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The Applicability Index of IPv4/IPv6 Encapsulation
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Abstract

The Softwire working group is currently discussing both encapsulation and translation based stateless IPv4/IPv6 solutions in order to be able to provide IPv4 connectivity to customers in an IPv6-Only environment.

The purpose of this document is to describe the basic issues and key elements of the IPv4/IPv6 encapsulation, and presents its applicability index that would help the operators decide on the development scheme for their IPv6 transition.It could lead to significant operational benefits and potential savings for the operators.

Status of This Memo

This Internet-Draft will expire on June 30, 2016.

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1. Introduction

The Softwire working group is currently discussing both encapsulation and translation based stateless IPv4/IPv6 solutions developed for the purposes of offering IPv4 connectivity to the customers in an IPv6-Only environment.

Generic mechanism for IPv4/IPv6 encapsulation mechanismsare specified in [RFC2529], [RFC3056], [RFC4380], [RFC4659], [RFC5214], [RFC5569], [RFC5747], [RFC6333], [RFC7040], etc. With the diverse characteristics and transition requirements of practical networks and the lack of overall transition architecture, the selection and deployment of IPv6 transition mechanisms are very difficult.

In an effort to push forward the IPv6 transition process, this document describes the basic issues and key elements of encapsulation mechanisms, and presents the applicability index that would help the operators decide on the development scheme for their IPv6 transition.It could lead to significant operational benefits and potential savings for the operators.

2. The Basic Issues and Key elements of Encapsulation Mechanisms

Encapsulation mechanisms can achieve communications between IPv6 networks/hosts across an IPv4 network (IPv6-over-IPv4), and communications between IPv4 networks/hosts across an IPv6 network (IPv4-over-IPv6).

2.1. Basic Issues

Its basic operations include encapsulation/de-encapsulation and route discovery between tunnel endpoints. Encapsulationoperation only affect the network layer:

a. The basic data operation Encapsulation/de-encapsulation is the basic data plane operation. For IPv6 transition usage, the encapsulation manners such as IP-IP, GRE (Generic Routing Encapsulation) L2TP (Layer Two Tunneling Protocol), MPLS (Multiple protocol Label Switching), IPsec (Internet Protocol Security) can all be adopted.For a wide selection, network operator can make the decision to select suitable transition mechanism.

b. The basic control operation The basic control plane operations include the routing interaction across heterogeneous network, the route discovery between tunnel endpoints, and the encapsulation address mapping by a particular address scheme or address/prefix binding.

2.2. Key Elements

a. Transition equipment In encapsulation mechanisms, the tunnel endpoints are the transition equipments. They need to support dual-stack which can be an AFBR (Address Family Border Router) or host equipments. They should support encapsulation/ deencapsulation and routing forward across heterogeneous network and the route discovery between tunnel endpoints. They also maintain the encapsulation address mapping by a particular address scheme or address/prefix binding. Thus, the tunnel transition equipment has requirements in the use of bandwidth, computing and finding, storage.

b. Encapsulation/de-encapsulation Encapsulation makes the IPv4/IPv6 packet as a payload of the other IP protocol. It retains the integrity of IP packet information. But it adds the size of packet and may create the fragment reassembly problem.

c. The routing across heterogeneous networks Encapsulation mechanisms need to support the routing forward across heterogeneous networks. And the border routers should maintain the binding and realizes the transparent data transmission. Thus, encapsulation is stateless and lightweight.

d. The routing discovery between tunnel endpoints In encapsulation mechanisms, the tunnel endpoints need to discover each other. And it involves some problems, such as the selection and dynamic or static configuration of tunnel endpoint, state maintenance.

3. Applicability Index of Encapsulation

There are applicability index which need to be analyzed by the operator when choosing which transition technology option they would like to deploy. The applicability index in terms of sustainable, applications, performance and development. This section describes some of those considerations.

3.1. Sustainable Index

Sustainable index would include:

a. The scenarios and function of transition represents whether meet the needs of transitional scenario.

b. Both (a)the coupling degree between IPv4 address and (b) IPv6 address and the reuse rate of IPv4 addresses resource represent whether promote the deployment and usage of IPv6.

3.2. The Support Degree of Business Application Index

The support degree of business application index would include:

a. The support degree of IPv4 application represents the impact on the IPv4 business application.

b. The support degree of IPv6 application represents the impact on the IPv6 business application.

3.3. The Preformance Index

The preformance index would include:

a. The performance requirements of tunnel endpoint can be divided into (a)The maintenance and finding of state or mapping table and (b) the routing discovery, which represents the capacity of bandwidth, computing and finding, storage.

b. The routing scalability can be divided into (a) the independence between IPv4 and IPv6 routing and (b) the aggregation of IPv6 addresses, which represents the impact on the scope of deployment.

c. Robustness represents the capacity of redundancy backup.

3.4. The Development Index

The cost of development index would include:

a. Technological and industry maturity represent the support degree of standard.

b. The update cost can be divided into (a) the impact on application layer, (b) the impact on network layerand and (c) the impact on end users layer, which represent the impact on the present network.

c. The cost of operation, management and maintenance represent the impact on the operator.

d. The problem of fragmentation and restructuring.

3.5. The Security Index

The security index includes the security issues and concerns.

4. Conclusions

For the consideration of deployment scenarios and address format, numerous encapsulation transition mechanisms have been proposed in the past ten years. However, due to a wide range of mechanisms and a lot of overlap and similar functions, no one encapsulation mechanism can be used in all transition scenarios.

The applicability index of IPv4/IPv6 encapsulation described in this document have highlighted the applicability of all encapsulation transition mechanisms to help the operators decide on the development scheme for their IPv6 transition.

5. Acknowledgements

6. IANA Considerations

This memo includes no request to IANA.

7. Security Considerations

All drafts are required to have a security considerations section.

8. Informative References

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