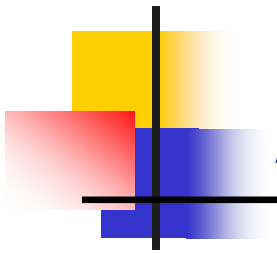
Web to Edge: Enterprise Integration with Wireless Sensor and Control Networks

Tom Bender

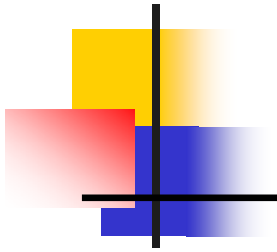
Tendril Networks, Inc.

tbender@tendrilinc.com



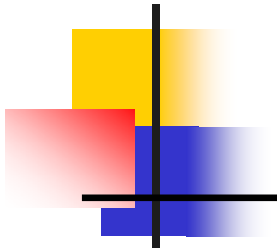
Agenda

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



Introduction

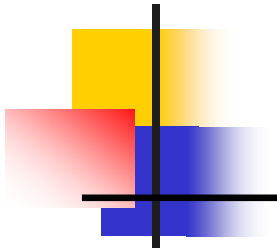
Tom Bender



Introduction

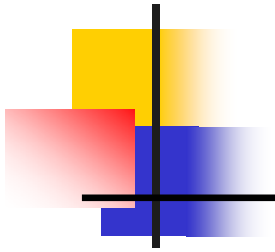
Systems Architect

Product Manager



Introduction

Industrial Machine Vision
Ann Arbor, Michigan

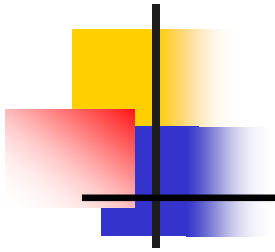


Introduction

Quantitative Expert

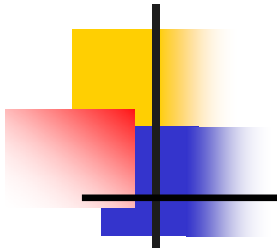
Trading Systems

Los Angeles, California



Introduction

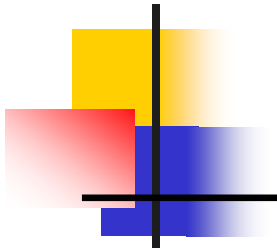
Constraint-based
Expert Systems &
Sales Force Automation
Golden, Colorado



Introduction

Consultant

Boulder, CO

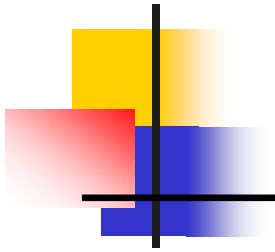


Introduction

Local Commerce

Jabber IM

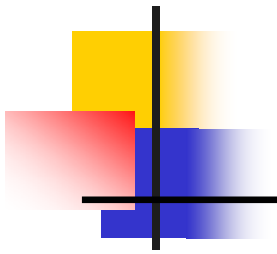
Denver, CO



Introduction

Satellite Scheduling & Geospatial Information Systems

Longmont, CO

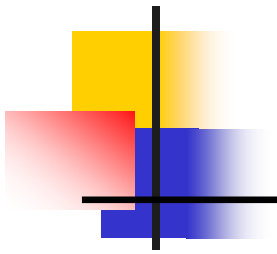


Introduction

Wireless Sensor Networks

802.15.4

Boulder, CO



Overview

WEST COAST

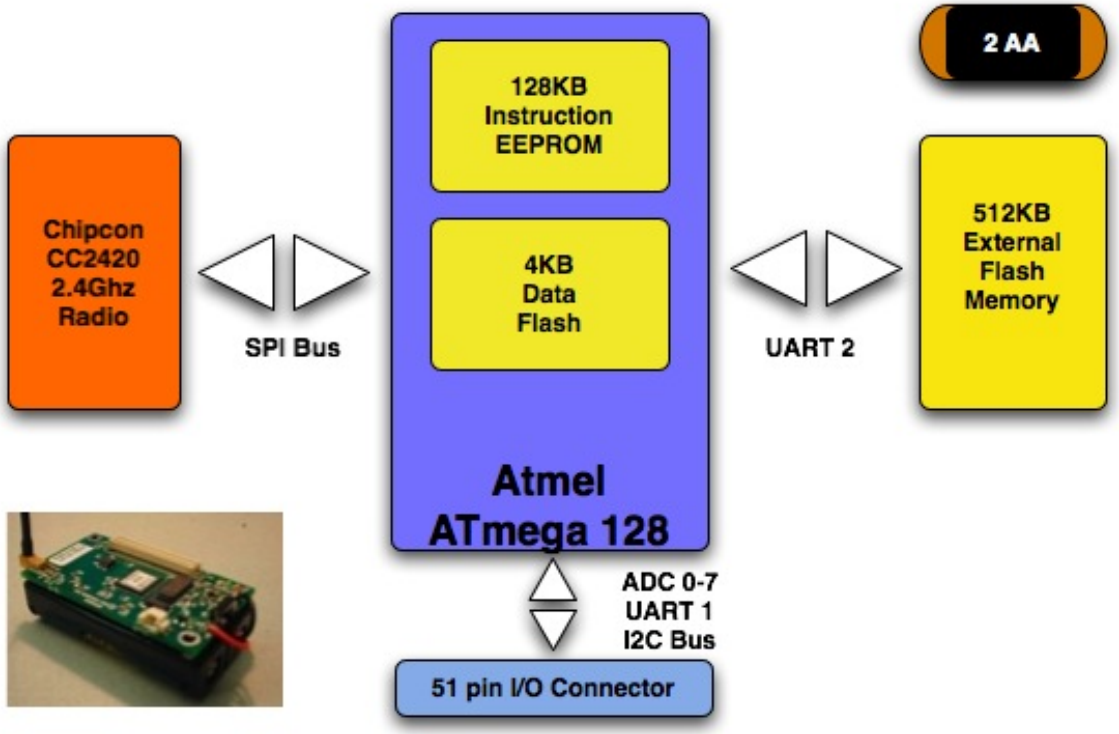
- David Culler & Friends
  - University of California Berkeley
  - Tiny OS
  - Co-Founder, Arch Rock
- Kris Prister
  - University of California Berkeley
  - Tiny OS
  - Co-Founder, Dust Networks

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

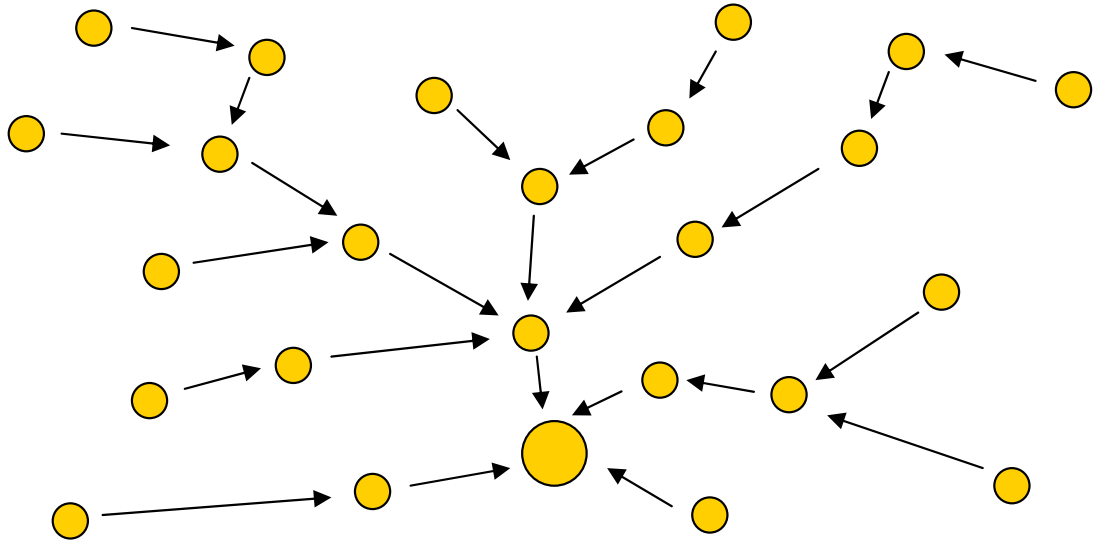
Overview

- Wireless Sensor/Actuator



Overview

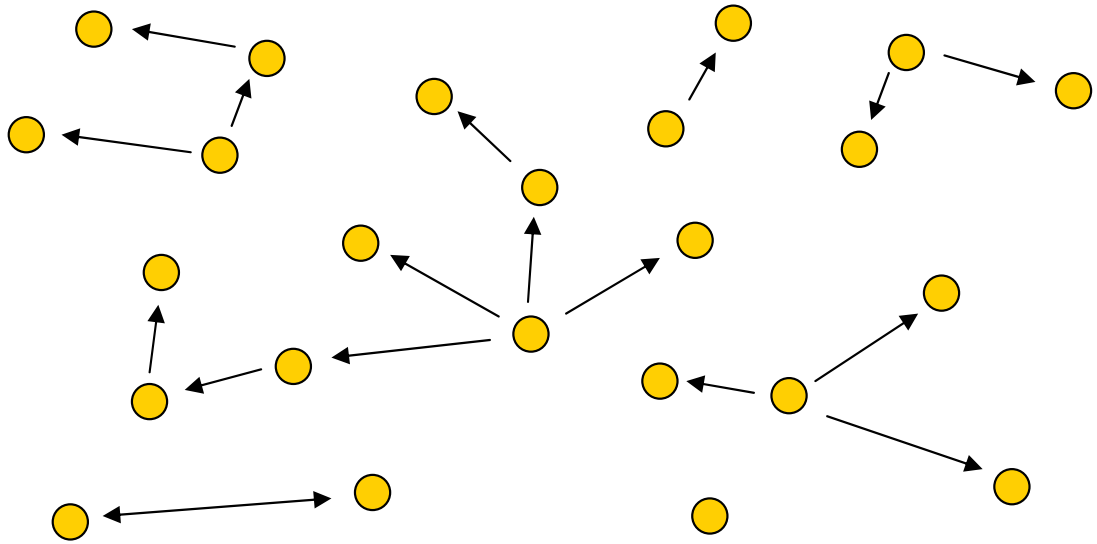
- Sensor



- 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

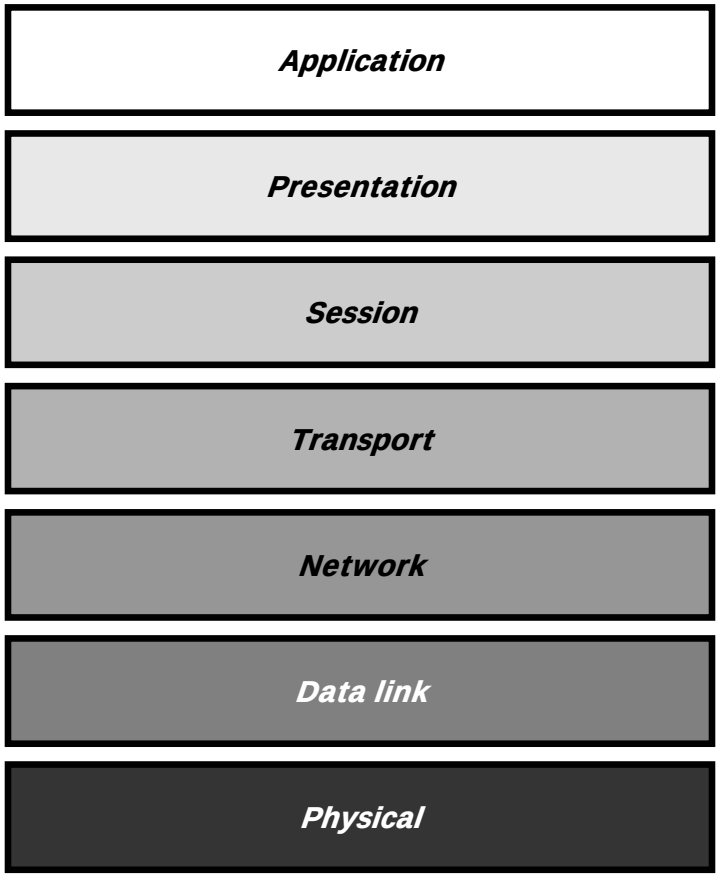
- Control



  - 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

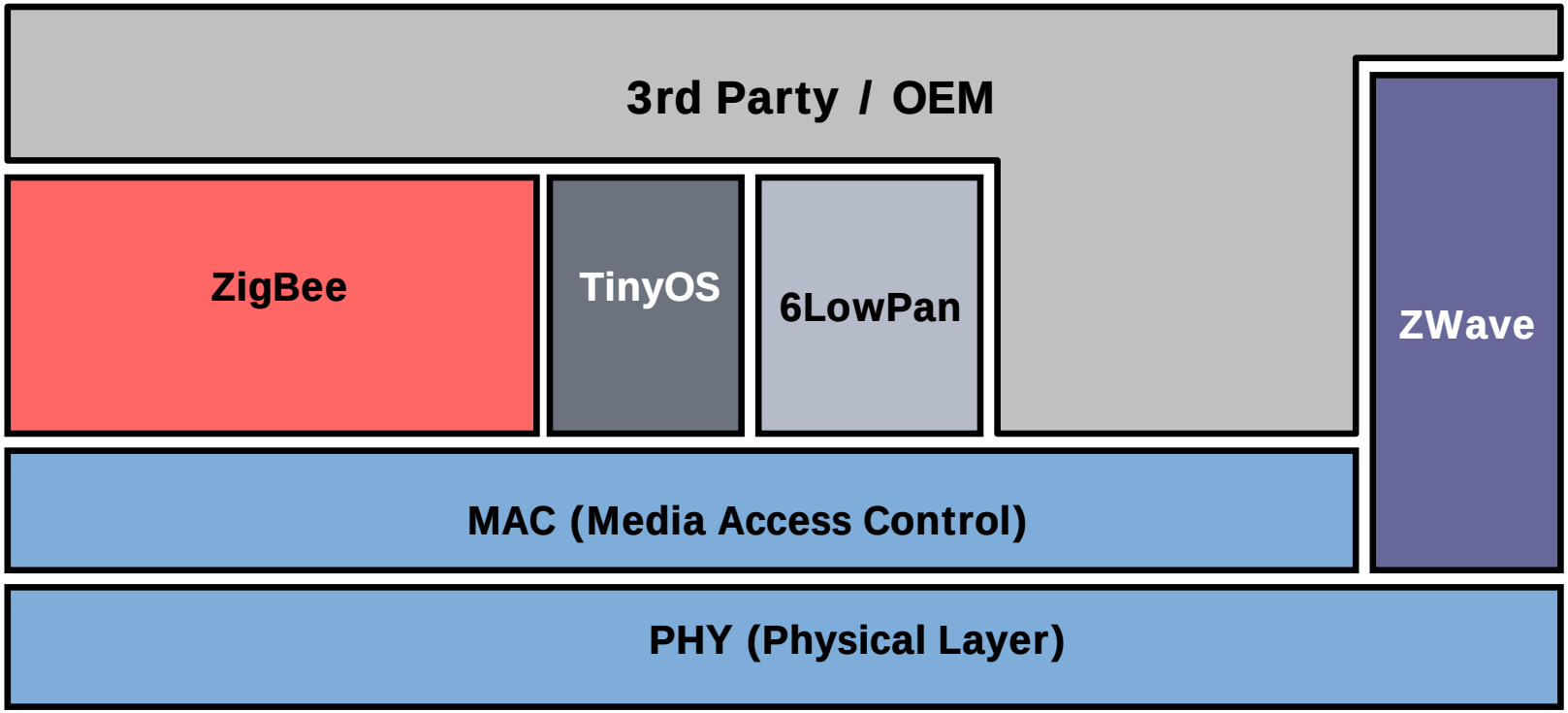
Overview

- OSI (7 Layer Protocol)



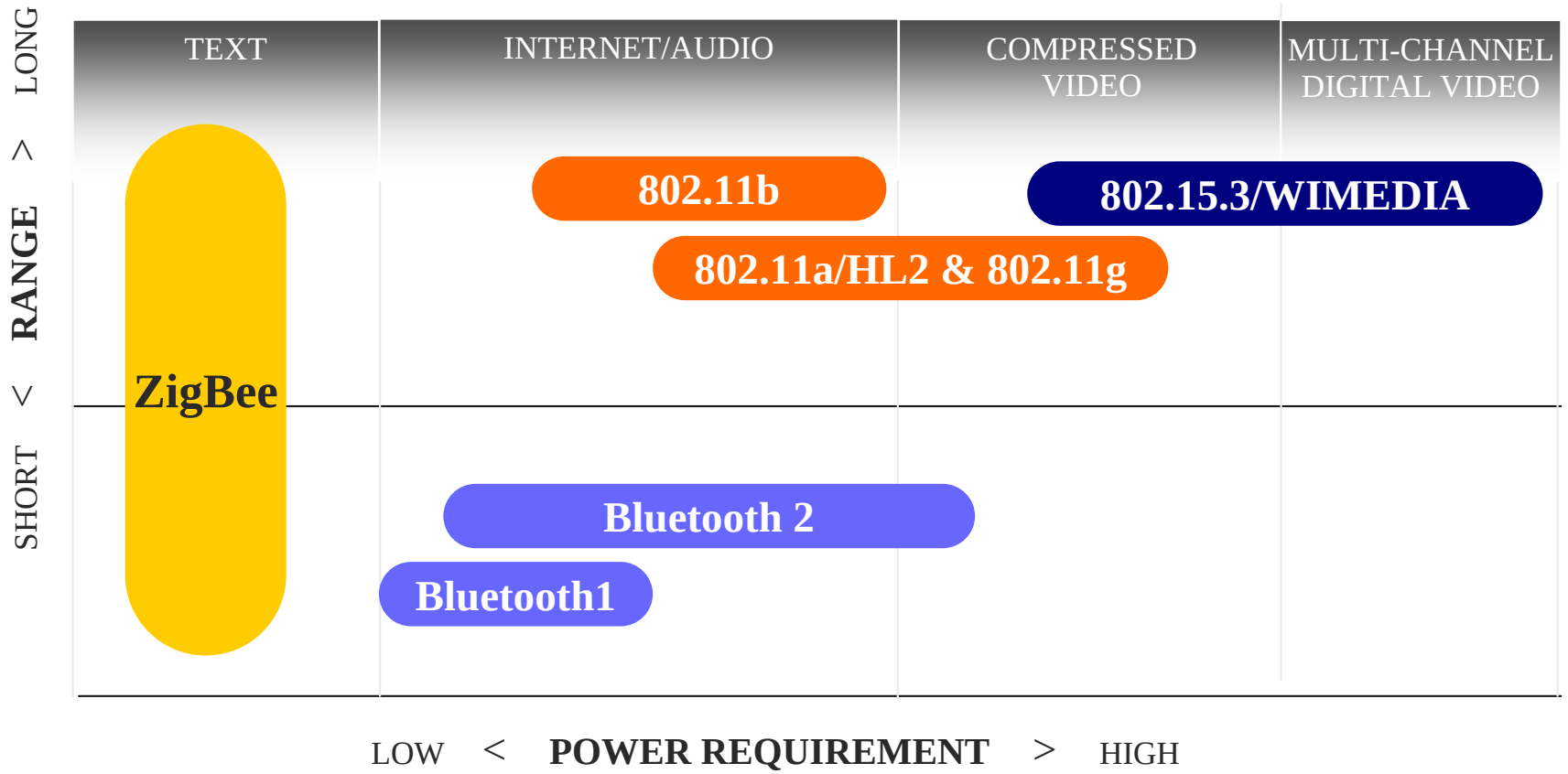
Overview

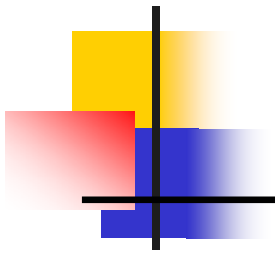
- Network Layers



Overview

- IEEE 802 Wireless Technologies

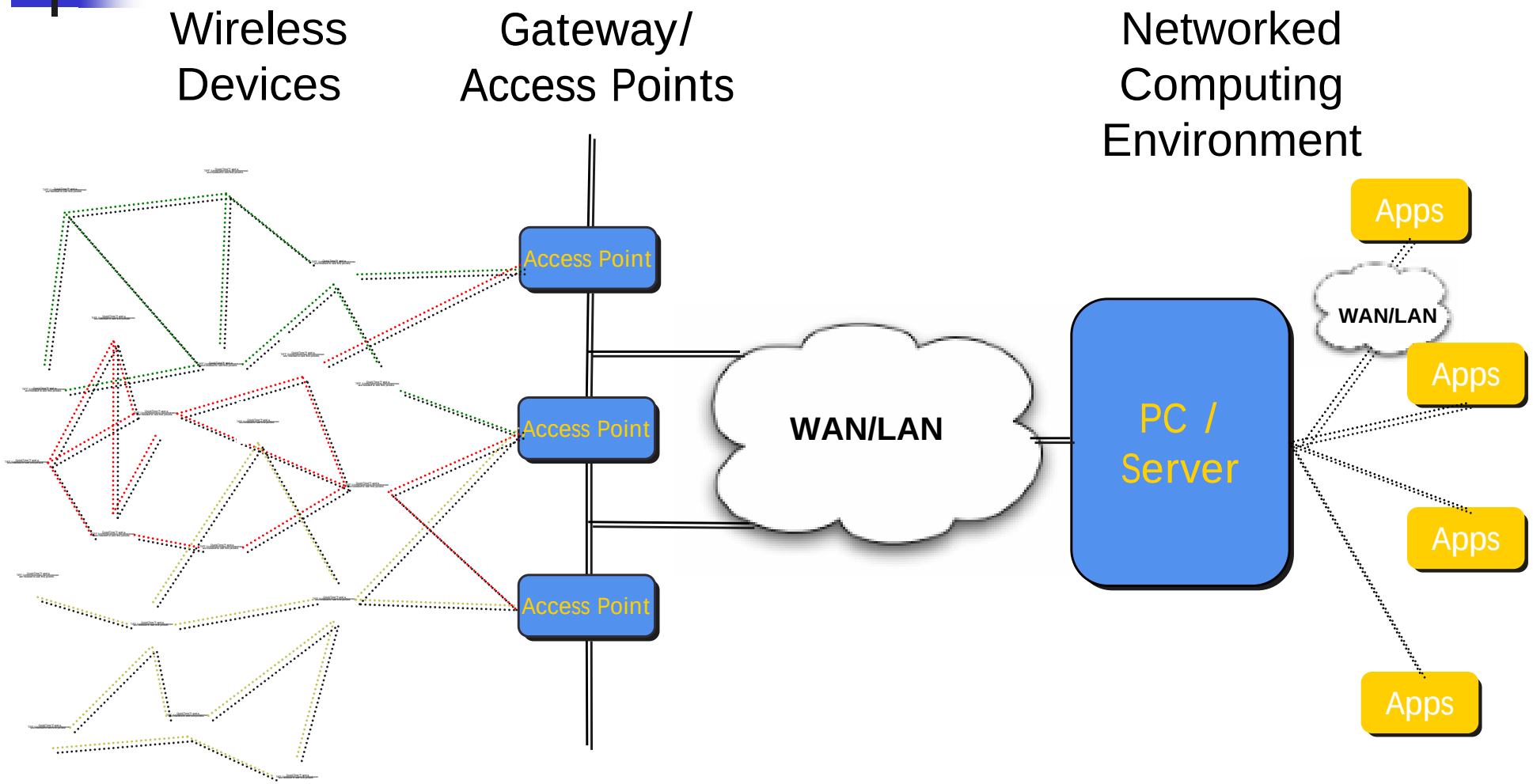




Agenda

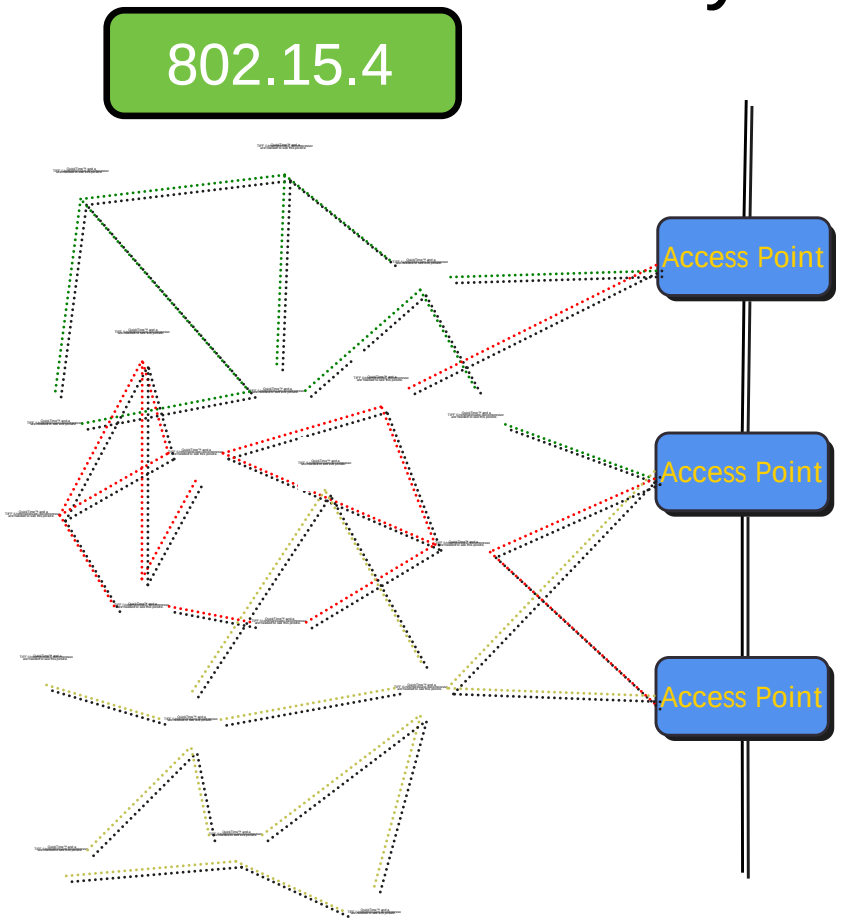
- Overview
- ***Enterprise Integration***
  - ***Application Server***
  - ***Enterprise Service Bus***
  - ***Custom / Distributed***
- Building Automation Control Systems
- Building Automation Demonstration

Enterprise Integration



Enterprise Integration

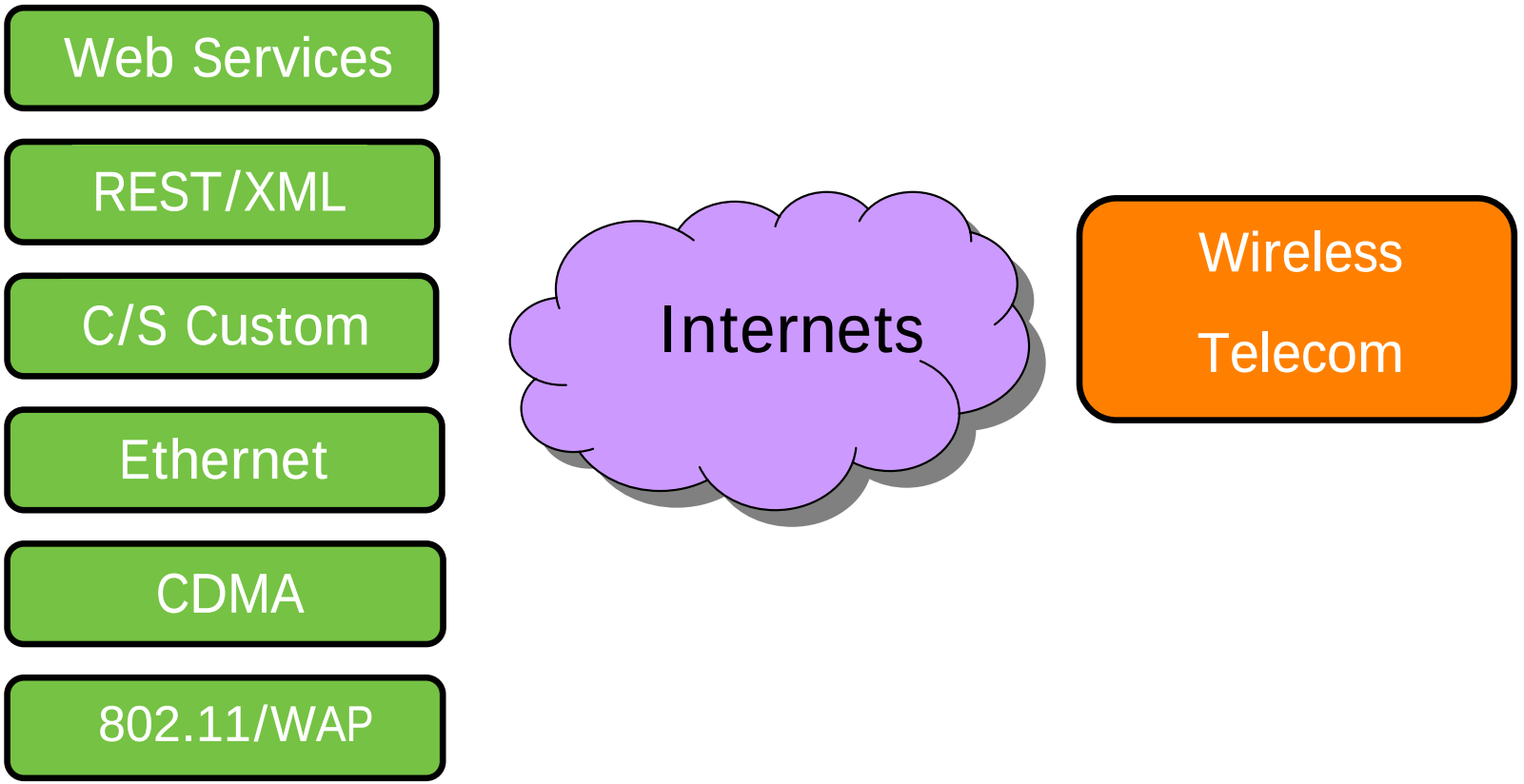
- Access Point/Gateway

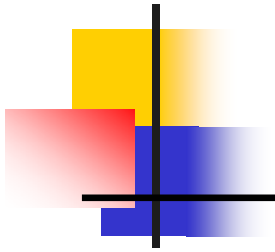


- Web Services
- REST/XML
- C/S Custom
- Ethernet
- CDMA
- 802.11/WAP

Enterprise Integration

- Beyond the Gateway



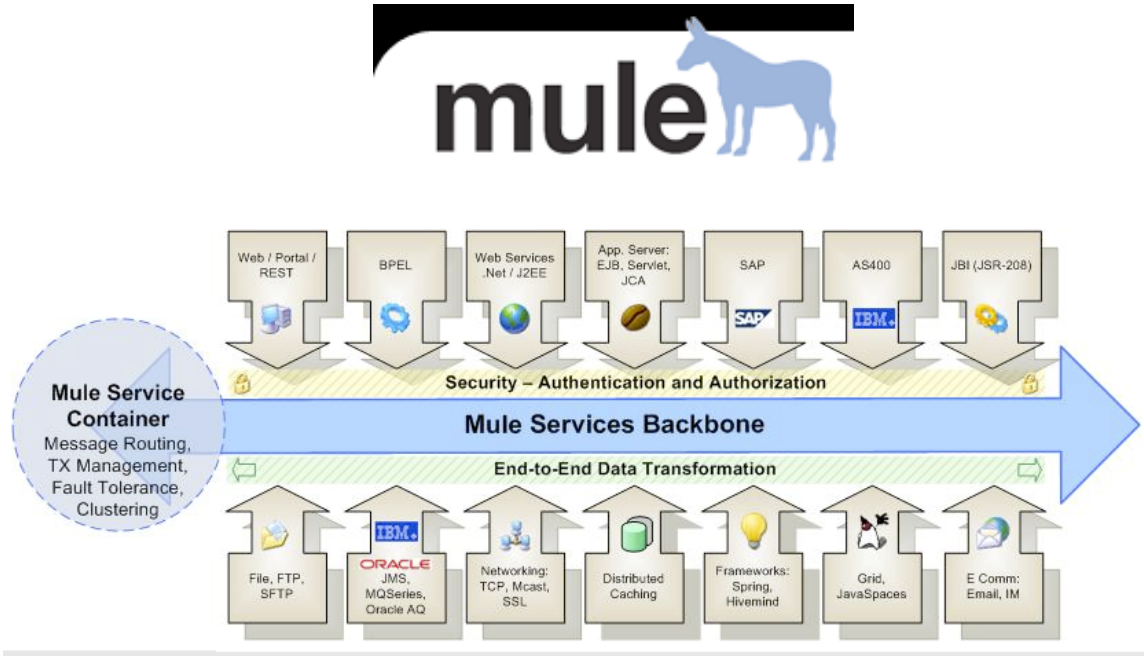


Enterprise Integration

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

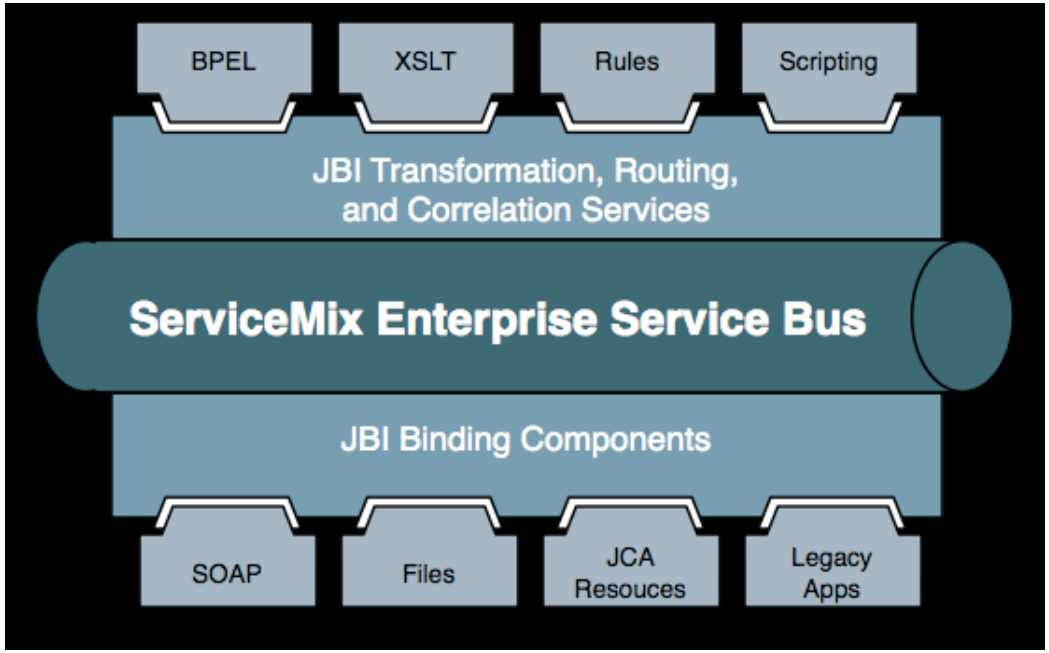
Enterprise Integration

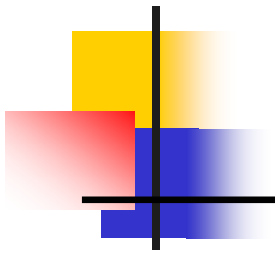
- Beyond the Gateway
  - Web Services
  - REST/XML
  - C/S Custom
  - Ethernet
  - CDMA
  - 802.11



Enterprise Integration

- Beyond the Gateway
  - Web Services
  - REST/XML
  - C/S Custom
  - Ethernet
  - CDMA
  - 802.11



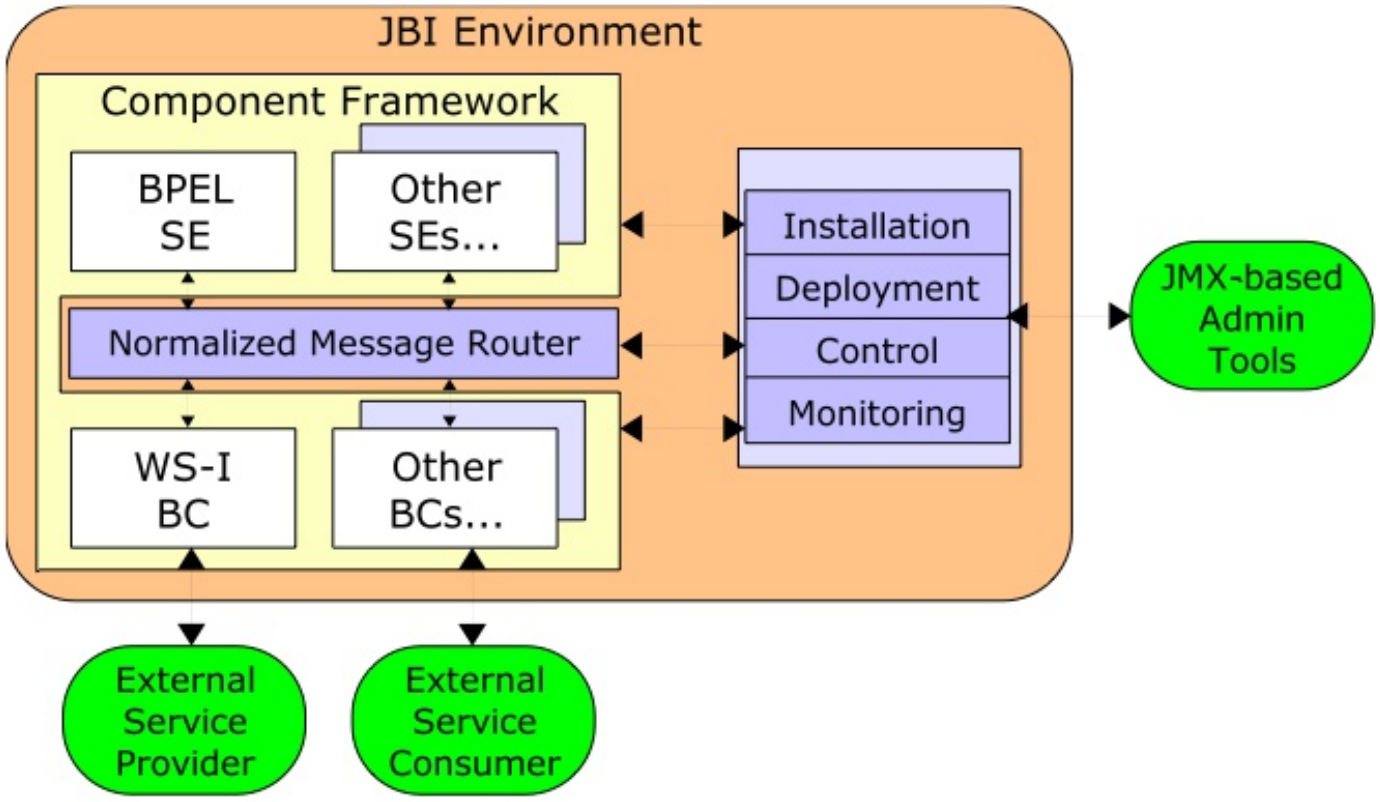


Enterprise Integration

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

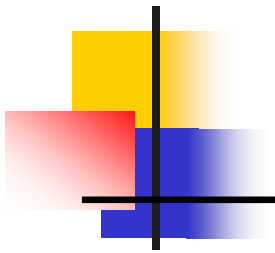
Enterprise Integration

- Java Business Integration



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

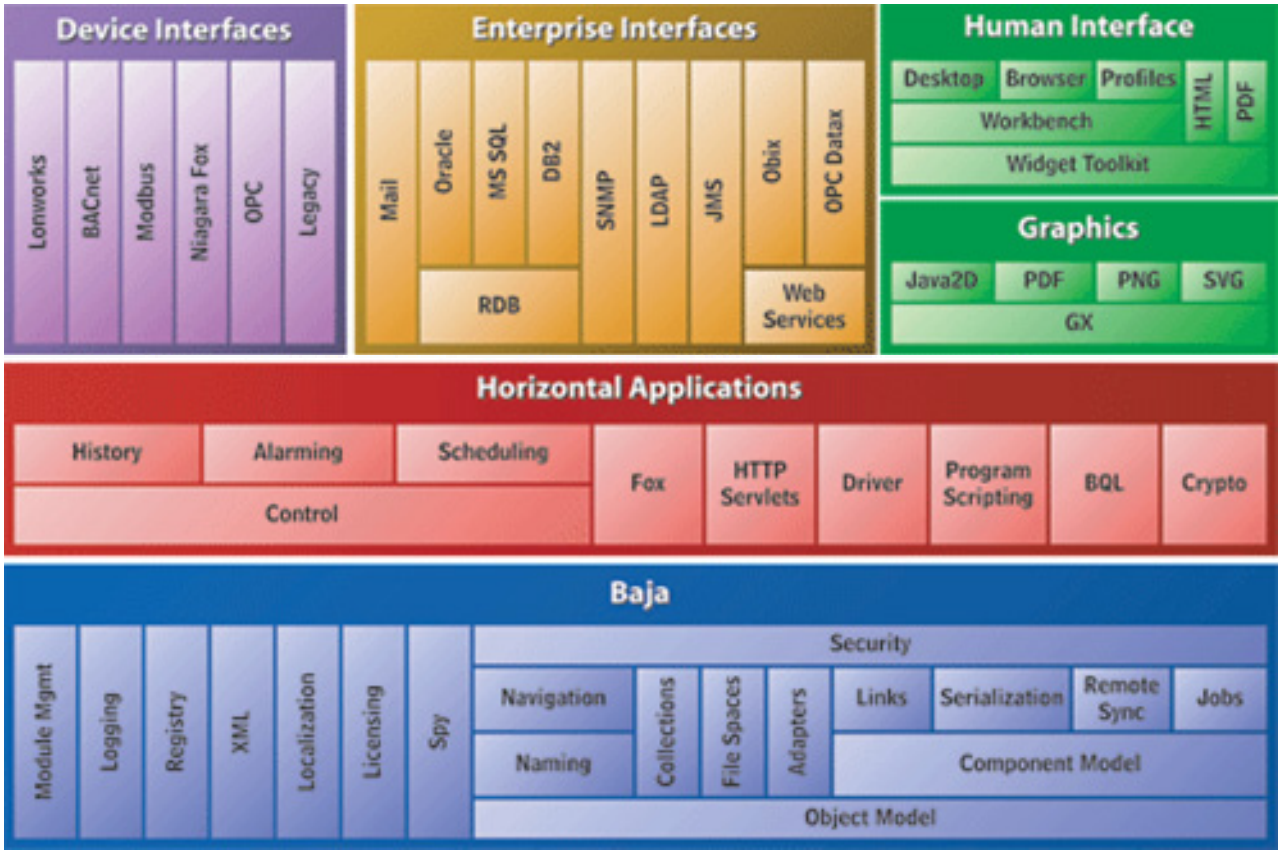
- Standards
  - Wireless
    - ZigBee
    - IEEE 802.15.4
  - Wired Building Automation
    - BACnet
    - LONworks
    - MODBus
    - DALI

Building Automation Control Systems

- Standards
  - Building Automation Software
    - JSR 60/BAJA - **B**uilding **A**utomation **J**ava **A**PI
      - ✓ http://java.sun.com/jcp
    - OBIX - **O**pen **B**uilding **I**nformation e**X**change
      - ✓ http://obix.org

Building Automation Control Systems

- Programming Language/Environment
  - Niagara Platform



Tridium - http://www.tridium.com

Building Automation Control Systems

- Honeywell/Tridium - Niagara Conference
  - Niagara Summit
    - http://www.niagarasummit.com/
  - Niagara Summit Introduction Movie
    - http://www.tridium.com/Videos/2006_Summit_Videos/Tridium_short_large.wmv

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

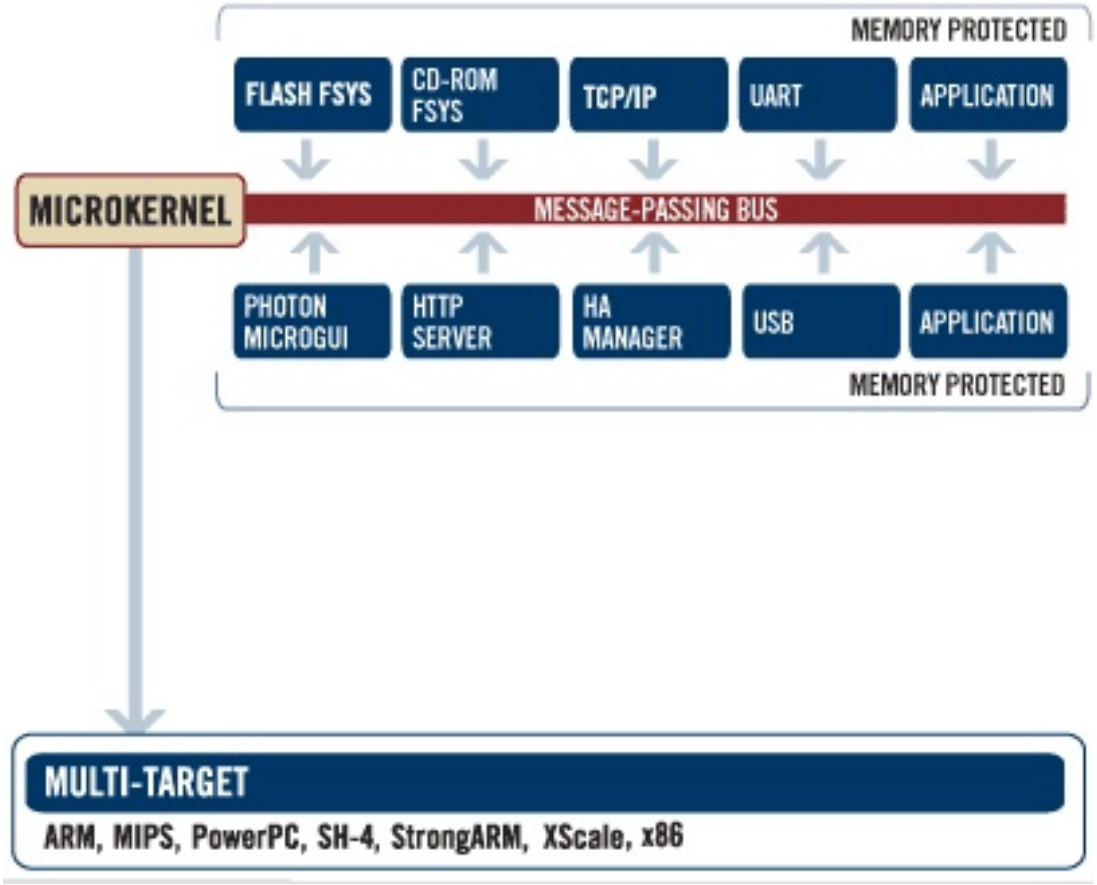
- Hardware
  - Vykon JACE-2 Device
    - Platform
      - ✓ IBM PowerPC 405EP 250 MHz processor
      - ✓ 64MB SDRAM & 64 MB Serial Flash
      - ✓ Battery Backup - 5 minutes typical
      - ✓ Real-time clock - 3 month backup max *via* battery
    - Communications
      - ✓ 2 Ethernet Ports 10/100 Mbps (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
  - More information: http://www.qnx.com/news/web_seminars/multi-core_tools.html
  - Registration: http://seminar2.techonline.com/s/qnx_oct2406

Building Automation Control Systems

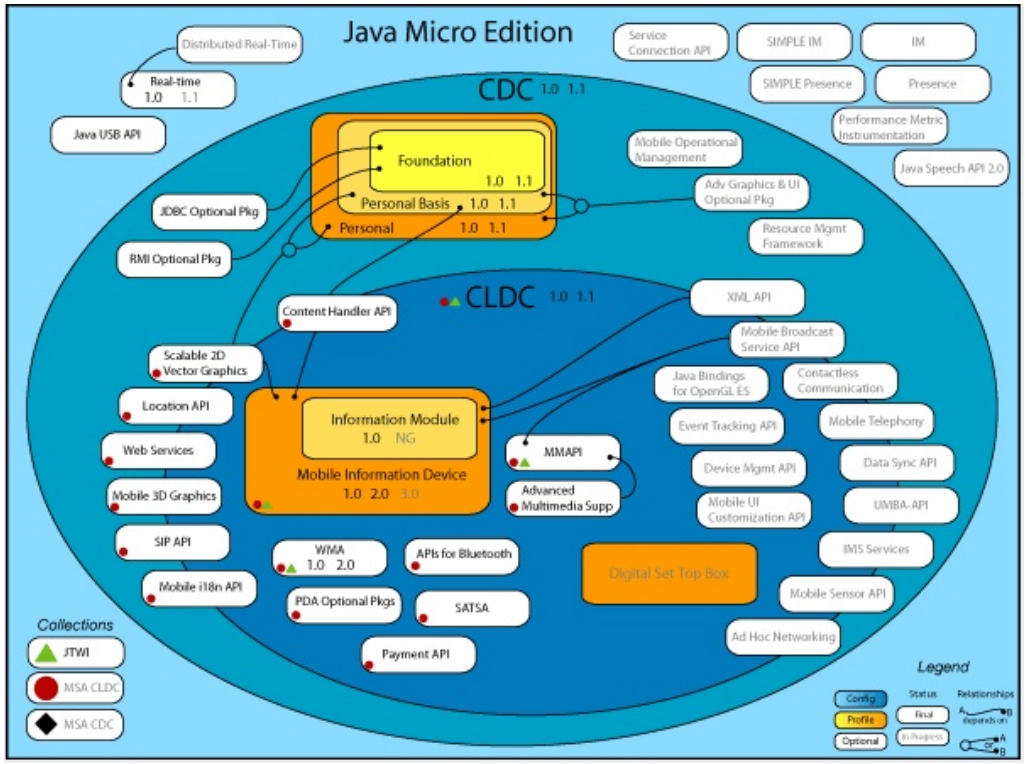
- IBM J9 JVM
  - Configurable, compact, fast and predictable architectural layer provides common interface for application programs to manage the specific interfaces with the OS and device hardware
  - Ideal for resource-constrained environments with configuration flexibility
  - Supports functions (such 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

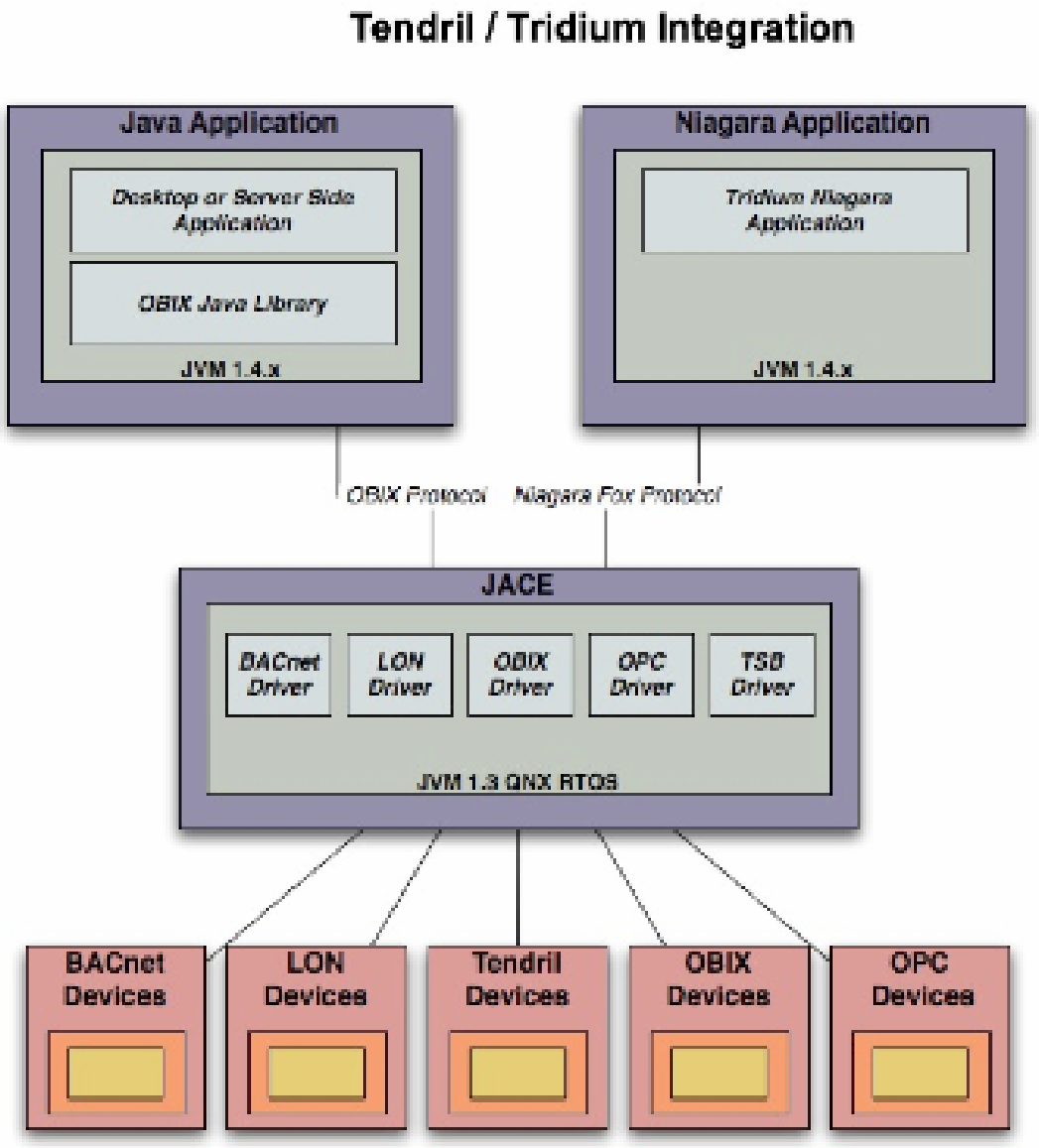
- Programming Language/Environment
  - Java ME
    - http://java.sun.com/javame/technologies/index.jsp#3

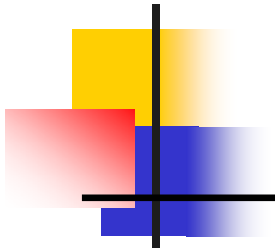


Building Automation Demonstration

- 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***

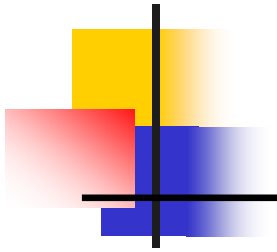
Building Automation Demonstration





Resources

- B & B Electronics - http://bb-elec.com
  - Great online electronics store. Sensicast devices are currently available.
- WiSuite - 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
  - ZigBee/802.15.4 Application Kit
  - Inexpensive $299.00
- Ember Jump Start for EM 250 - 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
- Crossbow - http://www.xbow.com/Products/productsdetails.aspx?sid=3
  - ZigBee/802.15.4 Devices; Mote Kites



Book

- 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.

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

Thank you

Tom Bender

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tbender@tendrilinc.com