Crystal Clear

Deploying KNX in one of the world's greenest buildings

The Crystal represents the Siemens' expertise in 'green' technologies. Using solar power and ground source heat pumps to generate its own energy, it has set the benchmark for sustainability. The building is the first to achieve the highest sustainable building accolades from the world's two leading accreditation bodies, LEED and BREEAM.

Building management and control technologies play a vital part in reducing the building's energy consumption. In February 2012 Abtec Building Technologies was commissioned to install and manage the KNX infrastructure.

The Crystal has over 2,500 individual building control devices including; window and blind actuators; HVAC controls; and lighting devices. Dave Watkins, Commercial Director, Abtec Building Technologies, explains "There are very few projects with this volume of connected building control devices." These devices create the highest levels of energy efficiency when connected and working together. Managing such a large number of devices would take expert IT and KNX knowledge as well as slick project management skills. These are exactly what Abtec displayed when working on this project.

expert IT and KNX knowledge

The Challenges
The project presented Abtec with several challenges. "We had three main challenges," explains Watkins, "first, managing the deployment of KNX devices; second, converging the KNX and corporate IP network, and third, device interoperability".

Even though KNX operates using a decentralised infrastructure, each KNX device is embedded with intelligence, there was a need for the devices to integrate with a Building Management System (BMS). Devices would need to broadcast their state to, and receive commands from, the BMS, such as dimming the current lighting state by 20%

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Covering over 6,300 square metres, The Crystal, a sustainable cities initiative by Siemens, is a unique, all electric building in the heart of London's Green Enterprise District.

"Working with Abtec has been a pleasure. The team's project management skills, significant KNX, DALI and IP networking expertise make Abtec easy to recommend for other projects"

Andy Chandler, Technology Manager Siemens UK

KNX shared the corporate IP network

Challenge One: Controlling the Controllers

As with most large build projects there were many Mechanical and Electrical (M&E) subcontractors working on individual elements of the project. Watkins quickly realised that the traditional way of working, each contractor installing their devices and then leaving the project, would cause problems. "The building controls and KNX infrastructure were at the centre of the M&E elements of the project. We needed to co-ordinate and manage how contractors connected to the KNX database, otherwise major delays could have occurred." Watkins explains.

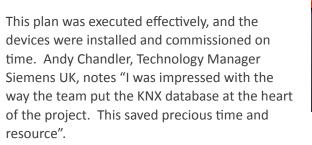Watkins and his team worked closely with the individual subcontractors. He got them to send their devices to Abtec's laboratories in Leicestershire, before installation. Liaising with the subcontractors, the team pre-configured each device and allocated a KNX address. These devices were then sent to The Crystal, ready for installation. "There was a bit of reticence from the contractors to start with, but once we'd explained that this method would save time and repeat visits to The Crystal they quickly bought into the idea", Watkins continues.

"major delays could have occurred"

Abtec's project management skills ensured that there was an industrious production line of activity. Phil Peer, Project Manager, Abtec Building Technologies, comments "We used ETS 4 to configure and download the application program into each device. It was a huge task, by the launch we were on the 25th iteration of the project plan."

This plan was executed effectively, and the devices were installed and commissioned on time. Andy Chandler, Technology Manager Siemens UK, notes "I was impressed with the way the team put the KNX database at the heart of the project. This saved precious time and resource".

Challenge Two: Networking Success

Another unusual aspect of the project was the connection between the KNX devices and the BMS. In a traditional KNX environment the building would have a hardwired KNX network that would connect to a discrete, dedicated IP network. In this project the KNX infrastructure would share Siemens' corporate IP network. It's a configuration that is becoming increasingly popular. Watkins explains "We are seeing more KNX projects utilise the client's IP network. It's definitely the way forward as it cuts costs for both the contractor and end user."

Converging those networks would create considerable challenges for many KNX integrators, but not Abtec. It has a unique advantage. The company's sister organisation, Abtec Network Systems, is an IP networking specialist and often works with KNX integrators. Its recent projects include deploying the IT infrastructure for National Grid's new, award winning offices.

"The biggest risk in using the corporate network was KNX itself. We didn't want it multicasting telegrams over the IP network as this would clog up the IP network, causing chaos" says Watkins. Detailed network control was required, and Abtec Network Systems had the answer. Using its Cisco expertise the Network team devised a way of partitioning Siemens' corporate LAN. Segmenting the LAN, using the Cisco VLAN Trunking Protocol, would mean that both sets of data, KNX and corporate, would travel over the network without interference. It's as if the virtual LANs (VLANs) were physically separate networks.

"biggest risk... was KNX itself"

Abtec Network Systems worked closely with Atos UK and Ireland, who manage Siemens' data network. Giving Atos the necessary configuration details it directed Atos to create the VLANs. "Creating VLANs was the most secure way to tackle this issue," says Watkins "we are fortunate to have Abtec Network Systems' Cisco expertise at hand."

Challenge Three: Device and Network Interoperability
The final challenge was the large amount of data that needed to flow from one protocol to another. Ensuring that these discrete protocols communicate with each other was a challenge that Duncan Greene, Abtec KNX Project Engineer, tackled.

The device interoperability challenge is best exemplified with The Crystal's boardroom. The 150m^2 room contains 117 DALI LED and fluorescent light fittings, and five, floor ascending blinds. The KNX database for this room alone was more complex than many typical projects. The real challenge came when Abtec learnt how the client wanted to control the room's lighting and blinds. Siemens wanted control in two ways. First, an IP touchscreen situated in the boardroom, second, a smartphone compatible website accessible wirelessly from the corporate network.

"This presented some interesting issues," explains Greene "the touchscreen and smartphones are IP devices, the blinds KNX and the lighting DALI over KNX. I had to make sure that they could communicate with each other. The second issue was that the boardroom is one room in a sophisticated infrastructure. I needed absolute control of the network as I didn't want to unnecessarily overload the KNX bus."

The database of devices included:

- DALI lighting controllers
- HVAC controllers
  - VAV
  - CHB
  - FCU
- Actuators
  - Blinds
  - Windows
  - Roof vents
  - Trench heating
- Wall switches
- Setpoint adjusters
- Exhibition lighting
- AV system interfaces
- Fire alarm interfaces
- Occupancy detectors
- Weather station
- Comfort sensors

Multiple protocols were used with KNX

"I was impressed with the way that Abtec tackled the challenges that these new technologies produced"

**Andreas Schirm
Siemens Switzerland Ltd**

The building is both exhibition centre and wording offices

DALI LED lighting was controlled by KNX

To add to this complexity the touchscreen would display outdoor temperature and humidity levels. This information would be supplied to the device through a BACnet network. The potential security risk here is that both the corporate and BMS network could be open to abuse, if configured incorrectly.

Greene instigated a workshop with Andreas Schirm, Siemens Switzerland Ltd, and BAS. Together they could test the interoperability between Schirm's touchscreen, BAS' BACnet IP network and Abtec's KNX IP network. At Abtec's laboratories Greene built a series of VLAN networks, replicating the infrastructure at The Crystal. After rigorously testing several ideas, Greene was satisfied that he had found an acceptable solution.

the corporate and BMS network could be open to abuse

"The start of this solution was installing two virtual network interface points into the touchscreen," says Greene. Creating several VLANs for KNX and BACnet, using Cisco routers, would enable traffic to connect with the touchscreen securely. The touchscreen could interact with each protocol independently, mitigating some of the security risks. "I tested the networks, checking for penetration opportunities and points of failure, paying close attention to wireless access points. With appropriate network security measures I managed to harden the networks, locking them down with no detrimental effects to the traffic on the networks."

Greene's testing enabled Abtec to create a blueprint for the IP and KNX network design, which Atos duly implemented. Siemens employees now have full control over the environment in the boardroom, which should lead to more productive meetings.

"The Crystal is a showcase for new technologies. I was impressed with the way that Abtec tackled the challenges that these new technologies produced. My expertise is in KNX, not IP devices. I was really impressed with Duncan's KNX and IP knowledge and the way he broke the issue down into the component parts and communicated this effectively. Duncan helped us solve the problem faster" comments Andreas Schirm.

Equipement used:

Crabtree:	Push button interface UP 220/21	IP-Router N 146/02	Siemens HVAC:
Push Button Platinum 2g (1-fold) 7172	KNX / DALI Gateway N 141/02	Venetian blind actuator N 523/04	AQR2570N Flush Mount Sensor
Push Button Platinum 4g (2-fold) 7174	Push button 1-fold UP 221 DELTA i-system	Switching Actuator UP 562/31	PX KNX (S-Mode)
Push Button Platinum 6g (3-fold) 7176	Motion Detector AP 251	Switching actuator N 567/01, (8 Amp)	RMS705B Switching and Monitoring unit
	Weather Station GPS AP 257/22	Text display UP 587/01	
Siemens:	Presence detector – brightness sensor UP 258/E11	Combi Sunblind Actuator N 501	WindowMaster A/S:
Power supply unit N 125/21 (230V/640mA)	Presence detector - constant light UP258/E21	Scenes- / Event Controller N 305	WEA11M
Line backbone coupler N 140/03	Motion Detector UP 258 Delta i-system		

The Results

The team completed its KNX integration work successfully for the opening on 19th September 2012. The building has since gone on to win numerous awards, including the prized British Council of Offices National Innovation Award. It has also achieved the highest international sustainability credentials for a building, LEED Platinum and BREEAM Outstanding. This makes The Crystal one of the most sustainable buildings in the world. At the heart of that efficiency is Abtec' KNX integration.

In this project Abtec demonstrated broad skills in several protocol areas; KNX, IP and DALI. These skills, and the team's tenacity, helped it overcome considerable challenges. Abtec also clearly demonstrated that it can work on large scale projects, with many subcontractors. As Andy Chandler, Technology Manager Siemens UK, comments, "Abtec's KNX, DALI and IT skills made the deployment much smoother. The team demonstrated great leadership qualities, overcoming a number of difficult challenges throughout the project. Working with Abtec has been a pleasure. The team's project management skills, significant KNX, DALI and IP networking expertise make Abtec easy to recommend for other projects."

"great leadership qualities"

About Abtec Building Technologies Ltd

Based in Market Harborough Abtec Building Technologies Ltd provides technologies that enable organisations to reduce the running costs of their buildings. Those technologies include the intelligent, automated control of a building's lighting, heating and ventilation.

Recent projects include:

- Providing the lighting and environmental controls for Damien Hirst's new gallery in London
- Audi City London – providing the lighting controls for the world's first digital car showroom.

About Abtec Network Systems Ltd

Abtec Network Systems Ltd has 22 years of experience in helping businesses cut their operating costs. It is one of a handful of Authorised Partners of BT, one of two Strategic Partners of Virgin Media Business and recently became the only O2 wholesale partner in the East Midlands.

Recent projects include:

- Installing the communications infrastructure for Nation Grid's new offices
- Building a comprehensive 'disaster recovery certified' IT data centre for Darlington Building Society
- Installing and maintaining Market Harborough Building Society's data network, IT and telephony.