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The architecture for Service Customized Networks is expected to provide differentiated service quality by using simple and open systems that are flexible, scalable, and secure. >>

Future Networks Trending toward Service Customization

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After more than 40 years of development, Internet history can be divided into two stages. From 1969 to 1989, the technology featured studies on long-distance data transmission, and in the early 1990s, we saw the emergence of web technologies and electronic commerce. The Internet faces a new era of challenges that include the ability to adapt to new business requirements, accommodate huge and increasing volumes of traffic, and integrate seamlessly with the real economy.

Inflexible Network Architecture

According to industry statistics for 2016, Over-The-Top (OTT) services accounted for 71 percent of all Internet traffic. The positive effect for telecom operators is an overall increase in revenue. However, owing to the fact that the business model for carriers is based on access not volume, the rewards for their large investments in backbone networks are limited and subject to negative pressure. In addition to a hesitation to make long-term capital commitments, the consequences include risks to the industry value chain.

Can this problem be resolved simply by charging users for the amount of traffic they use? Obviously, charging all OTT services indiscriminately by traffic negatively impacts Internet industry innovations by hindering the healthy development and prosperity of the entire Internet ecosystem. According to a survey, 85 percent of users are willing to pay up to 25 percent more for a better customer experience, which means additional income for telecom operators who can meet the requirements of particular users for a higher Quality-of-Service (QoS) experience.

For example, in 2014, U.S. content provider Netflix agreed to pay U.S. broadband provider Comcast for faster speeds after Netflix customers complained about slow services that disrupted video quality. However, the current network architecture is not flexible enough to meet the QoS requirements of all users.

Rapid Internet Traffic Increases

An industry research report predicts that global IP traffic will increase from 59.9 Exabyte (EB) per month in 2015 to 168.4 EB per month by 2019, with video traffic accounting for about 80 percent of the total traffic. According to Vlinkage, as of October 2015, 232 Chinese TV dramas were played one billion or more times, revealing that a significant proportion of Internet traffic is redundant. If IP traffic continues to grow at the current rate, Internet traffic will soon become a thousand times greater than what we see today and telecom operators will be unable to meet the surging demand with a simple expansion of existing network capacity.

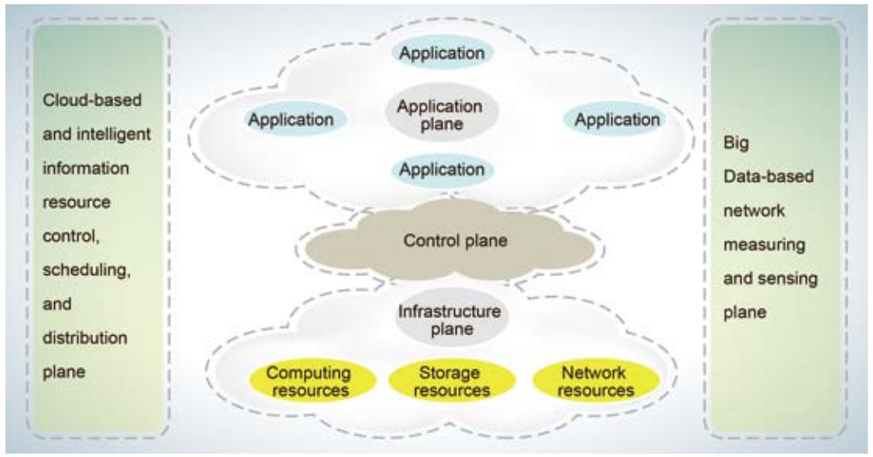

Figure 1: Service Customized Network Architecture

Unsupported Information

The next blue ocean strategy for the Internet is its integration with the real economy. In China, this is called 'Internet+' or 'Made in China 2025,' and in the U.S., Germany, and Japan, it's called 'Industrial Internet,' 'Industry 4.0,' and the 'Robot Strategy,' respectively.

Each of these strategies is designed to help businesses improve productivity. According to global consulting firm McKinsey & Company, a productivity overhaul in China could add USD 5.6 trillion to the economy by 2030. The reason is that China's labor productivity — a measure of output per hour worked — is only 15 to 30 percent of the average in Organization for Economic Cooperation and Development (OECD) countries.

The effort to improve productivity is a global issue, and many countries are pushing to start research on how best to participate in the Industrial Internet. In 2011, General Electric (GE) started R&D in Industrial Internet platforms and applications by establishing a global software center in San Ramon, California. The next year, GE released a report entitled *Industrial Internet: Pushing the Boundaries of Minds and Machines* that hailed the industrial Internet as the most significant player in the third wave of industrial innovation and revolution. GE announced in 2013 that it would invest USD 1.5 billion in their Industrial Internet program over the coming three years.

The global ICT industry is researching future-facing network infrastructure solutions such as Software-Defined Networking (SDN) and Content-Centric Networking (CCN) to address current and anticipated challenges.

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Service Customized Networks

To ensure sustainable, healthy development of the Internet and resolve major challenges, the industry must implement an architecture that provides differentiated user QoS. The Chinese Academy of Engineering is proposing a Service Customized Network (SCN) architecture to accomplish this goal. The SCN concept is derived primarily from the operating mode of the current transport system, which provides users with variables based on price and speed. Users select their desired means of transport according to need and ability to pay.

As shown in Figure 1, the SCN architecture comprises the following planes:

- Infrastructure, control, and application plane in the middle
- Cloud-based resource control, scheduling, and distribution plane on the left
- Big Data-based network sensor and measurement plane on the right

The infrastructure control plane consists of computing, storage, and network resources that allow flexible construction of virtual networks to provide differentiated services by user. The cloud-based resource controller intelligently schedules the distribution of content to resolve redundant transmission inefficiencies. The Big Data-based network sensor and measurement plane collects network status information to facilitate network scheduling, control, and security.

The SCN architecture has been acknowledged by Scott J. Shenker, Ph.D., a professor at the University of California, Berkeley and U.S. National Academy of Engineering in Washington D.C., and a leader in the movement toward SDN; Zhao Wei, Rector of the University of Macau in China and former Director of the Division of Computer and Network Systems at the U.S. National Science Foundation in Arlington, Virginia; and Peter Steenkiste, Ph.D., computer science professor at Carnegie Mellon University in Pittsburgh, Pennsylvania and head of the eXpressive Internet Architecture (XIA) project.

Future-oriented Pilot Network

Based on the SCN architecture, Jiangsu Future Networks Innovation Institute organized a program to construct a small-scale pilot network. To date, the network has been deployed in 26 Chinese cities, and over 80 user teams have applied for their own virtual networks to conduct private customized tests.

In August 2015, the China Environment for Network Innovations (CENI) project was initiated under the auspices of the National Development and Reform Commission. As the coordinator of the CENI project, Jiangsu Future Networks Innovation Institute has organized with over 60 universities and 40 research institutes and enterprises to pursue research, development, and construction. Once completed, the CENI pilot platform will be available for network architecture verification to promote further research and commercialization of future-oriented networks.▲