

A photograph of two men in a server room. The man on the left is wearing a light pink shirt and holding a laptop. The man on the right is wearing a light blue shirt. They are both looking at a rack of Siemens equipment. The equipment includes a 'PowerLink' unit, a 'SIEMENS SWT 3000' unit, and several other units with the 'SIEMENS' logo. Cables are connected to the equipment.

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Power network telecommunication

PowerLink – power line carrier system

Answers for infrastructure & cities.

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Power line carrier – always up-to-date

A few years ago, it was looking as if digital fiber-optic networks would replace the traditional PLC (power line carrier) systems at power supply utilities. As it turns out, however, PLC is still an indispensable communication alternative for numerous applications – and will remain so in the future: This technology ensures extremely high standards of communication in network protection, and can easily be integrated into a wide range of communication networks, as in the case of the Siemens PowerLink PLC system.

Perfect matching to modern communication environments, along with built-in technical potential for the requirements of the future, make PLC systems more attractive today than ever before.

PowerLink – the versatile solution

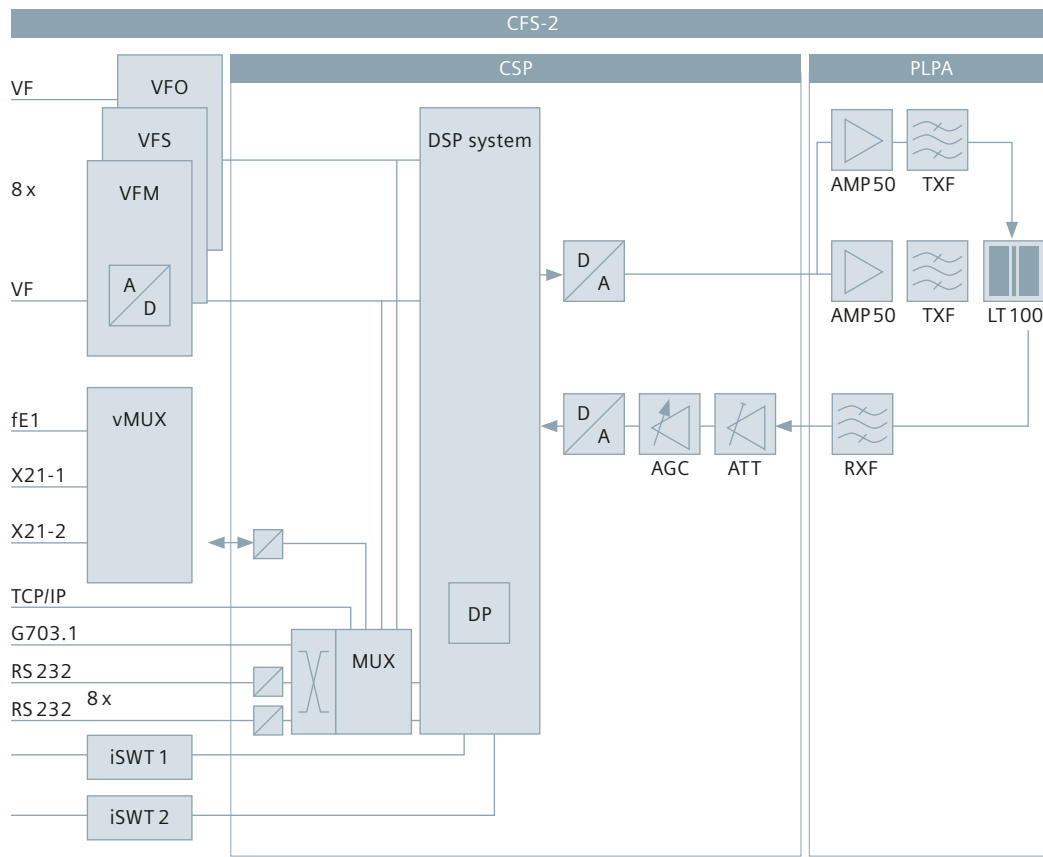
PowerLink uses the high-voltage line between transformer substations as a communication path for data, protection signals, and voice. This technology, which has been tried and tested over decades and adapted to the latest standards, has two main application areas:

- as a communications link between substations where a fiber-optic connection does not exist or would not be economically viable, and
- as a backup system for transmitting protection signals parallel to an installed fiber-optic link.

A basic distinction is made between analog (aPLC) and digital (dPLC) systems. Newer digital systems allow more efficient use of the frequency band, while traditional analog PLC systems offer advantages in cases where transmission conditions are less favorable (low signal/noise ratio, for example). With PowerLink, both operating modes are open to you. You can even combine aPLC and dPLC services in a single communications network.

Advantages at a glance:

- Cost-effective for small to medium data volumes over long distances
- Processes analog and digital signals
- Dynamic transmission rate
- Adjustable transmission power
- Variable bandwidth
- Transmission capacity up to 320 kbps
- Integrated TCP/IP interface
- Voice compression
- Versatile multiplexer
- Integrated teleprotection systems
- Cross-functional management system for all integrated services
- Can be used effectively in combination with broadband technologies for optimal availability



- DSP Digital signal processing
- VF Voice frequency
- VFO Voice frequency interface FXO
- VFS Voice frequency interface FXS
- VFM Voice frequency interface E & M
- X.21-x Synchronous digital interface
- RS 232 Asynchronous digital interface
- iSWT Integrated SWT 3000
- vMUX Versatile multiplexer
- iFSK Integrated FSK channel
- DP Data pump
- AGC Automatic gain control
- ATT Attenuator
- FE1 Fractional E1 2 Mbps
- CFS-2 Carrier frequency section
- PLPA PowerLink power amplifier
- CSP Central signal processor unit
- AMP 50 50-W power amplifier
- RXF Receive filter
- TXF Transmit filter
- TCP/IP LAN interface

High performance

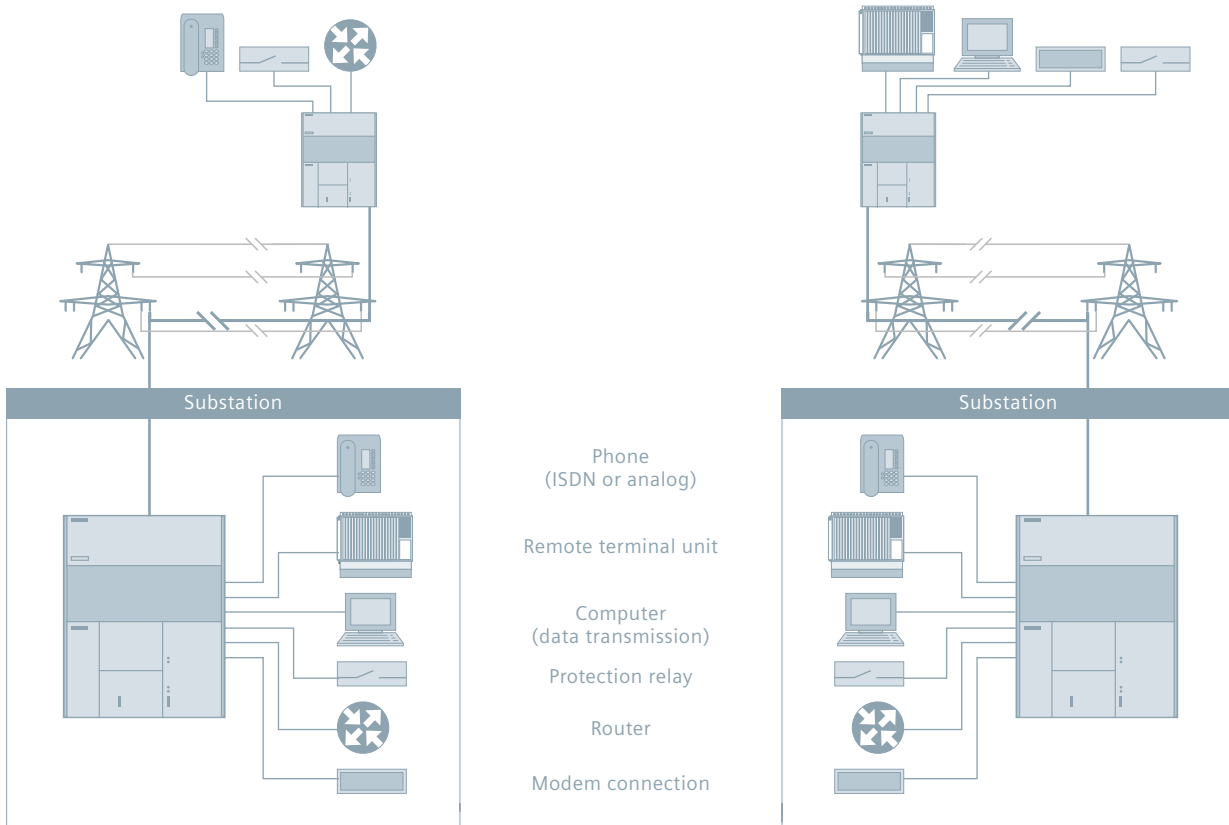
PowerLink offers a transmission capacity of 320 kbps and an integrated TCP/IP interface. This means that many different types of IP terminals can use the power line communications network effectively.

Easy to manage

PowerLink not only simplifies communications, it also makes communications cost-effective. The PowerSys software administers all of PowerLink's integrated applications under a standard user interface. This ensures higher operating security while keeping training time and costs to a minimum.



Features	Digital PLC system	Analog PLC system
Universally applicable in analog, digital, or mixed operation	■	■
Frequency range 24 kHz – 1,000 kHz	■	■
Bandwidth selectable 2 – 32 kHz	■	■
Data rate up to 320 kbps @ 32 kHz	■	■
Transmission power 20/50/100 W, fine adjustment through software	■	■
Operation with or without frequency band spacing with automatic cross talk canceller	■	■
Digital interface		
Synchronous X.21 (max. 2 channels)	■	
Asynchronous RS 232 (max. 8 channels)	■	
TCP/IP (2 x electrical, 1 x optical)	■	
E1 (2 Mbps) for voice compression	■	
G703.1 (64 kbps)	■	
Analog interface		
VF (VFM, VFO, VFS), max. 8 channels for voice, data, and protection signal	■	■
Asynchronous RS232 (max. 4) via FSK		■
Miscellaneous		
Adaptive dynamic data rate adjustment	■	
TCP/IP layer 2 bridge	■	
Integrated versatile multiplexer for voice and data	■	
Max. 5 compressed voice channels via VF interface	■	
Max. 8 voice channels via E1 interface	■	
StationLink bus for the cross-connection of max. 4 PLC transmission routes (compressed voice and data without voice compression on repeater)	■	
Reverse FSK analog RTU/modem data via dPLC (2x)	■	
Protection signal transmission system SWT 3000		
Integration of two devices	■	■
Remote operation via cable or fiber-optic cable identical to the integrated version	■	■
Single-purpose or multipurpose/alternate multipurpose mode	■	■
Element manager, based on a graphical user interface for the control and monitoring of PLC and teleprotection systems	■	■
Command interface binary and in accordance with IEC 61850	■	■
Remote access to PowerLink		
Via TCP/IP connection	■	■
Via in-band service channel	■	■
SNMP compatibility for integrating NMS	■	■
Event memory with time stamp	■	■
Simple feature upgrade through software	■	■



PowerLink – developed for the challenges of the future

PowerLink has numerous outstanding features and functionality, many of which are patented. The real hallmark of the system, however, is its openness and flexibility, which offers you a host of technical options for the best operation of your communication networks. You can use PowerLink for the transmission of:

- Protection signals
- Telecontrol signals
- Voice
- Data
- TCP/IP communication

For this purpose, PowerLink has analog and all current digital interfaces. Because these can be combined flexibly, you can protect investments you have already made, and continue to use the older analog terminals while you gradually switch over to the new communication technologies. At the same time, with PowerLink, you already have at your disposal all the possibilities of TCP/IP communication – which is increasingly emerging as the standard in the power supply area as well.

One solution for highest performance

Best transmission performance under all operating conditions

Variable transmission power

The transmission power can be configured via software in two ranges (20–50 W or 40–100 W), based on the requirements of the transmission path. This makes it easy to comply with national regulations and to enable optimized frequency planning.

Optimal data throughput under changing environmental conditions

PowerLink adapts the data rate to changes in ambient conditions, thus guaranteeing maximum data throughput. Thanks to PowerLink's integral prioritization function, which can be configured for each channel, routing of the most important channels is assured even in poor weather conditions.

Integrated versatile multiplexer (vMUX)

The vMUX is a statistical multiplexer with priority control. Asynchronous data channels can be transmitted in "guaranteed" or "best effort" modes, to guarantee optimal utilization of available transmission capacity. The priority control ensures reliable transmission of the most important asynchronous and synchronous data channels and voice channels even under poor transmission conditions. Naturally, the vMUX is integrated into PowerLink's management system, and – with its extended options for transmitting digital voice and data signals – perfectly equipped for the power line communication requirements of the future.

For highest bandwidth efficiency, PowerLink offers integrated voice compression with different compression rates between 5.3 and 8 kbps. To prevent any impairment of voice quality, the compressed voice bands are routed transparently through transit stations without requiring additional decompression and compression.



Bridge to IP

This functionality is best suited for the migration from TDM to packet-switched networks. PowerLink offers electrical and optical Ethernet interfaces, including an integrated L2 switch, extending the IP network to remote substations with a bit rate up to 320 kbps.

Integrated teleprotection system SWT 3000

Two independent SWT 3000 systems can be integrated into PowerLink. Each SWT 3000 system can be used to transmit up to four commands in different operation modes. For maximum availability, an alternate transmission path via a digital communication link can be connected.



One technology – many applications

PowerLink’s high degree of flexibility becomes readily apparent when we take a closer look at each of its potential applications. No matter what tasks are assigned to the system: PowerLink’s high quality and protective function are first-class in every case.

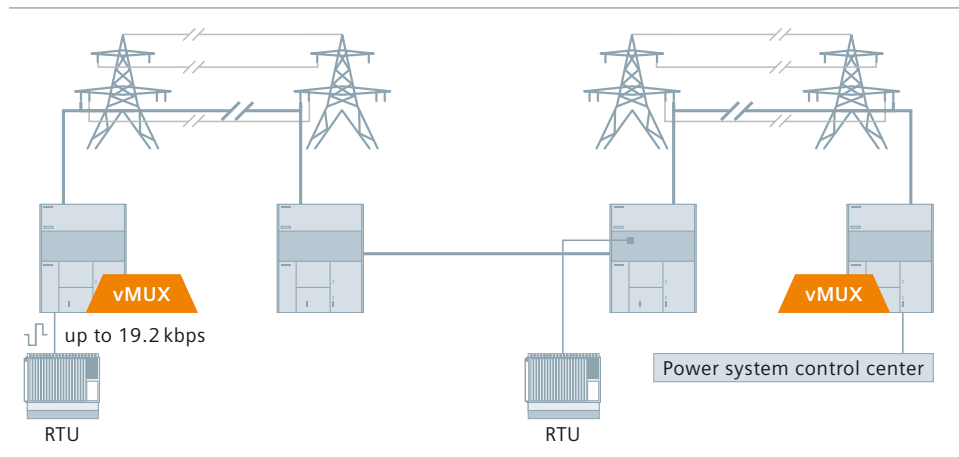
PowerLink for telecontrol transmission

RTU – remote terminal unit polling is, together with protection signal transmission, still a core requirement and use case for PowerLink. This is why RTU polling is available in many different ways. Typically, a number of RTUs are spread over several substations and connected in a daisy chain to a centralized power system control center (SCADA). PowerLink can be applied in analog mode via FSK channels or in digital mode via the implemented data pump to transmit RTU information. Even “old” RTUs with a VF modem can be connected directly to PowerLink. Our integrated multiplexer and the StationLink function offer point-to-point and point-to-multipoint operation for remote terminal units.

Telecontrol via the integrated multiplexer

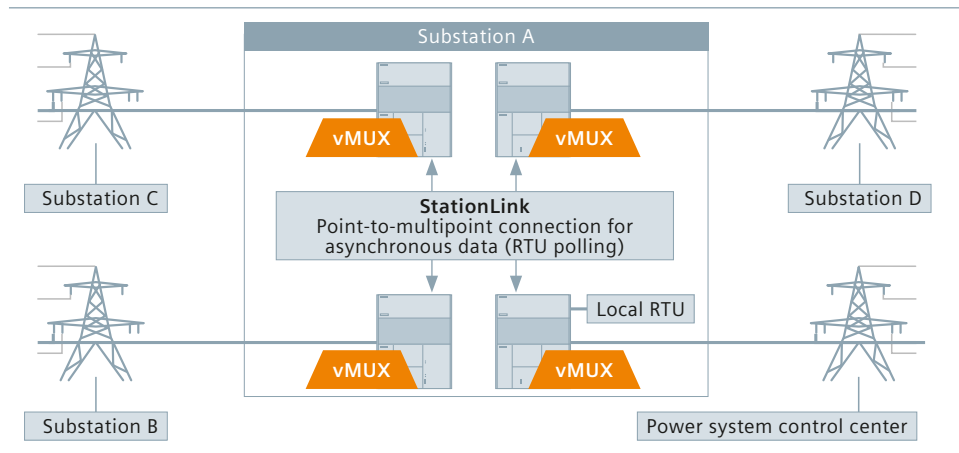
Digital modulation (dPLC)

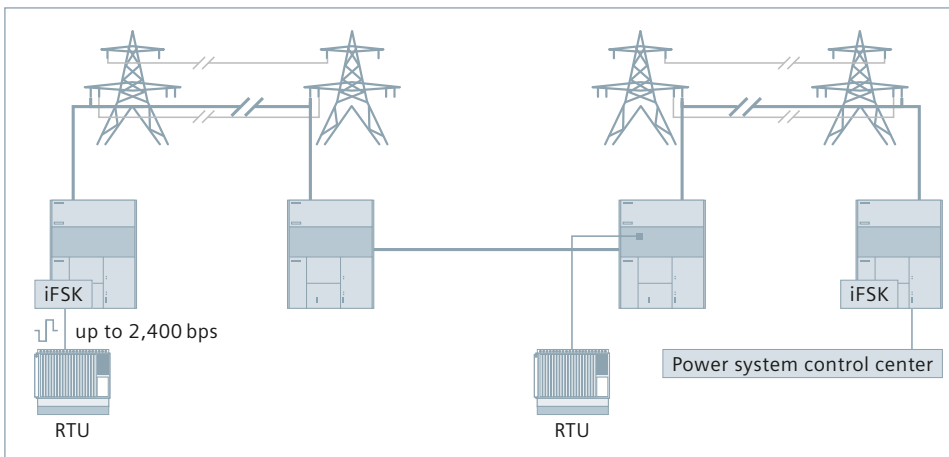
Polling telecontrol data via the integrated multiplexer vMUX with data rates up to 19.2 kbps



Telecontrol via point-to-multipoint connections

The functions of a power system control center include the regular interrogation of event data from the telecontrol units. Point-to-multipoint polling can be implemented in a substation between the PowerLink systems by means of the StationLink function.

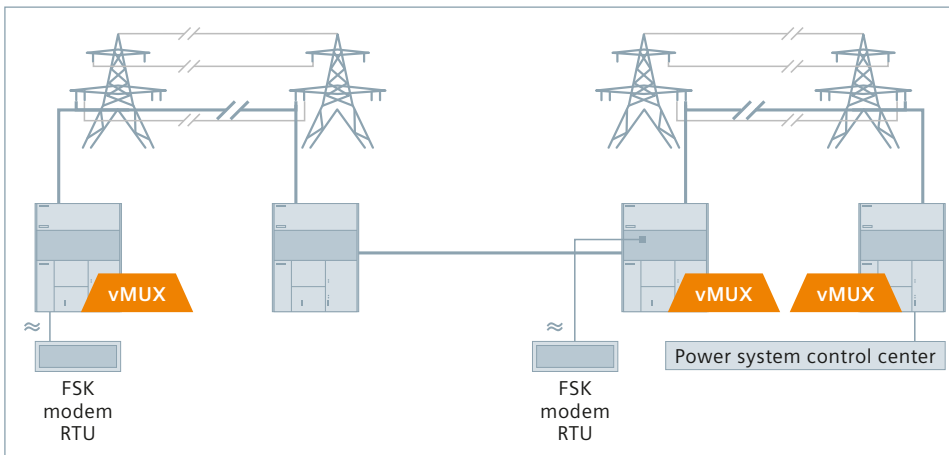




Telecontrol via the integrated FSK channel

Analog modulation (aPLC)

Connection of a telecontrol unit to an integrated modem



Telecontrol with modem via the rFSK channel

Digital modulation (dPLC)

Polling telecontrol data from TCUs with integrated FSK modem via the vMUX at up to 2,400 bps

PowerLink for data transmission

The versatile multiplexer integrated in PowerLink provides the following functions:

Asynchronous data transmission

Up to eight data terminal devices can be connected to PowerLink via the RS232 interface. These asynchronous data channels can be transmitted in the “guaranteed” or “best effort” modes, and thus guarantee optimal utilization of the available transmission capacity.

Synchronous data transmission

PowerLink provides 2 X.21 or 1 G703.1 interfaces for the data link between plesiochronous (PDH) or synchronous (SDH) transmission networks.

LAN connection

PowerLink permits the establishment of a LAN connection between substations in the high-voltage network. Electrical and optical Ethernet interfaces as well as an integrated L2 switch allow IP-enabled data terminal equipment to be connected directly at low cost.

Transparent analog data transfer

When PowerLink is used in analog mode, a maximum of four conventional asynchronous data channels (up to 2,400 bps) can be transmitted transparently by means of FSK modulation.

Flexible combination of interfaces until full transmission capacity is attained

Max. 2 x X.21 or 1 x G703.1

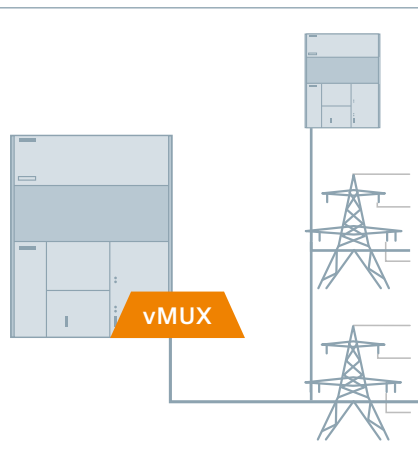
- For example, data terminal

Max. 8 x RS232

- RTU connection PtP, PtMP
- Optional 4 x RS232 with FSK modulation in analog operation

Ethernet TCP/IP

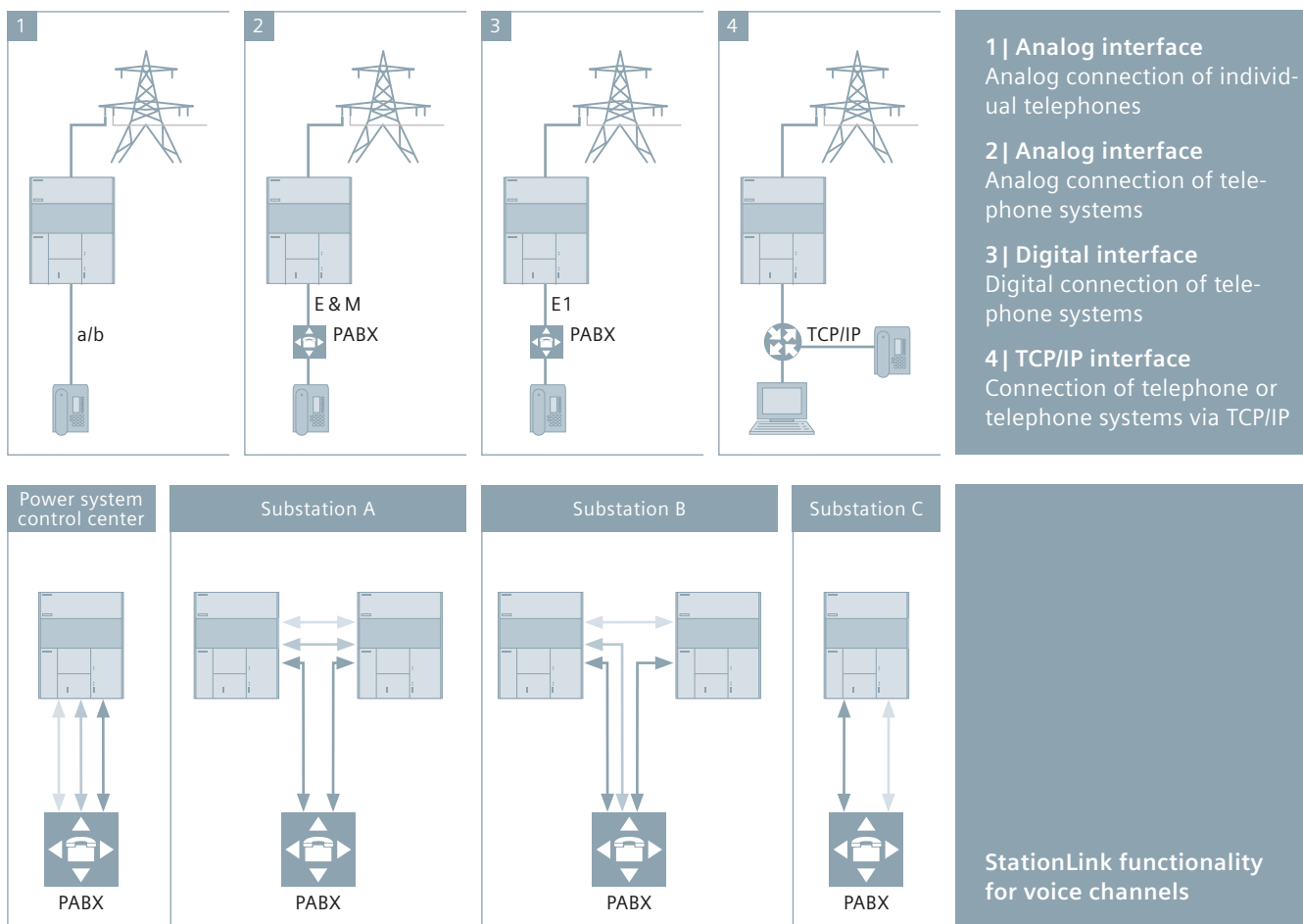
- For example, router





PowerLink for telephone networks

PowerLink is designed to connect different types of telephone systems and individual telephones – from analog to IP. In transit stations, the compressed voice band is routed transparently, with no additional decompression and compression, so that the end-to-end voice quality is not degraded. This StationLink functionality for voice channels is shown in the graphic below.



StationLink functionality for voice channels



PowerLink for protection signal transmission

The teleprotection system SWT 3000 can be operated as an integrated system (with a maximum of two systems) or adapted with PowerLink. Every SWT 3000 system can transmit up to four protection commands. The command interface type for distance protection devices can be either standard binary or compliant with IEC 61850. Even a combination of both command interface types is supported. For highest availability, an alternate transmission path via a digital communication link (for example, SDH) can be connected.

The SWT 3000 system offers you a unique and varied range of operating options:

■ Single-purpose mode:

In this operating mode, the PowerLink transmission channel is used exclusively for transmitting protection signals. Maximum transmission range, with the highest reliability in the case of pulse noise and the minimum signal propagation delay, are achieved in this mode.

■ Multipurpose mode:

In this mode, voice and data are transmitted parallel to protection signals.

■ Alternate multipurpose mode:

In this mode, the entire transmission capacity is used for voice and data as long as it is not needed for protection purposes. The PowerLink pilot tone is used as the guard tone in this mode. If a protection command needs to be transmitted, voice transmission is interrupted for the duration of transmission of the protection command. Data transmission may also be interrupted if the relevant parameter is set.

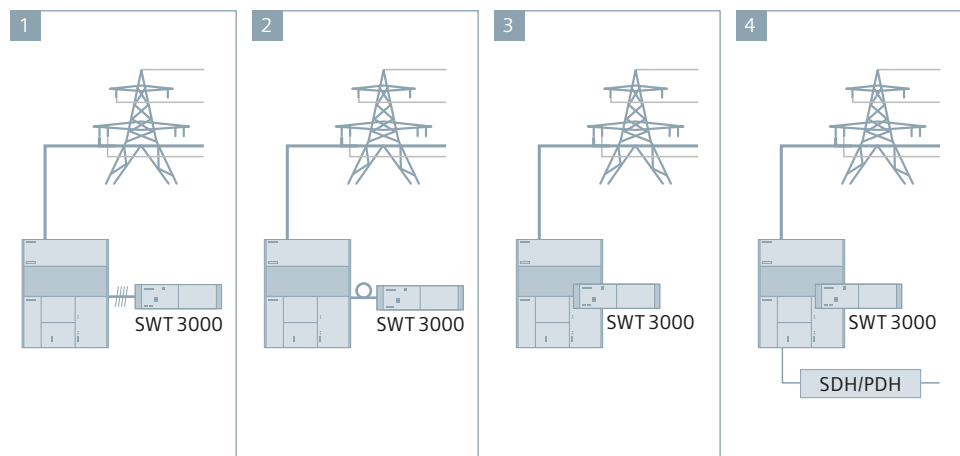
Protection signal transmission

1 | External SWT 3000
4-wire link

2 | External SWT 3000
Fiber-optic link

3 | Internal SWT 3000
Integrated in PowerLink

4 | Internal SWT 3000
Integrated SWT 3000 with
path switching via digital
networks (1+1)



Easy-to-operate – the PowerLink management system

All applications in PowerLink, like the versatile multiplexer and the integrated and external SWT 3000 devices, use one common HMI.

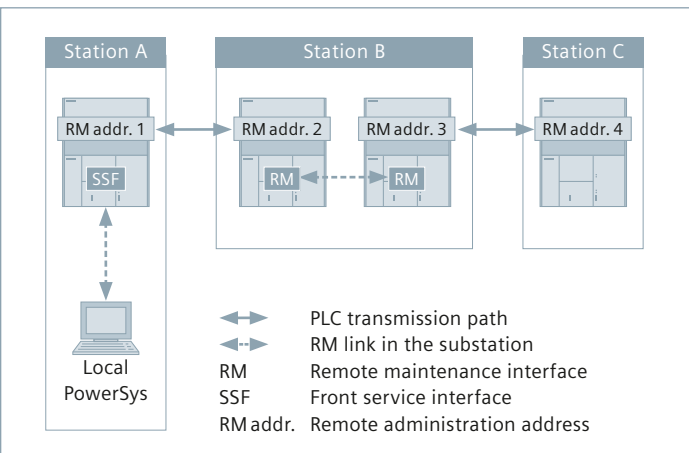
PowerSys administration interface

Intuitive and easy-to-operate, the Windows-based PowerSys software runs on all standard PCs. In addition to local operation, PowerLink also offers two options for remote administration. This makes it possible to meet a wide range of different customer infrastructure requirements. Regardless of the chosen solution, the user has complete system access – just as with a direct local connection. For easy maintenance, the integrated event recorder with real-time clock synchronization options provides the required information.

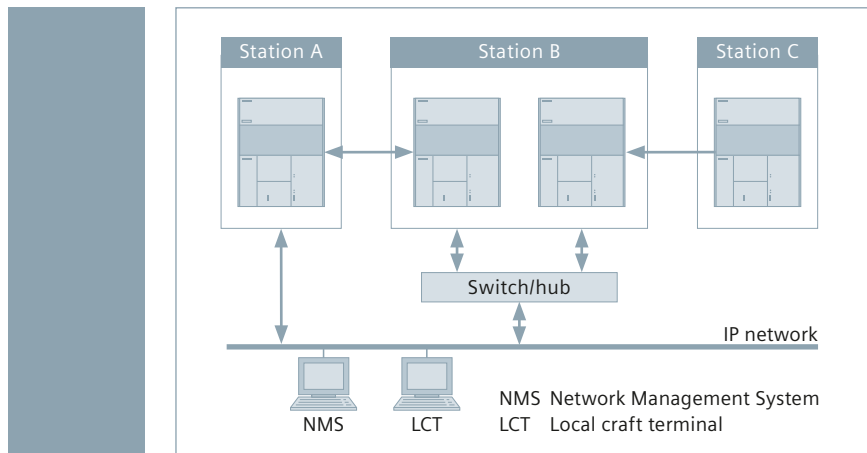
- Remote access via in-band channel RM
- Remote access via IP

The administration of remote PowerLink systems can be easily performed from the local operator console via a customized service channel or the IP network. Administration can also be performed via the corporate LAN network, using the common TCP/IP network protocol. The system can be connected with its own network protection equipment and a firewall to ensure the security level necessary for the company.

PowerLink systems can be integrated in higher-level management systems via the IP access, using the SNMP protocol (simple network management protocol). System and network status data can be transferred, for example, to an alarm, inventory, or performance management system. In case the PowerLink devices in stations B and C are enabled with Ethernet service, station C is also part of the NMS supervision.



Remote access via in-band channel



Remote access via IP

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