



Yang Liu

Using an IPv6 IoT network, CNPC has simplified network O&M, and boosted the rates of oil and gas recovery. >>

# China National Petroleum Corporation Transitions to IPv6

By Yang Liu, Key Enterprise Market & Solutions Sales Department, Huawei Enterprise Business Group

China National Petroleum Corporation (CNPC) is China's largest oil and gas producer, a major international oilfield services provider, and an engineering construction contractor. With operations in nearly 70 countries, CNPC is active in exploration, refining, storage, transportation, engineering services, and trading.

The two major challenges facing CNPC, and oil and gas enterprises in general, are that crude oil and natural gas are becoming increasingly scarce, and that market competition is intensifying.

Worldwide, the oil and gas industry is growing increasingly automated. The system-wide addition of networked sensors at every measurement and control-point has brought the entire industry to the threshold of creating a ubiquitous Internet of Things (IoT) for oil and gas production and distribution. It is within this context that CNPC chose to enhance their competitiveness by upgrading their digitized production automation platform to a fully intelligent solution.

## Limits of IPv4

IoT-enabled oilfields rely on intelligent infrastructures built on the integration of information and communications components. For legacy plants, like CNPC that have developed their digital automation capabilities step-by-step, one of the primary technical issues standing in the way of a fully realized IoT environment are the communication networks based on the IPv4 address protocol. Because the inventory of available IPv4 addresses has been exhausted,



the requirements for a complete IoT solution are impossible to meet using this old protocol.

In the production areas where IPv4 has seen continued use, address-block allocations are often discontinuous, which force artificially higher Operations and Management (O&M) costs. In addition, shared physical connections between production networks and office networks have a negative impact on service quality and security.

For all practical purposes, IPv6 breaks the limitations of overextended IPv4 networks by having an unlimited number of IP addresses. IPv6 is highly

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efficient and supports clear network hierarchies and convenient network expansion. Based on these ease-of-use factors alone, IPv6 users have immediate information management advantages and gains in competitive position.

- Design and deploy secure information exchange solutions between the (IPv4) CNPC intranet and the (IPv6) wellhead production network.
- Support access to production monitoring and management databases on both IPv4 and IPv6 networks.
- Implement three-layer information security architecture, including boundary defenses between internal and external networks for data center applications. Conduct encrypted-transmission experiments.

### IoT Production Network

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Huawei designed a two-phased solution based on CNPC's dedicated network.

- NE40E high-end routers were deployed to build a core layer between the information and data centers.

- CloudEngine CE12800 switches for internetworking Layer 2 traffic with legacy switches using the Spanning Tree Protocol (STP).
- S12700 Agile Switches as gateways to terminate Layer 2 traffic and perform Layer 3 forwarding.
- Implement Virtual Router Redundancy Protocol version 6 (VRRPv6) and Dynamic Host Configuration Protocol version 6 (DHCPv6) for IPv6 functionality.

Designed for data centers and high-end campus networks, Huawei's CloudEngine switches have five unique features:

- Orthogonal Switch Fabric design.
- Clos non-blocking, multi-stage (crossbar) switching architecture with fewer ports.
- Cell switching.
- Virtual Output Queuing (VoQ).
- Super large buffer.

S12700 Agile Switches utilize the fully programmable Huawei-devel-

oped Ethernet Network Processor (ENP) chips that support the smooth evolution to Software-Defined Networking (SDN) for CNPC.

Phase One construction of CNPC's dedicated IPv6 IoT network has been completed, and Phase Two is underway. The Huawei solution has included security, reliability, scalability, and extensibility. Huawei's advanced products are meeting CNPC's business needs.

All Huawei network products support standard interfaces for proper communication with devices on existing networks. In addition to incorporating advanced technologies such as MPLS VPN, IPv6, IPv6 VPN Provider Edge (6VPE), and VRRPv6, the CNPC solution incorporates years of Huawei's accumulated experience in large-scale network delivery.

### IoT Benefits

Most important, the CNPC IPv6 IoT solution fully illustrates the advantages of intelligent oilfields and has laid a solid foundation for the company to implement advancements in geology, engineering, and management. Following this installation, CNPC has seen higher productivity and a significant improvement in the recovery rates for oil and gas — including progress in the production of cleaner energies, such as coalbed methane. Other benefits of Huawei's solution include lower network O&M costs, a lighter human workload in harsh environments, and improved security for coalbed methane production.

By completing a dedicated IPv6 IoT production network, CNPC has achieved the goal of cross-connecting its IPv4 and IPv6 networks. CNPC has gathered basic research data and gained important experience for the construction of subsequent IoT networks across China and around the world.▲

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### IPv6 Maturity

With the understanding that new technologies take time to mature, network operators worldwide have adopted a step-by-step approach to the transition of their business operations to an IPv6 platform. China, for example, has chosen several provinces for its pilot deployment of IPv6 services — an approach that CNPC also took in its transition to IPv6.

According to the “China's Twelfth Five-Year Plan” (from 2011 to 2015), the government has selected Chinese oil and gas producers to pilot the construction of dedicated IPv6 communication networks. The goal is to establish examples for using IPv6 in IoT environments with an emphasis on collecting security research data and developing security protection solutions.

Within the framework of the plan, CNPC outlined a blueprint for its IPv6 network construction, with the following major tasks:

- Build a three-layered, dedicated IPv6 backbone network (Access, Aggregation, and Core), for oil and gas wells. Trial networks would be built in production plants and in regional sites in a piecemeal manner until a dedicated IPv6 network for the entire oilfield is completed, including the construction of wireless IPv6 networks to transmit wellhead production data from the field.