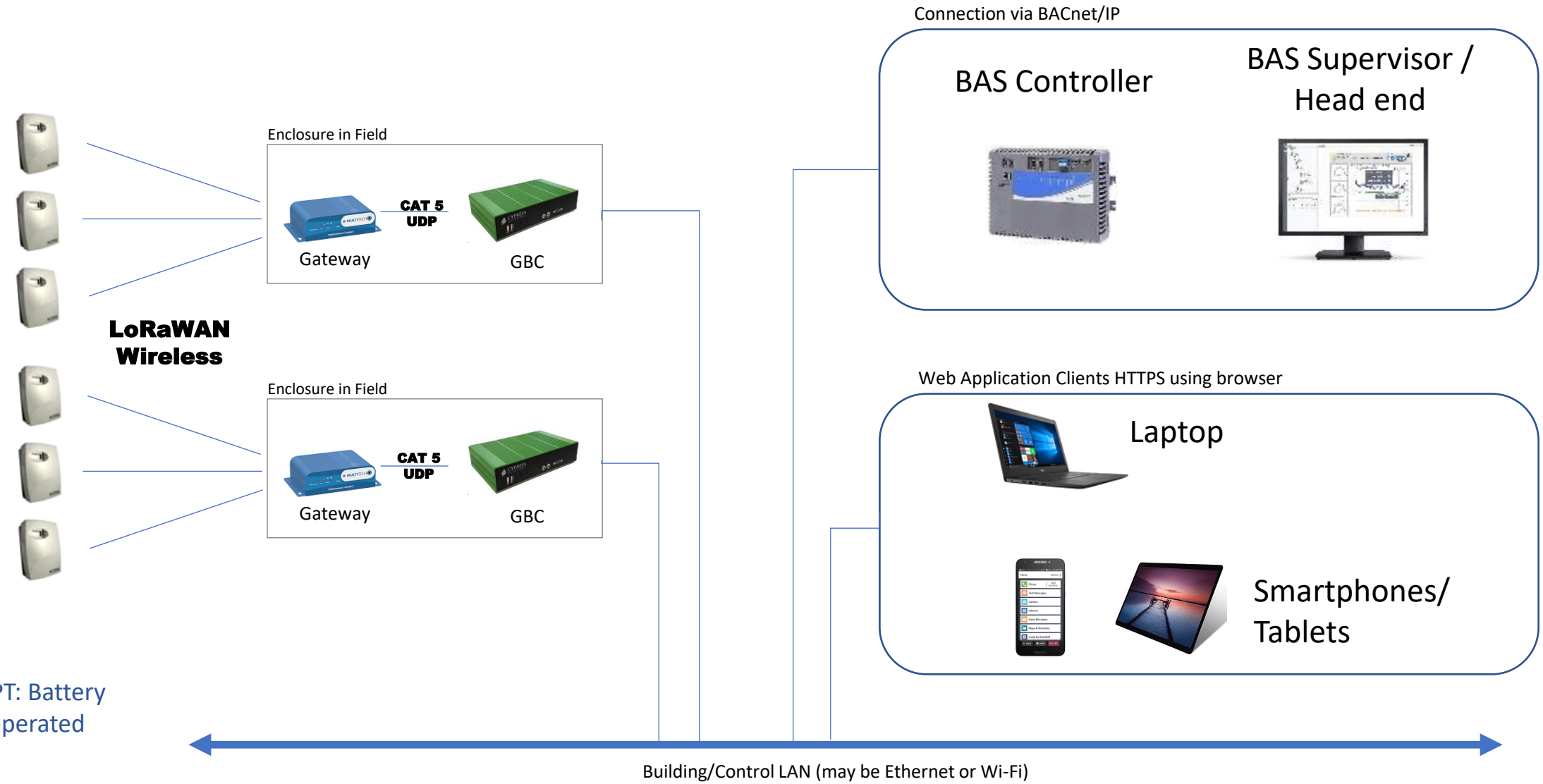
Wireless Pneumatic Thermostat Network Architecture and Cyber Security Overview

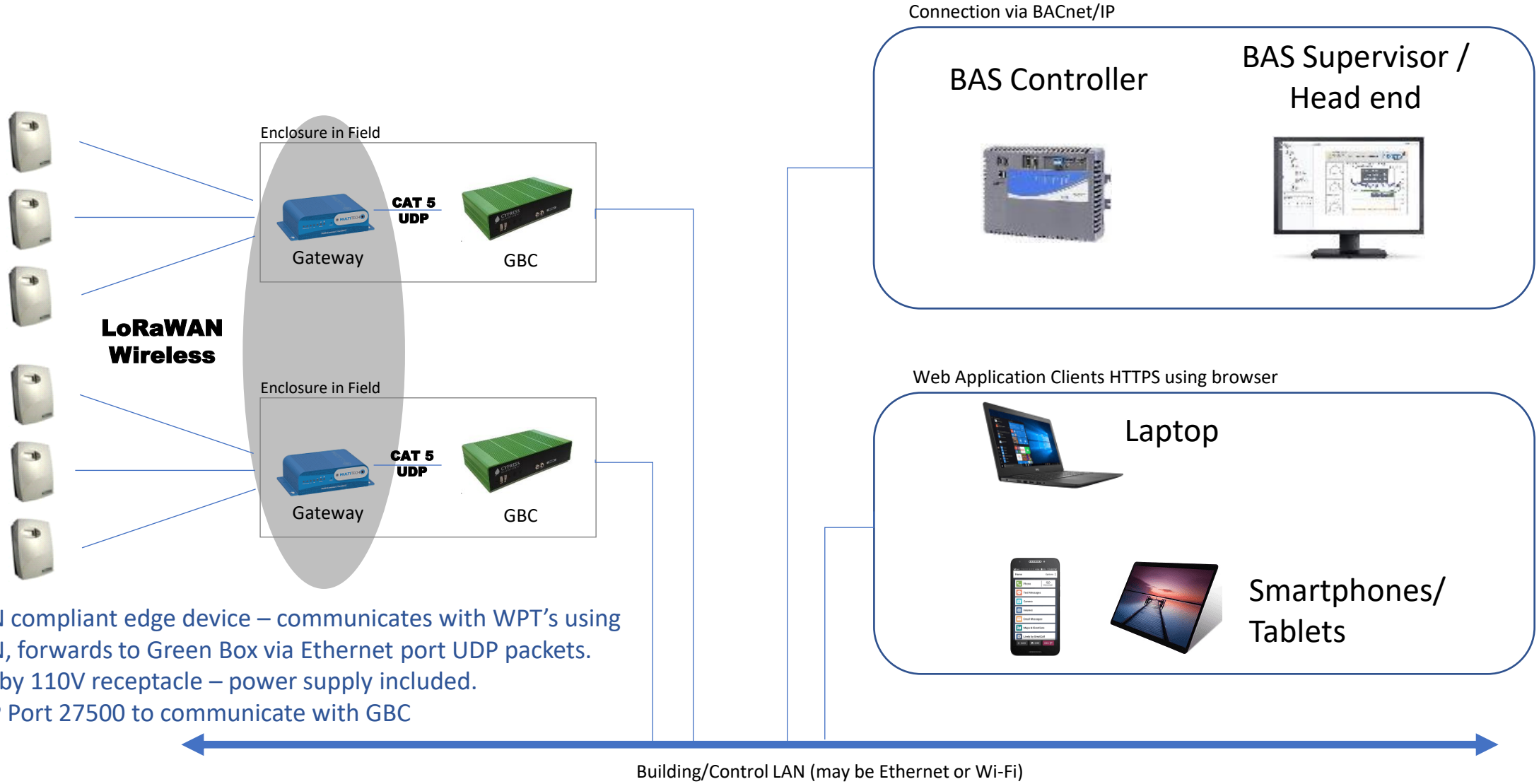
5/26/2025

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WPT Typical Network Architecture



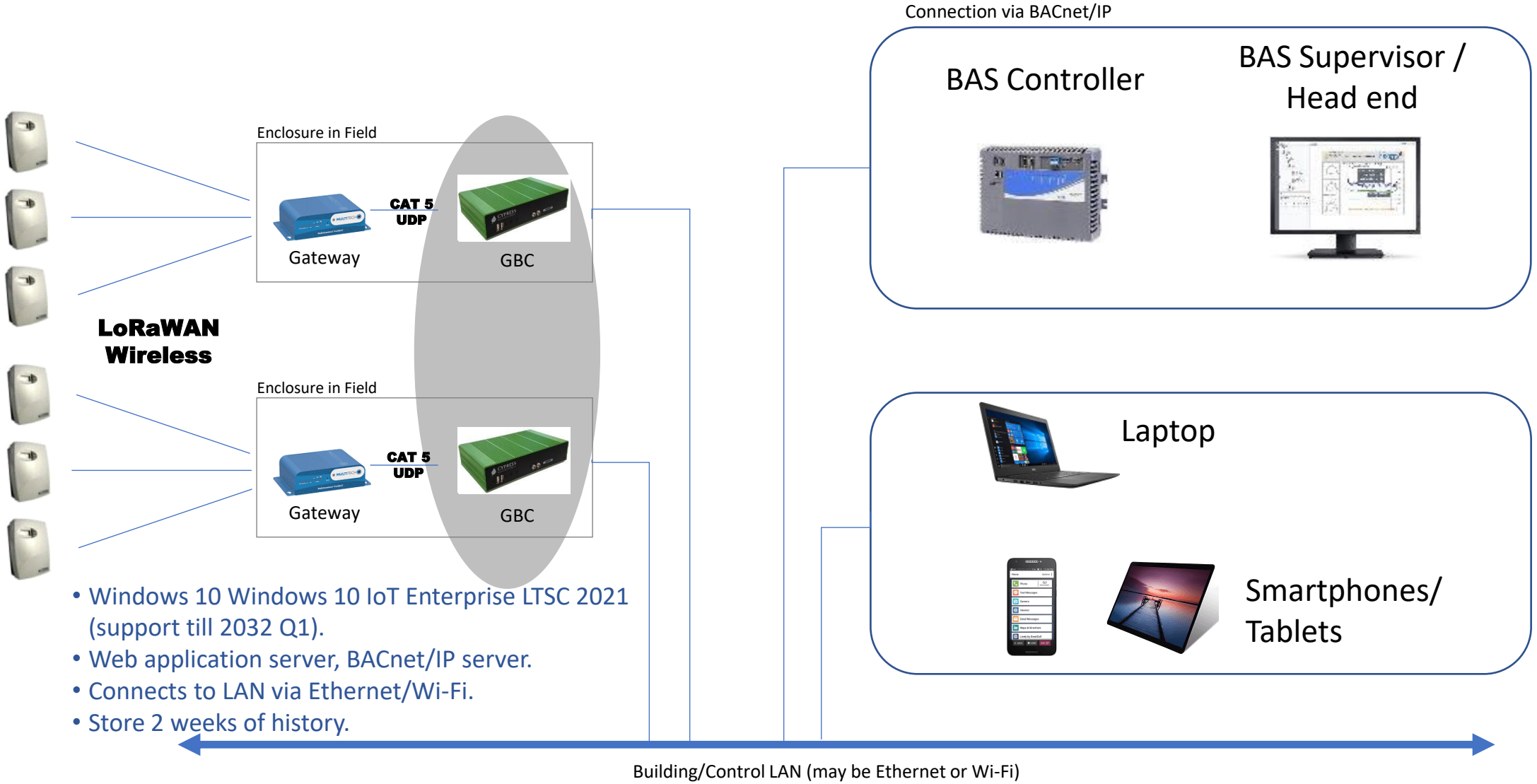
Blue Box (LoRaWAN Network Gateway)



- LoRaWAN compliant edge device – communicates with WPT's using LoRaWAN, forwards to Green Box via Ethernet port UDP packets.
- Powered by 110V receptacle – power supply included.
- Uses UDP Port 27500 to communicate with GBC

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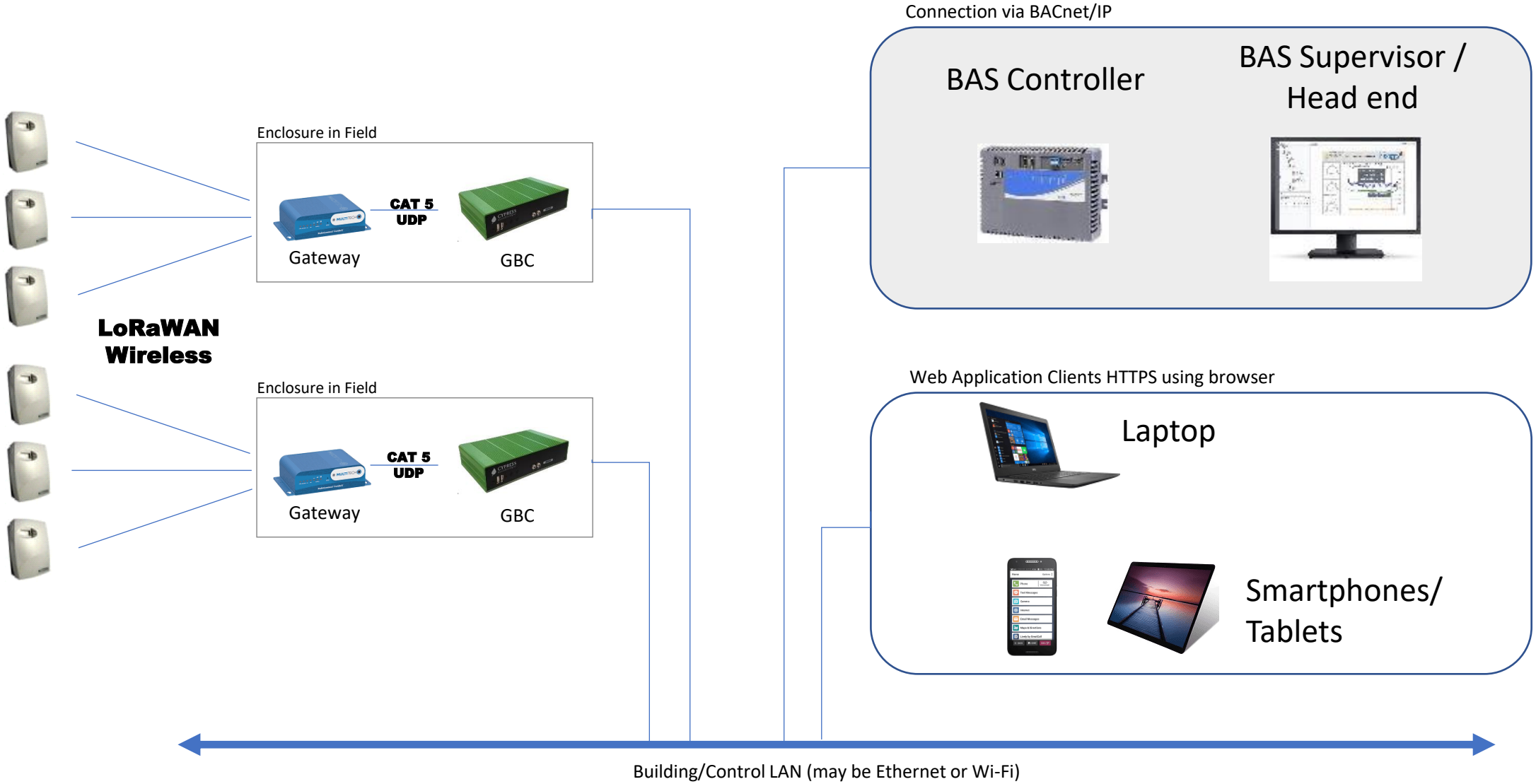
Green Box Controller (Applications Server)



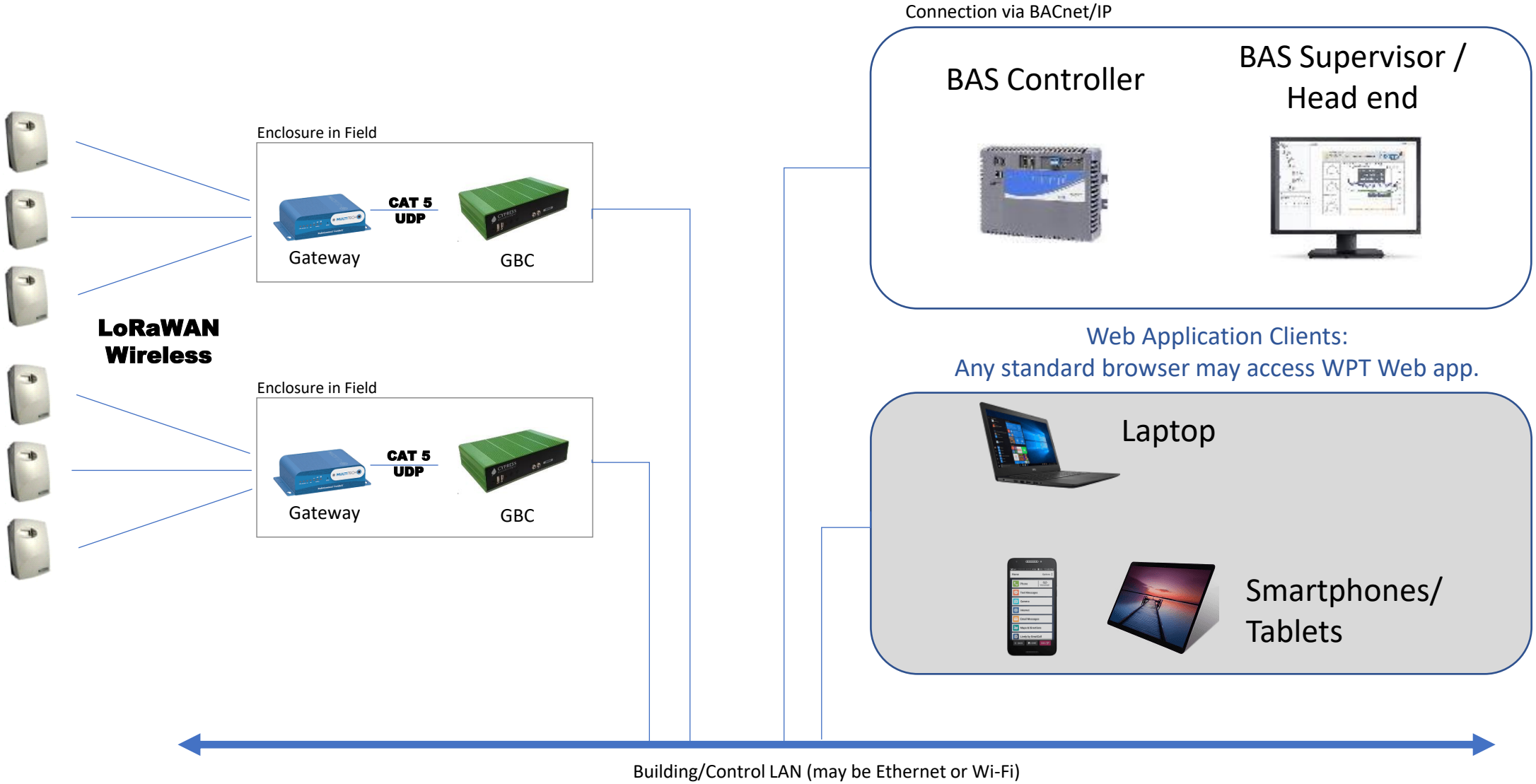
- Windows 10 Windows 10 IoT Enterprise LTSC 2021 (support till 2032 Q1).
- Web application server, BACnet/IP server.
- Connects to LAN via Ethernet/Wi-Fi.
- Store 2 weeks of history.

BACnet/IP Clients

- BAS can send commands and receive status to/from WPT via BACnet/IP
- Should be on same subnet as the GBC(s) or will require BBMD to communicate.



Web Application Clients



Appendix

Cyber Security FAQ

GBC:

- Windows 10 Enterprise IoT LTSC 2021 with support till Q1/2032
- Hardened operating system, all ports disabled except for those in use:
  - TCP 443 for HTTPS (web app)
  - UDP 27500 for Gateway communication
  - UDP 47808 for BACnet communication
  - TLS 1.2
- May install firewall and anti-virus of choice (Windows Defender included as default)
- Typically connects to building LAN via Ethernet or WiFi (requires optional USB WiFi adapter, not included)

Gateway:

- Linux based appliance
- Typically connected to GBC via a private ethernet connection (i.e. not on building LAN)
- Communicates with GBC via proprietary UDP packet format

Entire WPT Solution is assessed by U.S. Federal Government and remediated to comply with NIST 800-53

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.

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

- Sutter Health (6 sites)
- CommonSpirit (Baylor St. Lukes)
- Aurora (St. Luke’s Milwaukee)
- Advocate (3 sites)
- VA Medical Centers (12 sites)
- NY Health and Human Services (3 sites)
- Ascension
- Wyoming County Hospital
- LifePoint (6 sites plus 16 pending)