Web to Edge: Enterprise Integration with Wireless Sensor and Control Networks

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Agenda

- Overview WSCN
- Enterprise Integration
- Building Automation Control Systems
- Building Automation Demonstration
Introduction

Tom Bender
Introduction

Systems Architect
Product Manager
Introduction

Industrial Machine Vision

Ann Arbor, Michigan
Introduction

Quantitative Expert Trading Systems

Los Angeles, California
Introduction

Constraint-based Expert Systems & Sales Force Automation
Golden, Colorado
Introduction

Consultant
Boulder, CO
Introduction

Local Commerce
Jabber IM
Denver, CO
Introduction

Satellite Scheduling & Geospatial Information Systems

Longmont, CO
Introduction

Wireless Sensor Networks

802.15.4

Boulder, CO
Overview

WEST COAST

- David Culler & Friends
  - University of California Berkeley
  - Tiny OS
  - Co-Founder, Arch Rock
- Kris Prister
  - University of California Berkeley
  - Tiny OS
  - Co-Founder, Dust Networks

EAST COAST

- Robert Poor & Friends
  - Massachusetts Institute of Technology
  - Co-Founder of Ember with Bob Metcalfe
  - Board of Directors, Tendril Networks
- Adrian Tuck
  - Royal Military Academy Sandhurst
  - Interim CEO, Ember
  - CEO, Tendril Networks
Overview

- Wireless Sensor/Actuator
Overview

- Sensor

- Most data flows in to central “gateway” device
- Occasional data flows from gateway device to outlying devices
- Data almost never flows between adjacent devices
Overview

- **Control**

  - May be no central "gateway" node
  - Data often flows from a local control node to a nearby actuator node
  - Data almost never flows long distances across the network
Overview

- OSI (7 Layer Protocol)
Overview

- Network Layers

- PHY (Physical Layer)
  - ZigBee
  - TinyOS
  - 6LowPan
  - ZWave

- MAC (Media Access Control)

- 3rd Party / OEM
Overview

- IEEE 802 Wireless Technologies

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<th>COMPRESSED VIDEO</th>
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<td>802.15.3/Wimedia</td>
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Agenda

- Overview
- **Enterprise Integration**
  - Application Server
  - Enterprise Service Bus
  - Custom / Distributed
- Building Automation Control Systems
- Building Automation Demonstration
Enterprise Integration

Wireless Devices

Gateway/Access Points

Networked Computing Environment

PC / Server

WAN/LAN

Access Point

Access Point

Access Point

Apps

Apps

Apps

Apps

Apps
Enterprise Integration

➢ Access Point/Gateway

802.15.4

Web Services

REST/XML

C/S Custom

Ethernet

CDMA

802.11/WAP
Enterprise Integration

➢ Beyond the Gateway

- Web Services
- REST/XML
- C/S Custom
- Ethernet
- CDMA
- 802.11/WAP

Internet

Wireless
Telecom
Enterprise Integration

- Application Server
  - Java API
  - Messaging API
- Enterprise Service Bus
  - Service Mix
  - Mule
  - Synapse
  - Tuscany
  - Other
- Windows
  - .NET
  - Message Bridge
Enterprise Integration

➢ Beyond the Gateway

- Web Services
- REST/XML
- C/S Custom
- Ethernet
- CDMA
- 802.11
Enterprise Integration

➢ Beyond the Gateway

- Web Services
- REST/XML
- C/S Custom
- Ethernet
- CDMA
- 802.11
Enterprise Integration

Java Business Integration: JSR 208
- Container of containers
- Facilitates the interoperation of containers
- WSDL-based messaging model
- Normalized Messages
- Normalized Message Router
- Binding Components
Enterprise Integration

- Java Business Integration

![Diagram of JBI Environment]

- BPEL SE
- Other SEs...
- Normalized Message Router
- WS-I BC
- Other BCs...
- Installation
- Deployment
- Control
- Monitoring
- External Service Provider
- External Service Consumer

JSR 208 Specification
Enterprise Integration

- Beyond the Gateway

- Web Services
- REST/XML
- C/S Custom
- Ethernet
- CDMA
- 802.11
Agenda

- Overview
- Enterprise Integration
- Building Automation Control Systems
  - Standards
  - System Architecture
- Building Automation Demonstration
Building Automation Control Systems

- Standards
  - Wireless
    - ZigBee
    - IEEE 802.15.4
  - Wired Building Automation
    - BACnet
    - LONworks
    - MODBus
    - DALI
Building Automation Control Systems

- Standards

- Building Automation Software
  - JSR 60/BAJA - Building Automation Java API
    - http://java.sun.com/jcp
  - OBIX - Open Building Information eXchange
    - http://obix.org
Building Automation Control Systems

- Programming Language/Environment
  - Niagara Platform

Tridium - [http://www.tridium.com](http://www.tridium.com)
Building Automation Control Systems

- Honeywell/Tridium - Niagara Conference
  - Niagara Summit
    - http://www.niagarasummit.com/
  - Niagara Summit Introduction Movie

Tridium - http://www.tridium.com
Building Automation Control Systems

- System Architecture
  - Hardware
    - JACE-2
      - 250 MHz PowerPC
  - Operating System
    - QNX RTOS
  - JVM
    - IBM J9
  - Programming Language/Environment
    - Java ME
    - Niagara Platform
Building Automation Control Systems

Hardware

Vykon JACE-2 Device

• Platform
  ✓ IBM PowerPC 405EP 250 MHz processor
  ✓ 64MB SDRAM & 64 MB Serial Flash
  ✓ Battery Backup - 5 minutes typical
  ✓ Real-time clock - 3 month backup max via battery

• Communications
  ✓ 2 Ethernet Ports 10/100 Mbps (RJ-45 Connectors)
  ✓ 1 RS 232 Port (9 pin D-shell connector)
  ✓ 1 RS 485 non isolated port (3 Screw Connector on base board)
Building Automation Control Systems

- Operating System
  - QNX “Neutrino” RTOS
    - Micro-kernel architecture
  - Benefits
    - Reliable
    - Fault Tolerant
    - Scalable
Building Automation Control Systems

- Operating System
  - QNX “Neutrino” RTOS
Building Automation Control Systems

- Operating System
  - QNX “Neutrino” RTOS
  - Date: Tuesday, October 24, 2006 Time: 13:00 EDT
  - Duration: 1 hour
  - Registration: http://seminar2.techonline.com/s/qnx_oct2406
IBM J9 JVM

- Configurable, compact, fast and predictable architectural layer provides common interface for application programs to manage the specific interfaces with the OS and device hardware
- Ideal for resource-constrained environments with configuration flexibility
- Supports functions (such as dynamic class loading), memory usage and stack size, incremental allocation sizes of memory, ROM and RAM sizes for class loading
- Consistent virtual machine implementation for ease of application portability between configurations and devices
- Java ME CLDC and CDC Support
Building Automation Control Systems

- Programming Language/Environment
  - Java ME
    - Configurations
      - Connected Limited Device Configuration (CLDC)
      - Connected Device Configuration (CDC).
    - Profiles
      - CLDC with MIDP Extensions for Cellular Industry
    - Optional Packages
      - Emerging Technologies
Building Automation Control Systems

- Programming Language/Environment
  - Java ME
    - http://java.sun.com/javame/technologies/index.jsp#3
Building Automation Demonstration

- Overview
- Enterprise Integration
- Building Automation Control Systems
- **Building Automation Demonstration**
  - **Jace-2**
    - Tendril ZigBee Driver
    - LonWorks Driver
  - VAV Controller w/ LonWorks
  - Tendril-Enabled (EmberZNet) Thermostat
  - Tendril-Enabled (EmberZNet) Motion Sensor
Building Automation Demonstration

Tendril / Tridium Integration

Java Application

Desktop or Server Side Application
OBIX Java Library
JVM 1.4.x

Niagara Application

Tridium Niagara Application
JVM 1.4.x

OBIX Protocol
Niagara Fox Protocol

JACE

BACnet Driver
LON Driver
OBIX Driver
OPC Driver
TSB Driver

JVM 1.3 QNX RTOS

BACnet Devices
LON Devices
Tendril Devices
OBIX Devices
OPC Devices
Resources

- B & B Electronics - [http://bb-elec.com](http://bb-elec.com)
  - Great online electronics store. Sensicast devices are currently available.

- WiSuite - [http://www.wisuite.com](http://www.wisuite.com)
  - Wireless Control Company
  - 30 Kern Road, Suite 202 Toronto, Ontario Canada M3B 1T1
  - Contact Information: 866-862-2240

- Rabbit Semiconductor - [http://www.rabbitsemiconductor.com](http://www.rabbitsemiconductor.com)
  - ZigBee/802.15.4 Application Kit
  - Inexpensive $299.00

- Ember Jump Start for EM 250 - [http://www.digikey.com](http://www.digikey.com)
  - Search for Ember
    - RF Evaluation & Development Kits Boards
    - RF Transmitter, Transceiver & Receiver ICs & Modules
      - EM 2420 and EM 250 Parts
  - Expensive $2500.00 Development Kit

  - ZigBee/802.15.4 Devices; Mote Kites
Low Rate Wireless Personal Area Networks

*Enabling Wireless Sensors with IEEE 802.15.4*

- Jose A. Gutierrez
- Edgar H. Callaway, Jr.
- Raymond L. Barrett, Jr.
Web to Edge: Enterprise Integration with Wireless Sensor and Control Networks

Please complete the questionnaires in the back of your CSS notebook.

Thank you

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