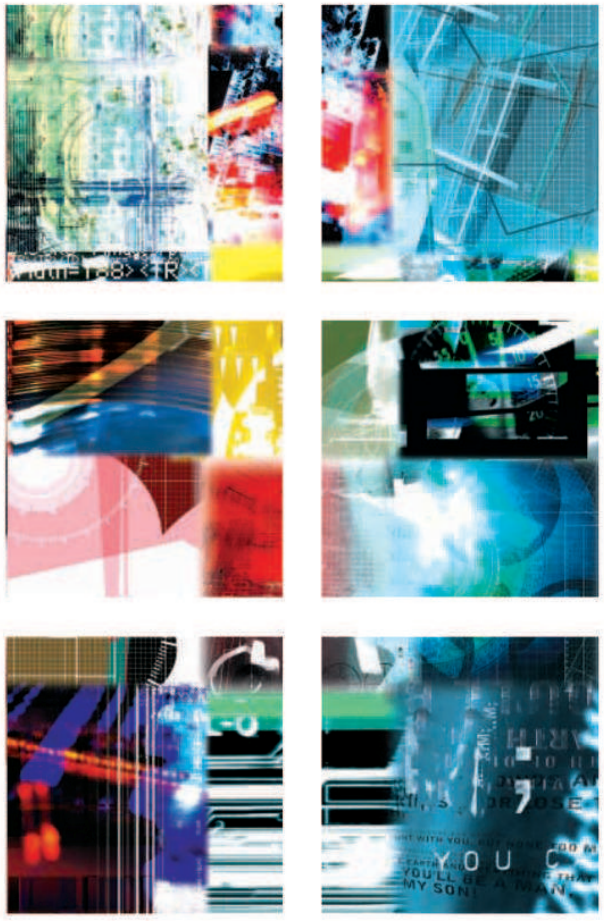

www.knxuk.org

KNX UK
CONSULTANTS' GUIDE

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KNX® The worldwide STANDARD for home and building control

Introduction

This guide is aimed at consultants and specifiers working within the electrical and mechanical industry who are actively involved with the design of intelligent sustainable low energy buildings.

This subject features at the top of every building services engineer's agenda today and will remain there in the future as we all take up the challenge and social responsibility of protecting our environment.

With any 21st century development, design for energy conservation is paramount if the demands of regulations, industry targets and client requirements are to be achieved. This is where building controls play their part within the electrical and mechanical design process by providing the operating parameters, strategy, measurement and monitoring by which all systems can operate.

So why are building controls so important?

Consider all of the plant, equipment and components that would normally be specified by the building services engineer to achieve the optimum energy performance against the client's requirements. These include luminaires, central battery units, fans, chillers, pumps, HVAC terminal units and many other items.

Imagine not having control systems to set these items to work, add to this the ever changing climate, times of day as well as the human comfort factor and you should start to see the critical role for building control systems.

Without a functional, well designed and commissioned building control system, achieving optimum efficiency would be very difficult. This is only the start of the story as the control system should evolve and change as the building does over time. Intelligent building control systems should be designed to cater for the changing needs of the building and offer suitable upgrade paths and expansion capability for the future.

This guide will introduce the concept of Open Protocol integrated building control as opposed to the older traditional approach of many standalone separate systems. We will also show why lifecycle costing must be considered at specification stage and form an integral part of the tender process if we are going to achieve the carbon reduction targets set by Government and associated advisory bodies.

Challenges Faced by the Consultant

In the past few years we have seen major shifts within the industry which have led to new challenges and opportunities for the M & E consulting engineer.

The need to deliver sustainable design and to optimise the energy consumption from our buildings is now top of the agenda and possibly the single most important aspect of the design process. This topic has been highlighted by CIBSE (Chartered Institute of Building Services Engineers) as the industry's most important area of national focus and has been subject to many incentives and working groups.

New training courses and associated qualifications are now available for consultants to allow them to address the key issues of sustainability with many practices now offering their services as Low Carbon Energy Assessors. With the mandatory requirements for Energy Performance Certificates and Display Energy Certificates (EPCs & DECs), the services engineer is possibly now the most important figure within the construction industry when it comes to reducing our CO2 emissions.

Recent studies have been conducted by a number of bodies to discover where our CO2 emissions are coming from. One such study by the Greater London Assembly concluded that around 62% of the CO2 emissions in London originated from heating and lighting, the two key areas of building services that the building services consultant would normally be responsible for. This amplifies the role of the service engineer and gives him the challenge of finding smarter ways to control this sector.

The UK has committed to cutting carbon emissions to 50% of 1990 levels by 2025 and the introduction of carbon reporting (April 2013) was the next step to making this reduction a reality. All UK companies listed on the main market of the London Stock Exchange will have to comply with the mandatory carbon report. By measuring and reporting emissions, companies can begin to set targets and manage initiatives to reduce emissions in the future.

End clients are now becoming aware of the CRC (Carbon Reduction Commitment) requirements that will change the way many large energy users control and manage their real estate. This will give M&E consultants additional work with end clients, reviewing and offering ways to improve their overall carbon footprint. We believe that building control systems can have the largest effect and offer sensible energy payback periods on an annual basis. This is another good reason to consider KNX control as a key part of your energy strategy.

The Sustainable Approach

Sustainability has many meanings to many people and has a very wide scope for interpretation.

Within our industry the quote below has generally been adopted to define its meaning, it is all about considering the balance of energy and associated carbon emissions. It generally would not be considered sustainable to specify a low energy item that has been manufactured in conditions that fall below acceptable standards. By the nature of the manufacturing process, any energy savings made after manufacture would be outweighed.

"Meeting the needs of the present without compromising the ability of future generations to meet their own needs"

Sustainability starts at the very beginning of any product or system with a good understanding of the manufacturing process and origins of the product. These are important when considering the environmental impact of your design. Coupled with this, the installation phase should be examined to see if environmental savings can be made. It is not uncommon for traditional electrical systems to be installed by a number of different companies with many different sets of cables, materials, components, plant/tools and associated transportation. In many cases this is found not to be cost effective or sustainable when there are smarter alternatives to specify.

Using the traditional model as described above can lead to higher site wastage as cable off-cuts, leftover containment and packaging will all add to the overall carbon cost of the construction process.

Using the lifecycle approach to consider any system must take into account the operation and maintenance phase. Will the systems be easy to maintain, be reliable / robust with an upgrade path and spares available in the future? If, for example, a proprietary system was installed and after a short period of operating, needed to be repaired or parts replaced and the end user found that the manufacturer had now moved on to the new system with very little support for the old product, what would you do? At this stage it may be time to start thinking about replacing the whole system. This is a dilemma that many end users face and one that is clearly not sustainable and should be avoided during the design phase.

This guide will illustrate a smarter more sustainable way to the design and management of intelligent integrated building control systems.

Steps to Good Design Practice

The requirements for intelligent building control systems has never been in more demand than now due to more stringent regulations, increasing cost of energy, our awareness to save carbon emissions and the requirements to enhance human environmental comfort within buildings.

With the above criteria we have listed the following key points as the basis to good design practice:

- Start by considering the mechanical design with the electrical design and don't separate the two as there are many cross over points and many aspects that could be designed together. Very often one part of the controls system could be covered within the mechanical specification and another part within the electrical specification, both separated by strict works packages.
- Have an open mind to integration or one system for all. With today's open protocol systems we do not need to have standalone separate systems. This approach can also lead to more efficient building control as many elements under control will interact with each other to give better human comfort.
- Allow flexibility within the project contractual documentation, works packages and budgets to promote good sustainable design. Get the cost consultants (QS) to buy-in to what you are trying to achieve. More often than not the client will be on your side as the cheaper upfront cost of the alternative product or system will be the more expensive over a short period of time.
- Introduce lifecycle costing to the tender process and review energy payback calculations. You will be surprised how short payback periods can be with integrated building control systems.
- Design to save installation / cabling. Promote the use of a site-wide IP network for all systems to use. A CAT6 data network installed by a data cabling company throughout a building is now a standard feature. Let's all use this network for communication around the building and save on installation, labour and materials. The structured cabling network will prove to be very reliable and is a single asset to maintain. With most control systems very little bandwidth is required so don't worry about overloading the network.

Steps to Good Design Practice (continued)

- Consider using the electrical contractor for all of the cabling installation (you may have a separate data cabling company). Why have different companies installing different cabling systems for multiple services? Modern integrated systems promote this approach as their design is intended to be simple and logical to understand. This approach, if managed well, will prove to be beneficial in terms of cost saving and the overall sustainability of the project.
- Consider at design stage the upgrade path and supply of spare parts for the future. Many end clients are faced with the problem of non-maintainable systems after a very short service life.
- Early engagement of the Systems Integrator is always a good idea for advice and design input. Many problems can be solved early on with the specialists on-board.
- Don't consider building controls as a 'black art'. Make the effort to understand what is being offered as there can be major differences between systems.
- Specify energy metering and monitoring systems to allow system performance checks and targeting. If you can measure the building's performance, then you stand a far better chance to improve the overall energy performance.

Why Open Protocol?

To start with it is probably worth defining exactly what open protocol means. In the world of controls this can very often have a wide interpretation.

Open protocol refers to a bus system based around a known international standard, not manufacturer specific with one software tool used for programming and open to all to purchase.

One of the key benefits of an open protocol bus system is that it is supported by more than one manufacturer and a truly open protocol system will allow products from many manufacturers to be seamlessly connected together on the same network without the need for special application programmes or drivers etc.

The advantages of open protocol bus networks are vast and will give benefits to designer and end client alike.

Key Advantages of Open Protocol:

- Multi-vendor products and support.
- Wide range of applications available on one network.
- You will never be tied into any one company.
- No expensive maintenance contracts to be locked into.
- Common software platform not manufacturer owned.
- Select from a wide range of products, mix and match the best in class.
- Standardised training open to all.
- The full system including software can be handed over to the end-user for ongoing maintenance.

With the open protocol approach you will find that your system will never date as there is an upgrade path to follow, and in particular with KNX based systems, there is a guaranteed forwards and backwards compatibility of products that could be used on the existing bus network.

The open protocol KNX system is very easy to extend at any later date as new bus lines can simply be added to the existing network. The approach is a bit like Lego for building controls.

About KNX – The World's Only Truly Open Standard

KNX is possibly the world's only truly open protocol system endorsed by worldwide standards.

Formally known as EIB (European Installation Bus), and regulated by the KNX Association of Brussels, KNX is supported by some of the world's leading manufacturers within the electrical industry.

There are over 27,000 approved KNX products from more than 400 manufacturers covering all aspects of building control and automation. All KNX products are guaranteed to be interoperable between each other regardless of the manufacturer and product type. This is one of the unique features of KNX - this interoperability allows you to mix and match without special software drivers or applications.

One standard piece of software, which is produced and sold by the KNX Association of Brussels, is used by all to commission the system. The ETS software (Engineering Tool Software) is manufacturer independent and is used all over the world by many Systems Integrators for engineering and commissioning of the KNX system. Regulated training is also given in many countries by approved training schools to allow Engineers to obtain the KNX Partner status. This qualification is also regulated by the KNX Association of Brussels who keeps a list of the approved Partners on the international website: **www.knx.org.**

All approved KNX products show the KNX logo and are recorded by Brussels. There are other set procedures and design standards laid down on how to design the bus topology and how a system is set out. These standards are set out later within this guide.

Why Choose KNX?

The KNX Technology is the result of the pooling of knowledge and experience gained over the last 20 years with the predecessor technologies to KNX i.e. the European Installation Bus (EIB), the European Home System (EHS) and BatiBUS.

Main Advantages:-

1. International Standard, therefore future proof
2. By product certification, KNX guarantees interoperability & networking products
3. KNX standards for high product quality
4. A unique manufacturer independent Engineering Tool Software (ETS)
5. KNX can be used for all applications in home and building control
6. KNX is fit for use in different kind of buildings
7. KNX supports different configuration modes
8. KNX support several communication media
9. KNX can be coupled to other systems
10. KNX is independent from any hard - or software technology

International Standard
- ISO/IEC 14543-3

European Standard
- CENELEC EN 50090

European Standard
- CEN (EN 13321-1 and EN1332.2)

Chinese Standard
- SAC GB/Z 20965

US Standard
- ANSI/ASHRAE 135-2010

Overview of Applications

The KNX bus system can be used for a very wide range of building control and automation applications across all market sectors from industrial / commercial through to residential projects. It is typical for the system to be used for many different applications on any one project.

Typical KNX applications:

- Lighting control applications
- Blind and solar control
- Window control / natural ventilation
- Field control of HVAC
- Underfloor heating control
- Metering and energy management
- Security applications
- Monitoring systems
- AV control and interfacing
- Smart home automation systems
- Touch screen control & visualisation packages
- IP connectivity & remote access systems
- Interfaces with many third party systems
- Many other forms of control & automation
- OpenTherm
- Smart metering

There is no limit to the size and scale of the KNX system as the technology is equally well suited to large-scale projects and small residential projects alike. There are many reference projects to demonstrate the strength of the system. Some are shown in later sections of this guide.

In terms of device limits one KNX line can support up to 64 devices using a single power supply. These lines can be repeated and cascaded to include many lines of 64 and when using IP as the backbone the system is virtually limitless.

KNX is very powerful when it comes to interfacing with other systems or bus networks as there are many well established gateways into a large number of systems. This also includes an OPC Server (OLE for process control) for SCADA type interfaces. These interfaces and gateways are commonly used all over the world and have been tried and tested and are now 'off the shelf' solutions.

Overview of Applications (continued)

KNX interfaces to third party systems and other bus networks include:

- BACnet
- LON
- Modbus
- RS232
- M-BUS
- DALI
- SMI
- DSI
- DMX
- 1-10V Analogue systems
- Crestron
- AMX
- MP-BUS
- EnOcean
- Bluetooth
- Infrared interfaces
- RadioBus Wireless systems
- IP Interfaces
- USB Interfaces
- Serial Interfaces
- Boiler Controls
- Air conditioning equipment
- Domestic appliances
- Access control / locking system interfaces

System Layout & Installation Details

The topology of a KNX bus system is designed around a simple logical set of rules making it easy to install and understand.

The bus network is wired using one type of cable for all parts of the bus and connections to devices. The bus cable is recognised by its green outer sheath and will always have the KNX or EIB logo stamped at regular intervals. The cable is generally a single twisted pair 2 x 0.8mm2, red and black insulated conductors of solid copper construction. However, it is very common for a two pair version to be used with the yellow and white insulated conductors being spare or used for auxiliary power for devices.

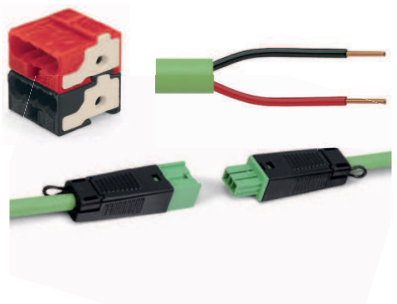
Whether the single or two pair cable is used, the specification and properties of the cable will always be the same and should be manufactured by a KNX Association approved supplier. The bus cable is designed to be installed with mains 230V cabling, very often using the same containment and routing. The outer sheath offers insulation resistance to 600V and the communication protocol is immune to mains borne noise from surrounding cables. This is an advantage during the installation as the KNX bus cabling can be installed by the Electrical Contractor at the same time as the mains cabling is installed using the same methods. KNX bus cables are suited to most forms of wiring systems including traditional tray, trunking and conduit or modern pre-fabricated wiring systems.

There are many suitable plug and connector systems available for KNX bus wiring, as produced by Wieland and Wago for example, which offer simple fast installation methods that can form part of larger pre-fabricated wiring systems can all be installed by the one electrical contractor and not a specialist controls cabling company.

The end terminations of the bus cable have been designed to be simple and trouble free and generally the same connection method is used for all terminations.

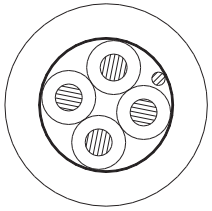
Along with the standardised bus communication, products and software, KNX also has its own approved bus cable (see next page). The cable is manufactured by KNX approved companies to the same specification, guaranteeing quality and performance.

Typical bus connector & cable details



Standard KNX Bus Cable Specification (2pr cable shown)

- Cores
  Conductor ..... **plain annealed copper, circular solid, 0.8 mm**
  Insulation ..... **zero halogen polymer**
  Colour code ..... **red, white, black, yellow**
- Further Construction
  Laying up ..... **Cores twisted to quad**
  Screen ..... **ALU / PETP-tape over tinned copper drain wire**
  Outer sheath ..... **zero halogen, flame retardant polymer, green (RAL 6018)**
- Cable marking
  Printing ..... **KNX-Bus Cable halogen free and *Manufacturer's id thread***



Technical Data

- *Flame retardancy:* **IEC 60332-1**
- *Amount of halogen gas acid:* **IEC 60754-1**
- *Degree of acidity of gases:* **IEC 60754-2**
- *Min. Bending radius:* **8 x Cable-Ø *(Installation)*** **4 x Cable-Ø *(Operation)***

- *Temperature range:*
  +5 °C up to +50 °C *(Installation)*
  -30 °C up to +70 °C *(Operation)*

Geometrical Data

Size	*Conductor size (nom.) n/mm*	*Overall-∅ (approx.) mm*	*Weight (approx.) kg/km*	*Calorific value (approx.) MJ/m*	
2 x 2 x 0.8 mm	**1 / 0.8**	**5.9**	**50**	**0.64**	

Electrical Data at 20 °C

	Character	*Unit*	*Values*	
Conductor size			0.8 mm	
Conductor resistance	***max.***	**Ω / km**	**36.6**	
Insulation resistance	***min.***	**MΩ x km**	**5000**	
Mutal capacitance	***nom.***	**pF / m**	**65**	
Characteristic impedance at 0.1 / 1 / 5 upto 100 MHz	***nom.***	**Ω**	**110 / 85 / 75**	
Attenuation at 0.1 / 10 / 100 kHz 1 / 16 / 20 / 31.25 / 62.5 / 100 MHz	 ***nom.*** ***nom.***	 **dB / 100 m** **dB / 100 m**	 **— / 0.46 / 1.16** **4.1 / 10.5 / 11.3 / 12.8 / 17 / 20.3**	
Crosstalk attenuation at			***nominal***	***min. request at EIB***
1 / 10 / 100 kHz		**dB / 100 m**	**90 / 80 / 78**	**80 / 70 / 60**
1 / 16 / 20 / 31.25 / 62.5 / 100 MHz		**dB / 100 m**	**73/61/60/54/52/48**	**nicht definiert**
Test voltage *(Core / Core)* ***(Core + Screen / Water)***	U_{rms} U_{rms}	**V** **V**	**800** **4000**	
Max. operating voltage	U_{ss}	**V**	**350**	
Operating voltage	U_0 / U	**V**	**250 / 250**	

A typical KNX installation will normally consist of a control panel designed to house the KNX power supply(s) and other DIN rail mounted devices. The control panel will be sized to suit the project as KNX is a modular system whereby components are selected depending upon the requirements of the project i.e. you can be provided with a system tailored to meet your design specification and not stuck with standard fixed equipment. The installation may include central KNX control panels housing the DIN rail equipment (central components) including the system's power supplies. The 230V lighting load circuits would normally be wired back to this panel as part of the general electrical installation for traditional switch control. If there is no space for central control panels, or due to wiring problems you cannot wire back to a central location, then there are many KNX distributed products that can be located in the field. For example the DALI gateway or dimming modules can be distributed and sited by each circuit under control, removing the need for any central control panels.

The green KNX bus cable would be run from the control panel linking together up to 64 KNX bus devices in the field (push buttons, presence detectors, room controllers, FCU interfaces, etc.). If there are more than 64 KNX devices in the field, a number of KNX bus lines can be run from the panel. Control panels located on different floors or zones can be linked together using KNX bus cable or via an IP network.

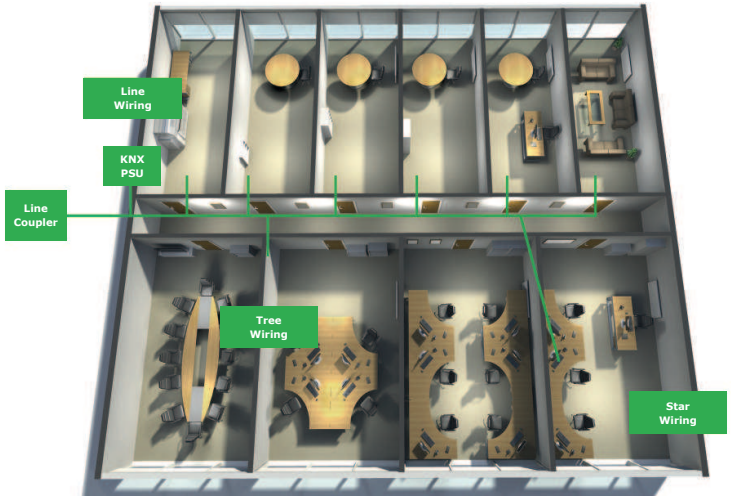
This modular design approach gives maximum flexibility without compromising functionality as the system can be designed to overcome many of the well-known site issues such as limited riser space and or ceiling void space. One other key point to note is that the control panel could form part of the electrical distribution board, saving site labour and space. A KNX system can also be designed without any central control panels and be completely distributed in the field.

The green KNX bus cable would be run from the control panel to link together up to 64 KNX bus devices in the field such as push buttons, presence detectors, room controllers and fan coil actuators. If there are more than 64 KNX devices in the field a number of KNX bus lines can be run from the panel. Control panels located on different floors or zones can be linked together using KNX bus cable or via an IP network.

System Layout & Installation Details (continued)

To design a KNX project, the starting point is the KNX cable and the start of a KNX Line which includes a KNX PSU plus a line coupler. The KNX cable can be distributed in several ways: Line, Star or Tree topology. You can combine all of the above as long as the line is not connected in a loop.

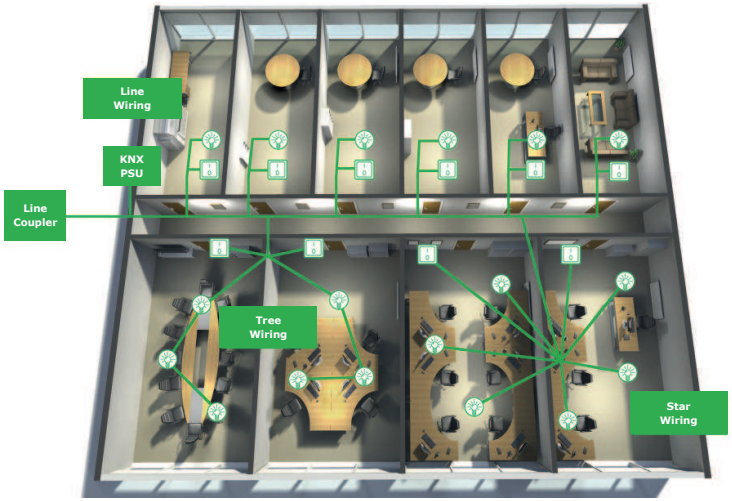
The next step is to design the requirements on that line, remembering the fact that per line you can have 64 devices and the KNX PSU needs to be sufficient to supply those devices. Most devices require 10mA each therefore 32 devices require a 320mA PSU.

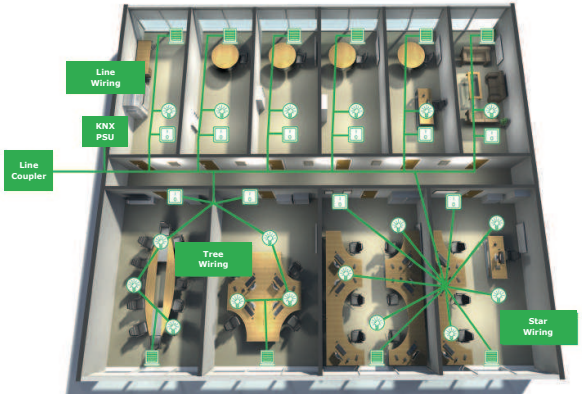


System Layout & Installation Details (continued)

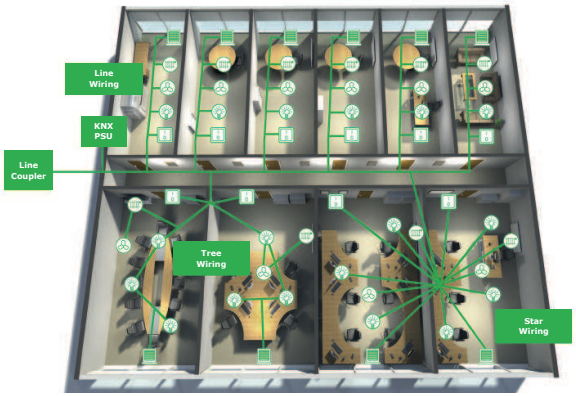
In the first instance KNX cable is dropped down the wall for connection of a switch. This could be a simple rocker or a keypad which sets a scene or centrally controls the lighting throughout the building. Secondly, the KNX cable is taken to a switching actuator or a lighting control system gateway such as DALI. Installing a PIR with daylight saving will enable absence/presence control and energy saving by dimming the lights to required light levels. As all items are on the KNX bus, the 230v supply is only required at the fitting, you have full flexibility in the configuration of the switches and PIR.

As with all KNX installations multiple services can be added to the system quickly and easily. In order to upgrade the above layout to include solar shading and blind control, the KNX cabling is simply linked to a blind actuator or blind gateway such as SMI similarly for lighting. The cabling to the switch remains the same however the switch would be simply expanded to include buttons for manual control. The intelligence for solar shading exists within the PIR and blind actuator so no other products are needed.



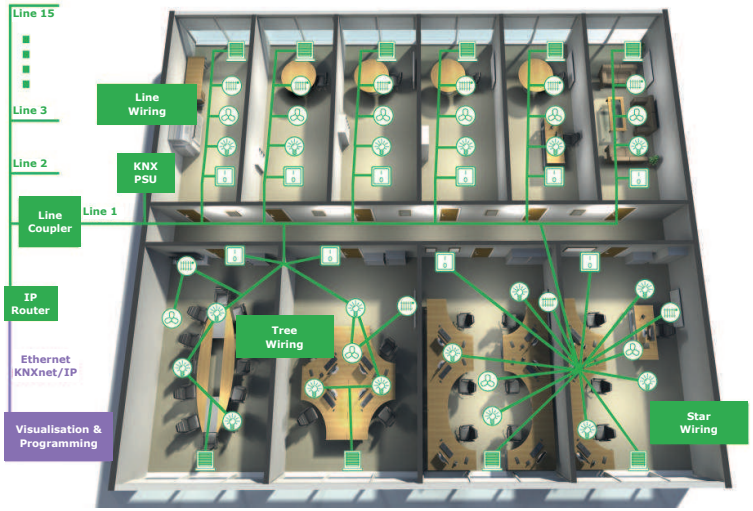


Now a room's heating and cooling control can be added to the network. The KNX cable can be broken and extended to include fan coil controls, VAV or valves for radiators if required. For energy efficient rooms these can be linked to the existing PIR, the switch on the wall can be either expanded with a room controller or replaced, depending on the user's requirements. With all services on the same bus there are no requirements for further keypads or room controls, reducing the cost and complexity of the installation.



Finally, the KNX system can be expanded with further lines and areas. With a total of 15 lines per area and 15 areas in total, the KNX system can be a powerful and flexible building control solution.

With the use of IP as an area, visualisation and programming of devices is quickly and easily realised.



KNX has always been at the forefront of integrated building controls as the underlining philosophy of KNX is to bring different manufacturers' products together on one bus network and to be completely interoperable with each other.

This has been achieved and will always be one of the core principles of KNX. With this in mind you can start to understand why KNX is now one of the world's widest used bus technologies with international standards recognition. So when we refer to integration we mean not only is KNX fully interoperable between manufacturers and their associated products, but KNX is at the heart of building-wide integration of control applications.

The traditional approach of considering every single control application as a standalone system can now be reconsidered to think of different applications working together on one single bus network. KNX can be designed building wide as the underlying bus technology for many control applications such as lighting control, façade control, underfloor heating and radiator zone control - all operating together on the same bus network. This example may consist of a number of different manufacturers' products but the bus network will be common to them all. Integration is all about bringing control applications together and allowing them to operate together sharing information about the space being controlled.

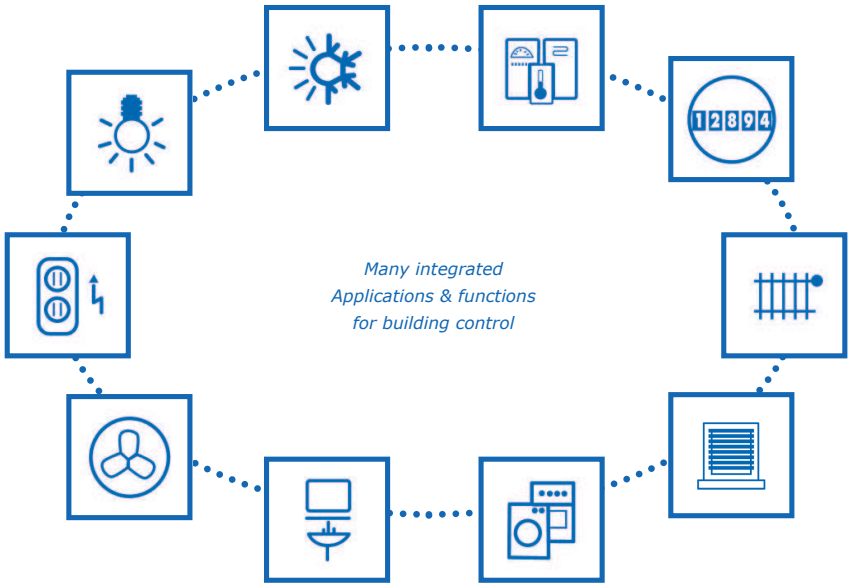
Consider a small office with lighting control, fan coil unit heating/cooling, automatic blind control and perimeter low level heating all being controlled by a single KNX bus network. This could have one wall mounted KNX device for the room temperature control, lighting scene set control and blind override along with a single ceiling mounted KNX presence detector. You will then be able to understand the savings.

The example above illustrates the saving in terms of installation and energy efficiency as the presence detector will set the room to occupied mode taking the fan coil unit to set point from the standby temperature, activate the lighting and daylight dimming strategy, set the blinds to the correct position based on external lux and solar radiation. Along with the KNX wall mounted temperature controller, the space will be controlled to achieve optimum efficiency and comfort with some manual override if needed. All of this is simply controlled by the various KNX devices communicating together within the space and not via some central PC or outstation.

When this form of integrated control is implemented across a large site you can really see how major savings can be made over and above the traditional approach, while still maintaining a solid robust system.

Advantages of Integration with KNX:

- Reduced site installation
- Less cabling, containment and wastage
- Efficient installation - one contractor – one system
- Increased levels of control and functionality
- Increased energy efficiency – more sustainable
- Improved environmental comfort
- Enhanced user experience
- Reduced number of devices on the wall
- Wider range of products to select from
- Not locked into any one company or manufacturer
- Data can be passed from one application to another
- Applications can share devices
- Standard commissioning procedures
- Open protocol – end client has full access
- Flexible and fully upgradeable
- Forwards compatibility
- Reduced maintenance



Practical Example 1 – Lighting Control

KNX is well suited for lighting control applications and is fully scalable to deal with small and very large projects alike.

The KNX bus system has products to support all form of lighting control including:

- DALI
- DSI
- Analogue 1-10V
- LED Dimming
- Universal phase cut dimming
- Switch actuator control
- DMX interface

A typical installation may consist of any one of the above forms of control or a mix of the above. KNX is all about selecting the necessary products for the application and not being restricted by the restraints of traditional lighting control systems. Most products are DIN rail mountable allowing a system to be provided with the components you need for your project.

Practical Example 1 – Lighting Control (continued)

KNX lighting control schemes can be applied across a wide range of buildings from residential to large commercial / industrial projects controlling many different forms of luminaires. Architectural along with general functional lighting can be controlled using the same system as there are many field KNX devices to complement the system.

Touch screens, scene set push button, presence detectors and remote control devices can all be provided by the KNX system in a wide range of finishes and styles. There are off-the-shelf gateways available to many AV systems including Crestron and AMX allowing seamless integration into third party systems.

Typical installations include a wide range of dimming technologies including DALI, DSI, DMX and LED Dimming and for a DALI system only a two core cable is needed to link up to 64 DALI ballasts / devices together from the central control panel. The design concept for KNX is very modular and flexible to allow scalability and future upgrades.

Within the KNX product basket there is a KNX wireless solution that can be used with the normal bus connected devices or as a standalone system. The wireless devices are excellent where you cannot get cables to a device or if installing bus cable is too expensive such as refurbishment projects in old buildings.

To complete a KNX lighting control installation there are a range of KNX products headend visualisation options and touch screens that could be incorporated within a system. There is also a tried and tested OPC KNX solution that could be used to connect a KNX network to a common SCADA system or Building Management System.

The key point to note with KNX lighting control is the flexibility of mixing and matching products. This allows you to specify exactly what you need for a project. After a KNX installation has been carried out, alterations can be made quickly and easily, often without major re-wiring. Alterations such as changing a room's function from presence detection to absence detection, the required changes may only involve software programming

In terms of energy saving, lighting is considered to be one of the main energy consuming components within a building. Up to 45% of the total energy used within a typical commercial building could be contributed to the lighting load. Using a well-designed KNX lighting control solution over conventional control you could save up to 60% of the energy that would normally be consumed. Presence control with daylight linked dimming using the KNX / DALI solution would generally offer the best overall savings.

Practical Example 2 – Blind Control

Automatic electric blind control systems are now considered to be part of the dynamic façade management solution for a building.

If you can control the glare and solar radiation entering the building, you can make major saving on the internal cooling energy. The saving on mechanical cooling could be up to 40% by reducing the solar gain within the internal space.

Glare control improves the internal environment for all occupants and increases the comfort within the occupied space.

With everybody at work now using PCs and visual display screens optical comfort must be considered at design stage. This is a key factor now that many buildings have a 90% glass façade.

KNX blind control solutions are modular and fully scalable, similar to the lighting control systems. There are products that can control 230V and 24V blinds along with other more specialist encoder motor systems. A typical KNX blind motor controller or shutter actuator, as it is sometimes called in central Europe, can be DIN rail mounted or field mounted. There are many different manufacturer products to select depending upon the application and wiring configuration.

Practical Example 2 – Blind Control (continued)

One of the key benefits with KNX blind control is that it can sit on the same KNX bus network as the lighting and/or heating control or any other KNX network that may be planned. No one KNX application should be considered as a separate standalone system as all KNX devices can sit side-by-side on the same bus network. Once you have your blinds connected to the motor controller you can use any KNX sensor or group of sensors to control the blinds.

Within the KNX product range there are weather stations, LUX sensors, temperature sensors, solar radiation sensors, wind sensors, rain sensors along with the normal internal sensors such as presence detectors and push buttons for override control that can all be used as part for the overall blind control strategy.

Savings can be made when you have a KNX lighting and blind control system together as they share the network and associated sensors.

KNX can be interfaced with many other systems including AV systems and building management systems (BMS) such as the BACnet based systems or via OPC. If needed, a head-end package can be provided for central control and monitoring.

Practical Example 3 – Smart Home

The benefits of using a connected control approach to residential applications can easily be demonstrated and there is no better example than a real smart home.

This residential project encompasses 25,000 square feet and occupies a rural position, virtually isolated from the outside world. It has provisions on site for sustainability and self-reliance and there was only one set of requirements for a core control system. This was to provide the main control interfaces, be able to communicate to all other devices via simple ports or gateways, that could be expanded if required and which would last for the duration of the buildings expected life span of 100 years.

London's best known electrical engineers were responsible for all aspects of the specification and when faced with the degree of anticipated systems provisions, had only one specified control solution. KNX was the only choice.

Lighting throughout the project is provided by advanced LEDs, giving great output with less than 50% of the energy used by conventional equivalents and offering extended lamp life too. The lights are all DALI variants, meaning free configuration on each light or emitter. This makes it easy to set up very specific scenes and low level operations as well as providing huge amounts of light when required.

The heating is taken care of by two large ground source heat pumps with eight 180m deep boreholes, six solar panels and no back up from gas fired equipment. The underfloor heating system is fully zoned, which actually means 40 separate areas of measurement and control. As an example, the master bedroom and master en-suite are separate adjustable zones. The heat stores used by the system are two 2,500 litre tanks, which after a day of solar charging, will provide hot water whenever required.

External Venetian style aluminium blinds are included, for three functions: privacy, security and heat control. The heat control aspect, when utilising the solar tracking device, will prevent direct sunlight solar over-heating in summer months (by controlling the angle of the slats) and encourage solar heating in winter when it may be required.

There are 48 Solar Photo Voltaic panels on one roof, generating almost 12kW of power, providing three phase power for heat pumps and motors, again improving efficiencies. This is measured and evaluated to provide real time information to the central touch screens and via an App.

Practical Example 3 – Smart Home (continued)

Providing native support for all lighting, heating, façade control, air conditioning control/manipulation, metering, alert functions and messaging was easy with KNX with over 400 manufacturers providing a huge variety of specialisms, the right products for the project were easily found.

Within this project, the system's capabilities have been utilised comprehensively. The KNX system acts as the manual and automatic control medium for the five hundred DALI lights, the sixty blinds and the windows. It also provides accurate real time feedback on energy use, energy production, incoming mains water, re-used rain water, measurement of external temperature, humidity, wind speed, presence of rain along with accurate solar tracking for blind deployment to control solar gain.

Various other critical systems are monitored such as waste tank levels, high level alarms, on site standby generator operation, low fuel levels and various pump system operations.

As the owner becomes conversant with all the operational uses of the system, additional requirements will easily be met with the KNX bus reaching all parts of the estate, allowing easy upgrades and alterations as required without the need for lots of additional cabling.

KNX has proved itself as the most suitable core system for this project and for the building's expected life cycle, should remain so.

Practical Example 4 – HVAC & Single Room Control

KNX is ideally suited for HVAC control within a room or rooms where multiple disciplines are linked together.

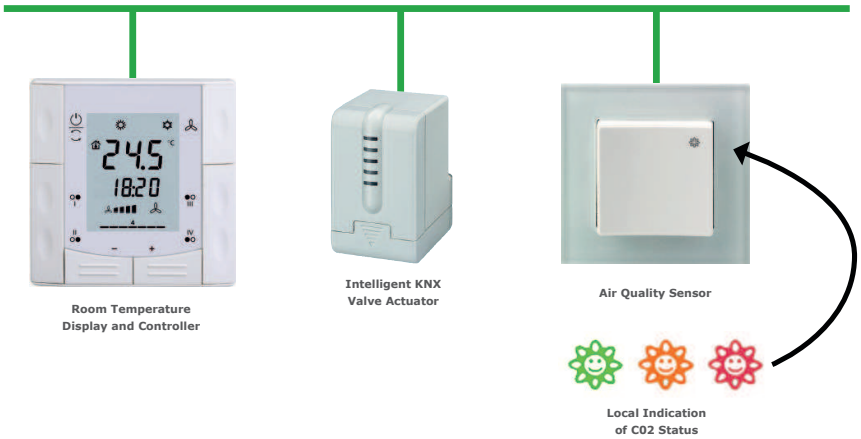
This can mean HVAC, lights and blinds all sharing information and coordinating with each other via the KNX network.

There are KNX devices covering many different elements of HVAC and room control, these include, but are not limited to:

- Fan coil units
- Chilled ceilings
- Radiators and zone valves
- Variable Air Volume (VAV)
- Damper actuators
- Air quality
- Status monitoring and interlocking
- Natural ventilation
- Window control

A typical example of HVAC control may be to have a fan coil unit (FCU) in a room whilst monitoring air quality, allowing the fan speed or fresh air input to the room to be adjusted automatically.

By using KNX, the FCU controller and the air quality sensor can be easily connected to the KNX network. As the air quality sensor only connects to the KNX bus its installation is easier and more cost effective than a traditional sensor which requires many more cable cores and connections.



Practical Example 4 – HVAC & Single Room Control (cont.)

In the example shown on the previous page the FCU controller, radiator valve and air quality sensor are all connected together via the KNX bus. Many of the devices themselves are also powered by the KNX bus; this keeps installation simple and cost effective.

A key benefit of this type of network installation is that the grouping of devices is very flexible as opposed to options when hardwired. This ensures any changes in room layout are easily achieved.

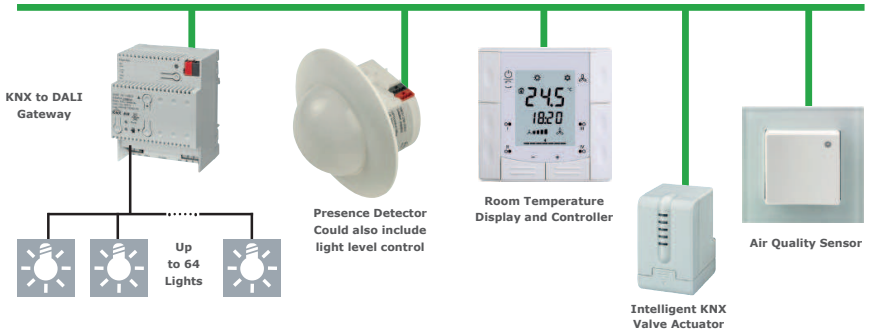
Air quality is a key factor in many modern buildings and where LEED or BREEAM certification is required often a high number of CO2 sensors are needed to ensure all zones are covered. Using KNX sensors for this CO2 air quality measurement greatly reduces the installation effort.

On a traditional hardwired sensor there may have been up to 5 cores required for each sensor with each sensor requiring wiring back to a controller.

This generated a lot of installation work especially when the cabling and containment is considered. By using KNX the installation is reduced to a single KNX cable linking all sensors within one zone or area. This single KNX device can deliver values for CO2, temperature and humidity and in some cases acts as a controller, further reducing installation costs.

The benefits of using KNX for HVAC are further demonstrated if we consider a room needing other disciplines such as lighting can also use the KNX network.

In the example above we have the HVAC elements from the previous example with lighting and presence detection added. The presence detection used for the lighting is now also used for the HVAC element ensuring that if a room is unoccupied electrical and thermal energy is saved, providing cost savings to the end user.



Practical Example 4 – HVAC & Single Room Control (cont.)

Furthermore the room controller may have additional functions such as push buttons that can be used to control the lights locally. Therefore the user only needs one device in the room to change temperature and override the lights.

Similar examples could be shown using natural ventilation and room control. For example, a KNX enabled weather station used to control the façade of building could also be used to link to windows and other natural ventilation solutions, sharing values such as wind speed and rain detection.

Therefore whilst using KNX for HVAC and room control makes sense, using it for all the disciplines within the room enables an extremely energy efficient solution to be achieved.

Local operation and monitoring is possible via a wide range of KNX displays, interfaces and touch screen panels. When multiple disciplines are linked via KNX the user interface can be simplified and optimised.

Many Building Management Systems (BMS) have links allowing the KNX to be shared to other parts of the system via BACnet, OPC or other open protocol solutions. This ensures that the complete building can be made as energy efficient as possible and data can be shared between all elements of the building controls. An example of this might be having chilled ceilings controlled via KNX and the building chillers controlled via BACnet. The ability to share the cooling demands from KNX to BACnet ensures the chillers will only run if a cooling demand actually exists, thus ensuring energy efficient operation.

Practical Example 5 – Energy & Smart Metering

Energy management can be defined differently depending on the perspective within a building or a town's network. Inside the building energy management is a method to save final energy costs such as electricity, heat and water.

These are to be saved whenever possible for both new and retrofit buildings. A key for effective energy usage inside a building is informing the consumer continually about their energy consumption. KNX Smart metering provides the necessary equipment for this solution.

There are KNX devices covering many different elements of energy management. These include, but are not limited to:

- Peak demand monitoring
- Current detection
- Network monitoring
- Load shedding
- Meters
- Interface to M-BUS
- Energy pulse counting
- Data logging
- Visualisation
- Sensors and actuators
- Controllers and data processing

KNX visualisation of energy consumption is useful for the consumer but insufficient to actively ensure energy efficiency within the building.

The KNX devices can give cost information for heating and electrical consumption but more importantly, room temperatures, status of windows, occupancy, active power of circuits and behaviour of electrical consumers can also be monitored. Better analysis of the user's consumption patterns and saving potentials can be made by the energy manager to achieve maximum savings. KNX provides solutions for visualisation and automation that can be combined with monitoring of utilities. The result of this approach produces active energy management and visualisation of energy consumption, providing the tools to achieve energy saving actions.

With KNX Smart Metering solutions it is possible to consume power generated by renewable resources as soon as they are physically available. For example, it is possible to charge electric vehicles, thermal storages via heat pumps or increase cooling of air-conditioning systems at times of surplus energy. Vice versa, these can be interrupted at times of lack of renewable energy.

KNX Reference Projects

The British Library
London

Heathrow T5
London

Oundle School
Peterborough

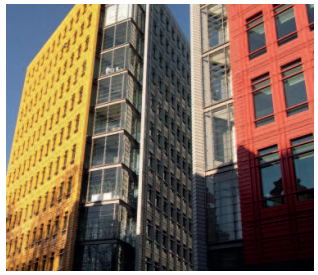
Media City
Salford

Residential Home
Isle of Man

Super Yacht

KNX Reference Projects (continued)

Bridgewater Place
Leeds



Central St Giles
London

Crystal Building
London

Mann Island
Liverpool

KNX UK Consultants' Guide – User Notes

KNX UK Consultants' Guide – User Notes (continued)

KNX UK Consultants' – Contact Details

For further information on any subject within this guide, please visit the KNX UK website where you will find information about our members and our technology.

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