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IPv6 development and current status of China Telecom
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Abstract

The draft presents China Telecom's deployment of IPv6 in multiple scenarios for the whole network transition, including the history, transition strategy, measurements and challenges.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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Table of Contents

1. Introduction

As one of the 3 operators in China, China Telecom not only provides voice, household broadband and mobile services to public customers, but also provides leased-line, VPN, IDC and cloud computing services to enterprise customers. Up to now, the quantities of mobile users and household users have reached to 308 million and 123 million respectively, of which 267 million are LTE/4G users. With the evolution of mobile networks, China Telecom has begun to provide SA-based 5G services. In addition, China Telecom also provides oversea services in some regions, for instances, North America, Europe and Australia, etc.

To support the services provisioning for tremendous amount of users in different scenarios, a large-scale IP infrastructure has been setup and operated. This document presents IPv6 deployment in the large-scale IP infrastructure of China Telecom, including its history, deployment strategy, measurements and challenges.

2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

3. Retrospection

China Telecom's IPv6 work can trace back to 2001, considering that IPv6 is the future of IP network and IPv4 address will be exhausted sooner or later, China Telecom begun to test IPv6 over ADSL network, and successfully tunneled through the workflow of IPv4/IPv6 dual-stack service in broadband network then.

In 2012, IPv6 deployment field-trial for MANs (i.e., Metro Area Network) was implemented in Jiangsu and Hunan Provinces, Dual-stack([RFC4787]), DS-Lite([RFC6333]) and Lightweight 4over6([RFC7596]) and IVI([RFC6144]) were tested in the trial. After the field trial IPv6 capability expanded and covered more than 10 million users.

Particularly, since Chinese government launched the IPv6 action plan in 2017 November, IPv6 commercial deployment was accelerated and extended to nearly every part of the network infrastructure, including enable IPv6 in the cloud computing platform, which is essential for customer to enable IPv6 in their application system. After more than two years efforts, comprehensive IPv6 deployment in the IP infrastructure have been achieved.

4. IPv6 deployment in multiple scenarios

China Telecom's IP infrastructure is an multi-AS system，as shown in figure 1,it consists of backbone networks, MANs, IP RAN, EPC(i.e., mobile core network of LTE), IDCs, cloud resource pools, etc.

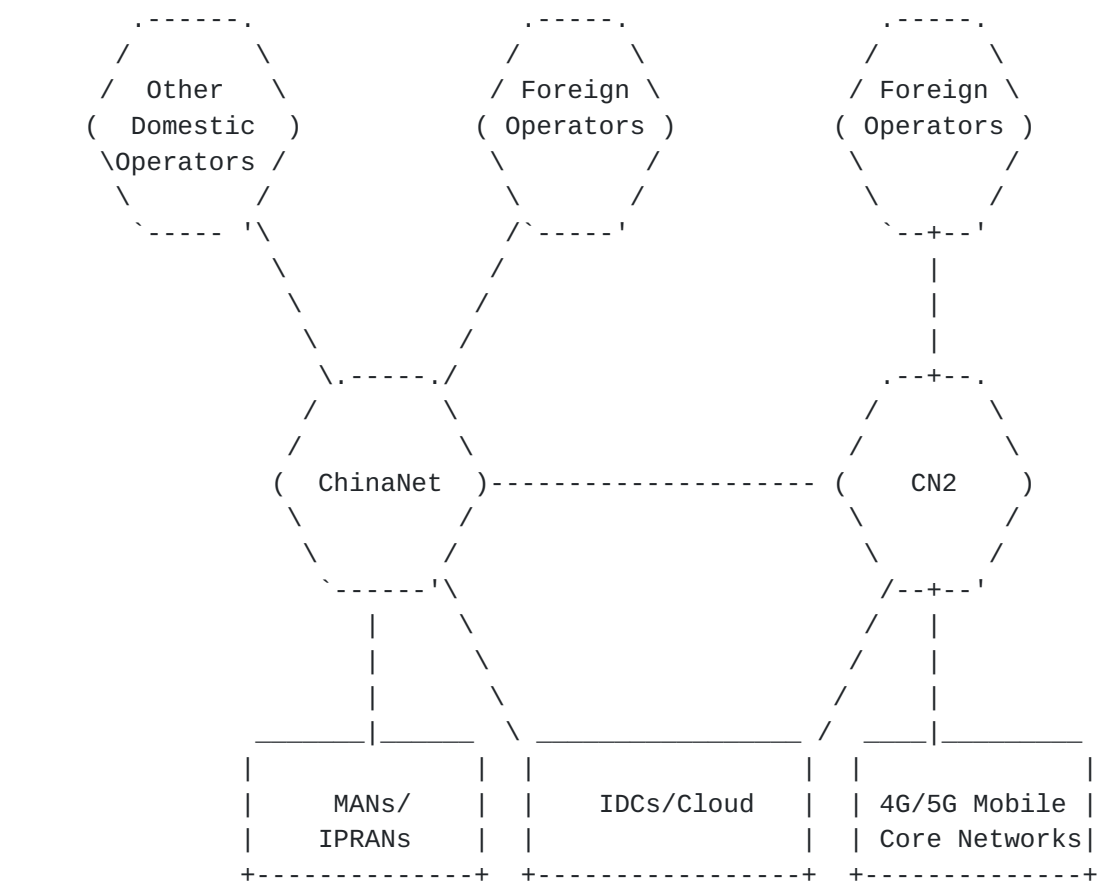

Figure 1: Overall architecture of network infrastructure

There are two inter-connected backbone networks, ChinaNet and CN2, both have not only nation-wide coverage, but also have some oversea POPs. The two backbones provide high-speed data switching domestically and overseas. MANs, EPCs, IDC and cloud resource pools are connected to the two backbones. ChinaNet is native-IP network, which provides high-speed data transfer for wireline and wireless broadband Internet-access and communications between different regions. In order to support IPv6 inter-connectivity for other local networks, all the routers in ChinaNet have been IPv6-enabled and operate in IPv4/IPv6 dual-stack mode. Different from ChinaNet, CN2 is a MPLS-based network, which mainly focuses on service provisioning to enterprise customers and some services with high-quality requirements. CN2 has enabled 6VPE and 6PE in its equipment, therefore, it can provide high-speed IPv6 data switching and IPv6 VPN to enterprise customers.

Currently MANs mainly uses dual-stack approaches, due to the shortage of IPv4 address, most users are allocated with private address by BRAS/BNGs. From 2012, multiple types of transition technologies, such as Dual-stack, DS-Lite, Lightweight 4over6, and IVI, were

evaluated in the field trial, this process is nearly in parallel with that of standardization in IETF, and most of the transition techniques were in the stage of draft then. In order to support multiple transition techniques, the supportive system of MANs was upgraded to support dynamic selection of transition approaches based on the type of CPEs and availability of the resource in the network locally. However, due to the fact that most transition techniques do not gain commercial support in CPEs, MANs later adopted dual-stack approach for household users, and CGN module has been installed in BRAS/BNGs for private and public address translation.

Same to the MANs, EPC of LTE also runs in dual-stack mode. When IPv6 deployment in LTE begun in 2015, it was required to switch on the IPv6 protocol in the user plane of EPC and each user was allocated one /64 Prefix of IPv6 and IPv4 address simultaneously. It should be noted that EPC network of LTE is constructed on the provincial basis, and each province has a set of EPC network, so for a given province, when IPv6 capability is turned on in the EPC, every user's UE in this province can get IPv6 address unless it does not support IPv6. Since IPv6 has good support in the UEs of LTE, IPv6 penetration rate of mobile user is higher than that of wireline user.

IDC is a place to provide stable and broadband networks with high performance computers as a service to their customers it is another scenario for IPv6. As the largest IDC providers, China Telecom has upgraded all its IDCs to support IPv6. In addition, China Telecom also provides cloud services and products based on the cloud resource pools located in different regions of China, currently more than 50 cloud products are IPv6-capable,e.g., Elastic virtual machine, ELB, Cloud desktop, Elastic IP, GPU virtual machine, which makes it possible to provide IPv6-based network-cloud-convergence services to customers.

Regarding to the IPv6 interconnection with other carriers, China Telecom has setup IPv6-BGP peers with domestic partners, e.g., China Mobile, China Unicom and CERNET, and the total bandwidth reaches to 5.4 Tbps in 13 inter-connection points, and also setup IPv6 BGP connections with some giant global ISPs.

5. IPv6 measurement

In order to see how broadly IPv6 is being used in China, a measurement system was developed by CAICT (i.e., Chinese Academy of Information and Communications Technology). All the major networks, including those of China Telecom, participate in the measurement. The metrics that can be measured include user penetration rate, traffic volume, end-to-end performance, etc. The measurement has been running continuously and the result can be presented in real

time.

From the measurement, it can be seen that the quantity of user who are allocated IPv6 address has increased dramatically during the last two years. However, compared with the quantity of user who are allocated IPv6 address, the quantity of active user deserves more attention, herein, the term of "active IPv6 user" refers to the user who have at least one visit of IPv6 content within one month. Recent measurement shows that the rate of active IPv6 users in Mobile network is about 79 percent. However, this metric in wireline network is about 30 percent, much lower than that of LTE network. This difference is mainly caused by the low rate of IPv6-capble home routers.

It should be noted that the data in this draft only shows the current status, the measurement result changes over time.

6. Challenges

Although IPv6 has gained widely deployment in China Telecom and most users have been allocated IPv6 addresses, several challenges still face operators. Regarding to the usage of IPv6, traffic volume of IPv6 is still much lower than that of IPv4, and the rates of IPv6 traffic of mobile network and wireline network are about 8.8 percent and 2 percent respectively, it is supposed that this is mainly due to the reasons below.

1. Low rate of IPv6 support in home CPEs: As a matter of fact, a portion of home CPEs are not customized by operators. CPE routers can be purchased from online shop and installed at home without any allowance of operators, some types do not support IPv6 at all. This factor makes it difficult to improve the penetrate rate and IPv6 traffic. However, there is good news that after realizing this problem, the IPv6 community has jointly pushed the vendors of CPE router to improve IPv6 support in their products.

2. Slow transition on contents' side:Compared with the transition of network operators, the transition of content's side is relatively slow. One reason is that service layer transition depends on the IPv6 capability of low-layer infrastructure, such as CDNs and IDCs; they are required to support IPv6 in advance. Another reason behind this is that content providers are very concerned about the end-to-end performance of the IPv6 networks, so even though IPv6 has been implemented in their products, they are still very cautious to switch from IPv4 to IPv6 in clients software, and the IPv6 coverage is increased step by step based on the result of performance test. One the other side, some OTTs

has taken bold step to use IPv6, for instance, the measurement show that the rate of IPv6 traffic of Youku, which is one of the largest video providers in China, is more than 70 percent.

Although Challenges lies ahead, China Telecom will persistently push forward the deployment and utilization of IPv6. Take advantages of ubiquitous IPv6 deployment, SRv6 field trial has been implemented in several use cases, including MAN, Mobile transport network, anti-DDOS, etc. Particularly, IPv6 will be planned to be used in new scenarios, such as IOT and network-cloud-convergence, and the transition to IPv6-only will be explored in the coming future.

7. Security Considerations

None.

8. Acknowledgements

During the long period, China Telecom's IPv6 deployment has received strong support from lots of people, some of them are Xing Li, Fred Baker, Latif Ladid, Zhenbin Li, Hui Tian, Shucheng Liu, Geoff Huston, Dong Liu, Yan Ma, etc.

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