SIEMENS

Reference

Industrial Communication

Networking power

A network for the energy future

In the Yuanba Gas Field, stable and reliable SCALANCE X switches create a high-redundancy Industrial Ethernet network with a four-layer structure to maximally guarantee network communications reliability and system availability for field data collection, parameter adjustment, and the equipment control process.

Yuanba Gas Field, located in eastern Sichuan province, has the potential to become the largest natural gas field in China. Discovered in 2011 and developed by China Petroleum & Chemical Corporation (SINOPEC), Yuanba is the deepest gas field in marine strata ever found in China, with deposits reaching as deep as 6,950 m. The gas-water ratio, climate, and geological conditions of the gas field are complex, and the exploitation and transmission of the gas is extremely difficult. The gas is intended to contribute to the energy supply for almost 14 million people in the region.

A logistics challenge

In addition to the challenges of developing the field, the natural gas must also be transported to consumers. This involves a close monitoring system for the pipelines to ensure the safety of the supply network and to detect leaks. The sensors installed along the lines need to be connected with the central monitoring system via a high-performance and reliable network that can bridge long distances.

For the Yuanba project, Siemens proposed a redundant solution using Industrial Ethernet networked by SCALANCE X switches. The SCALANCE X series of network switches is especially suited for applications with elevated safety and reliability requirements. The devices have a mean time between failure of more than 20 years, are fully compliant with the EN61000-6-2 and EN61000-6-4 standards for electromagnetic compatibility (EMC), and are certified in accordance with UL508. In addition to the switches, Siemens also supplied customized redundant power supplies for the network switches to ensure communications availability in the case of a power failure.

The communications network is designed as a completely redundant Industrial Ethernet system with fiber-optic cables with a virtual private network (VPN) link. The individual networks are linked to the central control system via a fiber-optic 1,000-Mbit/s Industrial Ethernet backbone. In addition to the main network, there are several dedicated systems for remote units such as valve hubs. To ensure maximum communications reliability, there are two independent networks in redundant configuration. This results in a fourfold redundant architecture.

For the networking of the distributed systems, the Siemens engineering team has designed a high-redundancy Industrial Ethernet network with a four-layer structure to ensure reliable communications, data acquisition, parameter adjustment, and equipment control

Reliable and flexible

A four-layer network is especially resilient against network failures. When a point failure is detected in the network, the SCALANCE switches use the High-availability Seamless Redundancy (HSR) protocol to reroute the communication through the intact segment of the ring in less than 300 ms. In the event of a switch failure, the affected network is isolated and the communication between units is switched to another system in less than 3 s. In a multipoint failure event in which several remote units are cut off from the wired backbone, the communication with the control center is switched to the wireless transmission link. This task is performed via the OSPF (Open Shortest Path First) dynamic routing protocol within 1–3 s. The other units still use a wired communications link, and the communication will not be affected or jitter. Because the two network structures in the dual-network system are identical, each system can compensate for a point or switch failure, allowing the network as a whole to compensate for up to five faults in the system, which would be a most uncommon event, likely involving a large-scale natural disaster.

Another key requirement for communication in industrial applications is that control information be transmitted in real time, that is, the signal must be transferred reliably and within a set transmission time. For this purpose, the communication in the backbone uses 1,000-Mbit/s full-duplex switched Industrial Ethernet, a technology that helps avoid collisions and channel conflicts. The switch forwards data packets with a delay of only 5 µs, and the delay in a series of 10 switches is 60 µs, so the system can transfer data with an event resolution of well below 1 ms.

As the SCALANCE technology is fully compliant with international guidance and standards such as the IEEE 802.3 protocol for Ethernet communication, the system can be flexibly networked with other Ethernet networks. Additionally, the fault tolerance of the ring architecture also allows the system to be extended or modified without interrupting communications. The SCALANCE switches offer various diagnostic features to facilitate the rapid identification of a fault or failure, supporting maintenance and system repair, further improving system availability.

Two SCALANCE switches during installation

A network for the energy future

The Yuanba Gas Field will be constructed in two phases. The first-phase project, completed at the end of 2013, has reached a production capacity of 1.7 billion m^3 of purified gas per year; the second-phase project, which will be completed at the end of 2015, will also have a capacity of 1.7 billion m^3 of purified gas per year. Together, the two projects will have a production capacity of 3.4 billion m^3 of purified gas per year. When the project is completed, it will become an important part of China's greener and cleaner energy future, helping pave the way for sustainable growth and resource preservation. The reliable and flexible network solution will ensure that this energy future is also safe and efficient by monitoring the pipelines' integrity and safety.

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