Industrial plants are often widely dispersed – in part across locations and even country borders. In these days of climate change, globalization, and urbanization, remote diagnosis and remote maintenance have become indispensable in modern automation technology. They are more effective and less expensive than deploying a service technician to the site. By means of remote maintenance, errors can be very quickly recognized and eliminated – thus reducing downtimes of machines and increasing their availability.

More and more frequently, machines and plants are operated at sites that are far away from their manufacturing location. Nevertheless, plant builders have to ensure services in the case of a fault. This calls for cost-effective solutions. Faced with fierce market competition, few companies can afford to deploy a service technician to the site. Therefore, fully automated solutions with remote access are demanded. Security must not be overlooked either, because high costs can arise in this respect – particularly during the warranty period. Telecontrol and teleservice help reduce the risk here. But what lies behind these terms?

**Perfect Interaction of the Elements**

Remote control, also called telecontrol, is the connection of physically distributed stations to one or more central control center systems for the monitoring and controlling of processes. The location-spanning communication necessary for this takes place over public and private networks – also called remote networks.

If not only monitoring from afar, but also an intervention from afar is required, remote maintenance, also called teleservice, comes into play. Remote maintenance includes the data exchange with physically remote technical plants for the purposes of error detection, diagnosis, maintenance, repair, and optimization of processes. The basis for optimal remote maintenance are reliable, always available, secured, and cost-effective data connections.
For this, renowned network equipment providers offer customers individual components, systems, and integrated overall solutions ranging from the determination of the customer requirements to the network design, implementation, and commissioning to remote services.

The first phase, the analysis phase, is primarily concerned with finding out what exactly the customer needs, which use cases he or she wants to realize with the installation, and what products and systems are to be integrated. The conceptual phase follows, during which a technical implementation concept is developed in close collaboration with the client. This usually involves telecontrol components as well as passive components such as cables and connectors or even entire industrial network infrastructures with switches, routers, and WLAN components plus services related to the system. In telecontrol installations, each of the elements must perfectly interact with each other. Just as each organ in the human body has its role and function, so does each component of a plant.

Communication Networks as Arteries and Veins
For the communication between the control center and the substations, different communication networks are utilized. They are like arteries or veins and form the infrastructure that enables information to be transported to the control center. In traditional WANs, dedicated lines (private or leased), private radio networks (such as WiMAX = Worldwide Interoperability for Microwave Access), as well as dial-up networks (analog, ISDN, GSM) can be used to communicate. In addition, the communication through an Ethernet-based WAN is possible.

- via Internet connections, e.g., with ADSL2+ routers (Asymmetric Digital Subscriber Line 2+)
- via two-wire lines, e.g., with SHDSL routers (Symmetric High-Speed Digital Subscriber Line)
- via serial or Ethernet-based radio systems, e.g., with UHF (Ultra-High Frequency) radios, Industrial Wireless LAN, or WiMAX; private WiMAX radio networks are suitable for widely distributed plants requiring high availability, because the bandwidth here is determined only by the application of the customer
- via fiber optic cables, e.g., with the use of switches possessing optical ports, or
- via cellular networks and the Internet using GPRS, GPRS(E), UMTS, and LTE

In the case of cellular networks, continuous advancements allow for increasingly higher data transmission rates and the transmission of ever larger amounts of data. At present, the following cellular communication generations are supported by products available on the market:

- 2nd Generation (2G): General Packet Radio Service (GPRS) is a packet-oriented service within GSM (2G)
- 3rd Generation (3G): Universal Mobile Telecommunications System (UMTS) plus High Speed Packet Access (HSPA) expansion
- 4th Generation (4G): LTE (Long-Term Evolution) advanced

The innovation cycles are becoming shorter and shorter – the 5th generation of cellular communication is already in the works.

The Control Center – the Brain of the Telecontrol Installation
Centrally located is the control center system, the brain of the telecontrol installation. From the control center system, the distributed substations can be monitored and controlled. In the control center, all process data collected from the stations are centrally displayed and evaluated. Furthermore, the connected services can be coordinated.

Although the brain forms an important basis for the system, more than just a brain is needed; a human cannot live with a brain alone, other body parts are needed – such as the central nervous system and also arteries and veins.
Outstations and Substations – the “Organs” of the Telecontrol Installation

In addition to the human brain and the blood vessels, the human body consists of organs such as the skin with sensors collecting information and passing it on. Similarly, the telecontrol components of the outstations and substations supplement the telecontrol system with corresponding hardware and software – allowing individual process stations to be linked by means of remote networks. At the station level, so-called remote terminal units (RTUs) are used, which are modular or compact remote transmission units that collect process data using connected sensors, process the data, and transmit the data to the control center system via a telecontrol protocol upon the occurrence of defined events or at defined times. The outstations and substations can communicate with each other and with one or multiple control centers.

Telecontrol Protocol – the Language of the Telecontrol Installation

The event-driven or cyclic bidirectional exchange of process data between station and control center takes place via special telecontrol protocols such as DNP3 (Distributed Network Protocol), Modbus RTU, Modbus TCP (Transmission Control Protocol), or IEC60870. The latter protocol embodies a general, open communication standard for industrial automation, which can also be applied to the field of telecontrol.

The data exchange between substations and control center by means of the abovementioned protocols makes it possible for the service personnel to effectively direct the overall process. With regard to telecontrol protocols, a distinction must be made between proprietary standards and cross-vendor standards that are compatible with each other. Cross-vendor protocols offer the advantage that the user is not dependent on individual vendors. This greatly simplifies the modernization and expansion of existing installations. Furthermore, the use of standard protocols can enable an integration into control center systems from different vendors. Increased protection against eavesdropping and data manipulation during the data transmission between the substations and the control center must not be overlooked. Data encryption, firewalls, and VPNs (Virtual Private Networks) are mechanisms that can provide safeguards.

Diverse Network Structures bring Flexibility

The remote network between the control center and the substations can be a star, line, or node structure, or be a mixed configuration of these basic structures. If a redundant data transmission is required, a station can be coupled via two transmission paths. The two paths can be either of the same type or be different, e.g., a dedicated line combined with ISDN or telephone network.

Diagram 2 depicts an example setup of a non-redundant telecontrol system with three substations, which Siemens has been successfully implementing in customer solutions for many years. The left station, based on the SIMATIC S7-1200, is connected to the PCS7 TeleControl control center via the remote network and a SCALANCE M modem (wired). The two outstations in the middle and on the right, based on the SIMATIC S7-1200 and SIMATIC S7-300, are also connected to the control center via SCALANCE M modems (wireless). The communication could, for example, be carried out via the open protocol IEC 60870-5-104 or DNP3. The small red lock icon indicates that the remote communication is secured by firewall and/or VPN mechanisms.
New Perspectives through Wireless Communication

In the context of industrial communication, wireless communication opens up new perspectives – from the partial modernization of a plant to the optimization of complex logistics or production processes. Based on Industrial Wireless remote networks, Ruggedcom WIN, Industrial Wireless LAN (IWLAN), and WirelessHART, Siemens is offering reliable solutions for the industrial wireless communication in production plants. The Ruggedcom WIN products, in accordance with the IEEE 802.16e-2005 standard (WiMAX), enable a long range and are intended for the use in critical areas and/or under demanding environmental conditions. The Ruggedcom WIN product series is the first wireless broadband product portfolio for private networks that delivers the benefits of 4G technology for applications with critical infrastructure in harsh environments. Diagram 3 illustrates a telecontrol system based on a private-radio WiMAX solution.

Leading vendors of industrial networks offer turnkey deliveries of such systems following their commissioning, if so desired by the operator. Afterwards, it is up to the plant operator to either choose services by an external service provider or to run the service in-house.

Besides products, Siemens is offering a comprehensive portfolio of services with regard to remote services and industrial security. The service concept of “Siemens Remote Services” is based on a secure, high-performance platform for remotely accessing machines and plants. By integrating “shared experts”, effective support through Siemens’ own specialists takes place.

Increased Plant Availability

Many plant projects implemented by Siemens experts have demonstrated that remote diagnosis and remote maintenance are indispensable in today’s times. In telecontrol systems, all components must be coordinated to ensure trouble-free communication from the stations to the control center. Security, too, must not be overlooked. Regardless of whether it concerns a greenfield plant or a plant expansion, Siemens is offering holistic automation and network solutions – from the initial analysis to the design and commissioning to the operation (hosting).