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KNX over IP

New Solutions for KNX Installations

Introduction

While KNX has grown into the most important building automation standard, Ethernet has evolved into a universal communications solution that can also be employed in automation systems. Because of their different system characteristics, KNX and Ethernet complement each other well.

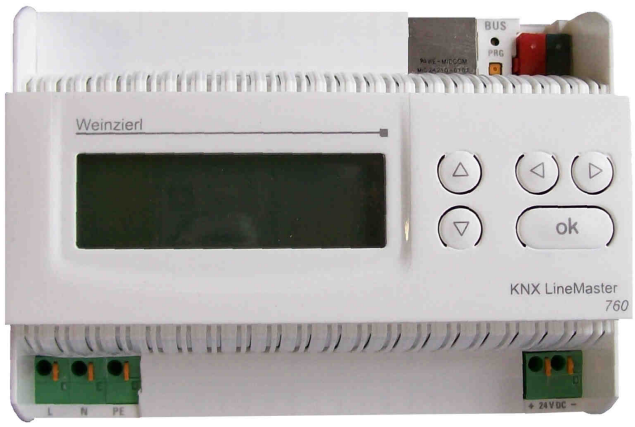


Photo: KNX IP LineMaster 760

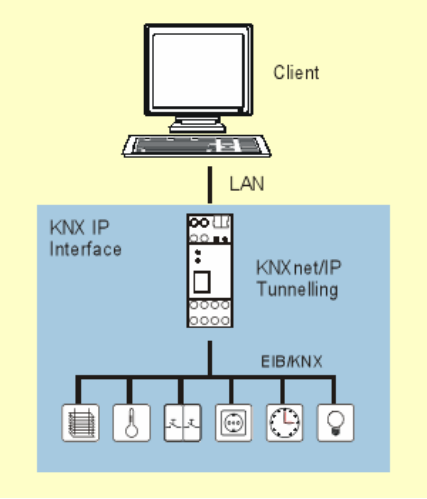
The advantages of the KNX bus are in the optimal adjustment of the KNX system to the special requirements of building control. Over a single twisted pair wire devices are not only networked but also supplied with energy. The relatively low bandwidth of 9600 bits per second is sufficient

for the communication within a bus line, but allows long cable lengths and a free topology. At the same time reduces the low transmission speed the energy consumption of devices because the power consumption of microcontroller depends heavily on the clock rate. KNX twisted pair is easy and inexpensive to install, because the bus can be looped from one participant to the next without a hub or switch through. Not least however, KNX devices are functionally and mechanically designed specifically for building installations.

The decisive advantage of Ethernet is in its high bandwidth at relatively low cost for components and its very widespread use. Today Ethernet is not only used for networking computers in the office, but also for multimedia applications in the home and for industrial automation.
Despite, and indeed because of, the high transmission speeds, LAN networks cannot replace the KNX bus. Instead, the combination of KNX TP and LAN provides an optimal solution for future building automation. KNX TP is primarily suited for local control, while the LAN is used for inter-system communication. The transmission of control commands can take place in a LAN network together with Internet use, PC networking and multimedia. Overall, this results in a hierarchical architecture for building networking.

Tunneling: PC access via a LAN connection

An important application of IP within the KNX system is the functionality of an interface to the bus. KNXnet/IP tunneling describes the access, for example, from a PC to a KNX network during the configuration and commissioning. The focus is always the connection of a client (PC) with a bus line. The tunneling protocol only uses UDP, but includes a security layer, so that telegrams will be repeated in case of error.



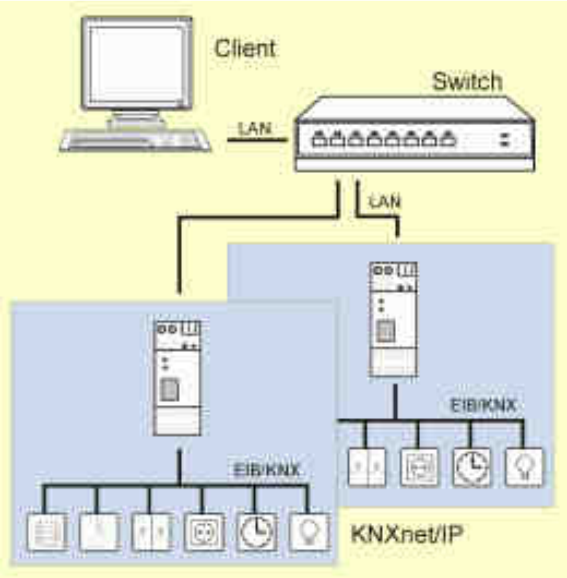
Usage of the KNXnet/IP Standard *Tunneling*

Photo: KNX IP Interface 730

The tunneling protocol can be selected in the Connection Manager of the ETS program and is also suitable for remote access over the Internet. It also can be used to connect a visualization device to a bus line. The tunneling protocol supports the busmonitor function.

Routing in hierarchical architectures

A major motivation for the extension of the KNX system using Ethernet/IP was to increase the transmission capacity of the overall system. While the transmission speed of KNX twisted pair is fully adequate to build a bus line with up to 256 participants, a much higher bandwidth may be needed in the backbone. This is especially the case when central devices such as visualization tools are connected, to which all telegrams need to be transferred. In this case, there can be no selective routing.



Usage of the KNXnet/IP Standards *Routing*

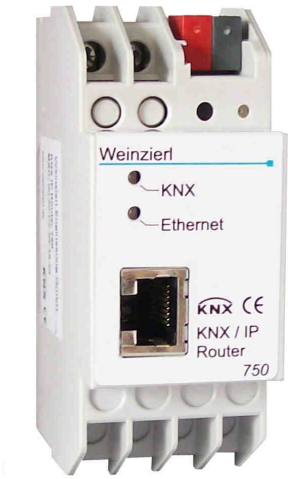


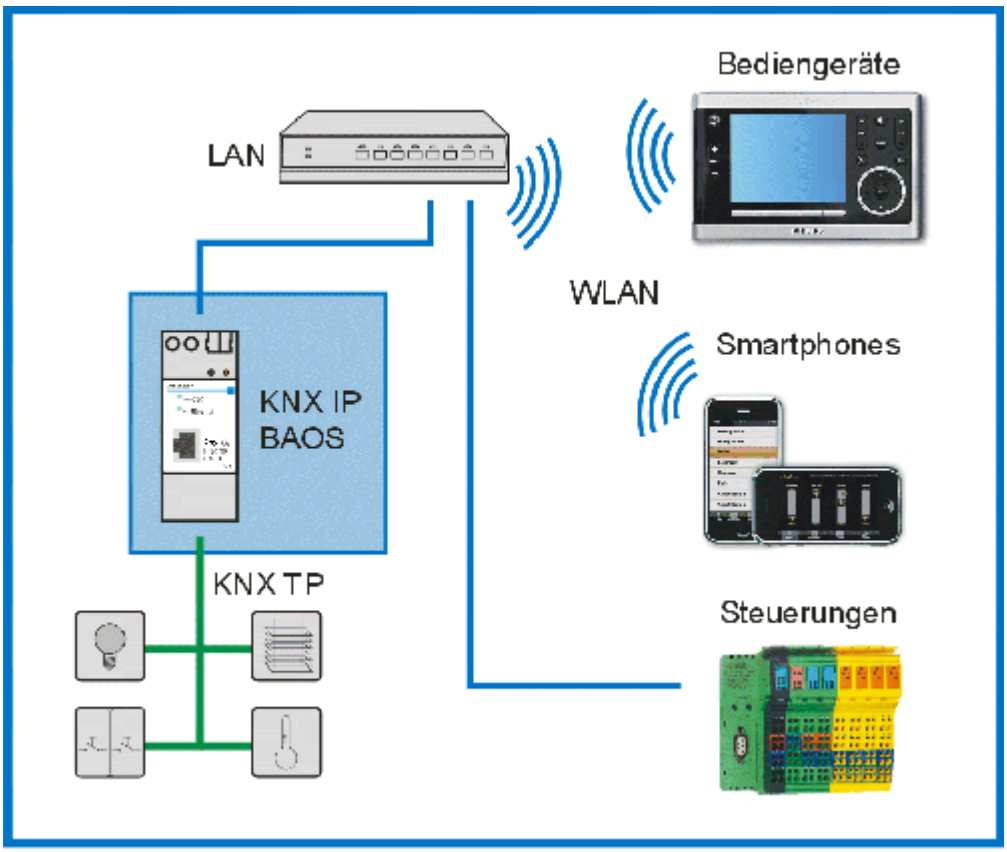
Photo: KNX IP Router 750

Here, the high bandwidth of a LAN network offers an optimal solution. While with KNX TP a maximum of only 50 telegrams can be transmitted per second, transmission via LAN exceeds 10,000 telegrams at 10 MBit/s. To process this traffic without loss, high computational power in addition to an adequate telegram buffer from IP to KNX TP is required.
Since Ethernet is of great significance as the backbone for the system, a corresponding protocol was standardized in KNX. The Routing subtopic of the KNXnet/IP specification describes how KNX/IP Routers forward telegrams via IP. For forwarding via Ethernet, the KNX telegrams are individually packed in UDP/IP telegrams and sent as multicast telegrams. All KNX/IP routers in the network receive these telegrams simultaneously and use their routing tables to determine whether to forward the telegram into the connected KNX line.
The routing protocol can be used to connect an unlimited number of visualization devices to a KNX installation with IP backbone but does not support the busmonitor functionality.

Object server: From the telegram to the data point

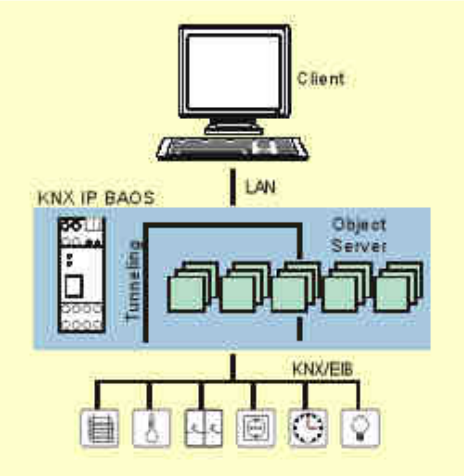
For an increasing number of devices, such as in the areas of multimedia and security technology, the exchange of control information with the building automation is of significance. However, for certain devices it is preferable to not access the bus directly. Instead, a connection can be established to the KNX via Ethernet. Communication via Ethernet is particularly interesting for devices that are already equipped with a network port. If the protocol stack for

TCP/UDP/IP already exists in the operating system, applications can communicate with other devices via Ethernet with little additional effort and thus also with KNX. This applies to many devices based on Linux or Windows CE.



Typical Application of the KNX IP BAOS

If you were to use tunneling or routing as a solution, the devices would be able to access the KNX network but would still have to generate and interpret KNX telegrams.
It is far simpler for the KNX/IP interface to take over this task. In addition to the standard interface functionality, which enables access to the KNX bus on the telegram level, the KNX IP BAOS is an Object Server and provides direct access to the data points (communication objects) of the building. That is, the KNX stack in the device assigns the received data packets to their associated communication objects and holds their values in memory. Registered clients are automatically informed of any changes to the data points.
The communication object values are automatically updated upon receipt, even when clients are not connected. This allows, for example, a Smartphone to instantly access the state of the KNX bus from the BAOS device, without loading the network with a burst of read requests.
In order to send data to the bus, a client has write access to the communication objects. The device can independently generate and send group messages.
The configuration of the data points within the BAOS device is performed with the ETS (Engineering Tool Software). In the ETS the device appears as a conventional bus participant. Within the parameters dialog, the data types of the communication objects can be set and the group addresses are assigned as usual.



Usage of the Object Server protocol

Photo: KNX IP BAOS 771

Using the BAOS protocol a client can access and control data points of other bus participants without having to know the encoding of KNX telegrams. The client addresses the data points on the same number that they have in the ETS. If the group addresses in the KNX network are modified the interface can be updated automatically by an ETS download, and the client application can remain unchanged. The KNX IP BAOS 771/772 offers two separate client access protocols:

Binary Protocol

The device supports an extension of the KNX BAOS binary protocol that is implemented by the BAOS 770 (Protocol Version 1). The KNX IP BAOS 771/772 device implements Protocol Version 2.0, an improved version. It is available over TCP/IP and UDP/IP. The binary protocol is particularly suitable for devices that support traditional programming languages like C, C++ or C# and IP sockets.

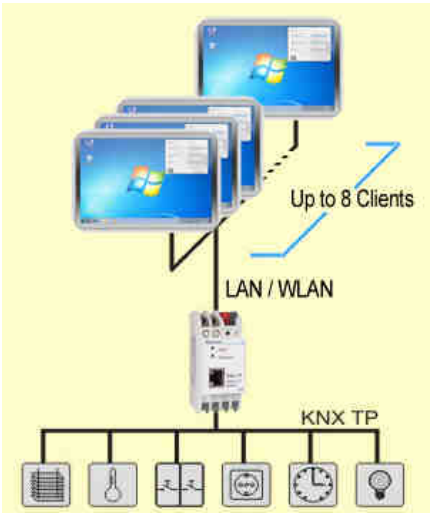
Web Services

The KNX BAOS Binary Protocol typically precludes the development of client applications that run in a Web Browser. For this reason access to the Object Server is now possible via the new KNX BAOS Web Services, based on HTTP and Java Script Object Notation (JSON). This means it is now possible to embed KNX IP BAOS 771/772 directly in your own Web applications.

The Web Services offer the same feature set as KNX BAOS binary protocol, however use a familiar text-based syntax that is sent over HTTP (port 80). The Web Services do not implement a graphical interface. This must be done separately, typically in HTML and Java Script, and can be stored, for example, in client memory, or wrapped directly into a stand-alone application using Webkit.

Sample application for WebServices of the KNX IP BAOS 772 (KNX BAOS gadget)

The KNX BAOS gadget is a minivisualization for windows desktop, which communicates with the BUS via KNX IP BAOS 772. The PC or laptop is connected to the BAOS interface via network or WLAN and receives all necessary information via WebServices.



Functional principle

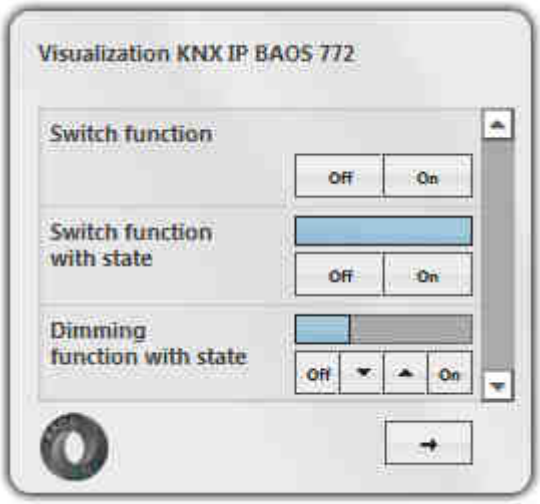


Photo: KNX BAOS gadget

Power over Ethernet replaces auxiliary voltage

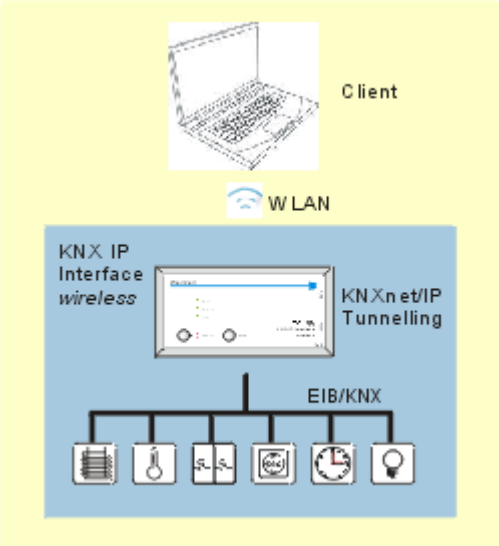
KNX IP devices can not be supplied completely from the KNX bus. Therefore they must be feed via a separate power supply or via Ethernet. Over Ethernet wire not only fast information but also energy can be transmitted. This technique is called Power-over-Ethernet or just PoE. It is specified as IEEE-Standard 802.3af.

Photo: Switch with Power-over-Ethernet (Source: Netgear)

For PoE a network switch is required which supports this feature. Power-over Ethernet replaces not only the additional power supply but simplifies the wiring within the switchboard.

WLAN - the wireless Alternative

With the introduction of KNXnet/IP the ETS® as well as other software programs gain the possibility to connect to the bus via IP. One essential benefit of the internet protocol is the independency from the transmission medium. Besides the network cable a wireless transmission based WLAN (wireless LAN) is possible as well.



Usage of a wireless Interface

Photo: KNX IP Interface 740 *wireless*

A WLAN adapter is already integrated in nearly all new laptops. Together with a wireless IP interface like the KNX IP Interface 740 *wireless* an installer can move around the building almost freely.

Overview KNX IP Devices

Weinzierl Engineering offers a set of powerful KNX IP devices for different applications. All KNX IP devices from Weinzierl are based on a 32-bit architecture and are optimized especially for KNX solutions. On overview of device features shows the following table:

Features / Devices	KNXnet/IP Tunneling (Interface e.g. for ETS)	KNXnet/IP Routing (Linecoupler over LAN)	BAOS IP ObjectServer Binary (Access to data points)	BAOS IP ObjectServer Web Services (Access to data points)	Integrated Power Supply for Bus	Power over Ethernet (PoE)	Wireless (WLAN/ Wi-Fi)
KNX IP Interface 730 	✓					✓	
KNX IP Interface 740 *wireless* 	✓						✓
KNX IP Router 750 	✓	✓				✓	
KNX IP LineMaster 760 	✓	✓			✓		
KNX IP BAOS 770 	✓		✓			✓	
KNX IP BAOS 771/772 	✓		✓	✓		✓	

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Further support is available from:

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