IPv6 Standardization in China

With decades of sustained investment, China's internet technologies and industries have been developing at a rapid pace and is moving toward the forefront of the world in its several ramifications. In recent years, driven by both policy guidance and market demands, China is laying out plans to develop next generation network technologies and has undertaken a host of technology research and standardisation works, striving for leading position in global industrial and technology competition on this new track.

1. Policies for IPv6

As early as 2017, the State Council issued the *Action Plan for Promoting the Deployment of Internet Protocol Version 6 (IPv6) on a Large Scale*, defining the large-scale deployment of IPv6 as "an urgent requirement to i) accelerate the construction of 'internet power[1]', ii) accelerate the process of national informatization, iii) facilitate economic and social development, and iv) win new advantages in future international competition". Subsequently, in April 2018, MIIT further break it down, proposing IPv6 transformation requirements for various networks and systems such as LTE networks, fixed networks, data centres, content distribution networks, cloud services, domain name systems, and government websites.

In the 14th five-year period (2021-2025), CAC, NDRC, MIIT and other ministries consecutively released the *Three-Year Special Action Plan for IPv6 Traffic Enhancement (2021-2023)* and the *Notice on Accelerating the Deployment and Application of Internet Protocol Version 6 (IPv6)* in July 2021, setting detailed targets for IPv6 development in the next five years. Specifically，

- By the end of 2023, China should have basically built up an advanced and autonomous IPv6 technology, industry, facilities, application, and security system.
- By the end of 2025, a leading IPv6 technology, industry, facilities, application, and security system should be fully built up.

In terms of the further evolution of IPv6, the two documents stress that

- China should i) become an important driving force for global IPv6+[2] technology and industrial innovation, and ii) strengthen research on IPv6-based new network architecture and technologies.
- Carry out research, development, and industrialization of IPv6+ products, promote protocol, technology and service innovation, and break through key technologies such as network intelligence, virtualization and cloudification.

At the implementation level, the *Notice on Accelerating the Deployment and Application of Internet Protocol Version 6 (IPv6)* proposes to "promote the standardisation of IPv6 scale deployment and application innovations, and collaboratively promote the development of national standards, sector standards and association standards to establish an IPv6 standard system", while "strengthen cooperation with international standardisation organizations such as the Internet

[1] Explanation of the "Internet Power" Strategy. http://keywords.china.org.cn/2016-07/27/content_38969400.html

[2] Generally, means the further evolution of IPv6

Engineering Task Force (IETF) and the European Telecommunications Standardisation Institute (ETSI), and actively participate in the development of IPv6-related international standards."

The *Three-Year Special Action Plan for IPv6 Traffic Enhancement (2021-2023)* is more specific in stating that "based on the good foundation of the previous IPv6 standardisation work, the China Communications Standards Association (CCSA) shall further gather industrial strength and continue to strengthen the development of sector standards for new technologies such as IPv6 monitoring and evaluation, IPv6+ technologies, IPv6 single-stack applications".

2. Standardization for IPv6

China's main standard developer in internet protocol is CCSA/TC3, whose WG1 and WG2 are specifically responsible for IPv6 standard development. On top of that, on 1 September 2021, CCSA established a new IPv6 standards-dedicated working group, and CCSA Secretary General WEN Ku serves as its chair. The working group consists of three sub-working groups headed by CCSA/TC3 chair ZHAO Huiling, CCSA/TC5 chair WANG Zhiqin, and the IETF IPv6 Transition Working Group chair Cui Yong, respectively. This staffing indicates that China has pooled domestic IP-related standardisation resources to promote IPv6 standardisation in a coordinated manner.

In terms of specific standards, China began to study and adopt IETF's IPv6 basic protocols, routing protocols, and other standards in 2001. Since 2009, China has started to independently develop equipment standards and testing standards for IPv6, and developed the country's IPv6 standards system (see the figure below.)

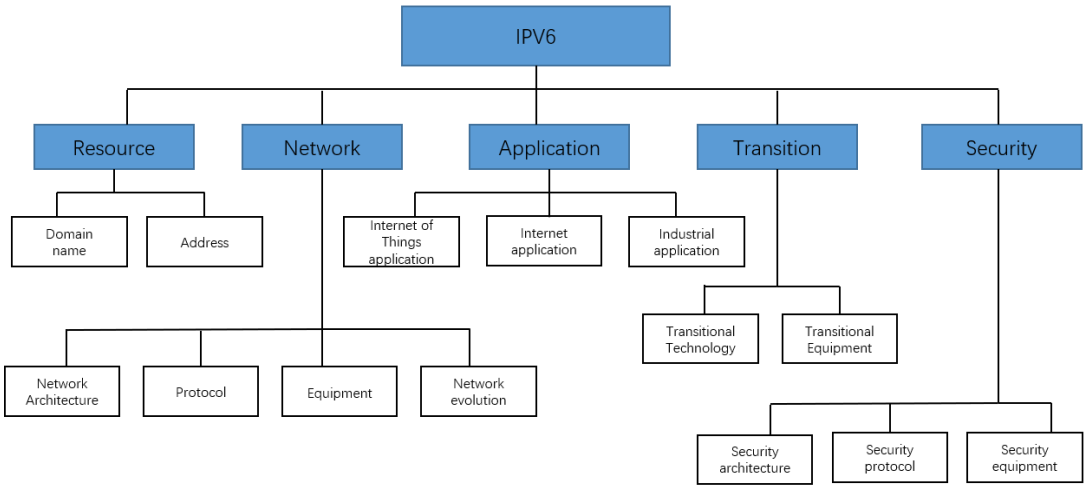

Figure. China's IPv6 standards system

Since 2017, China has turned its efforts to develop technically innovative standards, carried out scores of IPv6 monitoring and evaluation for them. Specifically, China has carried out research on IPv6 application and IPv6+ innovation standards (including SRv6, APN network-aware application, multi-domain pure IPv6 network, etc.) and made breakthroughs in IPv4-IPv6 transition technologies, security technologies and "IPv6+" innovation technologies and standards[3]. By October 2021, China has released

[3] Global IPv6 Summit Presentation "*IPv6 Industry Standards Enabling Network Deployment*", by CCSA/TC3 Chair ZHAO Huiling, September 2022.

about 120 IPv6 standards[4] and is developing a number of new SRv6 standards.

From an international perspective, CCSA is also one of the major IPv6 standard-setting organizations, working in parallel with IETF, 3GPP, ETSI, ITU-T and other international standards organizations. In the field of IPv6+, CCSA is progressing even faster than IETF due to the country's pioneering efforts in emerging areas such as 5G and cloud[5].

China not only develops its own standards, but also actively participates in IETF's standardisation work. According to the official website of CCSA, China has contributed to more than half of the international standard drafts in the field of IPv6+ and has become a major force in promoting the development of IPv6+[6].

Next, China's IPv6+ standardisation will be focus on the following key directions[7]:

- Cloud-network convergence standards: IPv6 supports intelligent collaboration at the cloud-network edge and deep integration of new resources such as data and computing power.
- Internet of everything standards: IPv6 supports seamless global coverage, allowing anyone to communicate with anyone at any place and time.
- Intelligent operation and maintenance standards: IPv6 supports end-to-end network quality assurance to ensure that cloud's demand for network in enterprise production scenarios are met.
- Security and Trustworthiness Standards: IPv6 supports end-to-end security endogenous mechanism, adaptive security framework and atomized security capability, security defence, detection, and prediction.

3. Conclusion

With the vigorous promotion of government policies, IPv6 has been applied nationwide in a rapid and large-scale manner. This created a great deal of standardization needs and resulted in hundreds of research projects being conducted and standards being developed. Taking advantage of this progress, China has accumulated quite a momentum in leading the development of international standards for IPv6 and its further evolution, and is seeking a bigger voice and influence in future international IP standards setting. However, the reality that developed countries lack motivation and interest to replace their current IPv4 network with IPv6 network on a large scale may dampen China's ambition to develop next generation IP technologies and play a leading role in it. Whether China can replicate its success in 5G standards remains to been seen.

[4] CCSA Secretary General WEN Ku's speech at the 2021 China IPV6 Innovation and Development Conference
[5] "*IPv6+ Technical Standards System*," Telecommunications Science 2020, Vol. 36 '' Issue (8): 11-21.
[6] "*IPv6+ innovation to create a new generation of high-quality network base*" written by WU Hequan, an Academician of the Chinese Academy of Engineering, in People's Post and Telecommunications Daily.
[7] Global IPv6 Summit Presentation "*IPv6 Industry Standards Enabling Network Deployment*", by CCSA/TC3 Chair ZHAO Huiling, September 2022.