

Building Management System Using Windows Communication Foundation And XAML

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Abstract—Building Automation System (BAS) will be extended for including different kinds of information, working towards to goal of Intelligent Building Management System. The next generation of Internet technology uses Windows Communication Foundation as middleware technology for integration of different building automation systems (BAS) since Web Services will support only http protocol which is stateless. The applications used for controlling building management system (BMS) components like sensors, actuators, and controllers. In this paper we propose a Service Oriented Architecture(SOA) for building Management system based upon Windows Communication Foundation and XAML used for integrating different BAS.A BAS which consists of BACnet network their BMS is applied. Their exist some publically exposed Windows Communication Foundation contracts, which write and read BACnet data points from the backnet work. These contracts will be called by other enterprise applications for realize BAS integration and get real-time data on BACnet network as a facilities Management. XAML will be provided at client side GUIs for the BMS which can be reused for different kinds of applications. Finally we discuss challenges in providing security to Building Automation Systems using proposed system

Keyword-Building management system, Building automation system, Windows Communication Foundation, XAML, Service Oriented Architecture

I. INTRODUCTION

A Building Automation Sytem (BAS) is an example of a distributed control system. Modern Building Automation System do not only provide improved comfort but offer significant energy cost savings, especially in office buildings and production halls, because of intelligent control systems such as lighting and sunblind functions. BAS explains functionalities provided by building control system, which is a computerized, intelligent network of electronic devices, designed to monitor and control the mechanical and lighting systems in building. The main application of Building Automation System is to increasing user comfort at minimum operational cost and get optimized control schemes for Heating, Ventilation and Control Systems (HVAC), shading and lighting. The BAS must be loosely coupled so that the controllers can communicated with any other application. It is difficult to for integration across BASs which may adopt different commincation protocols e.g.,lon protocol,bacnet protocol and integrating BAS with existing enterprise applications.Emerging Windows Communication Foundation based on Service Oriented Architecture will solve the problems.

American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) and Organization for the Advancement of Structured Information Standards (OSAIS) are international organizations to promote the development of service oriented architecture in BAS domain. The building management systems used to monitor and control building facilities in BASs. Desktop and Web based BAS have been developed .How ever using traditional Web, Desktop applications same code has to rewritten for each application. Here single XAML is reused between desktop, mobile, browsers and based upon the type of device the application will run. In simple XAML used for seamless user experience of mobile, web and desktop applications.

In this paper, Windows Communication Foundation and XAML used for developing next generation of BMS.Windows Communication Foundation allow to build distributed and loosely coupled systems E.g. BASs. It will support different types of protocols like tcp, udp. It is stateful protocol. The proposed BMS will applied to an intelligent building whose BAS is within a BACnet network. A set of Windows Communication Foundation endpoints which can read write BACnet data points from the BACnet network based on the BACnet

protocol stack. The Windows Communication Foundation service which is installed in the controller can be invoked XAML easily

The rest of the paper is organized as follows: Section II describes the related work and Section III presents the description of architecture of BAS integration based on Windows Communication Foundation. Section IV describes the proposed development of BAS using Windows Communication Foundation. Section V describes challenges in providing security in Building Automation System. Finally, conclusions are presented in section VI.

II. RELATED WORK

The approaches that have been profoundly established they are standard communication protocol and cross-protocol gateways not met the desired expectations. There is a need for building systems and services integration [9]. There exists individual automated building systems for Heating Ventilation and Air condition system and current solutions are not satisfactory level for integrating Building Management Systems [10]. The task of building automation and communication Infrastructure that is necessary to required to address integration problems[11].

sensors will get the HVAC details those details can be accessed by integrated building systems or enterprise applications using service oriented architectures web service[1]. Web services can be installed on controllers for providing communication across different protocols[2]. Using AJAX and web services installed on controller can provide asynchronously retrieve data from controller using web services[4]. Enterprise-wide architecture, for facilities management automation provides BMSs and building automation and control systems will access to additional information that will enable building to be used more effectively [12] .

Service oriented architecture and their applicability is building management system and building automation system [6]. controlling and managing building automation system through Windows phone mobile [14]. Security threats that may arise for building automation system [13].

III. WCF FOR BAS INTEGRATION

A. Principle Of Windows Communication Foundation

For integrating different Building Management Systems CORBA (Common Object Request Broker) RMI (Remote Method Invocation), COM (Component Object Model), DCOM (Distributed Component Object Model) is used. They are specific to platform. Although Web Services is platform independent it is stateless and supports only http protocol for communication.

As Building Automation System is example of distributed control system it is based on distributed application's "Service-oriented" architecture. The Windows Communication Foundation is a unified programming model for building service oriented applications. Mainly WCF is used for their purposes- unifications, service orientation, rich integration. Unifications means unifies today's all distributed technologies and used for on-machine, cross machine, and cross internet. Service Orientation means codifies best practices for building distributed applications. Rich integration means integrates with our own distributed stacks and interoperates applications running on other platforms.

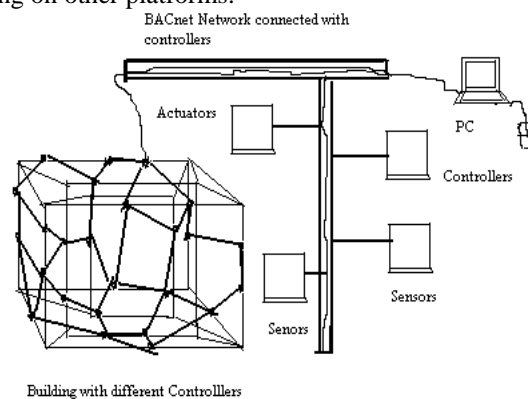


Figure 1: Sketch map of General BAS with different controllers, sensors, actuators

Compared to Web Services, WCF allows to send messages not only using http, but also using TCP and MSMQ and supports formats other than SOAP, which includes Representational State Transfer Protocol and Plain old XML (POX). It acts as an abstract layer, separating platform and programming language specific details from how application is invoked.

WCF is based on Service Oriented Architecture in which Service Provider who provides service. The Service provider will publish service in Service Broker from which a Service Requester can request a service. After finding the service, Service Requester bind to Service Provider using policy.

B. Windows Communication Foundation –based architecture for BAS Integration

It includes mainly three different types of integration problems that can be solved. Figure 1 gives a sketch map of BAS integration based on Windows Communication Foundation .The integration of different functional BAS subsystems(security, lighting and so on),integration among different protocols(BACnet,Lontalk) and integration between building automation system and existing enterprise applications.Windows Communication Foundation can be installed in controllers which have strong control functions.Windows Communication Foundation service is not to replace field bus standard communication protocols like bacnet but it adopts existing communication protocols and field bus network.

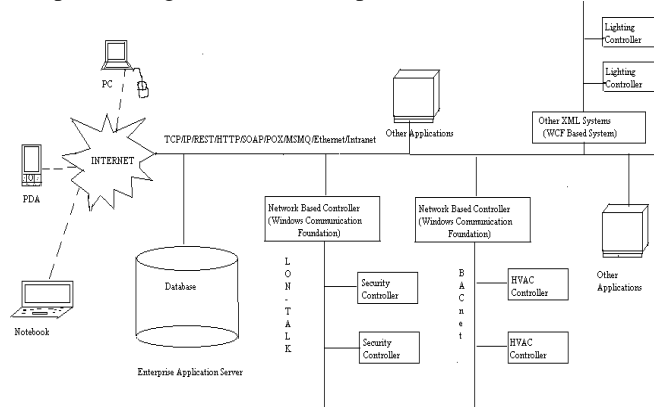


Figure 2: Sketch map of BAS Integration based on Windows Communication Foundation

Functional components resort to protocol drivers to communicate with field equipments in the field networks Lontalk and BACnet networks. Figure 2 illustrates the software architecture of the BAS integration. These functions are wrapped with public operational contract methods. Here the web server is used for only for browser based applications for storing silver light web pages and will parse specific protocol request (SOAP, REST,HTTP) and forward request to Windows Communication Foundation Service. For PDA and Multi touch screen will directly access installed Windows Communication Foundation service on BACnet controller.

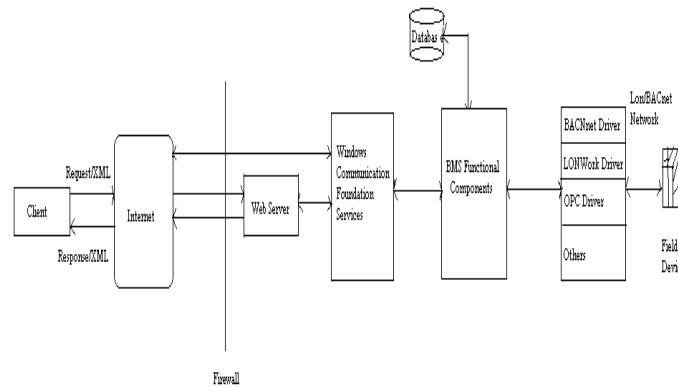


Figure 3: Windows Communication Foundation based software architecture for software Integration

The publicly available operational contracts can be invoked by other applications for accessing data on BASs on Internet. These contracts can read and write data to Field Devices.

IV. DESIGN OF PROPOSED BAS USING WINDOWS COMMUNICATION FOUNDATION AND XAML

A. Brief Description Of XAML

XAML is a declarative markup language. It is used for creating rich interactive user interfaces at client side.XAML language is used by Windows Presentation Framework(WPF) and Silverlight.Advantages of XAML are design/code(behaviour) seperation.At a time both designers and developers can share work and it will take hardware acceleration support to create new levels of visual complexity. For developing desktop

applications Windows Presentation Framework used, for browser and pda applications silver light used. XAML language applications will run resolution independently and uses vector based rendering.

B. Invoking Windows Communication Foundation Services With XAML

Figure 4 shows architecture of invoking BAS Windows Communication Foundation Service with XAML application.

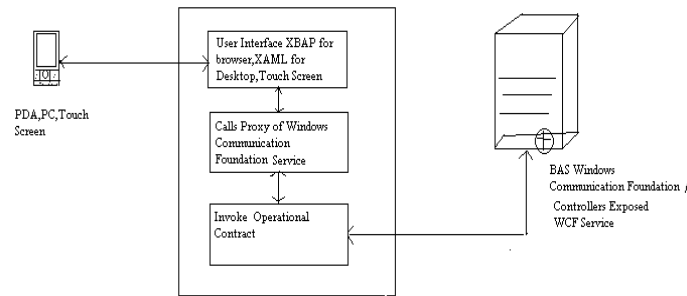


Figure 4: Architecture for Invoking BAS Windows Communication Foundation with XAML Application

Based on type of device the application will run. If it is browser based application xwap is returned by the server and user modifications will invoke WCF operation contract. Mobile or Touch Screen will invoke proxy of WCF Service from mobile, which will call BACnet device's publically exposed contracts.

The BMS will be applied to a BAS which has BACnet network. The public Windows Communication Framework contracts, which can read and write BACnet data points from the BACnet which can be developed by BACnet protocol stack.

The XAML is reused among Windows Presentation Framework and Silver light applications. So that single application can be used to control pda, touch screen and browser based applications. Here using XAML in phone can access WCF services [6].XAML uses vector based rendering and resolution independent. So XAML will provide rich internet client applications.

V. SECURITY ISSUES IN PROPOSED SYSTEM

The functions that will control building management system i.e., control functions has provided with unauthorized access. The Windows communication Foundation controller can access only after service provider agreement. It prevents malicious access to building management system.

VI.CONCLUSION

From the past two decades new protocols are coming in Building Automation System. Integration among these protocols, and integrate existing applications supported by these protocols and supporting new applications always challenge.

Technology is making so many things easier to us. Up to now Web services methods which can read and write BACnet data points from the BACnet network, are developed based on BACnetwork provided, web services are based upon single http protocol and these are stateless. As Windows Communication Foundation which is supporting TCP, REST and so on can be used. In future Windows Communication Foundation which can read and write BACnet datapoints from the BACnet network which are developed on BACnet network are provided.XAML is next generation client side application which can be used by PDA, Multitouch screen Browser and desktop applications. So reusing XAML code among applications will save amount of time and will give high performance as it is Vector based and resolution independent.

Here we propose next generation Building Management System which can real control and monitor Building Automation System using PDA, Touch Screen, Browser and desktop Applications. The BMS can be applied to a typical BAS within a Bacnet.

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