Wireless Pneumatic Thermostat Network and Cybersecurity Overview

July 2026

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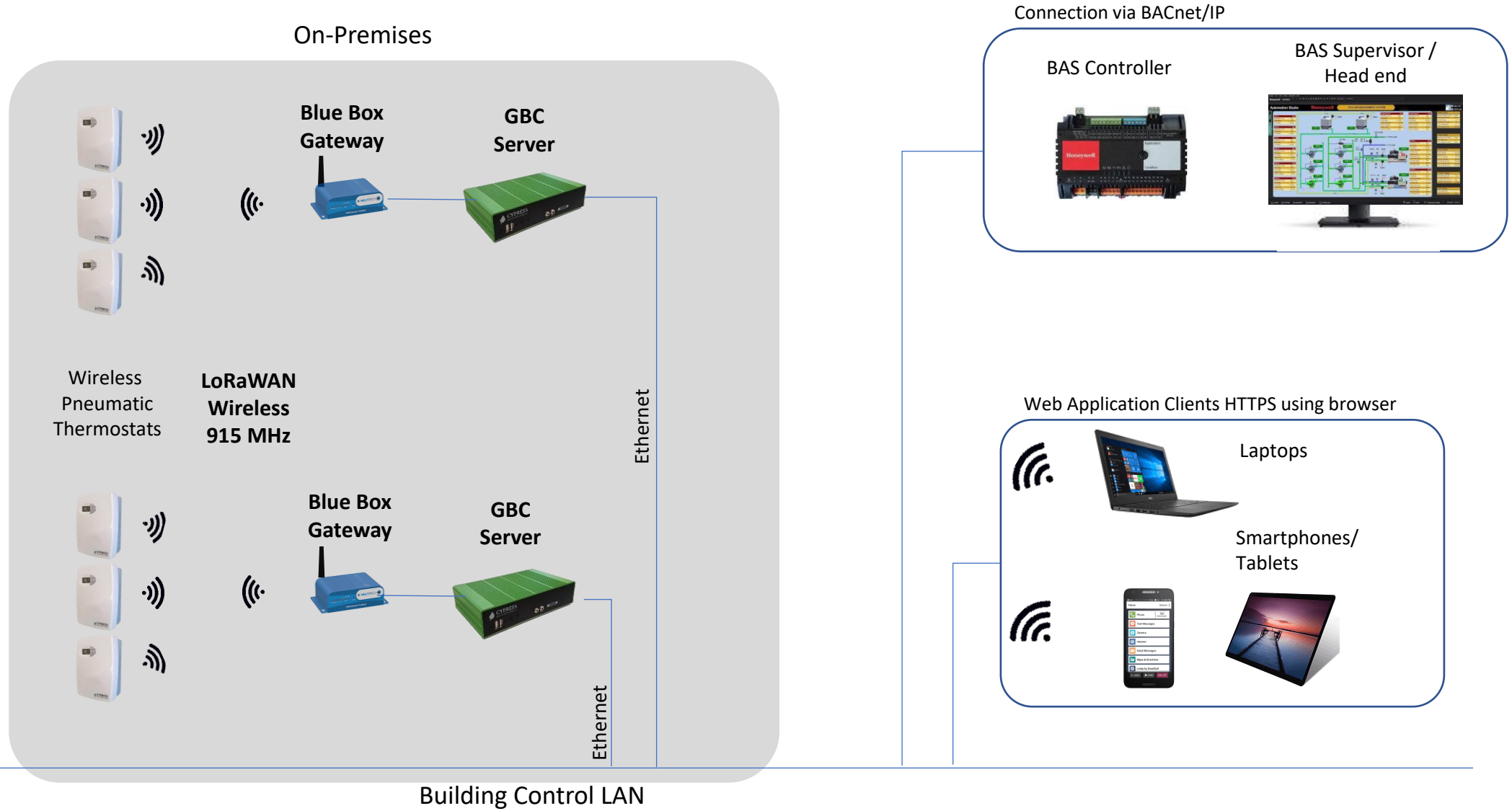
Wireless Pneumatic Thermostat Network Architecture

- **There are two options for deployment of the Wireless Pneumatic Thermostat system.**
  - Option A: Field GBC Servers
    - Typically used for smaller sites (under 100 thermostats)
    - Cypress provides GBC server hardware and software
    - Minimal reliance on customer IT/networking team
  - Option B: Centralized GBC Server
    - Typically for larger sites (more than 100 thermostats)
    - Customer provides/provisions Windows Server (may be a VM, typically in a data center)
    - Cypress provides GBC software to install on server
- **Both Options A and B are 100% on-premises solutions - no access to the public internet**

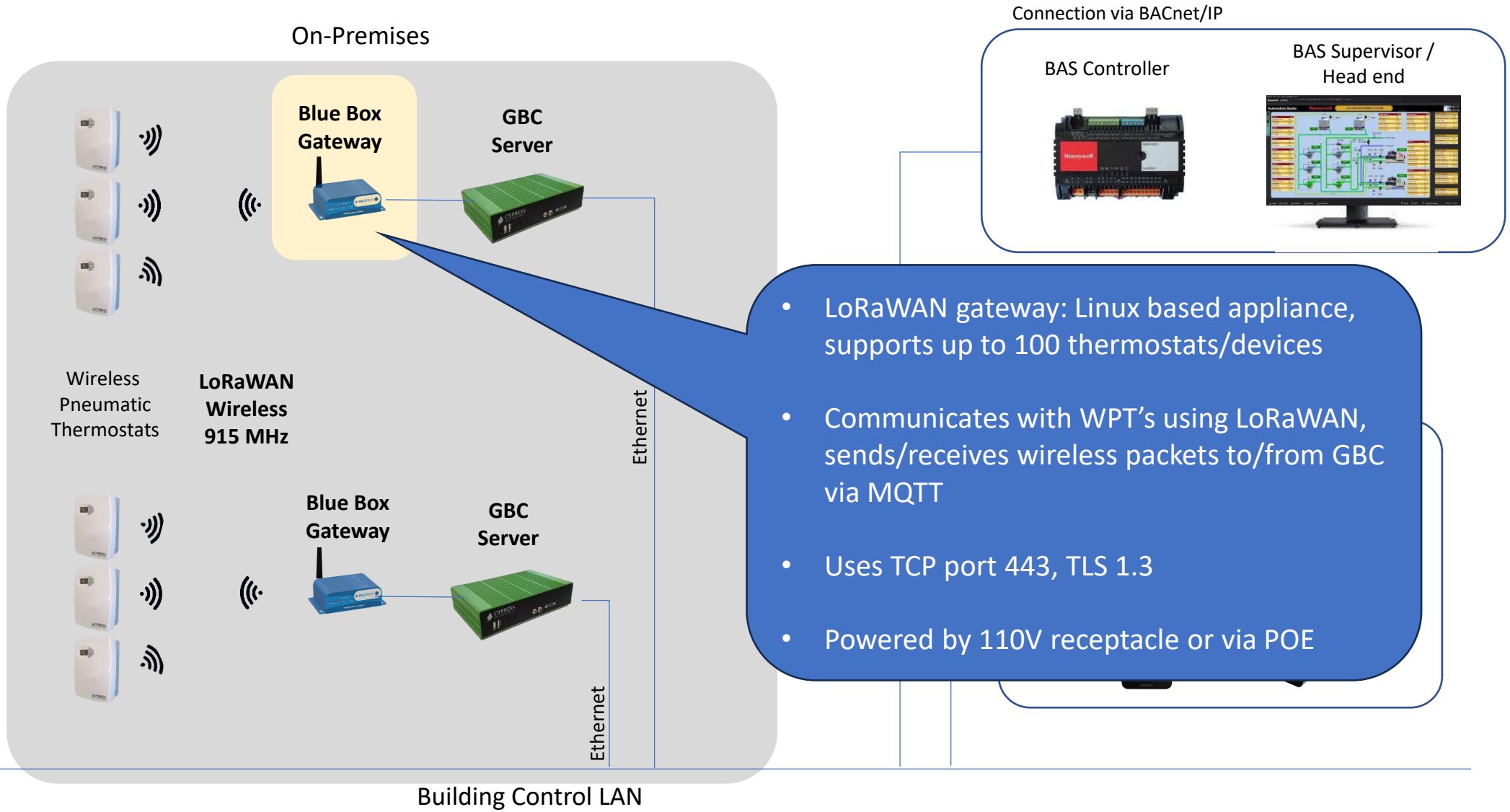
Option A:
Field Deployed GBC Architecture

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Field Deployed GBC Server Network Architecture



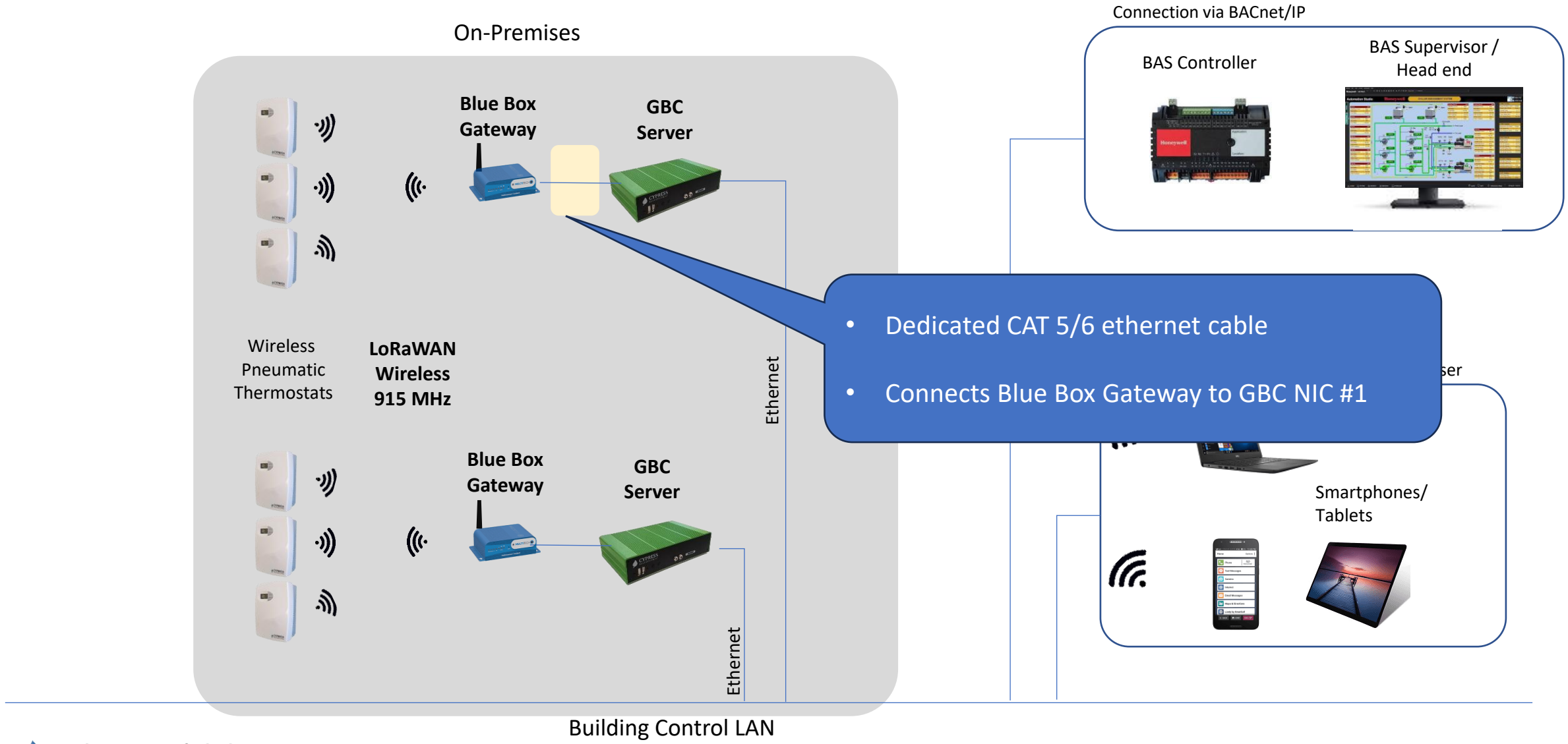
Field Deployed GBC Server Network Architecture



- LoRaWAN gateway: Linux based appliance, supports up to 100 thermostats/devices
- Communicates with WPT's using LoRaWAN, sends/receives wireless packets to/from GBC via MQTT
- Uses TCP port 443, TLS 1.3
- Powered by 110V receptacle or via POE

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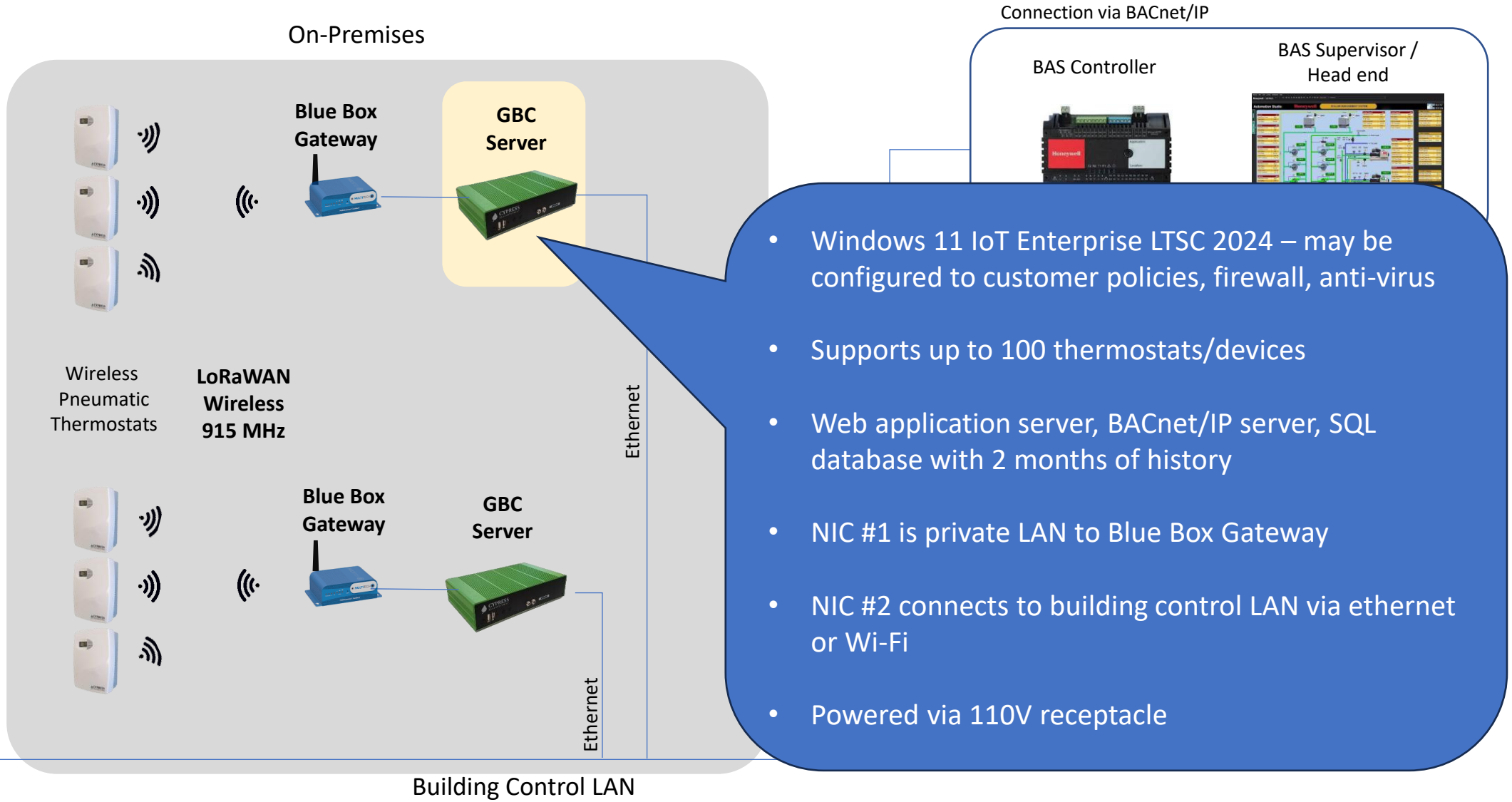
Field Deployed GBC Server Network Architecture



- Dedicated CAT 5/6 ethernet cable
- Connects Blue Box Gateway to GBC NIC #1

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Field Deployed GBC Server Network Architecture



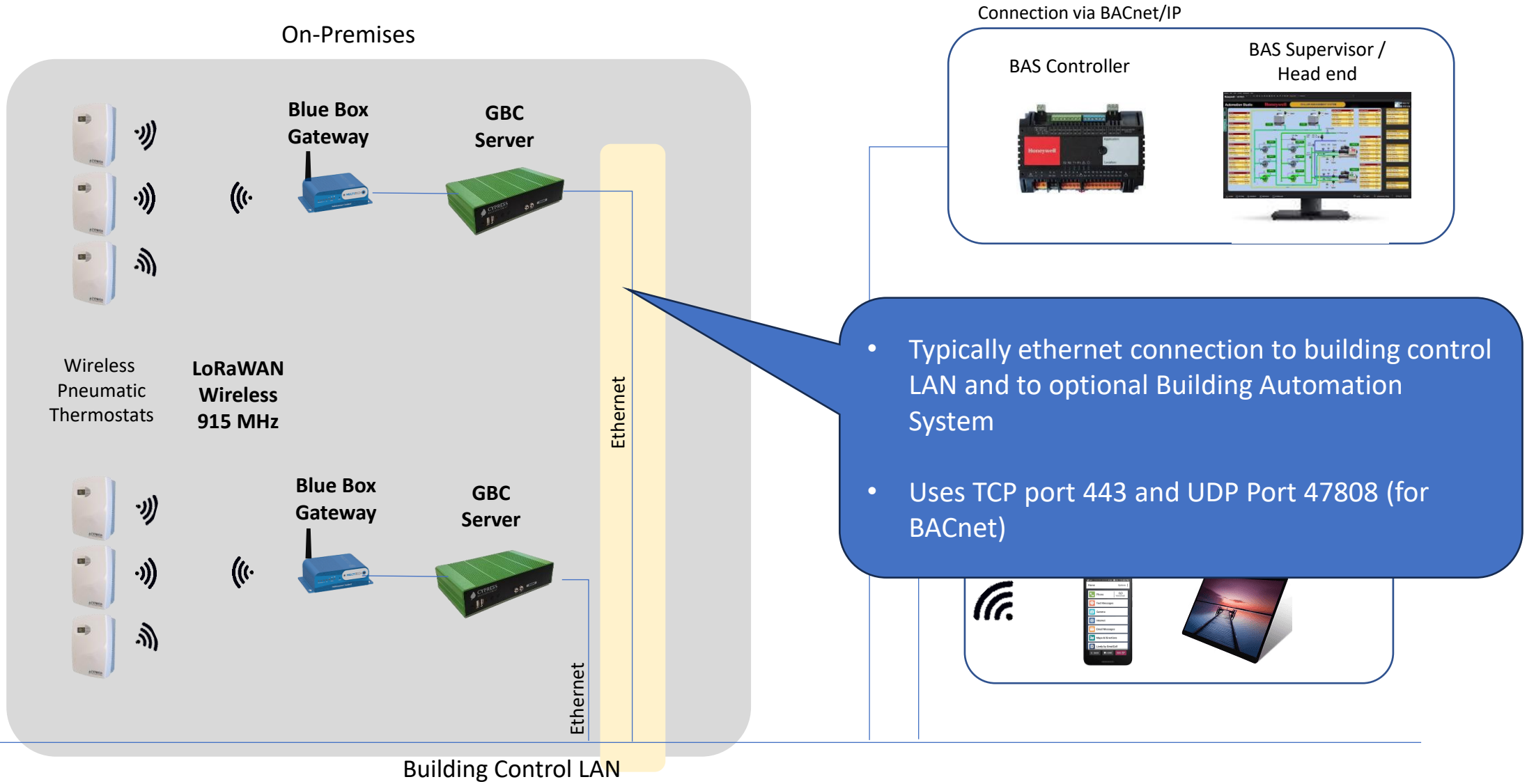
- Windows 11 IoT Enterprise LTSC 2024 – may be configured to customer policies, firewall, anti-virus
- Supports up to 100 thermostats/devices
- Web application server, BACnet/IP server, SQL database with 2 months of history
- NIC #1 is private LAN to Blue Box Gateway
- NIC #2 connects to building control LAN via ethernet or Wi-Fi
- Powered via 110V receptacle

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GBC Application - Details

- Green Box Controller Software:
  - Web Application for viewing, controlling and trending thermostat data
  - Database with 2 months data storage
  - BACnet/IP and RESTful API
  - TLS 1.3 compliant
- Web application accessible from any web browser on LAN
- Web application requires password login to view and control thermostats
- Cypress Envirosystems will provide periodic software updates for Cypress application software. Windows OS and Microsoft applications may be managed via customer Windows workstation policies.

Field Deployed GBC Server Network Architecture



Option B:
Centralized GBC Architecture

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Centralized GBC Network Architecture

On-Premises

Data Center (typical)

Blue Box Gateway

Wireless Pneumatic Thermostats

LoRaWAN Wireless 915 MHz

Ethernet

Blue Box Gateway

Ethernet

Ethernet

GBC Server



GBC Description:

Cypress provided GBC application software, installed on:

- VM or physical server
- Minimum recommended hardware:
  64 GB memory
  4 CPU's
  500 GB storage
- OS: Windows 2025 Server
- SQL Server Standard

Connection via BACnet/IP

BAS Controller



BAS Supervisor / Head end



Web Application Clients HTTPS using browser



Laptops

Smartphones/ Tablets

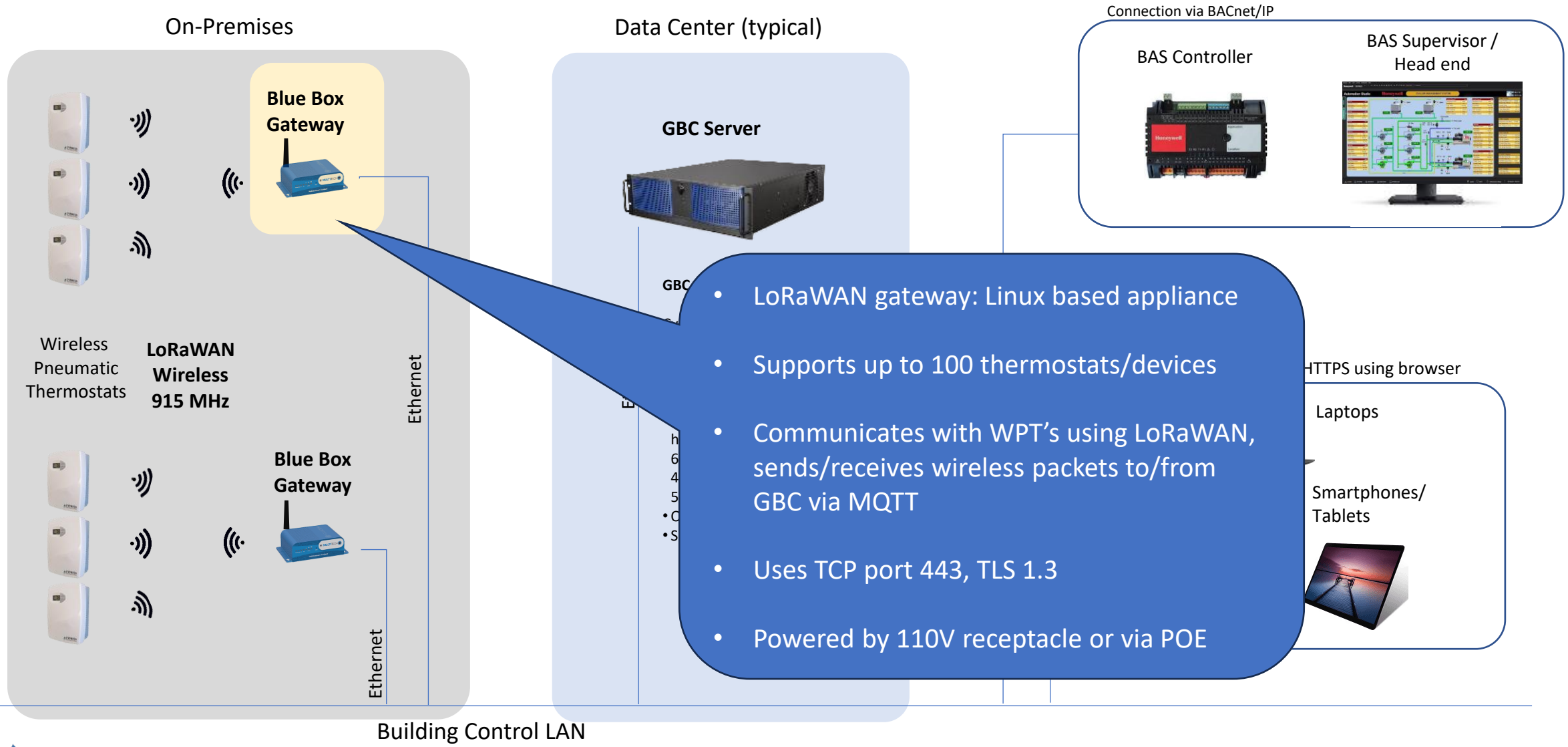




Building Control LAN

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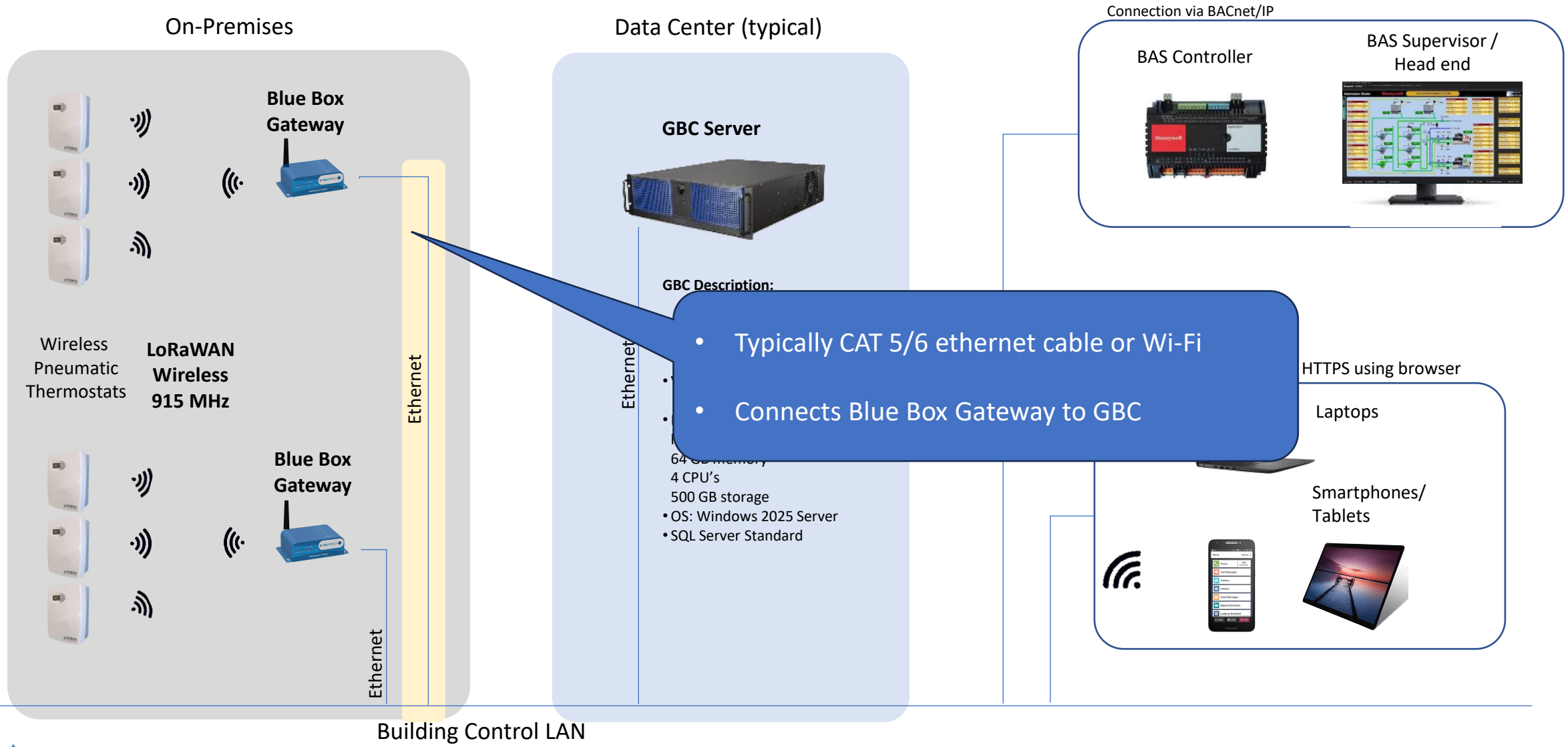
Centralized GBC Network Architecture



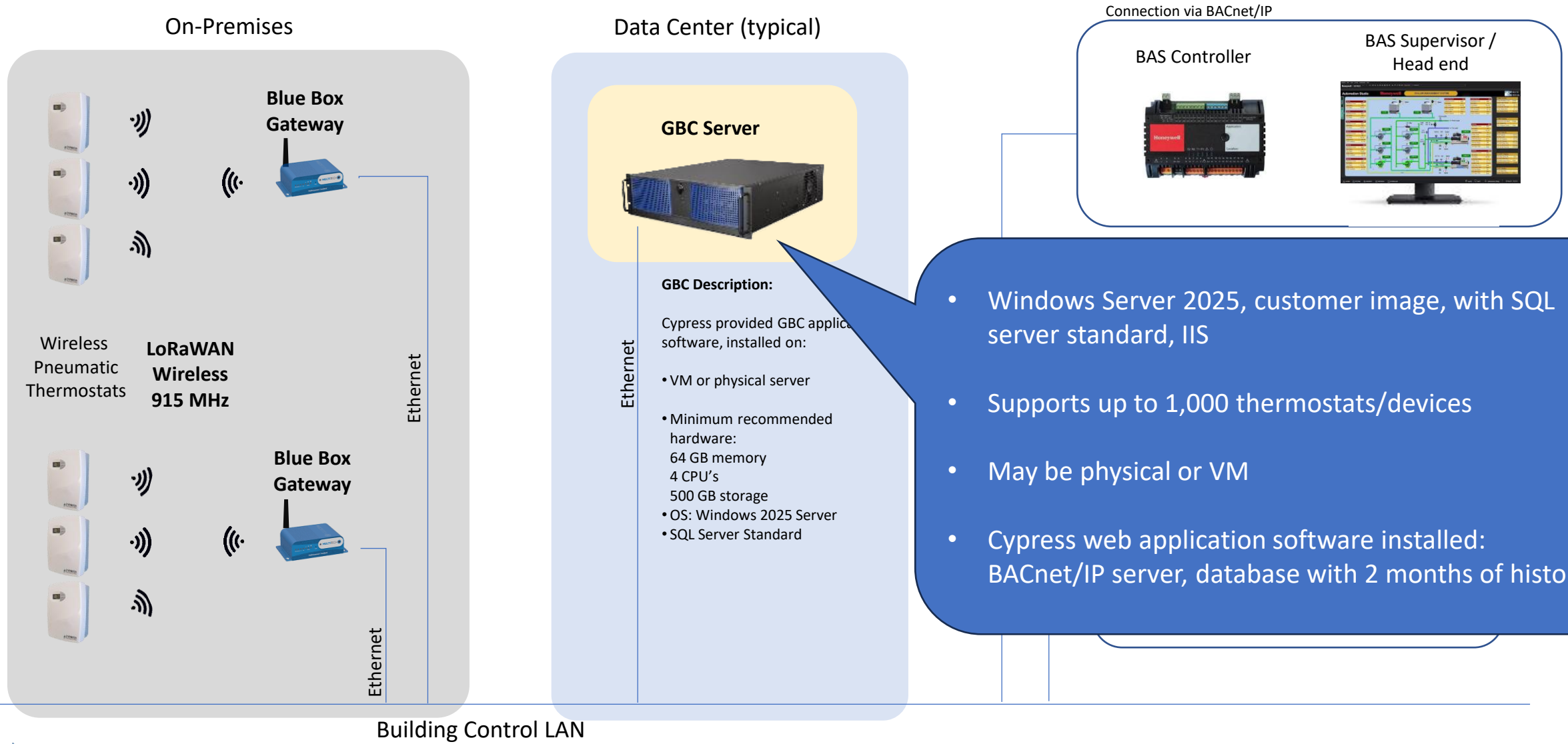
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Centralized GBC Network Architecture



Centralized GBC Network Architecture



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Deployment of GBC Application

- Customer provisions a Windows Server 2025, IIS, .NET, SQLServer (standard version or higher) – may be physical or virtual machine
- Cypress provides GBC software to customer
- Customer may perform security scan on GBC software. Cypress will support customer to install on Windows server

- Green Box Controller Software:
  - Web Application for viewing, controlling and trending thermostat data
  - Database with 2 months data storage
  - BACnet/IP
  - TLS 1.3 compliant
- Web application accessible from any web browser on LAN
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Appendix

LoRaWAN - FAQ

- What is LoRaWAN?
  - It is a Low Power, Long Range radio technology using patented chirp spread spectrum (CSS) technology.
- What are the benefits of LoRaWAN?
  - Long range, low power consumption, low interference, secure, broad adoption – compared to other wireless technologies.
  - See LoRaWAN Alliance https://lora-alliance.org
- What frequencies does it use? Does it interfere with WiFi, Bluetooth or cell phones?
  - 915 MHz band (902–928 MHz) in North America divided into multiple channels (can channel hop)
  - The 915 MHz band is a different frequency than WiFi, Bluetooth and cellular, so no interference
- What is the transmission range of LoRaWAN?
  - Maximum range can be up to 10 miles – but bandwidth and battery consumption suffers.
  - WTL range is 100-150 ft typically, on a single floor. Crossing floor plates or thick walls reduce range by up to 50%.
- Does LoRaWAN use repeaters to extend range?
  - No, it uses a STAR topology where each WTL communicates directly with the Gateway. There are no repeaters.

LoRaWAN - FAQ

- Can it be used in hospitals and other RF sensitive locations?
  - Yes, see https://resources.lora-alliance.org/healthcare
- Can 3rd party LoRaWAN devices use the Cypress gateways?
  - Yes, once a LoRaWAN gateway is installed, other 3rd party LoRaWAN sensors and devices can use the same gateway. It is necessary to configure the Gateway and write code to parse payload formats – a service provided by Cypress Envirosystems.
- Is LoRaWAN secure?
  - LoRaWAN has built-in mandatory authentication and encryption.
  - The WGR system has been tested and is in use by critical industries including nuclear power plants and NASA.

WPT BACnet Objects

BACnet object name	Data type	Read/Write	Function	Operational details
Current_Temp	AI	Read-only	Current space temperature	Displays the current space temperature at the thermostat in degrees Fahrenheit.
Branch_Pressure	AI	Read-only	Branch line pressure	Displays the current branch line pressure at the thermostat in PSI.
Battery_Level	AI	Read-only	Battery level percentage	Displays the current battery level as a percentage.
Humidity	AI	Read-only	Relative humidity	Displays the current relative humidity reading in % RH. Available only on relative humidity enabled models.
Setpoint	AO	Read/write	Occupied state setpoint	Displays and allows for control of the Occupied state setpoint value in degrees Fahrenheit.
Setpoint_CoolAbove	AO	Read/write	Deadband Cooling Setpoint	Displays and allows for control of the cooling setpoint value in degrees Fahrenheit. Available on Deadband models only.
Setpoint_HeatBelow	AO	Read/write	Deadband Heating Setpoint	Displays and allows for control of the heating setpoint value in degrees Fahrenheit. Available on Deadband models only.
Unoccupied_Setpoint_HeatBelow	AO	Read/write	Unoccupied Deadband Cooling Setpoint	Displays and allows for control of the unoccupied cooling setpoint value in degrees Fahrenheit. Available on Deadband models only.
Unoccupied_Setpoint_CoolAbove	AO	Read/write	Unoccupied Deadband Heating Setpoint	Displays and allows for control of the unoccupied heating setpoint value in degrees Fahrenheit. Available on Deadband models only.
Unoccupied_Setpoint	AO	Read/write	Unoccupied state setpoint	Displays and allows for the control of the Unoccupied state setpoint in degrees Fahrenheit.
Occ_State	BO	Read/write	Occupancy state status	Displays and allows for control of binary status indicator for the operation state of the thermostat, occupied or unoccupied.

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BACnet/IP Interface

- GBC and BAS BACnet Clients should be on the same IP subnet for BACnet communications. If on different IP subnet, a separate BBMD will be required – not included in WPT solution.

- GBC supports BACnet foreign device registration.

- BACnet Routers may be used to connect legacy BACnet MS/TP devices to the GBC

WPT BACnet/IP Polling Rate

- Each WPT is pre-programmed to “wake up” every five minutes. When it wakes up, it will send all current status (i.e. zone temperature, branch pressure etc.) to the GBC. It will also retrieve and execute any queued commands from the GBC (i.e. setpoint changes).

- Note:
  - At any given time, the WPT status shown on the BAS may be up to five minutes old.
  - Any commands sent from the BAS to the WPT may wait for up to five minutes before it is executed.

- If a WPT does not report to a GBC for more than 25 minutes, the “stale data” flag will be set for objects associated with that WPT. The BAS will report that unit as “offline”.

Setting Schedules via BACnet

- If a BAS is connected, turn off GBC scheduling and use the BAS to control all setpoints (this is the default GBC setting).

- BACnet Scheduling Considerations:
  - WPT BACnet supports Occupied and Unoccupied Modes and associated setpoints.
  - WPT BACnet interface does NOT support Schedule Objects or Groups.
  - WPT BACnet interface does NOT support setpoint limits – these can be configured on the GBC Web Application.

- Recommended BAS Schedule Implementation
  - Keep WPT on Occupied mode all the time, and let the BAS keep track of occupied and unoccupied times. The BAS will send setpoints to the WPT to execute at the appropriate time.

Healthcare Users – Select List

- Prime Healthcare
- LifePoint
- MedStar
- CommonSpirit
- Sutter Health
- Aurora
- Advocate
- VA Medical Centers
- NYC Health and Human Services
- Ascension
- Novant
- Orlando Health