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KNX and IP

Agenda

- **Introduction**
- **IP as media for KNX**
- **KNXnet/IP**
- **Network Basics**
- **Devices overview**
  - IP Interface 730
  - Interface Function with the ETS
  - IP Router 750
  - Routing Table
  - Installation of the KNX/IP-Router
  - IP BAOS 771 / 772
  - IP Interface 740 wireless
  - IP Linemaster 760
- **Example of an Installation**
- **Remote Control**
- **Starting / Troubleshooting**
- **Future Prospects**

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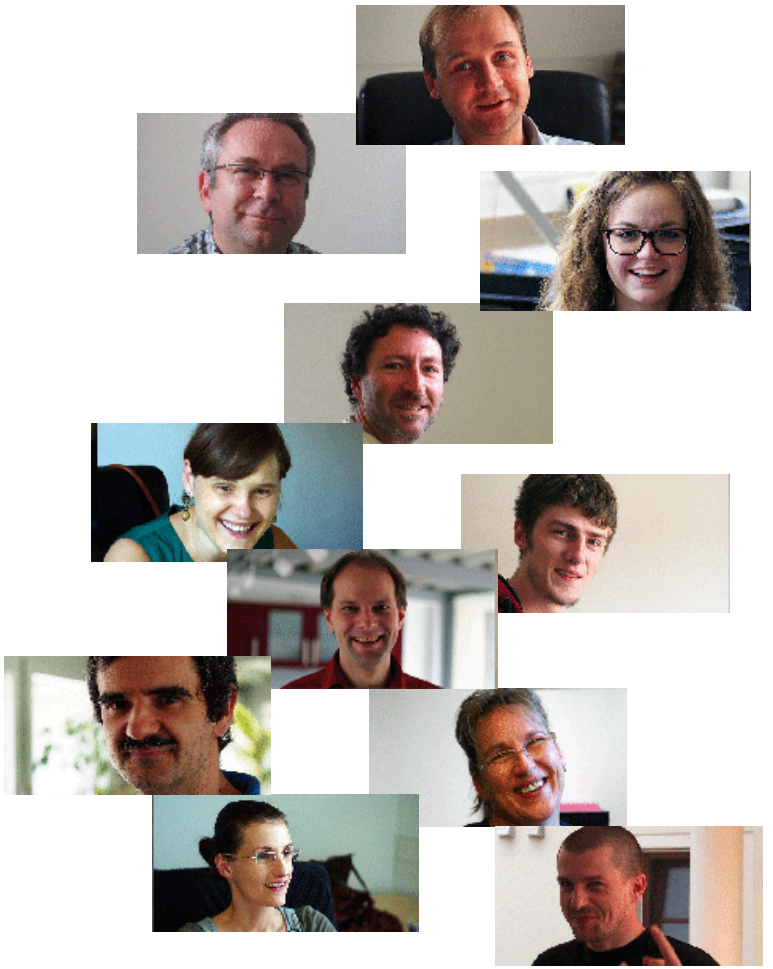
About us

- **Founded in 2001**
- **Management**
  - Dr.-Ing. Th. Weinzierl, CEO
- **20+ Employees**
  - 10 Developers
- **Quality management**
  - ISO9001
- **Own office building**



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Where to find us

- Burgkirchen an der Alz
- Germany
- South-East of Bavaria
- About 100 km East from Munich
- About 50 km North from Salzburg

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Focus: KNX

- **15+ years of experience**
- **Shareholder in KNX Association cvbl**
- **Active in the KNX System Group**
- **Complete support of the KNX Standard**
  - Technology
  - Solutions
  - Products
  - Accredited KNX Test Lab

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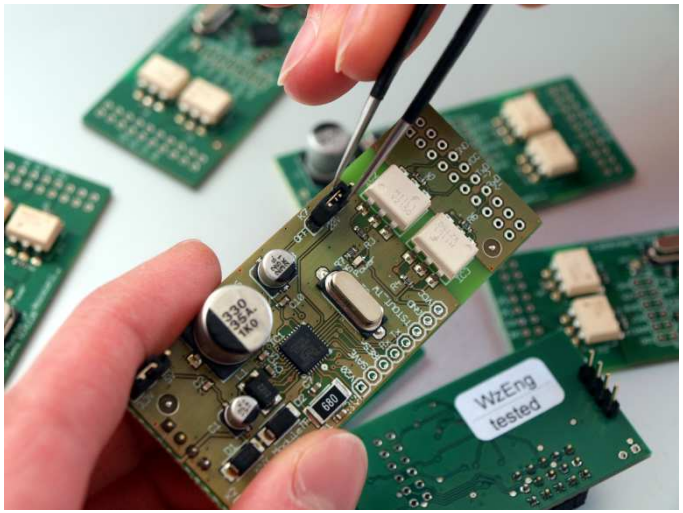
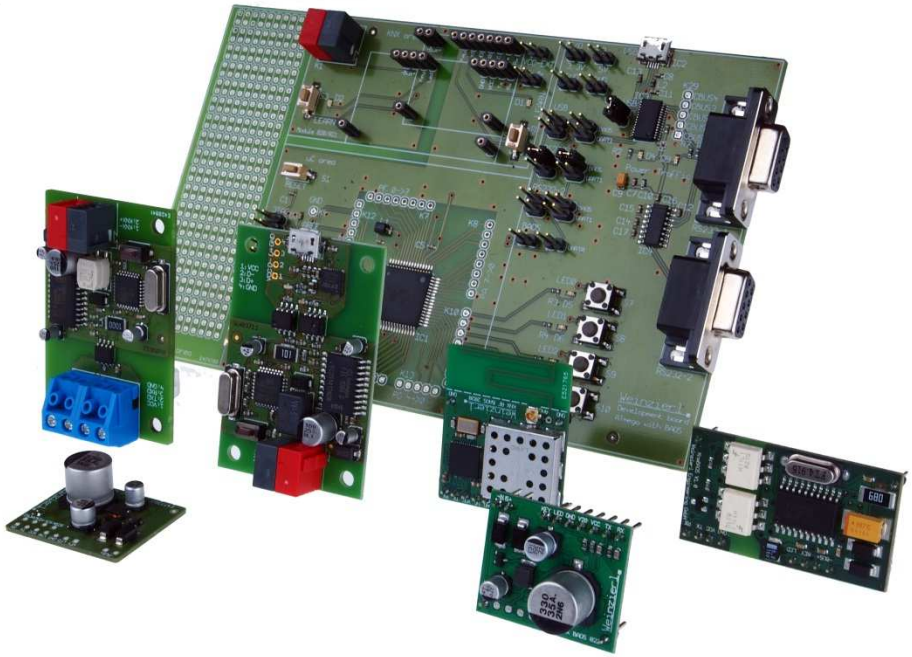
Services

- **Consulting**
- **Development**
  - Hardware
  - Firmware
    - For 8, 16 and 32 Bit Micros
  - Software
    - For Windows and Linux
- **Testing**
  - EMC, CE
  - KNX accredited Test Lab
    - System Software
    - Interworking
- **Production**
  - With external partners



KNX Modules

- **KNX Transceiver Modules**
  - KNX TinySerial 810
  - Frontends for KNX-RF
- **KNX BAOS Modules with certified Stack**
  - KNX BAOS 820 (TP)
  - KNX BAOS 822 (TP)
  - KNX BAOS 2830 (RF)



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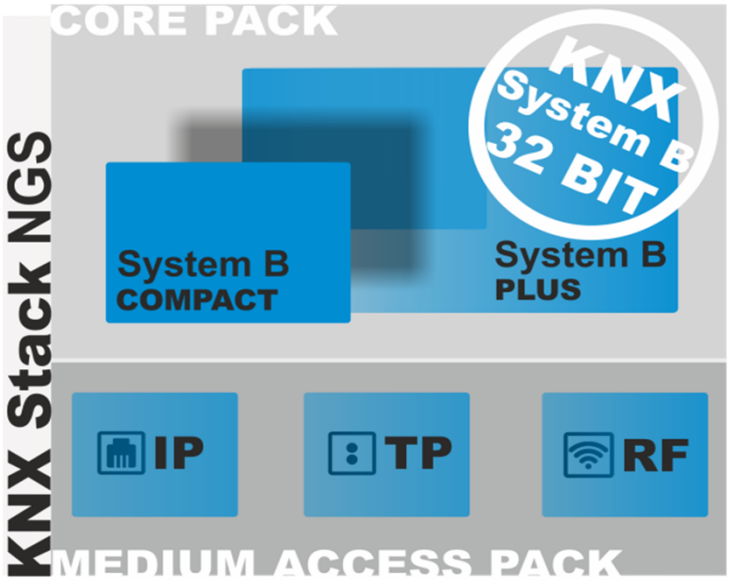
KNX Stack Implementation NGS

- **Professional solution for high volume products**
- **Modular**
  - Twisted Pair TP
  - Radio Frequency RF
  - Ethernet / KNXnet/IP
- **Scalable**
  - Compact
  - Plus
- **Development HW**
- **Tools**



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KNX Development Tools

- **Net’n Node**
  - Bus Monitor and Analyzer
- **TraceMon**
  - Optimized debug support
- **kScript**
  - Model driven design
  - Script based system
  - Automated generation of ETS product entries
- **kDrive SDK**
  - For tool development
  - Bus access and services
  - Free and commercial versions

Net 'n Node

kScript

kDrive

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KNX Devices

- **KNX IP**
  - Router, Interfaces
- **KNX USB**
  - Interfaces TP/RF
- **KNX Gateways**
  - EnOcean
  - RS-485

IP as Media for KNX

- **IP: Internet Protocol**
  - Widespread basis for communication applications
    - Data exchange
    - Email
    - Telephone (VoIP)
- **Media Ethernet commonly available in buildings**
  - Reduction of the installation effort
- **Connection to the Internet**
  - Available almost everywhere

IP as Media for KNX

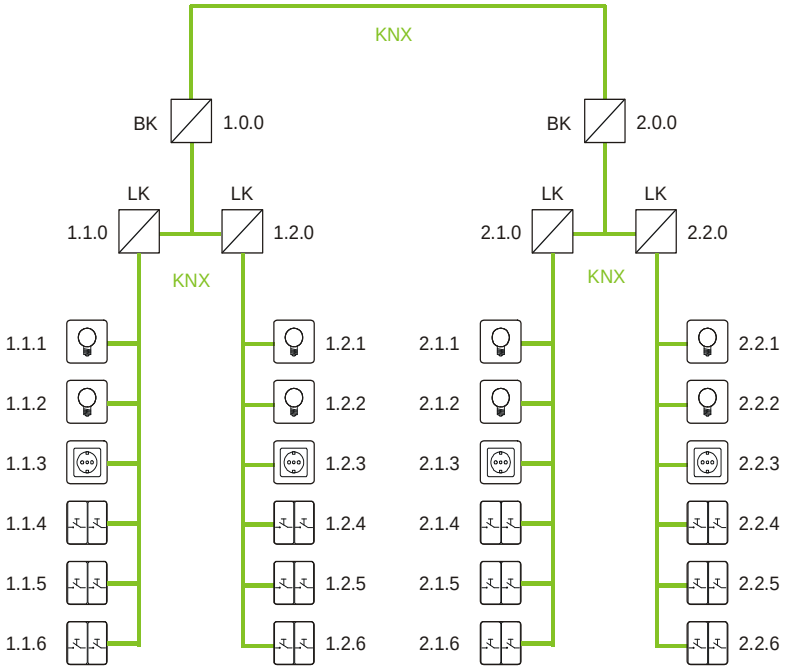
- **Usage as Interface**
  - Access from every point in the network possible
  - Access is also possible via the internet
  - Alternative for RS232 / USB interface

    -> KNXnet/IP ***Tunnelling***
- **Usage as fast backbone**
  - Replacement of line-/area coupler through IP Router

    -> KNXnet/IP ***Routing***
- **Clarification with example (topology)**

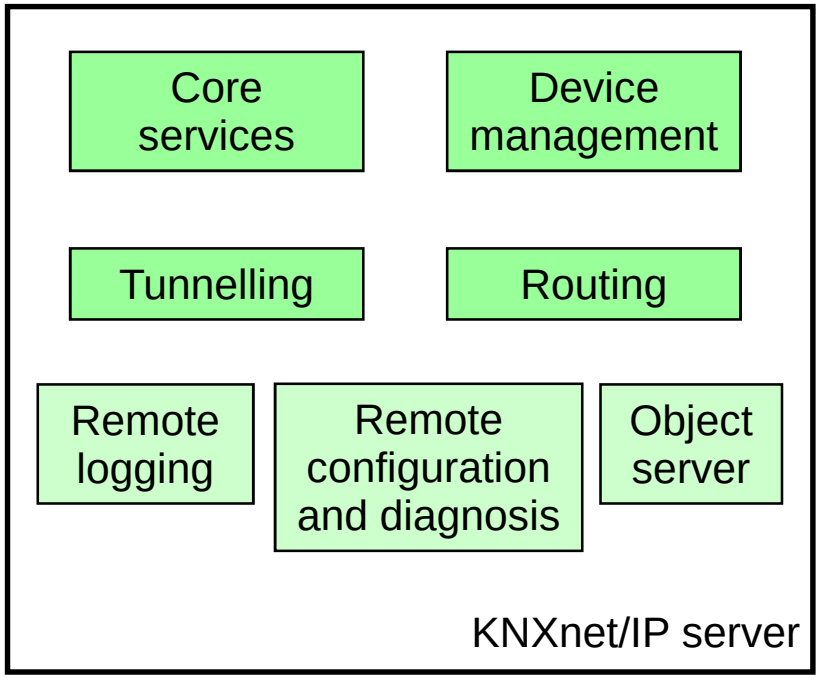
KNX-Topology

- **Common Installation**
- **Usage of**
  - Line couplers
  - Area couplers
- **Problem: Backbone**
  - Routing for Visualisation
  - Central function
  - Slow
  - Telegram loss possible
- **Solution: KNX/IP-Router**



KNXnet/IP Requirements

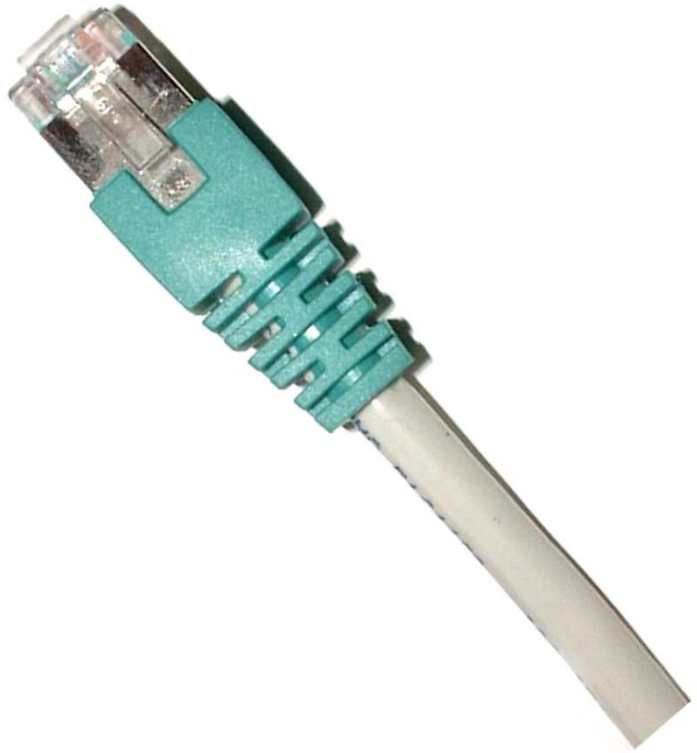
- Finding and discovering of KNXnet/IP-Devices
  - Core services
- Configuration of KNXnet/IP-Devices
  - Device management
- Bus access (ETS)
  - Tunneling
- Line / Area Coupling
  - Routing



Part of the KNX Standard!

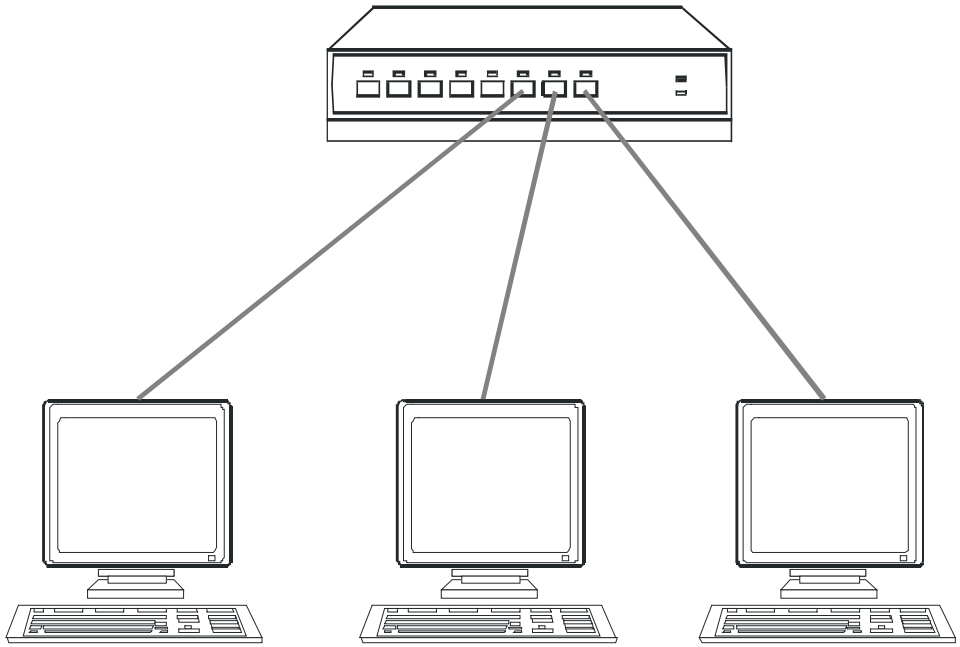
Network Basics / Media

- **10Base-T**
  - IEEE802.3i
  - Twisted Pair (CAT-3)
  - Length per segment: 100m
- **100Base-TX**
  - IEEE8002.3u
  - Twisted Pair (CAT-5)
  - Length per segment: 100m



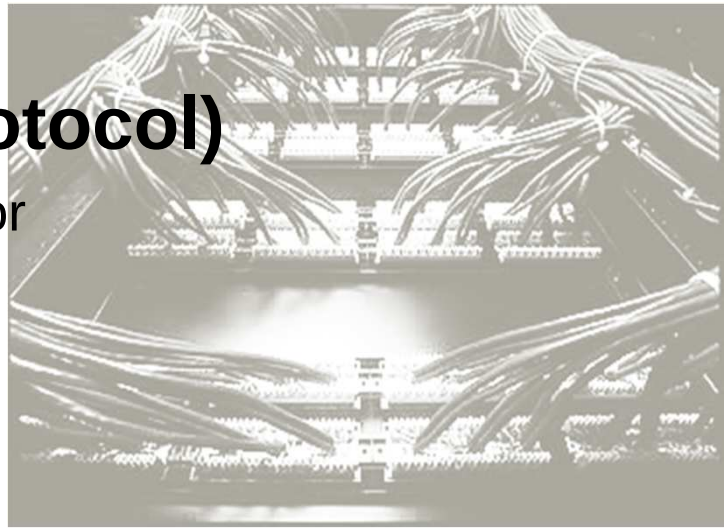
Network Basics / Topology

- **Star**
  - Connection of the segments to:
    - Hub
    - Switch



Network Basics

- **Addressing of a Device in the Network**
  - MAC-Address (Media Access Control)
    - Unique in the World
    - Unchangeable (fixed to the Hardware)
    - Length 6 Bytes
    - Syntax: 00-50-C2-55-40-00
- **IP-Address (Internet Protocol)**
  - Awarded by the Administrator
  - Length 4 Bytes (IPv4)
  - Syntax: 192.168.1.1
  - Subnetworks



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Network Basics

- **IP-Addressing**
- **Splitting to Subnetworks**
- **Splitting of the IP-Address to**
  - Net-ID
  - Host-ID

Example:

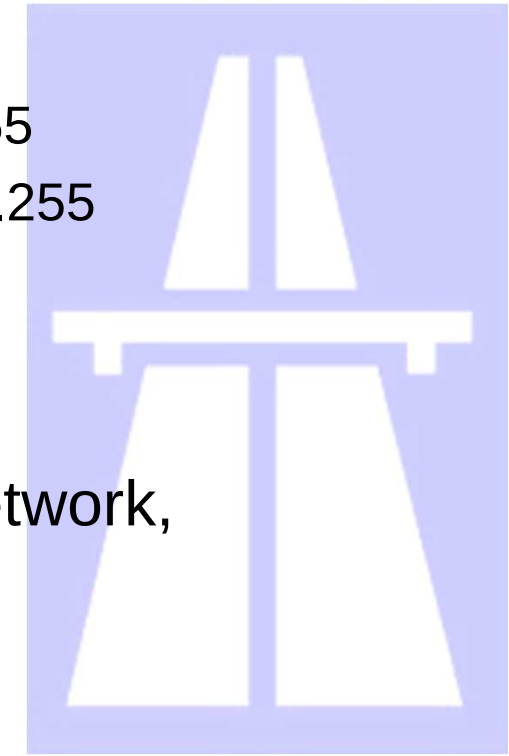
Subnet-Mask:	255.255.255.0
11111111.11111111.11111111.00000000	
Net-ID:	192.168.1.0
First IP-Address:	192.168.1.1
Last IP-Address:	192.168.1.254
Broadcast:	192.168.1.255
IP-Address:	192.168.1.25
Host-ID:	0.0.0.25

Network Basics

- **Subnetworks**
  - Usage of personal IP-Addresses
    - Are not used in public
    - Class B: 172.16.0.0 to 172.31.255.255
    - Class C: 192.168.0.0 to 192.168.255.255

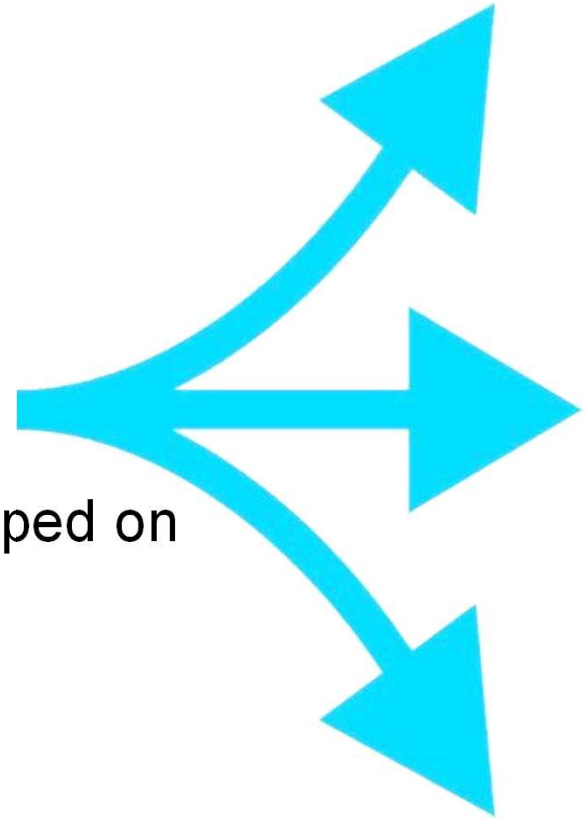
- **Gateway-IP-Address**
  - When a user is beyond the Subnetwork, it's necessary to have a gateway.

-> Remote access



Network Basics

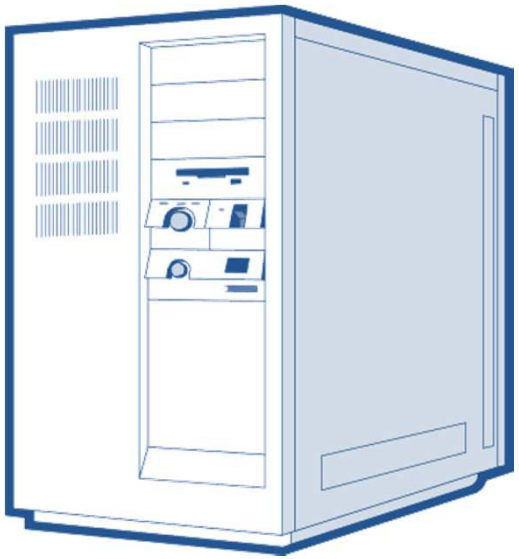
- **Multicast-Addressing**
  - One transmitter – multiple receivers
  - IP-Address area:
    - 224.0.0.0 to 239.255.255.255
  - Reserved for KNXnet/IP:
    - 224.0.23.12



- **Multicast MAC**
  - 23 Bits of the IP-Address are mapped on 01-00-5E-00-00-00
  - Example: 224.0.23.12
    - MAC: 01-00-5E-00-17-0C

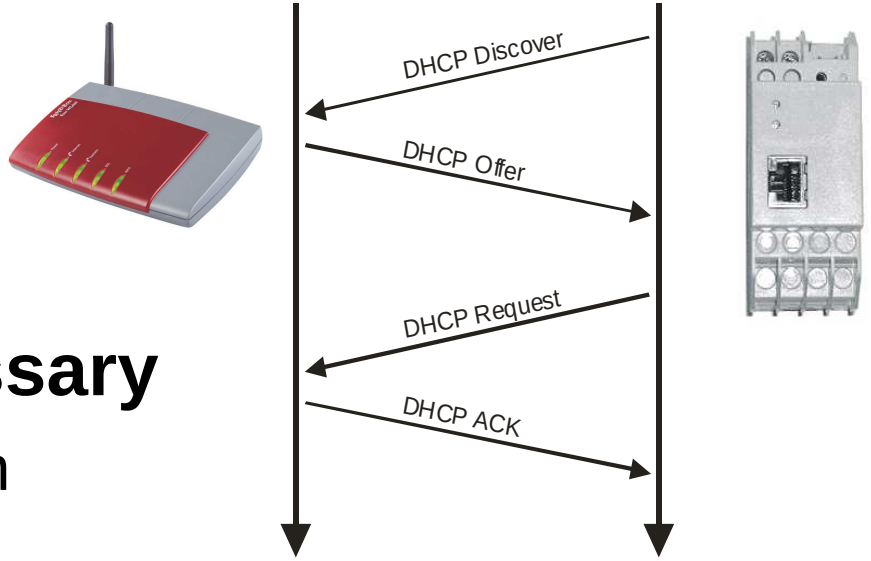
Network Basics / Port

- **Address element (Transport Layer)**
- **Assignment to corresponding Service (in Application Layer)**
- **Length 2 Bytes**
- **Reserved Ports**
  - 21 FTP Data Transferring
  - 80 HTTP Webserver
  - 110 POP3 Access to Email-Server
  - 3671 KNXnet/IP Building Information
- **Dynamic Ports**
  - Variable usable
  - Not fixed to an application
  - Interval from 49152 to 65535



Network Basics / DHCP

- **Dynamic Host Configuration Protocol**
- **Central placing of**
  - IP-Address
  - Subnetwork
  - Gateway-IP-Address
- **DHCP-Server necessary**
  - Contained in common
  - DSL-Routers



Network Requirements

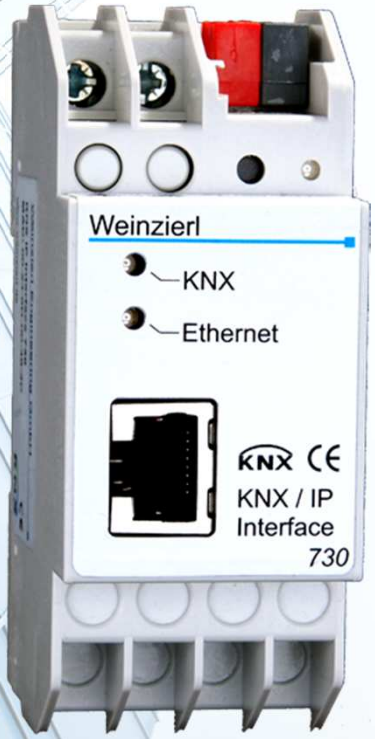
- **TP-Cable (at least CAT-3) with RJ-45-connector**
- **Free Bandwidth**
  - Hardly ever critical
- **Multicast**
  - Routing of Multicast-Telegrams
  - Multicast-IP-Address
    - 224.0.23.12
    - Probably more
- **Port**
  - 3671

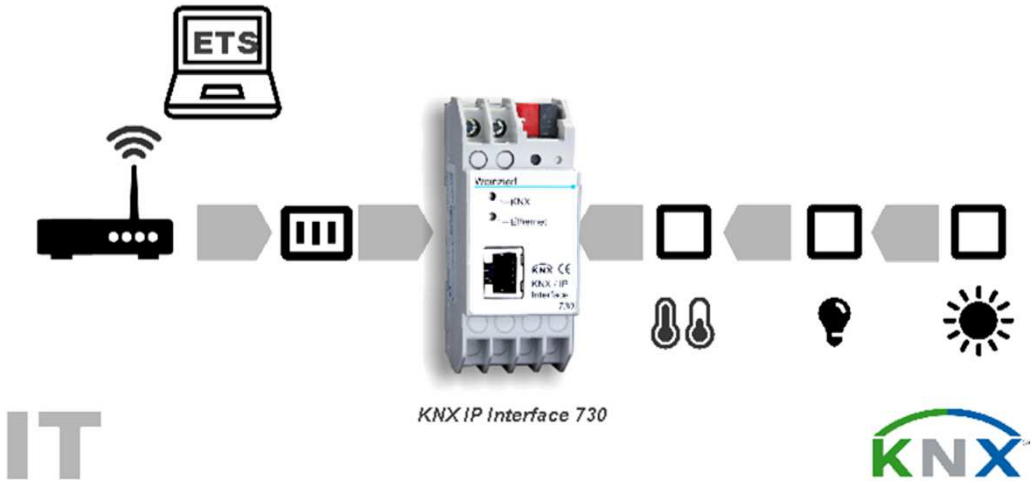
Overview: our KNX IP Devices

	KNXnet/IP Tunneling (Interface e.g. for ETS)	KNXnet/IP Routing (Line Coupler over LAN)	BAOS Object Server (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 771 / 772	✓		✓		✓	

KNX IP Interface 730

- Interface to KNX (Tunneling)
- e.g. for the ETS

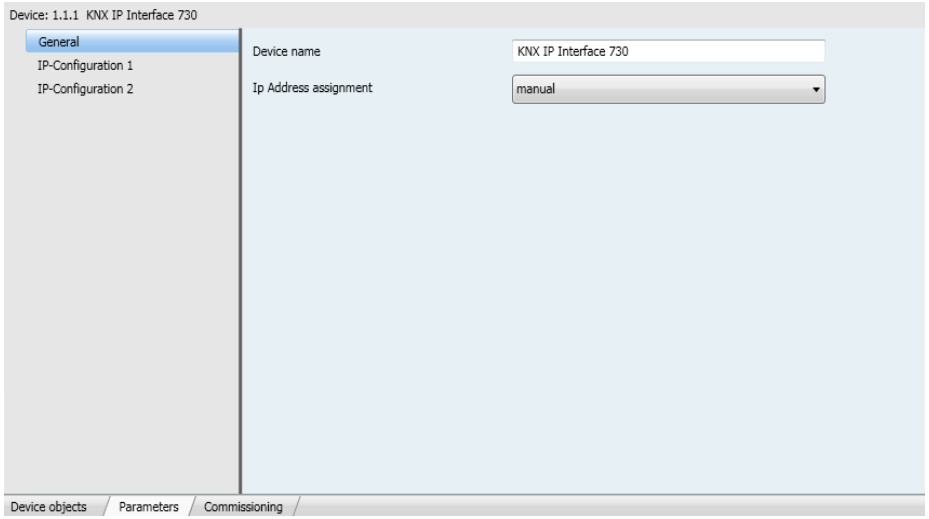




KNX IP 730: Parameter - General

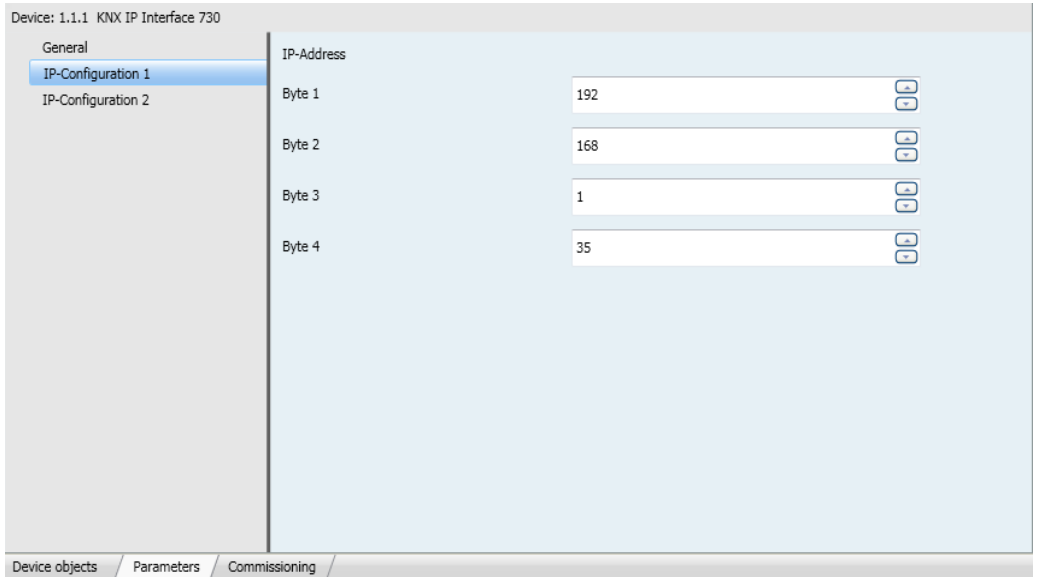
- **Device Name**
  - Identification of the KNX/IP-Interface
  - e.g. „first floor“

- **IP-Address assignment**
  - manual
  - automatical (DHCP)



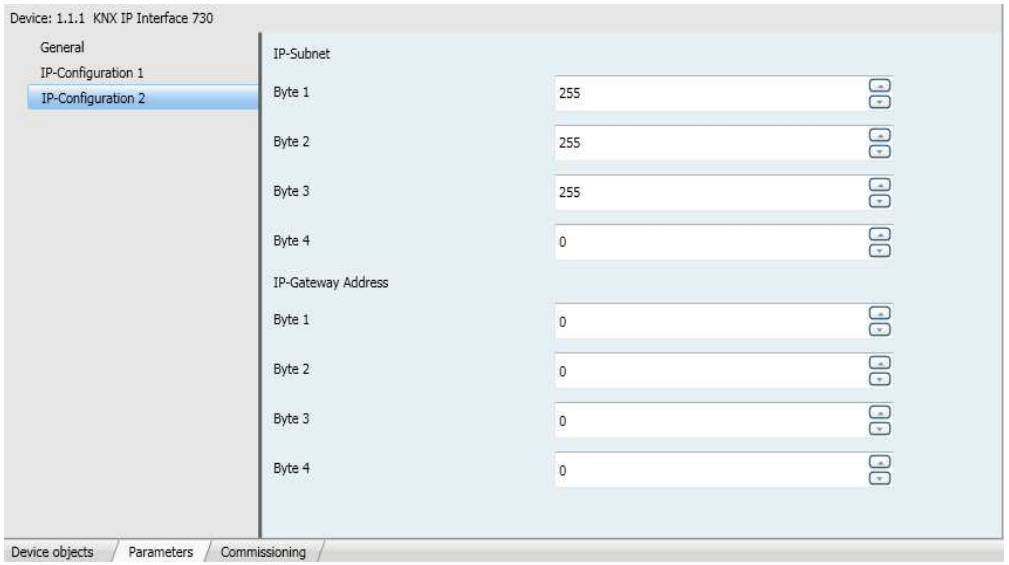
KNX IP 730: Parameter - General

- **IP-Address**
  - IP-Address of the KNX/IP-Interface



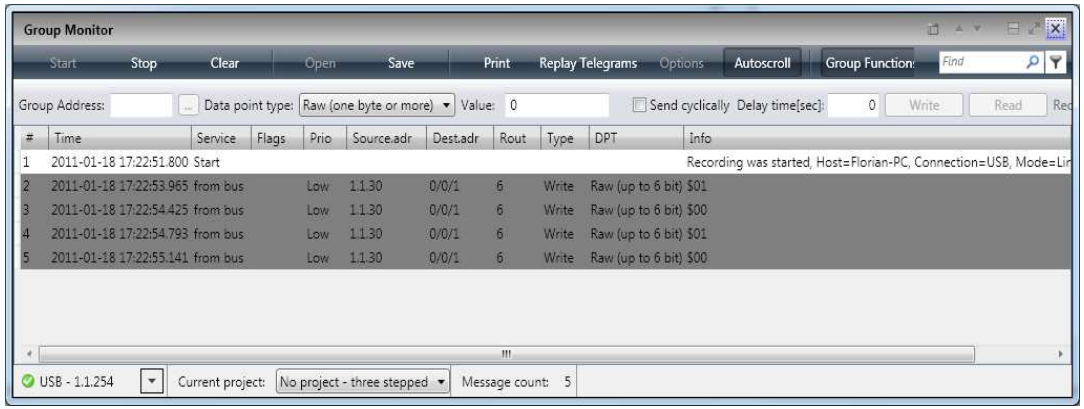
KNX IP 730: Parameter - General

- **IP-Subnetwork**
  - For decisions about Destination Address
    - Communication Partner
    - Gateway
- **IP-Gateway-Address**
  - For external communication



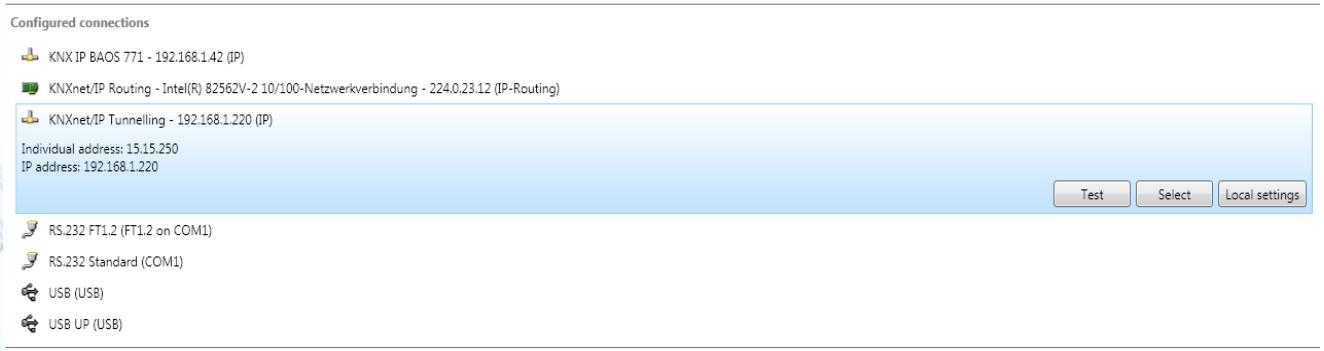
Usage as Interface (ETS)

- Interface to KNX
- Replacement for an USB / RS232 Interface
- Usage of Tunnelling (KNXnet/IP)
- Point-to-point-Connection
- Accessible by every PC in the network
- Minimum ETS 3.0c required
- Group monitor / Bus monitor



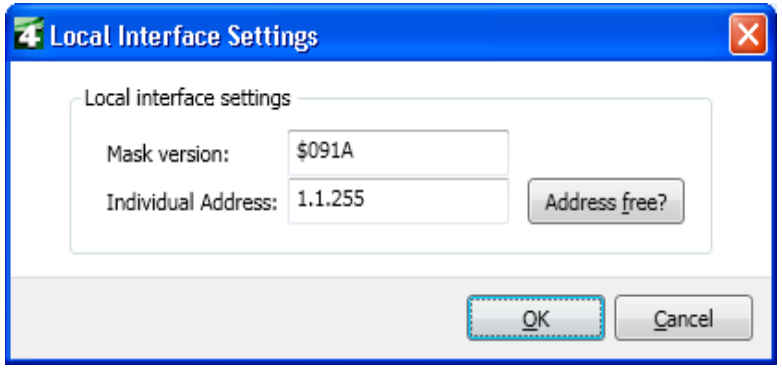
Usage as Interface (ETS)

- **Parameterising of the network options**
- **Settings: Communication**
  - Automatic search of all available interfaces
  - Choose the desired interface (Settings -> Communication)



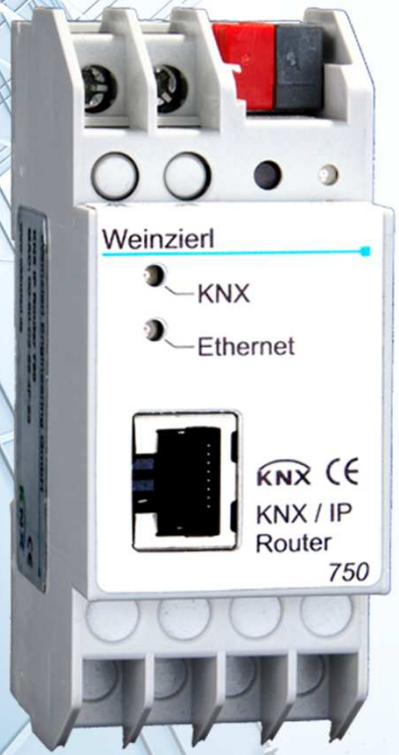
Usage as Interface (ETS)

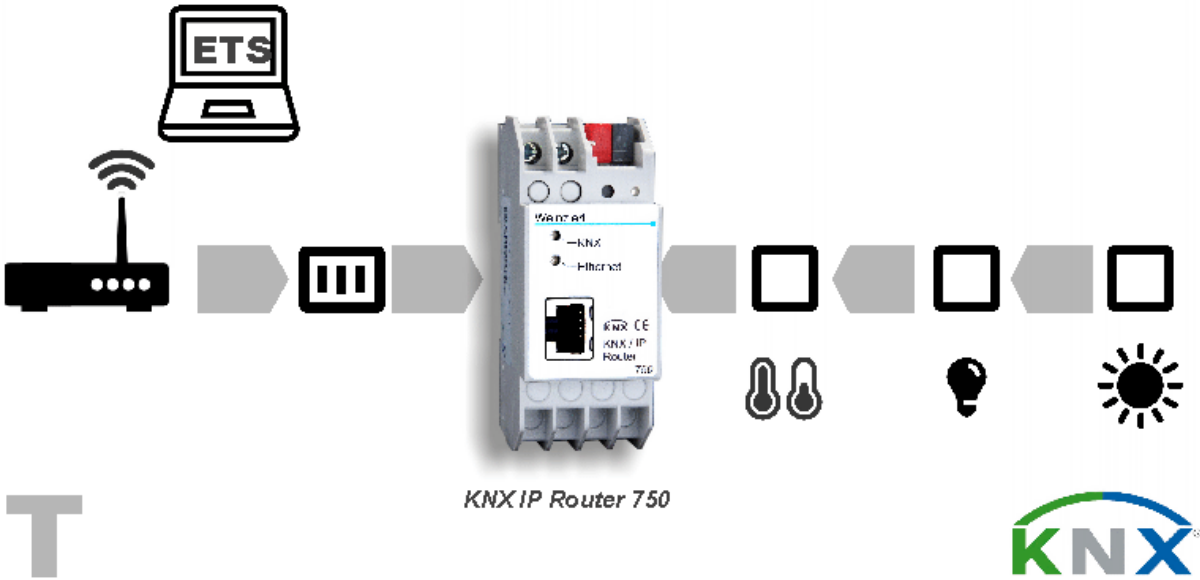
- **Choice of the 2. individual Address**
  - Is used for bus connection
  - Has to be configured manually
  - Saved in the Device
  - Must not already be in use
  - Has to fit topologically



KNX IP Router 750

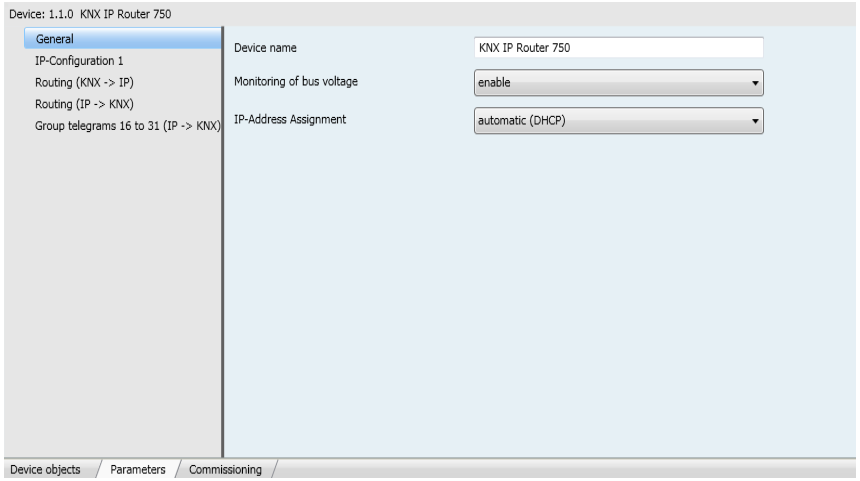
- Interface to KNX (Tunneling), e.g. for the ETS
- Line coupler functionality (Routing)





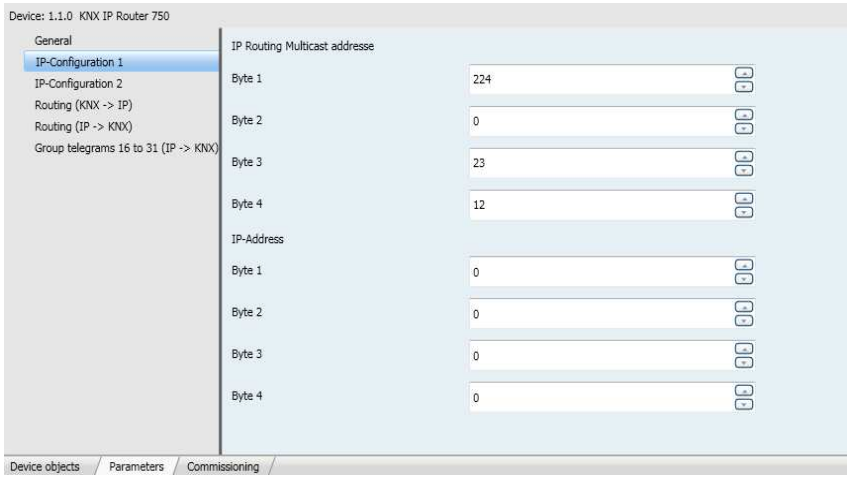
KNX IP 750: Parameter - General

- **Device Name**
  - Identification of the KNX/IP-Router
    - e.g. „first floor“
- **Monitoring of bus voltage**
- **IP-Address assignment**
  - manual
  - automatical (DHCP)



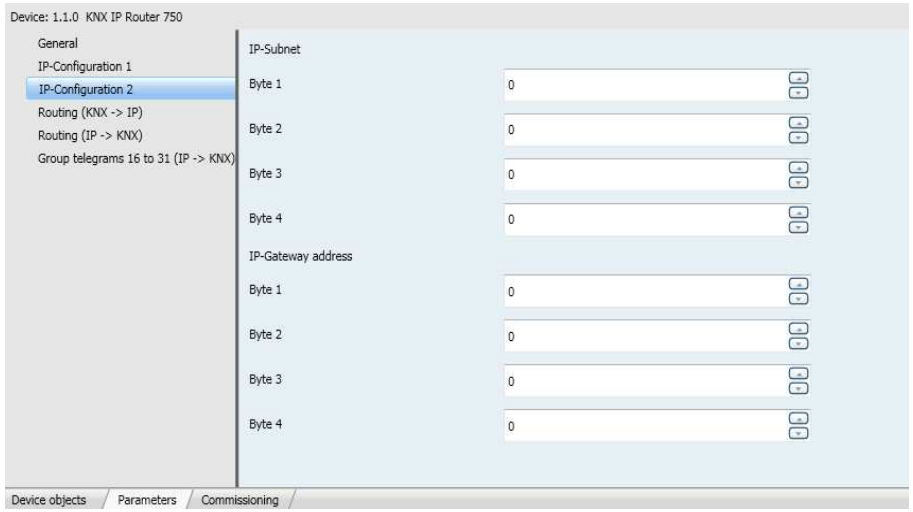
KNX IP 750: Parameter – IP Config.

- **IP Routing Multicast Address**
  - Used for Routing-Telegrams
- **IP-Address**
  - IP-Address of the KNX/IP-Router
  - Used for Tunnelling-Telegrams



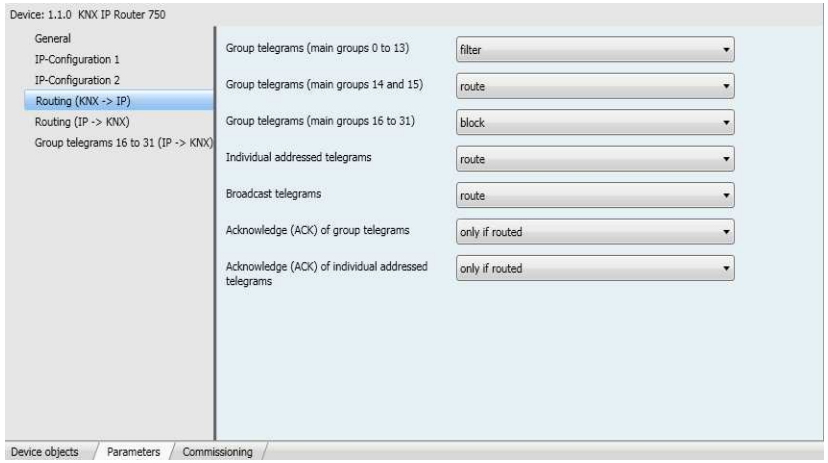
KNX IP 750: Parameter – IP Config.

- **IP-Subnetwork**
  - For decisions about Destination Address
    - Communication Partner
    - Gateway
- **IP-Gateway-Address**
  - For external communication



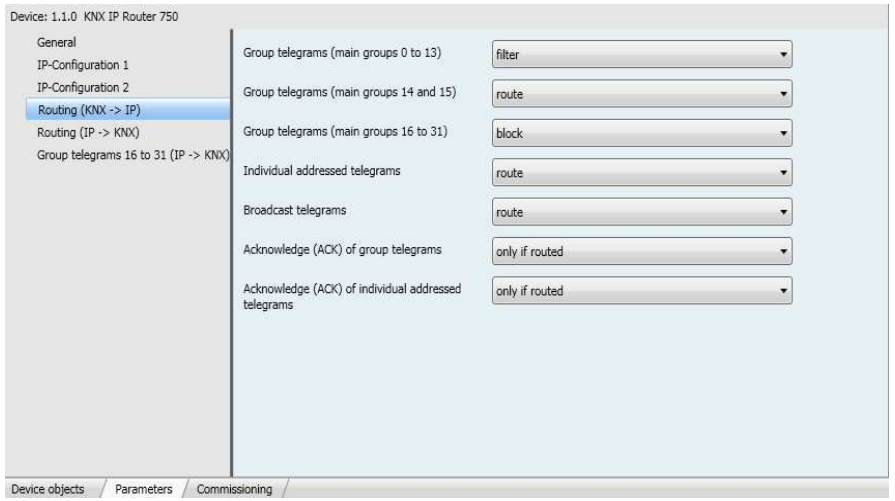
KNX IP 750: Parameter – Routing

- **Group Telegrams**
  - (Main Groups 0 to 13)
    - Block
    - Route
    - Filter
- **Group Telegrams**
  - (Main Groups 14 and 15)
    - Block
    - Route
- **Group Telegrams**
  - (Main Groups 16 to 31)
    - Block
    - Route (next page)



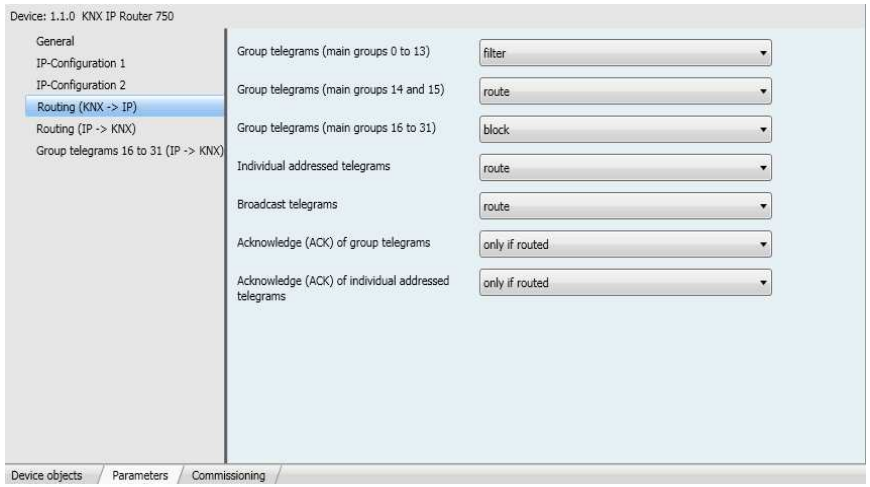
KNX IP 750: Parameter – Routing

- **Individual addressed Telegrams**
  - Block
  - Route
  - Filter
- **Broadcast Telegrams**
  - Block
  - Route



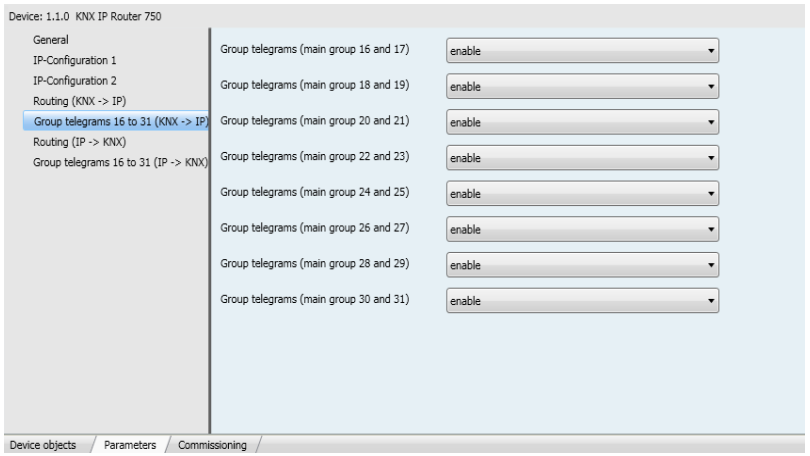
KNX IP 750: Parameter – Routing

- **Acknowledge of group telegrams**
  - Always
  - Only if routed
- **Acknowledge of individual addressed telegrams**
  - Only if routed
  - Always
  - Answer using NACK



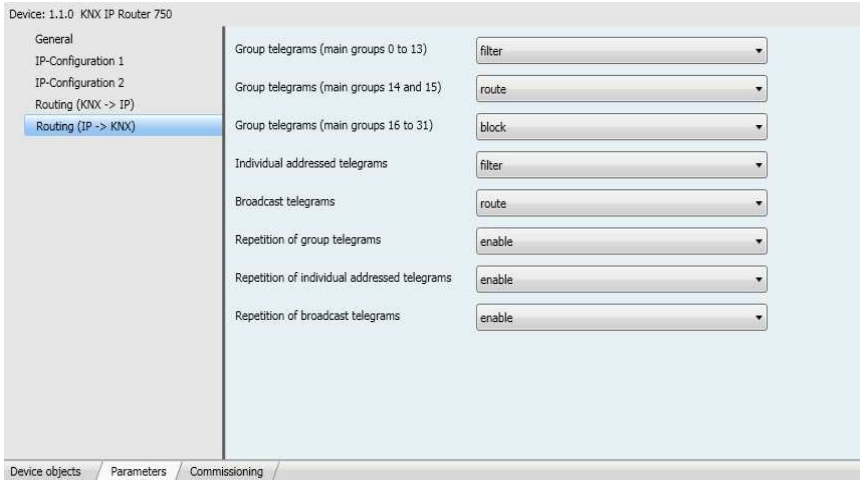
KNX IP 750: Parameter – Routing

- **Group telegrams (main groups 16 to 31)**
  - Enable
  - Disable
- **Paired routing**
  - Reserved Addresses
  - Only for special applications (e.g. Easy)
  - Not available in ETS



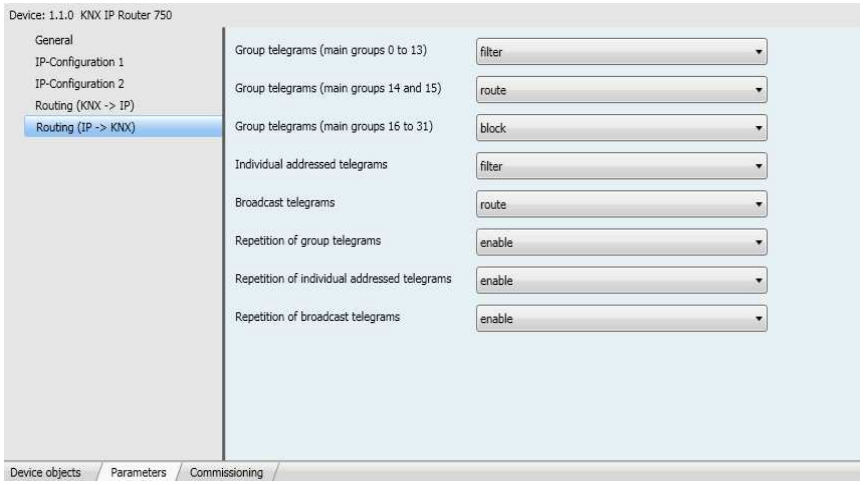
KNX IP 750: Parameter – Routing

- **Group telegrams (main groups 0 to 13)**
  - Block
  - Route
  - Filter
- **Group telegrams (main groups 14 and 15)**
  - Block
  - Route
- **Group telegrams (main groups 16 to 31)**
  - Block
  - Route (next page)



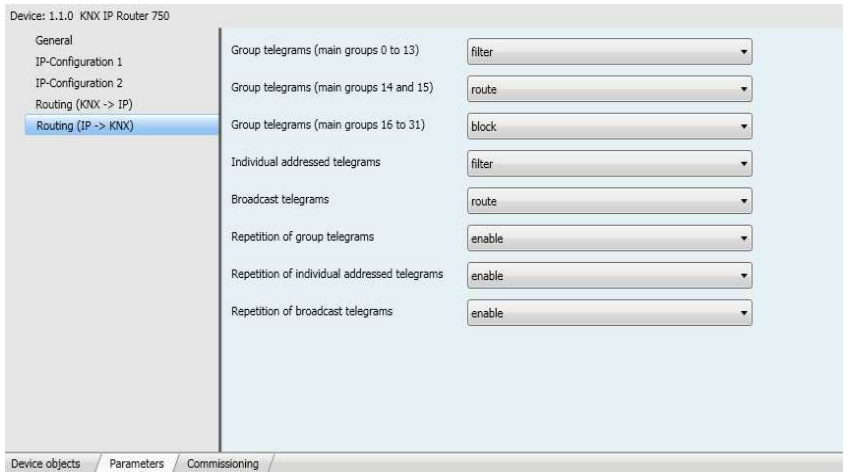
KNX IP 750: Parameter – Routing

- **Individual addressed Telegrams**
  - Block
  - Route
  - Filter
- **Broadcast Telegrams**
  - Block
  - Route



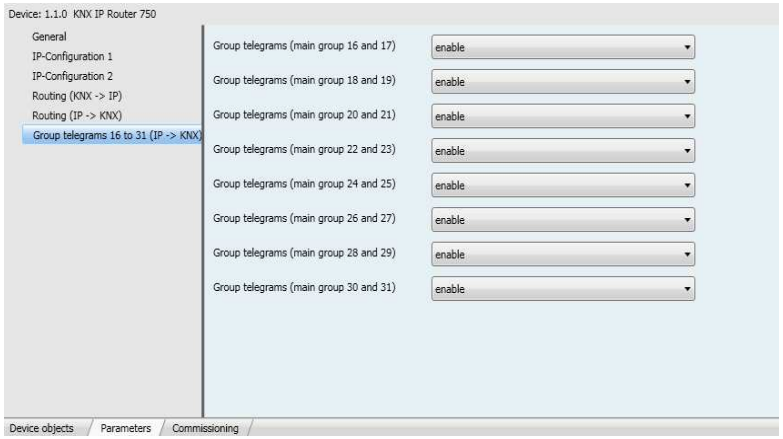
KNX IP 750: Parameter – Routing

- **Repetition of Group telegrams**
  - Block
  - Enable
- **Repetition of individual addressed telegrams**
  - Block
  - Enable
- **Repetition of Broadcast-Telegrams**
  - Block
  - Enable



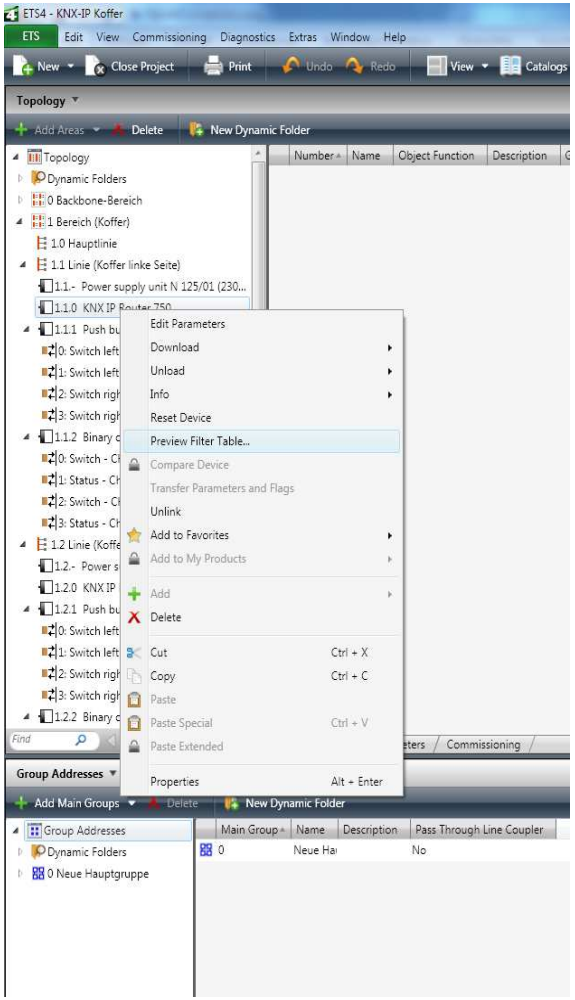
KNX IP 750: Parameter – Routing

- **Group telegrams (main groups 16 to 31)**
  - Enable
  - Disable
- **Paired routing Reserved Addresses**
  - Only for special applications (e.g. Easy)
  - Not available in the ETS



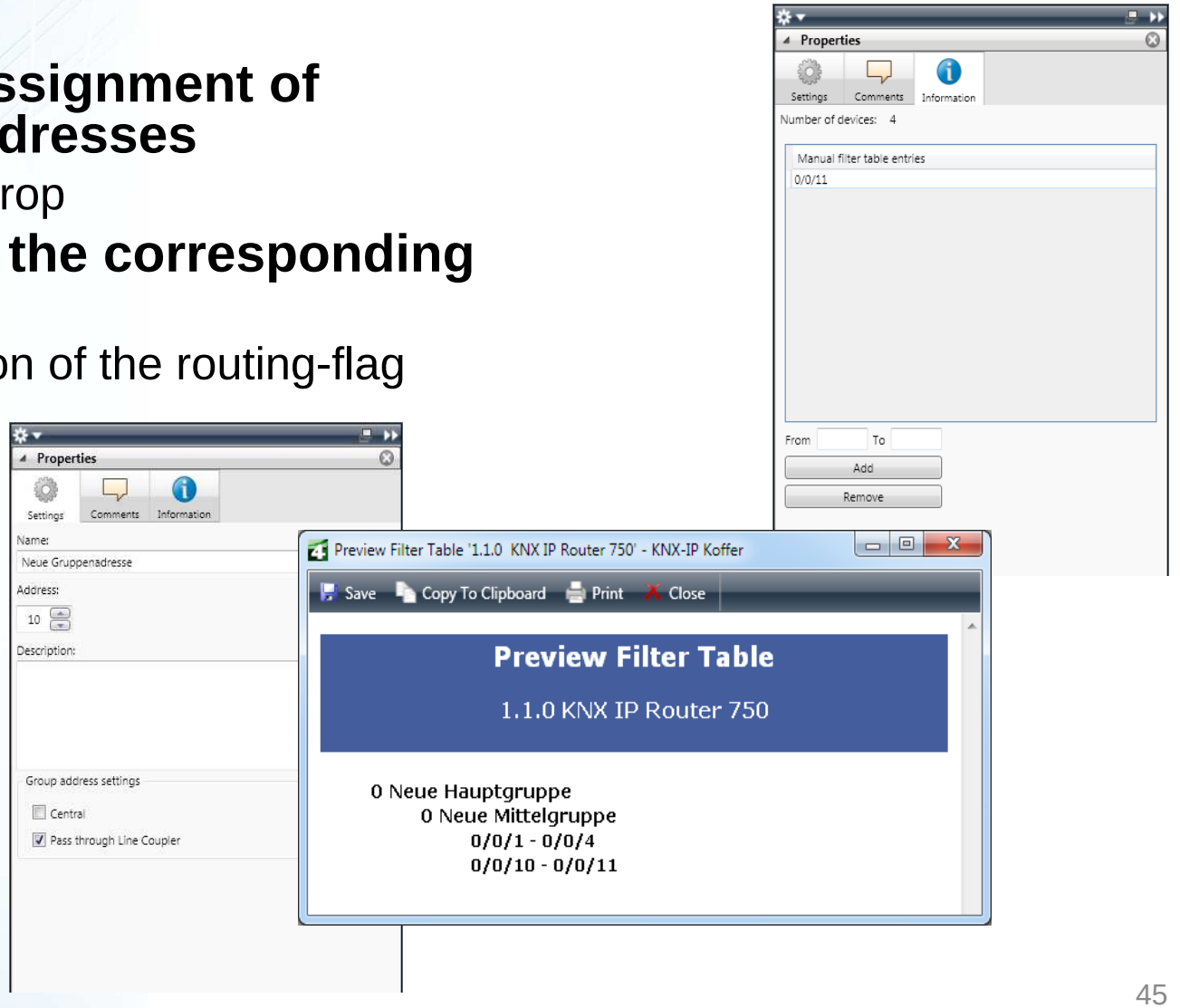
ETS – Filter Table

- Reduction of telegram traffic
- Automatically created by ETS
- Preview function



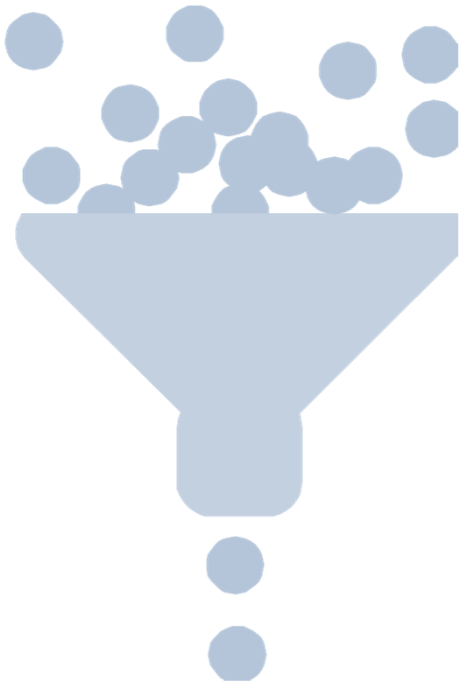
ETS – Filter Table

- **Manual assignment of Group addresses**
  - Drag&Drop
- **Drag it to the corresponding line**
  - Activation of the routing-flag



Why use a Filter Table?

- **Routing IP -> KNX (TP)**
  - From a faster network (10MBit/s) to a slower network (9600 Bit/s)
  - Around 1000 times slower
  - Filter table indispensable
  - Buffering of telegram bursts
  - KNX/IP-Router 150 buffers (FIFO)
  - Approx. 3 second buffer
  - Routing-Lost-Message

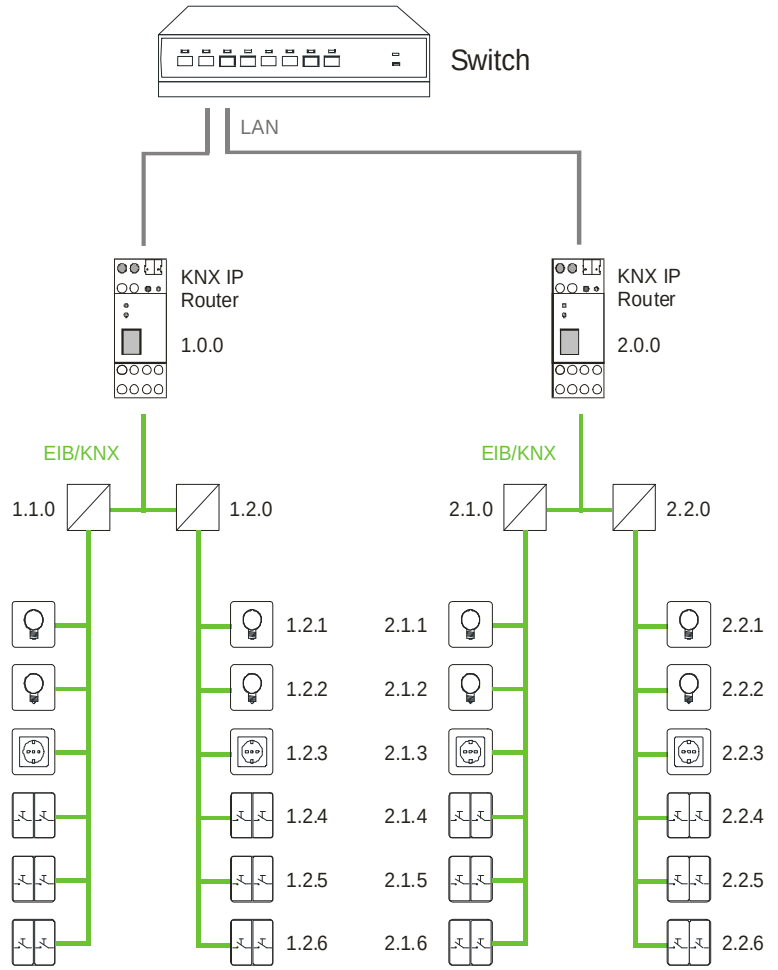


KNX/IP-Router as Area Coupler

- **Replacement of Area Couplers**
- **Preservation of Line Couplers**
- **Addressing:**
  - x.0.0 (x: 1..15)

Warning:

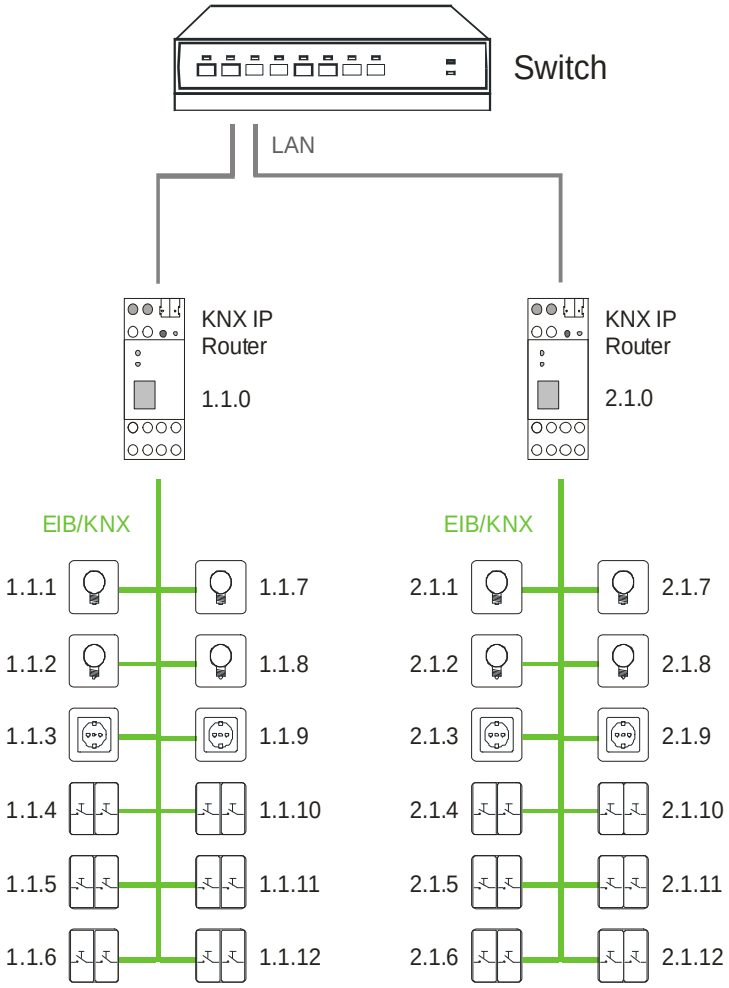
KNX/IP Router addresses must not conflict!



KNX/IP-Router as Line Coupler

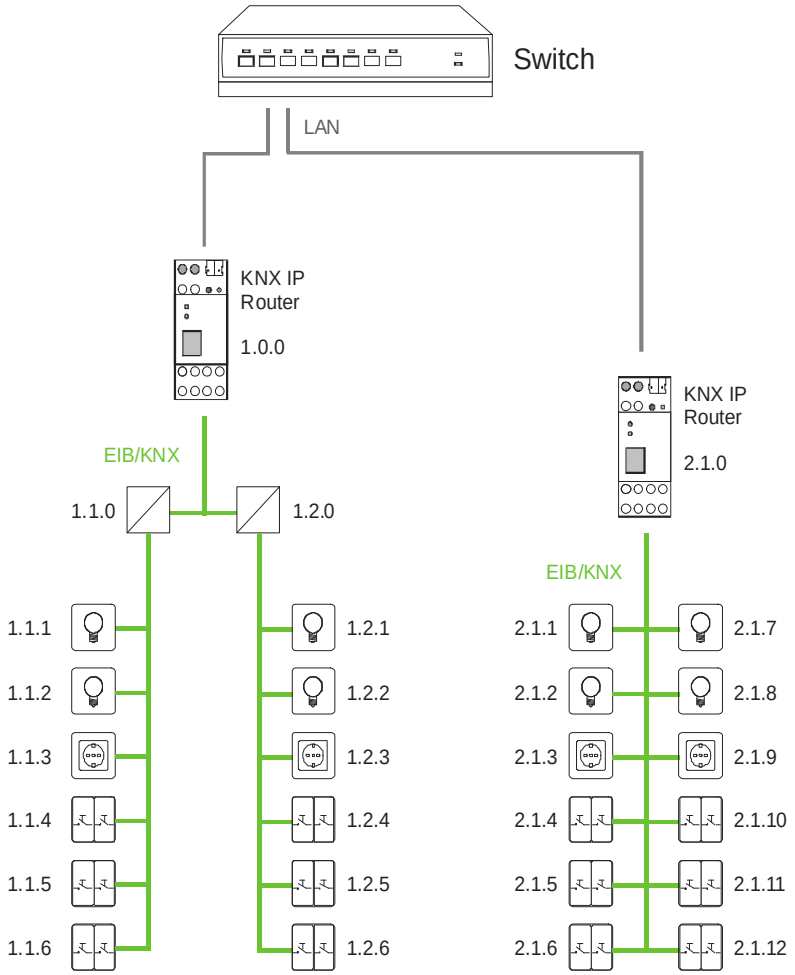
- **Replacement of Line Couplers**
- **No Area Couplers essential**
- **Addressing:**
  - x.y.0 (x, y: 1..15)
  - 225 Lines

Warning:
KNX/IP Router addresses must not conflict!



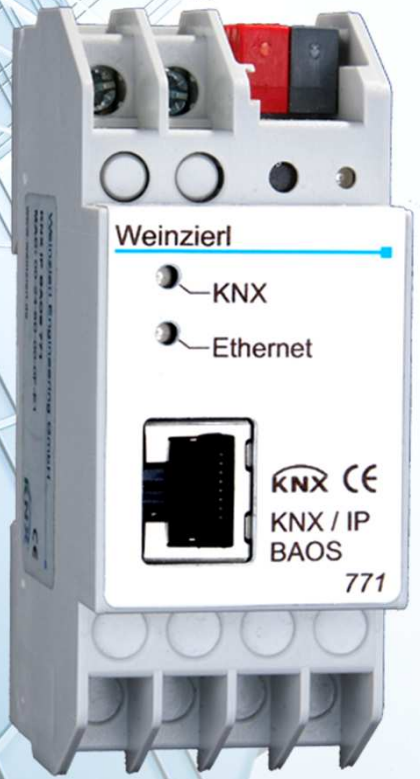
Mixed Installation

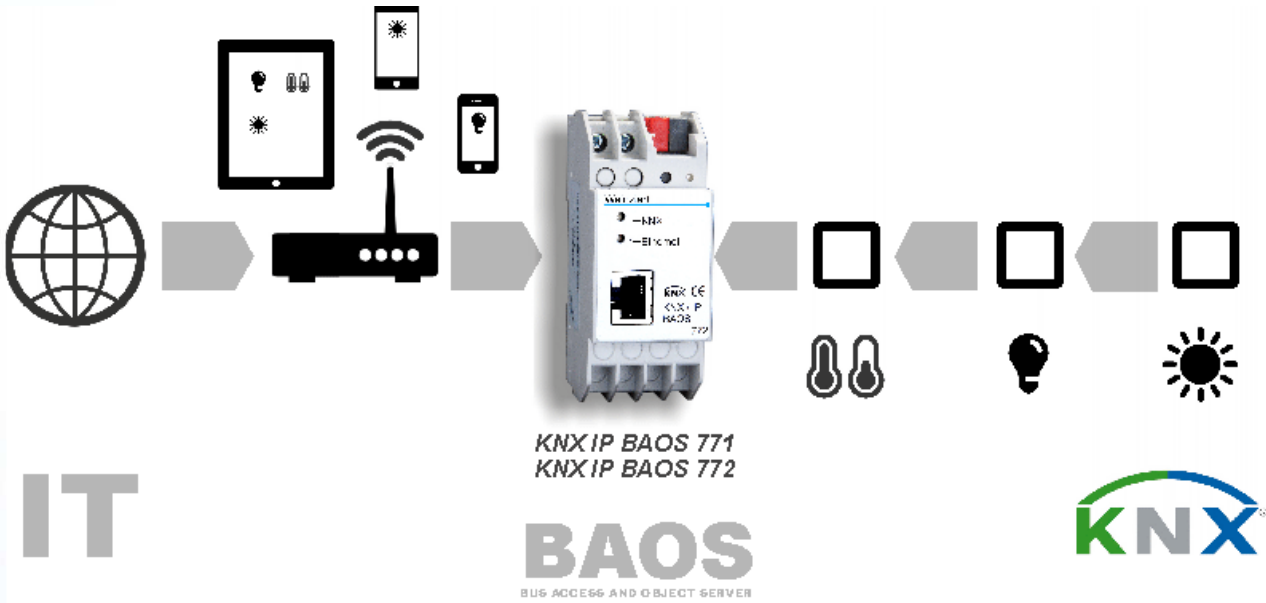
- **Usage of KNX/IP-Routers as**
  - Line Couplers
  - Area Couplers
- **Extension of existing installations**



KNX IP BAOS 771 / 772

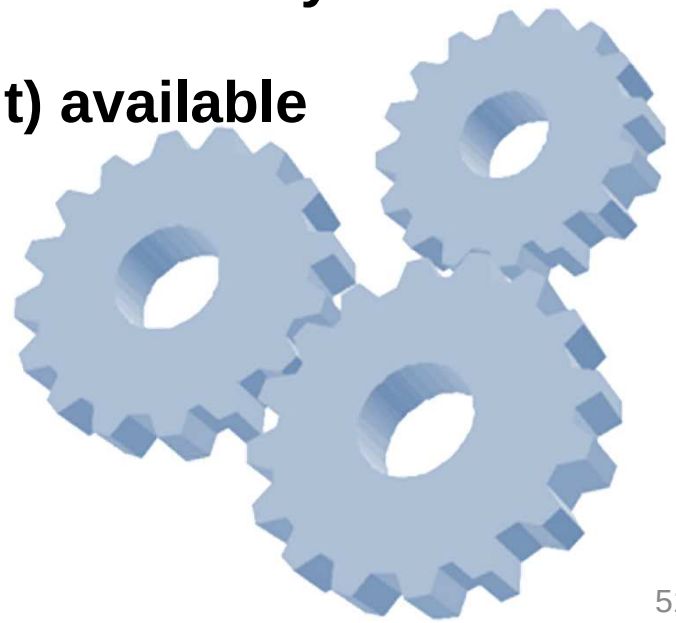
- **Bus Access and Object Server**
- **Interface to KNX (Tunnelling), e.g. for the ETS**
- **Object server functionality**





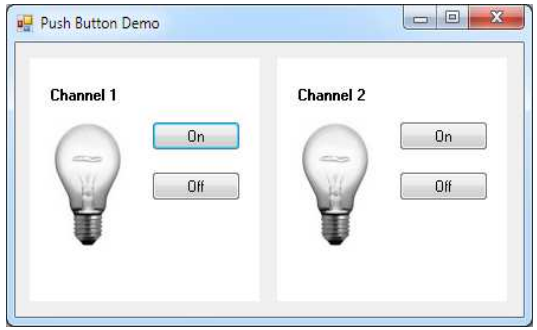
KNX IP BAOS 771 / 772

- Support of 1000 data points (KNX IP BAOS 772), respectively 250 data points (KNX IP BAOS 771)
- Binary Protocol based on UDP/IP respectively TCP/IP
- Web Service Protocol based on JSON (Java Script Object Notation)
- Add easily access to the KNX IP BAOS in your web pages
- SDK (Software Development Kit) available
- Windows
- Linux
- Apple (Mac OS X, iOS)
- Tools



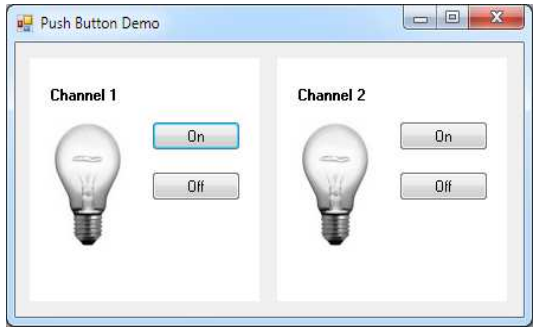
How to connect to KNX IP BAOS?

- **Native written applications**
- **Link a already built-in Ethernet device to KNX**
  - E.g. Audio actuator
  - PLC (Programmable Logic Control)
- **Usage together with the BAOS SDK (Software Development Kit)**
- **Easy start (no client-side implementation of the KNX BAOS Binary protocol necessary)**
- **C++, C#, VisualBasic.net**



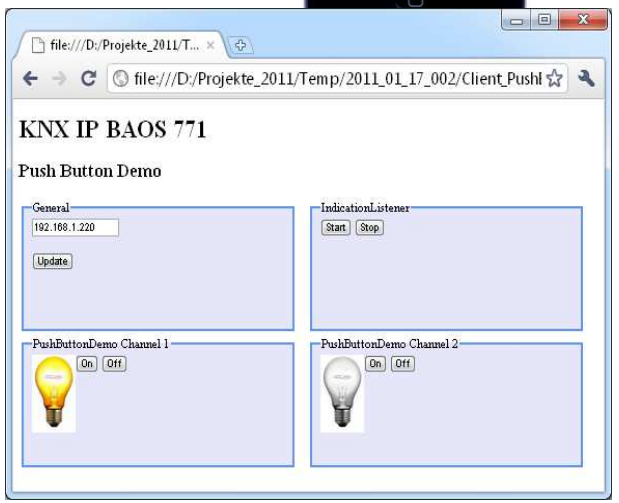
Connect to BAOS - Binary Services

- **Native written applications**
- **Link a already built-in Ethernet device to KNX**
  - E.g. Audio actuator
  - PLC (Programmable Logic Control)
- **Usage together with the BAOS SDK (Software Development Kit)**
- **Easy start (no client-side implementation of the KNX BAOS Binary protocol necessary)**
- **C++, C#, VisualBasic.net**



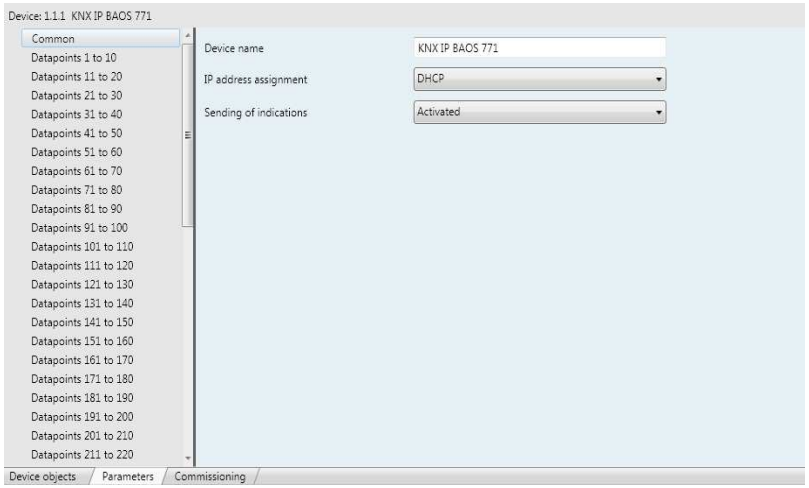
Connect to BAOS – Web Services

- **To be used within web applications**
- **Based on JSON (Java Script Object Notation)**
- **Perfect for web programmers**
- **Applicable on mobile devices**
  - iOS (iPhone, iPad)
  - Android based mobile phones
- **API (Application Program Interface) available**
- **Demo incl. usage of API available**



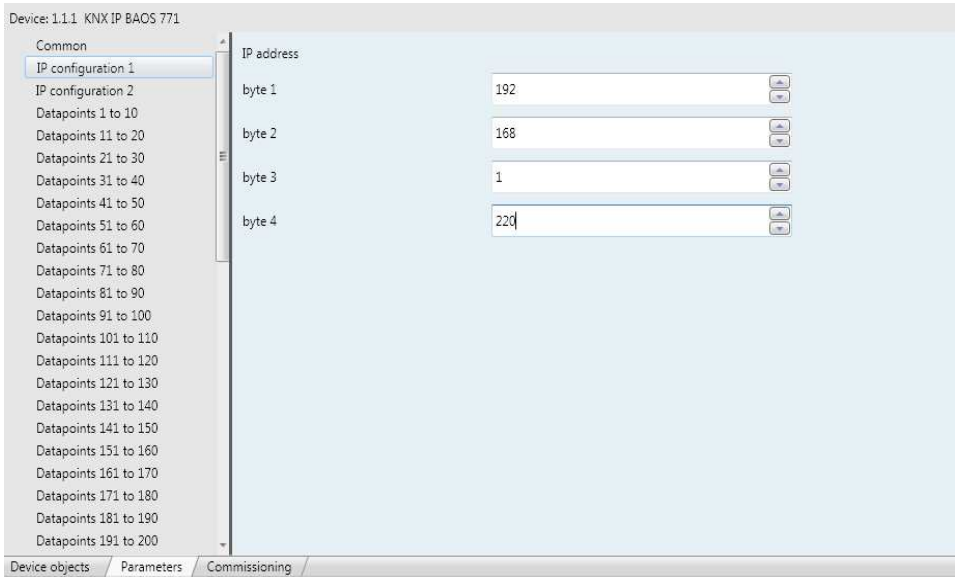
KNX IP BAOS Parameter - Common

- **Device Name**
  - Identification of the KNX/IP BAOS
  - e.g. „first floor“
- **IP-Address assignment**
  - manual
  - automatical (DHCP)
- **Sending of indications**
  - Activated
  - Disabled



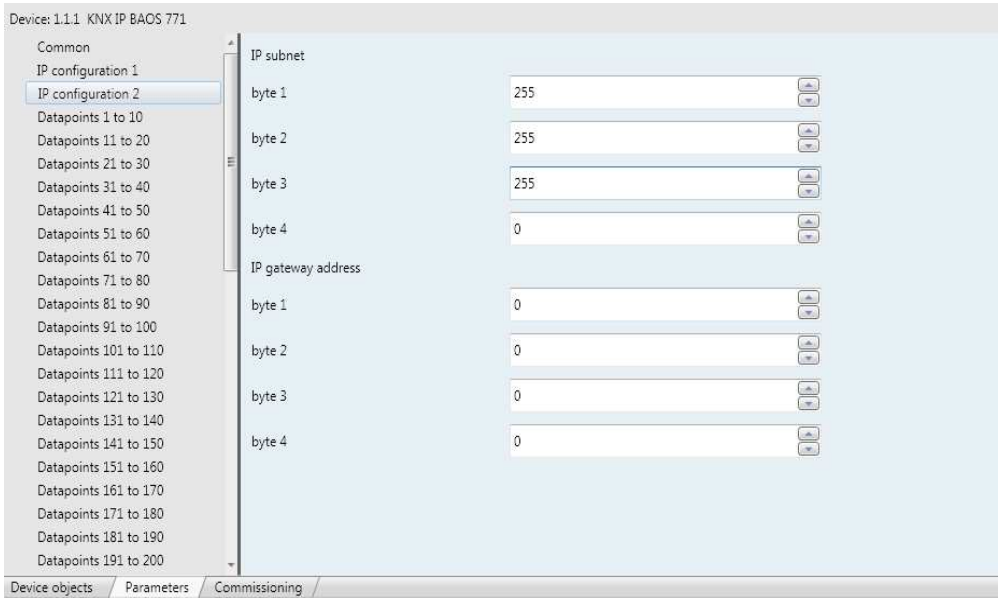
KNX IP BAOS Param. – IP Config.

- **IP address**
- **IP-Address of the**
  - KNX IP BAOS



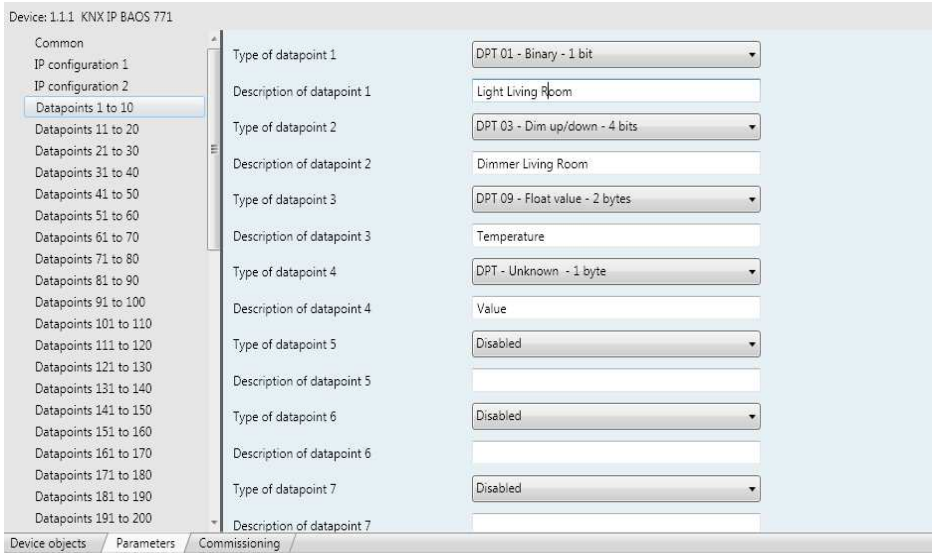
KNX IP BAOS Param. – IP Config.

- **IP Subnetwork**
  - For decisions about Destination Address
    - Communication Partner
    - Gateway
- **IP Gateway Address**
  - For external communication



KNX IP BAOS Param. – Data points

- **Type of datapoint**
  - Select datapoint type (DPT)
- **Description of datapoint**
  - String to identify datapoint, e.g. „Light Living Room“

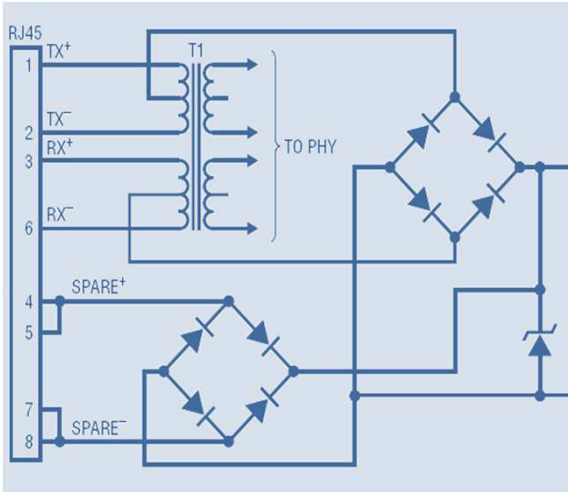


Mounting and installation

- **Rail mounted device**
- **Installation**
  - ❶ External Power Supply
    - 12 V to 24 V, AC
    - 12 V to 30 V, DC
  - ❷ KNX
  - ❸ Learning - key
  - ❹ Learning - LED
  - ❺ KNX LED (Bus voltage / Traffic)
  - ❻ Ethernet LED (Link / Traffic)
  - ❼ Ethernet-Connection (RJ45)
- **Power-over-Ethernet**
  - No external power supply necessary

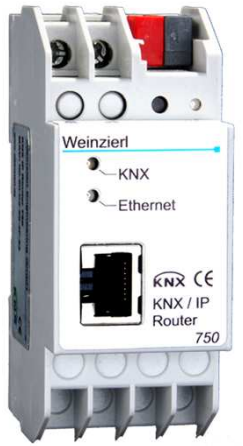
Power over Ethernet PoE

- **Power Supply via ethernet cable**
- **IEEE 802.3af**
- **Reduce power supply requirements**
  - Power supply unit
  - Wiring
- **Lower installation cost**
- **Available power up to 15 W**
- **Usage:**
  - VoIP-Phones
  - WiFi-Access-Points
  - Cameras



Power over Ethernet PoE

- **Energy provider**
  - Power Sourcing Equipment (PSE)
  - e.g. Switch
- **Energy consumer**
  - Powered Device (PD)
  - KNX/IP-Router

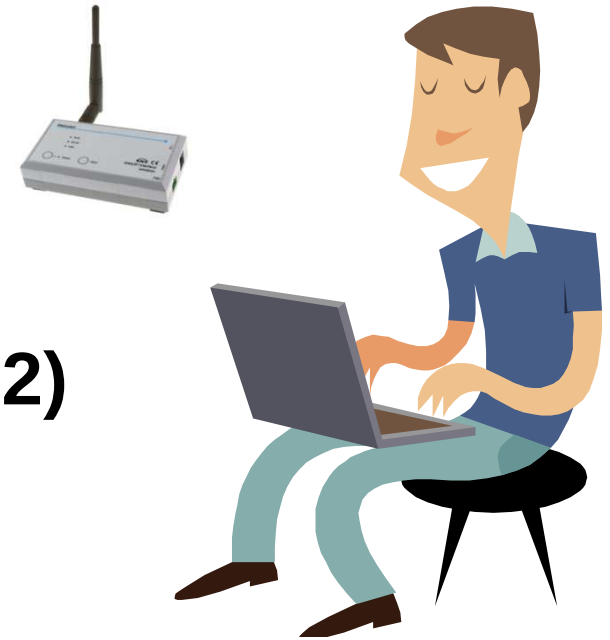


KNX IP Interface 740 *wireless*

- **Interface to KNX (Tunneling), e.g. for the ETS**
- **WiFi (integrated WiFi access point)**

KNX IP 740 *wireless - Benefits*

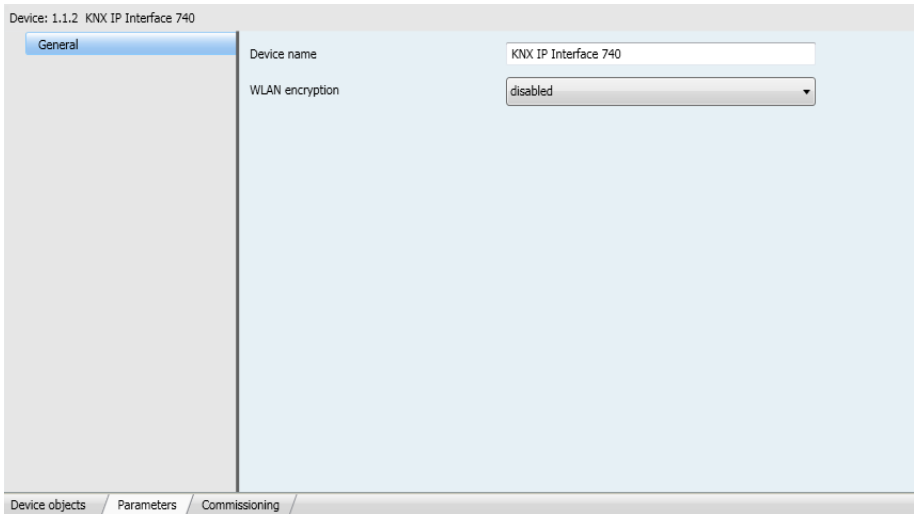
- **Supported by ETS**
- **Usage of common network components**
  - Notebooks already equipped with WiFi
- **Initial start up possible by one Person**
  - Installer can move around the building almost freely
- **Encryption possible (WPA2)**



KNX IP 740 Parameters - General

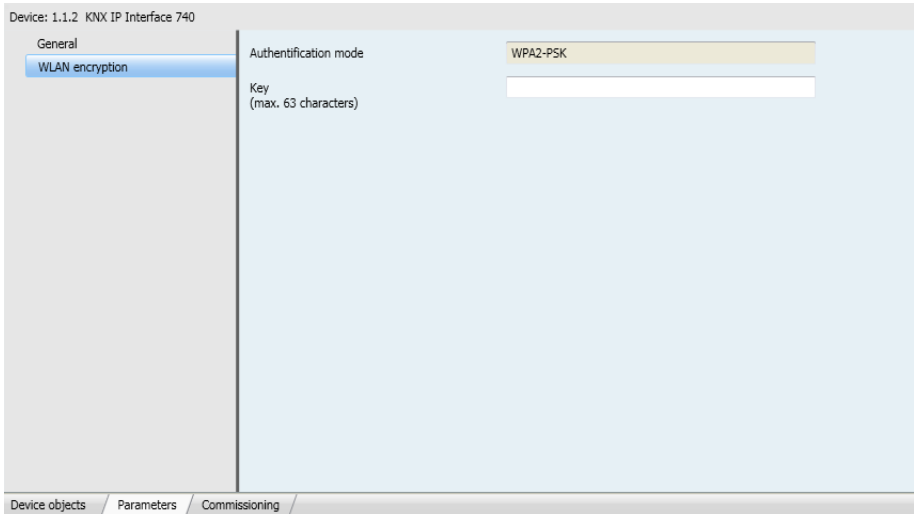
- **Device Name**
  - Identification of the KNX/IP-Interface
  - SSID (WLAN)

- **WLAN encryption**
  - Disabled
  - Enabled



KNX IP 740 Parameters - WLAN

- **Authentification mode**
  - WPA2-PSK (Wi-Fi Protected Access 2, PreShared Key)
- **Key**
  - 63 characters available

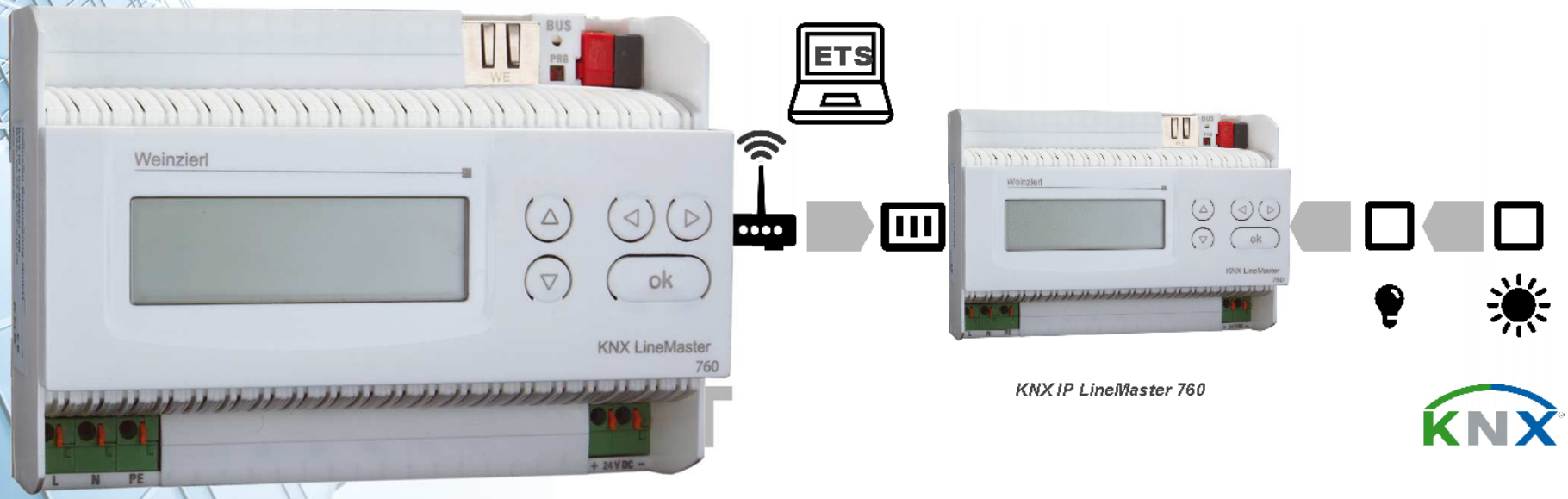


KNX IP 740 – What's in the box

- KNX IP 740
- Plastic case
- Wall power supply
- Antenna
- Screwing terminal
- Documentation

KNX IP LineMaster 760

- Power supply including choke
- Interface to KNX (Tunneling), e.g. for the ETS
- Line coupler functionality (Routing)



KNX IP 760 - Diagnostics

- **Reset of a line**
- **Data memory**
  - Operating hours
  - Overcharge, Electrical surge
- **Operating data**
  - Bus voltage
  - Bus current
  - Temperature
- **ETS data base based on KNX IP Router**

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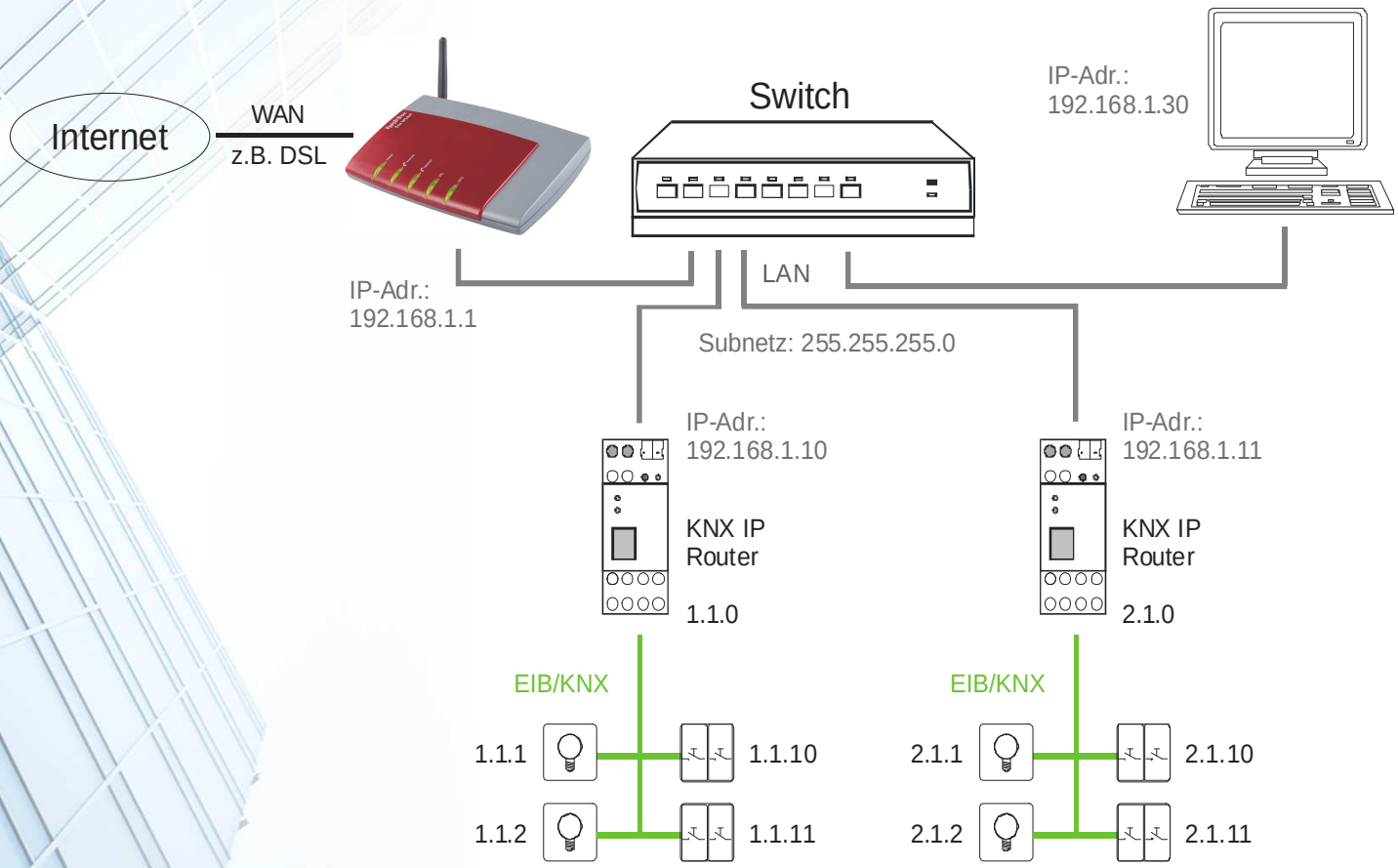
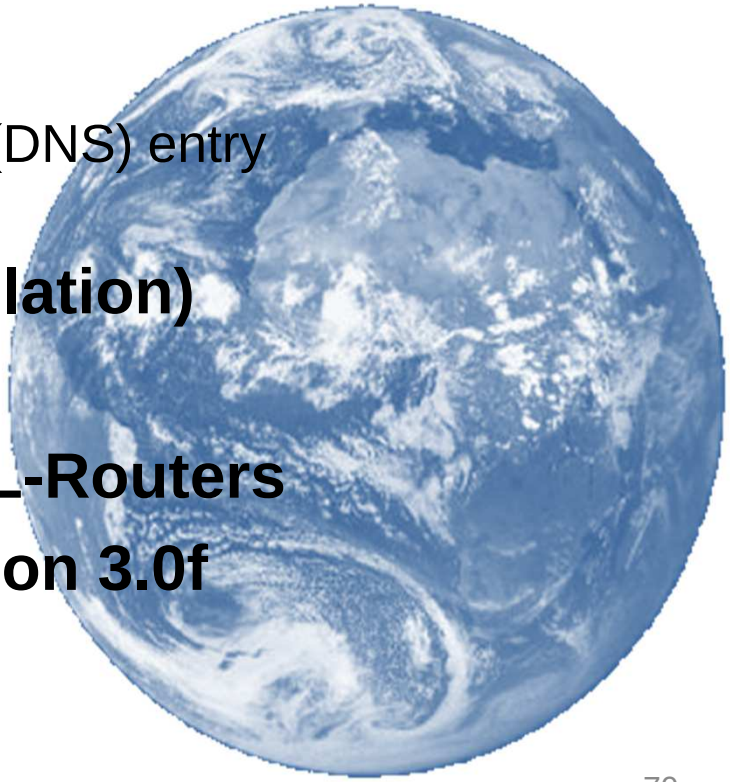
KNX IP 760 - Installation Example



Remote Control (NAT)

- **KNX/IP-Router works as server**
- **Available beyond the private Network**
- **IP-Address has to be known**
  - Static
  - Dynamic Domain-Name-System (DNS) entry
    - e.g. DynDNS.com
- **NAT (Network Address Translation)**
- **Routing to a private Network**
- **Implemented in common DSL-Routers**
- **Possible with ETS from version 3.0f**

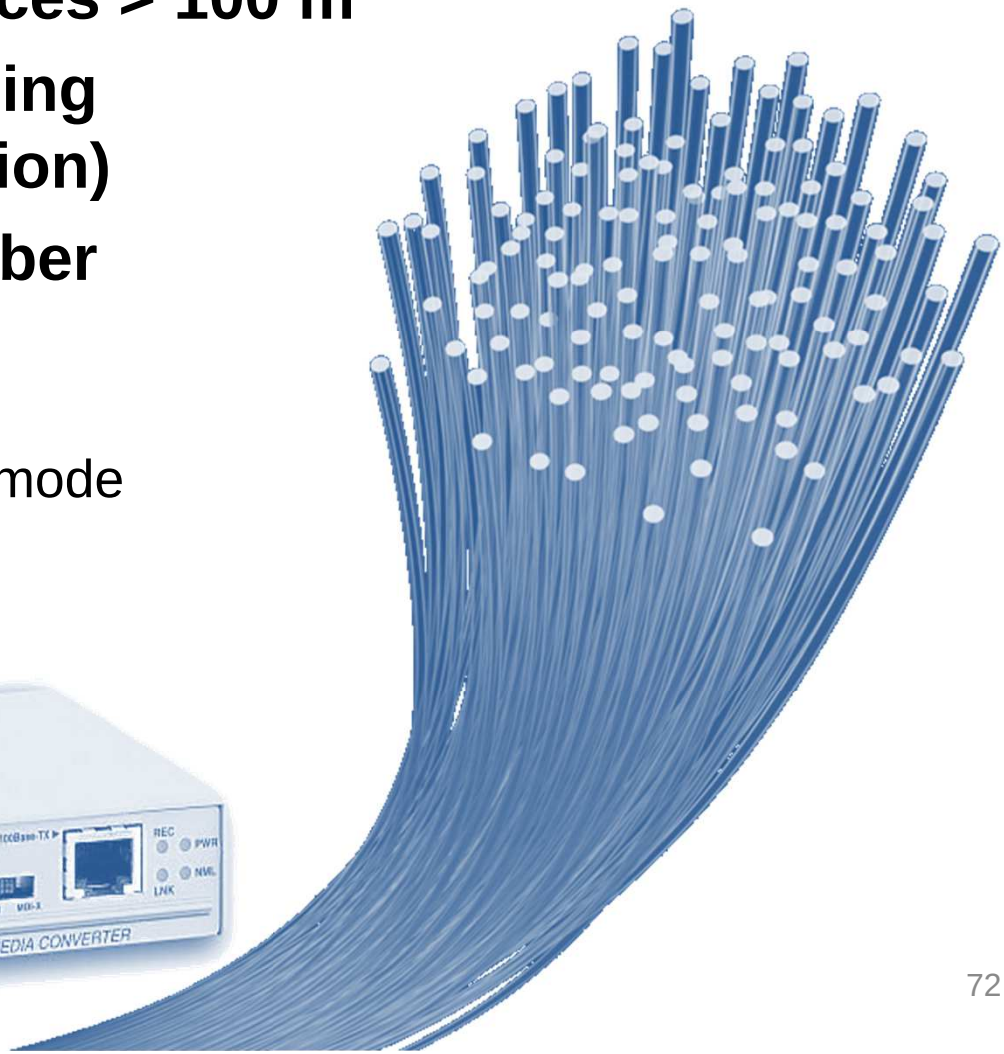


Remote Access (VPN)

- Access via NAT: unsecure
- Usage of VPN (Virtual Private Network)
- Common VPN-Routers available
- Connecting by PC to external VPN
- More effort during Installation

Optical Media

- **Bridging of distances > 100 m**
- **Electrical Decoupling (Lightning protection)**
- **Usage of optical fiber**
  - Multimode
    - Range < 2 km
  - Monomode / Singlemode
    - Range < 40 km
- **Media converter**



Future Prospects

- **KNX over IP increasingly more important**
- **KNX/IP-only Devices**
  - No TP1 Connector
  - Replacement of Ethernet / IP by KNXnet/IP as protocol
  - Interworking KNX
  - Management KNX
    - Initial start up via ETS
  - Databases like TP1-Devices
  - Link to multimedia
  - Task-Force-IP: Specification done
- **Expansion of KNXnet/IP**
  - Remote logging
  - Configuration and diagnosis
  - Object server
  - Security

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KNX and IP

Thank you for your attention.