Bus systemer

Til IBI

TECHCOLLEGE
EFTERUDDANNELSE

Formål med dagen

Give et indblik i forskellige bussystemer til brug i IBI systemer.

Fortrådet system

KNX (Konnex)

En international standard (ISO/IEC 14543) til bygningsautomation.

Bruges til belysning, varme, ventilation, persienner, og sikkerhed.

Understøtter både kablet (twisted pair) og trådløs kommunikation.

2x2x0,8 buskabel

KNX den eneste åbne standart

- **Fordele ved KNX**
- **Fleksibilitet:** Kompatibel med over 500 producenter og mere end 8.000 produkter.
- **Energieffektivitet:** Optimerer energiforbruget og reducerer driftsomkostninger.
- **Skalerbarhed:** Kan bruges til både små installationer (private hjem) og store projekter (kontorer, hospitaler, osv.).
- **Fremtidssikret:** KNX er en åben standard, der sikrer kompatibilitet med fremtidige teknologier.
- **Centraliseret styring:** Alle funktioner kan styres via en central enhed eller fjernadgang (apps, webinterfaces).

- **Tekniske Specifikationer**
- **Spænding:**
  - Busspænding: 21-30 V DC (typisk 30 V DC).
- **Strøm:**
  - Maksimal strømtræk pr. buslinje: 1280 mA.
  - Typisk strømforbrug for en enhed: 10-30 mA pr. enhed.
- **Datahastighed:**
  - Kommunikation: 9600 bit/s (seriel kommunikation via twisted-pair-kabler).
- **Kabellængder:**
  - Maksimal længde pr. segment: 1000 meter (afhængigt af kabelføring).
  - Maksimal afstand mellem to enheder: 700 meter.
- **Kabeldimension:**
- . 2x2x0,8

Fortrådet system

BACnet (Building Automation and Control Network)

En åben protokol til styring af HVAC, belysning, adgangskontrol og brandsikkerhedssystemer.

Udveksler data mellem enheder fra forskellige producenter.

BAC net

- **Fordele ved BACnet**
- **Åben standard:** Globalt accepteret (ISO 16484-5).
- **Producentneutral:** Muliggør integration af udstyr fra forskellige leverandører.
- **Fleksibel kommunikation:** Understøtter flere netværkstyper og protokoller.
- **Skalerbarhed:** Bruges til alt fra små bygninger til komplekse campusser og store industrielle anlæg.
- **Energieffektivitet:** Fremmer optimering af energiforbrug gennem integration og dataovervågning.

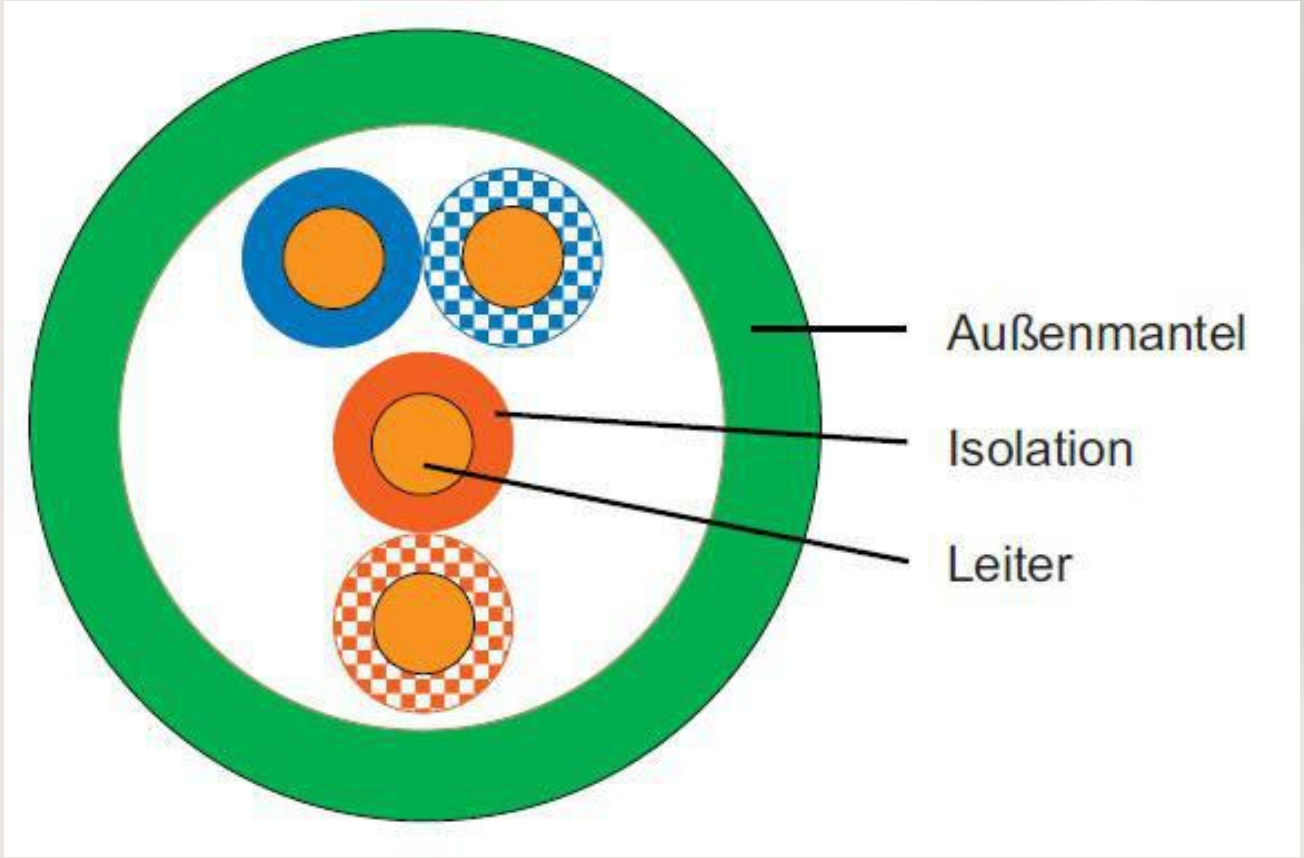
- **BACnet MS/TP via RS-485**
- **Spænding:** RS-485-bussen opererer ved signalniveauer mellem 0 og 5 V DC.
- **Strøm:**
  - Typisk strømforbrug pr. enhed: **10-20 mA**.
  - Busstrømkapacitet afhænger af antallet af enheder og busdriverens strømstyrke.
- **Maksimal afstand: 1200 meter** pr. segment uden brug af repeatere.
- **Antal enheder:** Maks. **32 enheder** pr. segment uden repeatere.
- **Kabelkrav:** Twisted-pair kabel med skærm (fx Belden 9841).

Fortrådet system

LONWorks (Local Operating Network)

Bruges til bygningsstyring, energioptimering og industrielle applikationer.

Understøtter en decentral arkitektur.



Lonworks

- **Kabellængder og Afstande**
- **Twisted Pair (TP):**
  - Maksimal kabellængde: **1200 meter** pr. segment.
  - Maksimal enhedsantal pr. segment: **64 enheder** (kan udvides ved brug af repeater).
- **Powerline Communication (PLC):**
  - Maksimal afstand varierer afhængigt af kvaliteten af det elektriske netværk, men typisk op til **1000 meter** i en given bygning.
- **Fiberoptik:**
  - Langdistancekommunikation, op til **40 km** (afhængig af fiberteknologi og type).
- **Datahastighed og Kommunikation**
- **Datahastighed (for de fleste medier):**
  - **19,2 kbps** til **1,25 Mbps** (afhængig af kommunikationsmedie og afstand).
- **Spænding og Strøm**
- **Spænding (Twisted-Pair/TP):**
  - **Nominal spænding:** 24 V DC (typisk for LonWorks-enheder).
  - **Tolerancespænding:** 18-30 V DC.
- **Strøm:**
  - Strømforbruget pr. enhed afhænger af enhedens type og funktion, men typisk:
    - **0,5-50 mA** pr. enhed ved 24 V DC.
    - Enheder med højere strømforbrug findes til specifikke applikationer, som fx store motorer eller klimaanlæg.
- **Powerline Communication (PLC):**
  - Brug af eksisterende strømnet til dataoverførsel kræver ingen ekstra strømforsyning, og enheder kan trække strøm direkte fra strømnettet (typisk 230 V AC).

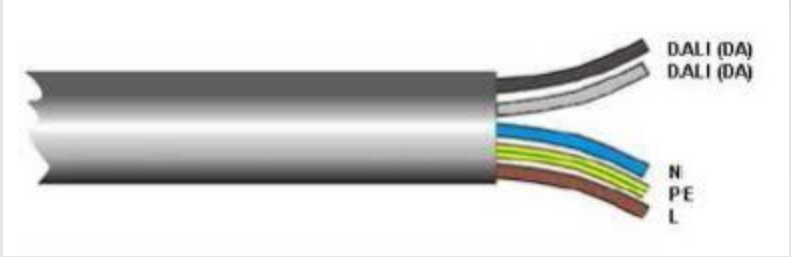
Fortrådet system

DALI (Digital Addressable Lighting Interface)

Specialiseret protokol til belysningsstyring.

Bruges til dæmpning, tænd/sluk og overvågning af armaturer.

En simpel busstruktur med lav båndbredde, velegnet til lysstyring.



Dali 1

- **Fordele ved DALI-1**

1. **Enkel installation og drift**:
    1. DALI-1 bruger to-ledningskabler til kommunikation og strøm, hvilket gør installationen nem og kræver mindre kabelføring.
    2. Standardiseret protokol betyder kompatibilitet mellem forskellige producenter.
2. **Individuel adresse til hver enhed**:
    1. Op til 64 individuelle enheder kan adresseres, hvilket giver mulighed for præcis styring af hver lampe eller driver.
3. **Fleksibel styring**:
    1. Understøtter zonestyring, dæmpning, tænd/sluk og forudindstillede scener.
    2. Nemt at konfigurere og omkonfigurere uden fysisk ændring af installationen.
4. **Energieffektivitet**:
    1. Dæmpningsmuligheder og programmerbare scener reducerer energiforbrug, især i store installationer.
    2. Kan kobles sammen med sensorer (f.eks. bevægelses- og dagslyssensorer) for yderligere optimering.
5. **Fjernovervågning og fejldiagnose**:
    1. DALI-1 giver mulighed for at overvåge status for hver enhed, såsom lampefejl eller driverproblemer.
    2. Forenkler vedligeholdelse og reducerer nedetid.
6. **Skalerbarhed og fremtidssikring**:
    1. DALI-1-systemer kan udvides eller opgraderes, da protokollen er åben og kompatibel med fremtidige opgraderinger til DALI

- **Protokolstandard**: IEC 62386 (DALI 1 refererer primært til de oprindelige dele af standarden).
- **Kommunikationstype**: Digital, envejs-kommunikation (Controller → Ballast).
- **Adressekapacitet**: Op til 64 individuelle adresser.
- **Gruppeadressering**: Op til 16 grupper.
- **Scener**: Op til 16 scener kan programmeres for hver enhed.
- **Elektrisk Spænding**:
    - Systemspænding: 9.5V til 22.5V (normalt 16V)
- **Strømforbrug pr. enhed**: Maks. 2 mA.
- **Buskapacitet**: Maks. 250 mA for hele bussen.
- **Dataoverførsel**
- **Datahastighed**: 1200 bit/s.
- **Signaltype**: Asynkron, seriel dataoverførsel.
- **Fejlkorrektion**: Paritetsbit og frame-baseret kontrol.
- **Kabellængde**: Maks. 300 meter (afhængigt af kablets tværsnit og modstand).
- **Kabeltype**: Tvistede par anbefales for støjreduktion, men standard kabler kan også bruges.
- **Polaritet**: Ingen krav til polaritet.

Dali 2

- **Fordele ved DALI 2**
- DALI 2 er en opdateret version af DALI-protokollen, der bygger videre på DALI 1, men introducerer en række forbedringer og nye funktioner:

1. **Forbedret interoperabilitet**
    1. DALI 2 sikrer, at enheder fra forskellige producenter fungerer sammen uden problemer. Det gør det lettere at vælge og integrere enheder fra flere leverandører i samme system.
2. **Certificering af enheder**
    1. Alle DALI 2-enheder skal gennemgå en certificeringsproces, hvilket sikrer en højere grad af pålidelighed og kompatibilitet mellem enheder og systemer.
3. **Udvidet enhedsadressekapacitet**
    1. DALI 2 understøtter op til **128 enheder** på et netværk, hvilket gør det ideelt til større installationer og komplekse bygningsautomationssystemer.
4. **Bedre styring af lysstyrke og farvetemperatur**
    1. DALI 2 giver flere muligheder for præcis justering af lysstyrke, farvetemperatur og scenarier, hvilket gør systemet mere fleksibelt og anvendeligt til forskellige belysningsbehov.
5. **Forbedret funktionalitet for sensorer**
    1. DALI 2 har forbedret integration af sensorer (bevægelser, lysniveauer osv.), hvilket giver mere præcis belysningsstyring baseret på omgivende forhold.

- **DALI Strømforsyning og Installationskrav**
- **Strømforsyning til DALI 2-bus :**
  Strømforsyningen til DALI-bussen skal kunne levere **16 V DC**, og strømforsyningen skal være dimensioneret til at kunne levere nok strøm til at dække alle enheders strømbehov. For **128 enheder** kan den totale strømforbrug være op til **250 mA**.
- **Maksimalt tilladt spændingsfald:**
  Spændingsfaldet på DALI-bussen må ikke overskride **2 V** (fra den nominale spænding på 16 V DC). Min 9 og max 22,5 volt dc
- **Strømforsyning til individuelle enheder:**
  Hver DALI-enhed får strøm fra den samme **16 V DC** bus, og strømforbruget afhænger af enhedens type. Lyspærer og armaturer vil trække mere strøm end f.eks. sensorer og kontaktorer.
- **Strømforbrug:**
  Hver DALI-enhed trækker en vis strøm (typisk mellem 2-10 mA). Hvis du har mange enheder på bussen, kan det samlede strømforbrug bidrage til et større spændingsfald, især over længere afstande.
- **Kabelføring:**
- DALI-bussen bruger **2 ledninger** (plus og minus) til at kommunikere mellem master (f.eks. lysstyringsenhed) og slave-enheder (f.eks. lysarmaturer).
- **Kabellængder:** Det er muligt at forlænge bussen til **op til 300 meter** (uden repeatere).
- DALI 2 gør det muligt at sende og modtage data mellem controlleren og enhederne, hvilket giver bedre styringsmuligheder og fejldiagnosticering sammenlignet med den envejs kommunikation, der blev brugt i DALI 1

Fortrådet system
Kan også være trådløs system

Modbus

En industristandardprotokol, der ofte anvendes i bygningsstyring og industriel automation.

Understøtter både seriel kommunikation (RS485/RS232) og TCP/IP.

Modbus

- **Open Source:** Modbus er en åben standard, hvilket betyder, at det ikke er bundet til én leverandør. Dette giver **frit valg** af udstyr og enheder fra forskellige producenter.
- **Kompatibilitet:** På grund af den åbne standard er Modbus kompatibel med mange enheder, software og hardware i både industrielle og bygningsautomationssystemer.
- **Fleksibilitet**
- **Modbus RTU (seriell)** og **Modbus TCP (Ethernet):** Modbus kan anvendes både i **seriell kommunikation** (Modbus RTU) og **Ethernet-baserede netværk** (Modbus TCP), hvilket gør det fleksibelt til både små og store systemer.
- **Forskellige enhedstyper:** Modbus understøtter mange forskellige typer af enheder, herunder sensorer, aktuatorer, måleinstrumenter, PLC'er (Programmable Logic Controllers), og DCS'er (Distributed Control Systems).
- **Kompatibilitet med mange systemer:** Modbus er meget let at integrere med andre kontrolsystemer, SCADA-systemer (Supervisory Control and Data Acquisition), samt IoT (Internet of Things)-baserede systemer.
- **Husk: respektafstand i mellem stærk og svagstrøm HD60364**

Parameter	Værdi
Spænding (Modbus RTU)	5 V DC til 15 V DC (RS-485)
Spænding (Modbus TCP/IP)	10-30 V DC (PoE) eller 220 V AC
Strømforbrug pr. enhed	< 100 mA pr. enhed (RTU), < 1 A (TCP)
Maks. kabellængde (RTU)	1200 meter (ved 9600 bps)
Maks. kabellængde (TCP/IP)	Op til 100 meter (Ethernet)
Antal enheder pr. netværk (RTU)	Op til 247 enheder
Antal enheder pr. netværk (TCP/IP)	Op til 65.000 enheder
Kommunikationshastighed (RTU)	Op til 115200 bps (afhængig af længde og hastighed)
Kommunikationshastighed (TCP/IP)	10/100/1000 Mbps (Ethernet)
Protokol Fejl:	CRC16 for fejlkontrol

Fortrådet system / kan også være trådløs

M-Bus (Meter-Bus)

Designet til målersystemer (vand, gas, varme og el).

Bruges til dataindsamling og energiovervågning.

M-BUS

- **Fordele ved M-BUS (Meter-Bus)**
- M-BUS er en **kommunikationsprotokol**, der primært bruges til **dataindsamling og fjernmåling** i bygningsinstallationer og industrielle applikationer. Det er specielt designet til at håndtere måledata fra enheder som **energimålere**, **vandmålere**, **gasmålere** og **varmemålere**.
- **Stor enhedsforbindelse**: M-BUS understøtter op til **250 enheder** (målere eller sensorer) på en enkelt bus, hvilket gør det muligt at skabe meget store netværk af målere.
- **Skalerbar Infrastruktur**
- **Mulighed for integration**: M-BUS kan integreres med andre systemer som **BMS (Building Management Systems)**, **SCADA** og **IoT-platforme**, hvilket gør det muligt at styre og overvåge alle enheder centralt.
- **Dataanalyse**: M-BUS giver mulighed for indsamling af data, som kan bruges til analyse og optimering af energiforbrug og systemydelse.

- **Kabelspecifikationer:**
- **Kabeltyper**: M-BUS-kabler bør være **skærmede** for at sikre pålidelig kommunikation og beskytte mod elektromagnetisk interferens (EMI).
  Ledningsmodstand: M-BUS kabler skal have en ledningsmodstand på omkring **75 ohm** eller **120 ohm**, afhængig af standarden.
  Bus-Topologi: **Bus-/stjernesystem:** M-BUS kan implementeres i både **bus** og **stjerne-topologi**. Det er meget fleksibelt i forhold til kabelføring.
  Strømforbrug **Master-enhed strømforbrug:** Typisk strømforbrug: **< 100 mA** for en master-enhed. **Slave-enhed strømforbrug:** **< 50 mA** pr. enhed (afhænger af typen af måler eller sensor).
  Batteridrevne enheder kan have et endnu lavere strømforbrug, nogle gange **< 10 mA** i hviletilstand.
- **Bus-spænding:**Den **spænding**, der bruges til at drive kommunikationen på M-BUS-bussen, er normalt **24 V DC**.
- **Datahastighed:**
  M-BUS understøtter en maksimal kommunikationshastighed på **9600 bps**, som er tilstrækkelig til dataindsamling fra målere i de fleste applikationer.

Fortrådet system / kan også være trådløs

Profibus/Profinet

Brugt i industriel automation, men også til bygningsstyring i komplekse miljøer.

Profinet er IP-baseret og bruges ofte i moderne installationer.

Profibus

- **Fordele ved PROFIBUS-teknologien**
- PROFIBUS (Process Field Bus) er en pålidelig og standardiseret feltbus-teknologi, der anvendes bredt i industrien til proces- og automationskontrol. Den er særligt velegnet til komplekse systemer, der kræver høj ydeevne og pålidelighed. Her er de vigtigste fordele ved PROFIBUS:
- **Hastighed:**Understøtter datahastigheder op til **12 Mbps**, / 100 m hvilket gør den velegnet til realtidsapplikationer og processtyring.
- **Skalerbarhed: 1.200 meter / 9600kbit** ved lave datahastigheder./ ip længere.
- PROFIBUS kan understøtte **op til 126 enheder** på én bus.
- Dette gør systemet ideelt til både små installationer og store industrielle systemer med mange sensorer og aktuatorer.
- **Integration med Andre Systemer**
- PROFIBUS kan nemt integreres med andre systemer som f.eks. **PROFINET** (Ethernet-baseret kommunikation).
- Det understøtter også gateways til at kommunikere med andre busstandarder som **Modbus** eller **CANbus**.
- **Topologier:**
- Busstruktur (primær struktur).
- Stjerne- og ringtopologier kan anvendes med brug af repeatere.
- **Spænding:**
- Typisk **5V DC** til elektronikken i feltudstyr.
- PROFIBUS PA kan også forsynes via buskabler med en maksimal spænding på **32V DC**.
- **Strøm:**
- Lavt strømforbrug for feltudstyr, typisk **10–50 mA** afhængigt af enhedstype.
- **Kabel:**
- Skærmet par-twisted kabel med specifikationer iht. RS-485 standard.
- Impedans: **135-165 Ω** ved 3-20 MHz.

Fortrådet system / kan også være trådløs

C-Bus

En protokol udviklet af Schneider Electric.

SpaceLogic C-Bus, muliggør fremtidens bygninger

Det robuste og intelligente C-Bus produktprogram giver mulighed for fuldstændig kontrol af belysning og andre elektriske enheder. Eksempler på disse omfatter vægafbrydere, kraftige kommercielle lysdæmpere, kontrolrelæer, tilstedeværelse, lysniveau og temperatursensorer; lydsystemer til flere rum; sikkerheds- og adgangssystemer; energikontrol- og overvågningssystemer; og softwarepakker. Gennem innovativt design og omfattende forskning og udvikling er C-Bus nem at installere, og langt det mest omkostningseffektive, brugervenlige kontrol- og styringssystem, der findes på markedet.

C-BUS

- **Fordele ved C-Bus fra Schneider Electric**
- C-Bus er et avanceret bygningsautomationssystem udviklet af Schneider Electric, der er designet til at levere præcis og pålidelig styring af belysning, HVAC, sikkerhed og andre elektriske systemer. Her er de vigtigste fordele ved C-Bus-systemet:
- **Energibesparelse**
- **Effektiv styring:**
    - Avancerede funktioner som dagslys-sensorer og tidsbaserede scenarier bidrager til energibesparelser.
- Integration med energiovervågning giver mulighed for detaljeret rapportering og optimering af strømforbrug.
- **Fleksibel Styring**
- **Central og decentral kontrol:**
    - Brugere kan styre systemet fra vægkontakter, touchpaneler, fjernbetjeninger eller mobile app
- **Kommunikationsspecifikationer**
- **Protokol:**
    - Proprietær protokol udviklet af Schneider Electric.
    - Brug af dedikeret C-Bus-kommunikationslag.
- **Datahastighed:**
    - Fast datahastighed på **38,4 kbps** over bussen.
- **Busspænding:**
    - 15-36V DC (nominalt 36V DC).
- **Strømforbrug pr. enhed:**
    - Typisk 18 mA ved 36V DC pr. enhed, afhængigt af typen (sensorer, aktuatorer, etc.).
- **Strømforsyning:**
    - Maksimalt **2A** pr. C-Bus strømforsyning.
- **Kabellængde:**
- Maksimalt **1 km** samlet kabellængde i et enkelt netværk.

Tak for jeres opmærksomhed

TECHCOLLEGE
EFTERUDDANNELSE

European Installation Bus
KNX - intro

Bussystemets Topologi

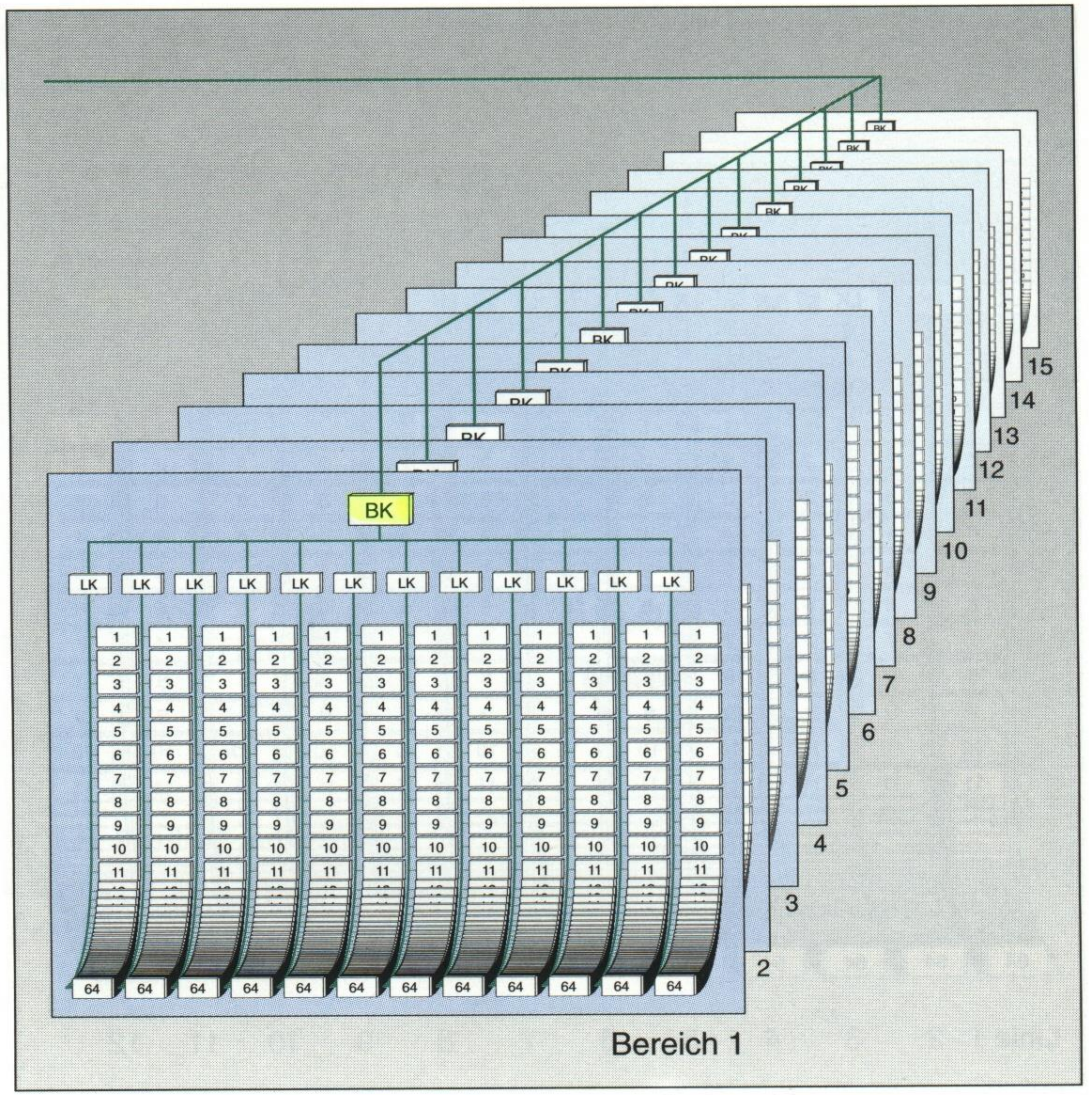


Bild 1-4 Topologie des Installationsbusses EIB, Bereiche

KNX begreber

- Sensorer
- Aktuatorer
- Deltagere
- Fysiske adresser
- KNX buskabel
- Busklemmer
- Programmeringstast
- Lysdiode

- ETS software
- Produktdatabaser
- Applikationer
- Objekter
- Parametre
- Gruppeadresser
- Download

Eksempel på en businstallation

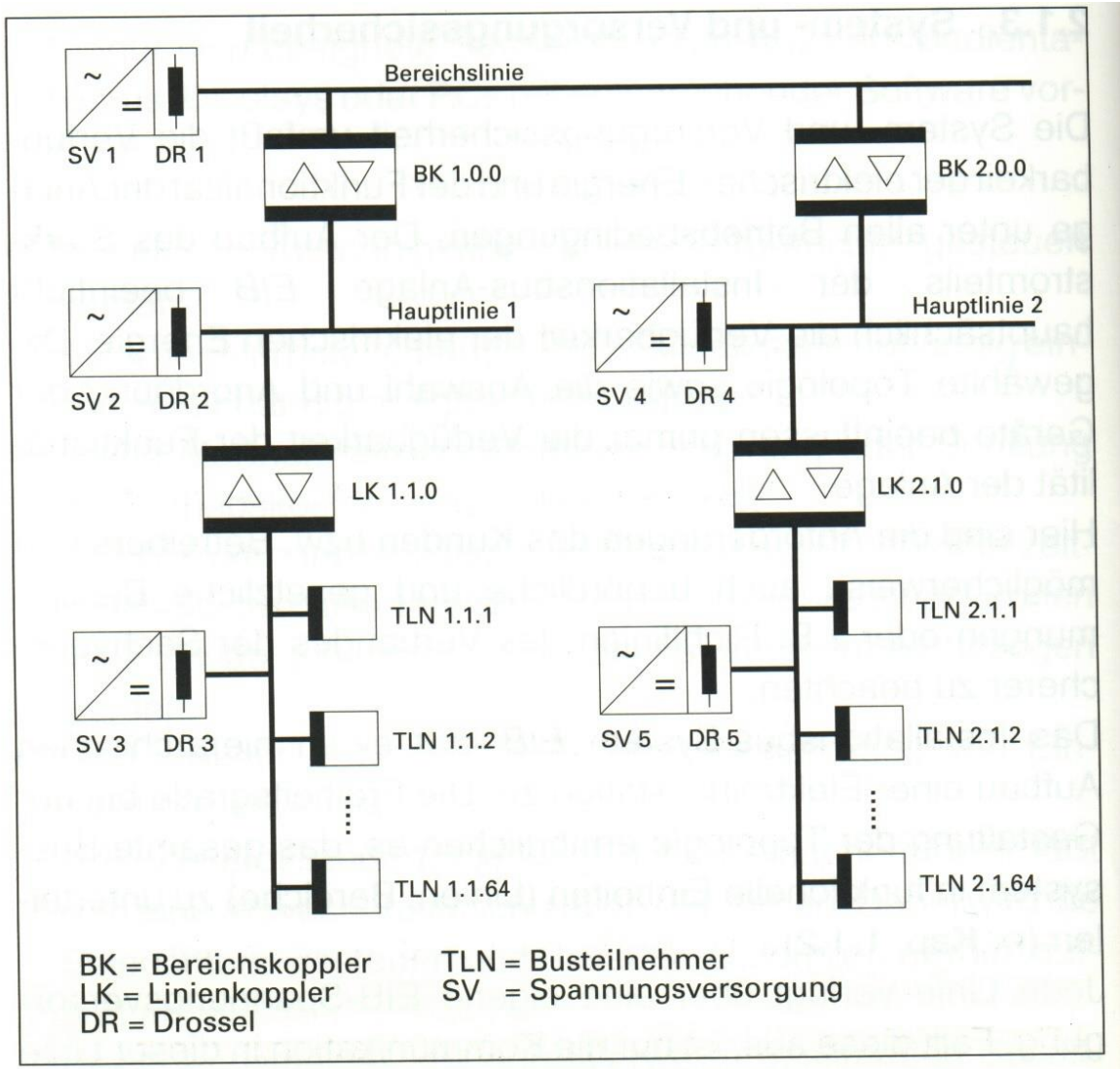


Bild 2-1 Beispiel des Aufbaus eines Installationsbus-Systems EIB

Bestemmelse af kabellængde

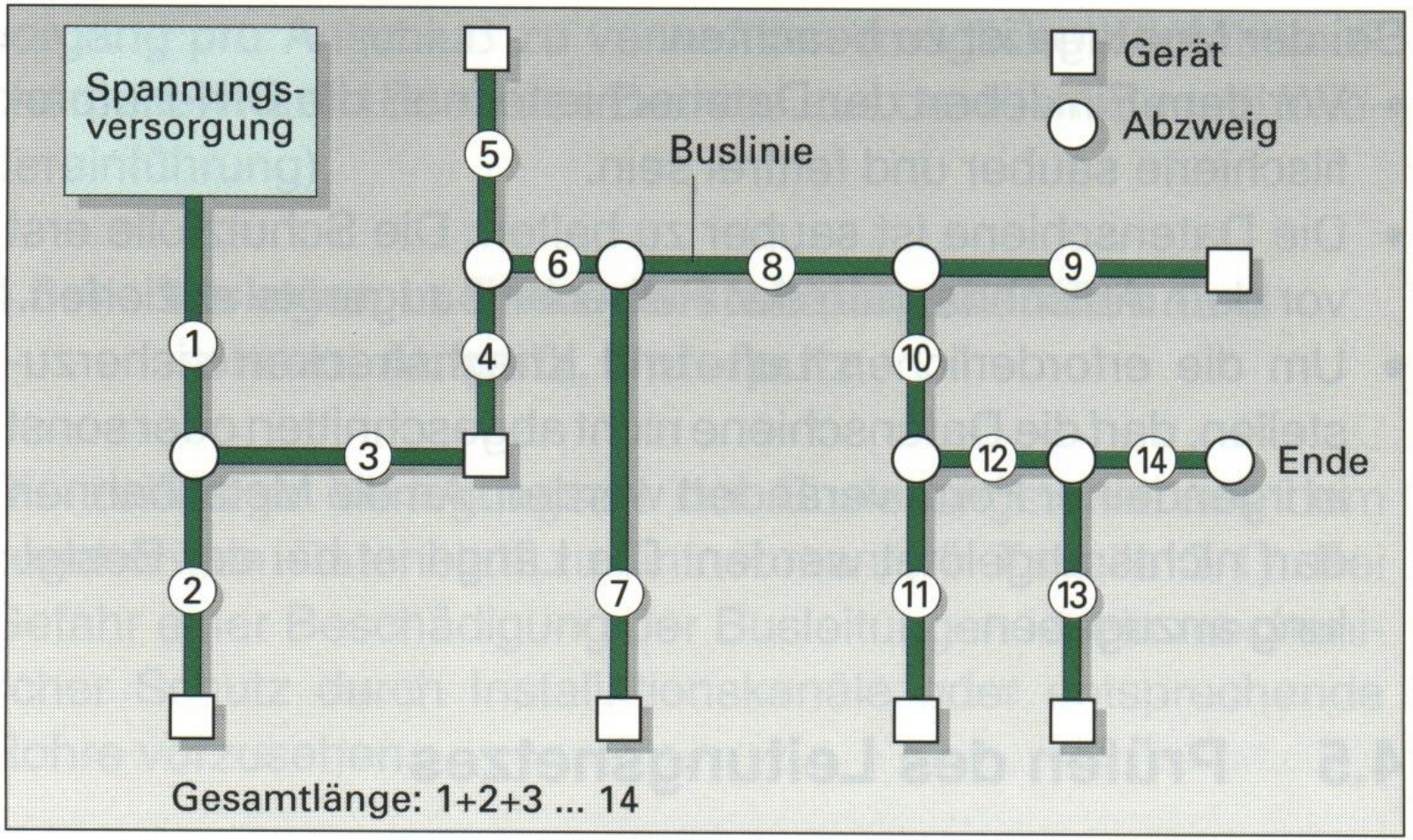


Bild 4-7 Bestimmung der Leitungslängen im Busnetz

Maksimale kabellængder

Gesamtlänge aller in einer Linie verlegten Leitungen	max. 1000 m
Maximale Leitungslänge zwischen zwei Busgeräten	max. 700 m
Maximale Leitungslänge zwischen Spannungsversorgung inkl. Drossel und jedem Busgerät	max. 350 m
Minimale Leitungslänge zwischen zwei Spannungsversorgungen (zwei Spannungsversorgungen inkl. Drosseln in einer Linie)	min. 200 m

Tabelle 4-1 Leitungslängen im Busnetz

KNX Tp-kabel (2x2x0,8 mm)

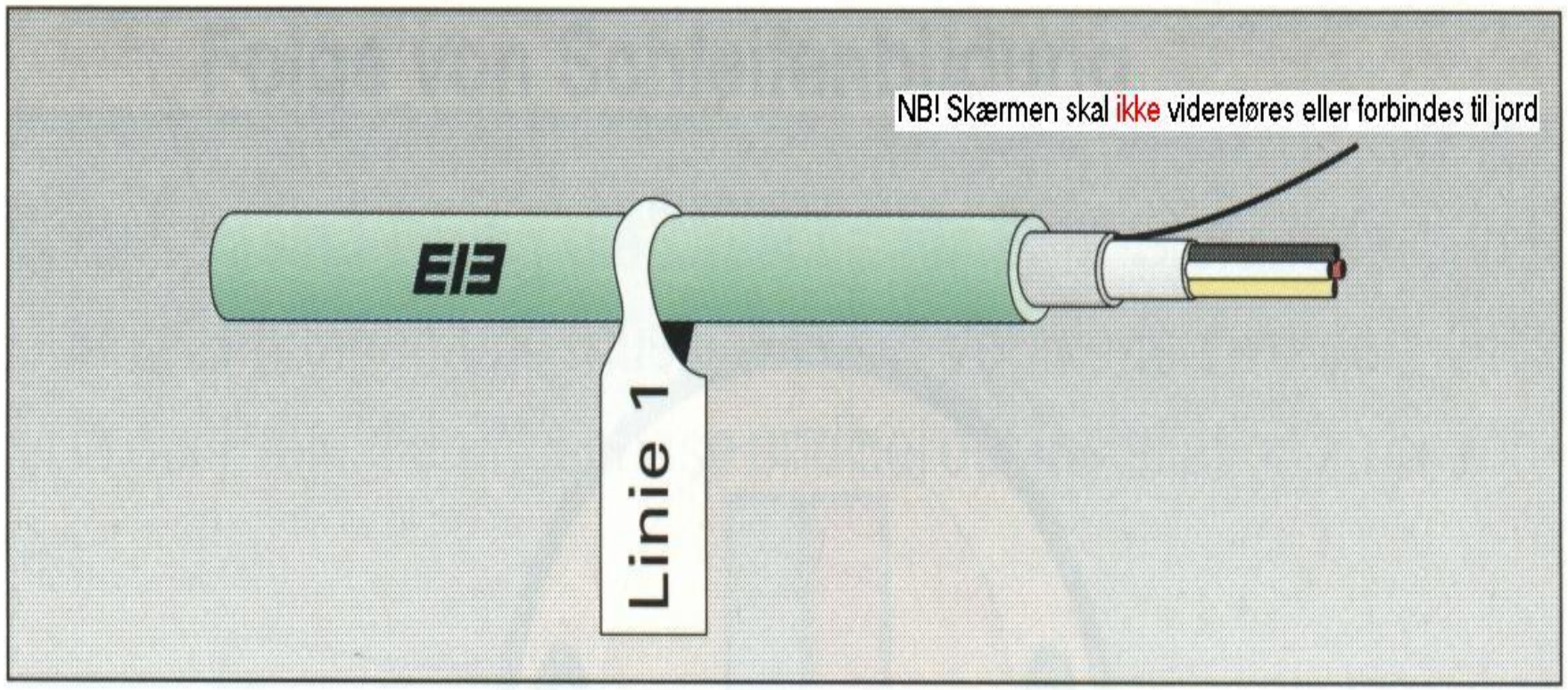


Bild 4-6 Beispiel einer Kennzeichnung

Busafgrening

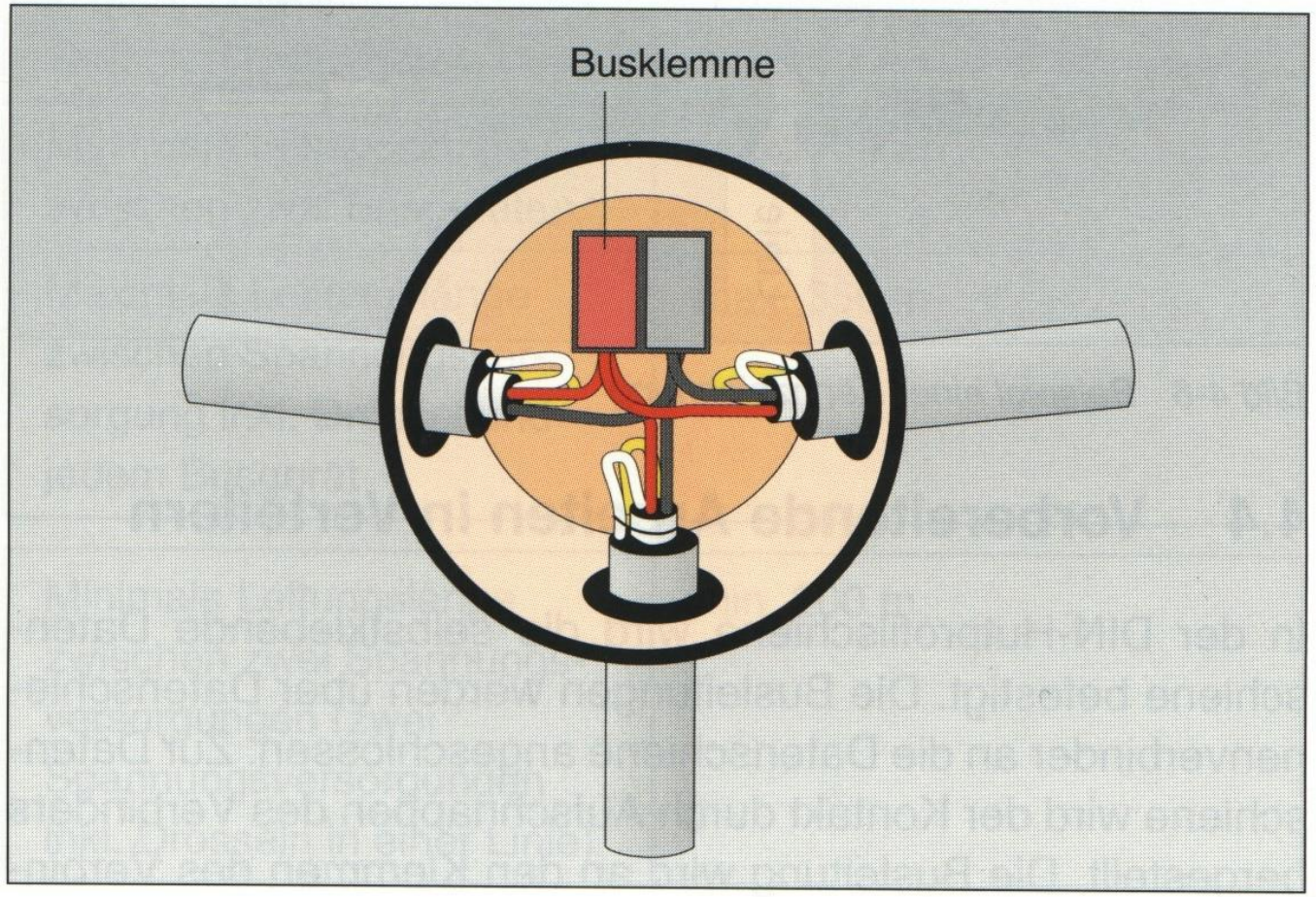


Bild 4-5 Verbindungsdose

Nærføring kabelleder/buskabel

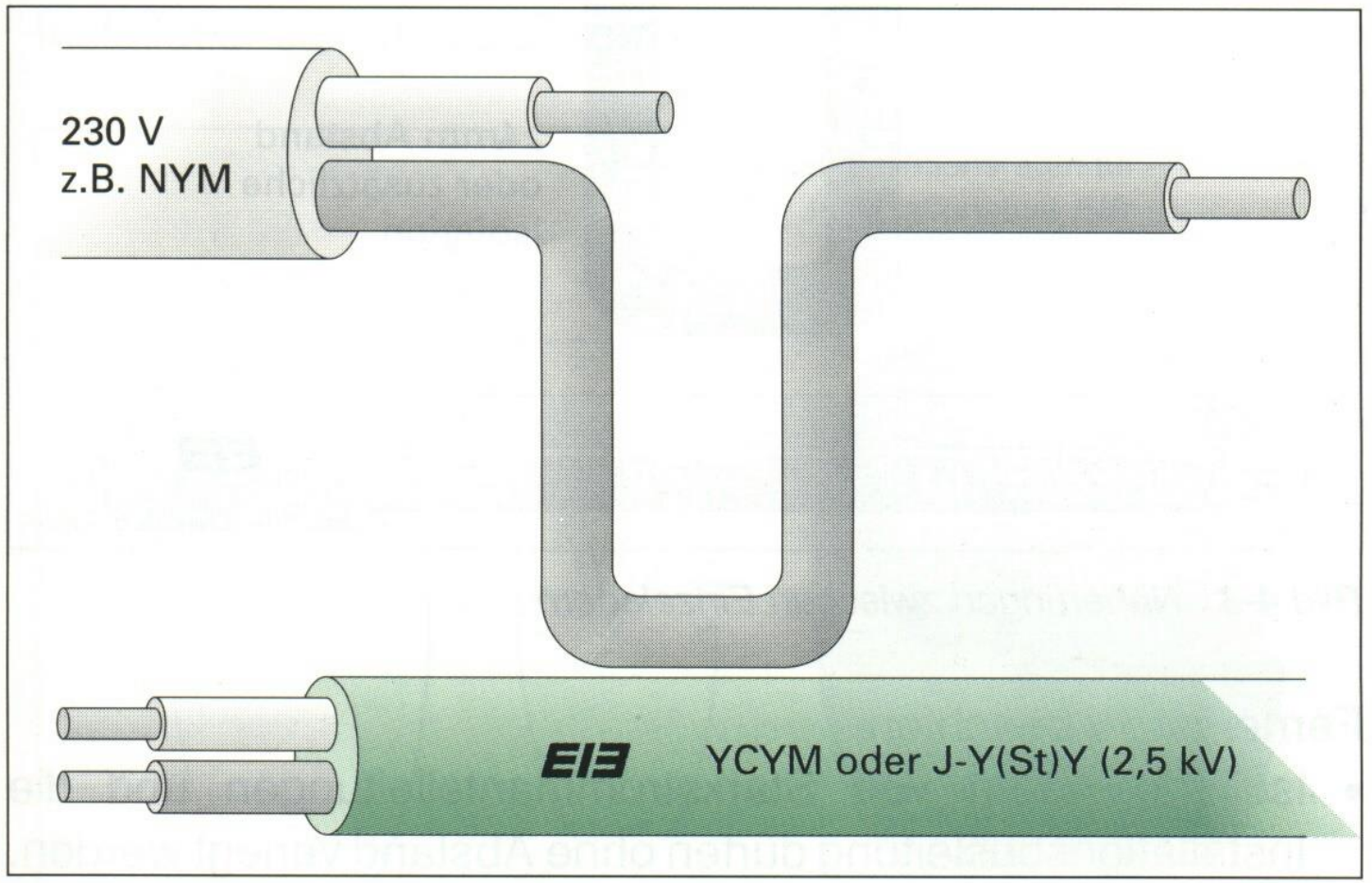


Bild 4-1 Isolierte Einzelader 230V neben dem Mantel der Busleitung

Nærføring busleder/PVIK

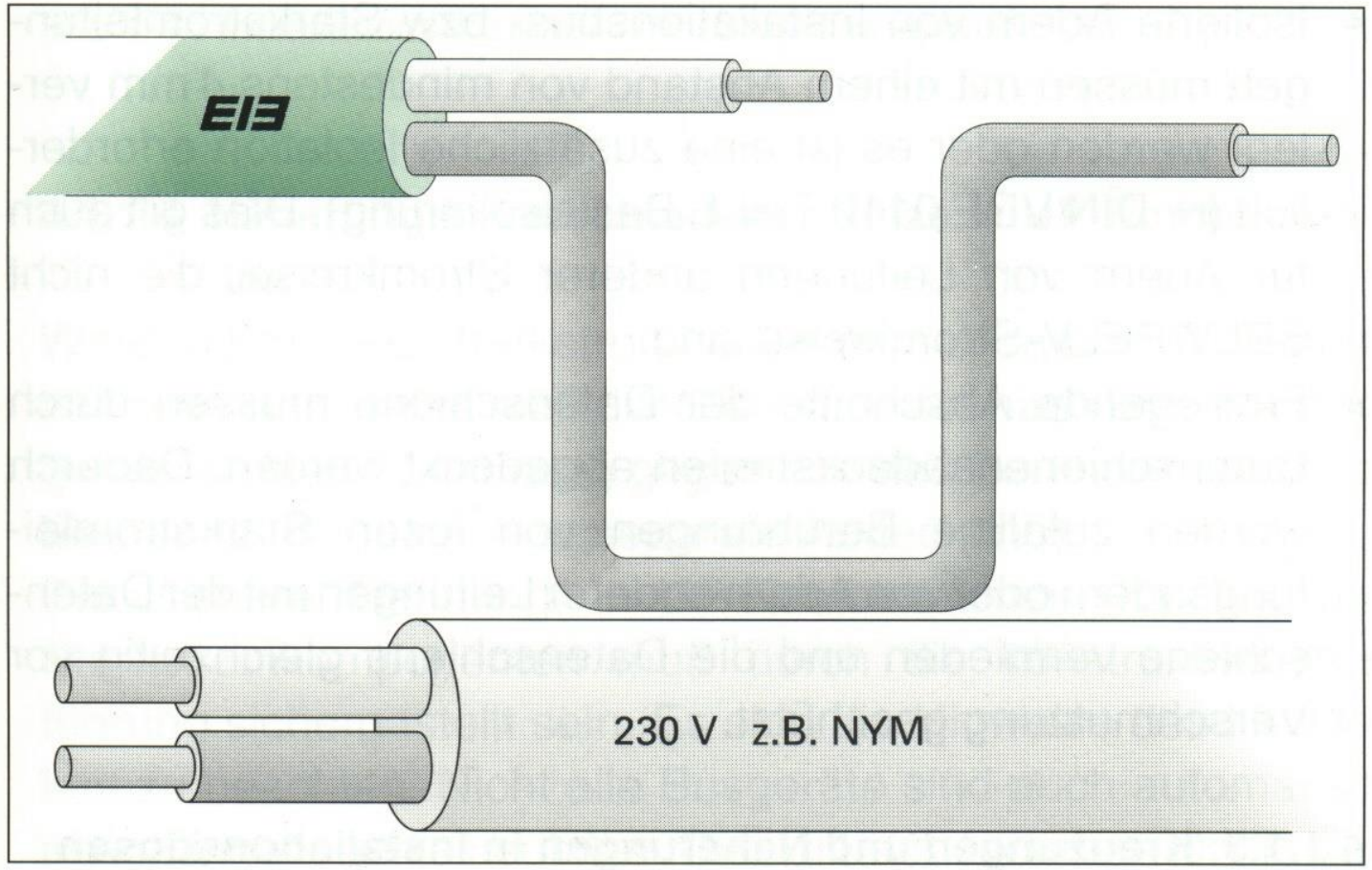


Bild 4-2 Isolierte Einzelader der Busleitung neben Starkstrommantel-leitung

Nærføring kabelleder/busleder

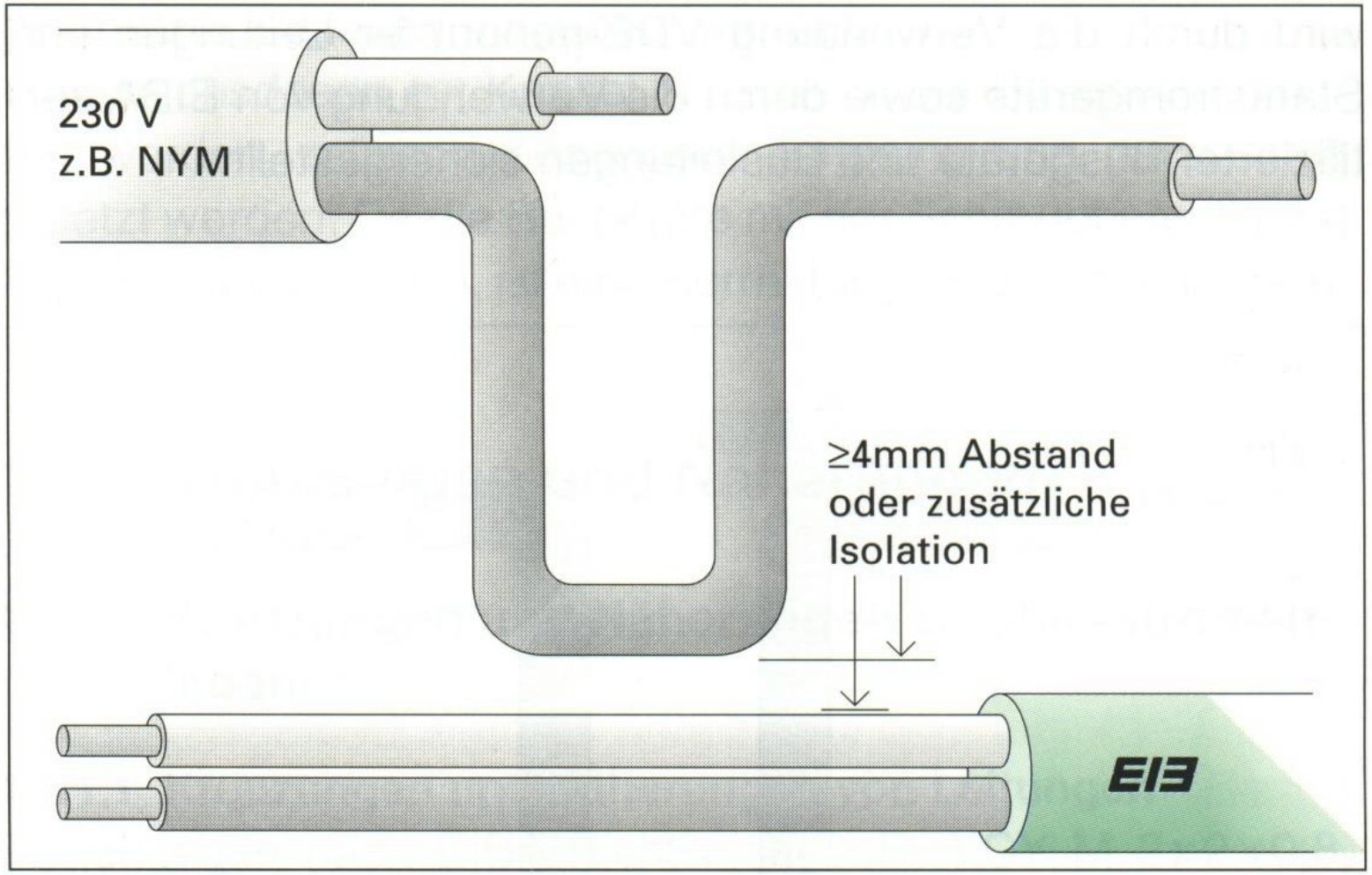
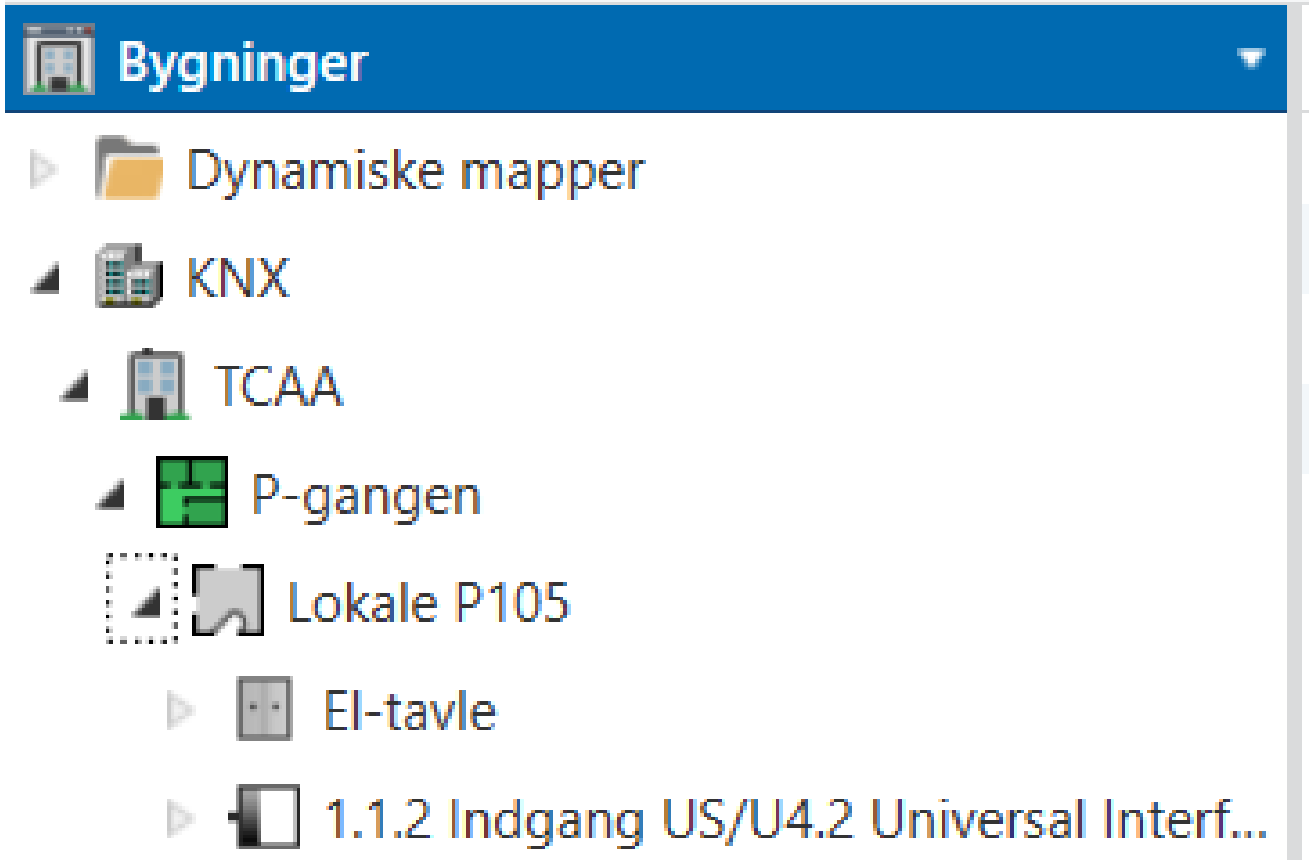
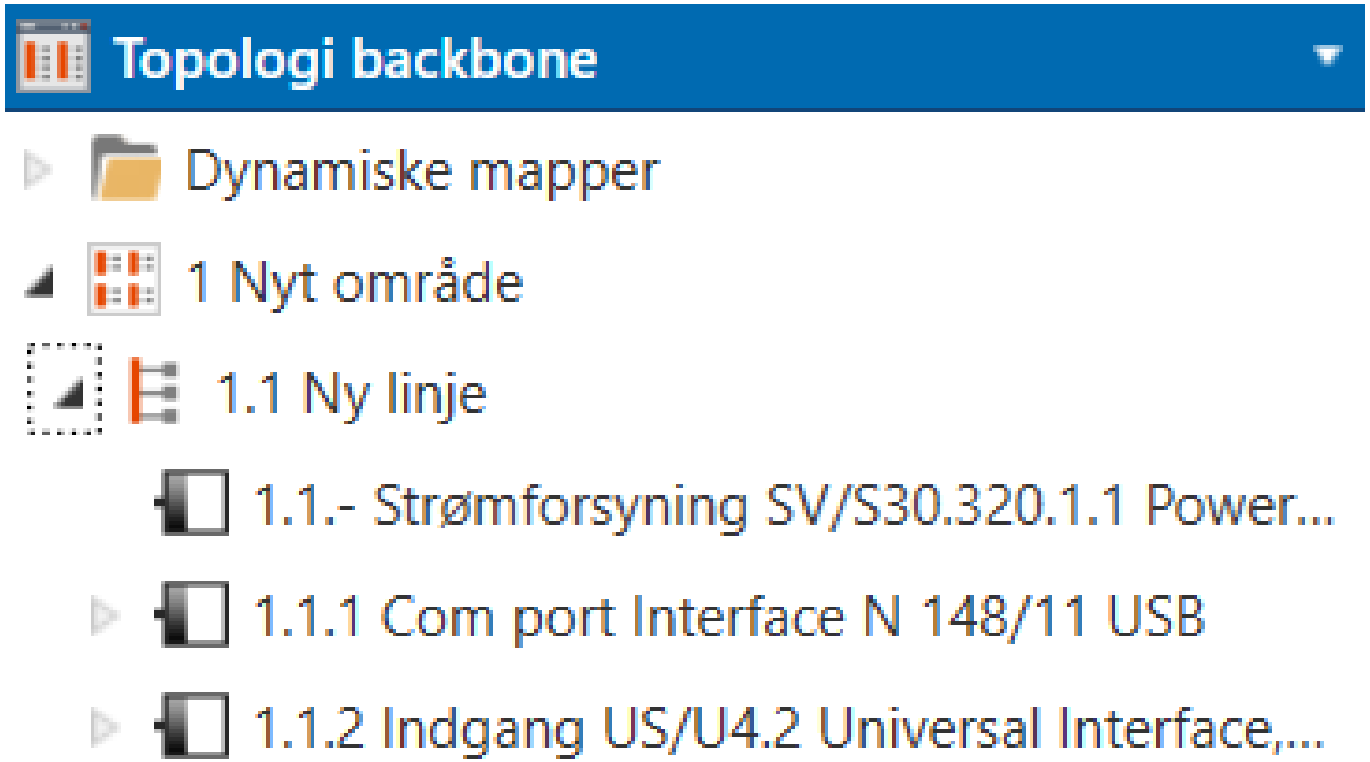


Bild 4-3 Näherungen zwischen Einzeladern

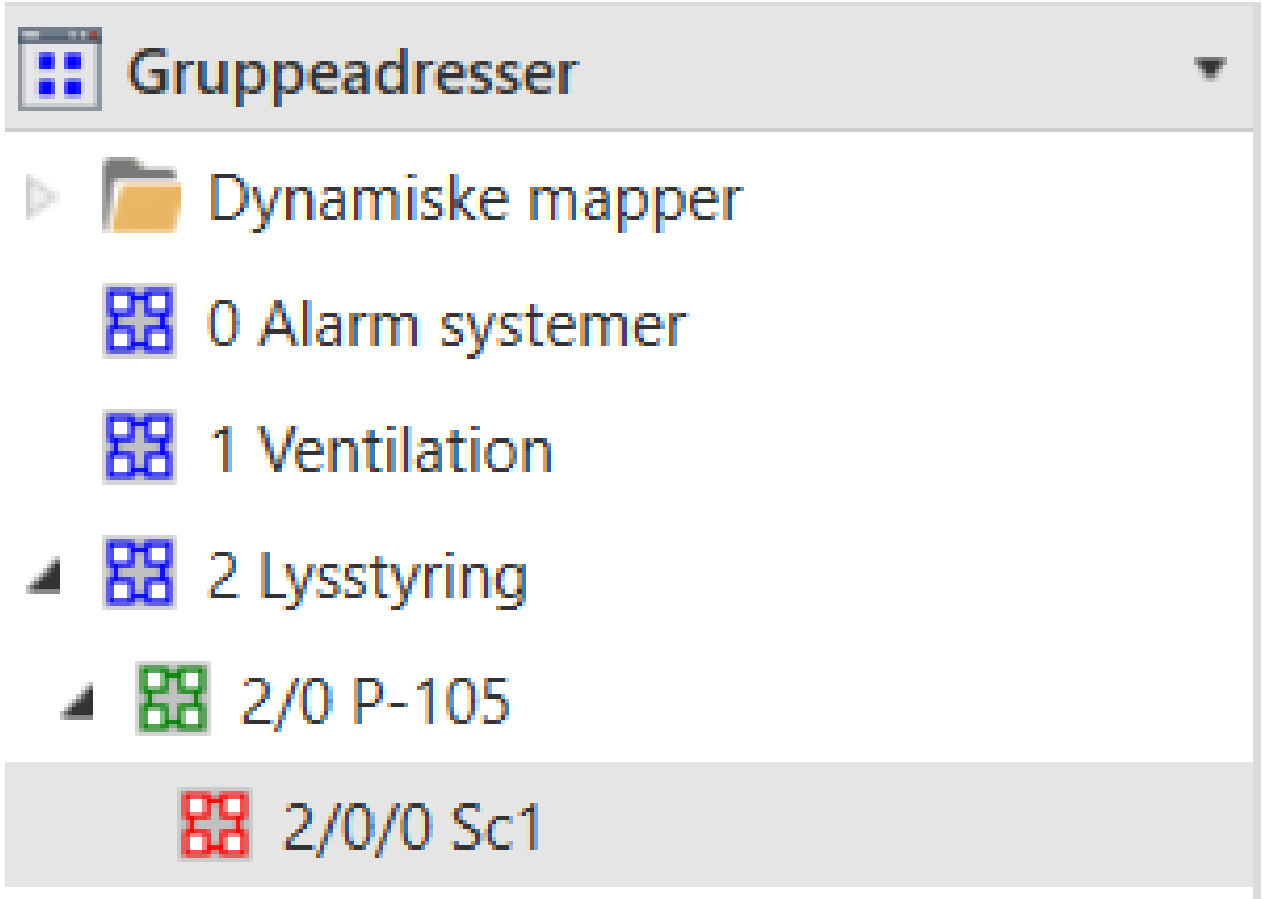
ETS Bygninger

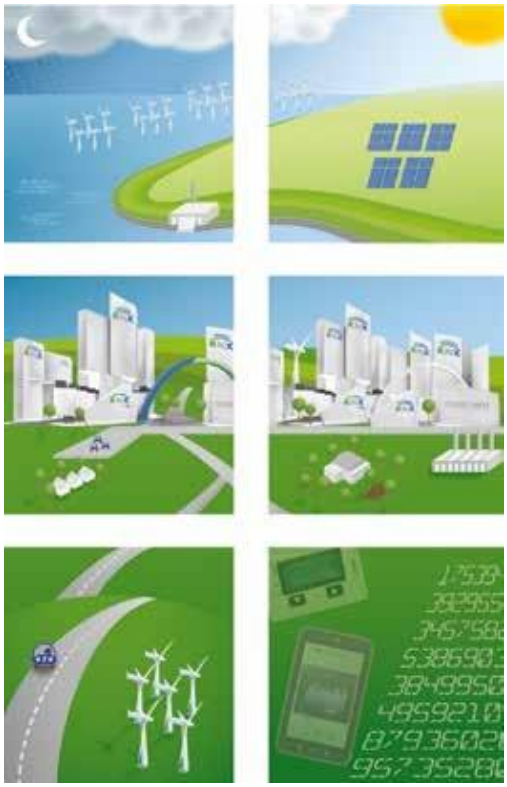


ETS Topologi



ETS gruppeadresser





Smart Energy Management

Solutions

Content

Safe integration of smart meter

The challenge
The consumption data of gas, water and electricity are confidential and must be protected from being accessed by a third party. The sensitivity of the consumption data lies in the fact that it allows conclusions to be drawn about the user behaviour of the occupants and can indicate their presence or absence. They may therefore not be transferred unprotected via publicly accessible data networks. The system integrator Elektronik Innovativ set themselves the task of protecting the transmission in the building system technology from unauthorised access.

The solution
KNX secure has been developed primarily to meet the new requirements of safe data transmission in a smart building. KNX IP Secure and KNX Data Secure offer the possibility of transferring the KNX consumption data via a KNX TP line or KNX IP Ethernet backbone, no longer transparently but encrypted with AES.

Practical implementation
The represented application simulates the typical building technology with a KNX installation for management and industry as well as a residential complex. It consists of three lines with different meters for gas, water and electricity.

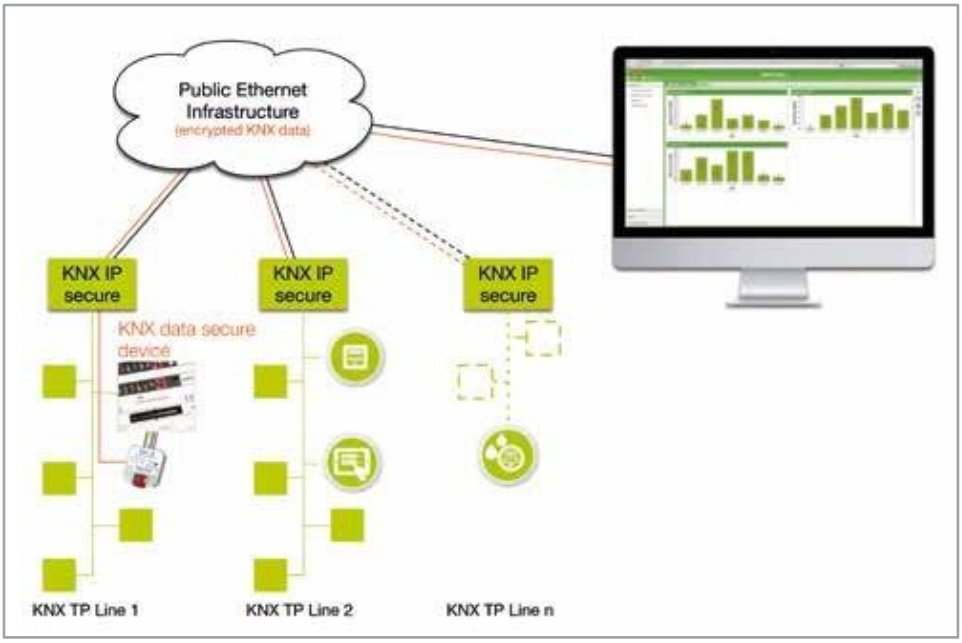
A Hager KNX energy meter has been installed as well as a conventional meter with a KNX SO interface. KNX IP Secure routers have been installed to safeguard the public KNX IP infrastructure. As the new KNX Data Secure binary interface Tapko TAI 4-gang can be used as an SO interface, the consumption data of this KNX TP application are likewise secured.

Functions
The data of different consumption meters is collected, encrypted using KNX Data Secure and made available to the central energy management system ICONAG-EnMS via secured KNX IP Secure transmission media.

Benefits
Previously, consumption data was largely transferred using a time-consuming and expensive method via proprietary data networks – not least due to the argument for guaranteeing data security. With KNX secure, sensitive smart metering applications can now be safely integrated in a comprehensive KNX system.

KNX secure components
- KNX IP Secure Router, Enertex
- KNX IP Data Secure binary input 4-gang, Tapko

Further KNX components
- KNX energy meter, Hager
- KNX power supply, Busch-Jaeger



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Smart Metering as a KNX application: consumption data and its transmission via the common building network is fully protected and illegible for a third party.

The secure way to replenish energy

The challenge
With the introduction of electrical mobility, charging devices have also become part of building system technology. It should be possible to integrate them in a KNX installation in the same way as other functions. The "CleverHome4you GmbH" in the KNX IoT city shows how communication with a conventional charging station can be implemented and how data about the charging processes can be monitored, managed and visualised with KNX. An essential element of the application is the protection of the communication paths and data from manipulation when importing energy.

The solution
With "Agentino Mobile", an intelligent IoT solution is available for integration. The logic and visualisation software has been conceived for control and visualisation devices in building system technology. Specific applications for the management of charging stations can be configured using the corresponding modules.

Practical implementation
A charging station from Walther Werke is used to provide a realistic demonstration. A LAN connection and web browser enable communication with the KNX installation via a KNX IP router. As a KNX Secure device, the router protects against unauthorised access. The KNX system is based on the usual components and is supplemented by KNX energy meters, KNX operating and display units, a KNX RGB controller and KNX LED luminaires. Using smartphones and tablets, it is not only possible to operate the applications but also to monitor the charging processes. With the help of the Agentilo Mobile software, the data about the charging process can be used in many different ways.

Functions
With modern charging stations, there are important protocols available. It is therefore possible for example to check a right of usage, monitor a charging process and even regulate the energy import. KNX makes the corresponding evaluation units available for this purpose. The charging station can thus be controlled dependent on personal user behaviour. A visualisation with graphics and diagrams provides an overview of the amount of chargeable energy, the charging levels expressed as a percentage as well as personal usage. The available energy from a photovoltaic system can be displayed for example.

Benefits
Integration of public, semi-public and private electrical charging stations in the existing KNX installation. Charging processes can thus be visualised, monitored and controlled in many different ways. The operating interface of mobile devices such as smartphones and tablets also enables transparent recharging processes for electric cars and bicycles.

KNX secure components
- KNX IP Secure Router, Enertex

Further KNX components
- Logic and visualisation software, Agentilo
- Power supply, Enertex
- Energy meters, Enertex
- Operating and display units, iddero, VERSO, Enertex, MeTa
- LED luminaire, arcus-eds

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Smart charging stations with access protection

Secure networks of distributed facilities

The challenge

For efficient building management, it is advisable to combine the technical monitoring of geographically dispersed facilities of residential buildings, factories, commercial or public buildings. Transmission paths outside self-contained buildings and properties can however be exposed to unauthorised access. Safety functions and confidential data are therefore threatened and demand additional protection against hackers. GePro mBH rose to this challenge with a model KNX installation.

The solution

The KNX systems of the individual, dispersed buildings generally communicate via an internet protocol based for example on Ethernet using an unsecure point-to-point connection. Now that KNX IP Secure devices are available, the KNX IP communication can be protected cost-effectively using additional encryption and authentication of telegrams along the entire IP transmission path.

Practical implementation

To simulate the situation of distributed facilities, KNX IP backbone and control centre, the sample installations are equipped with KNX IP Secure routers from ABB and Enertex. In the buildings, KNX sensors simulate the building functions for temperature, humidity, CO_2 sensors, leakage sensor, dew formation sensor, valve drive and switch actuators. Various KNX control panels adopt central operating and control tasks buttons and LED displays as well as a KNX alarm and signal panel.

Functions

Room functions, vents, access control and alarm systems can be controlled and operated from a central location. Status signals, faults and alarms are displayed and evaluated centrally via the building control system. Signals can be acknowledged and switching commands can be triggered via central panels.

Benefits

The IP communication between distributed KNX installations can be better secured against malicious tampering with KNX IP Secure. All the IP telegrams which are transferred here on the basis of LAN/Ethernet are authenticated and encrypted.

KNX secure components

- KNX IP Secure Router, Enertex
- KNX IP Secure Router, ABB

Further KNX components

- KNX signal and alarm panel, GePro
- KNX panel, GePro
- KNX sensor, Arcus Control
- KNX leakage sensor, Elsner
- Dew formation sensor, Insta
- KNX motor valve drive, Jung
- KNX switch actuator, Siemens

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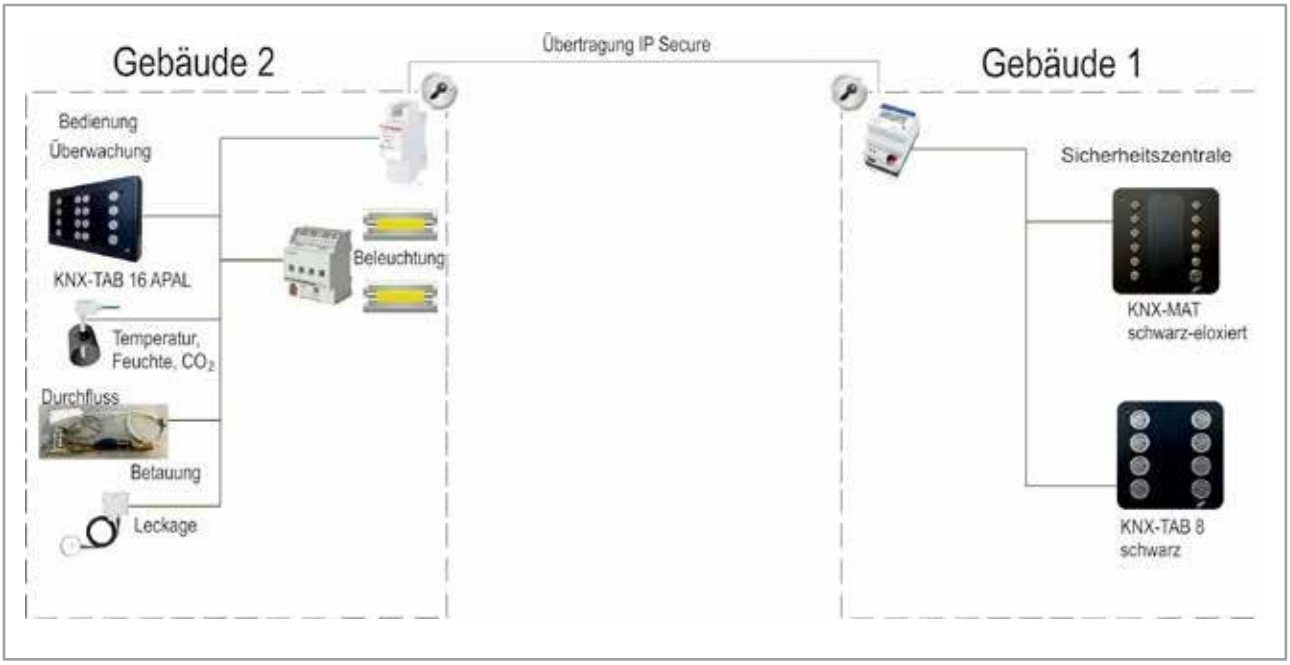
The routes between facilities can be far-reaching and dangerous, at least for confidential data. The Ethernet connection with KNX IP Secure protects simply and cost-effectively against unauthorised access.



Data protection of digital energy transition

The challenge

More than a third of the energy produced is consumed in residential buildings. The energy efficiency in your home is therefore very important. Digital energy transition within your own four walls is based on KNX and intelligent electricity meters - this is the vision of HSEG, the engineering office for electrical planning and building system technology. The sample installation has the task of controlling the flow of energy in the house dependent on consumption, costs and time. The temporary storage of energy should provide a certain level of independence from energy suppliers.

The solution

Surplus generated energy can be stored in batteries. It would also be feasible to charge electricity from the public network if energy suppliers offer incentives in terms of tariffs. In a similar way as maximum surveillance, it is also possible to regulate energy applications using KNX logic. The use of KNX secure meets the increased safety requirement of this application.

Practical implementation

At the core of the installation is an E3/DC solar power storage unit and the KNX Connect interface. The KNX installation illustrates how the IP backbone is protected with KNX IP Secure against access and how all the communication between the terminal devices is secured with KNX Data Secure using authentication and encryption. The IP Secure backbone between two KNX IP Secure Routers links two TP Lines. One is equipped with KNX secure devices such as Line Couplers, push-button interfaces, touch sensors, KNX room temperature controllers and switch actuators. The other conventional TP Line with KNX Connect integrates the E3/DC home power station with battery. The mixed installation documents the possibility of simultaneous secure and unsecure communication. An IP visualisation panel supplements the system.

Functions

KNX adopts the logical control of energy management, dependent on solar power generation, on tariffs in the public electricity network and on current energy consumption. The KNX logic queries performance and energy values, controls the battery charge or discharge, switches loads, reports faults and can even control an in-vehicle charger. Charging states, battery power, energy consumption and other values can be displayed via a visualisation screen.

Benefits

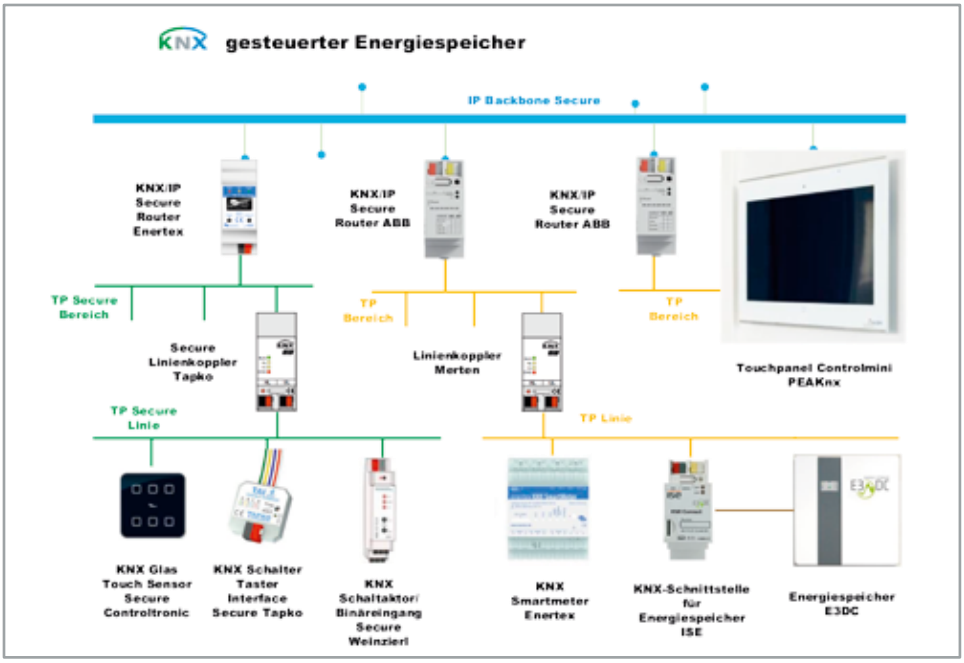
The battery storage in connection with KNX lowers energy costs, enables flexible energy usage and provides safety against power failures. KNX secure protects functions and confidential data against hackers and saboteurs.

KNX secure components

- KNX IP Secure Router, ABB
- KNX IP Secure Router, Enertex
- KNX Data Secure Line/ Backbone Coupler, Tapko
- KNX Data Secure 4-gang contact interface, Tapko
- KNX Data Secure glass touch sensor, CONTROLtronic
- KNX Data Secure switch actuator IO 511, Weinzierl

Further KNX components

- Line Coupler, TP, Merten
- KNX Connect, ISE
- KNX smart meter, Enertex
- Touch panel, PEAKnx



HSEG

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Energy management without snooping: sample installation with new KNX Data Secure devices and KNX IP Secure routers protect energy and consumption data against espionage.

Energy efficiency in retrofit

KNX as an advantage when retrofitting

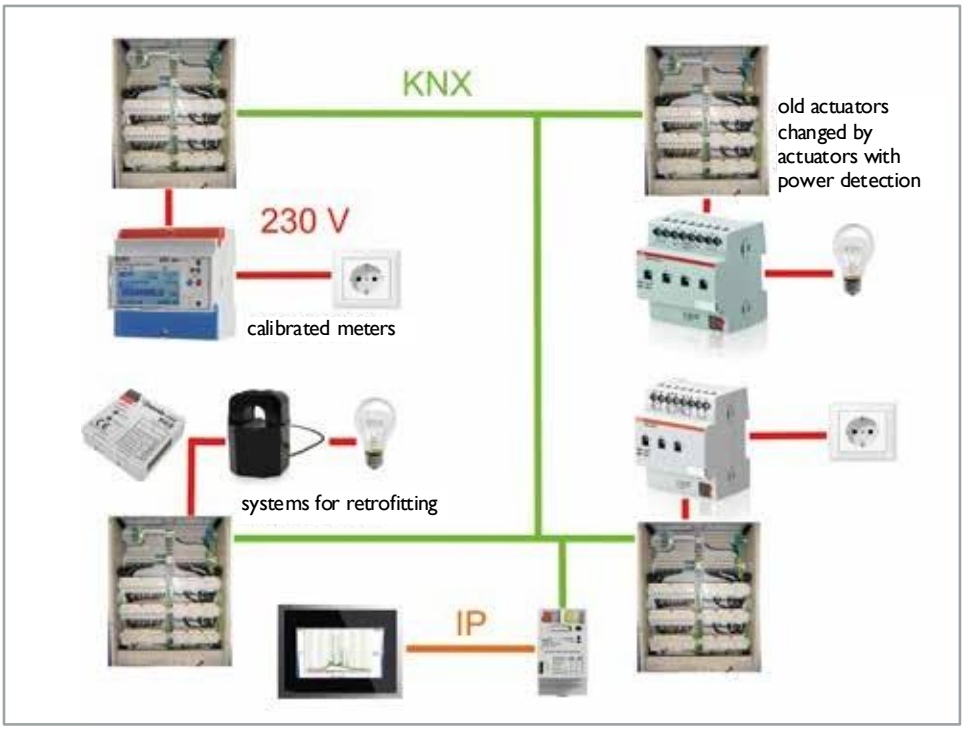
The challenge
The KNX city is built on solid foundations. That includes not just the trusted KNX system itself, but also the experience gained over the past 20 years of equipping buildings with KNX bus lines, either as part of early automation efforts or as a far-sighted precaution. KNX connects the key technical features in buildings better than any other system. Ingenieurbüro Beyer shows how this trump card can be played to make existing buildings more energy-efficient. The first step is always a detailed consumption survey in order to observe and document the energy consumption.

The solution
The KNX system offers numerous solutions for surveying consumption both centrally and decentrally. As well as single and three-phase KNX energy meters, KNX actuators with current detection and KNX modules with current transformers are also available. Although the measuring accuracy of the latter is not suitable for billing purposes, it is sufficient to give a general idea of the energy consumption in a building. They can be used, particularly in existing distributors, as space-saving replacements for the original actuators, or fitted in sockets.

Practical implementation
The project application uses various different energy meters: KNX meters for overall consumption (Gira), KNX energy actuators (ABB) and actuators with current detection for the consumption in consumer circuits, and a KNX ammeter with current transformer (Zennio) for individual appliances. Additional consumers can be switched on using KNX push buttons.

Functions
All the KNX energy data can be recorded, documented and visually displayed at a central location, as preferred by building operators in real life. The data are then available for processing with Excel or for access by a superordinate energy management system. Charts and graphics can reveal the energy consumption of a building over the course of a day. Individual consumers can be shown if desired, and photographs of distributors in existing buildings provide a convincing argument in favour of retrofitting with KNX measuring equipment and of how easy it is to carry out.

Benefits
- Use of the existing KNX bus line for retrofitting existing buildings with measuring equipment
- Centralised and decentralised energy consumption measurement
- Overview of energy flows for the optimisation of energy consumption
- Historical energy data for monitoring the effectiveness of energy-saving measures
- Database can also be used by other programs



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Demand Side Management

Use solar power instead of paying for peak power

The challenge

It makes sense in economic terms if urban electrical power requirements are matched to the power being generated at the time. The incentive for this is provided by energy supply contracts dependent on peak loads, or 'differential electricity tariffs'. Intelligent demand side management systems are growing in importance, especially as a way of complying with the conditions of these kinds of contracts and tariffs, particularly as a consequence of the increased contribution by solar and wind power. The company Gebäude-Programmierer-Service e. K. Helmut Haßenpflug, Frielendorf, shows how commercial consumers can use KNX to avoid expensive peak loads and benefit from low-cost tariffs or even self-generated solar power, taking a canteen kitchen as an example.

The solution

The consumer load consists of two boiling pans of 18 kW each, one tilting fry-top (20 kW), and three steamers (19 kW each). The aim is to control these heavy-duty units so that the total of their individual loads does not exceed a preset value. This set value is represented by energy values valid for 15 minutes at a time. In consultation with the chef, rules are drawn up setting out priorities so that the units can be switched off for short periods without any noticeable effect on performance.

Practical implementation

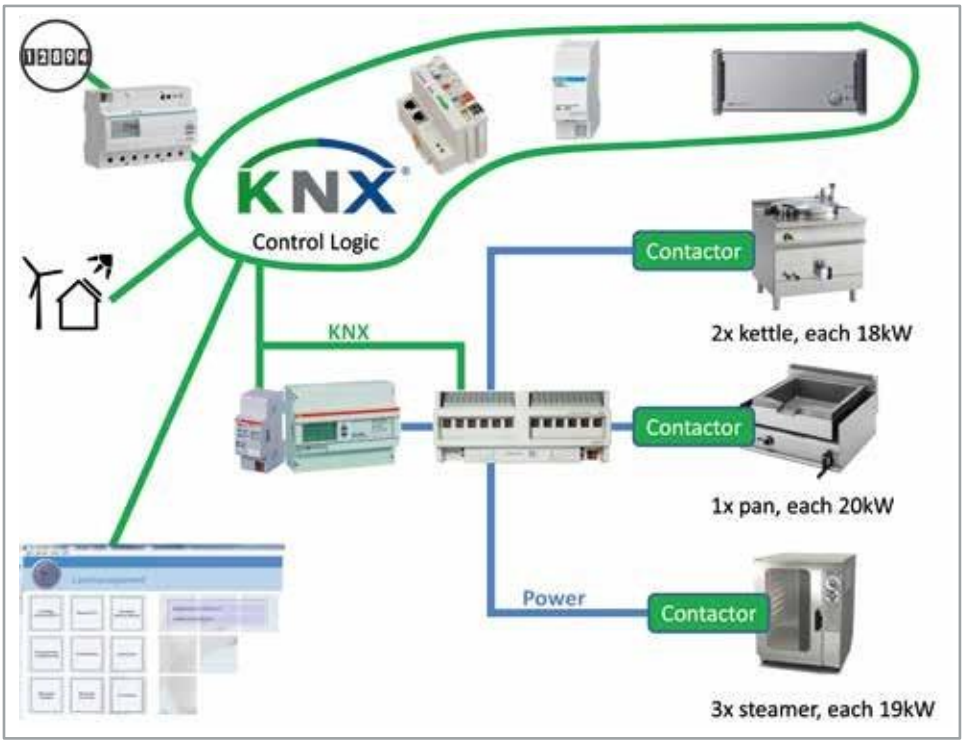
The electrical consumers are represented by KNX energy meters (Hager, ABB) or an S0 tap on the main meter. As the canteen kitchen units are fitted with potential-free contacts, their contactors can be operated directly by KNX switching actuators. The logic connections are implemented via a KNX visual display. The demand side management system also takes into account the power generated by the installation's own photovoltaic system (installed power: 30 kWp).

Functions

The demand side management system programmed using KNX software works in a more differentiated way than conventional maximum-value monitoring, and is based on a coordinated set of rules and setpoints. In order to be able to react at an early stage during the 15-minute intervals, the demand side management system continuously calculates the trend in demand. Furthermore, surplus solar power raises the setpoint, so that switch-offs that would have been necessary are avoided and self-generated energy consumption increases. One of the purposes of documentation of demand side management is to provide evidence of any manual intervention in demand side management (override switching) by the chef.

Benefits

- Demand side management integrated in the KNX system
- Prevention of peak loads
- Coordinated switch-off rules
- Increased use of self-generated solar power
- Expandable for tariff management purposes (high and low tariffs)
- Visual displays and documentation



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Renewable Mobility

Driving around town with your own solar energy

The challenge

Electric mobility will play an important part in sustainable cities such as the KNX city. A key aspect of this is that electric vehicles used in private transport will be charged using renewable, carbon-neutral energy. As the timeframe for charging electric cars at charging stations in car parks or garages is usually flexible due to long standing times, the charging operation can be adapted to the building's own solar collectors or wind turbines. The presentation by Koyne-System-Elektronik, Berlin, shows an intelligent solution to this problem based on KNX.

The solution

The project shows a single family home with its own photovoltaic system, the power from which is both fed into the grid and consumed on site. If a lot of solar power is produced and not much is used in the house itself, it makes sense to charge the electric vehicle using the surplus solar power as far as possible. The KNX system calculates an output target value from the difference between the current grid feed-in and private consumption. This is used for calculating the charging capacity.

Practical implementation

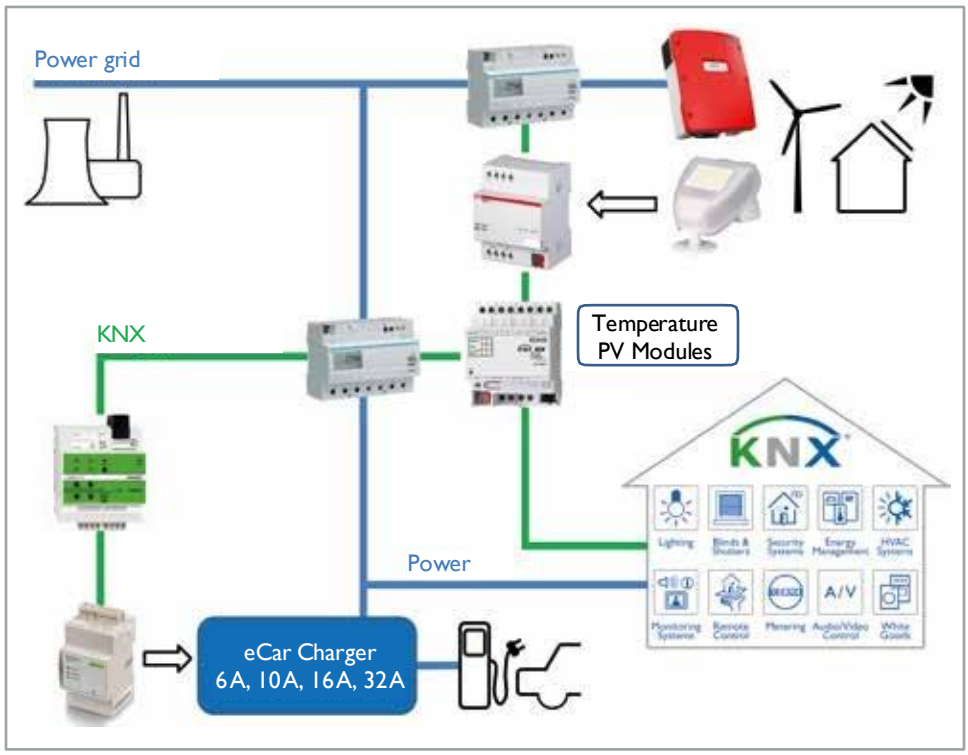
KNX meters (Hager) measure the consumption and generation figures. A KNX weather station (ABB) supplies data on wind, rain and solar radiation. Temperature values are sent to the bus by the KNX analogue input (Jung). The charging post is controlled using KNX logic and a KNX actuator. Current solar radiation values and the temperature of the solar modules measured by KNX are used for monitoring and control.

Functions

The particular technical refinement of the presentation is the interface between the electric vehicle and KNX. The charging post is fitted with a charging control unit (Wago Pilot-Box). This starts and stops the charging process and can automatically set different charging currents (6 A, 10 A, 16 A, 32 A) controlled by KNX. This is regulated using the set value calculated from the energy surplus. The underlying logic is: small surplus = low charging current, large surplus = high charging current. The channels of a KNX actuator drive the potential-free inputs of the Pilot-Box accordingly. The connection to the electric vehicle is via standardised pulse-width communication.

Benefits

- Use of carbon-neutral energy for private transport
- Increasing private consumption from solar power
- Solution is simple to implement
- Use of the KNX system which is already installed
- Based on the calculated energy surplus, KNX enables other consumers to be activated, further increasing the amount of power consumed on site.



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Saving heating energy costs

Efficient heating with fire and flame

The challenge

One single system to control all building services and components conveniently, reliably and energy-efficiently: that's KNX. One of the ways in which the KNX system increases energy efficiency is by making more efficient use of primary energy, thus benefiting the world's climate, the environment, the purity of the air in our cities, and last but not least the user's wallet. The project from the engineering company HSEG (Ingenieurbüro für Elektroplanung und Gebäudesystemtechnik Dipl.-Ing. Holger Schult) from Glienicke in Germany shows how KNX individual room control can be retrofitted in order to exercise direct control over the heating gas or oil burner.

The solution

Until now, consumption of primary energy has been regulated entirely by boiler controls, which respond to the outdoor temperature, in contrast to thermostatic valves that respond to the temperature indoors. However, a holistic heating control system will also take into account the current heating requirements for the supply temperature, which will save primary energy. This is achieved by a KNX gateway to the boiler control bus protocol, which creates the necessary link to the heating system. Individual room control can be retrofitted as a wireless system, and linking the valves with window contacts optimises the energy efficiency still further.

Practical implementation

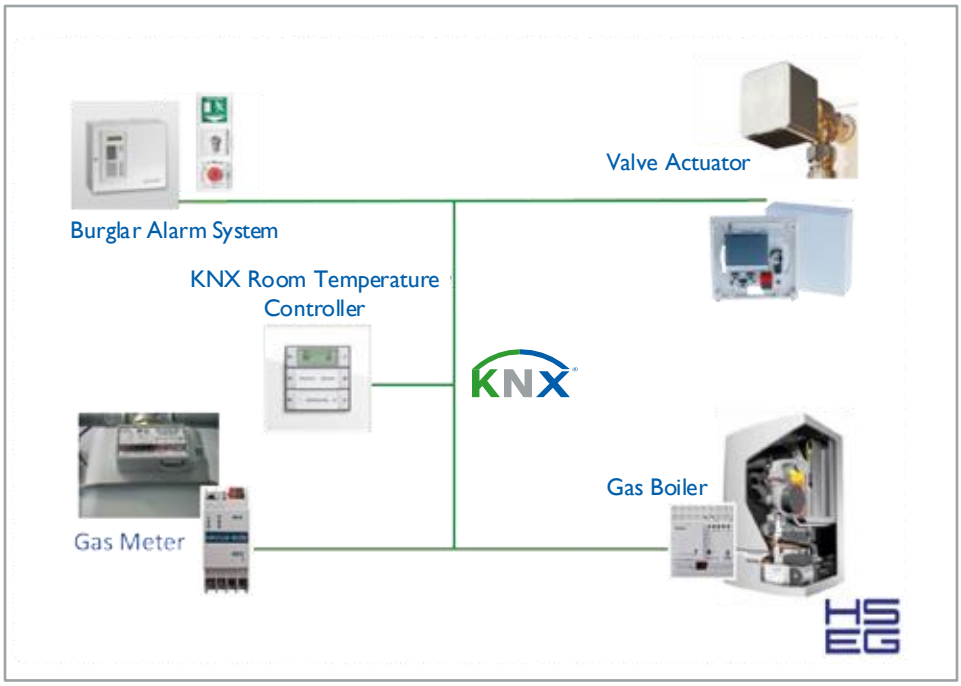
The presentation shows how KNX individual room control can be easily retrofitted via a wireless system (Weinzierl). The connection between KNX and the boiler is provided by an OpenTherm/KNX interface (Theben), allowing the KNX system direct access and regulate the gas flame, control a circulation pump and request information about the boiler temperature. The gas consumption is determined by an S0/KNX converter (Arcus EDS). The existing alarm system can be used to monitor the windows – an example of the synergies offered by the KNX system.

Functions

When heat is requested by a KNX room temperature controller (Gira) connected to the system, the request is transmitted to both the valve actuator and the gas flame. The intensity of the heat supplied is calculated on the basis of a sophisticated logic based on room sizes as a proportion of the overall building surface area, so that the supply temperature is matched exactly to the requirements. Furthermore, timer schedules ensure economical heating by automatically switching the room temperature controller to standby or reducing the temperature at night. A visual display and documentation of the heating control system and current gas consumption in the actual residential building can be consulted to optimise energy-saving efforts.

Benefits

- Energy-efficient heating
- Primary energy savings
- Permanently comfortable heating matched to requirements
- Simple to retrofit
- Continuous monitoring of consumption
- Flexible for further optimisation



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Self-sustainable single family home

Energy management when you're off-grid

The challenge

'Self-sustainable – that's what we ought to be!' is the thought running through the mind of many a householder every time the electricity bill comes in. In view of the energy turnaround and its constantly increasing prices, the trend towards energy self-sustainability could be interesting in the sustainable city as well. In remote areas, some buildings already meet all their power needs with self-generated electricity. The presentation by Smart Building Design GmbH from Switzerland shows how KNX can optimise the interplay of energy generation, storage and use.

The solution

The project shows the KNX installation at 'Finca Los Míticos' on the holiday island of Mallorca. The 450-square metre property includes a residential house, a guest house and a swimming pool. Electrical energy is generated by a 5.5 kWp photovoltaic plant and a 1.2 kWp wind turbine, and the energy storage unit consists of an 800 Ah/40 V solar battery. If these energy sources are not sufficient, an emergency power generator steps in. Heat for hot water and heating is provided by solar collectors or in an emergency by an oil-fired boiler. The KNX system performs a number of different tasks in order to match the electricity consumption in the building to the availability of electrical energy, and to coordinate the various energy sources with one another.

Practical implementation

The building services have been designed with energy efficiency firmly in mind. For example, the lighting uses power-saving LED technology, and importance is attached to having the highest Energy Label on the domestic electric appliances. The KNX system controls the lighting, solar control components and room temperatures and incorporates energy-saving automatic equipment such as presence detectors. If the electricity supply nonetheless starts to run low, a load-shedding function switches off certain predefined consumers for a brief period.

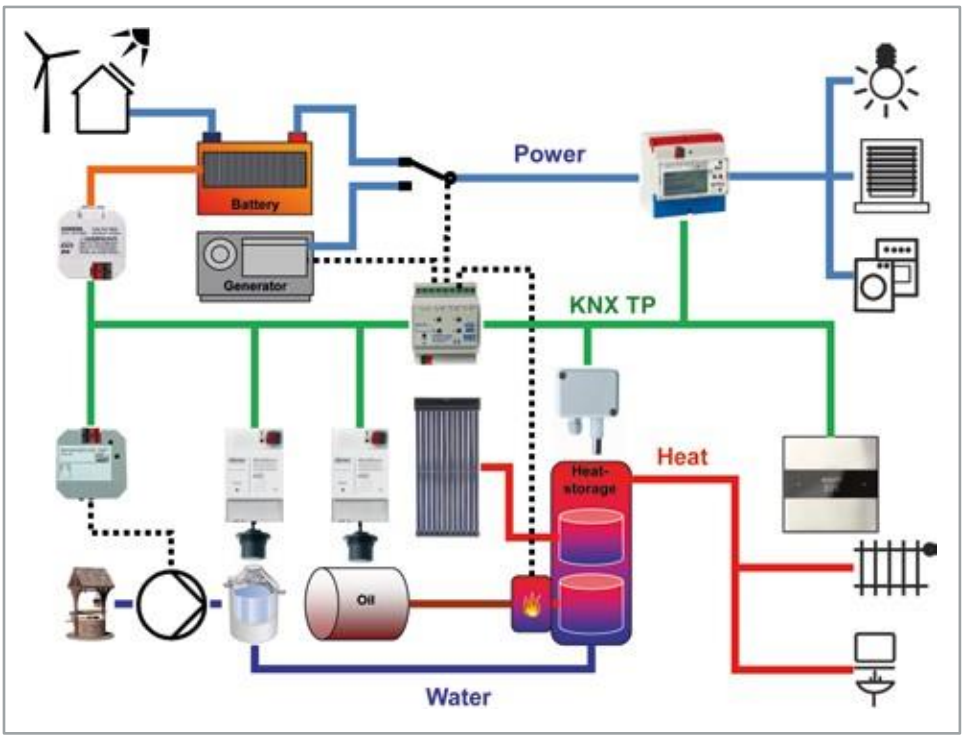
Functions

The system's sophisticated technical features also include battery charge monitoring by a KNX analogue input. If the charge drops to a level below 50 percent, KNX starts the generator and switches over the power supply line. Electricity consumption is measured, analysed and visualised by KNX.

KNX sensors (Lingg & Janke) measure the supply and return temperatures and also the temperature in the heat storage unit of the solar and heating system. If the heat hits a minimum level, the oil burner is started. KNX also controls the well pump as a function of the cistern level, and monitors the heating oil tank and the protective circuit breakers.

Benefits

- More economical energy use
- Reliable electricity supply
- Solar, photovoltaic and cistern systems all integrated
- Heating and ventilation performance optimised by KNX
- Visual displays for operation, monitoring and analysis
- High energy efficiency



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Distributed facilities

A quick check on what's going on at the office

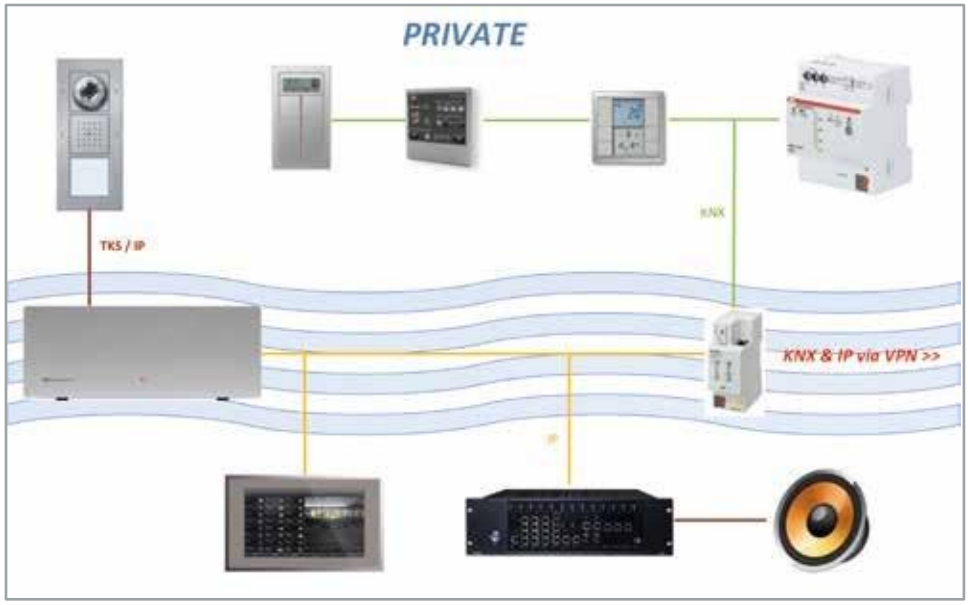
The challenge
Is there anyone still in the office? Has anyone remembered to put the alarm on? Employers in particular will appreciate the way that KNX makes it possible to check up on your business premises, turn down the air conditioning or switch the lights on or off, all without leaving your own home. Elektro Wagner GmbH in Wehrheim, Germany, has tackled the issue of networking two sites to permit the operation and monitoring of one building from the other. The project additionally shows how several sites can be incorporated into a single, centralised energy management system, in line with the 'sustainable city' concept.

The solution
The sample project is portrayed with the help of two examples, one representing the typical functions of a residential building, the other showing examples of the technology that might be found in a commercial building. All of the functions of the two buildings, for example lighting control, the shading system, home communication, media control and malfunction messages are integrated into a single, completely homogeneous operating concept. The internet is the network used to link the two 'buildings'.

Practical implementation
Both of these two building installations are based on KNX technology. They are joined by KNX IP via VPN (Gira, with ABB KNX IP routers). The VPN Tunnel ensures that communication between the buildings is adequately protected against unauthorised access.
In the residential building there are local operating keys for light, room temperature control, music and voice (Merten, Jung, Elsner, Arcus-EDS), a video entry phone system (Gira), and a Multiroom system (Trivum). All functions can be viewed on a single visual display (Homeserver), and monitored, controlled and preset via a touchscreen (Gira). This is where all alerts and video footage from the house system are displayed. The 'commercial building' demonstrates, for example, how a VdS-certified burglar alarm system can communicate with a KNX installation. The integrated KNX interface links the systems in a completely transparent way, allowing status information to be requested and control room equipment to be operated all via KNX.

Functions
KNX does not only allow the functions of the commercial building to be monitored and controlled from the residential building; conversely, it is also possible to determine from the office whether someone is ringing the doorbell, the heating system is faulty, or the CCTV has been triggered back at home. The convenient 'talking' room controllers (Enertex) will be a very popular attraction among visitors to the fair. Not only can they be used to control lighting scenes, multimedia and setpoint temperatures by voice, but they can even answer users' spoken questions about the statuses of these functions.

Benefits
- Easy monitoring of the building technology in separate buildings from a single location
- Consistent, ergonomic operating concept means two buildings can be operated just as easily as one
- Easy to quickly check operating statuses and remedy faults
- Better monitoring of energy use saves energy and money
- System is easy to modify or add to thanks to KNX technology



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Overall energy management in buildings

Central control increases hospital efficiency

The challenge
Everything in hospitals in the sustainable city is focused on the treatment and recovery of the patients. This requires the building services to function faultlessly. The sample project by ib company GmbH, Pforzheim, is based on a project that has already been implemented. The task was to network several buildings in an existing hospital complex to permit modern, efficient building control with central energy management. A central control station is required to monitor and operate the technical systems, receive error messages and process energy data. Additional tasks: the room functions also needed to be automated to increase comfort, convenience, safety and security in the wards, and as energy-saving measures.

The solution
The electrical installations in the hospital buildings were fitted with KNX a few years ago. An ideal solution to the task therefore presented itself. The existing KNX-based building services could simply be combined into a single unit using a KNX/IP router (Hager). The central control station for building management now allows visualisation of all the functions in the buildings. The sample project shows in particular the field bus level for regulating the individual room control, lighting control and blind control plus various operating options.

Practical implementation
If KNX is already integrated in the building, then functions can often simply be retrofitted. The KNX individual room control (Gira) was implemented using wireless window handles (EnOcean) and an appropriate KNX Gateway (Wago), without having to lay any cables. This measure helped to avoid heat loss e.g. through open windows. Automatic functions were also integrated for the lighting and solar control. The extensive parameterisation work in the actual project was facilitated by the KNX configurator with automatically generated Group Addresses.

Functions
In addition to wall-mounted push buttons with room temperature control, the tablet attached to the hospital bed allows barrier-free operation of the room functions. Patients have control of the lighting, blinds and room temperature at their fingertips. They can also switch on and select programmes on consumer audio and video devices. In addition the tablet allows communication with the nursing staff via the integrated patient call system. The central functions of the control centre include alarm management. Fault messages are relayed to the relevant service department depending on their type and priority. Centrally compiled energy data including those generated on site are used for monitoring and optimising measures for efficient energy use.

Benefits
- Technical management for efficient building use
- Central energy management
- Fast response to fault messages
- Retrofittable energy-saving measures
- Barrier-free operation from hospital bed
- Comfort, convenience, safety and security for patients

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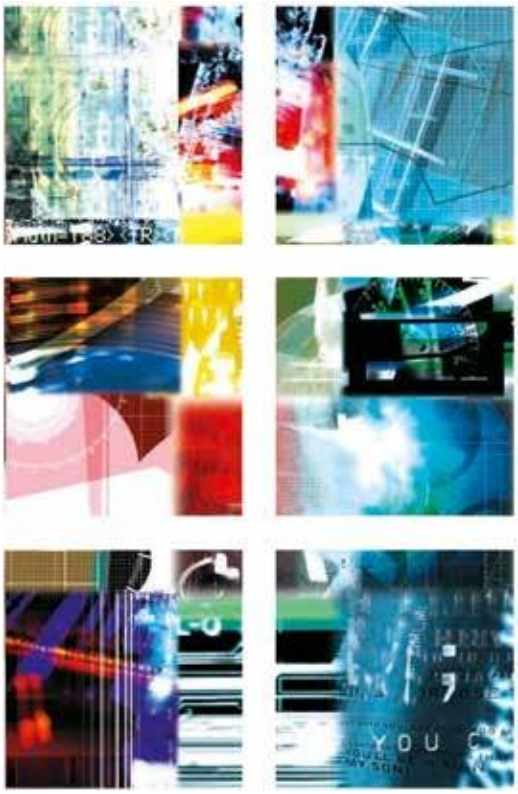
Control technology for distributed properties in hospitals



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