Building IT

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Integration has become standard and is now being widely applied on building projects. It can provide tremendous value to the smooth and energy efficient building operation.
Integrated or Intelligent buildings are usually let at a premium and therefore protect investments by taking full advantage of the information generated by the complementary building services systems installed within them.
With the need to reduce carbon emissions, Green House Gases and utility costs, as well as meeting new stringent EU Legislation, integrated buildings are an enabler to ensure energy is wisely used.

Much has been written recently on the subject of "Intelligent Building Management Systems" or "Integrated Building Management systems" – Building Integrated / Intelligent Technology. The intent of this paper is to identify some of the key points that constitute this type of building and look at a project reference.
Why have an integrated building**?**
What value does it offer to the property owners and occupiers?
When we started doing integration in the early 1980's, integration was associated with a computer being able to request small amounts of data from a third party device and display it in a non standard format.
Today the term building integrated technology is widely understood to imply both a read and write interface to a third party system to provide a standard object format for the entire building and pull data into consolidated databases for alarms, event logs and trend data. This provides a holistic view of the building from one single point.
As objects become standardised when displayed at the user interfaces, the users of the BMS get a single view of the building covering all aspects, if required, on a single screen – providing ease of use and much greater visibility of the entire system, probably comparable to the magnitude of additional information held in a colour picture compared with black and white.
As operators have only one system to interface with, training takes less time and users become very proficient at using the system and therefore can easily make the necessary ongoing "tuning" of parameters that is required within the normal building operation. Users are more likely to make changes that will result in energy reductions such as switching off plant temporarily where they know it is not in use.
Combining systems that freely exchange information results in an invaluable management tool.

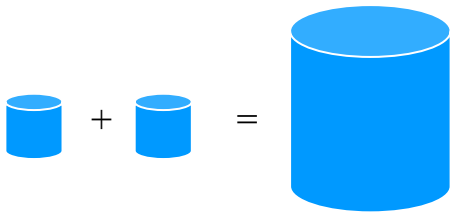

Figure 1: Consolidated database

Figure 1: "A consolidated database contains more information - Can answer more questions than the sum of the information in the smaller databases before combination" - Oracle
You will appreciate that the value of this to Owners / Occupiers is first of all in the information and visibility relating to their building operation - typically served up through Web pages - and ensuring that it is delivering the comfort to produce a productive work environment. This is the first element of delivering an integrated building system.

The second element of providing value to the owners / occupiers is the interaction of the systems by adding intelligence to the way in which the building operates.
Let us take the example of lighting controls, air handling units, chilled water systems and access control systems. In a non-integrated system each one operates independently with perhaps some common time control from the Building Management System.
The first person to enter in the morning (or the security guards) turn the lights on. They are usually turned off (manually by the cleaners or security guards) late in the evening.
Air Handling Units switch on under time control at a fixed time early in the morning and off at a fixed time. During the day the AHU's deliver a constant temperature.
Chiller's start under time control at a fixed time early in the morning and go off at a fixed time in the evening, and probably produce a constant 6'C temperature throughout the day.
Access Control systems grant / deny users access to the building areas according to their security settings.
Instead, an intelligent building could ensure that the building is in an energy saving mode and that only when events occur do changes happen.
For example:
When an occupant is granted access to the building this message is relayed to the lighting control system and the Air Handling Unit feeding the part of the building concerned. They go from background energy saving settings to occupied, and the reverse when the last person in a zone exits the building. The number of people identified by the access control system to be present in a zone regulates the percentage fresh air to the Air Handling Units. The Chilled water temperature is reset throughout the day depending on actual space conditions and the number of occupants which together represent the true load.
This will ensure the building provides the desired comfort level whilst ensuring energy is saved and the Green House Gases carbon emissions and utility costs are reduced.

An additional benefit is the visibility of energy distribution and energy reporting which uses data integrated from several sources such as metering around the building or calculated from the Building Management System. This data can be used to review control strategies to reduce peak loads and to renegotiate utility bills.
The ability to produce numerous report types based on data from several sources for example metering, Air Handling Unit performance, Access control systems can provide unsurpassed levels of information enabling detailed analysis based on scenarios of occupancy levels versus energy cost down to each area of the building occupied as shown in figure 2.

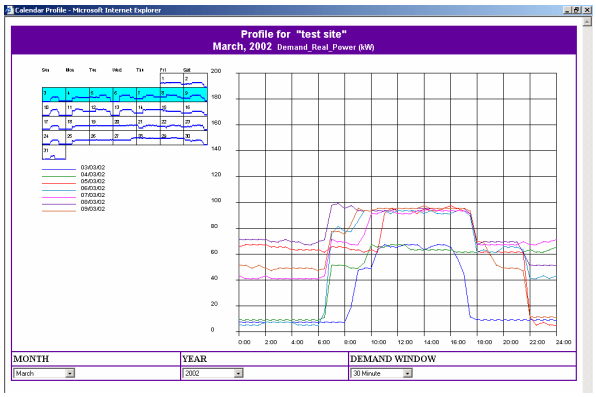

Figure 2: Weekly Energy profile

How are the integration aspects achieved?
It is dependant on the use of different protocols. There is no one protocol that is the panacea to all integration requirements as there are a large number of protocols used by different suppliers. It is true to say that the number of protocols applied is reducing. Choosing one only would prevent the opportunity to integrate multiple aspects of a building due to different protocols used by integration type.
Major suppliers generally support both their own proprietary protocols and have the ability to integrate devices using a broad multitude of "open" protocols
Manufacturers use proprietary protocols as a method of optimising communications performance to attain speed of response whilst

handling the high volumes of traffic that are prevalent on large Building Management Systems. It can also be more cost effective to do so.

What is an Open protocol?

It is a protocol that is published and available for suppliers to implement within their communications layers.

Modbus – originally defined by Gould Modicon it was first introduced in the 1970's! Modbus has been adopted by manufacturers of equipment such as Computer Room Air Conditioning units & Intelligent Electrical devices such as Power Meters. This is a popular protocol with a wide range of applications utilising it. It is used widely in the power and telecommunications industry.

LON (Local Operating Networks from Echelon) was first introduced in the late 1980's and its popularity has been growing ever since. It is applied widely in a variety of applications within buildings such as lighting control, electrical meters, smoke sensors and has been applied in intelligent home applications for communications to washing machines and other domestic appliances. To develop LON for your control device involves purchasing their development tools and using the LON silicon device "Neuron" chip, which includes 3 microprocessors including the protocol layers, into each control device you manufacture. There are a number of specialist tools required for the engineering, and this enables devices from different vendors to interact by the binding of SNVT's (Standard Network Variable Type) from one controller to another to enable interaction at the network level using LONWorks technology and the LONTalk protocol.

The independent LONMark organisation is able to certify against defined standard applications for Lighting Controls and Heating Ventilation and Air-conditioning applications. In building control terms this would apply to Fan Coil or VAV applications against standard schemes. When you pass their independent tests you are able to place a LONMark Logo on your control device. This only applies where you are doing standard schemes. For larger plant control such as AHU, Boiler and Chilled water plants there are currently no such standards to be certified against.

BACnet (Building Automation Control Network – defined by ASHRAE, the American Society for Heating Refrigeration and Air Conditioning Engineers). Originating from the 1980's, BACnet has gone through several iterations and is gaining share in the Building Controls market. It has seen a large uptake by major manufacturers in recent years. This is due to its level of documentation and the support through its members association. It does not require any special silicon communications devices or development kits and it has therefore become easy and competitive for manufacturers to adopt this technology.

BTL (BACNet Testing Laboratories) are able to certify devices that have correctly implemented the protocol and used the standard naming conventions.

BACnet is increasingly being adopted outside of HVAC devices and several fire system manufacturers offer this as an integration protocol.

OLE for Process Control

DDE/OPC Dynamic Data Exchange and OLE for Process Control offer many integration capabilities – This originates from the Process control industry where there are many dissimilar systems which need connecting to SCADA (Supervisory Control And Data Acquisition) systems controlling entire manufacturing or processing facilities.
Many suppliers of software systems support these methods of data exchange at the PC level. A search on the internet would show thousands of DDE or OPC drivers to a vast range of different and very diverse system types. It is easy to develop a proprietary protocol to DDE or OPC and this would be applied in Building Automation where a standard protocol is not used.
OPC certification testing is available to help OPC users reduce their systems
Integration costs when deploying OPC based systems.
Additional Integration enablers include Microsoft, HTML, SQL, XML, HTTP, EIB, Konnex, Java, TCP/IP, IP, SOAP to name just a few!
Protocols are used to get information both into and out of a Building management system. Where high volumes of data are required across a building backbone then BACnet or OPC would most commonly be used for live data requests in conjunction with ODBC (Open DataBase Connectivity) as the standard for the storage of data.
Below is an example of where you would typically employ different protocols within a Building Management System. The Architecture used is in 3 levels and it describes typical types of protocols that may be utilized:

- Management: This is where the IBMS system server interacts at the highest level of communications for integration and data collection and storage activity for transactions, logging and alarms for all the integrated. There will normally be other systems residing at this level which will form part of the integration.
- Automation which are the plant controllers for Access control, Lighting, electrical monitoring, HVAC. There is a high level of intelligence in each of these systems and using protocols they talk with each by the mapping of objects into Integration Controllers which standardize the objects and enable peer to peer communications between the different systems. This is achieved without the need to communicate to the management level first. Alarms, trend data, hours run information, plant start / stop reports, user event and transaction data that have been selected will be routed to the IBMS servers on occurrence. The IBMS Automation level provides the middleware that enables all this to occur seamlessly.
- Field devices include small plant controllers for lighting, access card readers, Fan Coil or VAV controllers, and their sensors and switches. These connect direct to the Automation level plant controllers either by hardware or a protocol.

This is represented in Figure 3.

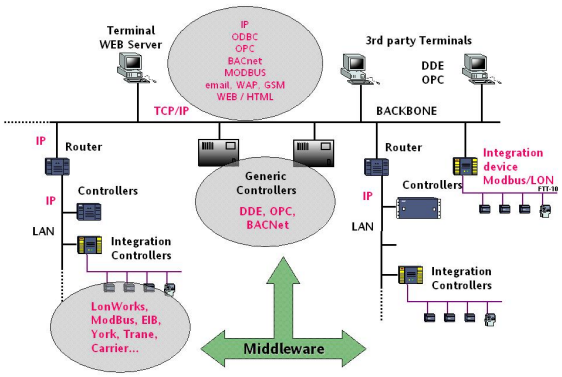

Figure 3: Protocol levels within a Building

How is Legislation moving the Integrated Building forward?

Since the signing of the Kyoto Protocol in 1997, the EU has continued to be a world leader in the development and implementation of Energy efficient programmes all designed to reduce the total EU Energy consumption by 20% by 2010.

The Energy Performance of Buildings Directive (EPBD) lays down requirements as regards:

- the general framework for a methodology of calculation of the integrated energy performance of buildings;
- the application of minimum requirements on the energy performance of new buildings;
- the application of minimum requirements on the energy performance of large existing buildings that are subject to major renovation;
- energy performance certification of buildings;
- and regular inspection of boilers and of air-conditioning systems in buildings and in addition an assessment of the heating installation in which the boilers are more than 15 years old.

These requirements have to be implemented by the 25 EU Member States. The deadline for implementation was January 4 2006. Only for the 2 last requirements (certifications and inspections), Member States may, because of lack of qualified and/or accredited experts, have an additional period of three years (before January 2009) to apply fully.

Within these general principles and objectives, it is the individual responsibility of each EU Member State to choose measures that corresponds best to its particular situation (subsidiarity principle). However, it is clear that collaboration and information exchange can
highly facilitate the implementation.

Example project International Finance Centre 2 - Hong Kong

This TAC system was supplied and installed by the Intelligent Systems Department of Analogue Technical Agencies Ltd, Hong Kong.

PROJECT INFORMATION

International Finance Centre 2 - Hong Kong was completed during 2003.

- 400 metre high tower plus podium
- 88 storeys
- 200,000 sq metres offices
- 50,000 sq metres retail
- Building Management System - TAC
- Dual Redundant Server configuration with Hot Standby
- Dual Ethernet backbone redundant communications

WEB browser user interfaces.

- 100,000 hardware control points, 30,000 software points

System integration

- HVAC Plant and VAV controllers (LON)
- Trane chillers (BACnet)
- Johnson fire alarm system in tower (BACnet)
- Honeywell fire alarm system in podium (BACnet)
- Electrical Power measurement system (DDE)
- Electrical power meters (ModBus)
- Carrier chillers (proprietary)

The building is one of the major financial centres for Hong Kong therefore it was critical for the building to continue to operate under failure scenarios and to collect data from multiple systems and provide extensive user interfaces combining data from different systems and as such included requirements such as;
inbuilt system redundancy throughout the building
utilise open systems to integrate several systems

provide operators a single holistic view of the operation of the building provide tenants a web page of their area and interaction for comfort.

International Finance Centre 2 – Hong Kong

The continuous increase in energy prices and the fact the world is becoming more and more conscious of the effects on our environment that pollution and waste produces, coupled with government initiatives, is forcing us to embrace technology and use it to our advantage.

Building owners and users have an obligation to understand better, how their environments are being used, and as a result of legislation, need to prove that it is to the best of their ability.

Technology will continue to aid us in this journey, standards and openness being a key to provide us with the Building IT solutions.

Intelligent and Integrated Building Management Systems are here to stay and become a standard part of any buildings infrastructure. Building IT – the path to a more comfortable and energy friendly environment.

TAC helps people feel and function better, as a direct result of greater indoor climate. This is made possible by TAC's concept of Open Systems for Building IT®, which utilises information technology to provide clients with advantages such as indoor climate optimisation, energy savings, flexibility, security, reduced expenses and user-friendly operation.

TAC is owned by Schneider Electric, the world's leading specialist power and control company. TAC has subsidiary companies and partners in more that 80 countries throughout the world. The company employs more than 5000 employees world-wide and generated revenues of €985m in 2006. Corporate headquarters and European business activities operate out of Malmo, Sweden. Regional headquarters for the Americas is located in Dallas and for the Asia-pacific market, in Sydney, Australia.