IPv6 Development in China

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Introduction

- The Problems of IPv4
 - scalability, security, QoS, short for IP address
- IPv6 development and deployment
 - IETF has promoted and announced IPv6 protocol .
 - IPv6 deployment in the world
 - Japan, Sep. 2000
 - South Korea, Feb. 2001
 - Europe Commission, April 2001
 - Internet2 of The US, the spring of 2002
- IPv6 development in China with the quarter of population in the world

IPv6 Requirement in China

- More IP addresses
 - Big population
 - Internet user trends
- New IP technology
 - VoIP: QoS
 - Mobile IP: Mobility
 - Applications: Multicast, QoS, Security,...

Need more IP Addresses

- IPv4 address space
 - Reserved and to be allocated: 103 /8s
- China situation
 - allocated
 - 1.2 /8s (20M) 1 IP / 60 persons
 - Requirement
 - 72 /8s (1200+M)
- 1 IP per person

Internet User trends



Telephone user trends



Applications

- Digital video (conferencing, streaming,...)
 - E-Government
 - E-Learning (1000+ university)
- Grid (computing, data accessing,...)
 - E-Science
 - E-Commerce



10-20 per province

IPv6 Projects

- 1998, CERNET-IPv6 Test-bed
- 1999, IPv6 demo system funded by MST 863
- 1999, CERNET-Nokia joint IPv6 project
- 2000, NSFCNET funded by NSFC
- 2001, IPv6 Router funded by MST 863
- 2001, IPv6 MAN demo system funded by CAS
- 2002, IPv6-CJ funded by Chinese government and Japanese government

CERNET-IPv6 Test-bed

- In 1998, China started IPv6 R&D by CERNET-IPv6 Test-bed project.
 - In June, the first tunnel connection to 6Bone via MERIT (3ffe:1cf9::/32) was set up.
 - In November, CERNET became a 6Bone backbone node (p-TLA:3ffe:3200::/24).
- Since April of 1999, CERNET-IPv6 Testbed via tunneling has been running.

IPv6 demo system funded by MST 863

- In the end of 2000, the project funded by the Ministry of Science and Technology (MOST) 863 program (a Hi-Tech R&D program of China) was finished
- The project was undertaken by Tsinghua Univ., Northeaster Univ. (NEU), Southeaster Univ. (SEU) and South China University of Tech. (SCUT).
- Based on CERNET-IPv6 Test-bed, common Internet applications such as Root DNS, FTP, WWW, and Email were supported.
- The researches on the transition from IPv4 to IPv6, network management, security and QoS based on IPv6 environment were made.

CERNET-Nokia joint IPv6 project

- CERNET-Nokia joint IPv6 project started in 1999.
- Using Nokia routers, a native IPv6 Trial MAN was constructed in Beijing.
- The services by tunnel broker or agent technology were in practice.
- Search Engine for resources supporting both IPv6 and IPv4 was developed.

NSFCNET funded by NSFC

- Tsinghua Univ., Peking Univ. Beijing Univ. of Post and Telecommunication (BUPT), Beihang Univ. (BUAA) and CSTNET Center took part in a joint project named NSFCNET funded by National Natural Science Foundation of China (NSFC).
- At the end of 2000, the trial network connecting 6 nodes with broad bandwidth was constructed.
- The first exchange GigaPoP in China named DRAGONTAP was set up, which was located in CERNET Center in Tsinghua Univ. and linked CERNET, CSTNET and NSFCNET to the global next generation networks.
- IPv6 routing and IPv6 address allocation were tested.

Other IPv6 projects

- development of IPv6 key technologies and a trial environment integrated IPv6 technologies funded by MOST 863
- CERNET2 by Ministry of Education(MOE)
- IPv6 key technology and trial MAN by China Academy of Sciences(CAS)
- IPv6 Collaboration between China and Japan project (IPv6-CJ) funded by Chinese government and Japanese government

IPv6-CJ Project

- A three-year project started in 2002.
- CERNET is the leader of the Chinese participates in the project.
- The project includes four areas.
 - IPv6 test-bed. A native IPv6 test-bed connecting three Cities, Beijing, Shanghai and Guangzhou, with 2.5Gbps transmission rate will be set up.
 - IPv6 system. Key network equipment supporting IPv6, including router, server, terminal and so on, will be developed.
 - IPv6 applications. The typical applications, which can exhibit IPv6 features, will be developed.
 - IPv6 standardization. Some new RFC relative to IPv6 could be submitted to IETF.

IPv6 Development

- Test-bed
- Services
- R&D

IPv6 Test-bed

- CERNET-IPv6 via tunneling
- CERNET native IPv6 MAN
- International links to BGP peers
- IPv6-CJ test-bed

CERNET-IPv6 via Tunneling



CERNET Native IPv6 MAN



CERNET-IPv6 BGP Peers





Services

- IP allocation by CerNIC
- Tunnel broker
- Common applications
 - WWW
 - DNS
 - FTP

CERNET 6Bone address Plan

General	Bit	3 13		32			16	64
address	Definitio	FP	TLA ID	NLA ID			SLA	Interface ID
archi-	n						ID	
tecture *		001	0x1FFE					
Address	Value	3FFE: TLA For 6bone		32	xr:	p000:	aaaa:	aaaa:aaaa:aaaa:aaaa
archi- tecture in the Testbed	Meaning			pseudo- TLA ID For CERNET	Region NLA1 ID	Organiz ation NLA2 ID	Subnet ID	Network Interface ID
	Bit	16		8	8	16	16	64

Notes 🗄

• Only global aggregateable unicast address architecture is described.

- **FP**: Format Prefix; 001 = aggregatable global unicast addresses
- **TLA** : Top Level Aggregation; 0x1FFE = 6bone
- NLA : Next Level Aggregation
- SLA : Site Level Aggregation
- x: 0 = Official ; 1 = Student Experiment
- r: Region Code (specified by CERNET)
- **p:** Code for Province (specified by NLA1 delegation in the region)
- ooo: Organization Code (specified by NLA1 delegation in the region)

Tunnel Broker

- Tunneling broker can be offered in CERNET-IPv6.
- TB server will automatically allocate an IPv6 address with /64 or /128 to a CERNET user when the user submits the service requirement to the server using HTTP browser or Tbclient program.

WWW (Dual-stack)



DNS

- Two types of IPv6 DNS
 - Dual-stack DNS serves as the operational domain name servers, which means the DNS supports both of the IPv4 and IPv6.
 - IPv6-only DNS, an experimental IPv6-only root server has set up.
- Two kinds of data denotations for IPv6 DNS
 - Forward lookup zones are described by AAAA and A6 as a chain of addresses
 - Reserve lookup zones are denoted by IP6.INT and IP6.ARPA (PTR & DNAME)

R&D

- Network management and measurement
- Transition
 - Network
 - Applications

Network management and measurement

- Network management and measurement were studied on the IPv6 test-beds.
- Dealing with the network features such as the physics, traffics, routing, troubles and user behaviors, a measurement system of IPv6 trial network is developed with flexibility and scalability capabilities.
- A demo IPv6 network management system (NMS) is used in CERNET-IPv6 test-bed.

Transitions in network layer

- Dual-Stack
- Tunneling
 - Manual
 - Tunnel Broker
 - ISATAP
 - 6 to 4
 - 6 over 4
 - 4 over 6
 - NAT-PT

Transitions of application Layer

- SUN Scrubber
- IPv6 Socket API
 - RFC2133,RFC2292,RFC2553
- IPv6 Applications
 - BIND
 - SENDMAIL
 - APACHE
 - TCPDUMP
 - NEWS...

Conclusion

- IPv6 is a very important technology for China.
- IPv6 test-beds, including WAN, MAN and LAN, via tunneling or native are in the development.
- IPv6 services such as address allocation, tunneling broker and common applications are in practice.
- Researches and developments of IPv6 have got a lot of achievements.
- The feasibility of IPv6 will be validated in China soon.