



# Emerging Trends and Technologies

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Jamie Ferdon, Business Development Manager, Canada





# Delta Value

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Our products aren't just products. We make tools to solve problems.

- Visualization – enteliWEB is a single pane of glass for all systems
- Connectivity – Networks and comm ports
- Acquire and Serve Data – Improve operations
- Integration – Key to delivering business value beyond basic operation
- Programmability – Not just sequences of operation. Use the data in unique ways to solve problems.





- 2023** RED5 IoT CONTROLLER FAMILY LAUNCHED
- 2022** OCCUPANT ESTIMATION WITH MACHINE LEARNING
- 2021** FIRST BTL LISTING FOR BACnet SECURE CONNECT
- 2020** enteliCLOUD
- 2019** FIRST BACnet SECURE CONNECT DEPLOYMENT
- 2018** INTEGRATION OF AI/ML MODELS FOR ACCURATE TEMPERATURE SENSING AND OCCUPANCY DETECTION
- 2017** O3 SENSOR HUB & INTEGRATED ROOM CONTROL
- 2013** COPPERTREE ANALYTICS & CLOUD ENGINEERING LAUNCHED
- 2012** FIRST POWER OVER ETHERNET
- 2010** enteliSYSTEM LAUNCHED
- 2004** FIRST GE LIGHTING CONTROLLER SHIPPED
- 2004** WIRELESS SENSORS DEVELOPED
- 2000** NATIVE BACnet LIGHTING AND ACCESS CONTROLLERS
- 2000** ORCAVIEW OWS RELEASED
- 1999** FIRST BACnet THERMOSTAT
- 1997** NATIVE BACnet HVAC CONTROLLERS
- 1992** FIRST ETHERNET CONTROLLER INTRODUCED
- 1989** INTELLISYS SYSTEM LAUNCHED
- 1987** 1<sup>st</sup> DDC LAN TO REACH 1 MILLION BPS
- 1982** 1<sup>st</sup> FULLY DISTRIBUTED DDC SYSTEM AVAILABLE IN CANADA



DELTA CONTROLS INC.

Headquarters in Vancouver BC  
Innovating Since 1986

We are a **campus of innovation**, growth, differentiation, empowerment

We believe a **collective vision** surpasses an individual one.

We **respect our roots.**

We are proactive, providing the unexpected extra to **create 'Wow.'**

We **make the world a better place** by reducing energy consumption and creating better experiences.

We take **extreme ownership**, move quickly & succeed together.

We believe **leadership is a responsibility**, not an entitlement.

We are guided by **facts & data.**

We treat every external interaction as a **moment of truth.**

We debate, learn, celebrate & **deliver.**

We **believe** it can be done.



“At **Delta Controls**, we create and grow organizations and the people within them”



## RECENT AWARDS

FROST & SULLIVAN

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**BEST**  
**2023** **PRACTICES**  
**AWARD**

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**NORTH AMERICAN  
BUILDING AUTOMATION SOLUTIONS  
COMPANY OF THE YEAR AWARD**

FROST & SULLIVAN

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**BEST**  
**2023** **PRACTICES**  
**AWARD**

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**GLOBAL IOT AND AI-ENABLED  
SMART BUILDING SOLUTIONS  
COMPETITIVE STRATEGY LEADERSHIP AWARD**

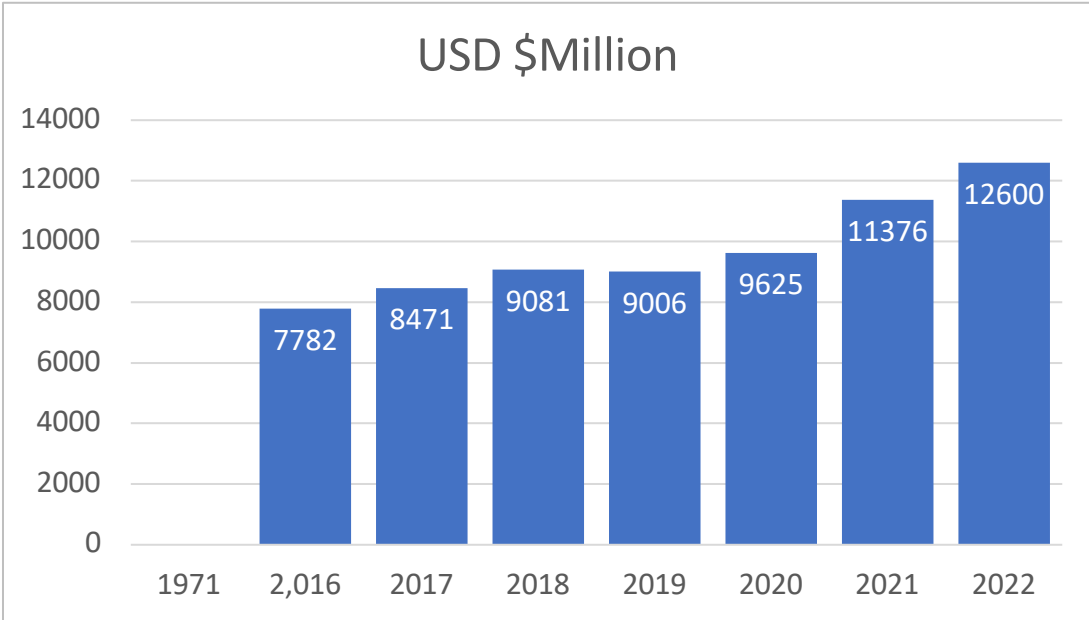


# DELTA ELECTRONICS OVERVIEW



## Dedicated to Providing:

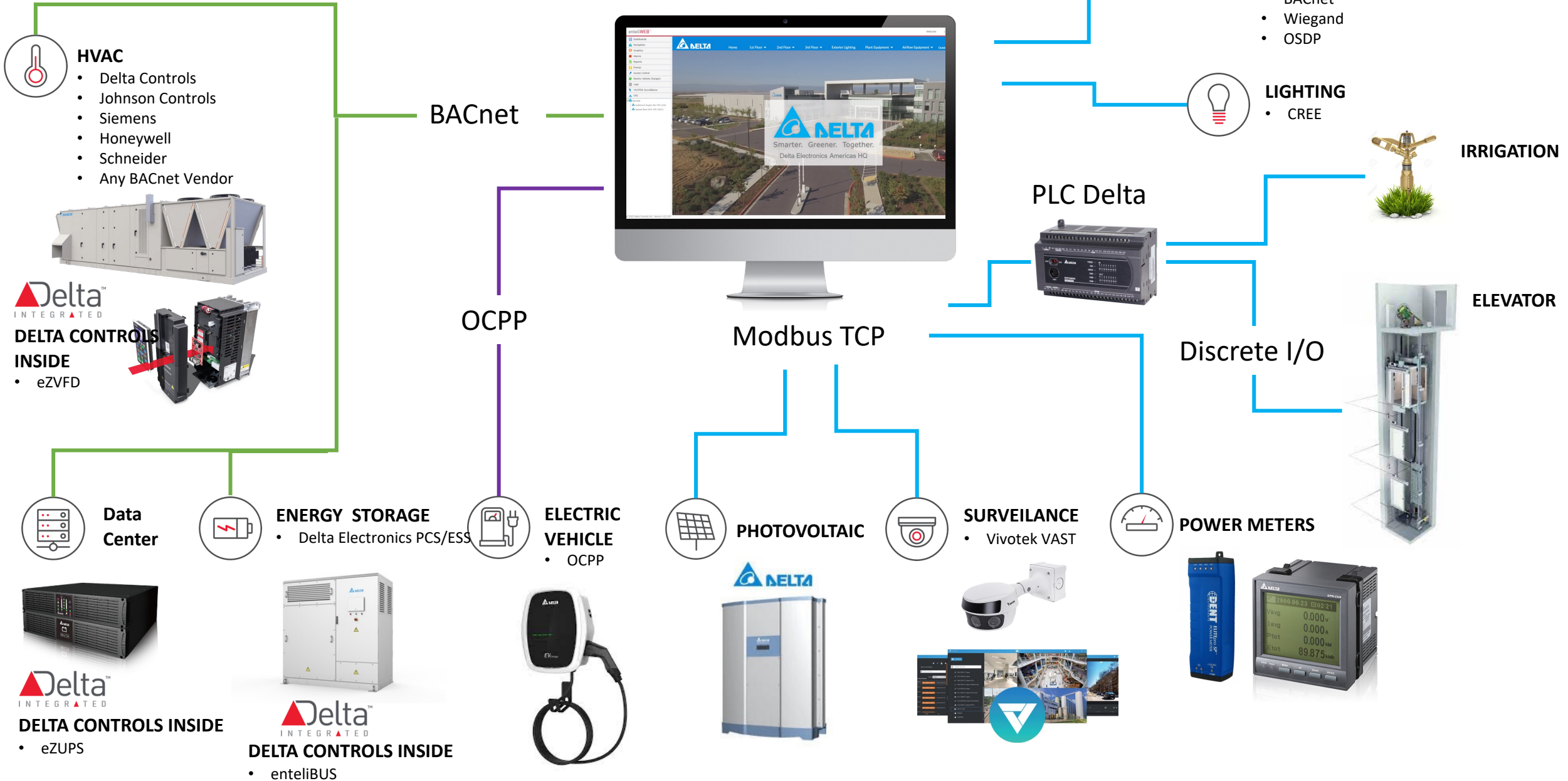
- Building Automation
- Industrial Automation
- Telecom Power Systems
- Passive and Magnetic Components
- Networking Products
- Visual Displays
- Datacenter Infrastructure
- Renewable Energy and Energy Storage
- EV Charging Infrastructure





# enteliWEB ARCHITECTURE

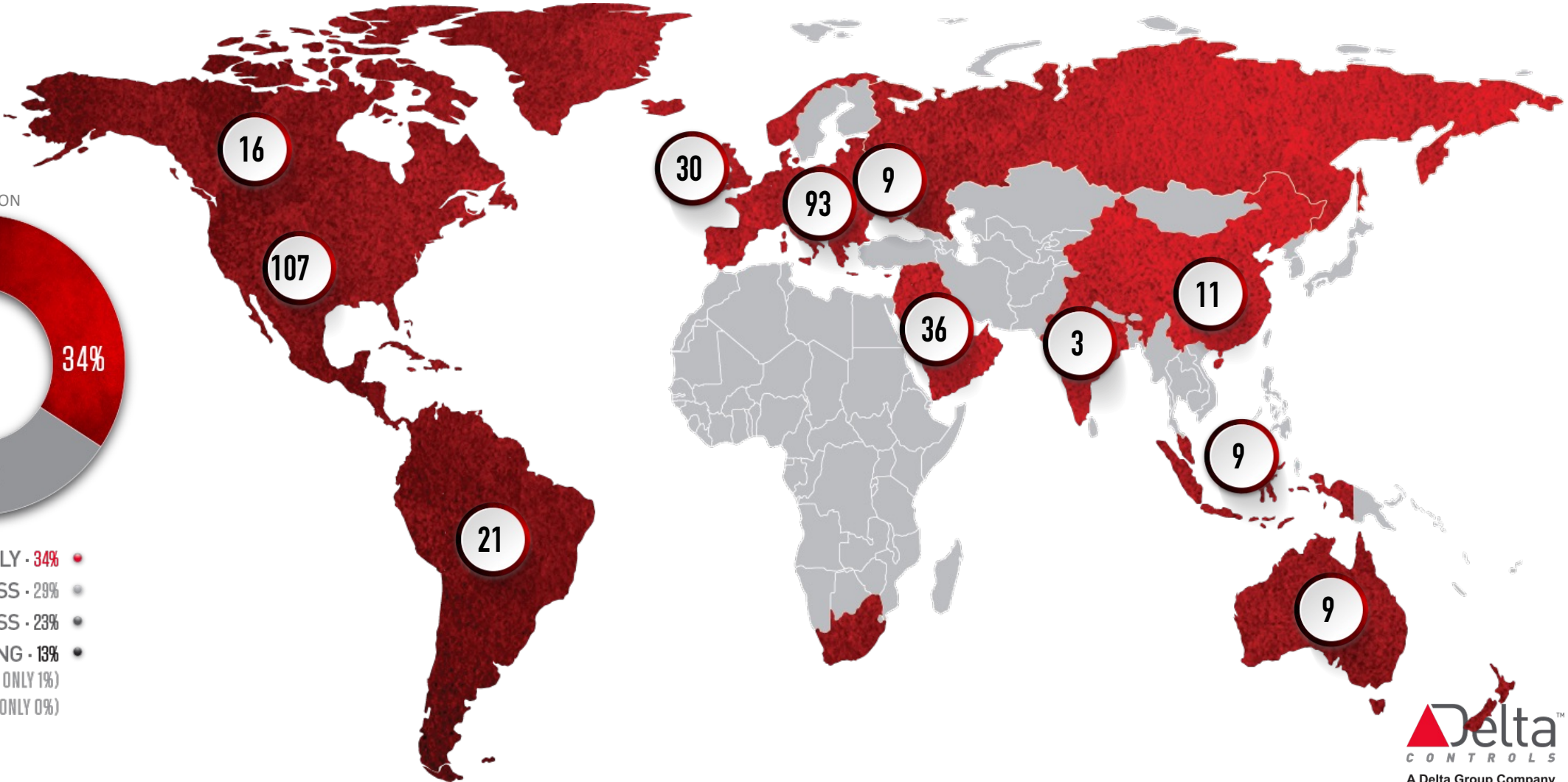
## enteliWEB™



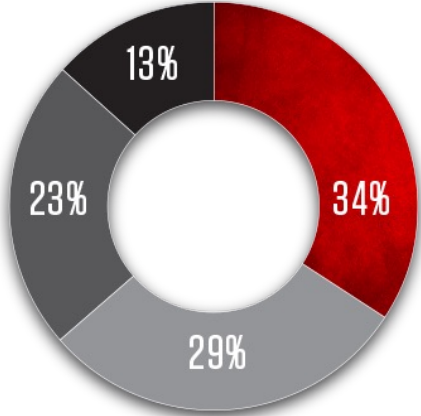


# DELTA CONTROLS PARTNER GLOBAL FOOTPRINT

300+ DELTA CONTROLS PARTNERS  
ON EVERY CONTINENT & IN OVER 80 COUNTRIES



PARTNER DISTRIBUTION



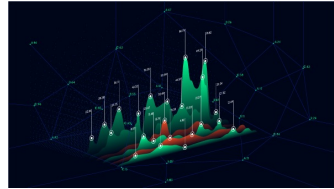
- HVAC ONLY - 34%
- HVAC LIGHTING & ACCESS - 29%
- HVAC & ACCESS - 23%
- HVAC & LIGHTING - 13%  
(LIGHTING ONLY 1%)  
(ACCESS ONLY 0%)

# INDUSTRY STANDARDS – TRENDS AND NEW TECHNOLOGY

## • Energy Saving Systems

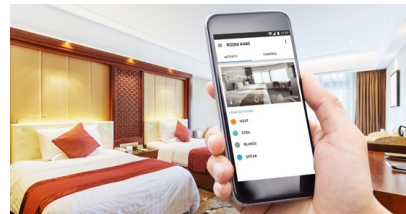
- New smart devices are being used to analyze environmental conditions for occupancy and high precision temperature/sensor control.

- Ex. O3 Edge, Occupant Estimation,
- Edge Analytics



- Fast acting control systems provide the exact heating and cooling necessary resulting in significant energy savings and increased occupant comfort

- Ex. Guideline36, Red5 VAV etc



## • Mobile Device Control

- Expectation is to control and program your HVAC system using your Smartphone

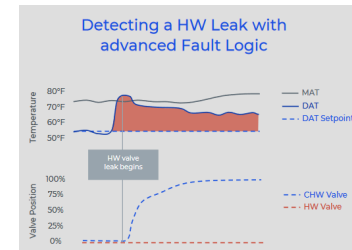
## • Smart HVAC Systems

- 69% of American households are equipped with at least one smart device
- Similar expectations are now passed on to commercial spaces
- It is important that HVAC devices are designed to be interoperable with these systems.
- Multiple programming capability. GCL/Python
  - Ex. Interoperability tools such as Node-RED



## • Analytics/AI

- Smart IoT devices synchronize data with cloud services
- Track consumer engagements and purchases
- Remotely detect potential faults or failures
- Analyze aggregate data for green initiatives.
- Import CHAT GPT information
- Use CHAT GPT to right GCL





# INDUSTRY STANDARDS – PROTOCOLS

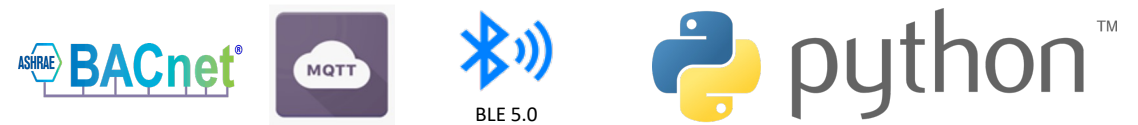
## Standard Connectivity

- NFC
- Dual-port Ethernet connection
- Bluetooth Low Energy (BLE 5.0)
- Universal I/O Ports



## Open Protocols

- Native BACnet communications: BACnet Ethernet, BACnet/IP, BACnet/SC
- MQTT allow for 3rd party development and integration
- BLE API for custom app development



## Interoperability

- Node-RED – tool used for wiring together hardware devices







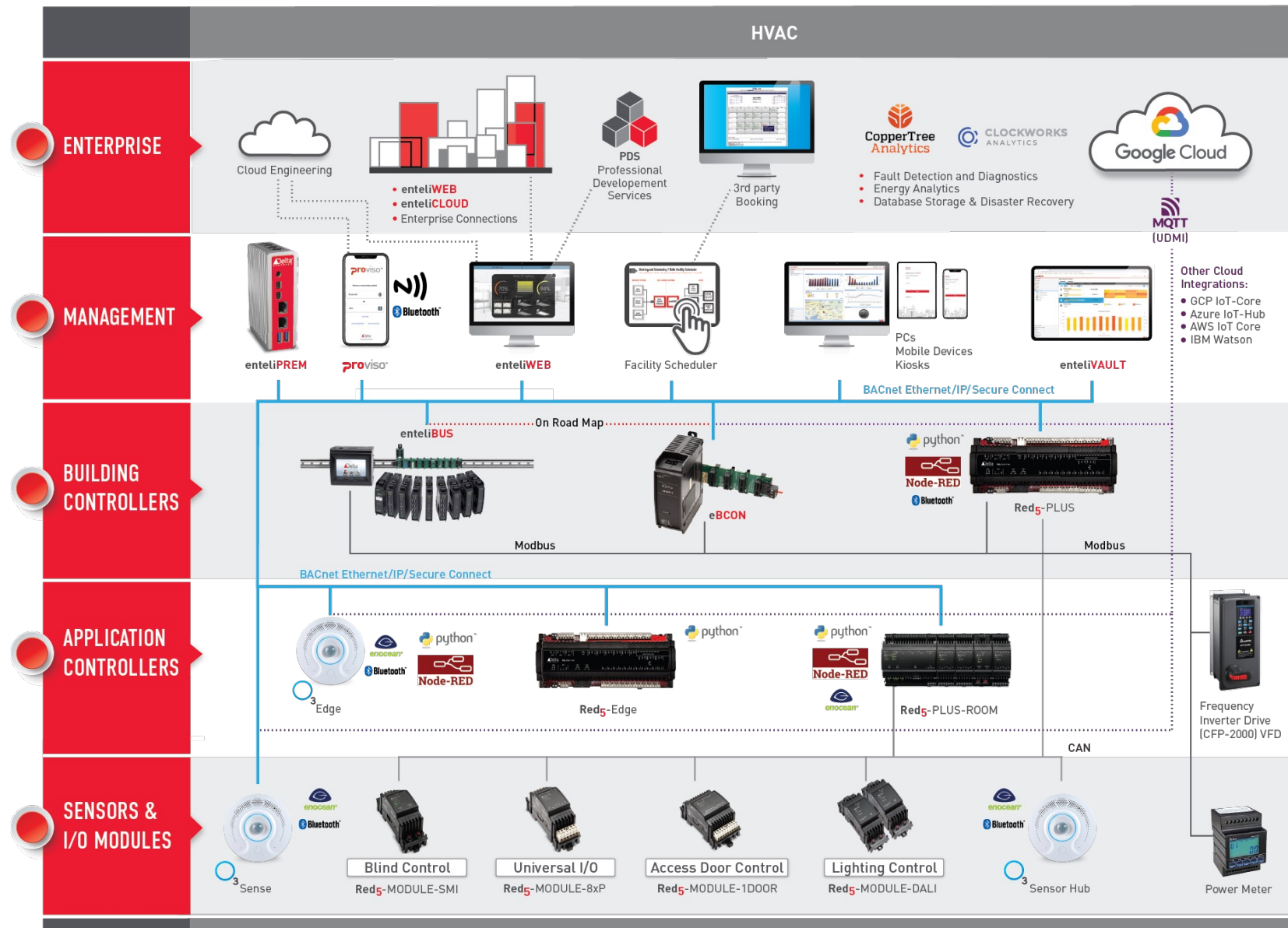
# IoT Connected Devices

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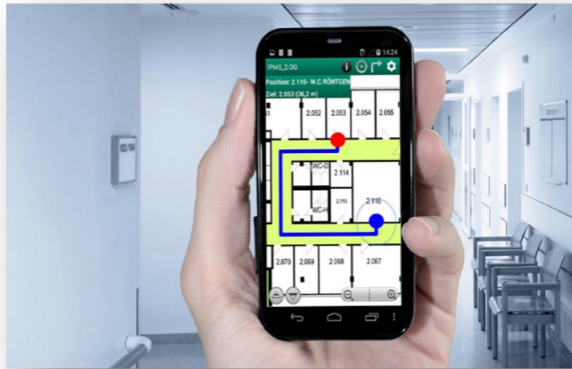


# IoT SYSTEM ARCHITECTURE

- Architecture physically flattens over time as most devices move to IP
- Logical levels of products shift over time
- Continue standardization to open protocols
- Management software at the system or Enterprise level are focused on data sharing
- Standardization of data access and APIs advance
- Sharing of data to more third-party organizations
- AI/ML will continue to propagate at the enterprise, system and edge level of devices



# O3 Edge Multisensor



OCCUPANCY  
(PIR + Audio)



TEMPERATURE



AUDIO OUTPUT



INFRARED  
TEMPERATURE



HUMIDITY



OCCUPANCY  
ESTIMATION



LIGHT COLOR



BLUETOOTH



WIRELESS



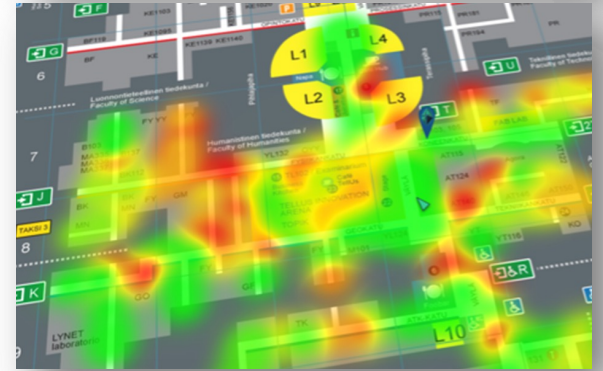
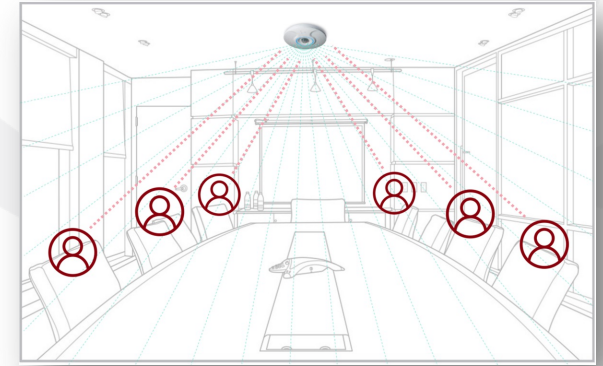
LIGHT LEVEL



IR BLASTER



LED RING

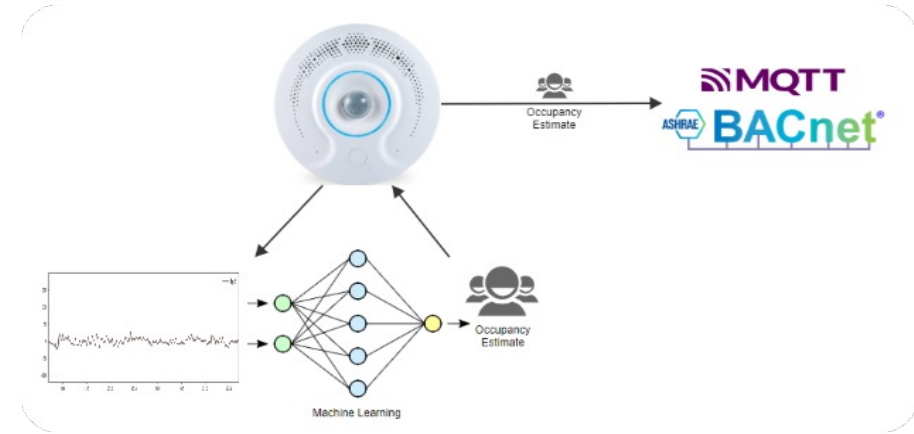
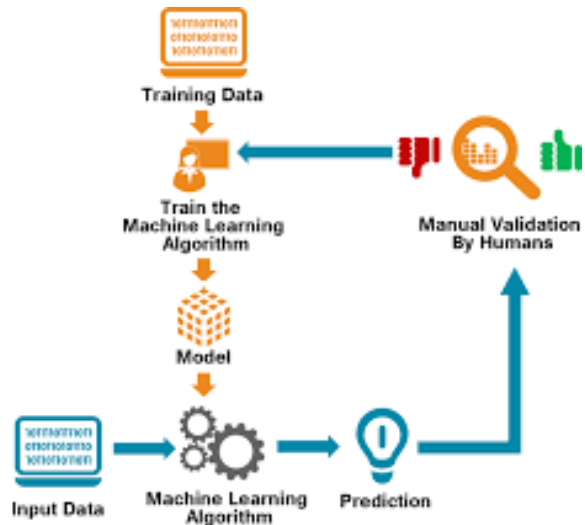




# MACHINE LEARNING APPLICATIONS

Continuing to build models that can be applied to our edge devices:

- Remote Accurate Temperature Sensing – model updates to accommodate different HVAC strategies
- Occupant Estimation – model to add people estimation to our sensor cluster at no extra cost
- Model Predictive Control – model to improve zone energy performance by 30%



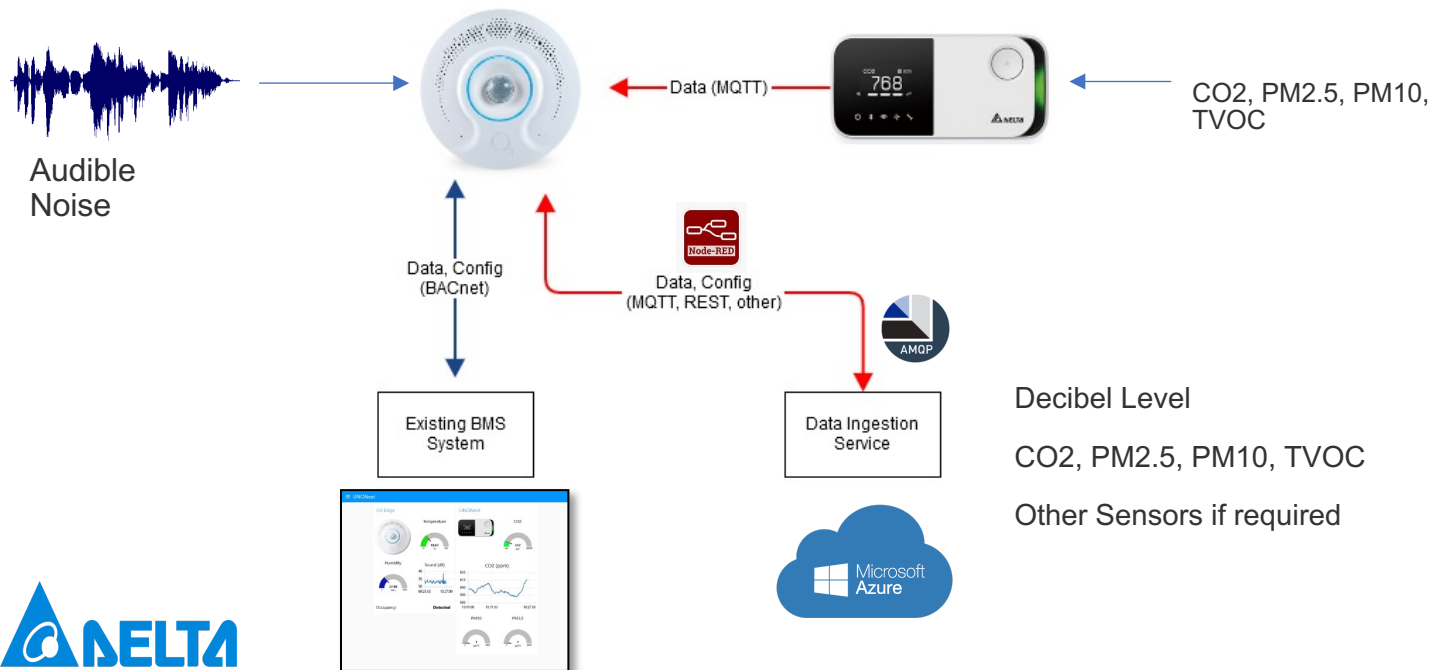
- Very low-cost people counting (use existing O3, no new hardware/peripherals required)
- Privacy – no camera, completely offline algorithm (no data sent to internet)
- Space sensing – open area occupancy (not door sensing)
- Large field of view (PIR sensor coverage)
- Approximate counts are adequate for many applications – demand control ventilation

# Acoustics



## ACOUSTIC OCCUPANT COMFORT

- Real-time and historical sound level monitoring
- Noise levels affect patient satisfaction scores
- Monitor, Temp, Hum, Occupancy, IAQ (CO2 levels)



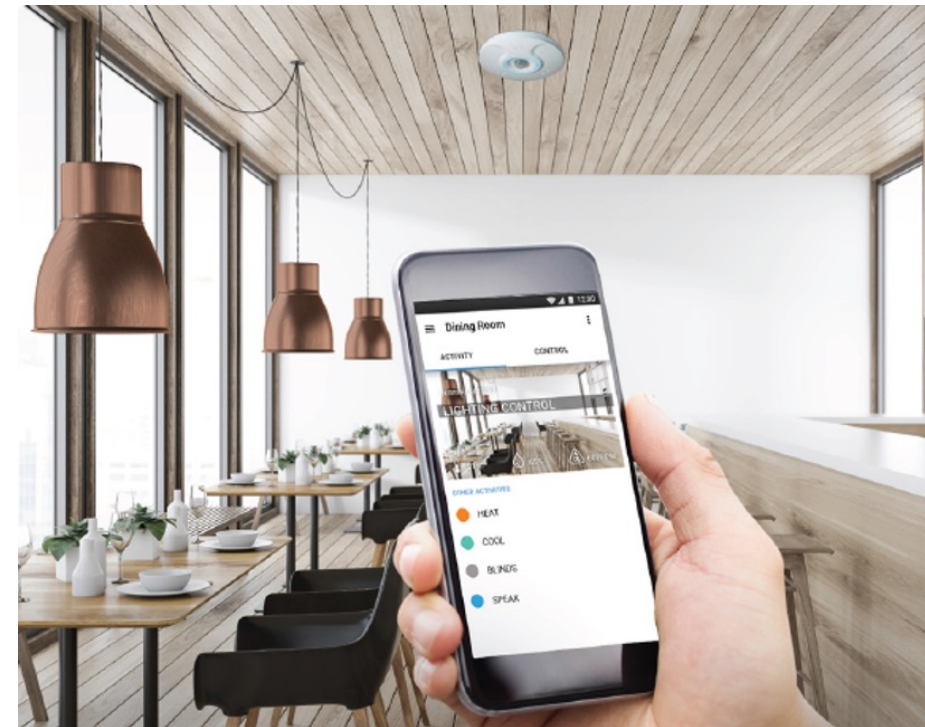




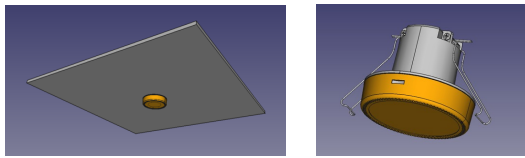
# Lighting

- Operate lights from enOcean switches using the O3 as an enOcean gateway
- Programming for circadian rhythm and for maximum energy efficiency
- Adjust lights according to the type of task

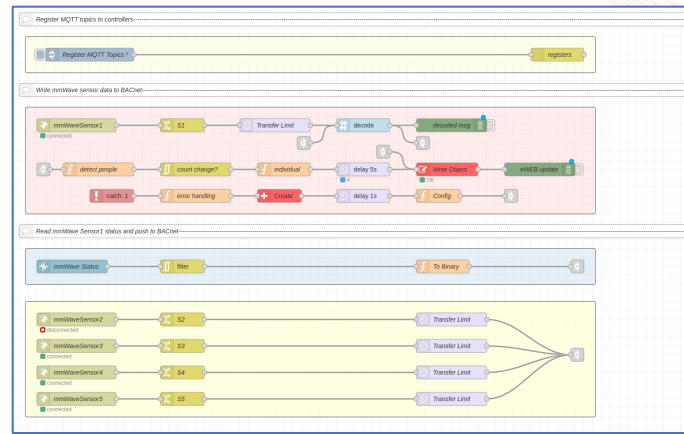
- Light level
  - Daylight harvesting
  - Shading control
- Light color (°K)
  - Color Temperature (Correlated Color Temperature – CCT)



# Fall Detection/People Counting –MMWave Sensor



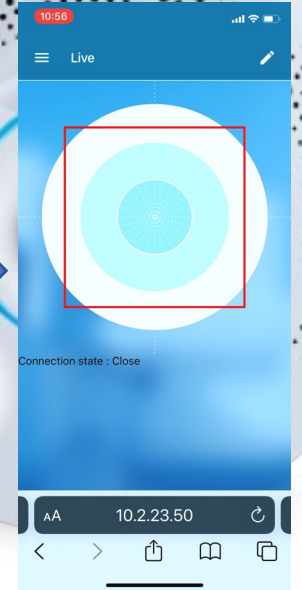
Feeds data to Node-RED running in O3 Edge



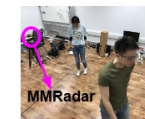
- mmWave radar uses Doppler Effect to detect objects
- Works under smoke/mist
- No images, High privacy
- Detect transparent objects
- Occupancy Detection, People Counting
- Fall Detection, State Detection

python

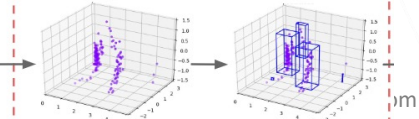
GCL+



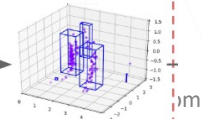
Data Collection



Point Cloud Generation



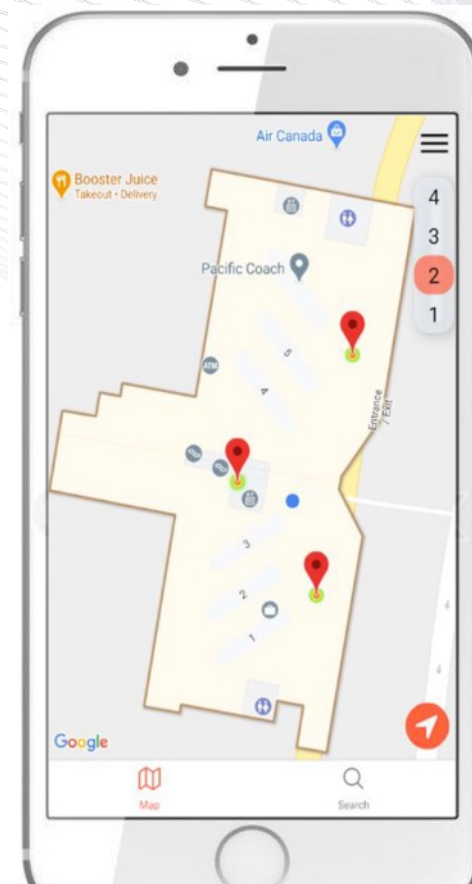
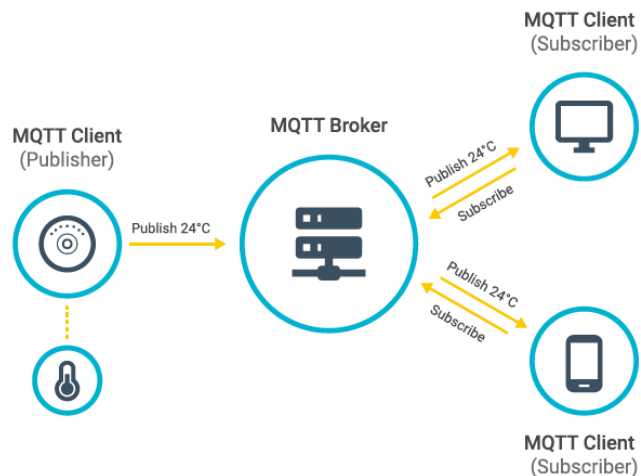
Clustering





# Indoor Position Tracking

- Mobile App interfaces with O3 Edge
- Bluetooth beacon used to track the user's position
- MQTT to communicate telemetry to Cloud Server
- Augment Google Maps floor plan with environmental data about nearby spaces
- Allows user to search nearby spaces that match set preferences



# Red5

## Red5-PLUS-ROOM Modular Room Integration

The Red5-PLUS-ROOM supports multiple communication methods, including BACnet/IP, BACnet over Ethernet, BACnet MS/TP and Delta LINKnet



Control HVAC, access and lighting with just one controller.



### Key Features

#### Universal I/O

No more inputs and outputs. Use universal points to control or read from field equipment. Reduce engineering and product costs by being able to use every point on the board.

#### Modular Room Integration

Connect to DALI, EnOcean and Modbus by adding modules. Control HVAC, access and lighting without having to run separate networks.



# enteliBUS

Modular. Expandable. Flexible.

The enteliBUS Control System is a powerful, fully programmable BACnet controller that features modular, expandable I/O up to over 300 points. enteliBUS has hot-swappable I/O modules for fast and easy installation. With HAO switches, save your equipment from short cycling and make troubleshooting a breeze. Use enteliBUS as a BACnet router or join multiple network segments.

Join multiple network segments while reducing troubleshooting downtime.



Expandable to over 300 I/O points

### Key Features

#### Hot Swappable

Multiple, configurable modules can be changed out while enteliBUS is powered. Reduce downtime for troubleshooting.

#### HAO Switches

Outputs use manual Hand-Auto-Off switches. You can change from Auto to On or Off without short-cycling equipment.

#### Connectivity & Security

BACnet BBMD and BACnet Secure Connect Routing.



27x Faster  
Processing Speed



2000x Flash Memory



1000x Memory

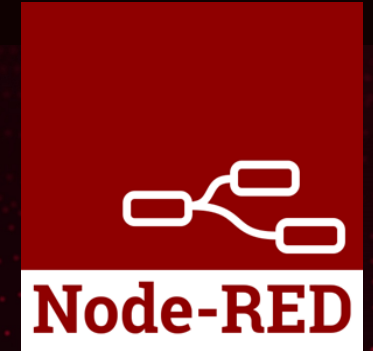
Software  
Configurable Inputs

BLE

NFC



# Red5



IoT Services

Internal Webserver

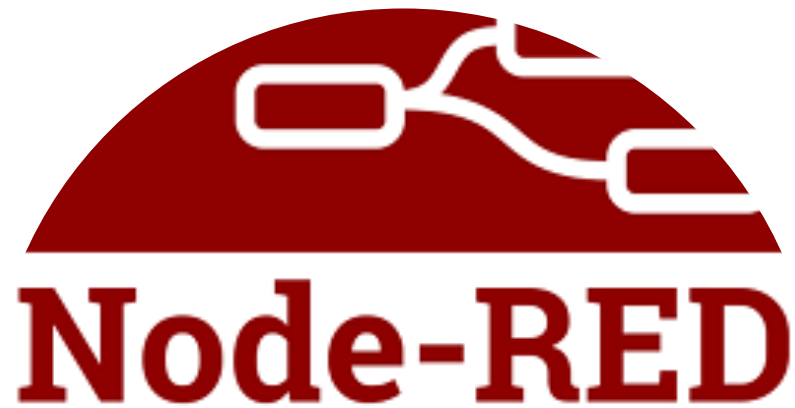
16 Bit Inputs



- **Integration Use Cases**
  - Red5-> ChatGPT
  - Red5->Weather App
  - Embedded Graphics
  - Dashboards
  - Integrated Ecosystems



Red<sub>5</sub>







ChatGPT

# Red5

- Node-Red Captures BACnet Alarm Notification
- ChatGPT helps diagnose the issue

Node-RED interface showing a flow named "Flow 1". The flow starts with a "BACnet Alarm" node (red) connected to a "switch" node (yellow). The "switch" node has two paths: one leading to a "debug 27" node (green) and another leading to a "function 18" node (orange). The "function 18" node is connected to a "BACnet Read" node (red), which is connected to a "function 19" node (orange). The "function 19" node is connected to a "set msg payload" node (yellow), which is connected to a "Chat GPT Control Sequence" node (teal). The "Chat GPT Control Sequence" node is connected to a "debug 34" node (green). The "Chat GPT Control Sequence" node is also connected to a "Response to BACnet MSG" node (orange), which is connected to a "BACnet Write" node (red). The "BACnet Write" node is connected to a "debug 33" node (green). The "BACnet Read" node is also connected to a "debug 35" node (green).

The right sidebar shows the "debug" console with the following output:

```

10/17/2023, 3:56:32 PM node: debug 27
msg.payload : Object
  { BACnet: object }

10/17/2023, 3:56:33 PM node: debug 35
msg.payload : Object
  { BACnet: object }

10/17/2023, 3:57:07 PM node: debug 34
databind : msg.payload : string[1684]
  "There could be several potential causes for a failed flow proof in an AHU (Air Handling Unit) supply fan. Some possible causes include:
  1. Faulty or malfunctioning sensors: The flow proof may have failed due to a malfunctioning or inaccurate sensor that measures the airflow. This could be a result of a sensor failure or a wiring issue.
  2. Fan motor issues: The supply fan motor might be experiencing problems, such as lack of power supply, mechanical failure, or issues with speed control. These issues can lead to inadequate or inconsistent airflow, causing the flow proof to fail.
  3. Obstructions or blockages: Blockages in the supply ductwork or at the fan inlet/outlet can restrict or disrupt the airflow, resulting in a failed flow proof. These obstructions can be due to debris, accumulated dirt, or improperly installed dampers.
  4. Damaged or worn fan blades: If the fan blades are damaged, bent, or worn out, they may not be able to produce the required airflow, leading to a failed flo..."

10/17/2023, 3:57:07 PM node: debug 33
databind : msg.payload : Object
  { BACnet: object }

```



## Flow Proof Alarm (200.EV1)



Save

Close

### Alarm

Auto

Alarm

Status	Flow Switch	Off
Command	Fan Enable	On
Reliability	No Fault Detected	
Pending Alarm	Alarm	
Pending Transition Time	0 Seconds	
Time of Transition	Oct 17, 2023, 4:11:49 PM	Alarm
	Oct 17, 2023, 4:11:11 PM	Normal
	Oct 17, 2023, 3:49:47 PM	Fault
Notification Class	Notification	

There are several potential causes for a failed flow proof in an AHU (Air Handling Unit) supply fan. Here are some possible reasons:

1. Faulty airflow sensor: The flow proof may fail if the airflow sensor is not functioning properly. It could be malfunctioning, damaged, or dirty, causing inaccurate readings.
2. Blocked or restricted airflow: If there is an obstruction in the ductwork or air filters, it can restrict the airflow and lead to a failed flow proof. Ensure that filters are clean and there are no obstructions in the ducts.
3. Damaged fan or motor: A malfunctioning fan or motor can result in reduced airflow or inconsistent performance, causing the flow proof to fail. Check for any mechanical issues, such as worn-out fan blades or motor failures.



ChatGPT

# Red5

## Chat-GPT Query:

**Write a Delta Controls GCL based program for an Air Handling Unit with 1 heating stage, 1 cooling stage, 1 outdoor air damper, 1 return air damper, variable speed supply and return fans, with duct static pressure control**



Browser tabs: Google Search, enteliWEB (8 new alarms), Red5-PLUS-1180, Node-RED : 10.0.0.93, Node-RED Dashboard

URL: <https://10.0.0.93/nodered/#flow/1b4d62cf15bf66f8>

Buttons: Deploy, User Profile

### Chat-GPT Interface

```
graph LR; M[Message abc] --> D2[debug 2]; M --> C[Chat GPT Control Sequence Response complete]; C --> F[Response to BACnet MSG f]; F --> B1[BACnet Write OK]; B1 --> D7[debug 7]; I[inject] --> B2[BACnet Write]; B2 --> D4[debug 4];
```

debug

4/19/2023, 1:43:31 PM node: debug 2  
msg.payload : string[221]

"Write a Delta Controls GCL based program for an Air Handling Unit with 1 heating stage, 1 cooling stage, 1 outdoor air damper, 1 return air damper, variable speed supply and return fans, with duct static pressure control"

# Where are we going with AI

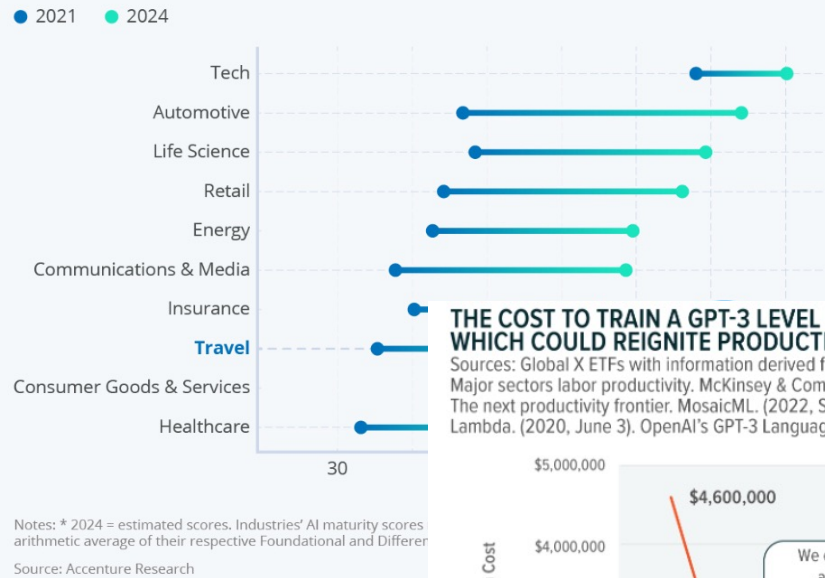
AI will continue to become more ubiquitous with accelerated adoption across all industries. However, the benefits of AI will be the result of **evolutionary rather than overnight changes**.

Organizations looking to build or deploy AI should mitigate the risk of not meeting compliance requirements later by **adopting responsible AI frameworks** now.

As generative AI technologies are trained by scraping the web to compile massive data sets for their models, questions arise about **who truly owns, controls, and has rights to that data**.

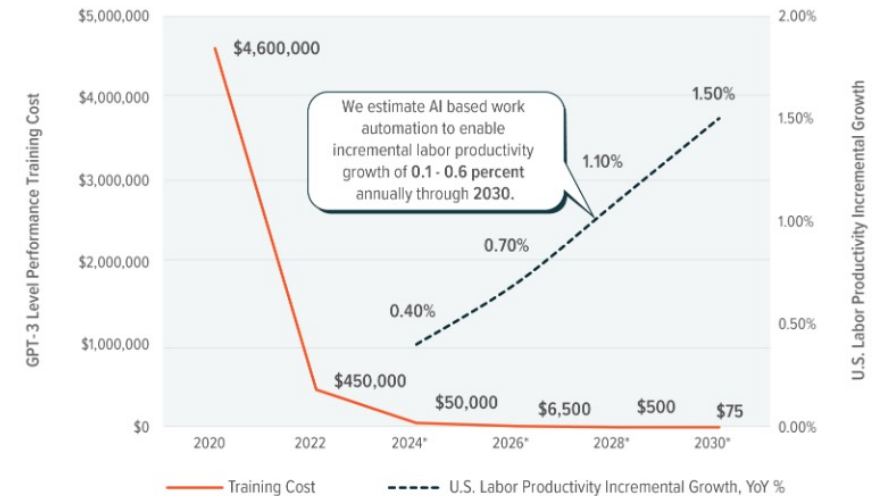
## FROM TECH TO TRAVEL, AI MATURITY IS EXPECTED TO GROW FAST

Levels of AI maturity by industry, 2021 and 2024\*



### THE COST TO TRAIN A GPT-3 LEVEL LLM DECLINED BY ABOUT 90% FROM 2020-2022, WHICH COULD REIGNITE PRODUCTIVITY GROWTH

Sources: Global X ETFs with information derived from U.S. Bureau of Labor Statistics. (2023, November 2). Major sectors labor productivity. McKinsey & Company. (2023, June 14). The economic potential of generative AI: The next productivity frontier. MosaicML. (2022, September 29). Mosaic LLMs (Part 2): GPT-3 quality for <\$500k. Lambda. (2020, June 3). OpenAI's GPT-3 Language Model: A Technical Overview.



\*Indicates forecast. U.S. Productivity Growth measures the incremental YoY boost to labor productivity, measured as output per hour worked, of non-farm business employees, delivered by increased use of automation in work.





# IoT, Ontology & Digital Twins

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# Normalization of Ontologies

**Ontology:** An abstract format for representing components/objects and their relationships with context.

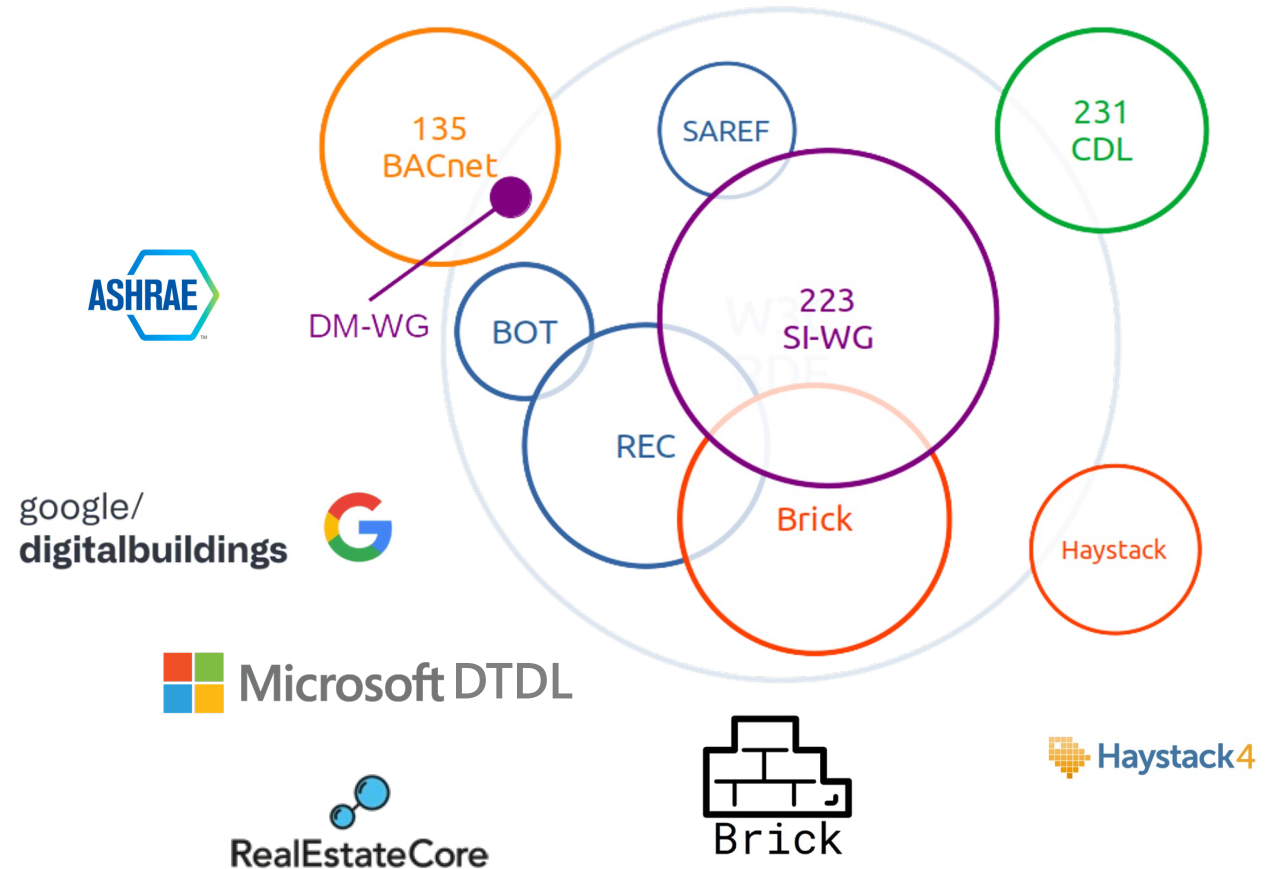
**Problem being solved:** Difficulty doing most BMS operational improvements beyond the simpler and easier basic changes without a large amount of site-specific knowledge.

**Goal:** To improve machine readability of natural language descriptors within BMS programming using a Data Ontology to support:  
Information retrieval/Application integration/Interoperability

Several Ontologies have been developed or are being developed.

## Digital Twin Description Language:

Haystack/BRICK/RealEstate Core/BOT/SAREF/Digital Buildings/Several others specific to analytics implementations

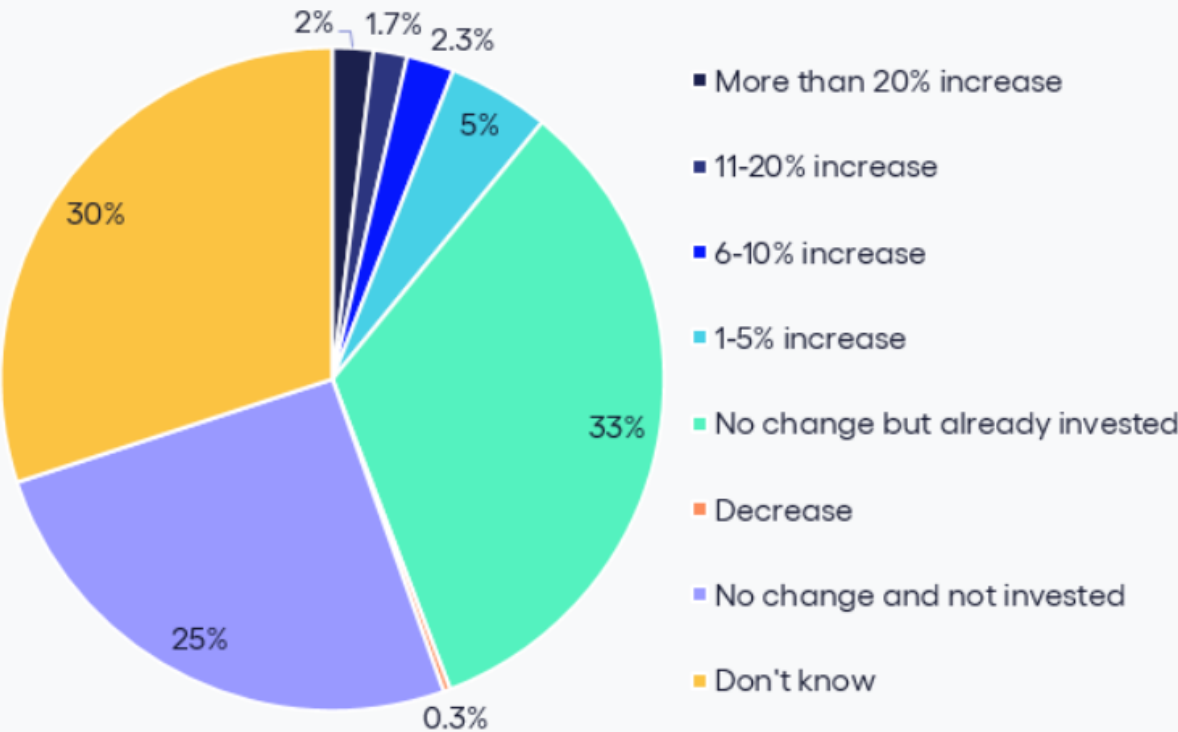




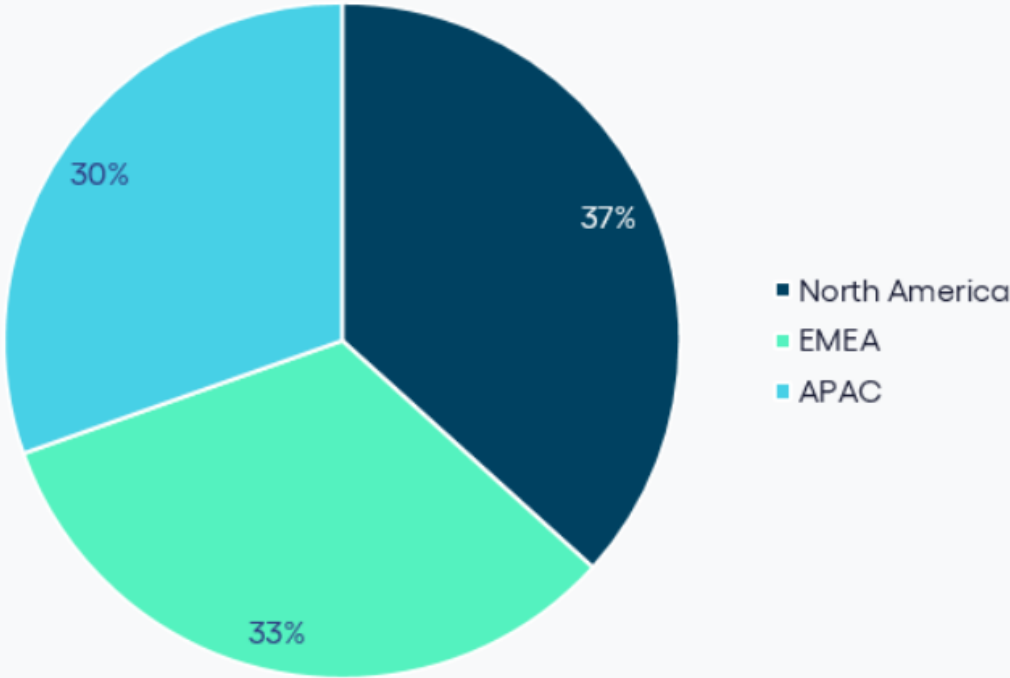
# Our latest corporate survey reveals that over a third of firms interviewed have already invested in digital twins, with North America leading in the number of invested firms

## Change in investment in digital twin software

Question: Over the next 12 months, how do you expect your spending to change for building digital twin software?



## Regional breakdown of firms already invested in digital twins



N=303  
Source: PRE-PUBLISHED: Verdantix Global Corporate Survey 2023: Smart Building Technology Budgets, Priorities & Preferences

# BUILDING CANVAS

Cloud Engineering  
Programming. Graphics.  
Documentation.

Cloud Deploy  
Provision. Startup.

enteliCLOUD  
Operate. Manage. Data.

Maintain  
Mitigate Risk. Increase  
Uptime.

Analytics  
Analyze Data. Improve  
Operation.



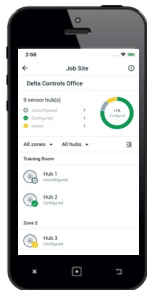
Engineer or PAS  
publishes finalized  
DB to Cloud Deploy  
  
(Webservice)

DTS:

- Standard HVAC databases ready to deploy via phone
- Manage devices / connections
- Updates to databases / firmware



Installers don't know  
or care about Canvas.  
They simply use a  
mobile app.



**Phone Apps**

- Provisioning
- Commissioning



Bluetooth + Mobile App



BACnet/SC



Joins BACnet Network



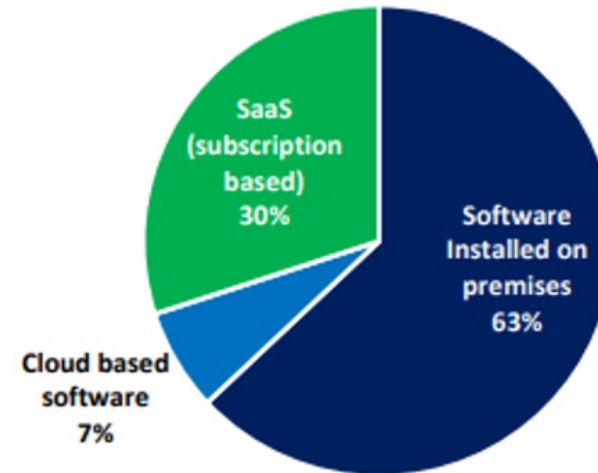
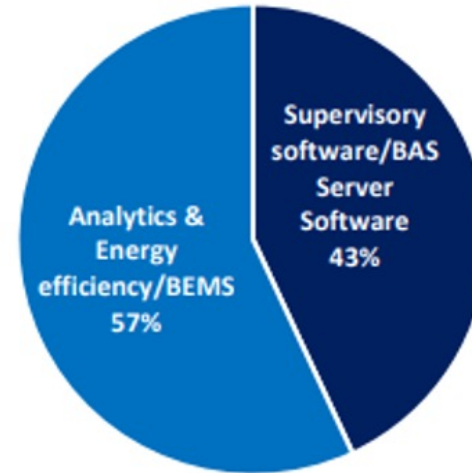
# Edge – Cloud & Analytics

*Nearly 100% of supervisory software is installed on premises as end-users and occupiers choose to have their critical infrastructure on premises.*

*Analytical & BMS software is nearly all cloud based and a large share is sold as SaaS.*

*Although building owners and operators understand the value of analytics, it seems that the lack of experience to interpret the increasing amount of data is still a barrier to further development in this market.*

Software by type and application, % split by value, 2022







# Cyber Security

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# Cyber Security & Climate Regulation

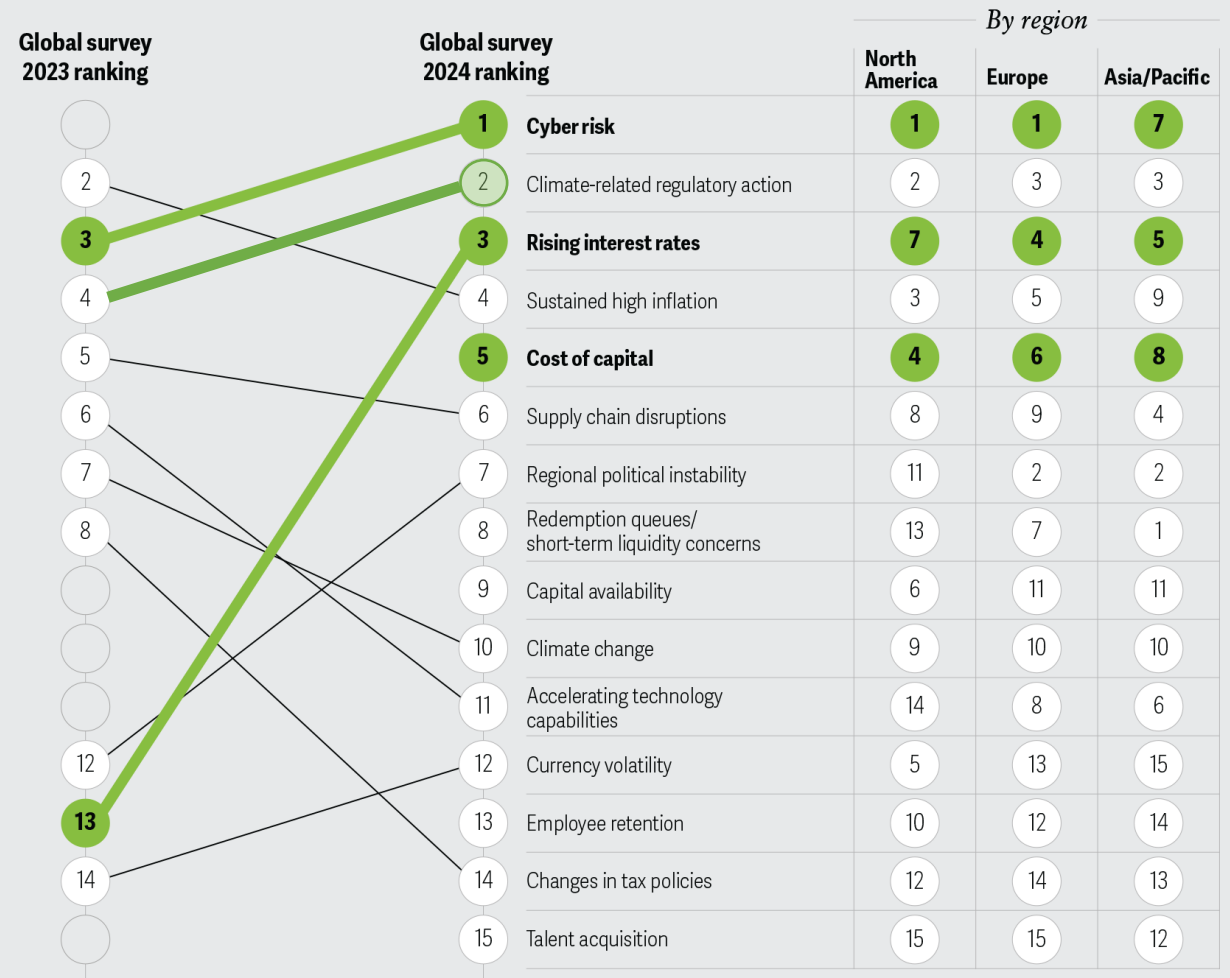
Respondents globally grew most concerned about cyber risk, identifying it as the most likely trend to impact their financial performance, especially in Europe, where nearly half of the respondents chose this option. This was anticipated as **the real estate industry increasingly incorporates smart technologies into their buildings** and thus, now faces asset-level vulnerabilities.

**Net zero buildings are achieving record rents** as occupiers increasingly look for spaces that reflect their sustainability commitments, according to JLL.

Figure 2

## Macroeconomic factors and cyber risk are top concerns through 2024

Which poses the greatest risk to your institution's financial performance over the next 12 to 18 months?



Notes: Respondents could make multiple selections, blank indicate response options that were not included in last year's survey, results compared against prior year's 2023 Real Estate Outlook Survey responses.

Source: The Deloitte Center for Financial Services 2024 Real Estate Outlook Survey.

# DELTA CONTROLS CYBERSECURITY



## BACnet Secure Connect

- BACnet/SC Adds Encryption and Authentication

## Delta Controls Security Processes and Advisories

- Best Practices based on OWASP, ISO 27001, and IEC 62443 4-1, SOC 2
- Delta Controls monitors and reports cybersecurity threats
- Dedicated product development security team

## Report Vulnerability

- On-line Vulnerability Reporting



# DELTA CONTROLS CYBERSECURITY PROGRAM



## Organization Infrastructure

- I.T., supply chain, development follow ISO, SOC compliance requirements



## Development Processes

- DCI has a SDLC in place, based on the Microsoft SDL platform and following OWASP



## Products

- Product cyber continues throughout the lifecycle of the product.
  - Firmware upgrade
  - Zero-day vulnerability updates



International  
Organization for  
Standardization



**OWASP**  
Open Web Application  
Security Project





# Red5



## What is BACnet/SC?

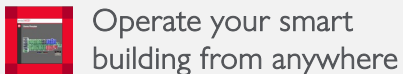
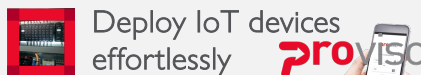
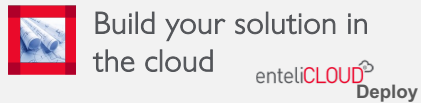
- BACnet addendum bj
- Adds **encryption** to native BACnet
- Adds **authentication** to native BACnet
- Puts BACnet/IP inside HTTPS (WebSocket)
- Additional medium to route traffic
  - Add-on to existing buildings/networks
- Not Proprietary - Interoperable

# Our Future Strategic Product Initiatives



Building Canvas compensates for the labor shortage  
Attracting new channel partners improving productivity.  
New routes to market with IoT & cloud.

Software-as-a-Service **recurring revenue**



AI at all levels  
O3 Sensor Hub AI for environmental, acoustic & occupancy  
Red5 distributed analytic integrations and support for future AI at the edge  
Canvas automates engineering workflows and introduces a Digital Twin platform to service system level analytics and optimization integrations



AI, ML and FDD workloads at edge  
Backwards compatible supporting existing engineering tools and simple upgrades.  
IoT integration support with new generation of prog. languages  
IOEM opportunities  
Cybersecurity with BACnet SC



Expansion of prog. languages and capabilities supports new generation of engineers:  
Legacy GCL+ supports traditional engineers  
Python brings a modern language that is familiar to BMS engineers and software developers  
Node-RED allows for low-code API & IoT edge integrations



Engineering and operations in cloud and on-prem:  
Choice of on-premises or cloud version of BACS  
Front end & archiving  
Cloud Engineering integrates DCI  
Partners project execution workflows into Delta Controls cloud ecosystem as a SaaS offer





THANK YOU