mySmartCTI™

KNX
The Smart Guide
Image disclaimer: All photographs used in this Smart Guide are of projects that have been completed by mySmartCTI. Photographs used may show installations that do not currently utilize the KNX protocol.
Welcome to the first edition of the mySmartCTI KNX Smart Guide. This guide aims to detail all of the information a consultant may require when researching a KNX solution for specification in a commercial building.

This guide includes information on KNX, applications for KNX, KNX topologies and interfacing KNX to other building controls. It also includes common KNX solutions including fully converged buildings, also known as 'baby BMS', lighting, façade automation, smart metering, audio-visual and HVAC.

We hope you find this guide beneficial and we look forward to working with you to deliver many KNX projects in the future.

Peter Garrett
Managing Director, mySmartCTI
KNX is now the world’s only truly open protocol endorsed by worldwide standards. KNX is regulated by the KNX Association based in Brussels and is supported by all of the world’s leading electrical manufacturers.

There are now over 7,000 approved KNX products from more than 270 manufacturers covering all aspects of building control and automation. Based on the strict testing standards and protocols established by the KNX Association all KNX products are guaranteed to be interoperable between each other irrespective of the manufacturer and product type.

This is a unique feature of KNX. No other bus system gives complete interoperability allowing mixing and matching of components without requiring special drivers or applications. All certified KNX products must display the KNX logo and are recorded by the KNX Association. Manufacturers of KNX products follow strict procedures set out by the KNX Association on how to design the bus topology and how a system is configured.

A standard piece of manufacturer independent software ETS is used to commission the system. This Engineering Tool Software, ETS, is produced and sold by the KNX Association. Systems Integrators all over the world use ETS software and applications to engineer and commission projects. In order to do commission projects integrators must attend and pass a KNX Certified training course at a KNX Certified Training Centre. The training courses, exams and training centres are all regulated by the KNX Association from Brussels.

In addition to standardised bus communication, products and software, KNX has an approved bus cable. Green in colour this cable is manufactured by KNX approved companies to a standard specification to ensure quality and performance.
Why Open Protocol?

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

A key benefit 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.

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 supplier.
- 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 on-going maintenance.

With the open protocol approach the system will never date as there is an upgrade path to follow. With KNX based systems there is a guaranteed forwards and backwards compatibility of products that can 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.
KNX solutions can be used across an extremely wide range of building control and automation applications across all market segments including commercial and industrial. It is highly flexible and is typical for the system to be used for many different applications within the one project.

Such applications include:
- Lighting Control
- Façade Automation – blinds, solar control, windows, natural ventilation
- HVAC
- Energy Metering and Management
- Security & Monitoring
- Audio-Visual Control and Interfacing
- Touch Screen and Visualisation Interfaces
- IP Connectivity & Remote Access
- Interfaces to many other third-party systems and protocols

The KNX Topology has no limit to the size and scale of the buildings in which it can be used. It is equally well suited to large scale commercial projects as to a residential building.

One KNX line can support up to 64 KNX devices using a single power supply. These lines can be repeated and cascaded to include multiple KNX lines of 64 devices by using IP or KNX backbones. In this manner the size of the system is virtually limitless.

KNX is extremely powerful when interfacing with other systems and protocols as there are many established gateways from a number of suppliers. These include OPC Servers, SCADA, BACnet, DALI and others. These interfaces and gateways are commonly used all over the world and have been tried and tested.
In recent years there has been a growth in gateways from established manufacturer-based proprietary systems offering their own gateway for KNX. If considering such a solution consideration should be given to whether the gateway has true KNX Certification and the benefits of working with a single manufacturer’s proprietary solution as this could be counter-intuitive to the power of KNX, i.e. manufacturer independence.
The Integrated Approach

FOR MORE THAN 20 YEARS KNX HAS 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 principals 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 and HVAC 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. If you consider a small office with lighting control, fan coil unit heating / cooling, automatic blind control and Audio Visual all being controlled by a single KNX bus network with 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 then you will 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 levels 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 with KNX across a large site you can really see how major savings can be made over and above the traditional approach while maintaining a solid, robust operating system.
Advantages of Integration with KNX:

- Reduced site installation
- Less cabling, containment and wastage
- Efficient installation - one integrator - 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
- Not locked into any one 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
The topology of a KNX bus system is designed around a simple logical set of rules making it easy to install and understand. The KNX bus network is wired using one type of cable for all parts of the bus and connections to devices. The KNX bus cable is identified by its green outer sheaf 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 2 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 one of the KNX Association approved suppliers. The bus cable is designed to be installed with mains 230V cabling, very often using the same containment and routing. The outer sheaf offers insulation resistance to 600V and the communication protocol is immune to mains born 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 which offer simple fast installation methods that can form part of larger pre-fabricated wiring systems, and again can all be installed by the one Electrical Contractor, not requiring 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.

Typical KNX bus connector and cable details
A typical KNX installation will 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 suite the project as KNX is a modular system whereby components are selected depending upon the requirements of the project.

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.

A typical KNX Bus network with mixed devices
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 retardancy polymer, green (RAL 6018)

**Cable marking**
- **Printing**: EIB-Buskabelhalogenfrei 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**

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<th>Size</th>
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<th>Overall-Ø (approx.) mm</th>
<th>Weight (approx.) kg/km</th>
<th>Calorific value (approx.) MJ/m</th>
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**Electrical Data at 20 °C**

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<tr>
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<tr>
<td>Attenuation at:</td>
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<td>dB / 100 m</td>
</tr>
<tr>
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<td>dB / 100 m</td>
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<tr>
<td>1 / 16 / 20 / 31.25 / 62.5 / 100 MHz</td>
<td>nom.</td>
<td>dB / 100 m</td>
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<tr>
<td>Crosstalk attenuation at:</td>
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<td></td>
<td>(Core + Screen / Water)</td>
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<td>U_{L} / U</td>
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KNX in Australia

Whilst some people would consider that it is a European protocol it has been present in Australia for many years and is now gaining wide-spread acceptance. The use of KNX in Australia was initially led by systems integrators looking for technology to deliver solutions that weren’t possible using products from existing suppliers. KNX in Australia is now supported by a number of leading manufacturers and systems integrators.

In 2010 these manufacturers established the not-for-profit KNX National Group of Australia. The KNX National Group was formed under the guidance and support of the KNX Association in Brussels with the goal of promoting and supporting the use of KNX in Australia. Founding members included ABB, Hager B&R, mySmartCTI and Somfy, all of whom have well supported KNX offers. Since the initial founding, a number of other manufacturers and systems integrators across the country have joined the KNX National Group.

mySmartCTI has designed and commissioned KNX projects around Australia. Key projects include;

- 161 Castlereagh St, Sydney
- Taronga Zoo, Sydney
- Villawood Detention Centre, Sydney
- University of Technology Sydney Great Hall
- Aurecon C7, Melbourne
- Surf Coast Shire Civic Building, Torquay
- CSIRO Super Computer Centre, Perth
- CSIRO Canberra Deep Space Communications Complex, Tidbinbilla
Converged Buildings

Sometimes referred to as ‘Baby BMS’, a fully converged building delivers all of the power and control of a building equipped with a full proprietary BMS package. Due to the flexibility of the KNX standard it is an ideal solution on which to base a fully converged building either at base building or tenant level. Using KNX and the appropriate devices it is possible to build a total building control system will all of the reporting, alerts and central monitoring of a full BMS at a realistic price. Not only this but the system can be easily added to and extended in scope and performance.

The following pages detail KNX solutions for lighting, façade automation, HVAC, smart metering and audio-visual. Each may be stand alone or integrated with others or all solutions to produce a fully converged building.
Integrated Switching and GUI’s

One of the key strengths of KNX is that multiple functions may be incorporated into KNX switches. This removes the ugly and unsightly mess that is switch acne where multiple switches from many different vendors in many different styles are clustered together in the one location. With many different switch manufacturers providing many different styles, finishes and functions not only is the building fully converged it is good looking as well.

Visualisation and Head-End Software

There are many solutions for providing software packages to visualize and control KNX solutions. Ranging from manufacturer solution based through to whole project based. Specialist providers offer totally customizable KNX visualisation software enabling control via PC, tablets and/or smart-phones. Where the preference is to use existing head-end packages links via OPC Server are also possible.
KNX may be used in a number of ways to control lighting:
› Directly over the KNX network with KNX switches and relays
› Via gateways – DALI, DMX, DSI, 1-10V
› Via IP networks
› Switching may be via KNX switches or touch screens, standard switches using binary inputs or smart switching via IP.

In all cases feedback and status is available over the KNX network. Controls and relays may be centrally mounted or field located. KNX networks in different areas or on different floors may be connected via KNX line couplers or KNX/IP gateways.

Façade Automation

KNX is ideally suited to façade automation. Weather stations and sensors monitor ambient conditions including light levels, radiation levels, wind speed and direction, external and internal temperatures and precipitation. Internal and External Blinds and Windows can be addressed in zones or individually depending on requirements.

An automated façade using KNX is ideally suited to controlling the amount of glare and solar radiation entering the building. A key benefit of KNX is that the lighting control and façade control can both sit on the same KNX network to deliver operating synergies. External sensors automatically position the blinds and windows to meet the immediate ambient conditions. Harnessing the power of presence detectors and internal light and temperature sensors a combined system will then keep internal lighting and temperature within defined parameters. Occupants can override their blinds and lighting to suit their requirements only whilst they're occupying the space. Once they depart the system will revert back to automatic control to ensure optimum energy efficiency is maintained.
**Smart Metering**

KNX may be used for direct energy, water and gas metering as these KNX meters are available. Alternatively, a KNX Gateway may be used more commonly with meters that use Modbus. The KNX Gateway allows receipt of both Modbus and KNX telegrams. Further metering data may be transferred from KNX to IP and onwards to users via information panels such as enGauge.

Tank probes and other similar devices are also available in KNX. As well as measuring the volume of a tank, outputs may be triggered when exceeding or dropping below specified levels.

**HVAC**

As HVAC is often considered the backbone of a Building Management System, it is imperative that KNX can be used for HVAC control. Many manufacturers of HVAC systems offer KNX control modules including most of the major air conditioning systems providers in Australia. KNX also offers seamless integration with BACnet and other protocols via BACnet or OPC interfaces.

Occupants have control over HVAC via dedicated KNX thermostats and other KNX multi-function switches.
Audio-Visual and 3rd Party Devices

Major Audio-Visual control suppliers such as AMX and Crestron offer well proven KNX interfaces in order to control audio-visual devices in boardrooms and other installations.

Many 3rd Party devices can also interface to KNX such as white goods, fridges, freezers etc., air conditioners, sound systems, etc.

KNX enGauge

The mySmart enGauge panel is a friendly and informative system designed for use in foyers, lobbies, shopping centres or any public space to display real time and historical data on building energy and environmental performance. The display uses the building’s energy meters and other devices to gather data on building environmental performance. Consumption data is presented in an easy to ready graphical snapshot on a flat screen panel accompanied by comments to explain the graphs displayed.

mySmart enGauge can be easily linked to a KNX solution through the use of a KNX enGauge Gateway.
mySmartCTI is an Australian company that prides itself on making a positive difference for its customers, their employees and the environment. mySmartCTI helps to create the most energy and resource-efficient environments possible.

Using the latest technologies with highly trained consultants and service technicians, mySmartCTI is able to optimize buildings and outdoor built environments so they are more comfortable and use less energy and resources with a resulting reduction in ongoing operational costs.

Established, originally as Complete Technology Integrations (CTI), in Sydney in 2001 before being rebranded in 2011, mySmartCTI remains wholly Australian owned. With almost 50 staff it has offices in Sydney, Melbourne, Brisbane, Canberra and Perth. The company operates across a range of markets, including hospitality, education, health services, aged care, retail, residential, defence and Industrial.

mySmartCTI’s solutions include:

- Lighting control solutions which provide daylight harvesting and timed control
- Basic and high performance metering and reporting solutions for energy, solar, water and gas usage
- enGauge behavioural change displays for showing energy usage and savings
- Fully integrated building automation systems providing lighting and façade management control, audio-visual interfacing, HVAC control, reporting and central control.
- Hotel room control systems for controlling lighting, HVAC and blinds with full integration to the hotel check-in system
- Stand-alone intelligent motion sensors
- Unique custom solutions