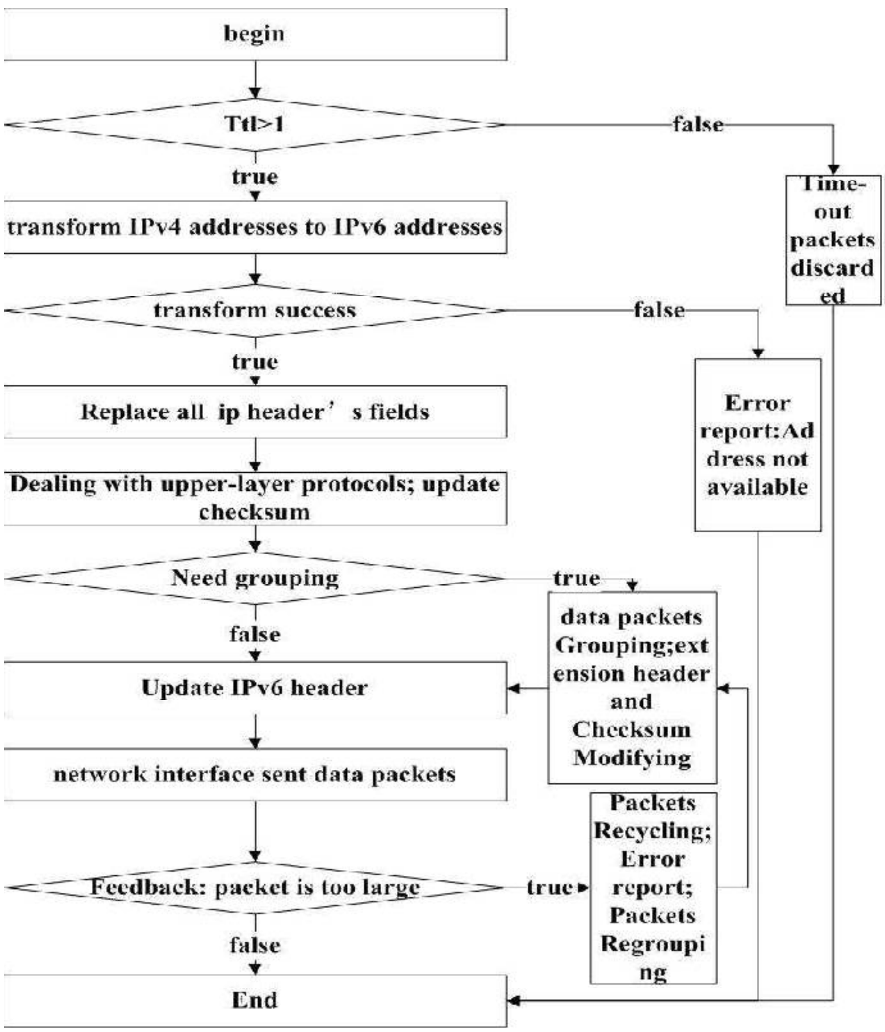

Fig. 3: IPv4-IPv6 Transition Process

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IV. MODELLING AND ANALYSIS OF IPV4-IPV6 ADDRESS TRANSITION PROCESS

Petri nets are broadly utilized in several application domains for its flexibility and simplicity in presenting dynamic system nature. Their inherently asynchronous concurrent semantics matches that of some physical systems of interest. For instance, they are very appropriate to define a networks architecture, protocols and services. Petri nets have benefits in simulating, analysis, and verification due to their intuitive graphical representation and right mathematical theory and their wealth of analytical mechanisms and tools [17, 18,19]. According to the above system flow chart and the described flow chart, the corresponding Petri translation model was set up besides explaining the function of IPv4-to-IPv6 converter by the setting up Petri net model, it is also

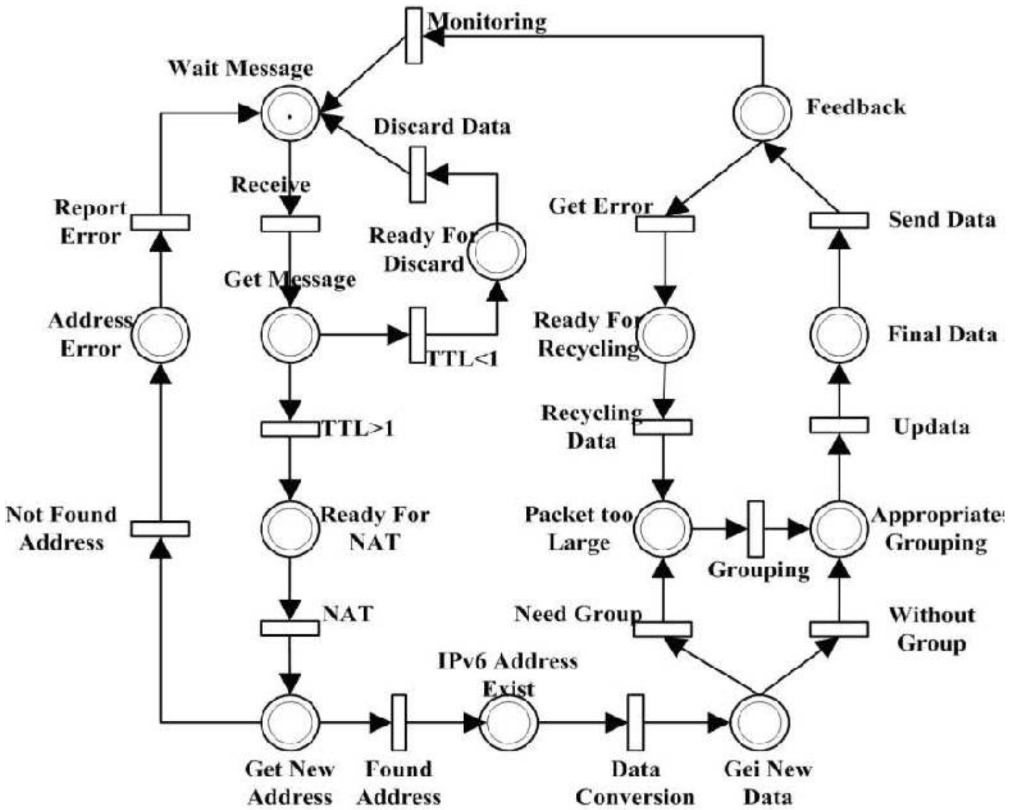

Fig. 4: The Translation Process Model based on Petri Nets

significant to prove that this is a secure system, instead of design flaws and system error during the translation procedure. Thus, we will examine dynamic behavior of the model to verify the system security and correctness. According to Figure4, IPv4/IPv6 translation properties are as follows: Besides fundamental functions, the model must also satisfy the roundedness, reversibility, the aliveness and other dynamic features for ensuring system accuracy and stability. The translation is transformed data frame one by one, which needs that the system can back to the initial state after the translation for one data frame is finished. That is, the initial state must be a home state. Also, the corresponding model depending on Petri nets must be a recoverable system. So, the model is a reversible network system. Depending on the Petri nets model, the Petri nets reachable graph can be made (as depicted in Figure.5). It represents that the reachable graphic is strongly linked, because any two states can arrive each other through a transition firing sequence in the reachable graph.

V. RESULT

Throughput can be described as the ratio of the total amount of data arrive a destination node from the source node. The time it consumes by the destination node to obtain the last message is known as throughput. It can be represented as bytes or bits per seconds (byte/sec or bit/sec). A greater throughput is absolute choice in each network. In fig 5. throughput comparison of enhanced OSPF and normal OSPF has been done. Clearly states that our proposed techniques presents better throughput as compared with normal OSPF has greater

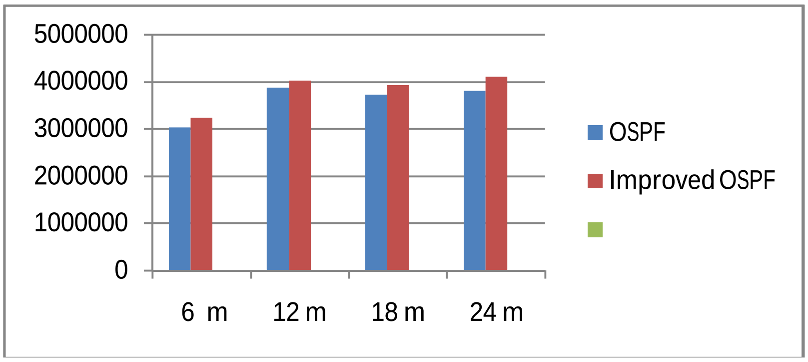

Figure 5: throughput of OSPF and enhanced OSPF.

VI. CONCLUSION

The requirement for Internet IP addresses is frequently developing with huge information explosion, but the current IPv4 protocol cannot meet the internet requirements. It is not possible to expect a fast, centrally coordinated cutover. To build the entire transition concept viable, the co-availability of both IPv6 and IPv4 must be arranged in a simple and practical way.The IPv4-IPv6 translation is introduced in this paper by network address. The paper showed an IPv4-IPv6 translation technique by utilizing network Address and simulated based on Petri nets that improve the OSPF routing Protocol using IPv4-Pv6 translation system. The paper introduces a translation scheme, which is based on determining two public addresses (IPv4 and IPv6) for every communicating session, understanding the obtained datagram, fetching and identifying the header, transformation of the datagram to the destination atmosphere, converting the header, and then transferring the datagram to the destination address. This technique utilizes a small amount of port no. to link with others and deals with the bi-directional operation that transforms the obtained packet into the destination atmosphere based on determining two public addresses for the two different atmospheres (IPv4 and IPv6 atmosphere). Additionally, we examined and verified more exactly the correctness and dynamic features of transition by simulating the translation system. To verify the model can iterate the operation after the successful implementation, and data is orderly and complete,

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