lamaPLC Communication: KNX / EIB

The KNX building automation system was originally known as the European Installation Bus (EIB), and was developed and marketed by the EIB Association (EIBA). In 1999, EIBA, Batibus Club International (BCI, France) and the European Home Systems Association (EHSA, Netherlands) amalgamated, the name KNX was adopted, and the Brussels-based KNX Association was set up. The technology used in modern KNX devices is compatible with that of the old EIB system, so all devices bearing either the KNX or the EIB logo are mutually compatible.

KNX EIB is abbreviation for "*European Installation Bus*" which is decentralized open system to manage and control electrical devices within a facility, that is by Lighting control "*ON/OFF and Dimming*", Shutters Control, Air Conditioning Components, Exhaust fans, … Etc.

KNX EIB System is developed by ABB, Zenio, Berker, Gira, Jung, Merten and Siemens AG . The EIB (European Installation Bus) allows all electrical components to be interconnected through an Electrical Cable Bus Cable.

KNX is based on its predecessors EIB, EHS and BatiBUS.
KNX and EIB are fully compatible!

Various communication media (and hence transmission methods) can be used for the exchange of data between devices in a KNX system:

- **KNX Twisted Pair (KNX TP)** : communication via a twisted pair data cable (bus cable)
- **KNX Powerline (KNX PL)** : uses the existing 230 V mains network
- **KNX Radio Frequency (KNX RF)** : communication via radio signal
- **KNX IP** : communication via Ethernet

KNX Twisted Pair (KNX TP)

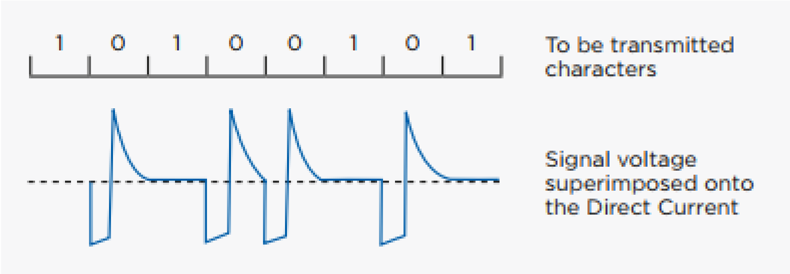
A two-core twisted pair data cable (bus cable) is the most common communication medium for KNX installations. Here all devices are connected with one another via the bus cable. Twisted pair cables are cost-effective to buy and easy to install.

Power supply

In KNX TP the bus cable supplies all bus devices with both data and power. The rated voltage of the bus system is **24 V**, while the voltage provided by the power supplies is 30 V. The bus devices work without error at voltages between 21 V and 30 V, so a tolerance range of 9 V is available to compensate for voltage drops in the cable, and contact resistance. In the devices, the DC supply voltage is first of all separated from the datacarrying AC voltage. The DC supply voltage is created by a capacitor, while a transformer decouples the data-carrying AC voltage. In transmitting devices, the transformer also serves to superimpose the outgoing data onto the bus voltage.

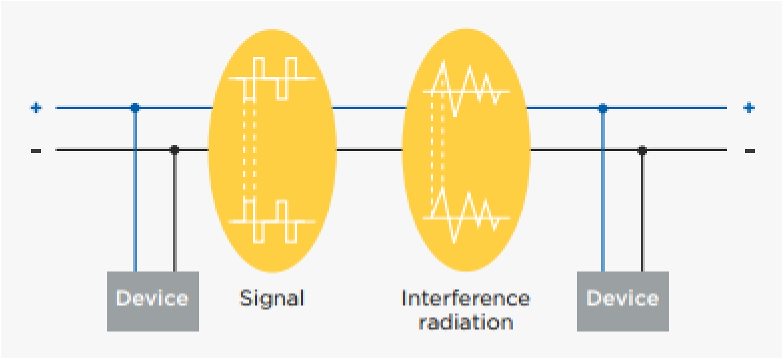
Data rate and signal shape

The data transfer rate is **9,600 bit/s**, and the data travel serially, one byte at a time, via asynchronous data transfer. When a logical zero is transmitted, the voltage drops briefly and then, after no more than 104 µs, increases again to even out at the original voltage. This is due to the inductor effect of the choke. The transmission of logical ones corresponds to the idle state of the bus.



An important feature of communication via KNX TP is that the signals are coupled symmetrically onto the bus, i.e. the data cable has no fixed reference point against earth.

This kind of communication is known as symmetrical, non-earthed transmission. The receiver does not register the voltage to eart in an individual data cable (like e.g. in the USB port), but instead evaluates changes in the voltage difference between the two data cables:



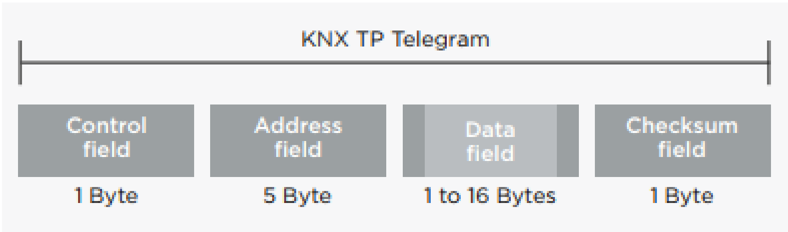
This means that, without any significant additional hardware, stability against coupled interference signals increases significantly, because e.g. the interference signals on both cores counterbalance each other (differential). The transmitter creates the AC voltage corresponding to the logical zero by only sending a half-wave, which it does by lowering the voltage on the pair of cores in the data cable by around 5 V.

After approximately half a bit period, the sender cancels this voltage drop again. The rest of the system – the bus cable, transformers and charging capacitors of all bus devices, and – very importantly – the choke of the power supply, then generates a positive compensating pulse (resonator).

Telegram structure

Information is exchanged between bus devices in the form of so-called telegrams. A telegram consists of a sequence of characters, with each character consisting of eight zeros and ones, in other words eight bits, or one byte. Often several characters are combined with one another to form a field.

KNX TP telegrams have four fields:

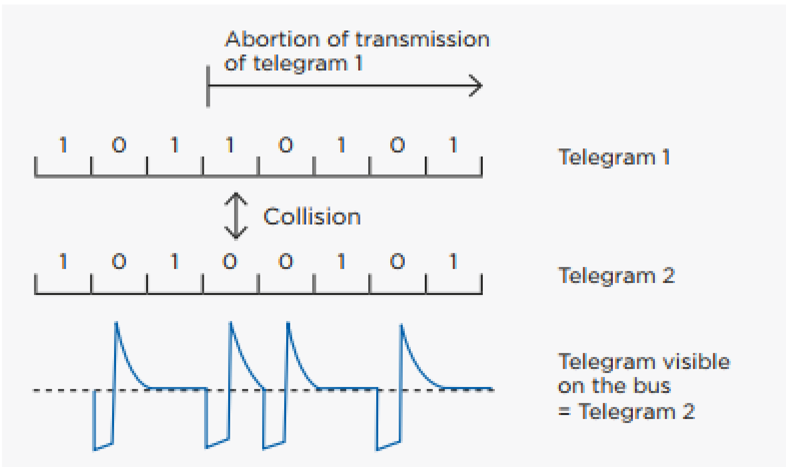


1. **Control field** – The control field defines the priority of the telegram and whether or not transmission of the telegram was repeated (if the receiver did not respond)
2. **Address field** – The address field specifies the Individual Address of the sender and the destination address (Individual Address or Group Address) of the receiver
3. **Data field** – The data field, which can be up to 16 bytes long, contains the telegram's payload
4. **Checksum field** – The checksum field is used for parity checks

Bus access method

Access to the KNX bus, like several other bus systems, is random and event-driven. A telegram can only be transmitted if no other telegram is being transmitted at the same time.

To prevent collisions during transmission, the priorities of the various sending devices are regulated by the CSMA/CA (Carrier Sense Multiple Access / Collision Avoidance) method:



This procedure is very similar to the CAN-bus arbitration procedure.

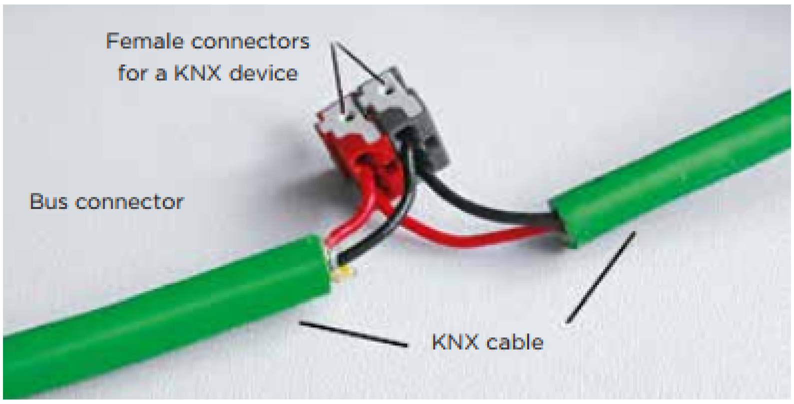
Each transmitting device listens in to every bit of data transfer along the bus. If two devices are sending a telegram at the same time, then inevitably (and no later than at the moment of transmission of the sender address in the address field), one sender will transmit a 0 while the other wants to transmit a 1.

The device sending the 1 “hears” that a 0 is being transmitted along the bus, and detects the collision. It is obliged to abort its own data transmission and give priority to the other transmission. After the transmission taking priority is complete, the aborted data transmission recommences.

A telegram’s level of priority can be defined in its control field; this enables the designer of the system to specify which telegrams have *“rightof-way”* in case of collision. If two telegrams have the same level of priority, which telegram is allowed to be sent first is determined by its physical address (0 has priority over 1).

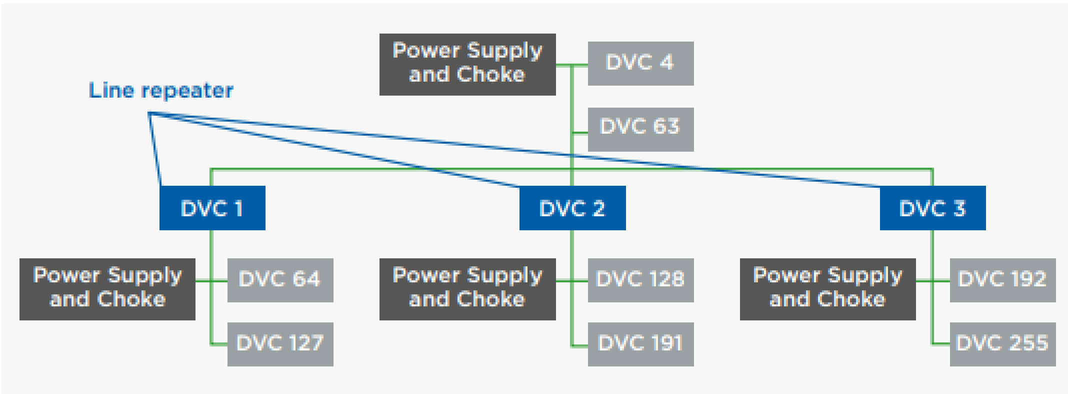
Connection of bus devices

Bus devices are connected to the data cable via components known as bus terminals – plug-in terminals able to accommodate up to four KNX cables. The bus terminals make it possible to disconnect devices from the bus without interrupting the bus line. This represents a key benefit of the KNX bus system: removing a single bus device from the system does not stop the other devices from communicating with one another.



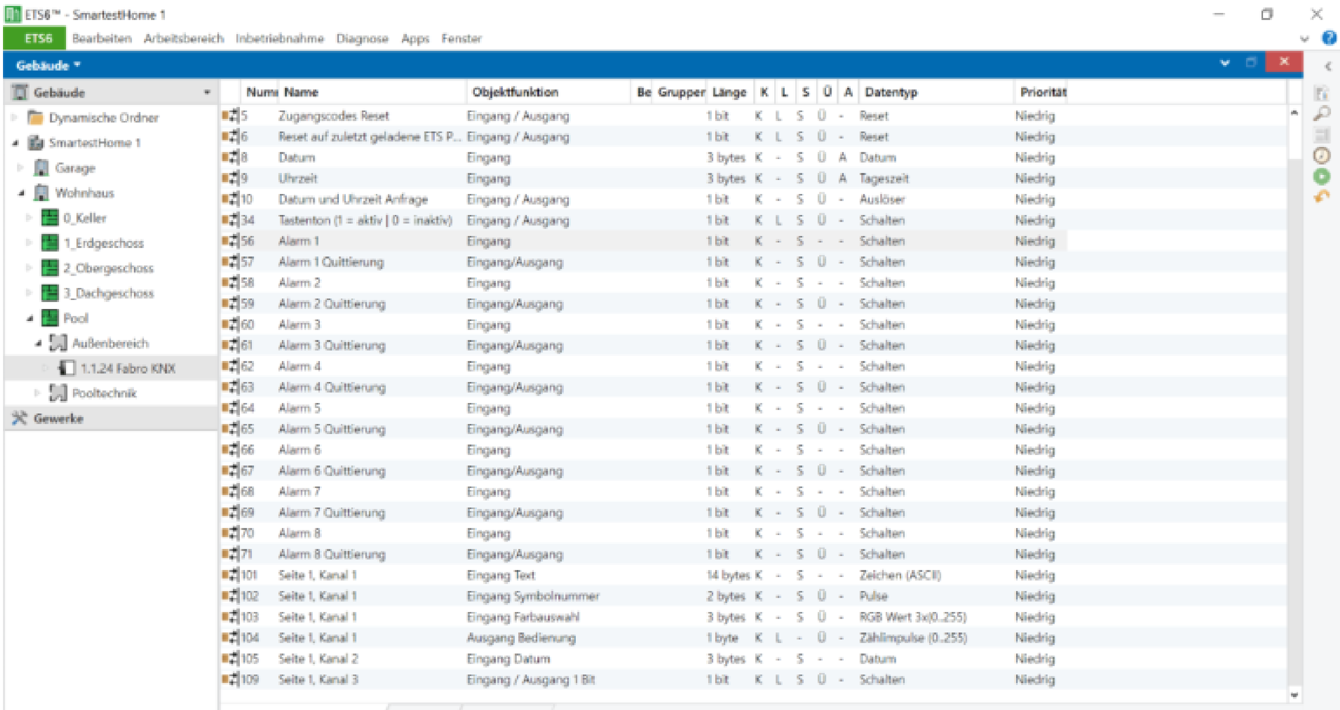
Topology

The basic unit of a KNX TP installation is a line:



A line includes a KNX power supply (including choke), and usually **no more than 64 other bus devices**. The power supply and twisted pair line (bus cable) perform two functions: they supply the bus devices with the power they need, and permit the exchange of information – i.e. the sending of telegrams – between those devices. The bus cable can be laid as desired, and branches can be added at any point. The resulting topology is a free tree structure, which allows a great deal of flexibility in terms of layout. Line Repeaters can be used to extend a line if more than 64 devices are needed. Sections added in this way are known as line segments. A line segment consists of a line repeater, a power supply (including choke), and no more than 64 further bus devices (line repeaters count as bus devices in the line).

ETS Software



A single manufacturer-independent Engineering Tool Software is used to plan, design and commission KNX installations with KNX-certified products: ETS®.

System integrators can use this tool for connecting products from different manufacturers and from different application domains to form a single installation.

A KNX installation can be programmed by one of the following two configuration modes:

- **Easy Mode (E-Mode)** : Here the system is configured not via a PC, but using a handheld unit, push buttons, or other means. This configuration method is suitable for electricians with a basic knowledge of bus technology, but no software skills. S-Mode devices can still always be added to the installation at a later stage.
- **System Mode (S-Mode)** : To configure S-Mode devices, a special program – the Engineering Tool Software (ETS) – is needed. ETS can also be used to connect and commission KNX devices.

Sources

- “KNX BASICS” White paper pdf file

KNX topics on lamaPLC

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