

# Cisco's Vision on Convergence in Connected Real Estate

## Introduction

Architecture is a crucial element in the development of real estate solutions, not just during the construction phase of a building but also in the development of the end-to-end information and communications technology (ICT) systems enabling the creation of smart buildings. These systems continue to evolve and to converge and are important to Cisco and its partner ecosystem.

## Architecture

Architecture refers to the design and construction of buildings and other physical structures, primarily to provide socially purposeful shelter. A wider definition often includes the design of the total built environment, from the macro level of how a building integrates with its surrounding manmade landscape to the micro level of architectural or construction details and, sometimes, furniture. In addition, in the IT space, the presence of an enterprise architecture across a company is becoming pervasive. The primary purpose of creating an enterprise architecture is to help ensure that business strategy and IT investment are aligned. Enterprise architecture thus provides a traceable path from the business strategy to the underlying technology.

## Convergence

The Cisco® Connected Real Estate (CRE) vision is the answer to a need for convergence in response to current economic requirements.

- **Why convergence?** Convergence reduces capital expenditures (CapEx) and operating expenses (OpEx) by reducing the duplication of components performing similar functions. This reduction applies to components at every level, from the types of wiring used to the human skills required to install, operate, and maintain the components. Convergence can also increase business value for the real estate promoter and developer.
- **When to converge?** Convergence is a process. Pragmatic considerations will require a trade-off between eliminating and maintaining duplication to isolate domains of responsibility or knowledge. In some cases, local regulations or requirements may indirectly impose this duplication.
- **Converge to what?** Convergence addresses a pervasive need to reduce costs. Convergence can appear autonomously as a consequence of market conditions, practices, etc. as in the establishment of de facto standards. Convergence can also be actively pursued through design and architecture. This active approach requires analysis of the various components and subcomponents and the functions they perform to identify sets of duplicate elements that may be candidates for convergence. In short, convergence is a general principle that takes different forms depending to what it is applied.

## IP Convergence

IP Convergence for information transport covers four standard technologies: fiber and minimum Cat6 for wiring, IEEE 802.x for framing (for instance, Ethernet and Wi-Fi), Power over Ethernet (PoE) for power, and IP for networking.

Such solution, supported by Cisco, has been as a proposal in the industry for some time, with Ethernet and IP already used with protocols such as Modbus/TCP, BACnet/IP, and Object Linking and Embedding (OLE) for Process Control (OPC).

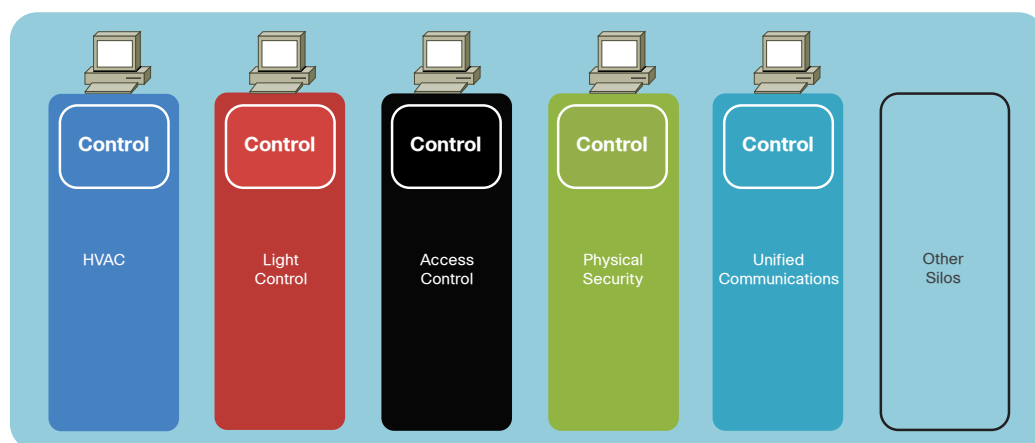
## Convergence in Building Management Systems

A building management system (BMS) is a computer-based system, consisting of both hardware and software, that controls and monitors a building's mechanical, electrical, and electronic equipment such as air conditioning, lighting, power, fire, and security systems.

## Automated Buildings - The Past

Building management subsystems are mainly implemented in silos, with each subsystem provided by a specific vendor as a standalone solution. This silo situation originated from the segmentation present at the academic level and, as a consequence, at the industrial level of the disciplines covering the various aspects of a building. Such silos gave rise to a variety of regulatory and practices frameworks. Today industry products and processes complement each other in maintaining the silo situation. As shown in Figure 1, all subsystem silos are disconnected from each other, and each requires its own specific end-to-end hardware and software components to perform its function.

Figure 1: Silo Automation

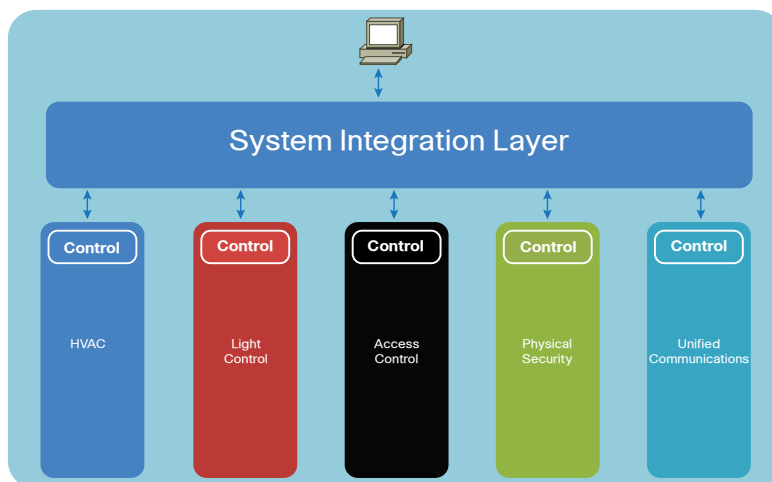


## Automated Buildings - The Present

A classic approach these days is to combine the separate silos and add a system integration component that logically incorporates all the silos in a single platform. Such a platform can directly implement the operations support system (OSS) and business support system (BSS) applications, or it can behave as middleware, offering a unique interface to third-party applications. System integration is not convergence, as it actually introduces an additional component: the integration platform itself. System integration is also expensive and is adopted only where the complexity of the building and the need for operational control justify the investment; otherwise, the silos are kept separated, and the only convergence is realized by the facility management personnel.

Figure 2 depicts the system integration component as an additional layer on top of the separate silos allowing interaction between the integration layer (and the system managers) and the subsystems. True convergence is not achieved as there is no clear reduction in costs or labor; instead, these systems typically are more expensive than the legacy systems.

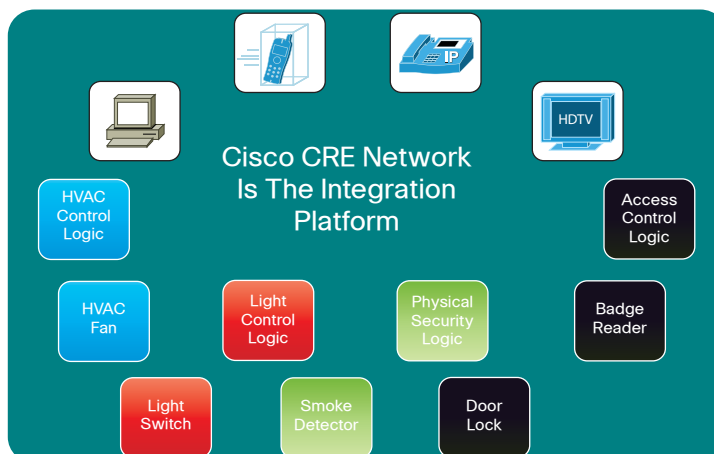
Figure 2: System Integrated Automation



## Converged Buildings

The architectural approach to BMS convergence starts by identifying the functions performed within each silo. If the silo is modular, it can be divided into discrete elements, hardware and software, each performing specific functions. After similar functions are identified in multiple silos, the potential for converging these elements in a single element can be assessed: converging to a single type of wiring, a single communications protocol, a single user interface, etc. Because the silos are not only physical but also cultural, with their roots, as already mentioned, in the academic world, the need to maintain the experience of separated domains remains a goal in the short and middle term. Technology can today provide resource savings through convergence of components, but technology must also complete the job by restoring the experience of separation. To achieve this goal, silos must remain, but only as logical entities, such as views in a relational database management system (RDBMS), realized by orchestrating the functions of the shared elements. In Figure 3, the teal part is the converged IP layer inside the building. As can be seen, the silos have almost disappeared as most components of each silo are now exposed to the rest of the converged BMS solution for use as resources by the other system components, actively reducing CapEx and OpEx. A normalized communication interface (typically using XML) for interaction among the components is a common practice. In some cases, additional middleware is introduced to enable systemwide tasks such as provisioning and support. The interaction with this middleware layer, which should be embedded in the network, is through a normalized programmatic interface.

Figure 3: Convergence – Eliminating Silos



## The Cisco Intelligent Building Network

The Cisco proposal for convergence is founded on an IP network that is secure, reliable, and pervasive by design: the Cisco Connected Real Estate Intelligent Building Network (CRE Network). As a result of such characteristics, the Cisco CRE Network can be the information utility, similar to the utilities for water, gas, and electrical power. In the classic approach, each BMS subsystem implements its own communication network using standard or proprietary solutions. For power, the BMS subsystem typically uses the power grid of the premises, and the BMS subsystem requirements become requirements on the power grid: the need to have a certain amount of power available in specific places in the building. In the same way, with a Cisco CRE Network, the BMS subsystem no longer has to implement its own communication network; its communication requirements become requirements on the Cisco CRE Network: the need to have a certain minimal bandwidth and maximum delay between two or more specific places inside and even outside the premises.

Some BMS subsystem vendors may be skeptical of this solution, because they are asked to give up control of a critical component of their own solutions—communication—while remaining responsible to users for successfully delivering building and control functions. By demonstrating the security, reliability, and flexibility of a Cisco CRE Network, Cisco is rapidly becoming a trusted advisor of these BMS vendors. Some of the principal features that need to be explicitly addressed by a Cisco CRE Network are:

- Real-time communication of both messages and streams
- Enforced security at all access ports, logical or physical
- Context awareness, both spatial and functional, for every node and for every access port, logical or physical
- Entrepreneurial approach in identifying and classifying all attached devices, using multiple authentication schemes
- Dynamic provisioning of any service to any port with adequate capabilities
- Near-real-time granular monitoring and measurement
- Unified and federated management of devices, users, and roles
- Data warehousing of logs
- Resiliency, which is the capability to autonomously respond to changes to help maintain the functions

## Services

A Service is a means of offering a functional or informational resource. For each Service, the function or information offered, the terms and conditions of use, the engagement by the provider and consumer, and so on are specified. As a result of the Web Services standards, the services available in an organization can be offered in a kind of managed IP-based market: the Service Bus. For instance, a surveillance camera could offer its video stream on the Service Bus by registering with a Service broker information such as its field of view—for example, the parking entrance—and the process for requesting its stream. A consumer, whether an operator or an application, needing a view of the parking entrance would then be able (if entitled) to discover the availability of such a view by interrogating the Service Broker, learn the conditions of use, and eventually access the video stream.

An important benefit of such an approach is that consumers do not need to know in advance the resources available, which, in the case of applications, would require hard-coding or configuration. Instead, as soon as a new resource is added to the Service Bus, it becomes available to consumers. Another benefit is that the resources can be described at the functional level; for instance, video cameras can be described by what they look at instead of by their network address or name. This way, consumers can search resources directly based on what they need, such as a view of the parking entrance as in the previous example, without needing to know the technological details of how the function is performed or the information obtained.

Another, and maybe the most important, benefit is that complex, high-level applications and processes can be performed by dynamically orchestrating shared services. Resources offering digital information can easily provide such information to multiple consumers at the same time, and functional resources can be better allocated and scheduled through clear use contracts with consumers. For instance, in a meeting center, a digital display panel used to present the program of activities for a particular room could also allow interruption of that information for a 10-second time slot every minute. An advertising application could discover the availability of such slots and buy them to show commercial video clips. The use contract would enforce the length of the clips and their frequency, and it could also add restrictions to prevent a single advertiser from buying more than 40 percent of the slots, to attract other advertisers.

Ideally, the whole Cisco CRE system should consist of granular resources available as reusable services over an IP-based Service Bus, and applications and services should be nothing more than particular combinations of those resources. However, it is extremely important to realize that, in most cases, the mere possibility of a new technology does not justify its adoption, and the path toward achieving such vision is not an easy one. Even the sharing of only sensor resources is not as simple as it may appear. Today sensors are planned and positioned based on a top-down approach: for example, during the design of the heating, ventilation, and air conditioning (HVAC) subsystem. Designers of another subsystem that needs similar sensors generally cannot be expected to coordinate and compromise with the HVAC designers. As a result, each subsystem commonly deploys its own sensors independently from the others. Each subsystem is today grounded in the deep cultural and technical silo of its own specialty. Convergence requires breaking down such silos and recognizing the existence of common requirements-information and functions—across subsystems.

## New Applications

Developing applications by orchestrating services offered by shared components is not a completely disruptive approach. Software developers already use libraries of reusable functions and objects, which allow designers to focus on the innovative parts of a solution without the need to master the details of the stable components. Use of such libraries is formalized in their APIs. Web Service interfaces adapt the concept of an API to access functions and information objects exposed as services over the Service Bus. This concept is part of an ongoing, steady shift in technology, but it still requires time to mature and become stable, as it asks programmers to rely on resources that, at run time, will be outside their control. It asks programmers to trust the Service Bus as much as they trust the operating system of the computer running the application. It asks the Service-oriented network to be an application platform, just like a computer operating system. A project fostering such an approach to building management is the Simple Access to the Building Lifecycle Exchange (SABLE), which exposes industry foundation classes (IFC) as information objects to the control applications. For more information, visit <http://www.blis-project.org/~sable/>.

The integration proposed by SABLE can be achieved with centralized servers over any IP network, but Cisco has much more to offer, by embedding such servers inside the Cisco CRE Network. Cisco modular routers and switches embedded in the infrastructure of the building and sitting in the path of all communications among sensors, actuators, and controllers become the best devices on which to distribute the functions of those servers. The Cisco CRE Network itself can then become the platform on which to implement not only applications for building automation but also a potentially infinite portfolio of business applications that use building control and communication functions.

## Conclusion

Different vendors will move toward convergence at different speeds; native IP starts being seen on sensors, actuators, and controllers, but Web Service interfaces, with their undeniable complexity, are still isolated instances of convergence for many players. The Cisco CRE Network is becoming the single platform that addresses a big part of that complexity. Another critical role that the Cisco CRE Network will play, as it did at the beginning of the Voice-over-IP (VoIP) telephony paradigm shift, is as the gateway that allows older existing devices to act as providers of Web Services while maintaining their native functions within the subsystems to which they belong. As the Cisco CRE Network can perform those two functions—serving as the system integrator middleware and providing Web Services to access each device independently of the maturity of the device - it is the clear choice as the communication and control infrastructure to embed in new buildings and to which to migrate existing buildings onto.



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