KNX
The worldwide STANDARD for home and building control

KNX Association International
KNX status quo

January 2017
KNX is the standard

**CENELEC**
- **EN 50090**
  The only European standard for Home and Building Electronic Systems (HBES) based on KNX.

**CEN**
- **EN 13321-1**
  The European standard for Building Automation based on KNX.

**ISO/IEC**
- **14543-3**
  The world’s only standard for Home Electronic Systems (HES) based on KNX.

**GB/T**
- **GB/T 20965**
  Chinese standard for Home and Building Control based on KNX

**US STANDARD**
- **(ANSI/ASHRAE 135)**
  The only European standard for Home and Building Electronic Systems (HBES) based on KNX.

The European standard for Building Automation based on KNX.

The world’s only standard for Home Electronic Systems (HES) based on KNX.

Chinese standard for Home and Building Control based on KNX.
KNX is interoperable (1)

Guaranteed interoperability through neutral certification

- KNX is the only home and building control standard running global certification schemes for
  - A. Products
  - B. Training centres
  - C. Persons

- Product compliance is checked at neutral third party test laboratories

KNX logo guarantees interoperability between products of different manufacturers and applications
KNX is interoperable (2)

Guaranteed interoperability through neutral certification

- One PC software tool for

  A Design  B Configuration  C Diagnostics

  of all KNX certified products

- Tool is independent of manufacturers, devices and applications – integrator can combine products of different manufacturers and applications in one installation

- Tool is extendable with customised apps
KNX is smart home

ETS Inside is...

- **Smart** - Finger tap instead of mouse click
- **Simple** – One tool for installers and end users
- **Safe** - No unauthorised access

1. ETS Inside is part of the KNX system. Operation and ETS data are decoupled.
2. The easily comprehensible user interface even runs on tablets and smartphones.
KNX is fit for use in ALL applications

- External services
- Door communication
- Air conditioning
- Shutters and blinds
- Irrigation
- Remote operation via web or telephone
- Building control
- Lighting
- Renewable energy
- Visualisation
- Ventilation
- Energy management
- Home appliances
- Audio & video
- Smart metering
- Heating
- Smoke detector
- Anti-intrusion
KNX is fit for use in all kinds of buildings

- New or existing buildings
- Single-family houses or large size buildings
- Easy extendable/adaptable to new requirements
KNX supports the most important transmission media

- Twisted Pair
- Power Line
- Radio Frequency
- Ethernet/WIFI
KNX is independent of any hardware or software technology

- KNX manufacturers can develop their own protocol solution
  1. From scratch
  2. On the basis of existing certified system components from other KNX members

- KNX is completely FREE of additional royalty fees: No IPR royalties to be paid for KNX standard features used in KNX certified products to other KNX members
KNX is easy to couple with other systems

- KNX members offer large variety of gateways to couple to other systems

- Examples

  - Mapping to BACnet
  - Interfacing with DALI
KNX is secure

KNX Secure uses AES128 CCM for encryption/authentication and Diffie-Hellmann for a secure key exchange.

1. **KNX IP Secure**

   All KNX telegrams between two (or more) IP couplers are SECURED

2. **KNX Data Secure**

   The group communication of a particular sender (one or more group objects) to another group object(s) is SECURED
KNX is part of Internet of Things

**KNX current ecosystem**

KNXnet/IP

**KNX IoT 1.0**

Web services
- A gateway maps the KNX project
- Using oBIX, OPC UA and BACnet-WS
- Open data exchange of values and states

**KNX IoT 2.0**

2018: Plug & Play internet connected web services

**KNX IoT 3.0**

2020: Direct IP devices within KNX ecosystem
KNX devices sit natively on IP

**KNX IoT 4.0**

> 2020: Self-learning adopting system
405 members in 42 countries
KNX members

Total number

Annual increase

KNX: The worldwide STANDARD for home & building control
More than 7000 certified KNX products (samples of HVAC devices)
KNX facts & figures

- 405 KNX Members in 42 countries
- 7000 certified product groups
- 16 Test labs in 8 countries
- 66430 KNX Partners in 157 countries
- 400 Training Centers in 66 countries
- 20 Userclubs in 18 countries
- 44 National Groups
- 130 Scientific Partners in 33 countries
- 15 Associated partners
- ETS sold in 140 countries
Heating, cooling, ventilation with KNX

Systems and products

www.knx.org
Networking of the room automation functions

• If class A is to be achieved according to EN15232, the following is necessary:
  1. networking of energy-efficient room automation functions for all applications
  2. demand-oriented control

• KNX fulfills all technical requirements for the integration and communication of the different applications and products

• The integration of HVAC technology in home and building automation has long been part of standard KNX applications

• Currently over 70 manufacturers have registered KNX products with heating, ventilation and air conditioning applications

KNX has already shown in a variety of studies and projects that savings of 50 % to 60 % can be achieved through individual room control and ventilation control alone.
Individual room temperature control

Individual room temperature control offers the possibility of regulating the room temperature of a single room regardless of the temperature in other rooms.

- The current controllers are mainly complete, aesthetically sophisticated room controllers which also control all the other functions in a room.
- Some of the current controllers can also measure the CO₂ content and air humidity as well as support the heating and / or cooling operating modes.
Valves control the rate of flow in the individual heating and cooling circuits

- The triggering of the valves is normally carried out via analogue thermoelectric or motor valve drives.
- Motor valve drives with an integrated KNX interface...
  - can be very precisely positioned
  - mostly have additional intelligence and diagnostic functions
  - transfer both the current valve position and error messages via KNX
Fan coil controllers

A benefit of fan coil control is the rapid availability of thermal energy or cooling capacity. It is therefore widely used in hotels and office buildings.

- The control of the fan and the heating or cooling register is carried out via special KNX fan coil actuators in the unit while the operation is usually carried out via KNX room thermostats with extended functions and setting options.
- It is possible via KNX to separate the unit and the operation cost-effectively in terms of rooms.
Interfaces to energy generation and distribution systems

With interfaces to power generation systems it is possible:

- to display the current state of their heating system using the KNX visualisation system
- to predefine setpoint values and set operating modes
- Fault signals are automatically transmitted to KNX and displayed
- As the current heat requirement in the rooms can be communicated via the KNX gateway to the heating controllers, the heat generation must be precisely matched to the current demand.
Variable volume flow controller

- Based on the recorded room conditions and the current air requirement, energetically intelligent and demand-controlled systems can be set up with KNX.

- A central control unit permanently monitors the flap positions of the individual VAV boxes via KNX. If the flaps eliminate excessive inlet pressure, this is reduced.

- The aim is to operate the system with the lowest possible pressure loss.
Room air control and interfaces to ventilation systems

- In addition to the baseline values, the values for the room temperature, air humidity and carbon dioxide content measured by the KNX individual room controllers and air quality sensors can be transferred via the KNX interfaces to the ventilation system and taken into account during the control.

- In the other direction, the ventilation system transfers status signals to KNX which for example signal the necessary replacement of ventilation filters.
The interfaces to the air conditioning systems are versatile. In addition to a few standardised interfaces, the manufacturers use a variety of proprietary hardware and protocol solutions.

Special KNX gateways enable the integration of almost all the air conditioning devices into KNX.
Summary

Over 7,000 certified KNX products

cover all the applications of heating, ventilation and air conditioning

The KNX worldwide standard

thus offers the best requirements to improve the energy efficiency of buildings.
Heating, cooling, ventilation with KNX

Case studies
Overview of case studies

Case study 1: Control and monitoring of the system functions of an HVAC device
Case study 2: Control and monitoring of temperature
Case study 3: Visualisation of HVAC relevant parameters
Case study 4: Optimisation for optional heat pump power consumption
Case study 5: Heat pump power consumption forecast
Case study 1 - Control and monitoring of the system functions of an HVAC device

The display and remote control of the operating modes (comfort, standby, night reduction) for the system functions (heating, cooling, ventilation and hot water) of a generator.

Case A: The user toggles the operating state via his smartphone.

Case B: The user starts the one-time heating of the hot water before showering.
Case study 1 - Control and monitoring of the system functions of an HVAC device

KNX solution for case A
Selection of the operating mode

The user has different options depending on the system configuration:

1. To set the operating mode centrally on the power generation system. The system affects the respective heating circuit (e.g. one floor).

2. To set the operating mode separately for each room via the visualisation using individual room temperature control.

The setting under point 1 has the primary function.
Case study 1 - Control and monitoring of the system functions of an HVAC device

KNX solution for case A

1. The default operating mode is only carried out on the heat / cooling generator via a heating / cooling circuit with a corresponding feedback signal.

Selection and feedback of operating modes via HVAC mode, 1 byte / DPT 20.102 or 1 bit / DPT 1.00x

For example for a heat pump control:
0: Auto
1: Comfort
2: Standby
3: Economy
4: Building protection
Case study 1 - Control and monitoring of the system functions of an HVAC device

KNX solution for case A

2. The default operating mode is carried out primarily at the heat / cooling generator as well as per room on the individual room thermostats. Both the room thermostats and the heat / cooling generators send a feedback signal to the visualisation about the respective status.

Selection and feedback of operating modes via HVAC mode, 1 byte / DPT 20.102 or 1 bit / DPT 1.00x

For example for a heat pump control:
0: Auto
1: Comfort
2: Standby
3: Economy
4: Building protection

RTS: Room temperature sensor
RTC: Room temperature controller
KNX solution for case B

Domestic water heating

The one-time heating of the hot water e.g. via night mode, is triggered via a 1 bit command.

The status can be queried at the same object or a separate status object.

Alternatively, a temporary increase of the setpoint temperature of the hot water is possible.
Case study 2 - Control and monitoring of temperatures

The display of actual and setpoint temperatures of rooms, zones / heating circuits as well as the remote control of setpoint temperatures and the optional creation of setpoint temperature time profiles are among the standard functions of an individual room temperature controller.

Case A: The user sets the setpoint temperature from 19°C to 21°C.

Case B: The user would like the room temperatures to be displayed via a smartphone.

Case C: An energy manager optimises the inlet temperature of a heating circuit / zone using the predefined room temperatures.

Case D: The user configures time profiles so that the corresponding rooms have achieved the comfort temperature at the time of usage.
Case study 2 - Control and monitoring of temperatures

**KNX solution for case A**

**Changing setpoint temperature from 19°C to 21°C**

An individual setpoint value can be predefined for each room by the individual room thermostat via the visualisation.

- **Room 1**
  - RTS: Room temperature sensor
  - Heating actuator with RTC

- **Room n**
  - RTS: Room temperature sensor
  - Heating actuator with RTC

**Actual / setpoint temperatures:**

- 2 byte Float / DPT 9.001

**Active signals**

- Setpoint values
- Actual values
- HVAC mode status
- HVAC mode
- KNX interface
- Condensing boiler or heat pump

- KNX: The worldwide STANDARD for home & building control

RTS: Room temperature sensor
RTC: Room temperature controller

*photo: ThinKnx*
Case study 2 - Control and monitoring of temperatures

KNX solution for case B

Display of the room temperatures on a smartphone

Each temperature sensor sends the respective actual value per room via KNX to the associated room thermostat which routes it for display on the visualisation.

Setpoint values
Actual values
HVAC mode status
HVAC mode
Setpoint temperature per room
Actual temperature per room

Room 1
RTS
Heating actuator with RTC

Room n
RTS
Heating actuator with RTC

photo: ThinKnx

RTS: Room temperature sensor
RTC: Room temperature controller

Actual / setpoint temperatures:
2 byte Float / DPT 9.001
**Case study 2 - Control and monitoring of temperatures**

**KNX solution for case C**

For demand-based control, an energy manager optimises the energy consumption.

The valve drives send the valve position per room to the energy manager which calculates the optimum inlet temperature on the basis of the current valve positions.

**Room 1**

- **RTS**: Room temperature sensor
- **RTC**: Room temperature controller

**Room n**

- **RTS**: Room temperature sensor
- **RTC**: Room temperature controller

---

**Active signals**

- **Condensing boiler or heat pump**

**Actual / setpoint temperatures**: Value_temp 2 byte Float / DPT 9.001

- **Valve lift**: Percent (0..100%), 1 byte, DPT 5.001

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RTS: Room temperature sensor
RTC: Room temperature controller
Case study 2 - Control and monitoring of temperatures

KNX solution for case D

The user configures time profiles

Individual setpoint values can be preassigned for each room for individual room temperature control. The profile data is stored in the visualisation system.

The user configures time profiles

Individual setpoint values can be preassigned for each room for individual room temperature control. The profile data is stored in the visualisation system.

RTS: Room temperature sensor
RTC: Room temperature controller

KNX: The worldwide STANDARD for home & building control
Case study 3 - Visualisation of HVAC-related parameters

Display of HVAC-specific parameters

Case A: The user would like the power consumption of HVAC devices to be displayed.

Case B: The user would like the operating state (normal operation, faults, service requirements ...) to be displayed via smartphone.

Case C: The next service interval should be indicated to the user.
Case study 3 - Visualisation of HVAC-related parameters

KNX solution for case A

Power consumption of HVAC devices

Current heating controllers mainly make the energy consumption available as an absolute value on the KNX:
- electricity for heating
- electricity for hot water
- gas for heating
- gas for hot water

The energy consumption values are prepared in the visualisation system and displayed as:
- diagrams
- absolute values
- daily, weekly, monthly or annual values

Energy consumption: real energy (kWh)
4 byte / DPT 13.013
KNX solution for case B
Displaying operating states on the smartphone

Almost all the operating states can be queried via the KNX interface and displayed in the visualisation including: heating, cooling, active heating program, day / night mode, HV pumps, DHW heating, active electric night heating, service, etc.

When there are system errors, error messages are automatically sent to the visualisation via the KNX, either as individual fault messages or as group messages ("Faults of heat generator").

Fault message,
Operating status:
1 bit / DPT 1.00x
1 byte / DPT 6.020
1 byte / DPT 20.xxx
Case study 3 - Visualisation of HVAC-related parameters

KNX solution for case C

Note about the next service interval

The note about the next service date can be carried out in different ways:

1. The heat / cooling generator determines the necessity of a service appointment itself and sends a request in the form of a yes / no telegram to the visualisation system.

2. The running times of the HV and storage pumps, compressors, electric heaters etc. are sent as absolute values to the visualisation, compared with the specified maintenance intervals and the next service period is calculated.

Running times: TimePeriodHrs 2 byte / DPT 7.007
Case study 4 - Optimisation for optional power consumption of heat pumps

Heat pumps belong to the most energy-intensive devices in the building. There is therefore a high added value for the customer to integrate these systems in the energy management so that they can be operated cost-effectively.

Case A: The service water is heated if the electricity is reasonable.

Case B: The heating or cooling is carried out within a tolerance range defined by the customer if the electricity is reasonable.
Case study 4 - Optimisation for optional power consumption of heat pumps

KNX solution for cases A/B
Heat pumps can represent optional processes (e.g. heating or cooling) on the communication interface, so that these processes can be started by an energy management system under favourable conditions.

Use of SG ready functions for heat pumps with Smart Grid capability
Operating status 1 is backward compatible to utility lock, incorporates a maximum lockout period of two hours
Operating status 2 is the energy-efficient normal operation with pro-rata filling of thermal store for the maximum lockout period of two hours
Operating status 3 is the controller mode for heating rooms and water
Operating status 4 is a definitive start-up command

http://www.waermepumpe.de/waermepumpe/sg-ready/
Case study 4 - Optimisation for optional power consumption of heat pumps

KNX solution for cases A/B
Heat pumps can represent optional processes (e.g. heating or cooling) on the communication interface, so that these processes can be started by an energy management system under favourable conditions.

Control with a conventional heat pump via operating modes and setpoint values.
Case study 5 - Heat pump power consumption forecast

Heat pumps belong to the most energy-intensive devices in the building. There is therefore a high added value for the customer to integrate these systems in the energy management so that they can be operated cost-effectively.

Case A: Further energy-intensive processes which exceed the domestic current of the PV system are prevented from starting during the heating cycles.

Case B: The user can be shown when heating cycles take place and at what price.
Case study 5 - Heat pump power consumption forecast

KNX solution for cases A/B
Heat pumps can represent optional processes (e.g. heating or cooling) on the communication interface, so that these processes can be started by an energy management system under favourable conditions.

Operating states and forecast data can be communicated by heat controllers to a visualisation program via the KNX and displayed as values, diagrams or graphics.

The heat pump determines the thermal energy demand of the building and communicates the power requirement to the PV system.

The PV system plans the operating time of the devices under consideration of a yield and consumption forecast so that the power consumption makes an optimum contribution to the domestic consumption.

The heat pump converts this proposal dependent on the operating state and thus increases the domestic consumption. Electrical energy is converted into thermal energy cost-effectively and stored temporarily in the house.
Heating, cooling, ventilation with KNX

HVAC specifications
HVAC specifications

HVAC ObIS Application Description (AD)

- AD for HVAC devices exists for more than 20 years
- AD contains:
  - General description(s)
  - Functional specification(s)
  - Limitations
  - Function Block Diagram(s)
  - List of used DPT
HVAC specifications

Specification of Application Descriptions for S-Mode devices

- In recent years, applications and requirements have been added which are no longer covered by the "ObIS Application Description" (e.g. due to new datapoint types)

- The KNX WG-I updates the HVAC ObIS ADs and the function block assignments.

- Implementations in development and system integration are significantly facilitated.

- The "Channel specifications" and specifications for LTE devices remain unaffected.
HVAC specifications

HVAC S-Mode application model

- Function blocks, communication objects and dependencies are clearly structured and defined for HVAC applications
- For manufacturers and system integrators
HVAC specifications

HVAC S-Mode room controller

- The application-specific configurations can be derived from the overall scheme
- Here: room controller only heating
Datapoint types (DPT)

- DPTs are available for all HVAC applications
- The complete description of the relevant DPTs are contained in "Volume 7" of the KNX specifications

<table>
<thead>
<tr>
<th>Name</th>
<th>DPT_ID</th>
<th>Encoding</th>
<th>Size (bit)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPT_Enable</td>
<td>1.003</td>
<td>B₁</td>
<td>1</td>
<td>To enable or disable all types of modes e.g. comfort mode.</td>
</tr>
<tr>
<td>DPT_Trigger</td>
<td>1.017</td>
<td>B₁</td>
<td>1</td>
<td>Sent by a push button or display to inform the room temperature controller that the room will be occupied for a longer period. (“Party Mode”).</td>
</tr>
<tr>
<td>DPT_Occupancy</td>
<td>1.018</td>
<td>B₁</td>
<td>1</td>
<td>Between a presence detector, a push button or other sensors to inform the room temperature controller about the room occupancy.</td>
</tr>
<tr>
<td>DPT_Window_Door</td>
<td>1.019</td>
<td>B₁</td>
<td>1</td>
<td>Between door and window sensors to inform the room temperature controller that a door or window is open.</td>
</tr>
<tr>
<td>DPT_Heat/Cool</td>
<td>1.100</td>
<td>B₁</td>
<td>1</td>
<td>Supplied by a controller to make the system either heat or cool.</td>
</tr>
<tr>
<td>DPT_Scaling</td>
<td>5.001</td>
<td>U₈</td>
<td>8</td>
<td>Used for controlling the speed of fans, between off and full speed, even fans with a different number of discrete speeds.</td>
</tr>
<tr>
<td>DPT_Percent_U8</td>
<td>5.004</td>
<td>U₈</td>
<td>8</td>
<td>Controlling the position of valves.</td>
</tr>
<tr>
<td>DPT_Value_Temp</td>
<td>9.001</td>
<td>F₁₆</td>
<td>16</td>
<td>Used for setpoint for room temperature, actual room temperature, boiler temperature, outside temperature.</td>
</tr>
<tr>
<td>DPT_Value_Tempd</td>
<td>9.002</td>
<td>F₁₆</td>
<td>16</td>
<td>To adjust the setpoint by a few degrees up or down.</td>
</tr>
<tr>
<td>DPT_Value_AirFlow</td>
<td>9.009</td>
<td>F₁₆</td>
<td>16</td>
<td>How much air (m³/h) is currently flowing through the ventilation system at any location?</td>
</tr>
<tr>
<td>DPT_PowerDensity</td>
<td>9.022</td>
<td>F₁₆</td>
<td>16</td>
<td>A sun intensity sensor reports on the intensity of the sunlight, which will heat the room from outside, so that the room temperature controller can take this into account.</td>
</tr>
<tr>
<td>DPT_HVACMode</td>
<td>20.102</td>
<td>N₈</td>
<td>8</td>
<td>Common encoding to indicate whether the house or building should be heated or cooled as normal, or should save energy, when nobody is in, or even more when the building or house is not occupied for a long time. The setpoint temperatures result from this.</td>
</tr>
<tr>
<td>DPT_StatusRHCC</td>
<td>22.101</td>
<td>B₁₆</td>
<td>16</td>
<td>For a room temperature controller to report its current operation state and device state.</td>
</tr>
<tr>
<td>DPT_TempRoomSetpSetF16</td>
<td>222.100</td>
<td>F₁₆F₁₆F₁₆</td>
<td>48</td>
<td>Setpoint temperature values for comfort, standby and economy mode given by a supervisor (display, scheduler…) to the room setpoint manager.</td>
</tr>
</tbody>
</table>
HVAC specifications

Where can I find the KNX specifications and information on the technology?

www.knx.org → KNX → Technology
Heating, cooling, ventilation with KNX

HVAC website
HVAC website

http://hvac.knx.org
Membership of the KNX Association
Membership of the KNX Association

Why join the KNX Association?

1. Profit from the promotional value of using the KNX trademark on your products

   • As a sign of quality, only KNX members are able to use the KNX logo on their KNX certified devices and on their KNX-related promotional material.

   • Let your KNX devices and company be part of the worldwide network of providers of KNX certified products.
Membership of the KNX Association

Why join the KNX Association?

2. Boost the international profile of your products and company

Benefit from the impact of publications in the KNX Journal

- read by more than 100,000 people in 125 countries
- free presentation of any new KNX member to the KNX community and free promotion of your latest KNX products
Membership of the KNX Association

Why join the KNX Association?

3. Free access to KNX know-how

• The KNX technology will be at your fingertips in the form of the latest version of the KNX specifications.

• The KNX standard will guide you through all topics related to KNX development, including system features, profiles, certification rules, application descriptions, testing requirements, and lots more.
Membership of the KNX Association

Why join the KNX Association?

4. The KNX team and community at your service

- As a KNX member, the Brussels KNX team is at your service for support related to KNX administration, certification, testing, marketing and tool licensing issues.
- Via the KNX Working Groups, you can exchange views with other involved KNX members on KNX related matters.
Membership of the KNX Association

Why join the KNX Association?

5. Privileged access to KNX tools

- As a KNX member, only you have access to the specialised KNX tools such as the KNX ETS Manufacturer tool for the creation of KNX ETS product descriptions and EITT, the uniform KNX conformity test tool.
Membership of the KNX Association

Why join the KNX Association?

6. Extend your worldwide visibility through the KNX website

- Your company name will appear on the international KNX website, translated into many languages and also constituting the communication platform for the KNX country organisations (KNX National Groups) in the individual countries (so far more than 40).
Membership of the KNX Association

Why join the KNX Association?

7. Influence the KNX decision-making process

• You can participate in the KNX Working Groups and KNX Task Forces, the driving forces in KNX marketing and communication, as well as technical aspects.

• As a shareholder you have the opportunity to influence the future of KNX by participating in official KNX decisions during the KNX annual general meeting (AGM).
Membership of the KNX Association

Why join the KNX Association?

8. Open up new markets through your involvement in KNX

- Participate in KNX events organised in several countries or get involved in local KNX National Groups.
Membership of the KNX Association

Why join the KNX Association?

9. Enhance your campaigns with free KNX PR material

- Common PR material such as KNX brochures, merchandise… is available from KNX to support you when creating more awareness for KNX with new customers.
Membership of the KNX Association

Why join the KNX Association?

10. Stay informed on the latest developments in international standardisation

- KNX has partnerships with many international standardisation organisations, with the purpose of further embedding KNX in international standards: in view of this privileged position, KNX will be able to keep you posted on the latest developments in standardisation of new home and building control related standards.
Membership of the KNX Association

Why join the KNX Association?

Start video “How to become a KNX member”
Membership of the KNX Association

Where can I find membership information?

KNX
The worldwide STANDARD for home and building control

KNX Association International

www.knx.org
More info needed?

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Thank you very much for your attention

For any questions, contact info@knx.org – www.knx.org