

Building automation: the Renaissance

Resurgence and revitalisation
– that is what is happening
in the world of building
automation, says *Ken Sinclair*.

JTC

I was extremely pleased to be asked to provide an article with a update on how the Internet, IT convergence, wireless networks, globalisation and the whole M2M thing is causing a Real Renaissance that is Reshaping the Building Automation Industry.

A renaissance – which implies a cultural rebirth and resurgence and revitalisation – is certainly what is happening in the world of Building Automation Connectivity. We must completely rethink how we do everything while immersing ourselves in a new IP/IT culture. As we move from a physical world to a virtual world with our products and services, it is a true renaissance that will change us and our industry forever.

Of course, the renaissance has already begun for the masses in their transition from a physical world to an “anything, anywhere” virtual world powered by powerful Web services delivered by the Pervasive Internet. Our task is to provide all our future building services, products, existing infrastructure and services virtual connections so that they seamlessly mesh with the new world renaissance.

And with burgeoning emerging markets around the world needing fuel, and the increasing concern for a green planet, the energy subject is also high on the agenda. The use of technology to resolve energy problems is here and building automation is right in the middle of it all, holding many of the cards.

Catalyst: The 800 Pound IT Gorilla

Cisco is the most significant IT company to come into the building automation space. In the CCRE (Cisco Connected Real Estate) whitepaper, it talks of harnessing the power of Internet Protocol (IP) to turn traditional building construction and management paradigms on their heads.

In so doing, CCRE will bring huge financial and operational advantages not only to the construction, real estate and property services industries but also to downstream constituencies such as hotel operators, multiplexed retail outlets, and corporate tenants, and in sectors as diverse as leisure, healthcare, education and retail finance.

This will bring with it IT integrators, consultants and for the first time for years, will allow top level executives to get a new way to look at their facilities. The IT people are coming with the next wave of convergence: BAS along with Voice, Video & Data.

The participants gathering at the Cisco sponsored roundtable at BuilConn Americas 2006 is an inspiring list of the key movers for the new world of building systems. The Cisco Connected Roundtable involves key stakeholders in the building automation industry. The purpose is to discuss the needs of building owners and the issues regarding the supply of products and services within a context of increasing adoption of IP-centric systems in building systems.



Cisco

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solutions will be a little while coming.”

Regarding the channel, Allan McHale alludes to ‘super-integrators’; although we are not sure what to call them, we all agree that they are necessary. Even our best integrators must get out of their box and not only guide the renaissance but lead with their strong example of great integrations that add virtual value. How do we make our existing integrator super strength? Get them out to events like BuilConn is one way.

The Demand Is There

The New Breed of Owners are business centric, IT aware, demanding, using enterprise systems as their lifeline and connection to the new world of Web service and remote operations. The market is huge and the time is now.

For example, according to Allan McHale, Director, i&i Ltd, a leading European research and consultancy company specialising in Intelligent Buildings, the total commercial market potential for retrofitting existing building stock with Web enabled systems that can directly connect to the business enterprise is worth US\$4 billion in North America.

“The new construction market is taking longer to penetrate but it could be worth some US\$2 billion by 2010, and that only includes the value of the revenues that ‘super-integrators’ will achieve for ‘gluing’ all the technical services together and interfacing with the business enterprise,” says Mr McHale.

The company has carried out multi-client studies in all the developed markets of the world for IBC(e) Intelligent Building Controls for the environment, and similarly for IBC(f) fire detection, and IBC(s) electronic security, including access control, CCTV Surveillance and Intruder Alarms.

Continues Allan McHale, “If we just take IBC (e), then in 2005, the global market was worth approximately US\$11.5 billion at installed prices excluding servicing. Security in all its forms was worth approximately US\$20 billion at installed prices but not all of this would be resident in a building. I have not included fire detection for its inclusion within IT-Convergence

Connectivity is King

Sun Microsystems stated, "The Network is the Computer"; Echelon stated, "The Network is the Controller"; we all now say, "The Internet is our life—business and pleasure". And now, Anto's Connectivity Law – "The value of a piece of information is proportional to the number of uses that piece of information is connected to" – gives us a way to envision the value of connectivity to devices. (Anto Budiardjo is President & CEO of Clasma Events Inc, organiser of BuilConn Americas 2006.)

All points in a building connectible by IP, envisages BuilConn founder Anto Budiardjo.

"The point here is that if you are installing a sensor (or any other "point" in a building), in the past you would typically think about its usefulness to your immediate purpose, to control a fan, open a door, a PID loop or some other need of the system you are installing.

"With ubiquitous connectivity, the sensor can actually be used by many other purposes that you could have absolutely no knowledge of, but purposes that are likely to bring significant value to some other system, person or business process within the building, the building owner's organisation or even further afield," says Mr Budiardjo.

As for IP (Internet Protocol), no argument here, just a question of how low into the field it will go, and it's a question of time. Anton Budiardjo: "Soon, all points in a building will be connectible via IP (through routers or gateways) to all other points, systems, controllers, computers, servers and databases (with security protocols of course). This now becomes part of the compelling reason for integration, open systems and convergence."

Of course you cannot ignore Wireless. Much talked about as a game changer – just a question of being comfortable with reliability. As wireless network technology player Kiyon, which was awarded the 2006 Innovation Award in Building Automation (from ASHRAE Journal), emphasises: "Today there are many scenarios where wireless is a viable and preferable option, such as hard-to-wire or expensive-to-wire locations, interconnecting multiple buildings, and need for mobility.

"Such applications, which may include data, voice, video plus emerging search and location based service (LBS) applications, inherently rely on a wireless network. Ultimately, the decision is about which option makes economic sense while meeting all the service requirements."

And the whole M2M phenomenon is based on the realisation that there are now more devices on the Internet than humans on the planet. Technology and services for connecting devices eg: building system controllers and peripheral components is widely available.

From this year's M2M Expo in Palm Springs: "While much of M2M has to date been about technology and applications within specific vertical segments and markets, the full power of M2M will only be realized as a grand integration platform enabling cross vertical interoperability and business opportunities."

Relational Control

Control theory is also undergoing a renaissance – at least according to Tom Hartman of The Hartman Company, which specialises in applying computer technology to commercial and industrial building control and energy management.

Relational control is a technology developed for the era of digital network controls, and focused on replacing PID (Proportion+Integral+Derivative) control when the control platform has suitable networking features. Relational control techniques can be employed to operate building energy



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systems much more efficiently and more effectively than has ever been possible with PID based controls.

"PID control has a number of substantial shortcomings that the industry no longer needs to accept. What's quite remarkable is the newer control theory behind relational control shows that from an optimisation standpoint, conventional PID controls the wrong variables.

"So, as we move to implementing newer more efficient control techniques for today's large systems, the entire landscape of control theory and strategy needs to change. This is why the idea that a 'paradigm' shift is coming does not overstate this developing change," he explains.

Demand based control is one type of relational control that operates components in a system based on the real-

| CONTROL TYPE | Classical Feedback Control | Relational Control | |
|----------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| CONTROL NAME | PID | Demand Based | Intelligent Iterative |
| CONTROL PROCESS | Feedback from controlled variable | Optimum power relationships among system components | Condition of components served |
| CONTROL BASIS | Analogue proportional control | Equal margin performance principle | Iterative problem solving |
| MAX RESPONSE TIME INTERVAL | 0.1 to 5.0 secs | 0.5 to 5 mins | 0.5 to 5 mins |
| ENERGY OPTIMISATION | Not feasible within control loop over entire operating range; requires separate tep | Inherent in this type of control | Energy optimised relationships are recommended in developing control algorithms |
| EXAMPLE CASE | Conventional temp or pressure setpoint control | Control of all-variable speed HVAC system with chilled water plant & VAV fan units | Control of fan or pump serving multiple loads or control of valves or dampers |

Table 1: A comparison of the two types of relational control with classical feedback control.

time power consumption of each component in a multiple component system. One of the most dramatic applications for demand based control is in the coordination of the chiller plant and fan operation to cool building spaces.

Such a system is optimised only if the same added power to the chiller plant or the fan systems will result in the same additional cooling effect to the spaces served. Current practice is to distribute chilled water at one temperature and provide supply air at another temperature. As demand for cooling increases, independent PID loops provide additional airflow, and adjust valves and plant operation to maintain temperature setpoints.

Additional power is supplied to the fan and the chiller plant as the load increases. But the question is: “How can we operate the system to ensure that the ratio of power added to the chiller plant and fan systems results in optimised overall system operation?”

This is a very difficult task to accomplish with conventional temperature setpoint control. As practiced today, such optimisation requires the continuous reset of chilled water and supply air temperature setpoints based either on a complex array of real-time information or on a reset table. However, the old adage applies – you can’t control what you don’t measure. Since neither of these optimisation techniques actually measure power use, neither accurately results in effective energy optimisation.

However, with demand based control, a simple control algorithm monitors actual power consumption of the chiller plant components and fan units in response to changes in space cooling loads. Neither the chilled water nor the supply air is maintained at fixed temperature setpoints. Instead, the demand based control algorithm coordinates the operation of the chiller plant, chilled water distribution system and the fan units so that as cooling load changes occur, optimized operation is maintained by regulating the increase (or decrease) in power to each component in the ratios required to meet the changing cooling load optimally.

Another type of relational control useful in HVAC control is intelligent iterative control (IIC). A comparison of various features of these two types of relational control with those of classical feedback control is shown in Table 1 above.

Infometrics: Analyse This

Companies like Cimetrics provides independent data analysis and portfolio-wide consolidated reporting to the facilities and energy departments of building owners. These reports analyse and improve energy efficiency and reduce energy, operations, maintenance and regulatory costs, mining data for value.

The results are a wealth of ongoing, unbiased recommendations and management information that enable firms to reduce energy and operational costs, identify potential equipment problems in order to avoid downtime, and enjoy the benefits of a continuously commissioned facility.

This process of data acquisition, analysis, and reporting is called Infometrics. The infometrics service provides a means to understand and manage building

operations and their implications for cost structure and economic returns. By requiring little capital up front, infometrics can create an immediate and lasting reduction in the operating cost structure of a building.

Infometrics has numerous potential benefits to building owners, including the following:

- Reduced energy consumption and energy cost
- Prioritisation of equipment maintenance
- Reduced downtime caused by mechanical equipment failure
- Improved facility operations
- Ongoing commissioning of mechanical systems and control systems

"The Intelligent Building has morphed into the Intelligent Enterprise and is on the way to the World Wide Grid"

– Jack McGowan on GridWise Expo (www.gridwiseexpo.com).

"In a nutshell, oBIX will allow integrators to connect control systems, such as access control, with enterprise systems, such as human resources. Therefore, oBIX is much more than just a way to describe points, historical trends and alarms. It is an extensible model that describes other models – a meta-model. oBIX allows control vendors to fully describe their proprietary systems and allow enterprises to discover non-standard data and invent new applications for it."

– Aaron Hansen, Tridium.

In Quotes

Thoughts from some of the key industry players on the building automation/IT convergence phenomenon.

"The delivery of data and physicality of a 'point' complicates things enough; but it really starts getting interesting when Enterprise Facility Management systems incorporate data sources from outside the HVAC/control system."

– Keith Gipson, CTO and Co-Founder, Impact Facility Solutions.

"A key event for LONMARK is BuilConn, in Palm Springs May 16-18, 2006. Of significant interest at this event is the strong role that Cisco Systems is playing, bringing with them IT vendors, integrators and building owners."

– Earl Gray, Chairman, LONMARK Americas Board of Directors.

"Conventional building automation is being transformed by three megaforges that promise to dramatically change our industry: HVAC unitary equipment now includes factory-mounted open protocol communicating controllers; IP connectivity is everywhere connecting enterprise systems as well as building/facility systems; and disruptive technologies like wireless and microsystems are now a reality. Each megatrend is a market changer but in combination, they will totally restructure building automation."

– Rick LeBlanc, Senior VP, Siemens Building Technologies.

- Reduced risk of indoor air quality problems
- Identification of profitable mechanical retrofit opportunities
- Improved occupant comfort
- Knowledge of facility energy consumption patterns and trends

BuilConn

BuilConn, the special event for Building-IT Convergence, is scheduled to make its first appearance in Asia later this year.

Come To BuilConn

BuilConn is a unique event that unites all the individuals involved in buildings and IT to take an objective and comprehensive view of buildings and facilities, understand the technologies and trends that shape it, and discover the steps required to implement truly intelligent, integrated buildings.

The name BuilConn is no accident, it's about Building Connectivity ("building" both as a verb and a noun). BuilConn is the only venue focused on this very important subject, not about the disciplines of HVAC, security, lighting, IT or any of the other systems found in buildings, but about connecting them with each other, and extracting their true value.

As the gathering place for Building-IT Convergence, all issues pertaining to the evolution of this space will be presented, discussed, and developed at BuilConn, with the focus for 2006 being the broad adoption of IP and related technologies as the convergence with the IT world evolves.

The supporters of BuilConn are evolving to be a veritable list of connectivity-centric companies and organisations: LONMARK, BACnet, oBIX, OASIS, OPC, ZigBee and CABA to name a few, plus commercial support from Cisco, Tridium, Gridlogix, Lantronix, Cimetrix and many others. It is also not an accident that BuilConn is co-located with events that also focus on connectivity – M2M in generic devices and GridWise Expo for the smart Grid

As well as being able to write about the renaissance in this article, it is my plan to tell you about the changes I have seen as a presenter and a track leader at the first ever BuilConn event to be held in Asia, which takes place in Singapore in November 2006.

The challenge at BuilConn this year is to establish the value of building information systems. We have the technology, we have the infrastructure, we have the attention of the buildings and IT industries, we have the demand from corporations who own buildings, and now we have a way to measure the value of connectivity. It is time to turn connectivity into new business opportunities.

Ken Sinclair is Editor/Owner of AutomatedBuildings.com, an online magazine and Web resource for the building automation industry.

Internet Standards Provide Data Visibility

The adoption of Internet Standards in the Building Automation Systems (BAS) market is giving birth to a new industry focusing on information management and analysis, says a new report out from ARC Advisory Group.

In sharp contrast to traditional BAS protocols, the adoption of Internet standards allows building owners to perform sophisticated business intelligence analysis on facilities data that is typically reserved for business applications.

Recognising the emerging demand for Internet standards in the BAS market, IT companies such as Cisco are taking greater interest in partnering with suppliers already active in the BAS controls market. At the same time, traditional BAS suppliers are looking for help in providing high-level facilities data analysis tools to a new breed of customers in the increasingly IP-centric BAS market.

"Businesses are increasingly transitioning toward dynamic, demand-driven models that require increased agility, flexibility, and productivity to be responsive to ever faster market changes," according to Senior Analyst David Clayton, the principal author of ARC's *Building Automation Systems Worldwide Outlook*, which forecasts the worldwide market for BAS to grow at a CAGR of nearly five percent over the next five years—from US\$22 billion in 2004 to more than US\$25 billion in 2009.

Achieving Interoperability

Business agility, however, demands a level of data visibility and sharing that is not present in the infrastructure of most businesses today. Most businesses have an extensive installed base of disparate equipment and systems that are unable to coexist on a single network including IT systems, BAS, and numerous building devices. These systems and devices were implemented using a variety of suppliers with different needs in mind.

Use of Internet standards helps achieve interoperability by simplifying and reducing the risk associated with exchanging data across various networks and systems. It also promotes the concept of "smart buildings" by allowing companies to create a single repository for all facilities data for sharing between all applications and organisations within an enterprise. Once facilities data is easily retrieved, companies are able to perform intelligent analysis on the enterprise's entire portfolio of facilities data.

In addition to providing enhanced data integration, the ability to work with numerous types of equipment and systems



from numerous vendors using Internet standards is also key to providing facilities managers reduced uncertainty by removing the fear of the solution becoming obsolete due to the rapidly changing landscape of the controls market with new vendors and new technologies appearing on the market almost daily, states the ARC report.

Internet standards promote interoperability by simplifying data exchange across various networks and systems.

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Behind The Biopolis

A look at the building automation technology behind the gleaming glass towers of Singapore's Biopolis complex.

JTC

Increasing innovation and technology is escalating demands in building functions today and forcing electrical installations to evolve to meet these complex requirements that call for better interaction between functions. Conventional electrical installation, despite being able to fulfill many of these tasks, is having to keep pace with modernity.

And modernity is certainly something that comes to mind when you see Singapore's Biopolis – a new 185,000 sq m biomedical complex of seven buildings in which government agencies, publicly funded research institutes and R&D laboratories of pharmaceutical and biotech companies are located. The building automation requirements include the control and monitoring of more than 1,500 ACMV equipment such as exhaust fans, AHUs, FCUs, etc.

Hidden behind the futuristic façade sits Carlo Gavazzi's Dupline installation bus, a new way to implement the wiring and programming of a building automation system.

Due to its high noise immunity, Dupline is capable of transmitting signals over distances of up to 10 km via a non-shielded, non-twisted two-wire cable, without using repeaters. Therefore, the two bus wires can follow the wiring path of the main supply in the same cable trunking or conduit, providing considerable cost savings. The free topology wiring system that Dupline allows further minimises cabling costs.

Delivering Reliable Control

The Dupline Master Generator Controller offers a selection of predefined functions such as real time clock functions which allow outputs to be programmed to switch on or off at specific times of the day and days of the week. Logical functions can be programmed to enhance the functionality and the flexibility of the system.

For the Biopolis project, redundant Master Generator Controllers were implemented to allow a "hot standby" function should the primary Master Generator Controller fail. This ensures the reliability of the control and monitoring systems.

At the complex, the ACMV equipments are programmed to run at predetermined timings. In the event that the building management




At the Biopolis, Dupline controls and monitors more than 1,500 ACMV equipment such as exhaust fans, AHUs, FCUs, all over normal two-wire cables.

system (BMS) fails, the Dupline control and monitoring system will take over, and run the equipment accordingly. The system also allows individual equipment to be controlled at two remote locations (namely the FCC and Chiller Plant Room) within each building.

All Along The Bus

In addition, the Dupline product range includes a wide range of dedicated building automation components such as intelligent light switches, movement detectors, light intensity sensors, dimmers, relays and thermostats. All the components use the same two wires to connect to the Dupline controller, which makes it possible to implement intelligent functions by combining the signals from the different bus components.

In larger buildings, multiple Dupline controllers can be linked together via Carlo Gavazzi's RS485 for exchange of data. With this open protocol, the entire network of data can be easily interfaced to any type of Building Management System. 

Based on information supplied by Carlo Gavazzi (www.gavazzi.com)