Goals for presentation

- Use case for building automation and control
- Developments since the presentation in October 2016

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 Network of Things, but not an Internet of Things.

- The future is IP even if the installed base is not.

  - IP networks are physically ubiquitous, world-wide and in buildings.
  - IP networking is the most known and familiar kind of network.

Outline

- BACnet standard
  - This holds the system together.
- Present uses of Ethernet in building automation and control networks
- Future uses of Ethernet

BACnet Standard

- Short for "Building Automation Control Network".

- Both an international (ISO) and US (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)

- The standard is successful because customers have opted for open standards.

BACnet Addendum BJ

- Published for public comment in December 2016.

- Not yet adopted.

- Addresses issues that have made BACnet unfriendly in IT environments (for example, using system-wide broadcasts).

- Preserves the existing BACnet Application layer.

BACnet/IT

- Adds a thin BACnet/IT layer that binds general services to specific IP protocols. For example:

- Defines message transport to be HTTPS.

- Defines service discovery to be DNS and mDNS.

- This creates a version of BACnet that :
  - Leverages the IP protocol suite
  - Integrates smoothly into IT infrastructure

BACnet Application Layer	
BACnet/IT Layer	
WebSockets	DNS-SD
IP Transport Layer	
IPv4 or IPv6	
DL	DL
PHY	PHY
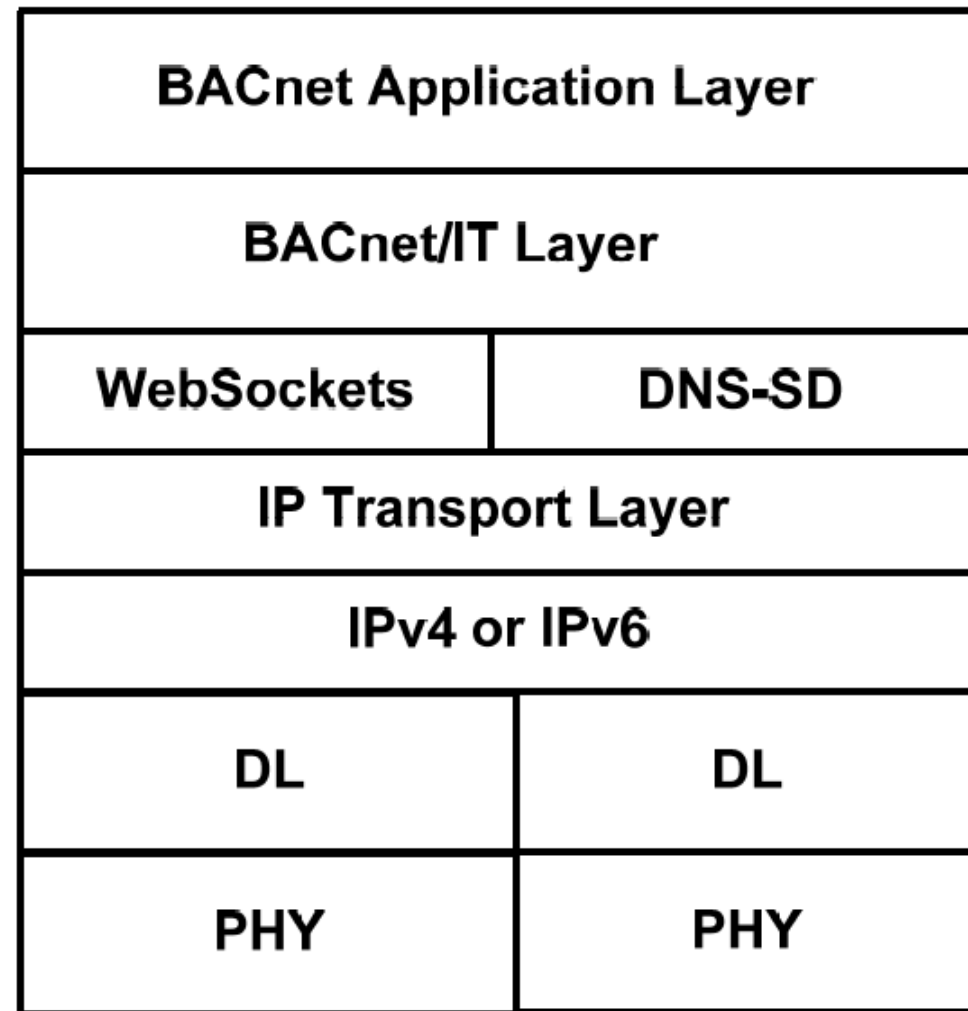
BACnet collapsed architecture of the BACnet/IT stack

IP

- BACnet's protocol stack was defined in the 1995 revision, a time in which IP protocols were associated with computers.

- BACnet has used IP since the 2004 revision, mostly to serve the upper tiers of a multi-tier network.

- In 2017, the barriers to using Ethernet are low:
  - Cost of the wiring infrastructure.
  - Complexity of integrating the microcontroller, MAC, and PHY as a system.
  - General unfamiliarity with Ethernet.

- BACnet/IT looks ahead to a flat network using IT infrastructure.

Need and Opportunity (I)

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

- There might be 10 sensors/actuators per controller, of which a negligible amount of IP enabled.

- In any given year, retrofits are 90% of the market.
  - The retrofit market with cable reuse is large and available, and will remain so for many years. The RS-485 controllers could be replaced by IP equivalents.
  - Cable reuse requires Ethernet over quality single-pair wiring with reach greater than 100 meters. (Exiting RS-485 is 1200 meter and multidrop.)

Need and Opportunity (II)

- The market for new construction is 10% of the annual business.
- Today, this market is served by conventional Ethernet.
- In the long term, 10SPE is a better fit.
  - Controllers have low bandwidth requirements (1 kilobit per second).
  - There is no use for the extra pairs of wire.
  - IT will likely want some limits to interconnection between IT and OT networks.
  - Riding on the IT network means that 100 meter reach is almost always adequate, but there must be a solution for the cases > 100 m.
  - HVAC system is installed before IT is operational. Therefore new construction is a case where long runs are needed. (Switches might have to stay in tool cages.)

Effect of starting with conventional Ethernet

- Industry is adopting point-to-point architectures

- Dual port devices are connected as a chain to reduce the number of switch ports needed.

- Already use power separate from communication.
  - Field bus communication runs in parallel to 24 V AC power.
  - Sensor bus communication runs in parallel to 15 V DC power.

Miscellany

- Customers will require a standard connector so that equipment from different vendors can be interconnected.

- Field termination is useful for long cables, but
it is reasonable to stock pre-terminated cables of short length.

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

Conclusions

- The building segment is driven by the BACnet standard, which drives the need for a widely accepted communication standard.

- The BACnet standard is moving to IP enabled devices riding on IT-like infrastructure.

- Controllers can absorb the cost of Ethernet more easily than sensors.

- The market for cable reuse is much larger than for new construction and gives access to the total available market.

Thank you

Questions as time permits