SIEMENS

Technical article

New Network Structures with DNP3

New Functions complement an open Protocol for new Network Structures

The open protocol DNP3 enables the setup of classic, hierarchical telecontrol networks. With new functions, though, even more effective networks for meeting requirements can be realized on the basis of this open protocol.

In the area of automation solutions, there is often the need to remotely monitor and control installed systems from central locations by means of telecontrol solutions; this is especially true for the water/wastewater as well as oil and gas industries. Available on the market are various solutions for both less advanced RTUs (remote terminal units) and RTUs with a high degree of automation. For the communication with the control center system, the protocol to be used is often specified, e.g., in the request for proposal. With the open DNP3 protocol (www.dnp.org), systems from different manufacturers can now be coupled together. This means that RTUs as stations can be connected to a SCADA system control center functioning as DNP3 master – independent of the manufacturer of the systems.

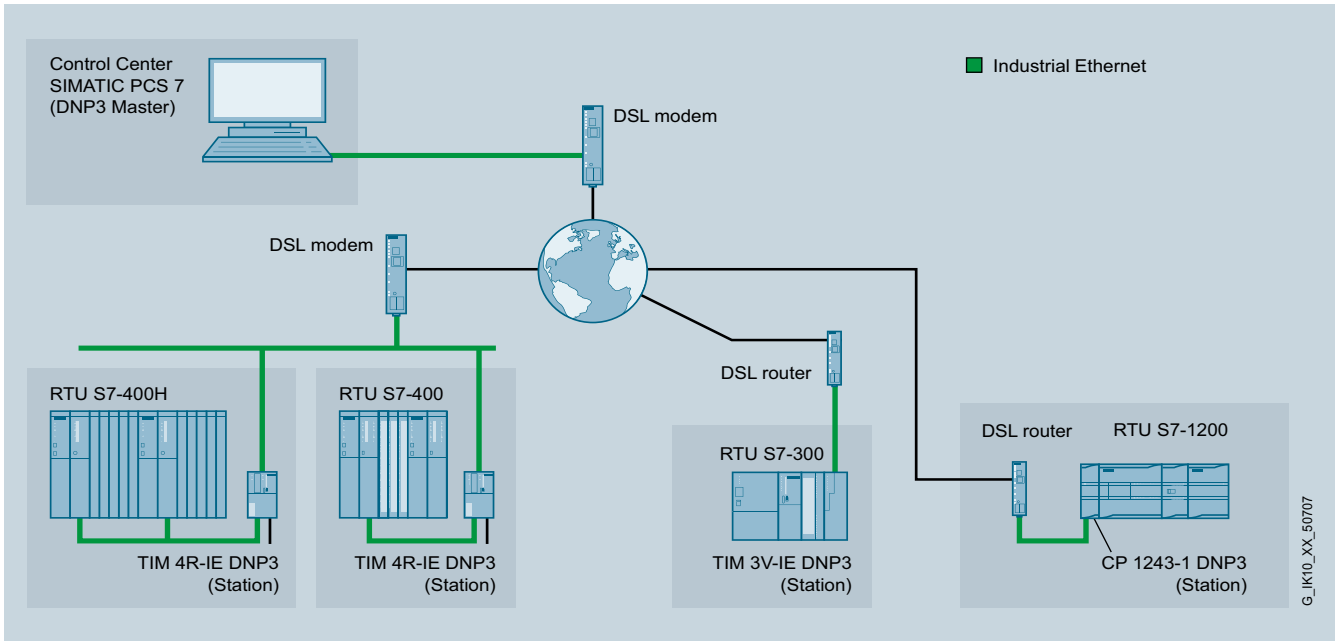siemens.com/industrial-remote-communication

Image 1: Simple telecontrol network with DNP3 for monitoring stations operated at remote locations.

Image 1 depicts the basic network structure of a telecontrol network based on the DNP3 protocol. The main task of such a network is the event-driven or cyclical transmission of data to the higher-level control system or other RTUs. This transmission is further secured through a buffer storage inside the devices of the station – in case there is a malfunction on the transmission path. In addition, the central SCADA system monitors the remote stations.

The basic structure of a telecontrol network also makes it very easy to adjust the demanded solution to an already existing network infrastructure. If, for example, locations are already connected with each other through existing fiber-optic cables, these can also be used for the connection of the stations. Besides the frequently utilized star configuration, the building of a ring topology is also possible when using appropriate network components (Image 2).
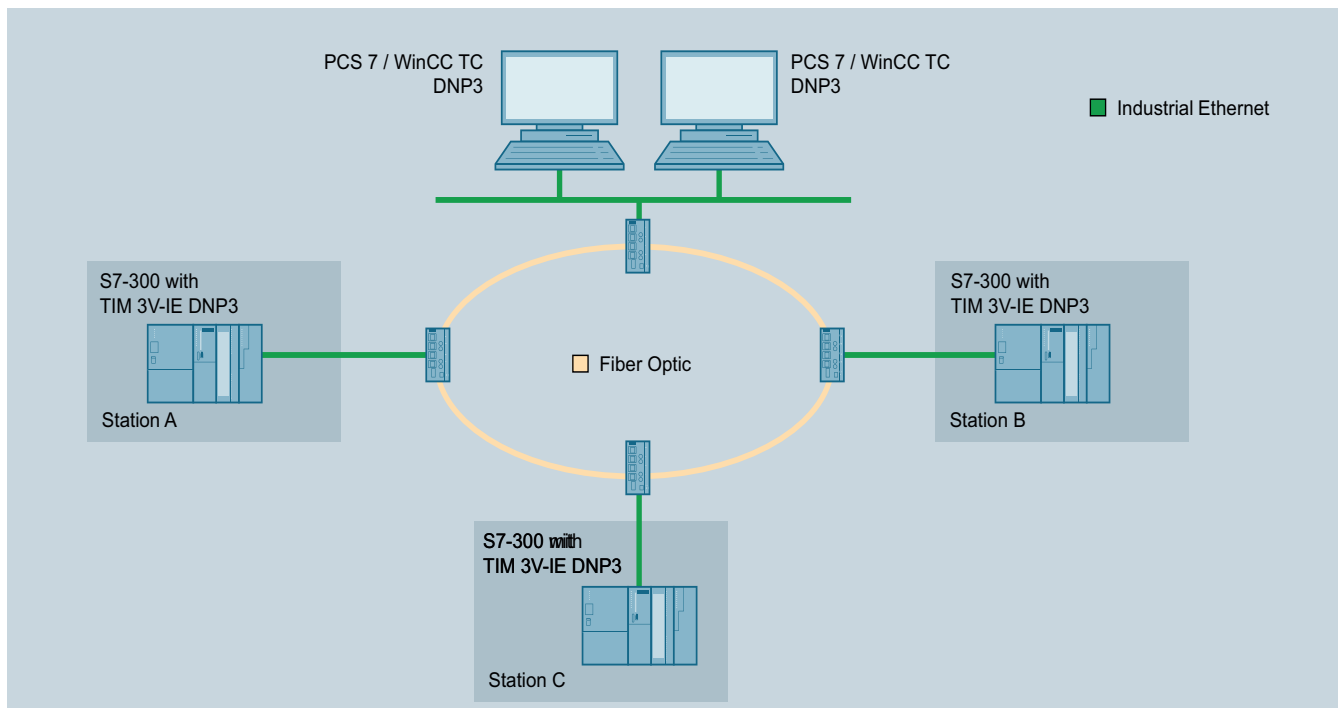

Image 2: Setting up an optical, IP-based network in ring topology provides failsafe communication.

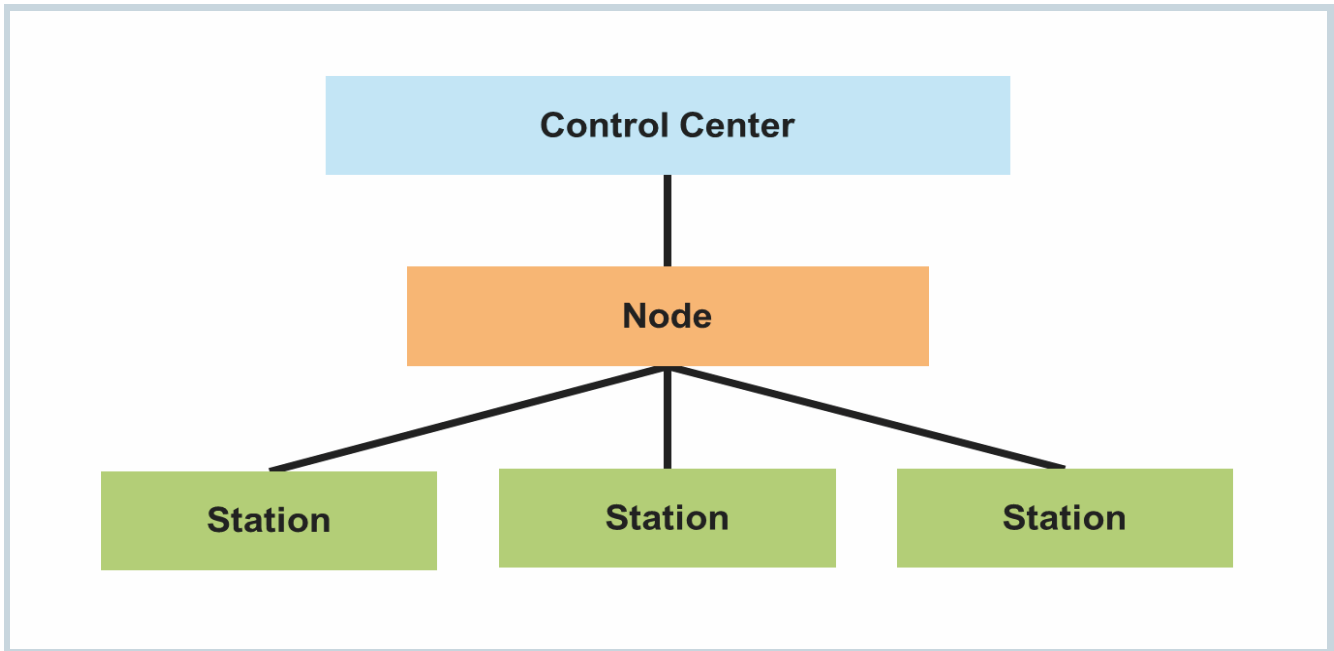siemens.com/industrial-remote-communication

Image 3: Hierarchy of a complex DNP3 telecontrol network – a clear structure simplifies the administration.

In particular at large firms, however, the requirements for the data exchange between the remote stations and the control center change as the number of stations used increases. Depending on the data volume, it can make sense to insert an additional system as a central node into the complex network. This node function then consolidates the data of the stations and transmits it to the control center. It can also perform a preprocessing function and thus relieve the central SCADA system with regard to communication volume. A node station represents a station in the direction of the control center system, while it acts as a master in the direction of the RTUs.

Besides its dual function as station and master, the node station also has to handle the cross traffic between the stations in the DNP3 network. The current module TIM 4R IE DNP3 from Siemens already supports this function as a node station. In addition, the direct communication between the stations – which must be equipped with either a TIM 3V IE DNP3 or TIM 4R IE DNP3 module – is supported via a proprietary mechanism (peer-to-peer). This reduces the data traffic for the node station acting as master system and thus also optimizes the internal operations. Apart from the basic function of reliably transmitting data, the open DNP3 protocol thus also provides the opportunity to fulfil special user requirements with regard to communication performance.

Another influence on building and operating a telecontrol network results from the requirement for redundant communication paths, with which the accessibility of the stations can be ensured even if one connection fails. The technologies employed and thus the corresponding costs always play a major role here. For instance, at larger pumping stations, DSL connections are often encountered. To guarantee the accessibility of the stations, either supplementary GSM/GPRS/UMTS/LTE routes or in some cases even dial-up modems for analog telephone networks are frequently used as redundant connection paths.

The connection to the networks of the service providers takes place with corresponding devices such as modems, mobile communications routers or DSL routers. By selecting suitable devices, e.g., a SCALANCE M874 router from Siemens, the data can then be securely transmitted by establishing a VPN tunnel.

Due to the still very low price and the availability on-site, operators of smaller, remote pumping stations in some parts of the world still prefer to exclusively use analog dial-up connections as the sole connection of the station to the control center, despite the very low data rate. These can likewise be easily integrated into a telecontrol network. Since a media redundancy cannot be realized in these cases due to a lack of coverage with GSM/GPRS/UMTS/LTE networks, the operators ensure the transmission of the data by means of a buffer storage inside the stations.
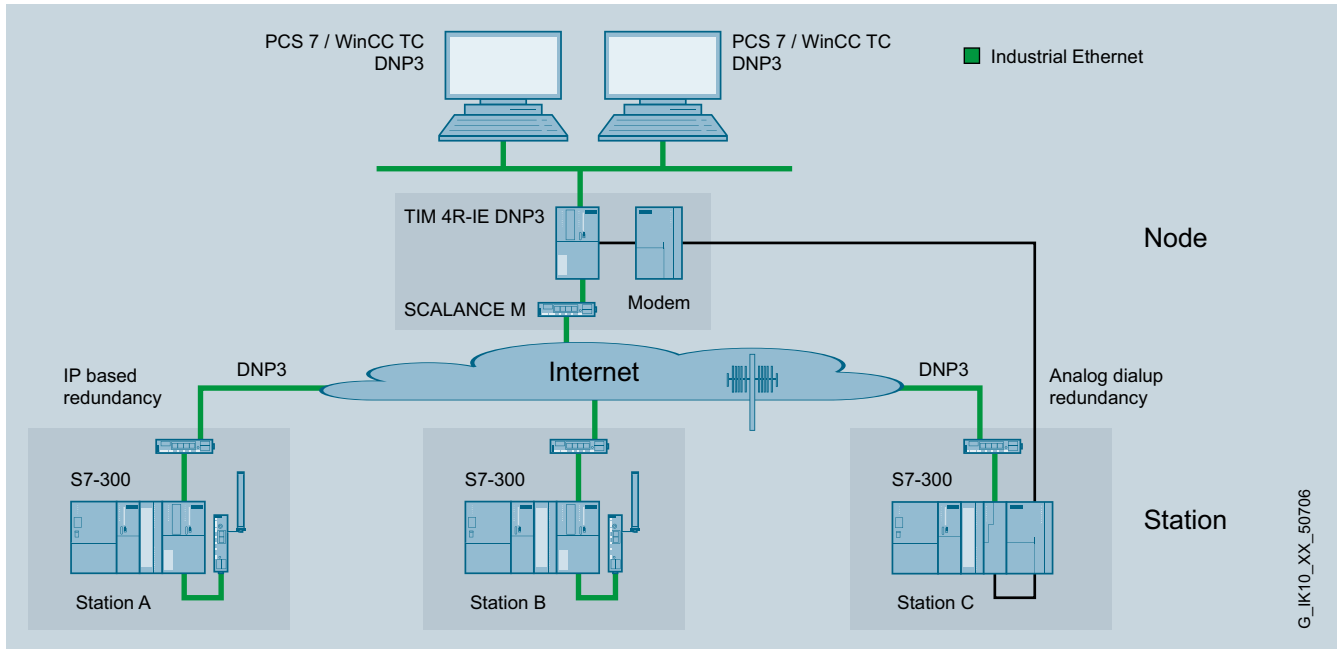
Image 4: Path redundancy in the DNP3 network – the communication with the stations can also take place via another path should one communication route fail, which increases the accessibility inside the telecontrol network.

Private radio networks or dedicated lines can also be used for the connection of the stations. In comparison, modern DSL connections are often significantly more expensive and/or not available in remote regions. This also applies to mobile communications networks with GPRS or LTE, which have spread strongly in recent years due to rapid developments on the mobile communications market (UMTS/LTE).

Conclusion

The open protocol DNP3 offers a high level of flexibility in the connection of stations from different manufacturers to a central control system. To optimize the operating costs of a telecontrol network, component manufacturers are implementing additional functions in their devices. In particular for connections with medium or high data rates, new network structures – utilizing a node station and associated network components from Siemens – allow for new functions such as peer-to-peer communication, i.e., the direct communication between the stations via IP-based networks or a switched telephone network. In a hierarchical DNP3 network, this therefore represents an important cost factor for the optimized operation of a telecontrol network. By establishing a direct connection, this function also reduces the communication load on the corresponding master system.

Security information

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions only form one element of such a concept. For more information about industrial security, please visit **http://www.siemens.com/industrialsecurity**

siemens.com/industrial-remote-communication