An enterprise architecture for integrating building services

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Outline

- Introduction
- Motivation
- Related work
- Service oriented architectures
- Enterprise-wide networking architecture for building services
- Architecture specification
- Conclusion
Introduction

- Building Services (BS) refer to technical building processes, e.g. HVAC, lighting, security, etc.

- Traditional administration drawbacks
  - BS seen as having confined scope and operating in a standalone fashion or tightly coupled
  - Minimal support for holistic management and overall coordination
  - Complicated, rigid management solutions and increased costs

- Need for broader perspective
  - Open and extensible architecture
  - Dynamic integration of new BS and existing ones
  - Flexibility, scalability, interoperability support
Integration is the key and the driving force to the effective operation of intelligent buildings

Service oriented architecture to enable dynamic, coordinated, integrated and distributed BS management
  - Interoperability through open standards
  - Support for wide spectrum of BS
  - Assembles underlying functionality and hides complexity

Reference model for an overall, integrated enterprise-wide SOA to address building management issues in a holistic manner
The main benefits behind the convergence of BS, IT and building management systems include:

- Reducing operation cost
- Reducing complexity of system, hence staff training
- Reducing capital cost (wiring, equipment etc.)
- Providing value-added services, such as access to additional information

The rationale for pursuing BS integration is 3-fold:

- Optimize the information flow and accessibility
- Increase the coverage, resolution and accuracy of the information awareness
- Enable high-level facilities management applications design, allowing seamless inter-working
Building management systems & IT integration

Common Networking Platform (IP)

- Administration Systems
- Building Management Systems
- IT Systems
- Building services systems
- Power Management Systems
- Fire & Life safety Systems
- Other Facility Management Systems
- Security Systems
Related work

- Providing intelligence in buildings and enabling automatic control and management of BS has attracted significant research interest [Snoonian, 2005], yet reality has fallen short of this vision [Braun, 2007]

- Different, proprietary communication protocols are traditionally employed for every BS, hindering therefore interaction amongst these services
  - Employing a hardware gateway to translate between the non-cooperating protocols [Wang et al, 2004]
  - Adoption of open, standard protocols to uniform the communication process, e.g., BACNet (Building Automation and Control Network), LonWorks, KNX, etc.
The most recent development in building automation systems communication protocols is the introduction of Web Services for the integration with other higher-level enterprise systems, i.e. BACNet/WS.

New approaches to achieve integration of building automation systems and building services at a higher layer, using middleware technologies:

- Do not affect or substitute proprietary, low-level building automation systems.
- Provide smooth integration of diverse systems and services by using the notion of middleware, e.g. OPC [Ming et al, 2006], [Wang et al, 2007], CORBA [Wang et al, 2001] and JAVA/RMI [Davidsson et al, 2005].
Service oriented architectures

- A means of developing distributed systems, where the participating components of those systems are exposed as services.
- A service can be defined as “a loosely coupled, reusable software component that encapsulates discrete functionality, which may be distributed and programmatically accessed” [Sommerville, 2007]
- The provision of a service is independent of the application using the service.
BS architecture reference model

- Enterprise middleware services
  - Service registry/discovery
  - Service access control
  - Information exchange

- Application services
  - Enterprise level services
  - Building application services
  - Legacy systems services

- Service/communication bus
BS architecture reference model (cont’d)

Service registry

Service access control

Enterprise level services

Legacy systems services

Building application services

Building assessment tools

WSN

IT systems

Ambient UI

Service bus

Legacy system wrapper

existing conventional BMS

BMS
Various service models that support SOA
- CORBA, Jini, WS, etc.

We opt in favour of Web Services (WS)
- Interoperability, integration of legacy systems, wide acceptance, straightforward deployment over enterprise networks
- SOAP-based and REST-based

Enterprise Service Bus as the unifying communication platform
Conclusions

- Developed an open, dynamic, flexible and standard way of connecting traditionally independent systems
- Proposed and specified a SOA as a new approach towards an enterprise networking environment to integrate facilities management, building services and BMSs for the purpose of monitoring, controlling and managing the enterprise environment
- Implementation efforts of the proposed architecture employing identified technologies have commenced; initial proof-of-concept exists
- Use case scenario considers the integration of WSNs with the enterprise architecture