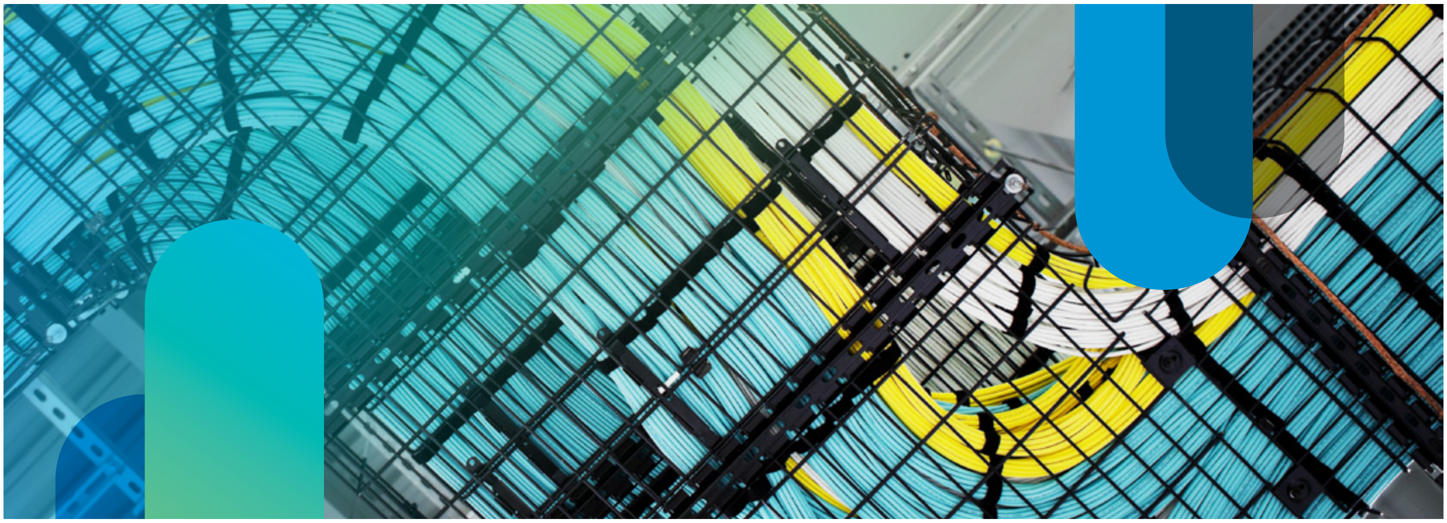
The Making of a Smart Building

How Wells Fargo’s Corporate Properties Group Raised The Bar

The Making of a Smart Building

Case Study

HOW WELLS FARGO'S CORPORATE PROPERTIES GROUP RAISED THE BAR



Overview

BUILDING

- 1.5 MM square feet, 48 stories with 23 acres of below-grade parking
- Multi-tenant office tower that serves as headquarters for Duke Energy Corporation and other Fortune 500 Corporations
- Owner: Wells Fargo & Co

CHALLENGE

- Reduce risks from building technology changes with current-day approach
- Build in long term cost-efficiency and flexibility for property management and occupants
- Budget, schedule and contracts already set

SOLUTION

- Eliminate overlapping, disparate IT cabling and networking with single backbone
- Require controls contractors to focus on core strengths and leverage backbone for connectivity
- Continuously commission and adapt to experience and operational cost requirements

RESULTS

- 22 percent reduction in energy costs, over $400,000 lower capital expense, and lower risk
- Superior tenant experience, control and satisfaction
- Complete system interoperability without compromising independent functionality and service

Executive Summary

In 2010, Wells Fargo & Co. completed what would soon be called one of the smartest buildings in America by reevaluating the decades-old development approach. The Duke Energy Center (DEC) is a 1.5 million square foot, 48 story multi-tenant office tower that is headquarters for Duke Energy Corporation and serves multiple tenants including Wells Fargo, KPMG, Deloitte and others.

The bank and its predecessor, Wachovia Corporation, set out to make this building the measure for a modern, sustainable and operationally cost-efficient building while creating a next generation occupant experience. They realized that in order to accomplish this, they could not build and manage it in the traditional way. However, it still had to be on time and on budget, and efforts to change the process would face the ultimate financial and risk evaluation during the height of the economic crisis. This scrutiny was compounded by the substantial cultural resistance to change in the real estate and construction industry.

The bank and its project partners—Childress Klein Properties, Intelligent Buildings, LLC and Cisco—upended "construction-as-usual" and worked with 16 different building systems controls companies to groom all of them onto a common Cisco backbone and empower a new way of managing the building. This approach would set the building ahead of its peer buildings in multiple measurable ways, which included:

- Reduced capital and operational cost structure
- Mitigated change order, schedule and operational risks
- Simplified building management
- Built in scalability, reliability and flexibility
- Improved occupant experience and choices

Even with the inclusion of these powerful benefits, the physical changes in the building itself were minor, affecting only the method that control systems connect vertically between floors, while also reducing the number of connections to the main server. Ultimately, the changes not only saved capital expenses, but also resulted in less than 0.5% of the project cost.

The Making of a Smart Building

Case Study

HOW WELLS FARGO'S CORPORATE PROPERTIES GROUP RAISED THE BAR

Background

Bob Bertges, Executive Vice President in Wells Fargo's Corporate Properties Group, sought to use the development of the Duke Energy Center to create a new model for future development and operations that raised the bar not only for Wells Fargo, but for the entire industry. Curt Radkin, Senior Vice President and Sustainability Strategist for Wells Fargo Corporate Properties Group, was the executive in charge of developing the building, leading the new process and making the critical decisions to change from the old development approach.

> "There is no more rigid industry segment than real estate development, so we knew even though we were driving the process, we could meet resistance at many points along the way, both internally and externally. This is a decades-old process and culture that resists change despite technology and the economy."
>
> Curt Radkin, SVP
> Wells Fargo Corporate Properties

With the property being on a fast track, most major building systems and design had already been determined in early schematic and design development. The building itself was already 14 stories completed from bedrock when the intense "smart building" evaluation began. While somewhat late in the process, it was nevertheless helpful to have real numbers for comparison of any potential changes, given a schedule that was already firm. Potential design and construction tweaks would have to be cost and schedule neutral or better.

Under Wells Fargo leadership, Intelligent Buildings developed the strategy and technology standards, along with the risk and financial analysis for the new design. Intelligent Buildings also developed and supported the value proposition and business case for the controls contractors. Childress Klein validated the impact on construction budget, schedule, and future operations, as well as oversaw any changes on site. As both the developer and the property management company, Childress Klein was able to credibly determine both the job site issues and the life cycle impact. Cisco provided real estate networking expertise, design and solutions for all building system connectivity requirements.

At this juncture, the team determined that the controls systems such as HVAC, lighting, security, metering and others would have the most impact on operational costs and would also share common IT characteristics. However, since the building was already out of the ground, this meant that vendors and controls manufacturers had been selected and contracts had been let. Thus the contractors would need to agree that the changes would be as good for them as they would be for Wells Fargo. Like the recession itself, working with vendors already under contract would also prove to be a tall test of any change from the legacy approach.

...controls systems such as HVAC, lighting, security, metering and others would have the most impact on operational costs...

The Construction Standards Institute (CSI)

CSI developed the Master Format that all projects follow from a design, pricing and bidding format. This is what categorizes issues such as mechanical, electrical etc. In 2004, the CSI developed a new master format (MS 2004) that much more accurately reflects the IT nature of building systems and expands the categories from 16 to upwards of 48.

However, it is not used often because most firms are more familiar with the old format. Hence, the old format keeps all technology requirements in each divisional silo and then "dumps" miscellaneous technologies into division 17 which prevents interoperability, flexibility and consistent electronic security.

The Making of a Smart Building

Case Study

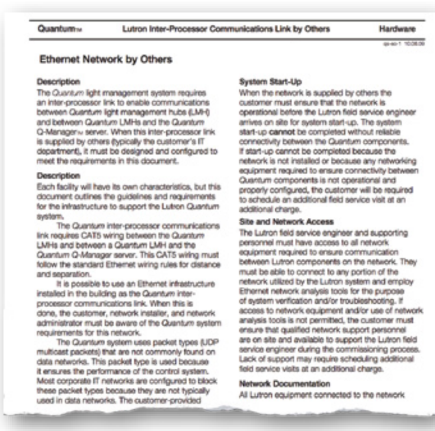
HOW WELLS FARGO'S CORPORATE PROPERTIES GROUP RAISED THE BAR

Common Characteristics

Wells Fargo, Intelligent Buildings, LLC and Childress Klein observed that the building controls systems for the DEC such as HVAC, lighting, metering, elevators etc. had all changed significantly in recent years and now utilized nearly identical information technology networking as part of their basic functional requirements. Hence, the traditional plans showed multiple, overlapping, redundant infrastructure including conduit, cable, networks, servers etc. Additionally, the IT infrastructures varied in design, level of security and quality. The disparate network problem was due to the older divisional design and development process and thinking.

The IT requirements of such separated systems show a consistent trend in the controls manufacture marketplace that has forced developers, managers and the support vendors to take on a growing amount of IT responsibility in design, development and operations.

An example of the IT nature of controls systems is Lutron lighting controls solutions, which now include a prescriptive option and documentation for "Ethernet by Others" indicating that their system can be "plugged in" to a building backbone shared by other systems. Their system requires IT connectivity as a commodity point-to-point communications function but it is not important that Lutron self perform something that is not their core business or skill set. This also reflects Lutron's awareness of the broader strategic realities for owners and managers and their willingness to partner with companies like Cisco for seamless networking and interoperability.



Quantum™ Lutron Inter-Processor Communications Link by Others Hardware

Ethernet Network by Others

Description
The *Quantum* light management system requires an inter-processor link to enable communications between *Quantum* light management hubs (LMH) and between *Quantum* LMHs and the *Quantum* Q-Manager™ server. When this inter-processor link is supplied by others (typically the customer's IT department), it must be designed and configured to meet the requirements in this document.

Description
Each facility will have its own characteristics, but this document outlines the guidelines and requirements for the infrastructure to support the Lutron *Quantum* system.

The *Quantum* inter-processor communications link requires CAT5 wiring between the *Quantum* LMHs and between a *Quantum* LMH and the *Quantum Q-Manager* server. This CAT5 wiring must follow the standard Ethernet wiring rules for distance and separation.

It is possible to use an Ethernet infrastructure installed in the building as the *Quantum* inter-processor communications link. When this is done, the customer, network installer, and network administrator must be aware of the *Quantum* system requirements for this network.

The *Quantum* system uses packet types (UDP multicast packets) that are not commonly found on data networks. This packet type is used because it ensures the performance of the control system. Most corporate IT networks are configured to block these packet types because they are not typically used in data networks. The customer-provided

System Start-Up
When the network is supplied by others the customer must ensure that the network is operational before the Lutron field service engineer arrives on site for system start-up. The system start-up **cannot** be completed without reliable connectivity between the Quantum components. If start-up cannot be completed because the network is not installed or because any networking equipment required to ensure connectivity between Quantum components is not operational and properly configured, the customer will be required to schedule an additional field service visit at an additional charge.

Site and Network Access
The Lutron field service engineer and supporting personnel must have access to all network equipment required to ensure communication between Lutron components on the network. They must be able to connect to any portion of the network utilized by the Lutron system and employ Ethernet network analysis tools for the purpose of system verification and/or troubleshooting. If access to network equipment and/or use of network analysis tools is not permitted, the customer must ensure that qualified network support personnel are on site and available to support the Lutron field service engineer during the commissioning process. Lack of support may require scheduling additional field service visits at an additional charge.

Network Documentation
All Lutron equipment connected to the network

- Lutron Inter-Processor Communications Link by Others

As a similar example, the Siemens building automation system required connectivity of all floor-level controllers and the master server at the base of the building. However, that large networking design, implementation and management was only a requirement for the system and not part of the HVAC and mechanical controls functionality. They were clear that the system only needed secure, reliable networking and nothing proprietary to the controls system.

This held true for the elevator system, daylight harvesting, water reclamation, parking, barrier gate, exterior lighting, security and other systems as well.

Risks

This shift in domain expertise requirements (IT networking necessary for all controls systems) has far outpaced the capabilities of traditional design, construction and operations practices and support services. Supporting traditional controls systems through the implementation of substandard, disparate and incompatible networks, can create a variety of risks for owners and managers: increases in maintenance expenses, operational costs, and capital costs for future add-ons, the risk of more system down time, and an inability for systems to work together. Understanding this, Wells Fargo was able to react with a quick shift in planning that would redefine how they now approach design changes, construction and management processes for building technologies. Childress Klein was equal to the change task, working with Intelligent Buildings, LLC, to creatively engage property management and IT staff in the development process. By doing so, they added critical IT capabilities while maintaining a sensitivity to all of the downstream operational impacts.

Solution

The new design approach centered on helping controls contractors (for the aforementioned systems HVAC, lighting, elevator, metering, security, etc.) remain focused on their skill sets, while allowing the IT networking experts to focus on the controls contractors' IT networking systems aspects. As such, Cisco was called upon to design and install a building-grade backbone network as part of their "Smart + Connected" real estate solution. The Cisco solution would be accompanied by open communications protocols and the Tridium middleware product that in combination would lower maintenance costs and enable easier interoperability.

All of the 16 controls systems companies agreed that a neutral, secure backbone was the most reliable, flexible approach for the owner and that it would not compromise their performance, profit, warranties or service quality. Cisco ensured that all connectivity requirements would be met and network performance would exceed any individual system need, while staying within the planned cost of each system's separate infrastructures. The Cisco backbone leverages air blown fiber optic lines, along with copper cabling, flexible patch panels and secure enclosures for all equipment and terminations.

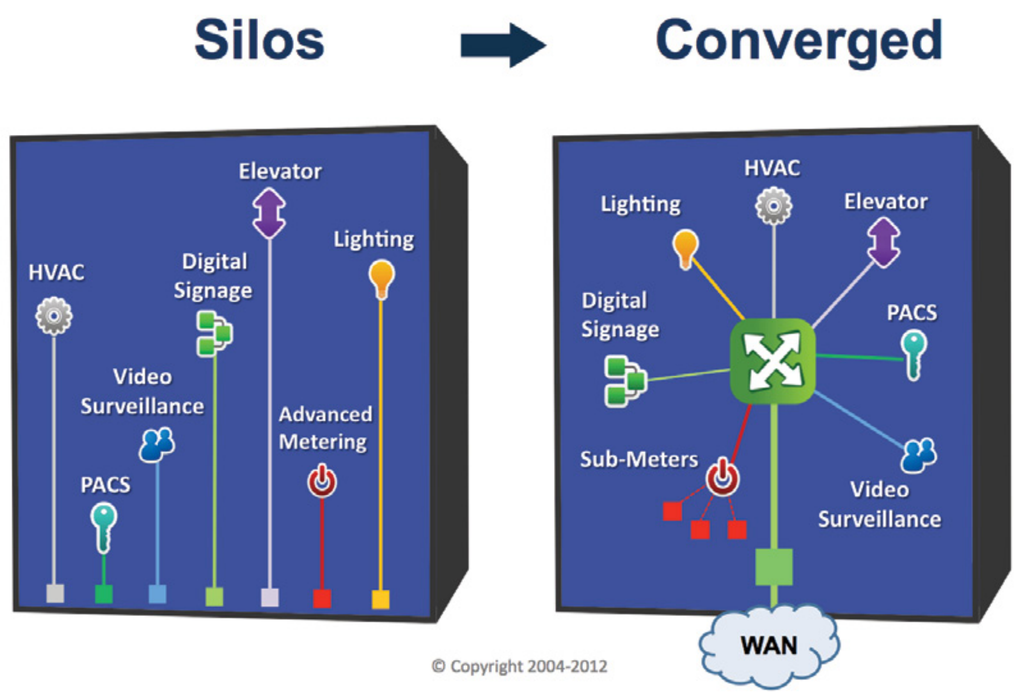
Traditional Controls System Approach

The risks created by a traditional controls system approach would have manifested in increases in maintenance expenses, operational costs, and capital costs for future add-ons, more system down time, and an inability for systems to work together.

The Making of a Smart Building

Case Study

HOW WELLS FARGO'S CORPORATE PROPERTIES GROUP RAISED THE BAR



This neutral, standards-based backbone accommodates a myriad of systems regardless of manufacturer or type. Vendors will only need to be able to connect to a standard office-type network similar to ones that allow for printer sharing, email and Internet access in any standard office environment. This approach is increasingly common practice and has been endorsed by most major controls systems manufacturers in HVAC, lighting, security, video surveillance, parking and others.

The Backbone Included:

- Cisco core switch
- 20 Cisco PoE switch
- 16 blade servers
- 480 strands of air blown multimode fiber
- 20 active, locked cabinet enclosures
- 15 Tridium JACE middleware appliances

> "In my view, I perceive the converged network as far more reliable than the sum of the reliability of the non-converged networks."
>
> Jim Patterson,
> Regional Director of Facility Management, CKP

Converged Building Systems on to Cisco Network

1. Electrical sub-metering
2. Water metering
3. Automatic blinds
4. Irrigation control
5. Audio & video conferencing
6. VOIP
7. Exterior lighting
8. Interior lighting
9. Digital signage
10. Elevators
11. Barrier gate
12. HVAC – sensors
13. Parking controls
14. Video surveillance
15. Access control
16. BAS – energy

The Making of a Smart Building

HOW WELLS FARGO'S CORPORATE PROPERTIES GROUP RAISED THE BAR

Results

Vendor Impact

The controls systems contractors and manufacturers all complied with the solution albeit for different reasons. Some were anxious about cost or schedule overruns, yet prepared because they understood the realities of IT. Others were willing to make the systems change since IT was not core to their value. Still others were relieved since IT networking exceeded their internal capabilities. In every case, they were able to provide a cost deduct for their now unnecessary networking, validate warranties, and service their systems both remotely and onsite.

A converged building network did not change what contractors and manufacturers do as their core competency. In other words Cisco would not design, sell or service elevators, chillers, boilers, lighting systems, parking systems or electrical metering. Rather, those vendors made a very slight adjustment in their design and installation to exclude the non-core aspects of their product that relate to IT. For example, when installing HVAC controls systems there is vertical connectivity between floor-level controllers down to a server - all of which are commodity IT connectivity linking "Point A" to "Point B" and initially have no impact on the functionality and control of the system.

Representatives Quote and Comments as Follows:

> "We were encouraged and inspired by the process at the Duke Energy Center. This helped us move more affirmatively towards the reality that every system, including ours, does not need a siloed infrastructure. We have responded to this by institutionalizing this as an option for any of our clients. Whether you have 16,000 ballasts that are all addressable and dimmable—like the Duke Energy Center—or a smaller number, the information technology realities have forever changed the way controls systems will be designed, installed and managed."
>
> Brian Daskurdus, Director Global Energy
> Lutron Lighting Controls

> "We are experts in building automation and energy solutions for some of the largest and most complex buildings in the world. Our systems, like nearly all other building automation systems, require servers and vertical networking for connectivity and functionality. With a reliable, secure Cisco network, we were able to stay focused on our core business and simply leverage the connectivity on each floor for communication between the many different integrated components of our system."
>
> Brian Beebe, Area Manager
> Siemens Industry, Inc

> "It is clear to us that common IT infrastructure is the current-day approach to design, development and management of buildings. Our Niagara Framework is the essence of convergence at a device and protocol level so a network backbone is natural and efficient for our solution, as well as the entire building. This combination lowers operational cost and enhances the occupant experience."
>
> Mark Petock, Global VP Marketing
> Tridium Corporation

Operational Impact

The operational impact was immediate and ongoing because of the standards, open protocols, scalability and flexibility introduced by the change in systems approach. Each of the floors has the same technology configuration right down to the fabricated metal enclosures which helps managers keep order and manage vendor policy. Since each system is linked through the network and software, the building can continuously adapt to new experience desires or operational cost issues. Secure remote access means that vendors can more easily service and update systems and property managers can monitor and adjust systems from anywhere.

Leveraging IT staff to ensure proper design, installation and management greatly increases building system reliability and service issue resolution by eliminating a complex variable. Additionally, management staff will have more service options in the future, longer system life and lower service costs due to the elimination of proprietary vendor protocols and service contracts.

Financial Impact

The financial impact during construction was minimal. Ultimately the areas under consideration for change, which were building systems controls networking, represented less than 0.5% of the project cost. Nevertheless, the project saved over $400,000 (see Appendix A) by eliminating 16 disparate networks and implementing one reliable, robust, secure backbone even when having to request deducts after contract awards. This has lowered the capital cost structure of all future system additions or enhancements since these systems will only need to plug into the existing backbone for full building connectivity and access.

The interoperability and control gained have allowed the building to continuously reduce energy and operational costs. For example, Wells Fargo/Childress Klein Properties conducted a detailed lighting control study on seven Wells Fargo floors and through control changes and output trimming have realized an additional 20-25% energy efficiency from the lighting system. This reduction will produce energy savings of $1,100 per year or over $60,000 per year if implemented throughout the building. Results of this study are being shared with other tenants in the building in hopes of driving lighting energy efficiencies on all floors.

The building is now preparing for continuous commissioning analytics allowing it to lock in savings and participate in utility demand response load shedding programs. Easy Access to data and granular control of every system are essential to these benefits.

Overall Resource Reductions

ENERGY

- 22% more efficient than a similar sized building which lacks energy control strategies accomplished via a converged network;
- Saving approximately 5 million kilowatt hours per year, equivalent to the annual energy use of about 450 homes or more
- Savings were gained through the use of daylight harvesting blinds that direct light into the building, lighting controls that respond to the amount of daylight, high performance glazing on the exterior walls, and highly efficient HVAC systems and controls, all of which reduce demands on the Duke Energy Center's lighting and cooling systems.

WATER

- 85% more water efficient with approximately 30 million gallons of water per year through a combination of rainwater collection and 46% reduction in domestic water used from use of low flow faucets, waterless urinals and dual flush toilets:
- Rainwater is collected into a large underground storage vault for the DEC's cooling tower makeup water and a large ozone generator is used to keep the water in the underground storage tank free of potentially harmful bacteria
- Of the 25 million gallons of water per year required for the water used for cooling the building from the HVAC system, 95 percent is captured and treated contaminated groundwater

AIR

- The building provides secure bicycle racks, as well as showers and changing rooms for tenants who bike to work, and preferred parking for low-emission vehicles. In addition to easy access to the Charlotte Area Transit System bus and light rail routes, these options could help improve air quality as it relates to the potential decrease in car travel.

WASTE

- 93%, or 16, 500 tons of the construction waste was diverted from landfills.
- 75,000 cubic yards of soil were remediated to cleanse and revitalize the land on this brownfield site.
- 350,000 cubic yards of rock from the site were excavated, crushed, and reused for the construction of four miles of new highway.

Environmental Sustainability Impact

In addition to overall financial and operational benefits, convergence efficiencies along with other design features provide environmental sustainability results that contributed to its LEED Platinum status.

Conclusion

The trends for real estate development and management include controlling systems of all types, such as HVAC, lighting, security , metering, and elevators, with converged network connectivity.

This approach presents both risk and opportunities to owners and managers. Most important is to then acknowledge and plan around the risk/opportunity reality as well as the limitations of the traditional support vendors. Doing so will prevent the predictable rise in maintenance and operational expenses, help better manage energy and utility costs, improve rentable space and order in the reduction of closets and mechanical spaces, and reduce risk of extended downtime and finger pointing when multiple vendors manage multiple networks.

Convergence of building systems onto a single network presents an opportunity to create interoperability inside the building and more dynamic interaction with electrical grid and other major utilities as well as creating a "data driven" building. In the world of "big data", the real estate industry and our individual buildings have significant opportunity to capture, analyze and act on data as a profound low-cost, high value way of driving down operational costs.

Construction Budget

Appendix A

Network Costs	MasterFormat 2012 Construction Codes	Silo Approach	Converged Approach	Savings	Savings
Access Control Network	25 05 13 Conductors and Cables for Integrated Automation 25 05 28.29 Hangers and Supports for Integrated Automation 25 05 28.33 Conduits and Backboxes for Integrated Automation 25 11 13 Integrated Automation Network Servers 25 11 16 Integrated Automation Network Routers and Switches 28 13 19 Access Control Systems Infrastructure	$118,637	N/A	$118,637	Networking for access control card readers and security.
Audio & Video Conferencing Network	25 05 13 Conductors and Cables for Integrated Automation 25 05 28.33 Conduits and Backboxes for Integrated Automation 25 11 13 Integrated Automation Network Servers 25 11 16 Integrated Automation Network Routers and Switches	* $57,890	N/A	$57,890	*Estimated amount Networking for conference rooms.
Building Management System (BMS) Network	25 05 13 Conductors and Cables for Integrated Automation 25 11 13 Integrated Automation Network Servers 25 11 16 Integrated Automation Network Routers and Switches	$30,186	N/A	$30,186	
Daylighting Blind Controls Network	25 05 13 Conductors and Cables for Integrated Automation 25 05 28.29 Hangers and Supports for Integrated Automation 25 11 13 Integrated Automation Network Servers 25 11 16 Integrated Automation Network Routers and Switches	$275,271	N/A	$275,271	
Digital Signage Network	25 05 13 Conductors and Cables for Integrated Automation 25 05 28.33 Conduits and Backboxes for Integrated Automation 25 11 13 Integrated Automation Network Servers 25 11 16 Integrated Automation Network Routers and Switches	* $45,173	N/A	$45,173	*Estimated amount Networking for 1 screen in lobby and 1 screen per floor.
Elevator Network	25 05 13 Conductors and Cables for Integrated Automation 25 11 16 Integrated Automation Network Routers and Switches	$28,963	N/A	$28,963	
Exterior Lighting Controls Network	25 05 13 Conductors and Cables for Integrated Automation 25 05 28.29 Hangers and Supports for Integrated Automation	$16,646	N/A	$16,646	*Estimated amount
Metering Network (electrical, gas, power and electrical submetering)	25 05 13 Conductors and Cables for Integrated Automation 25 05 28.33 Conduits and Backboxes for Integrated Automation 25 11 13 Integrated Automation Network Servers 25 11 16 Integrated Automation Network Routers and Switches	* $40,733	N/A	$40,733	Networking for electrical sub-metering = $15,849. * Networking for electrical, gas and water metering estimated at $24,884
Parking Machines/ Barrier Gates/Intercoms Network	25 05 13 Conductors and Cables for Integrated Automation 25 05 28.29 Hangers and Supports for Integrated Automation 25 05 28.33 Conduits and Backboxes for Integrated Automation 25 11 13 Integrated Automation Network Servers 25 11 16 Integrated Automation Network Routers and Switches 27 05 13.33 DSL Services	* $38,339	N/A	$38,339	Networking for parking machines = $19,715 Networking for parking intercoms = $1,443 * Networking for parking barrier gates estimated at $17,181
Video Surveillance Network	25 05 13 Conductors and Cables for Integrated Automation 27 25 23 Graphics/Multimedia Software 28 23 19 Digital Video Recorders and Analog Recording Devices 28 23 23 Video Surveillance Systems Infrastructure	$857,500	$84,435	$773,065	Eliminate DVRs and cabling by using the network, software and servers to store video.

Soft Costs					
Contingency	01 21 16 Contingency Allowances	$117,192	N/A	$117,192	The converged approach did not have any change orders.
Planning/ Consultants	Division 1 General Conditions	$153,300	144,935	$8,365	Intelligent Buildings consultants and cabling design.
Converged Network					
Data Center Design & Construction		$12,931	$340,898	($327,967)	
Network Equipment	27 11 16 Communications Cabinets, Racks, Frames and Enclosures 27 11 26 Communications Rack Mounted Power Protection and Power Strips 27 21 16 Data Communications Routers 27 21 29 Data Communications Switches and Hubs 27 22 19 Data Communications Servers 27 25 29 Operating System Software	N/A	$496,918	($496,918)	Includes switches, routers, servers, racks, UPS, enclosures and operating systems.
Fiber / Low Voltage Cabling / Conduit	27 05 33 Conduits and Backboxes for Communications Systems 27 13 23 Communications Optical Fiber Backbone Cabling 27 15 13 Communications Copper Horizontal Cabling	N/A	$647,998	($647,998)	Air blown fiber vertical babckbone cabling. Low voltage horizontal cabling for blinds, 774 controllers, 4 daylight sensors, 311 cameras and 255 building network drops
TOTAL		**$2,151,018**	**$1,750,379**	**$400,639**	**18.6% Savings**

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.