Goals for presentation

• Describe the use case for building automation and control
• Support CSD with respect to broad market potential
Ethernet for Building Automation and Control

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The Big Idea

• Buildings are managed by a large number of sensors connected to distributed controllers and a centralized user interface.
• It is a true Network of Things.
• It is not an Internet of Things.
• The future is IP.
  • IP networks are physically ubiquitous, particularly in buildings.
  • IP networking is the most known and familiar kind of network.
Outline

• Devices and networking for incumbent technology
• BACnet standard
  • This holds the system together.
• Present uses of Ethernet in building automation and control networks
• Future uses of Ethernet
  • As a replacement for the Field Bus
  • As a replacement for the Sensor Bus
Devices for Building Automation and Control

Web-server for UI
- Command and control
- Reports
- History

Facility-wide integration and control
- Supervisory control
- Data normalization/routing/organization
- Subsystem integration
- Add alarm/trend functions for simpler devices

Local control and interface to instrumentation
- Real-time logic
- Alarm/trend/schedule options
- Local UI

5 to 5000 devices per installation
Networking for Building Automation and Control
BACnet Standard

• Short for “Building Automation Control Network”.

• Both an international (ISO) and ANSI standard for interoperability between cooperating building automation devices.

• “The motivation for this Standard was the widespread desire of building owners and operators for ‘interoperability,’ the ability to integrate equipment from different vendors into a coherent automation and control system – and to do so competitively.” (from the Foreword to the BACnet standard)

• Customers have opted for open standards.
BACnet Networking

• BACnet supports several networking options, including Ethernet.
• BACnet/IP is dominant for devices in the upper tiers of the network.
• BACnet MS/TP is dominant for the more numerous devices in the lower tiers of the network.
• The BACnet/IP and BACnet MS/TP are compatible at the application layer.
• The two-PHY approach means one translation layer
BACnet/IP

• BACnet/IP was published as a standard in 2004.
• We know Ethernet works, for example:
  • Frame format and frame size.
  • Typical message size.
• Implemented at the top tier devices because:
  • Need for bandwidth.
  • Need for IP connectivity.
  • Ethernet became standard on the computers required to run the software.
BACnet/IP

• Historically the problems using Ethernet in lower tiers were:
  • Cost of the wiring infrastructure.
  • Cost pressure on the hardware (cost of chip sets).
  • Complexity of integrating the microcontroller, MAC, and PHY as a system.
  • General unfamiliar with Ethernet.

• These issues have faded.
Need and Opportunity (I)

• Incremental conversion of buses to Ethernet networking means field controllers are next.

• Worldwide market estimate for year 2016 is 9 million units of which 10% are IP enabled.

• In any given fiscal year, the opportunities for retrofit are 90% of the market.
  • The retrofit market with cable reuse is large and available, and will remain so for many years.
  • The new-construction market will be served in the short run by existing Ethernet.
Specification for Field Bus (BACnet 9.2)

• Single twisted-pair.
  • 18 AWG/3-wire stranded twisted shielded cable.
  • Reach up to 1200 m per segment up to three segments.
  • Impedance between 100 and 130 ohms.
  • Distributed capacitance less than 100 pF per meter.

• Multi-drop.
  • Up to 32 devices per segment. Up to 64 devices over 3 segments.
  • No T connections permitted.

• Speeds from 9600 baud to 76800 baud.

• No option for power (24 VAC power is available on separate wires).
Terminal block connections are typical
Reach for field bus

• The existing reach specification is largely driven by bus topology (multidrop).

• If existing devices were replaced by dual port devices, then a 1200 m reach is required only for connections between buildings.
Need and Opportunity (II)

• Development of IP-enabled field controllers increases the number of possible BACnet/IP nodes per deployment by an order of magnitude.
• Market for edge devices is much larger, but much more cost sensitive.
  • No foreseeable need for significant communication bandwidth.
Specification for Sensor Bus (typical)

• Single twisted-pair wiring.
  • 22 AWG, stranded 4-wire, two twisted pair, shielded cable.
  • Reach up to 400 m.

• Multi-drop and linear chain.
  • Up to 10 devices per segment.
  • No T connections permitted.

• Speeds from 9600 baud to 76800 baud.

• Power available is 15 V DC; max 100 mW per device steady-state.
Terminal block connections are typical
Reach for Sensor Bus

• The existing reach specification is largely driven by bus topology (multidrop).
• If existing devices were replaced by dual port devices, then a 40 m reach would suffice for most point-to-point connections.
Bus (typical, field bus and sensor bus)

• Operating range 0 deg to 50 deg C.

• Terminations
  • Spade lugs or screw terminals.
  • Protected against misapplication of 24 VAC.

• Meets EN61000-4-4 (Electrical Fast Transient / Burst Immunity Test) and EN61000-4-5 (Electromagnetic compatibility, surge immunity) requirements for heavy industrial applications.
Miscellany

• Simplex/Duplex – BACnet is simplex in its origins, but BACnet/IP means the duplex also works. This is an effect, not a driver.

• Reduced pin count is important because there is limited space on circuit boards.

• Already use power separate from communication.
  • Works well with multi-drop.
  • Field bus communication runs in parallel to 24 V AC power.
  • Sensor bus communication runs in parallel to 15 V DC power.
Conclusions

• The building segment is driven by the BACnet standard, which drives the need for a widely accepted communication standard.
• Controllers can absorb the cost of Ethernet more easily than sensors.
• The field bus for controllers needs longer reach than the sensor bus.
• The market for cable reuse is much larger than for new construction and gives access to the total available market.
Thank you

Questions if time permits