

# BDNS IFC Summit

London | 2025-09-17

# Agenda

# Agenda - morning

- 9:30 - 11:30 Using BDNS - Case Studies Presentations
  - 9:30 - Introductions (5 min) [Francesco Anselmo](#)
  - 9:35 - History and scope of BDNS (10 min) [Francesco Anselmo](#)
  - 9:45 - Using BDNS at Google (30 min) [Francesco Anselmo](#)
  - 10:15 - Using BDNS at Max Fordham (30 min) [j.gunstone@maxfordham.com](mailto:j.gunstone@maxfordham.com)
  - 10:45 - Using BDNS at Arup (30 min) [andrea.spanu@arup.com](mailto:andrea.spanu@arup.com)
- 11:15 - Coffee Break (15 min)
- 11:30 - 12:30 Building Systems Ontologies
  - 11:30 IFC (15 min) [alex.plenty@skanska.co.uk](mailto:alex.plenty@skanska.co.uk)
  - 11:45 Brick Schema (15 min) [Francesco Anselmo](#)
  - 12:00 Haystack (15 min) [Francesco Anselmo](#)
  - 12:15 Digital Buildings Ontology (15 min) [Francesco Anselmo](#)

# Agenda - afternoon

- 14:00 - 17:00 Future of BDNS discussion
  - 14:00 - 15:00 Round table
    - Equipment reference naming discussion (Revit Conventions)
    - Smart Buildings Guide
    - Aligning BDNS and IFC to other Building Systems Ontologies
    - Potential collaboration between BDNS and other ontologies such as BrickSchema and Haystack
  - 15:00 - Coffee Break (15 min)
  - 15:15 - 16:15 BDNS in BIM tools
    - IFC bSDD workflow [alex.plenty@skanska.co.uk](mailto:alex.plenty@skanska.co.uk)[kyamamoai@kajima.com](mailto:kyamamoai@kajima.com)
  - 16:15 - Coffee Break (15 min)
  - 16:30 - 17:00 BDNS tools
    - Github automation [j.gunstone@maxfordham.com](mailto:j.gunstone@maxfordham.com)
    - QR code generator [Francesco Anselmo](#)
    - QR code scanner [Francesco Anselmo](#)

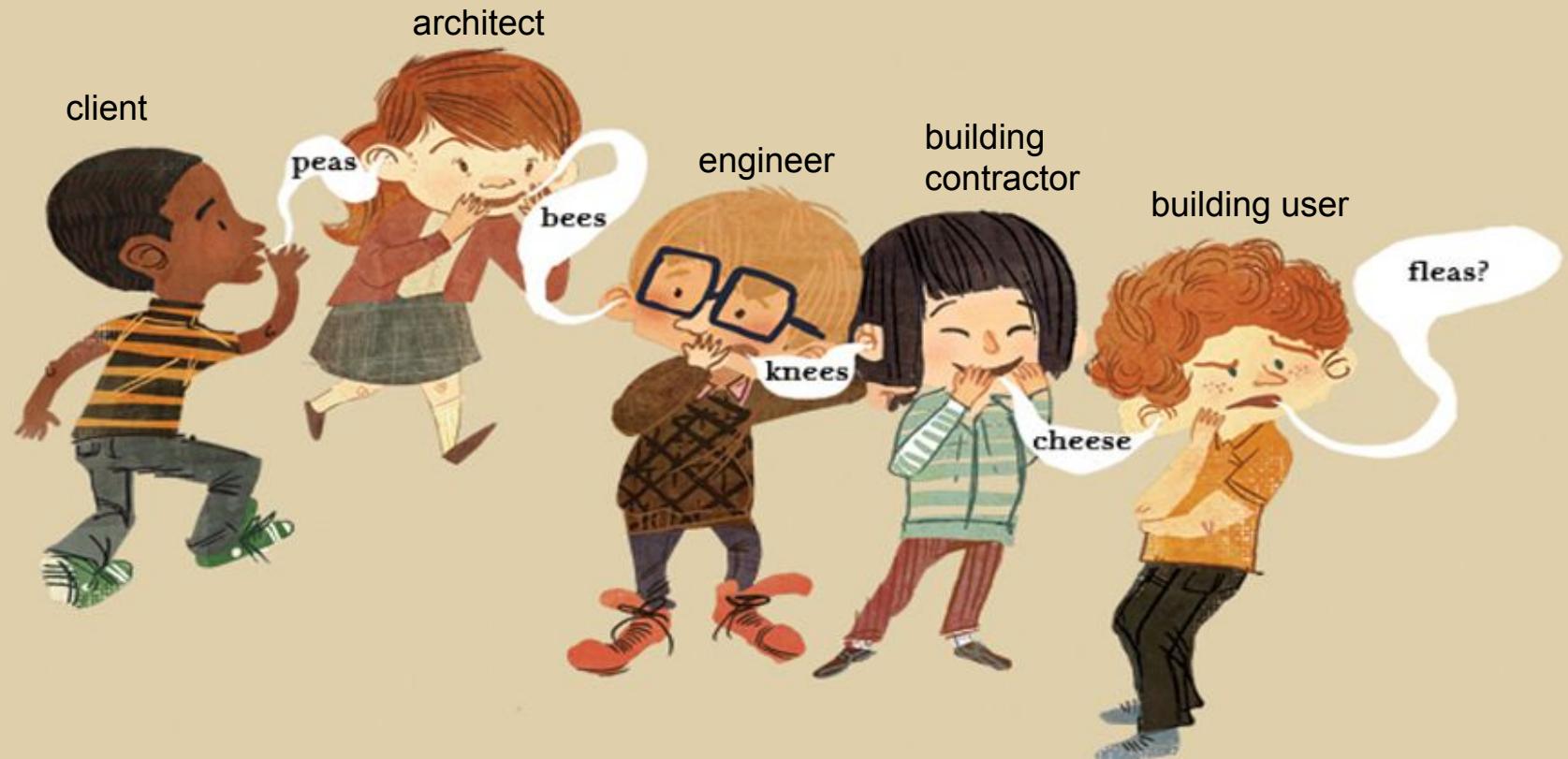
# Introductions

# Using BDNS

# History and scope of BDNS



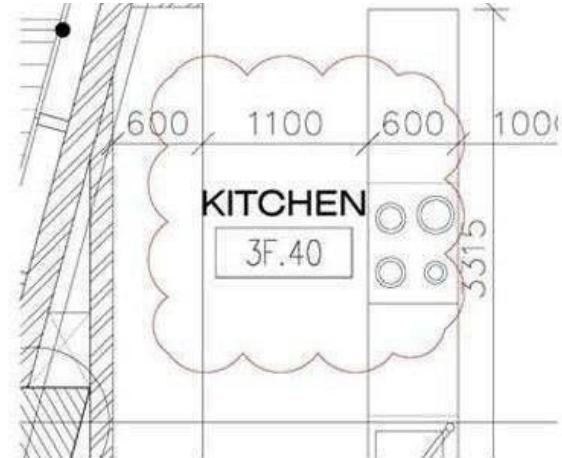
### [Image Attribution](#)



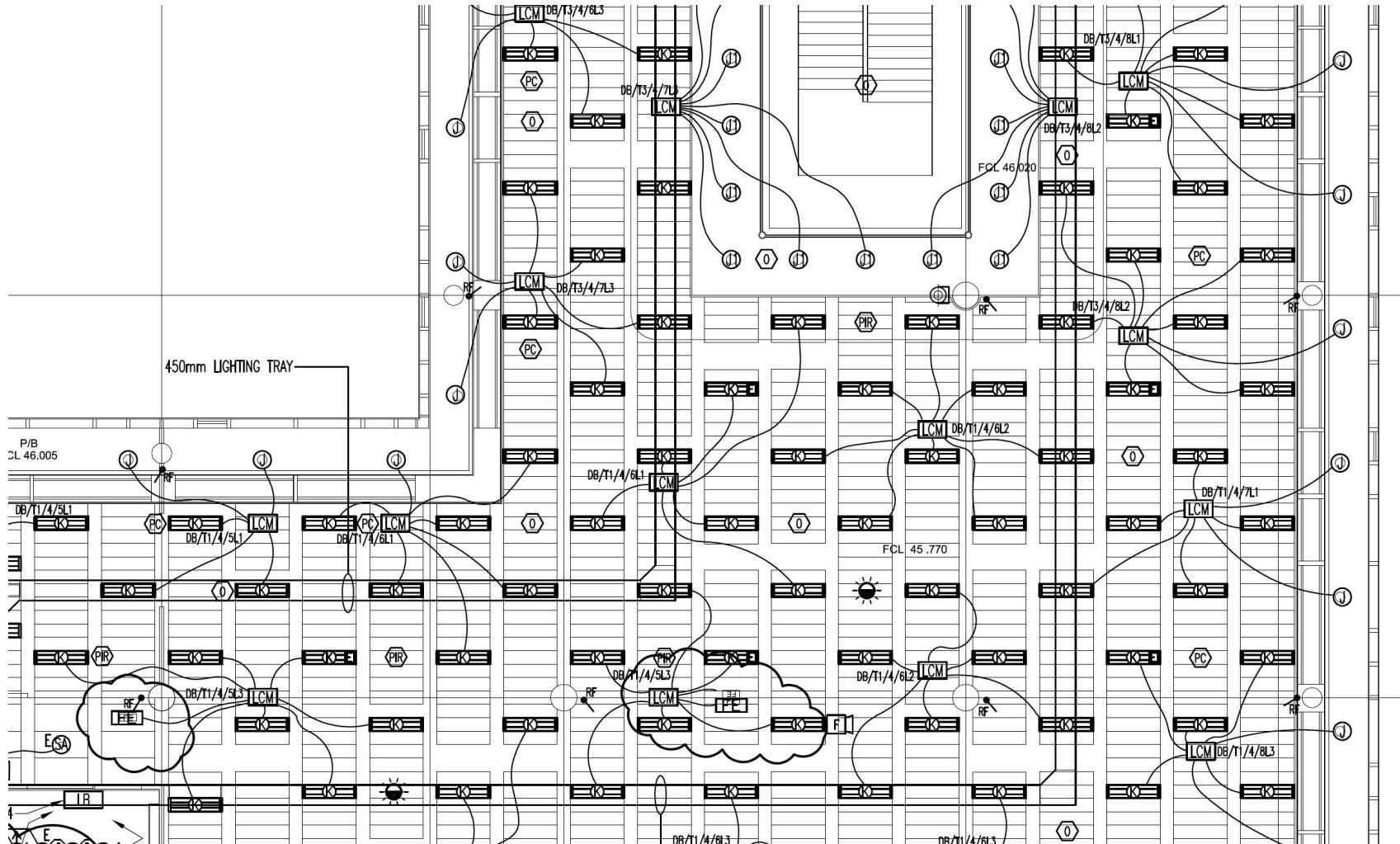
### [Image Attribution](#)

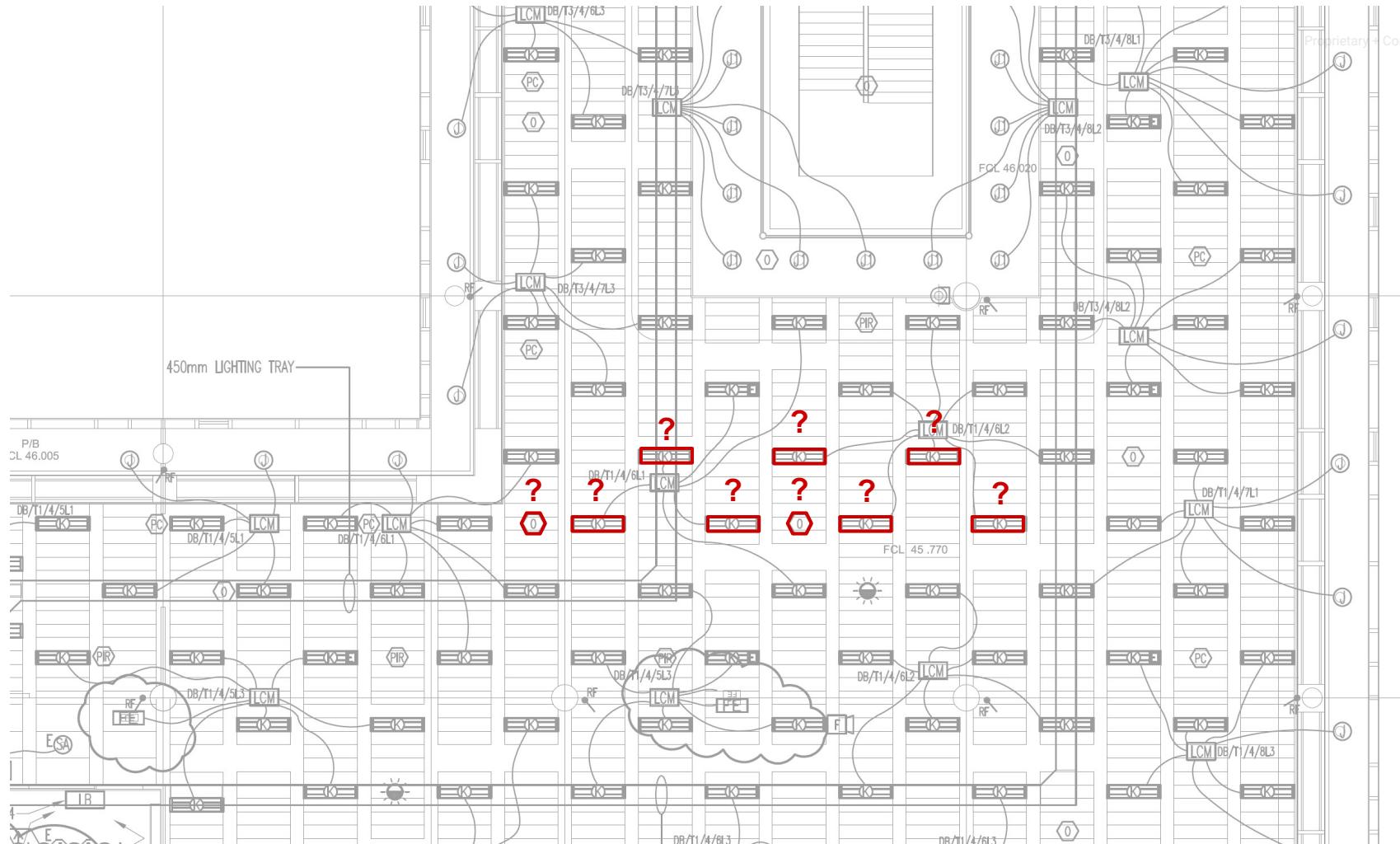


[Image Attribution](#)



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# RIBA



Employer

End user

Facilities manager

Designer

Contractor

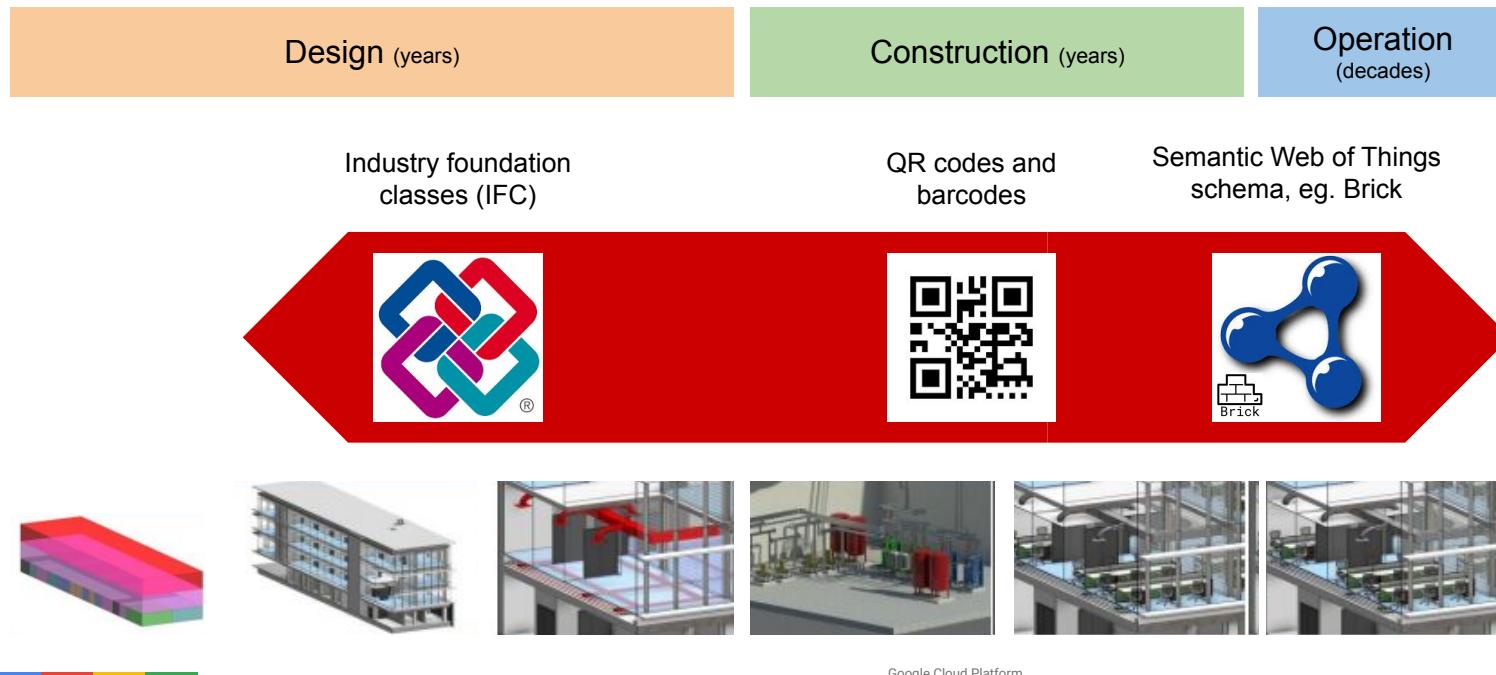
Product supplier

Device models



# Seamless data sharing between phases

- 1) Use open standards for physical device models representation
- 2) Transfer parameters from design model to physical labels and metadata
- 3) Keep the device identity consistent across phases



# BIM

# Physical label

# Asset registry

Design (years)

Construction (years)

Operation (decades)

Space definition	Device definition
IfcProject	IfcProduct
IfcUnitAssignment	<a href="#">IfcGloballyUniqueID</a>
IfcUnit	<a href="#">IfcObjectPlacement</a>
IfcBuilding	<a href="#">IfcTypeProduct</a>
IfcZone	<a href="#">IfcTypeObject</a>
IfcSpace	...
IfcGeometricModelResource	
IfcShapeRepresentation	
...	

Industry foundation classes (IFC)

Human readable label

TSTAT-1

US-MTV-TC2 \_ TSTAT-1

TSTAT-1\_RH-2-3-25-CO2

Machine readable  
physical label



AHU-1

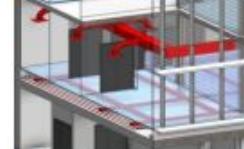
QR codes and barcodes

- ▼ Equipment
  - 'Fire Safety System'
  - HVAC
    - AHU
    - Fan
    - Pump
  - 'Terminal Unit'
    - 'Fan Coil Unit'
    - VAV
  - Valve
  - 'Lighting System'
  - Water System'

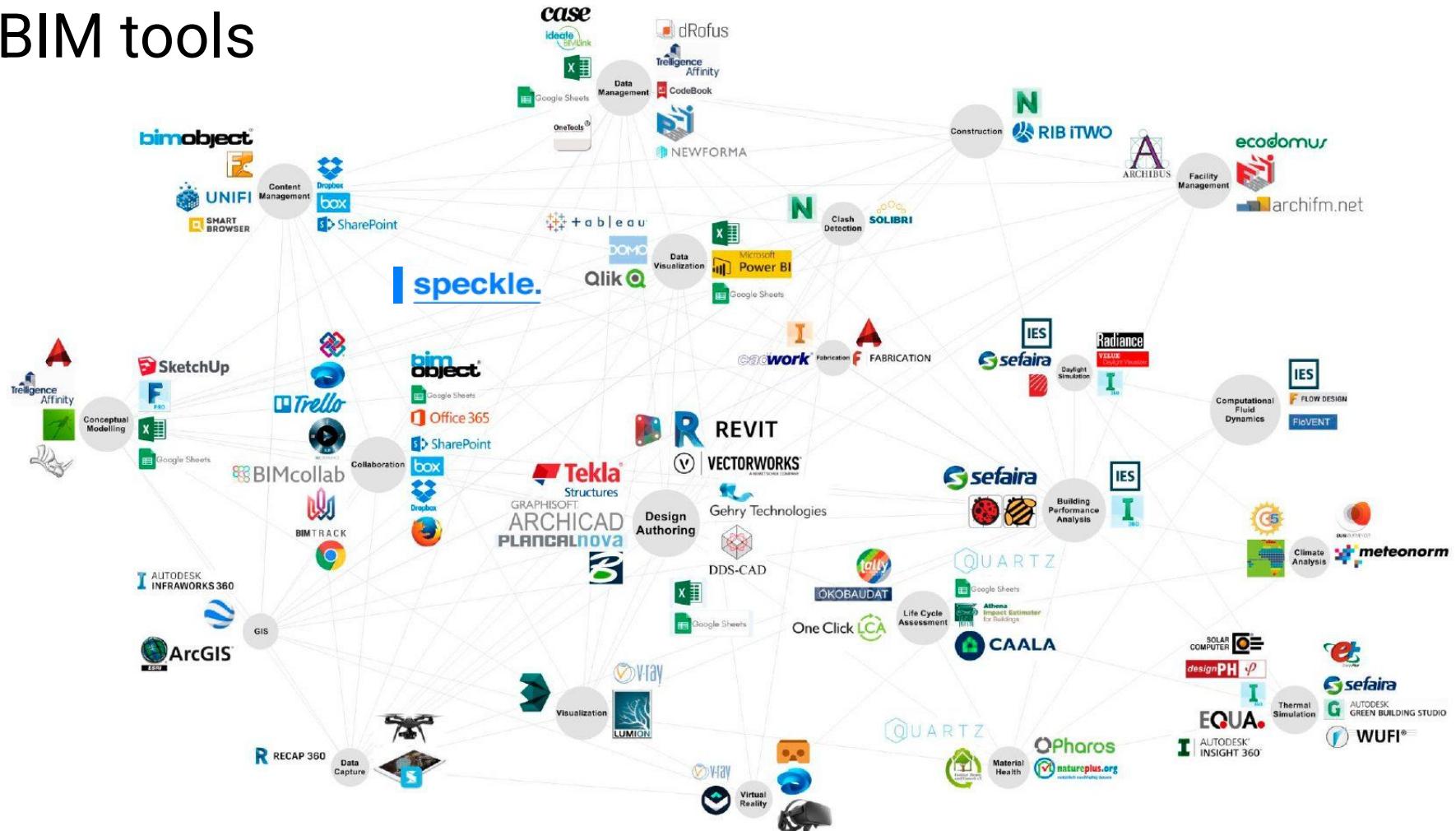
- ▼ Location
  - Building
  - Floor
  - 'HVAC Zone'
  - 'Lighting Zone'
- Room
- ▼ Point
  - Alarm
  - Command
  - Sensor
  - Setpoint
  - Status

Brick [TagSets](#), [Tags](#), [Relationships](#) and [Dimensions](#)

Semantic Web of Things schema,  
eg. Brick



# BIM tools



There are only two hard things in Computer Science: cache invalidation and naming things.

— PHIL KARLTON



**Leon Bambrick**

@secretGeek



There are 2 hard problems in computer science: cache invalidation, naming things, and off-by-1 errors.

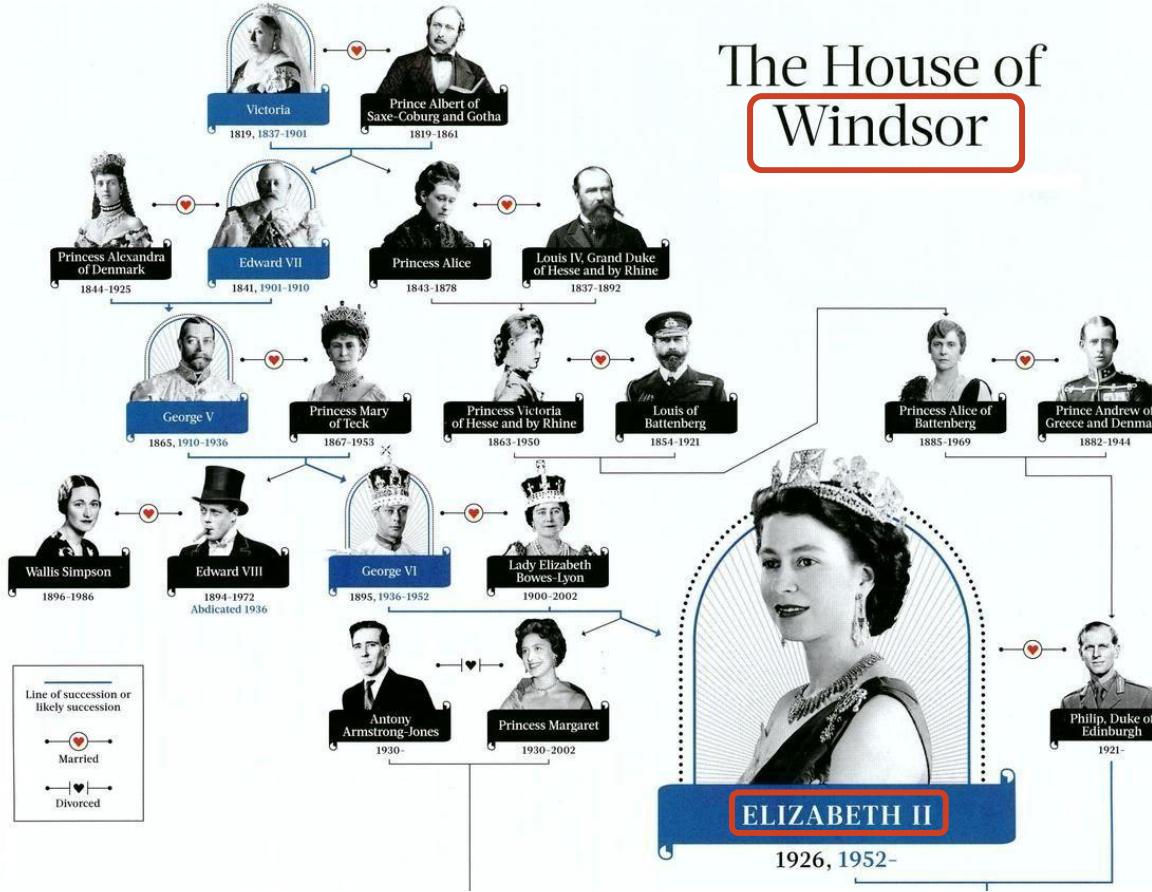
902 3:20 PM - Jan 1, 2010



1,196 people are talking about this



# The House of Windsor





# Google

Naming and Labeling Standard for BOS Devices

V1.1

Google Confidential and Proprietary - NDA Required

Page 1

## Naming and Labeling Standard for BOS Devices

**GLOBAL!!!**

# Terminology

- **Device Role**
  - Specific function fulfilled by the device. Fixed even if hardware is replaced
- **Device Instance**
  - Specific individual piece of hardware. Device instance changes when replaced
- **Machine Generated Globally Unique Identifier (device instance GUID)**
  - Globally unique alphanumeric sequence specific to the device instance
- **Device Role Human Readable Name (device name)**
  - Device role human readable name. Alphanumeric sequence according to global standard
- **Physical Label**
  - Physical piece of material affixed to a building asset including name and QR code
- **Metadata** : Provides information about other data (Carson, Asset Registry)



A	B	C	D	E	F	G	H	I	J	K	L
Label	Plant/Equipment Type	Label	System Type	Label	Level	Label	Quadrant/Zone	Label	Area Reference	Label	Unique Unit Reference
AHU_	Air Handling Unit	FA_	Fresh Air	B1_	Basement 01	BLKA_	Block A	AUD_	Auditorium	01	Unit No. 01
CAV_	Constant Air Volume Box	GN_	General	B2_	Basement 02	BLKB_	Block B	AVR_	AV Room	02	Unit No. 02
CHB_	Chilled Beam	MD_	Mechanical Ductwork	B3_	Basement 03 ...	BLKC_	Block C ...	BLD_	Building	03	Unit No. 03 ...
CRAC_	CRAC unit	RA_	Return Air	BAS_	Basement	C1_	Core 1	CAFE_	Cafeteria	01M	Unit No. 01 Master
DX_	Direct Expansion Cooling Unit	SA_	Supply Air	GND_	Ground	C2_	Core 2	GAM_	Game Room	01S	Unit No. 02 Slave
EF_	Extract Fan			L01_	Level 01	C3_	Core 3 ...	IDF_	Intermediate Distribution Frame		
FCU_	Fan Coil Unit			L02_	Level 02	E_	East	KIT_	Kitchen		
HRU_	Heat Recovery Unit			L03_	Level 03 ...	N_	North	LIB_	Library		
RF_	Return Fan			LG_	Lower Ground	NE_	North East	MDF_	Main Distribution Frame		
SF_	Supply Fan			MEZ_	Mezzanine	NW_	North West	MTG_	Meeting Room		
TEF_	Toilet Extract Fan			RF_	Roof Top	SE_	South	OFF_	Office		
TPF_	Tea Point Fan			UG_	Upper Ground	SW_	South West	TSTL_	Test Lab		
TRH_	Trench Heating					W_	West	RBM_	Robotics Room		
VAV_	Variable Air Volume Box							CRM_	Control Room		
VRV_	Variable Refrigerant Volume										
VSD_	Variable Speed Drive (Inverter Drive)										
BP_	Booster Pump	CHW_	Chilled Water								
CCC_	Critical Cooling Chillers	DCW_	Domestic Cold Water								
CH_	Chiller	NPCW_	Non-Potable Cold Water								
CON_	Condenser	CCHW_	Critical Chilled Water System								
CP_	Circulating Pump										
CT_	Cooling Tower										

# Compulsory Device name

- Human readable based on device name
- Unique per building
- According to the Building Assets Naming Abbreviation

## Compulsory device name (**same as asset.name**)

<X>-<Y>

where:

X = <name abbreviation>

Y = <building unique incremental identifier>

## Compulsory short format name label

TSTAT-1



# Asset Naming Abbreviation

Standardized GLOBAL building ASSET Abbreviations V2.0					Abbreviations (Legacy by region)		
				Global	US	EMEA	APAC
Tracked by	Discipline	Asset Type Description	IFC Class	Standardized Abbreviations (2 to 6 characters)	"Known As" Abbreviation		
BOS	Architectural	Electronic Key Cabinet	Furniture	EKC		EKC	
BOS	BMS	Direct Digital Controller	Controller	DDC	DDC	DDC	DDC
BOS	BMS	Building BMS System	Controller	BMS	BMS	BMS	
BOS	BMS	High Level Interface or Gateway	Controller	HLI	HVACGW	HLI	HLI
BOS	BMS	Remote I/O Panel	Controller	RIO	N/A		
BOS	BMS	CO2 (Carbon Dioxide) Sensor (CDOS)	Sensor	CDS	CO2S	CO2S	
BOS	BMS	CO sensors (CMOS)	Sensor	COS	COS	COS	CO SENSOR
BOS	BMS	Humidity Sensor	Sensor	HMS	HUMS	HS	RH SENSOR
BOS	BMS	Leak Detector (Sensor)	Sensor	LDS		LDS	
BOS	BMS	Temperature Sensor	Sensor	TPS	TMPS	TS	TEMP SENSOR

# Prefix to guarantee global uniqueness

## Location code identification

<COUNTRY>-<CITY>-<BUILDING> = assigned location code for building

## Prefix format label

US-MTV-TC2\_TSTAT-1



# Suffix for practical description (Optional)

- Example BMS naming convention for Bay Area using suffix

## Optional suffix

```
_<text>
_<floor>-<idf>
_<floor>-<ahu>
where
```

`text` = a free text alphanumeric sequence without underscores and without white spaces

## Suffix format label example

**TSTAT-1** \_ VAV-RH-2-3-25-CO2

**TSTAT-2** \_ EF



Scope	CAD / BIM / Asset management	BOS, CAFM and asset management	Control system (BACnet, lighting control, etc.)	Network connectivity
Purpose	Human readable device instance name in CAD/BIM <a href="#">asset.name</a>	<a href="#">Physical label</a> that maps the device name created in the CAD/BIM model to other systems	Name of devices and data points in control systems	Hostname assigned to a device (a host) on a network
When	Created by designer at detailed design stage and updated by contractor at construction stage	Construction stage, during device provisioning and commissioning	Construction stage, during device commissioning	When a device is configured to be connected to the network, when an entry is added to the nameserver
By whom	BIM operators (designers and contractors) or asset tagger	Master system integrator or 3rd party subcontractor	Control systems subcontractors	Control systems subcontractors, network configuration operator
Format	<p><a href="#">X-Y</a></p> <p>where:</p> <p>X = &lt;type_enumeration&gt; (variable length, between 1 and 6 characters)</p> <p>Y = &lt;building_unique_incremental_identifier&gt; (variable length, integer numbers only)</p>	<p>Optional location code prefix</p> <p>&lt;COUNTRY&gt;-</p> <p>&lt;CITY&gt;-</p> <p>&lt;BUILDING&gt;</p> <p>Compulsory device name (same as <a href="#">asset.name</a>)</p> <p><a href="#">X-Y</a></p> <p>where:</p> <p>X = &lt;type_enumeration&gt; (variable length, between 1 and 6 characters)</p> <p>Y = &lt;building_unique_incremental_identifier&gt; (variable length, integer numbers only)</p>	<p>Device name (same as <a href="#">asset.name</a>)</p> <p><a href="#">X-Y</a></p> <p>where:</p> <p>X = &lt;type_enumeration&gt; (variable length, between 1 and 6 characters)</p> <p>Y = &lt;building_unique_incremental_identifier&gt; (variable length, integer numbers only)</p>	<p>Location code</p> <p>&lt;country&gt;-</p> <p>&lt;city&gt;-</p> <p>&lt;building&gt;</p> <p>Compulsory device name (same as <a href="#">asset.name</a>)</p> <p><a href="#">X-Y</a></p> <p>where:</p> <p>X = &lt;type_enumeration&gt; (variable length, between 1 and 6 characters)</p> <p>Y = &lt;building_unique_incremental_identifier&gt; (variable length, integer numbers only)</p>
Example	AHU-1	<p>AHU-1</p> <p>Prefix format label</p> <p>UK-LON-6PS_AHU-1</p> <p>Suffix format label</p> <p>TSTAT-1_RH-2-3-25-CO2</p>	AHU-1	uk-lon-6ps-ahu-1





Compulsory short format name label

**TSTAT-1**

Prefix format label

US-MTV-TC2 **TSTAT-1**

Suffix format label example (Optional for capturing existing tagging information)

**TSTAT-1** \_ RH-2-3-25-CO2

**TSTAT-2** \_ EF



# Machine readable physical tag - QR code

- Human readable label + JSON object encoding into QR code / NFC tag
- Created according to ISO/IEC 18004:2015 in the Version 5 (37x37) format
- Payload shall be minified to reduce the number of characters

## Model format (encoding) example for BIM models

```
{  
  "asset": {  
    "guid": "ifc://04aEp5ymD_$u5IxhJN2aGi",  
    "name": "UK-LON-6PS_AHU-1"  
  }  
}
```



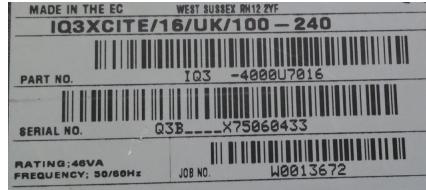
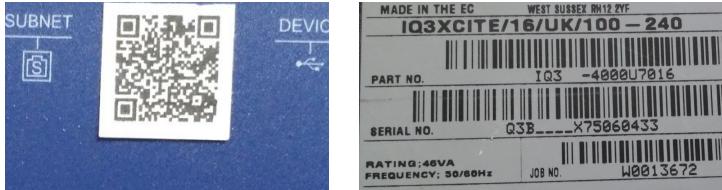
## Minified model format (encoding) example

```
{"asset": {"guid": "ifc://04aEp5ymD_$u5IxhJN2aGi", "name": "UK-LON-6PS_AHU-1"}}
```

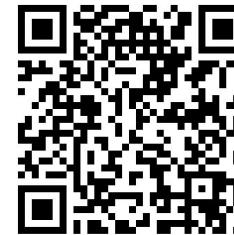
# Physical tags and QR codes

The physical tag must have a human readable label and a machine readable code

## Current practice - no common template



## New practice



- Human readable label + JSON object encoding into QR code / NFC tag
- Labels shall be adhesive and made of a heavy-duty, durable, UV-resistant and weather resistant material, using permanent ink or CO<sub>2</sub> laser engraving to generate the label.

# Labeling process

- The MSI/Labeling Contractor identifies suitable label printing machines or third party services that are able to manufacture the labels
- NFC tags shall be embedded inside the label



TSTAT-1

# Building Device and Asset Naming Standard (BDNS)

The screenshot shows a GitHub repository page for 'theodi/BDNS'. The repository is public and contains 35 issues, 18 pull requests, 3 projects, and no wiki. The master branch has 119 commits. Recent activity includes a merge pull request from 'pisuke' and updates to '.github/workflows' and 'tools'. The repository has 31 stars, 24 watchers, and 18 forks. It features a 'Building Device Naming Standards initiative' README and a 'Release 1.0.0' (Latest) from Dec 15, 2020. Contributors include 8 individuals and organizations.

<https://github.com/theodi/BDNS>

<https://github.com/theodi/BDNS>

# How to Contribute

## For comments and issues: Github

Github offers a powerful issue reporting and tracking system used by major software and many other collaborative projects.

<https://github.com/theodi/BDNS/>

## For Significant contribution: W3C Group

The group will hold regular meetings to address feedback.

<https://www.w3.org/community/bdns/>



## COMMUNITY & BUSINESS GROUPS

W3C®



CURRENT GROUPS



REPORTS



ABOUT

[Home](#) / Building Device Naming...

# BUILDING DEVICE NAMING STANDARDS COMMUNITY GROUP

Being able to efficiently collect, analyse and leverage data insights from buildings is a catalyst for optimising building performance, improving the use of resources and moving towards predictive maintenance and buildings that can respond to the climate emergency. The lack of standardised naming and labelling for connected devices in the built environment means we are failing to leverage the value of data to allow interoperability, improve building efficiency and increase occupant productivity. A naming and labelling standard (complementing other industry initiatives) will simplify and drive consistency thus increasing value by unlocking the application of technologies such as machine learning. The work of this community group will align with and complement other initiatives in the industry such as BRICK, Haystack, Omniclass, Uniclass, IFC etc. In scope for this work are:

- A simple specification for naming syntax
- A register of building device names and labels

## Tools for this group

Mailing List

IRC

RSS

Contact This Group

## Get involved

Anyone may join this Community Group. All participants in this group have signed the [W3C Community Contributor License Agreement](#).

[JOIN OR LEAVE THIS GROUP](#)

## Guidelines to Implementation

# Guiding Principles

- Granularity should be guided by defining the level of experience of people that have to apply naming.
- Granularity should avoid ambiguity, introduce context and be what most people in industry would do.
- The device identity and naming must remain consistent across the lifecycle of the device, throughout design, construction and operational phases in order to enable seamless data transfer across phases.

## Guidelines to Implementation

# Device/Asset Instance Global Unique Identifier (asset.guid)

All devices or assets shall have a unique identifier. Once generated, this shall not be changed at any point for a specific device or asset instance.

### Definition

The device/asset instance globally unique identifier (GUID) is a machine generated and machine readable unique identifier. It is an auto-generated 128-bit number, which can be encoded using the modalities of the RFC 4122 standard or as an IFC GlobalId object of type [ifcGloballyUniqueld](#).

### Format

Auto-generated 128-bit integer number. If generated from BIM processes, the GUID is represented by 22 [IFC base 64](#) characters encoding. If generated by GUID tools, the GUID is usually represented by a 32 digits hexadecimal integer number. Flexibility of format is to allow for multiple workflows, for example some projects may choose to automatically generate a GUID using BIM software.

### Examples

58e6591f-0cef-4bb1-ac9c-6ef03ec58111 (32 digits hexadecimal integer)

04aEp5ymD\_\$u5IxhJN2aGi ([IFC base 64](#) format)

## Guidelines to Implementation

# Device/Asset Role Name (asset.role)

### Definition

The device or asset role name is a human-generated identifier that is unique to the building. It combines a standard abbreviation for device/asset types and a numerical ID that is unique to each specific device/asset.

### Format

<X>-<Y>

where:

X = <type\_abbreviation> (alphabetic characters only, variable length, between 2 and 6 characters)

Y = <building\_unique\_incremental\_number> (variable length, unique integer numbers by building, non zero padded)

### Examples

Name example for a lighting fixture: LT-15

Name example for an air handling unit: AHU-3

Name example for a distribution board: DB-2

## Guidelines to Implementation

# Device Abbreviation Register

- 2 to 6 uppercase alphabetical characters long
- No space, No numbers, No other characters

11 lines (11 sloc) | 980 Bytes

Raw Blame History

Search this file...

1	asset_type	abbreviation	ifc_class	ifc_type	haystack_parent	haystack_child	brick_parent
2	actuator	ATR	IfcActuator	NOTDEFINED	Actuator	actuator	
3	air handling unit	AHU	IfcUnitaryEquipment	AIRHANDLER	Air Handling Unit	ahu, airHandlingEquip	Air Handler Unit, AHU
4	heat recovery unit	HRU	IfcAirToAirHeatRecovery	NOTDEFINED	Air Handling Unit	ahu, airHandlingEquip	Air Handler Unit, AHU
5	make-up air handler	MAU	IfcUnitaryEquipment	AIRHANDLER	Air Handling Unit	mau	
6	run around coil	RAC	IfcAirToAirHeatRecovery	RUNAROUNDCOILLOOP			Coil
7	thermal wheel	TW	IfcAirToAirHeatRecovery	ROTARYWHEEL			
8	constant air volume box	CAV	IfcAirTerminalBox	CONSTANTFLOW	Air Terminal Unit	cav	
9	variable air volume box	VAV	IfcAirTerminalBox	UNDEFINED	Air Terminal Unit	vav	Variable Air Volume Box
10	automatic transfer switch	ATS	IfcProtectiveDevice	NOTDEFINED			
11	boiler	BLR	ifcBoiler	UNDEFINED	Boiler	boiler	Boiler

## Guidelines to Implementation

# Physical Device/Asset Human and Machine readable label

- A human readable label with the device/asset name.
- A machine readable label with encoded identification in at least one of the following two formats:
  - Quick response (QR) code
  - Near field communication (NFC) tag

## Model format (encoding) example for BIM models

```
{  
  "asset": {  
    "guid": "ifc://04aEp5ymD_$u5IxhJN2aGi",  
    "site": "GB-LON-BLD1",  
    "name": "AHU-1"  
  }  
}
```



## Minified model format (encoding) example

```
{"asset": {"guid": "ifc://04aEp5ymD_$u5IxhJN2aGi", "site": "GB-LON-BLD1", "name": "AHU-1"}}
```

AHU-1

## Guidelines to Implementation

# Physical Asset Human & Machine readable label

## - Optional Prefix

Guarantees global uniqueness

### Location code identification

<COUNTRY>-<CITY>-<BUILDING> = assigned location code for building, composed of:

<COUNTRY> = [ISO Alpha-2 Country Code](#)

<CITY> = [UN LOCODE City Code](#)

<BUILDING> = the project specific abbreviation for the building

### Prefix format label

UK-LON-BLD\_ **TSTAT-1**

## Guidelines to Implementation

# Physical Asset Human & Machine readable label

## - Optional Suffix

Provides practical information typically used by FM operators

### Optional suffix

\_<text>  
\_<floor>-<idf>  
\_<floor>-<ahu>

where

text = a free text alphanumeric sequence without underscores and without white spaces

### Prefix format label

**TSTAT-1\_FCU-CO2-2-3-25**

**TSTAT-2\_EF**

## HOW STANDARDS PROLIFERATE:

(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)

SITUATION:  
THERE ARE  
14 COMPETING  
STANDARDS.

14?! RIDICULOUS!  
WE NEED TO DEVELOP  
ONE UNIVERSAL STANDARD  
THAT COVERS EVERYONE'S  
USE CASES.



YEAH!

SOON:

SITUATION:  
THERE ARE  
15 COMPETING  
STANDARDS.

# Using BDNS at Google

# BOS program and system architecture

# What is BOS?

Google's approach to digital buildings is implemented through the **Building Operating System (BOS) Program** and technical framework. The program includes a number of products, solutions, strategies, standards and transformations to create end-to-end digital buildings at Google.



Policy



Process

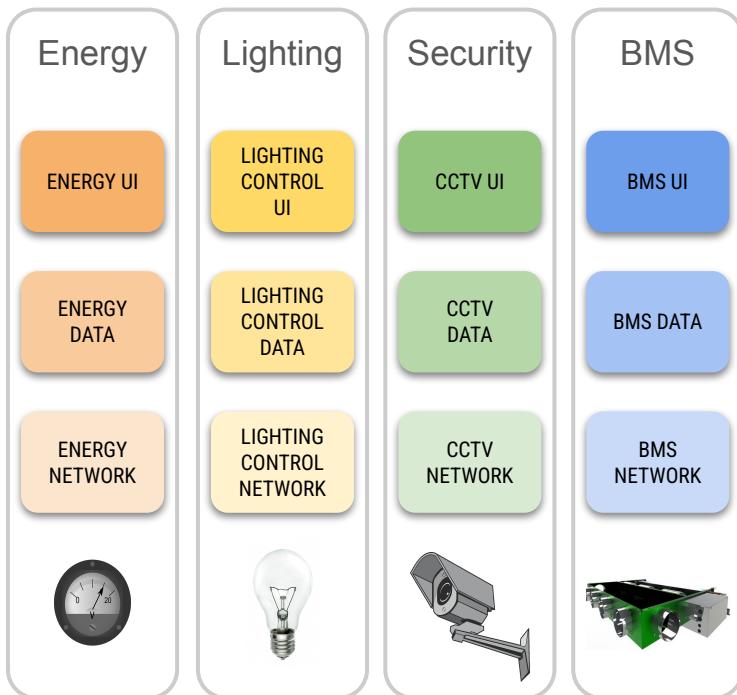


Products

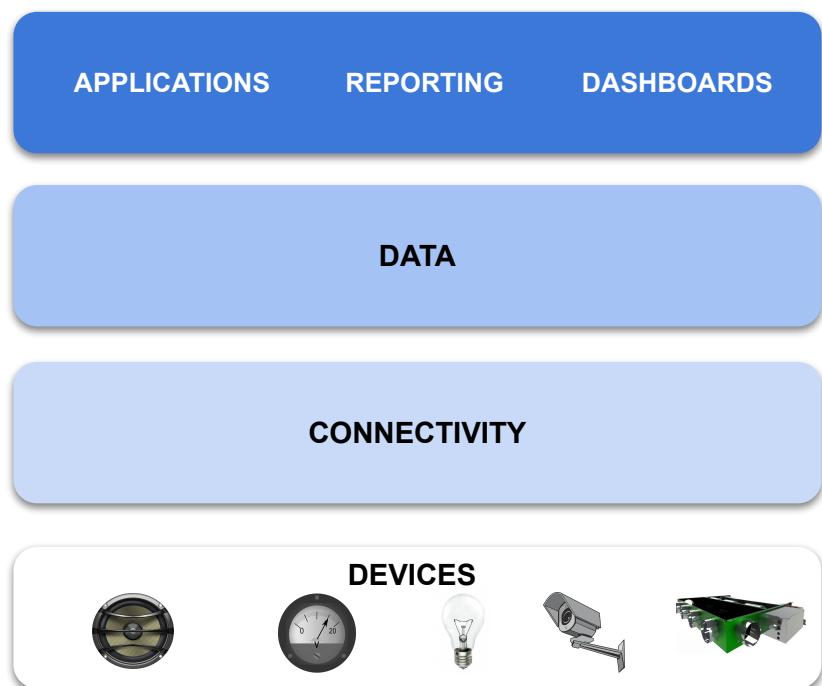


People

# Vertical, Siloed



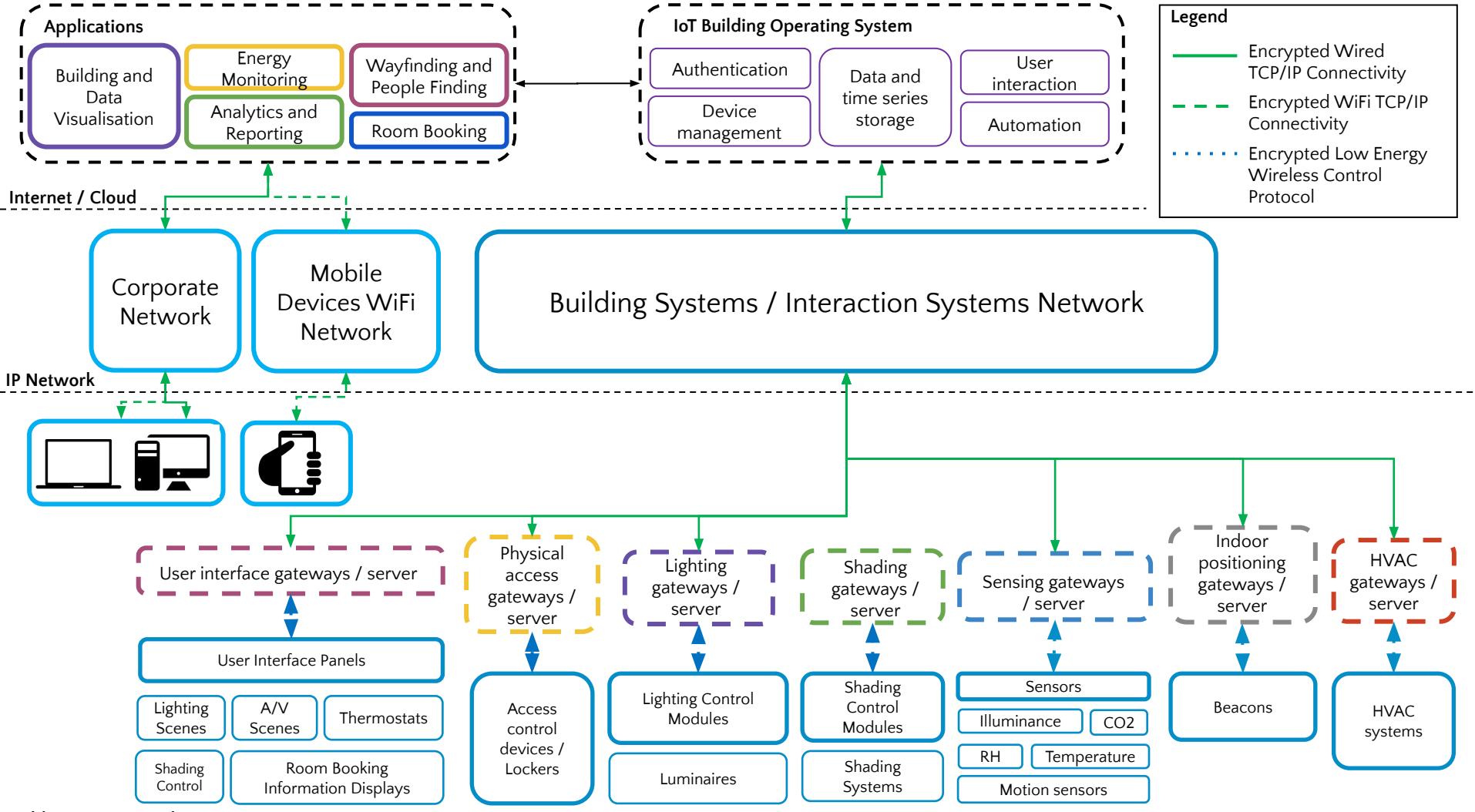
# Horizontal

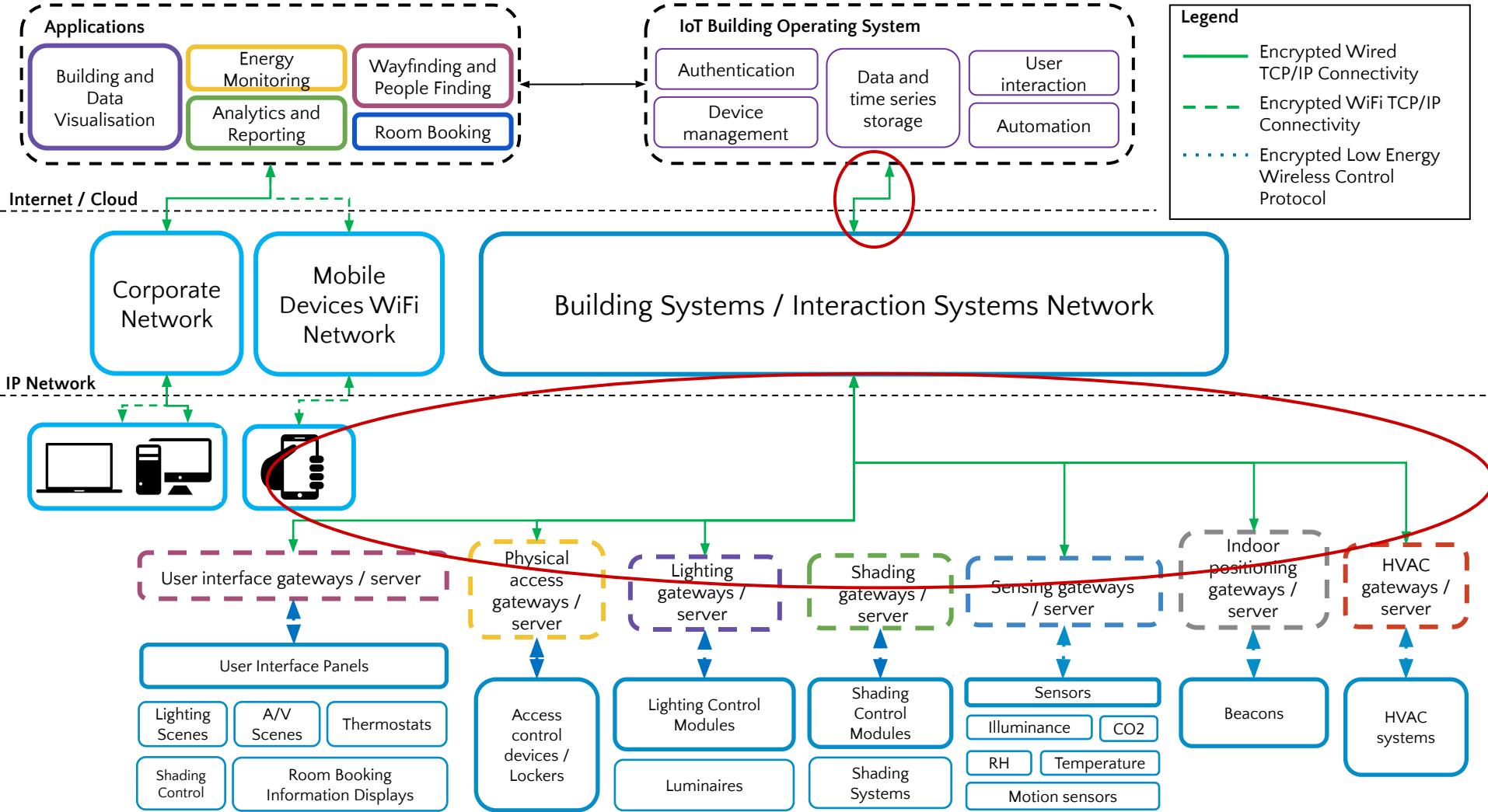


# Digital Building Components Stack

Proprietary + Confidential

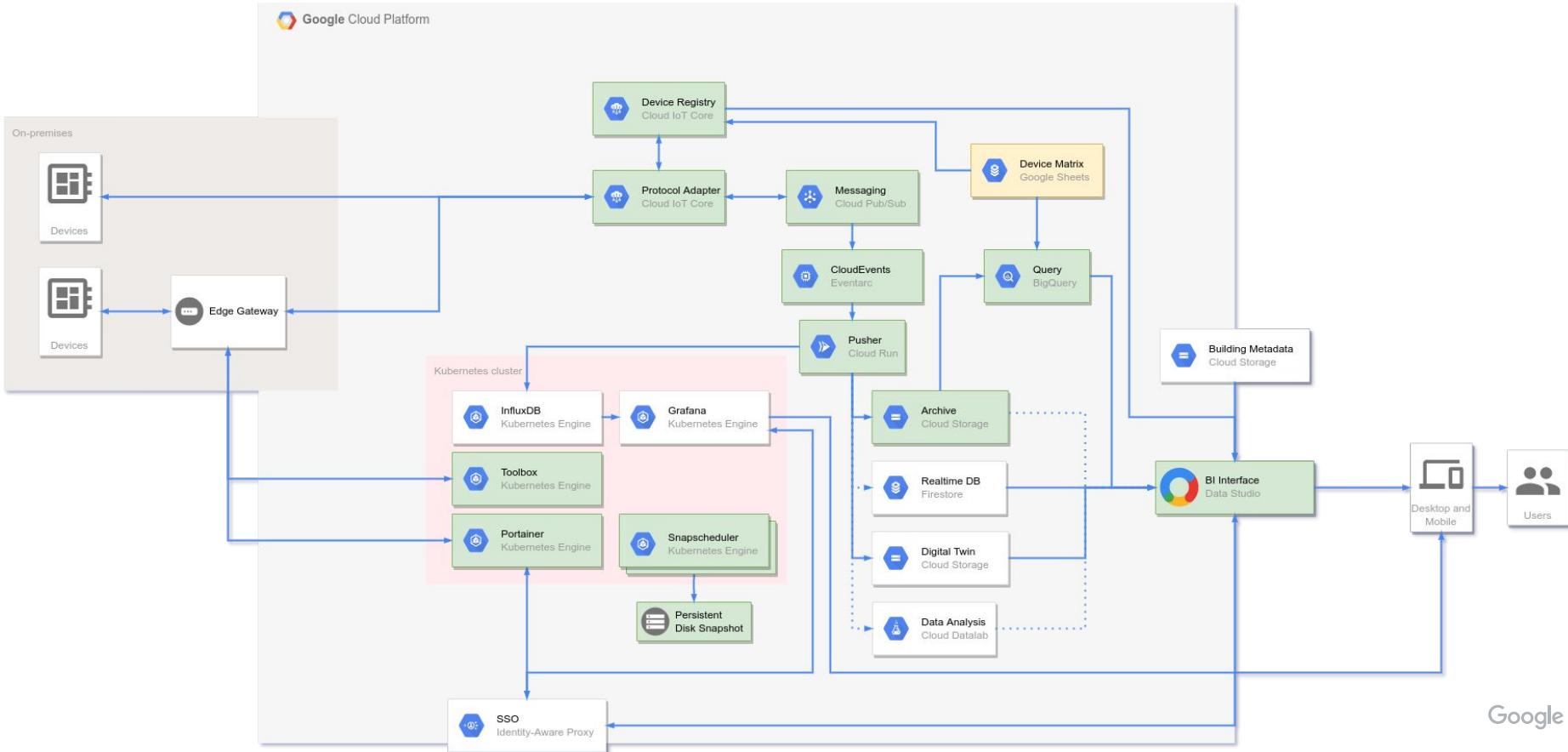
Generic	BOS	
Application	<i>Open ecosystem</i>	Fit-for-purpose applications and capabilities.
Business Intelligence	Looker Studio, Grafana, Looker, ...	Customizable data visualization and analysis.
Machine Learning	Tensorflow	Machine learning and big data analytics.
Data Lake	Spanner, BQ	Coordinated access to telemetry data and spatial information.
Data Structure	<b>DBO, Brick, Haystack - BDNS</b>	Structured relationships between building entities.
Cloud Ingestion	CB IoT Core, AWS IoT Core, Azure IoT Hub - <b>BDNS</b>	Scalable data ingestion systems.
Cloud Interface	<b>MQTT + (UDMI   Sparkplug   WoT   ...) - BDNS</b>	Management interface between cloud and devices..
Edge Compute	Anthos, K3S, ...	Edge cloud computing and capabilities.
Testing & Validation	DAQ, Testrun	Security and network behavioral compliance.
Network	Convergent IT/OT network, ESDN, ZeroTier, ...	Secure managed networking for in-building communications.
Devices	<i>Open ecosystem of devices / BDNS</i>	System controllers and building system interfaces





# A system architecture example

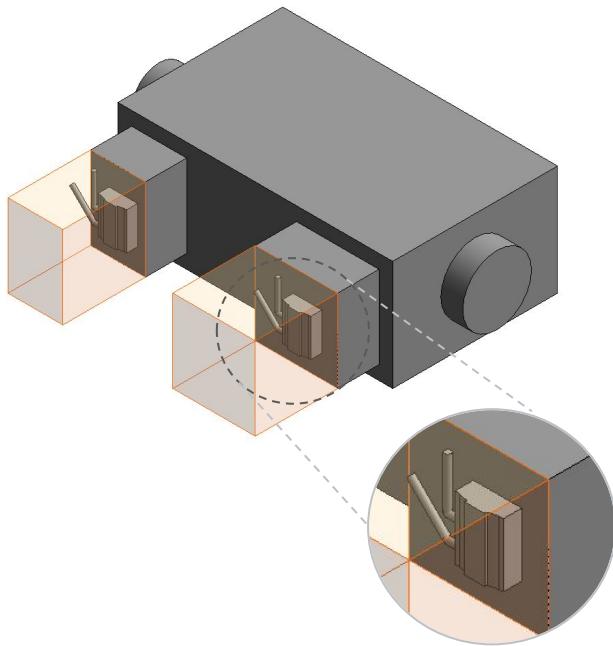
Proprietary + Confidential



# Naming: BDNS

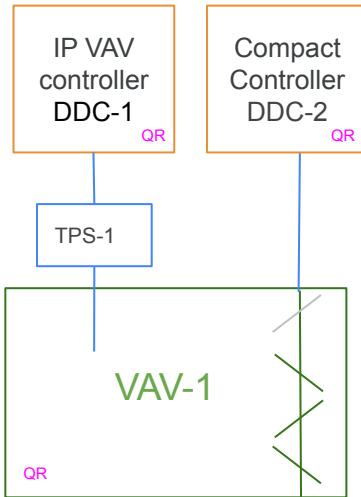
Device Name (asset.name):

VAV-1



DDC-2  
IP field controller

# Building Information Models



## Scope Key

- by Mechanical contractor
  - by MEP Controls contractor
  - by Google
  - by MSI (if required)
  - by Electrical contractor

## Technical documentation / Schematics

Control point naming shall be aligned to [Appendix 1 - Points and Alarms List](#).

For example:

- building\_air\_static\_pressure\_sensor
  - return\_air\_damper\_command
  - supply\_air\_damper\_percentage\_command\_1
  - supply\_air\_damper\_percentage\_command\_2



## Model format (encoding) BIM example

```
{  
  "asset": {  
    "guid": "ifc://04aEp5ymD_Su5IxhJN2aGi",  
    "site": "UK-LON-BNG1",  
    "name": "DDC-1"  
  }  
}
```

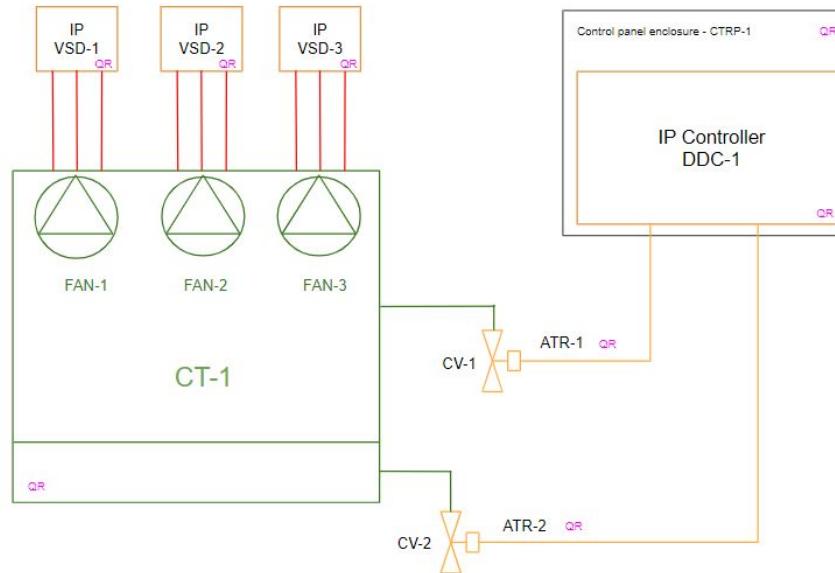
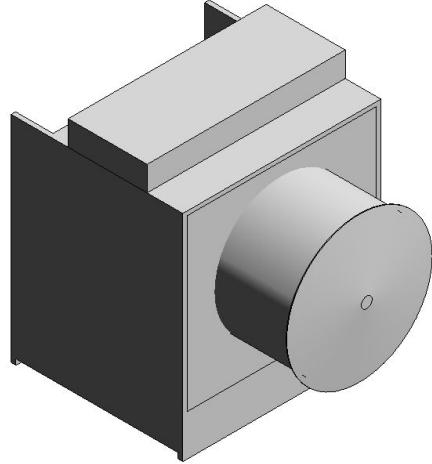
## Minified example

```
{"asset":{"guid":"ifc://04aEp5ymD_$u5IxhJN2aGi"},  
"site":"UK-LON-BNG1","name":"DDC-1"})
```

## Physical labels

Note: The name can also be used in IP hostname.  
Refer [Appendix 20 - BOS Naming and Labeling standard](#) for more details.

Asset name:  
CT-1



#### Scope Key

- by Mechanical contractor
- by MEP Controls contractor
- by Google
- by MSI (if required)
- by Electrical contractor

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Model format (encoding) BIM example

```
{  
  "asset": {  
    "guid": "ifc://04aEp5ymD_8u5IxhJN2aGi",  
    "site": "UK-LON-BNG1",  
    "name": "DDC-1"  
  }  
}
```

Minified example

```
{"asset": {"guid": "ifc://04aEp5ymD_8u5IxhJN2aGi",  
"site": "UK-LON-BNG1", "name": "DDC-1"}}
```

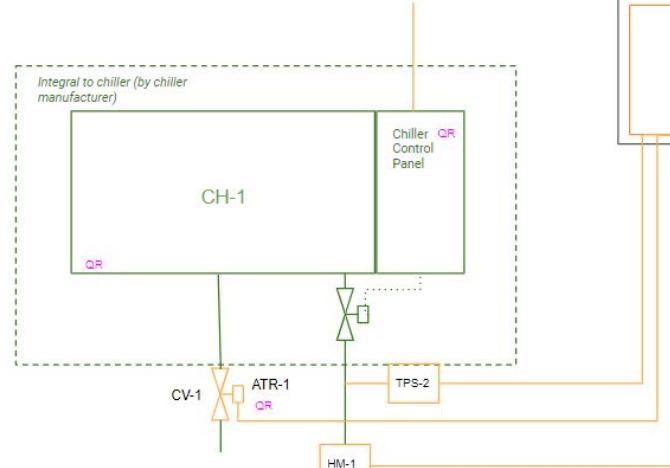
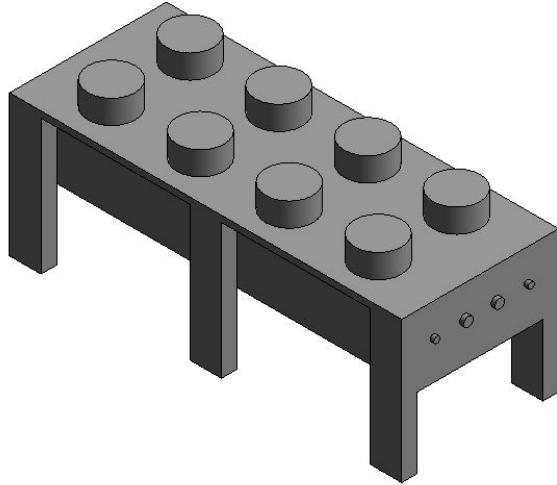
Building Information Models

Technical documentation / Schematics

Physical labels

Asset name:  
CH-1

Proprietary + Confidential



Model format (encoding) BIM example

```
{  
  "asset": {  
    "guid": "ifc://04aEp5ymD_8u5IxhJN2aGi",  
    "site": "UK-LON-BNG1",  
    "name": "DDC-1"  
  }  
}
```

Minified example

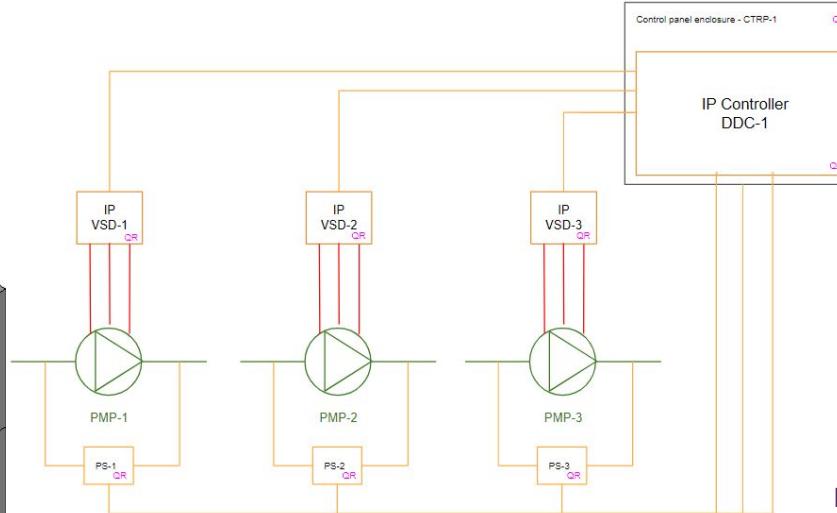
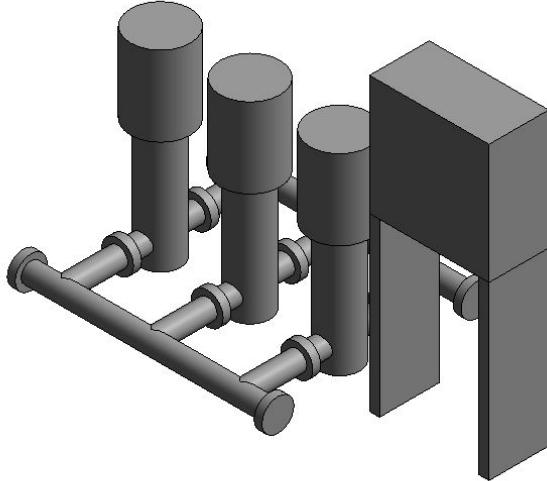
```
{"asset": {"guid": "ifc://04aEp5ymD_8u5IxhJN2aGi",  
"site": "UK-LON-BNG1", "name": "DDC-1"}}
```

Building Information Models

Technical documentation / Schematics

Physical labels

Asset name:  
PMP-1, 2 & 3



Scope Key

- by Mechanical contractor
- by MEP Controls contractor
- by Google
- by MSI (if required)
- by Electrical contractor

Proprietary + Confidential



Model format (encoding) BIM example

```
{  
  "asset": {  
    "guid": "ifc://04aEp5ymD_8u5IxhJN2aGi",  
    "site": "UK-LON-BNG1",  
    "name": "DDC-1"  
  }  
}
```

Minified example

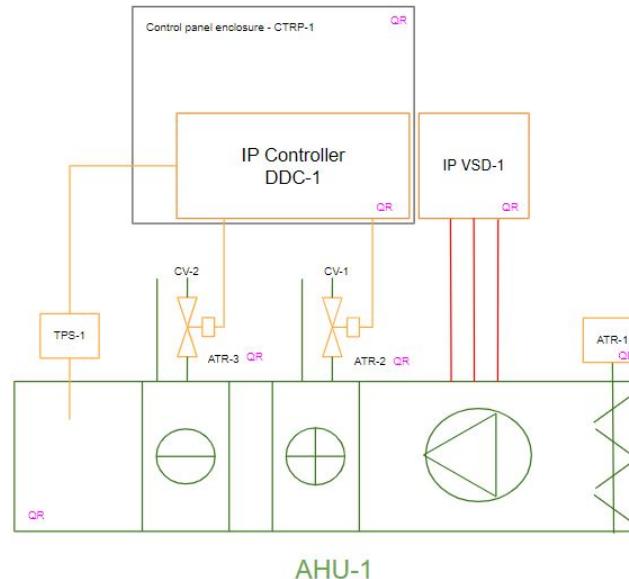
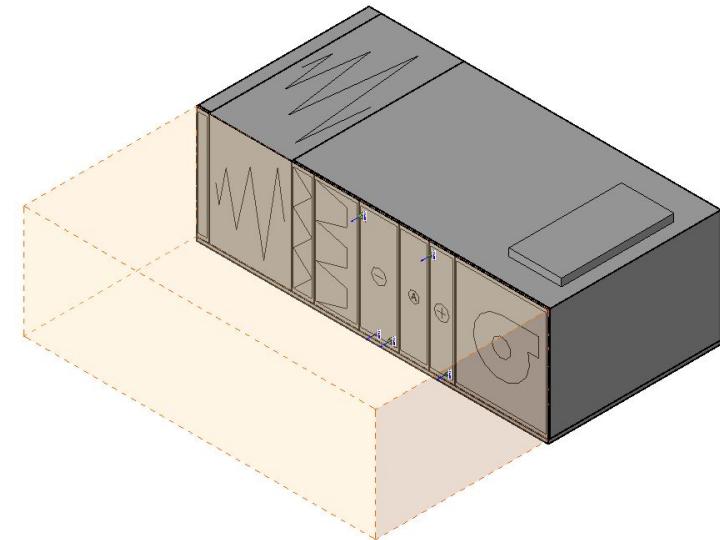
```
{"asset": {"guid": "ifc://04aEp5ymD_8u5IxhJN2aGi",  
"site": "UK-LON-BNG1", "name": "DDC-1"}}
```

Building Information Models

Technical documentation / Schematics

Physical labels

Asset name:  
AHU-1



## Model format (encoding) BIM example

```
{  
  "asset": {  
    "guid": "ifc://04aEp5yMDSu5IxhJN2aGi",  
    "site": "UK-LON-BNG1",  
    "name": "DDC-1"  
  }  
}
```

## Minified example

```
{"asset": {"guid": "ifc://04aEp5ymD_$u5IxhJN2aGi",  
"site": "UK-LON-BNG1", "name": "DDC-1"} }
```

# Building Information Models

## Technical documentation / Schematics

Control point naming shall be aligned to [Appendix 1 - Points and Alarms List](#)  
For example: heating\_water\_valve\_percentage\_sensor  
cooling\_water\_valve\_percentage\_sensor

## Physical labels

# Communication: MQTT/PubSub + UDMI

faucetsdn/udmi: Universal

github.com/faucetsdn/udmi

tests	Bad config sequence checks (#248)	yesterday
udms	Bump karma from 6.2.0 to 6.3.16 in /udms (#256)	10 hours ago
validator	Bad config sequence checks (#248)	yesterday
.gencode_hash.txt	Mark gencode as generated code for PR diffs (#...)	3 hours ago
.gitattributes	Mark gencode as generated code for PR diffs (#...)	3 hours ago
.gitignore	Basic script for configuring terraform through en...	16 days ago
AUTHORS	Adding boilerplate files	8 months ago
CONTRIBUTING.md	Adding boilerplate files	8 months ago
LICENSE	Adding boilerplate files	8 months ago
README.md	Documentation updates and improved navigation	2 months ago

README.md

# UDMI

[Documentation - docs/](#)

[Schema - schema/](#) ( Interactive viewer)

[Mailing list & discussion - udmi-discuss@googlegroups.com](#)

---

The Universal Device Management Interface (UDMI) provides a high-level specification for the management and operation of physical IoT systems. This data is typically exchanged with a cloud entity that can maintain a "digital twin" or "shadow device" in the cloud. Please join the [udmi-discuss@googlegroups.com](mailto:udmi-discuss@googlegroups.com) mailing list for questions and discussion.

By design, this schema is intended to be:

**Contributors** 10

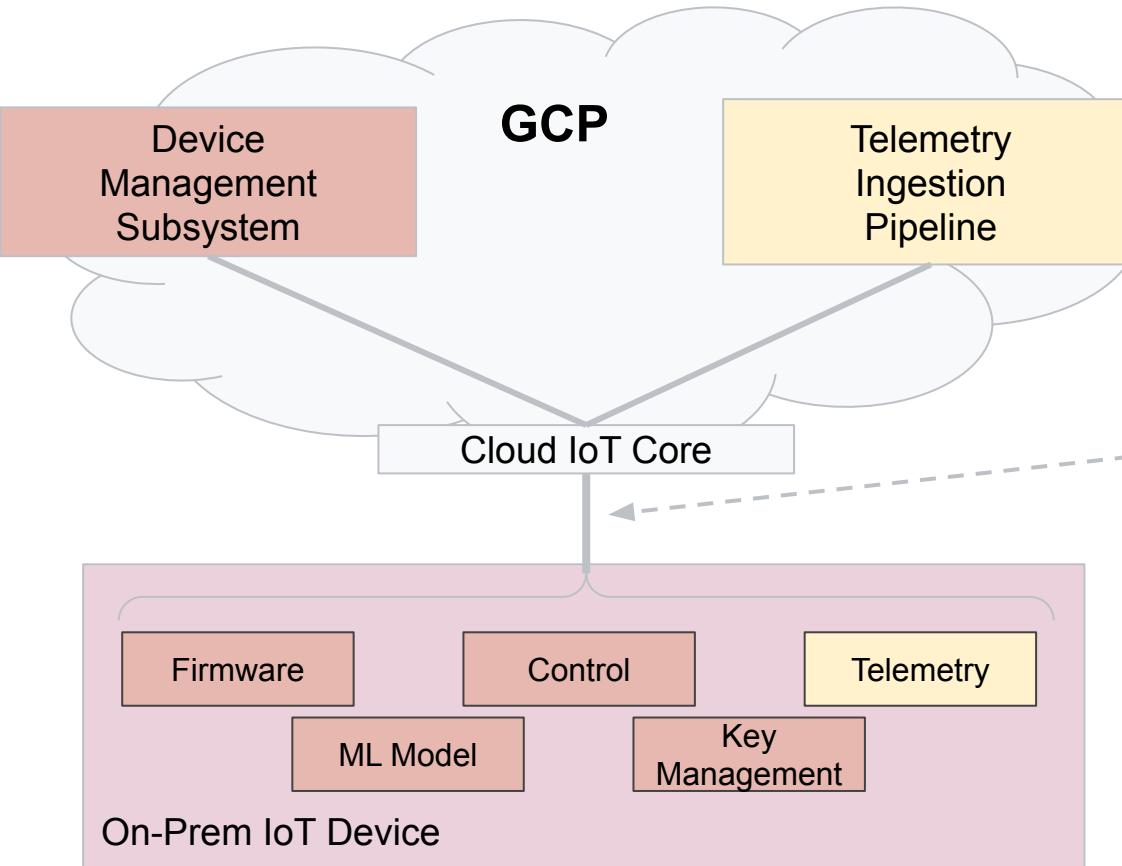
+ 5 contributors

**Environments** 1

github-pages (Active)

**Languages**

Language	Percentage
Java	62.4%
TypeScript	10.8%
Python	8.9%
JavaScript	6.5%
Shell	6.4%
HTML	2.6%
Other	2.4%



UDMI defines a standardized mechanism for on-prem device management.

Every on-prem device should be managed independent of function & manufacturer.

Why should a *FCU* be managed any differently than a *Power Meter*?

<https://github.com/faucetsdn/udmi>

# Universal Device Management Interface

## Universal:

Generic specification that should apply to BMS, AV, PhySec, etc...

## Device:

Headless and typically limited end-node with links to the physical world.

## Management:

What's needed for fleet management, not all device functionality.

## Interface:

This is an API specification, not a library/platform/runtime.

# Motivating Use Cases

What constitutes *Management*?

- Simple Telemetry
- Auth and Key Management
- Testability
- Firmware Updates
- Operational Diagnostics
- Commissioning Tools
- Status and Logging

It is not:

- High-Bandwidth Telemetry (e.g. cameras)
- Complex Interactions (e.g. web access)

# Design Principles

- Vertical ⇒ Horizontal
  - Focused layer as part of a complete solution
- Open Source
  - Wide availability
- Specification usable on any cloud platform (GCP, AWS, Azure, etc.)
  - Not a tech-island
- Model Based Design
  - Describe what should be, not what to do

# UDMI Tech Stack

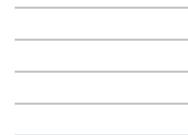
(UDMS)	Management Tools (access/displays data) ⇒ <i>Current focus of development</i>
	<a href="#"><u>Firestore Repository</u></a> (unified structure representing contents of UDMI schema)
	<a href="#"><u>UDMI Schema</u></a>
	JSON Encoding
	<a href="#"><u>Expected MQTT Topic Mappings</u></a>
	<a href="#"><u>MQTT Bridge</u></a> or MQTT broker: State, Config, Events, Commands, Gateways
	<a href="#"><u>ES256</u></a> or RS256
	<a href="#"><u>MQTT</u></a>
	TCP 8883 or 443

# IoT Core: Interfacing with Scale

Sticky declarative blob  
geared towards automation  
and manageability



Transient messages  
providing high-throughput  
or low-latency capabilities



Cloud to Device



Device to Cloud

# Example: Pointset Telemetry

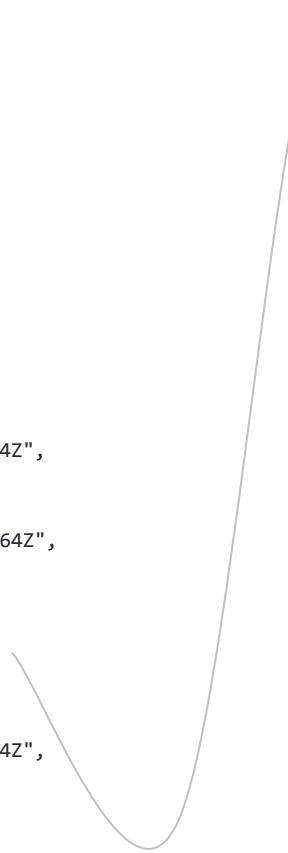
```
{  
  "version": "1.5.2",  
  "timestamp": "2018-08-26T21:39:29.364Z",  
  "points": {  
    "reading_value": {  
      "present_value": 21.30108642578125  
    },  
    "nexus_sensor": {  
      "present_value": 21.1  
    },  
    "yoyo_motion_sensor": {  
      "present_value": true  
    },  
    "enum_value": {  
      "present_value": "hello"  
    }  
  }  
}
```

# Example: Config

```
{  
  "version": "1.5.2",  
  "timestamp": "2018-08-26T21:39:29.364Z",  
  "system": {  
    "metrics_rate_sec": 10,  
    "min_loglevel": 400  
  },  
  "pointset": {  
    "sample_limit_sec": 2,  
    "sample_rate_sec": 500,  
    "points": {  
      "return_air_temperature_sensor": {  
      },  
      "nexus_sensor": {  
        "ref": "AV:10"  
      }  
    }  
  }  
}
```

# Example: State

```
{  
  "version": "1.5.2",  
  "timestamp": "2018-08-26T21:39:29.364Z",  
  "system": {  
    "hardware": {  
      "make": "ACME",  
      "model": "Bird Trap"  
    },  
    "software": {  
      "firmware": "3.2a"  
    },  
    "serial_no": "182732142",  
    "last_config": "2018-08-26T21:49:29.364Z",  
    "operation": {  
      "operational": true,  
      "last_start": "2018-08-25T21:49:29.364Z",  
      "mode": "active",  
      "restart_count": 121  
    },  
    "status": {  
      "message": "Tickity Boo",  
      "category": "system.config.apply",  
      "timestamp": "2018-08-26T21:39:30.364Z",  
      "level": 600  
    }  
  },  
  "pointset": {  
    "status": {  
      "message": "Invalid sample time",  
      "category": "pointset.point.invalid",  
      "timestamp": "2018-08-26T21:39:28.364Z",  
      "level": 800  
    },  
    "points": {  
      "return_air_temperature_sensor": {  
        "status": {  
          "message": "Point return_air_temperature_sensor unable to read value",  
          "category": "pointset.point.failure",  
          "timestamp": "2018-08-26T21:39:28.364Z",  
          "level": 800  
        }  
      },  
      "nexus_sensor": {}  
    }  
  }  
}
```



# IoT Core Devices

IoT Core    bos-platform-prod    ?    ⚙    F

Registries    Devices

Registry Details    Registry ID: UK-LON-KGX1  
us-central1

Devices are things that connect to the internet directly or through a gateway. [Learn More](#)

Filter Enter exact device ID

<input type="checkbox"/> Device ID	Communication	Last seen	Cloud Logging
AHU-1001	Allowed	—	System default
AHU-1002	Allowed	—	System default
AHU-1003	Allowed	—	System default
AHU-1004	Allowed	—	System default
AHU-1005	Allowed	—	System default
AHU-1006	Allowed	—	System default
AHU-1007	Allowed	—	System default
AHU-1010	Allowed	—	System default
AHU-1011	Allowed	—	System default
AHU-1012	Allowed	—	System default
AHU-1013	Allowed	—	System default
AHU-1014	Allowed	—	System default

Rows per page: 50    1 - 50 of 4525



# IoT Core Device Configuration

IoT Core    bos-platform-prod

Registries    ← Device details

Registry Details    Devices    Gateways    Monitoring

**Device ID: AHU-1001**

Numeric ID	Registry	Cloud Logging	Communication
2801644336271390	projects/bos-platform-prod/locations/us-central1/registries/UK-LON-KGX1	System default <a href="#">View logs</a>	Allowed

DETAILS    CONFIGURATION & STATE    AUTHENTICATION

**Latest activity**

- Heartbeat (MQTT only) -
- Telemetry event received -
- Device state event received -
- Config sent -
- Zone Config ACK (MQTT only) -
- Error -
- Error status and message -

**Device metadata**

You can add or edit metadata in device settings. Edit device

key\_bytes    MIEvQIBADANBgkqhkiG9w0BAQEFAASCBKcwggSjAgEAAoIBAQDGM7yDi3rla70xWAFChsa0kNVvN94+XX8T/an5P2WISHzq00kq2xrtfb40lqHumypy3CKrxPC9WG/XMY8076NU3kFRcmvx26Aue59Vdk4nAMeHPwibDfFnqBwYgDtIBcX9Slk5qPjxxs6WzD0bx+JsD6P0nrup8St

udmi\_config

```

11 "sample_rate_sec": 300,
12 "points": {
13     "air_leaving_cooling_coil_temperature_sensor": {
14         "units": "Degrees-Celsius"
15     },
16     "cooling_valve_percentage_command": {
17         "units": "Percent"
18     },
19     "extract_air_co2_concentration_sensor": {
20         "units": "Parts-per-million"
21     },
22     "fire_alarm_status": {
23         "units": "No-units"
24     },
25     "heating_valve_percentage_command": {
26         "units": "Percent"

```

udmi\_updated    2021-09-15T12:04:32Z

Google

# IoT Core Device Security and Certificates

The screenshot shows the Google Cloud IoT Core interface for managing device authentication keys. The main navigation bar includes 'Registries', 'Devices', 'Gateways', and 'Monitoring'. The current view is 'Device details' for a device with ID 'AHU-1001'. The device has a numeric ID of 2801644336271390 and is registered under the path projects/bos-platform-prod/locations/us-central1. The 'AUTHENTICATION' tab is selected, showing options to 'ADD PUBLIC KEY' or 'DELETE'. Two formats are available: 'Key format' (selected) and 'RSA\_PEM'. A modal dialog titled 'Update authentication key' is open, prompting the user to specify a public key for authentication. The 'Input method' section offers two choices: 'Enter manually' (selected) and 'Upload'. Under 'Enter manually', a dropdown menu shows 'RS256' as the chosen algorithm. The 'Public key value' field contains a long string of base64-encoded RSA public key data, starting with '-----BEGIN PUBLIC KEY-----' and ending with 'G8fibA+j9J67qfEm2lzcJlxNQKmk0VN5IW8CQx2JW/env2yA70a/MW8'. Below this, there is an optional 'Public key expiration date' field with a calendar icon, which is currently empty. At the bottom of the dialog are 'CANCEL' and 'UPDATE' buttons.

# UDMI adoption + Manufacturers engagement

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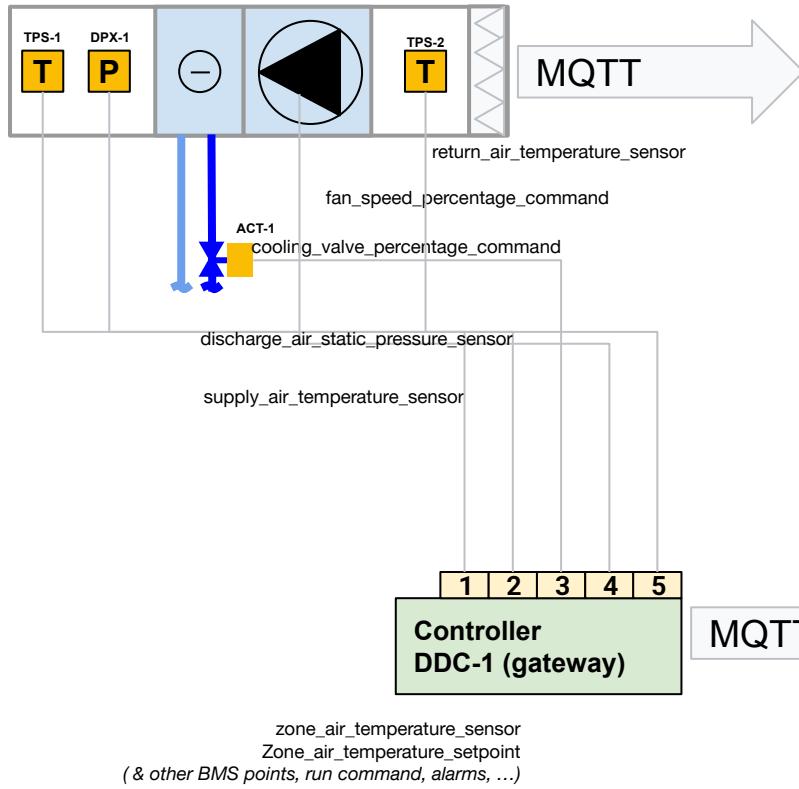
## UDMI test results for proxied devices

- Date: 2025-07-02T08:16:12.599Z

Bucket	Feature	Sta...	TE...	DD...	TE...	TE...	TE...	TE...	LT...	TE...	TE...	TE...	TE...	EM...	LT-1	LT-2
image																
make			Autom... Logic Corpor...	Delmatic	Delta Controls Inc.	Delta Controls Inc.	Delta Controls Inc.	Enlighted	JCI	JCI	JCI	LOYTEC electro...	Moxa	Prolojik	Prolojik	Prolojik
model compatibility	Model tested in the lab UDMI Driver Compatible Devices		OFHI	IP	Red5-	eBCON2	Red5-	Red5-	EN-	FW14/...	FW14/...	FS32/20	LROC-	UC8220	Perspe...	GN100
vendor_firmware			108.04....	D_IP_...	4.14.0.... (4141-001)	4.14.0.... (4141-001)	4.14.0.... (4141-001)	4.14.0.... (4141-001)	-	v3.0b2...	v3.0b2...	V3.0b6...	8.2.10	4.4.0-cip-rt-moxa-imx7d #1	2.0.4	-
vendor_udmi_module_version			108.04....	D_IP_...	1.4.09	1.4.09	1.4.09	1.4.09	-	3.1.8	3.1.8	3.1.8	2.2.0	4.4.0-cip-rt-moxa-imx7d #1	2.0.4	-
udmi_release_version			1.5.0-16-g48397...	-	1.5.2-40-g7ac62...	1.5.2-40-g7ac62...	1.5.2-40-g7ac62...	1.5.2-40-g7ac62...	1.5.1-19-g375c7...	1.5.2-111-ga7c4f...	1.5.2-111-ga7c4f...	1.5.2-75-gbd659...	1.5.0-16-g48397...	-	1.5.2-96-g5d520...	1.5.2-96-g5d520
test_date			2024-0...	2024-12-17T11:...	2024-12-19T11:...	2024-12-20T01:...	2024-12-20T10:...	2024-12-20T12:...	2024-06-13T14:...	2025-06-10T12:...	2025-06-10T12:...	2025-02-12T11:...	2024-10-01T15:...	-	2024-11-07T15:...	2025-02-19T17:..
manual	datapoint_mapping	-	✓	✗	✓	✓	✓	✓	✓	✓	✗	✗	✗	✓	✗	✗
manual	time_utc_format	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
pointset	pointset_publish	stable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
pointset	pointset_publish_interval	stable	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗
pointset	pointset_remove_point	stable	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗
pointset	pointset_request_extraneous	stable	✓	✗	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
system	broken_config	stable	✗	✓	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓	✗	✗

# Semantics and Dashboards

## FCU-1 (device)



## FCU-1

```
{
    "version": "1.3.14",
    "timestamp": "2018-08-26T21:39:29.364Z",
    "system": {
        "hardware": {
            "make": "Biddle",
            "model": "Proair 270"
        },
        "software": {},
        "serial_no": "",
        "last_config": "2018-08-26T21:49:29.364Z",
        "operational": true
    },
    "pointset": {
        "points": {
            "return_air_temperature_sensor": {},
            "fan_speed_percentage_command": {},
            "cooling_valve_percentage_command": {},
            "discharge_air_static_pressure_sensor": {},
            "supply_air_temperature_sensor": {}
        }
    }
}
```

## DDC-1

```
{
    "version": "1.3.14",
    "timestamp": "2018-08-26T21:39:29.364Z",
    "system": {
        "hardware": {
            "make": "Easy10",
            "model": "FW-14"
        },
        "software": {
            "firmware": "3.2a"
        }
    },
    "serial_no": "182732142",
    "last_config": "2018-08-26T21:49:29.364Z",
    "operational": true
},
"pointset": {
    "points": {
        "power_sensor": {}
    }
}
}
```



Active UDMI Sites  
**18** telemetry

Active DGLux Sites  
**165** telemetry

Total Active Sites  
**193** telemetry and state

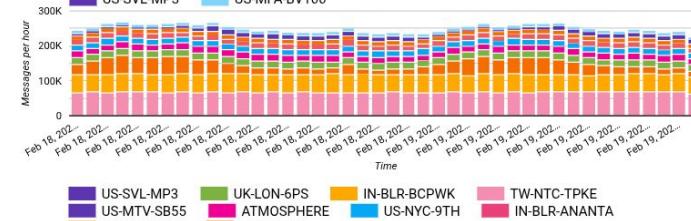
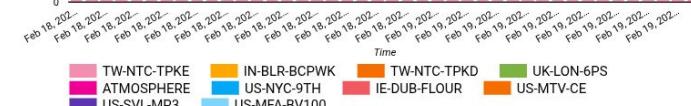
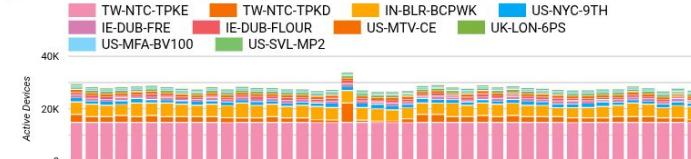
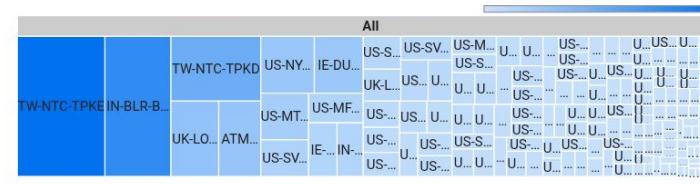
Total Registered Sites  
**288**

Proprietary + Confidential

	Site ▾	Registered Devices	Active Devices
1.	ATMOSPHERE	583	162
2.	AU-SYD-ODI	384	0
3.	AU-SYD-REVY	3	0
4.	CA-WAT-BRT1	131	0
5.	CA-WAT-BRT2	1	0
6.	CH-ZRH-EURD	86	0
7.	DE-FRA-NEM32	42	17
8.	FR-PAR-25C	371	135
9.	FR-PAR-50A	1,847	0
10.	IE-DUB-BOL1	502	0
11.	IE-DUB-FLOUR	1,572	1,088
12.	IE-DUB-FRE	1,621	1,151
13.	IE-DUB-GRCQ1	141	0
14.	IN-BLR-ANANTA	605	477
15.	IN-BLR-BCPEK	1,019	0
16.	IN-BLR-BCPWK	7,500	5,915
17.	IN-GUR-SIGD	1,444	0
18.	IN-HYD-SAR2	12,593	0
19.	IN-HYD-SAR3	3,601	0
20.	PH-CEB-ITPE5	30	0
21.	TW-NTC-TPKD	11,240	8,357
22.	TW-NTC-TPKE	14,826	14,822
23.	UDMI-REFLECT	287	0
24.	UK-LON-6PS	1,357	876
25.	UK-LON-BON	9	0
	<b>Grand total</b>	<b>88,071</b>	<b>51,717</b>

1 - 256 / 256 < >

Number of messages by site



Google

Summary

Gateway Asset Types

CGW

Control Asset Types

DDC

HVAC Asset Types

ACU

VAV

EF

WST

Metering Asset Types

EM

GM

WM

Messages

Asset Telemetry - Hour

Asset Telemetry - Minute

Asset State

Raw Messages

Reports

UDMI Registrar Report

UDMI Validation Report

## US-MTV-1161



Site: US-MTV-1161

Location: 1161 San Antonio Road Mountain View CA 94043

Tags: udm.udmi\_wip.monitored.mango.c71

Latitude: 37.431967481938

Longitude: -122.099708602708

Net Occupied Area (m²): 1953.0077

Gross Internal Area (m²): 2116.14545

Data Last Updated: 2/18/2025 11:15:59 AM | [Privacy Policy](#)

Feb 18, 2025 - Feb 18, 2025

Reset

## Active Devices

63

100.0% of 63 Registered Devices

## Pointset events



Asset Name	Device Numeric ID	IoT gateway	Message Bytes	Number of Messages
1. CGW-1	1727196356718		155,898,846	322
2. CGW-2	1727196357170		27,954,146	320
3. SRV-1	1733150938413		8,743,763	304
4. WST-1	1727196355465	CGW-1	578,050	298
5. VAV-2	1727196348862	CGW-1	608,996	297
6. VAV-1	1727196350655	CGW-1	577,929	297
7. VAV-8	1727196349631	CGW-1	625,629	296
8. VAV-17	1727196352941	CGW-1	577,711	296
9. VAV-10	1727196354417	CGW-1	608,603	296
10. EM-3	1727196355666	CGW-2	755,693	296
11. VAV-20	1727196351697	CGW-1	607,398	296
12. EM-1	1727196355519	CGW-2	706,175	295
13. VAV-24	1727196351126	CGW-1	624,638	295
14. VAV-16	1727196354136	CGW-1	607,519	295
15. EM-4	1727196356282	CGW-2	730,492	295

Grand total: 228,171,787 messages | 18,595 devices

1 - 63 / 63 &lt; &gt;

Registered Devices	Active Devices
1. ACU-1	ACU-1
2. ACU-2	ACU-2
3. ACU-3	ACU-3
4. ACU-4	ACU-4
5. CGW-1	CGW-1
6. CGW-2	CGW-2
7. DDC-1	DDC-1

1 - 63 / 63 &lt; &gt;

[Summary](#)[Gateway Asset Types](#)

CGW

[Control Asset Types](#)

DDC

[HVAC Asset Types](#)

ACU

VAV

EF

WST

[Metering Asset Types](#)

EM

GM

WM

[Messages](#)

Asset Telemetry - Hour

**Asset Telemetry - Minute**

Asset State

Raw Messages

[Reports](#)

UDMI Registrar Report

UDMI Validation Report



## Asset Telemetry - Minute data

[HOME](#)[Reset](#)

Feb 16, 2025 - Feb 19, 2025

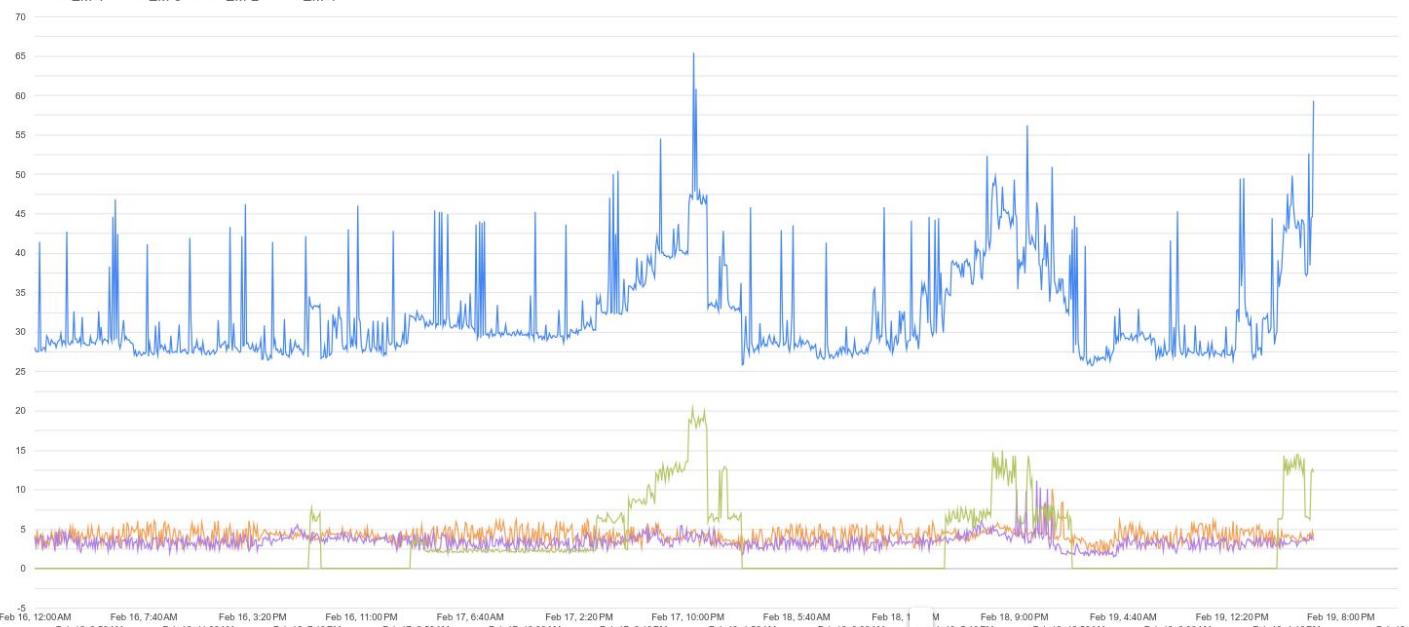
Asset Name: EM-4, EM-3, EM-2, EM-1

(4)

Point Name: power\_sensor

(1)

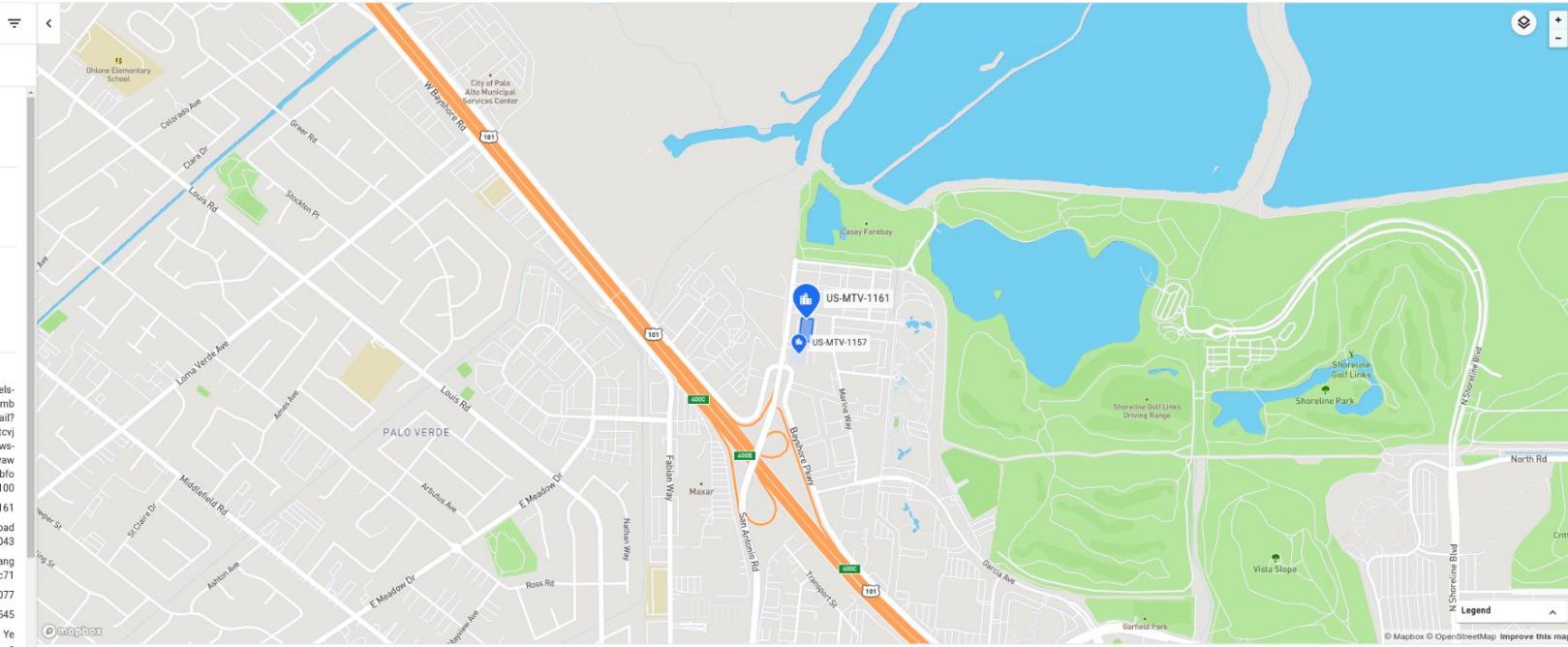
EM-1 EM-3 EM-2 EM-4



## Home



US-MTV-1161



## External

## Profile



Building



US-MTV-1161

## Status

## Events

No open events

## Last Update

Updated 5 days 4 hours ago,

14/02/2025, 13:03:45

## Attributes

Image [https://streetviewpixels-pa.googleapis.com/v1/thumb?panoid=k1qy6L7ID6Sed3xbtcvPA&cb\\_client=search.gws-prod.gps&w=408&h=240&raw\\_v=94.717674&pitch=-0&thumb\\_v=100](https://streetviewpixels-pa.googleapis.com/v1/thumb?panoid=k1qy6L7ID6Sed3xbtcvPA&cb_client=search.gws-prod.gps&w=408&h=240&raw_v=94.717674&pitch=-0&thumb_v=100)

Name 1161

Address 1161 San Antonio Road  
Mountain View CA 94043

Tags udml.udml\_wip.monitored.mang\_o.71

Net Occupied Area 1953.0077

Gross Internal Area 2116.14545

Building Data Processing Enabled?

Rules Enabled?

Yes

Dashboard <https://lookerstudio.google.com/c/reporting/4845e2df-c7ce-4574-b47c-c31512f766d/page/4GmD>Docs [https://drive.google.com/drive/folders/161HtReMggs5VWz231nb5H0jG8wpv57us?usp=drive\\_link](https://drive.google.com/drive/folders/161HtReMggs5VWz231nb5H0jG8wpv57us?usp=drive_link)Folder [https://drive.google.com/drive/folders/161HtReMggs5VWz231nb5H0jG8wpv57us?usp=drive\\_link](https://drive.google.com/drive/folders/161HtReMggs5VWz231nb5H0jG8wpv57us?usp=drive_link)

## Results

US-MTV-1157



Building



US-MTV-1157

about 11 hours ago

US-MTV-1161



Building



US-MTV-1161

about 11 hours ago

5 days ago

US-MTV-SB55



Building



US-MTV-SB55

about 11 hours ago

5 days ago

US-MTV-1220



Building



US-MTV-1220

about 11 hours ago

8 days ago

Assets

## US-MTV-1161

ID: US-MTV-1161

1161 San Antonio Road Mountain View CA 94043

0 OPEN EVENTS



TYPE

Building

ENTITY TYPE

Area

GROUPS

US-MTV-1161

LAST UPDATED

11 hours 4 minutes ago, 19/02/2025, 06:54:11

LOCATION UPDATED

5 days 4 hours ago, 14/02/2025, 13:03:45

TAGS

c71 mango monitored udmi udmi\_wip

DATA HISTORY CONTROLS EVENTS COMMENTS IMAGES

## Attributes

Collapse all

## US-MTV-1161

28 attributes

## Site Metadata

6 attributes

Image



Name

1161

Address

1161 San Antonio Road Mountain View CA 94043

Tags

udmi,udmi\_wip,monitored,mango,c71

Gross Internal Area (m<sup>2</sup>)2166.645 m<sup>2</sup>Net Occupied Area (m<sup>2</sup>)1953.0077 m<sup>2</sup>

4 attributes

## Tree

COLLAPSE ALL

US-MTV-1161

- US-MTV-1161\_WM-1
- US-MTV-1161\_CGW-2
- US-MTV-1161\_EM-2
- US-MTV-1161\_VAV-14
- US-MTV-1161\_VAV-42
- US-MTV-1161\_VAV-28
- US-MTV-1161\_VAV-27
- US-MTV-1161\_VAV-5
- US-MTV-1161\_VAV-33
- US-MTV-1161\_DDC-1
- US-MTV-1161\_VAV-10
- US-MTV-1161\_EM-4
- US-MTV-1161\_CGW-1
- US-MTV-1161\_VAV-40
- US-MTV-1161\_VAV-20
- US-MTV-1161\_VAV-32
- US-MTV-1161\_VAV-7
- US-MTV-1161\_VAV-9
- US-MTV-1161\_GM-1
- US-MTV-1161\_VAV-34
- US-MTV-1161\_VAV-11
- US-MTV-1161\_VAV-46
- US-MTV-1161\_VAV-44
- US-MTV-1161\_VAV-35
- US-MTV-1161\_VAV-36
- US-MTV-1161\_VAV-24
- US-MTV-1161\_VAV-25
- US-MTV-1161\_VAV-4
- US-MTV-1161\_EM-1
- US-MTV-1161\_VAV-1
- US-MTV-1161\_VAV-19
- US-MTV-1161\_VAV-23
- US-MTV-1161\_VAV-2
- US-MTV-1161\_VAV-31
- US-MTV-1161\_VAV-41
- US-MTV-1161\_VAV-39
- US-MTV-1161\_VAV-37
- US-MTV-1161\_VAV-30
- US-MTV-1161\_EF-1
- US-MTV-1161\_VAV-38
- US-MTV-1161\_VAV-8
- US-MTV-1161\_EF-2
- US-MTV-1161\_VAV-3
- US-MTV-1161\_VAV-6

← Assets

## Asset

US-MTV-1161

## LAST UPDATED

2 minutes 50 seconds ago, 19/02/2025, 17:56:25

## LOCATION UPDATED

Never

## TAGS

building electricity main meter site

## Tree

COLLAPSE ALL

## US-MTV-1161

US-MTV-1161\_WM-1

US-MTV-1161\_CGW-2

US-MTV-1161\_EM-2

US-MTV-1161\_VAV-14

US-MTV-1161\_VAV-42

US-MTV-1161\_VAV-28

US-MTV-1161\_VAV-27

US-MTV-1161\_VAV-5

US-MTV-1161\_VAV-33

US-MTV-1161\_DDC-1

US-MTV-1161\_VAV-10

US-MTV-1161\_EM-4

US-MTV-1161\_CGW-1

US-MTV-1161\_VAV-40

US-MTV-1161\_VAV-20

US-MTV-1161\_VAV-32

US-MTV-1161\_VAV-7

US-MTV-1161\_VAV-9

US-MTV-1161\_GM-1

US-MTV-1161\_VAV-34

US-MTV-1161\_VAV-11

US-MTV-1161\_VAV-46

US-MTV-1161\_VAV-44

US-MTV-1161\_VAV-35

US-MTV-1161\_VAV-36

US-MTV-1161\_VAV-24

US-MTV-1161\_VAV-25

US-MTV-1161\_VAV-4

US-MTV-1161\_EM-1

US-MTV-1161\_VAV-1

US-MTV-1161\_VAV-19

US-MTV-1161\_VAV-23

US-MTV-1161\_VAV-2

US-MTV-1161\_VAV-31

US-MTV-1161\_VAV-41

US-MTV-1161\_VAV-39

US-MTV-1161\_VAV-37

US-MTV-1161\_VAV-30

US-MTV-1161\_EF-1

US-MTV-1161\_VAV-38

US-MTV-1161\_VAV-8

US-MTV-1161\_EF-2

US-MTV-1161\_VAV-3

US-MTV-1161\_VAV-6

DATA HISTORY CONTROLS EVENTS COMMENTS IMAGES

## Asset History

TIMELINE MAP PLOTS TABLE Date Range Past Week

Attributes power\_sensor phase3\_power\_sensor phase1\_power\_sensor phase2\_power\_sensor

Plotting 1,916 updates from 12/02/2025, 17:59:00 – 19/02/2025, 17:59:00



?

## Savings Summary

Utility Performance

Data Health

Fault Detection &amp; Diagnostics

Building Optimisation

Indoor Environment

Plant Performance



## Site Performance Report



## Savings Summary

Jan 1, 2023 - Jul 3, 2023

KGX1



## Realised Savings - last 12 months

£0

vs. same time last year

## Electricity Usage vs. Baseline

NO BASELINE

## Not yet Realised

£3,494

## Savings Breakdown



## Realised Savings

£0

## Not yet Realised Savings

£3,494

## Identified Savings

£3,494



## Realised kWh Savings

0

## Not yet Realised kWh Savings

17,472

## Identified kWh Savings

17,472



## Realised tCO2e Savings

0

## Not yet Realised tCO2e Savings

4

## Identified tCO2e Savings

4



## Realised kL Savings

0

## Not yet Realised kL Savings

0

## Identified kL Savings

0

*Realised Savings* are Actions closed during the selected period, which may also include actions identified before the selected period.*Available Savings* are Actions currently in progress that have not been closed.*Identified Savings* are Actions identified within the selected period.

kWh = kilowatt hours

tCO2e = tonnes of carbon dioxide equivalent

kL = kilolitres

Savings Summary

Utility Performance

Data Health

Fault Detection &amp; Diagnostics

Building Optimisation

Indoor Environment

## ▼ Plant Performance

## Chiller Performance

Chiller Faults

AHU Performance

AHU Faults



## Site Performance Report



## Chiller Performance

Jun 4, 2025 - Jul 3, 2025

KGX1

Avg plant run hours for days active

20.9

No data vs. previous period

Average CHWT setpoint (C)

7.01

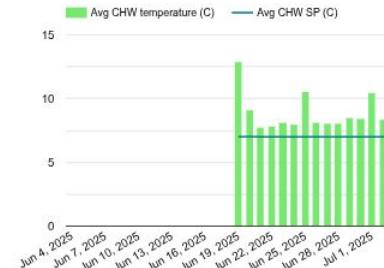
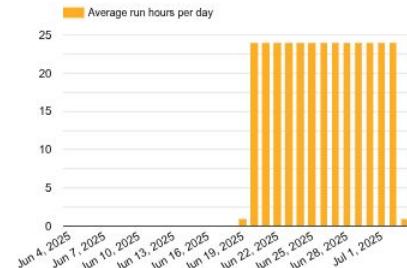
No data vs. previous period

% time leaving CHW temp SP met\*

61.94%

No data vs. previous period

\* Leaving CHWT within 1C of SP



Equipment	Link	COP	Avg CHW Setpoint (C)	Avg leaving CHWT (C)	%time CHWT SP met	Avg run hours per day
1. CH-1 (CH-B2-51)	<a href="#">Link</a>	No...	7.0	7.3	95%	11.9
2. CH-2 (CH-B2-52)	<a href="#">Link</a>	No...	7.0	7.5	86%	3.7
3. CH-3 (CH-B2-53)	<a href="#">Link</a>	No...	7.0	7.1	93%	5.2
4. CH-5 (CH-B2-55)	<a href="#">Link</a>	No...	7.0	8.4	65%	4.6
5. CH-4 (CH-B2-54)	<a href="#">Link</a>	No...	7.0	10.7	4%	20.9
6. CH-6 (CH-B2-56)	<a href="#">Link</a>	No...	7.0	7.5	94%	20.6

All Metering FDD Optimisation Data Uptime

1 Site 41 Insights 319 Equipments Last 3 days

[Expand All](#) [Export](#)

🔍
Group By Sort By History
  
 Site Hits Last 3 days 4

KGX1 (41) 278 of 319 Equipments Unassociated						<span>31 NEW</span>	▲
Latest ↓	Priority	Severity	Rule <span>41</span>	Rule Type	Equipments <span>319</span>	Hits <span>402</span>	
Today		Moderate	AHU CHW valve hunting	AHU/FCU FDD Rules	1 Equip	1 Hit Avg. 0.41hrs	
Today		Major	AHU cooling within deadband	OP08 Zone Deadband Optimisation	2 Equip	4 Hits Avg. 4.75hrs	
Today		Moderate	AHU SAT SP not reached during cooling mode	AHU/FCU FDD Rules	5 Equip	7 Hits Avg. 2.8hrs	
Today		Major	AHU cooling coil starved	AHU/FCU FDD Rules	5 Equip	6 Hits Avg. 2.62hrs	
Today	1	Moderate	No data received: BMS point	Data Uptime Rules	1 Equip	1 Hit Avg. 11hrs	
Today	1	Moderate	Chiller plant not running on optimal CHWT SP	OP5 CHW temp setpoint Optimisation	2 Equip	8 Hits Avg. 1.25hrs	
Today	1	Critical	Chiller entering CDWT too high	CHW System FDD Rules	5 Equip	8 Hits Avg. 3.05hrs	
Today		Major	AHU SAF static pressure below SP	OP10 Supply Air Pressure Optimisation	1 Equip	1 Hit Avg. 4hrs	
Today	1	Major	VSD speed fixed: Turn down possible	General FDD Rules	2 Equip	3 Hits Avg. 2.25hrs	

[+ Add Sources](#) [Templates](#)[Share](#)[Export](#)

Density: Normal ▾

Interval: Auto (Raw) ▾

&lt;

Jun 28 – Jul 4, 2025 (7 Days) ▾

&gt;

## Sources (15)

[Remove all](#) [Remove hidden](#)

...

 Insights

## KGX1

CRAC-18 (CRAC-09-B1-301A/B) (Air Handling Unit)

...

 AHU cooling within deadband

-

 °C (Degree celsius)

## KGX1

CRAC-18 (CRAC-09-B1-301A/B) (Air Handling Unit)

...

- air\_temperature\_sensor (Zone Temperature Sensor)
- 
- crac\_temperature\_setpoint (Zone Temperature Setpoint)
- 
- return\_air\_temperature\_sensor (Return Air Temperature Sensor)
- 
- supply\_air\_temperature\_sensor (Supply Air Temperature Sensor)
- 

...

 %RH (Percent relative humidity)

## KGX1

CRAC-18 (CRAC-09-B1-301A/B) (Air Handling Unit)

...

- air\_humidity\_sensor (Zone Relative Humidity Sensor)
- 

...

 % (Percent)

## KGX1

CRAC-18 (CRAC-09-B1-301A/B) (Air Handling Unit)

...

- chilled\_water\_valve\_percentage\_sensor (Chilled Water Valve Percentage Sensor)

...

## Insights

KGX1 • CRAC-18 (CRAC-09-B1-301A/B) • AHU cooling within deadband

Jun 28, 2025

Jun 29, 2025

Jun 30, 2025

Jul 01, 2025

Jul 02, 2025

Jul 03, 2025

Jul 04, 2025

°C (Degree celsius)

Formula: N/A ▾ Interval: Auto (Raw) ▾



%RH (Percent relative humidity)

Formula: N/A ▾ Interval: Auto (Raw) ▾



Open Actions Closed Actions



## Action #152

[+ Add Action](#) [Export](#)

ID Updated ↓ Status

#152 4 hours ago [New Action](#)

#152 • KGX1

Created Jul 3, 2025 by Joseph Chen

Updated 5 hours ago

CDW pump on while chiller off

Status

Severity

Type

[New Action](#)[Major](#)[Warranty](#)

Description

Primary CWP PMP 60, 75, 78, and 80 for CH-1, 2, 3, and 5 have been running without the chillers being on.

Per the desops A6245/DOP/B2/C5/CHW/Prim section 6.1.k:

"Condenser water pump sets are enabled when their associated chiller is required to run under demand for CHW from the secondary CHW circuits connected to the main CHW flow and return headers."

## Energy Savings Estimate

- Behavior seems inconsistent, but last week each pump ran for about ~1 day (9A - 5P) without chillers running
- Each pump runs at about ~112A and 374V, or ~42 kW
- Assume behavoe would have continued for 90 days (13 weeks) without Bueno intervention
- $42 \text{ kW} * 8 \text{ hrs/week} * 13 \text{ weeks} * 4 \text{ pumps} = 17472 \text{ kWh}$  (£3494 @ £0.20/kWh)

## Insights &amp; Equipment

## Activity



Add a comment or attach a file to the activity stream

Tip: send a notification to other users by @'ing them in a comment

Enter your comment...

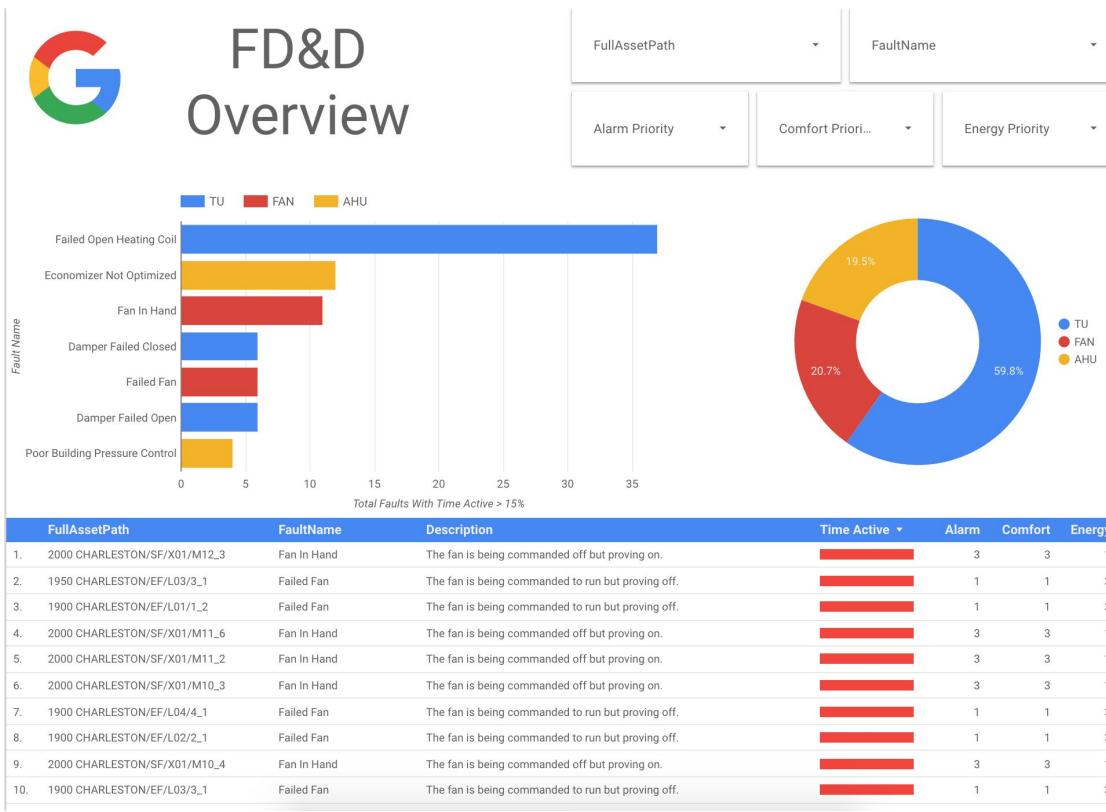
[Attach file](#)[Add Comment](#)Filter Status  
Applied (2) Sort By  
Updated

Team	Est. savings
Bueno	£3,494
Bueno	
Ashif Buksh	

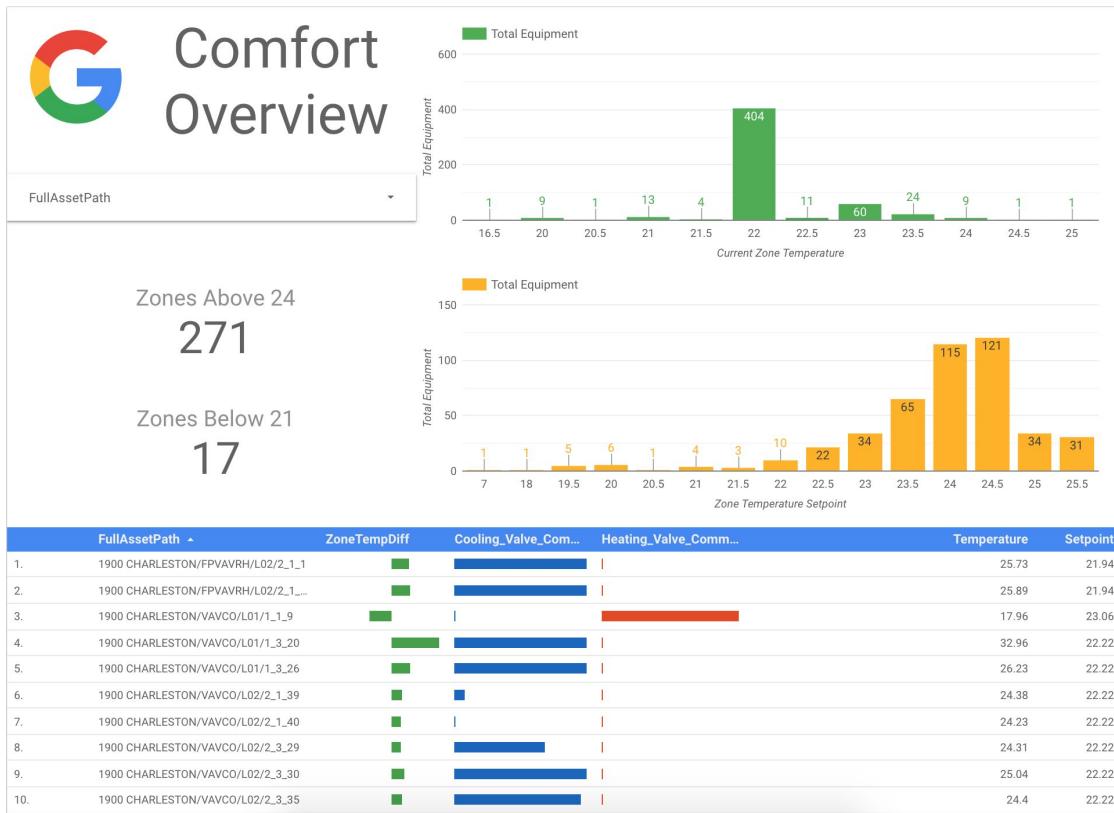
# Example: FCU Temperature Comparison

	fcu_reference_cell_value	ABS Temp Difference ⓘ	airtemp	setpoint	power ⓘ
1.	FCU/04/SE/11				76.09
2.	FCU/05/SW/21				91.29
3.	FCU/05/SW/09				66.15
4.	FCU/05/NW/05				141.41
5.	FCU/05/SW/17				85.83
6.	FCU/05/NE/18				43.99
7.	FCU/04/NW/05				67.75
8.	FCU/05/NW/01				93.2
9.	FCU/04/NE/20				35.41
10.	FCU/03/SW/18				46.36
11.	FCU/04/SW/11				101.45
12.	FCU/04/SW/22				46.86
13.	FCU/03/SW/10				100.2
14.	FCU/03/SE/31				47.77
15.	FCU/03/SW/05				88.77
16.	FCU/04/NE/17				53.59
17.	FCU/05/SW/11				83.08
18.	FCU/03/SW/14				42.89
19.	FCU/UG/SW/06				85.23
20.	FCU/04/NE/21				61.87
21.	FCU/03/SE/09				116.7
22.	FCU/04/NW/04				52.59
23.	FCU/05/SW/06				63.92
24.	FCU/UG/SW/18				92.36
25.	FCU/05/SE/21				61.37
26.	FCU/04/SE/07				158.9
27.	FCU/01/NW/03				152.38
28.	FCU/02/SE/08				51.37
29.	FCU/02/SW/07				80.49
30.	FCU/04/NW/01				118.58

# Example: FDD Overview



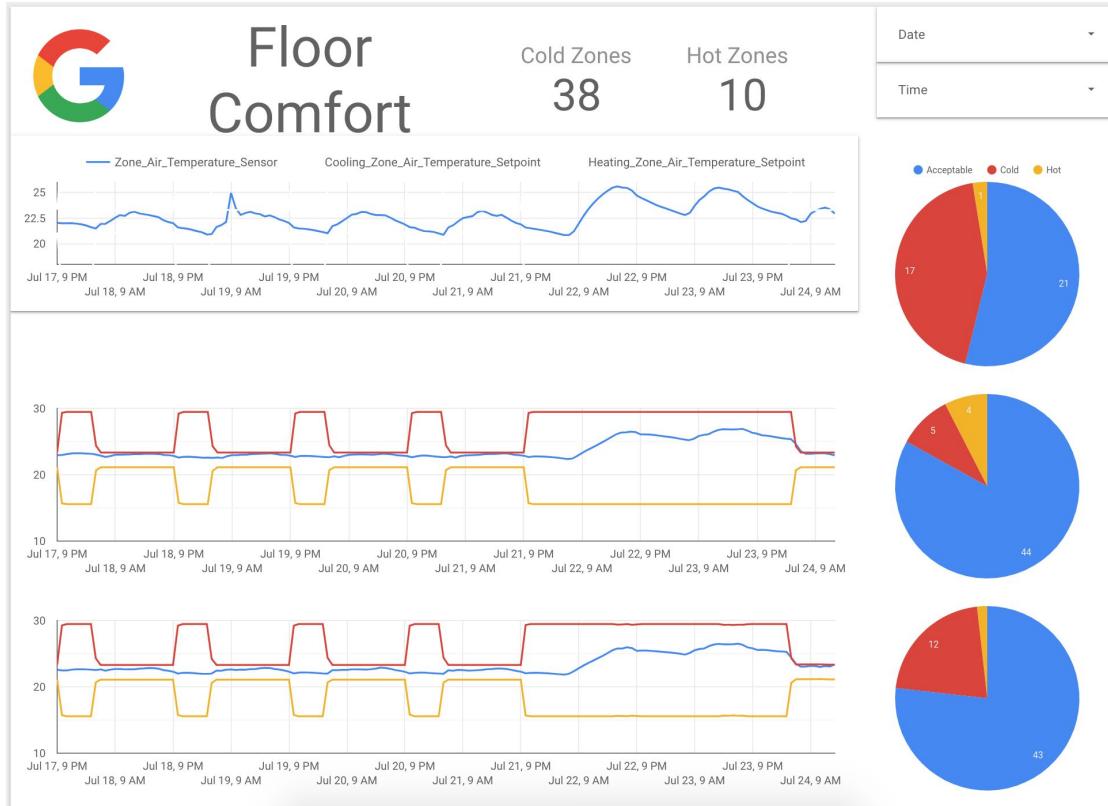
# Example: Comfort Overview



# Example: Comfort Overview



# Example: Floor Comfort



# Using BDNS at Max Fordham

# Using BDNS at Arup

# Break!

# Building Systems Ontologies

# How do we make sense of data?

When there is:

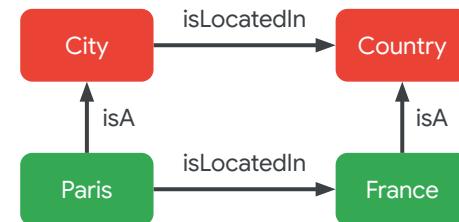
- Heterogeneity of devices & systems
- Disparity of data in various silos without consistent classification
- Need for data correlation across silos
- Serve data to various applications and personas

## Ontology

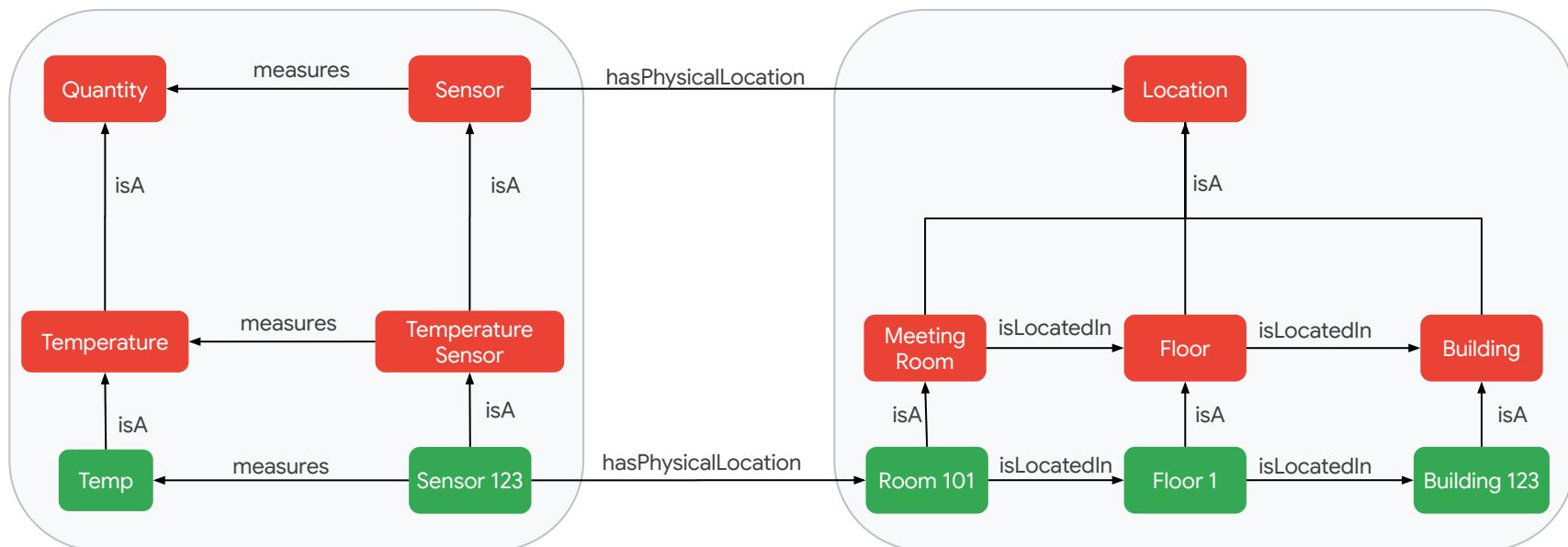
- As a common vocabulary to refer to concepts in the building
- As a way to capture knowledge inside the Building domain (relations)

# Ontology at a glance

- An Ontology: is a representation of domain concepts and relations that connect such concepts
- Ontologies are represented in triplets:  
(object, relation, object)
- **Classes** and **Instances**
- W3C Standards : RDF, OWL, JSON-LD



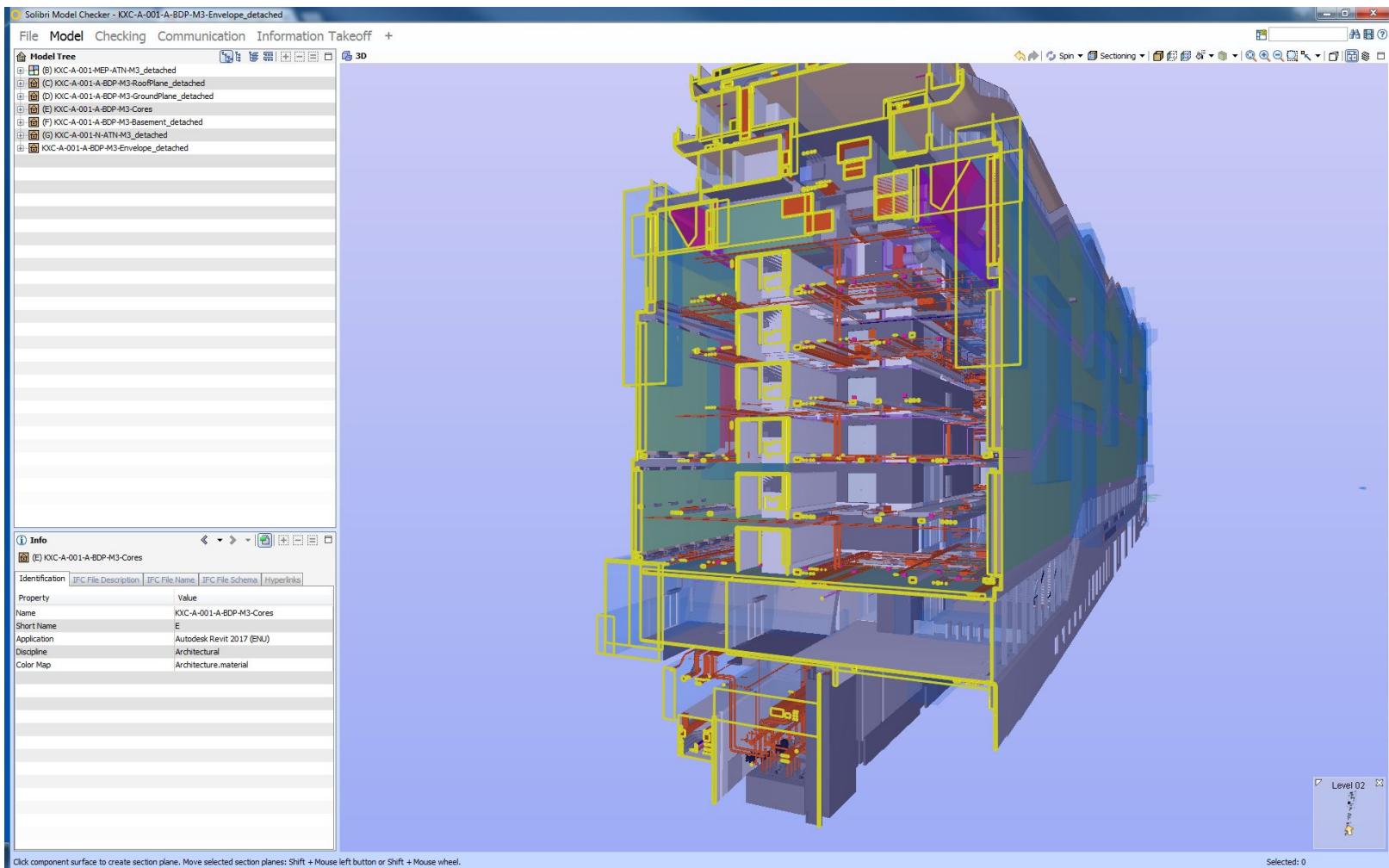
# Ontology Example

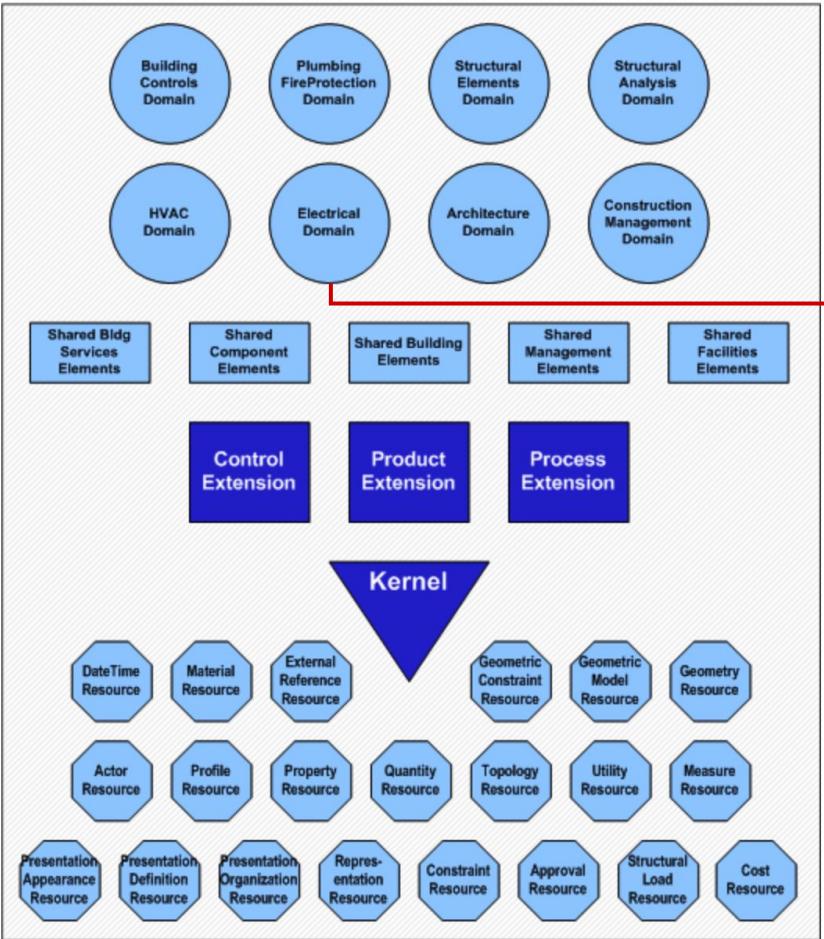


Instance

Class

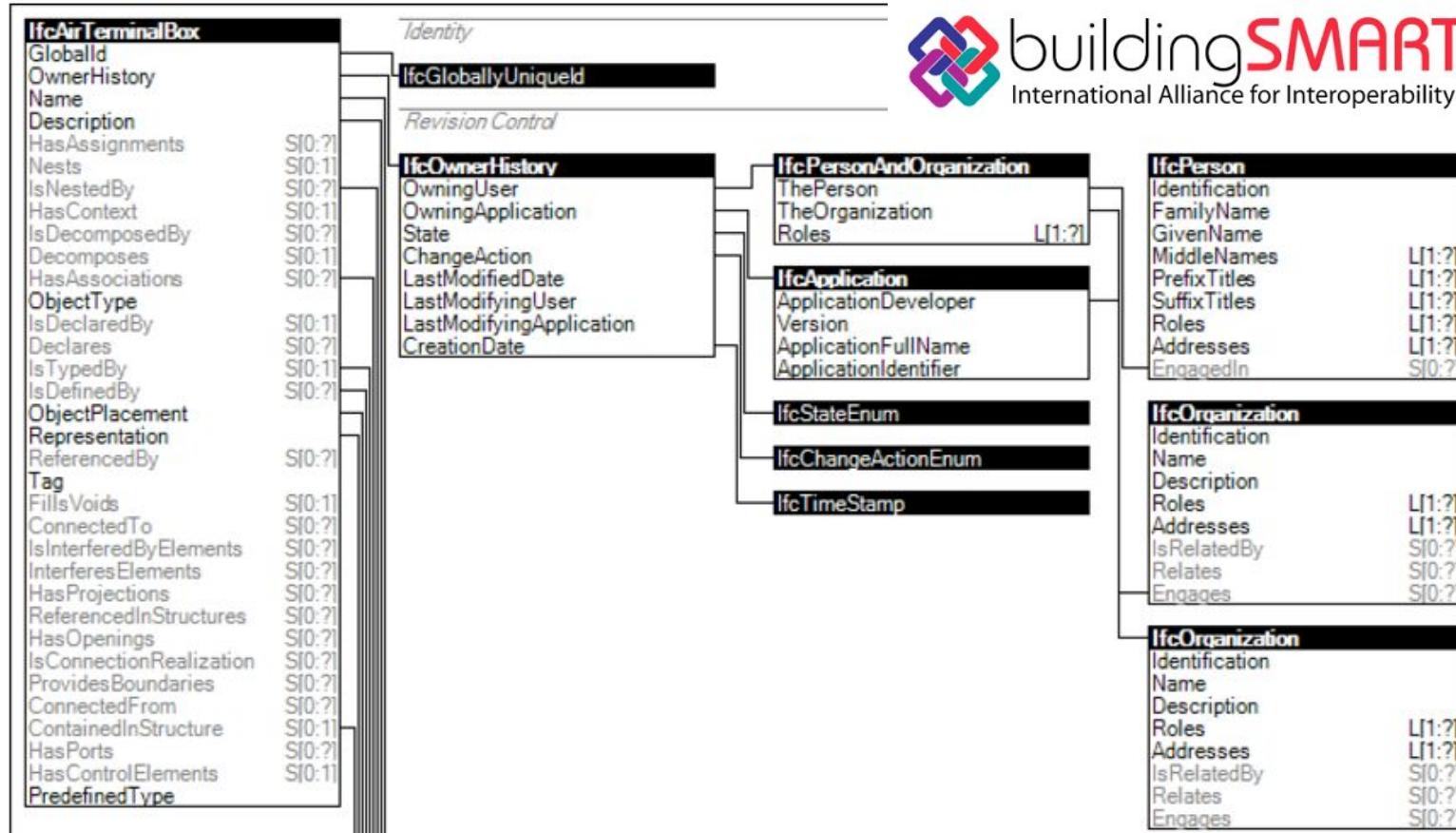
IFC



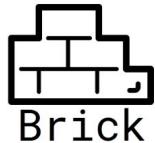


- 7.4.3.5 IfcCableCarrierSegment
- 7.4.3.6 IfcCableCarrierSegmentType
- 7.4.3.7 IfcCableFitting
- 7.4.3.8 IfcCableFittingType
- 7.4.3.9 IfcCableSegment
- 7.4.3.10 IfcCableSegmentType
- 7.4.3.11 IfcCommunicationsAppliance
- 7.4.3.12 IfcCommunicationsApplianceType
- 7.4.3.13 IfcElectricAppliance
- 7.4.3.14 IfcElectricApplianceType
- 7.4.3.15 IfcElectricDistributionBoard
- 7.4.3.16 IfcElectricDistributionBoardType
- 7.4.3.17 IfcElectricFlowStorageDevice
- 7.4.3.18 IfcElectricFlowStorageDeviceType
- 7.4.3.19 IfcElectricGenerator
- 7.4.3.20 IfcElectricGeneratorType
- 7.4.3.21 IfcElectricMotor
- 7.4.3.22 IfcElectricMotorType
- 7.4.3.23 IfcElectricTimeControl
- 7.4.3.24 IfcElectricTimeControlType
- 7.4.3.25 IfcJunctionBox
- 7.4.3.26 IfcJunctionBoxType
- 7.4.3.27 IfcLamp
- 7.4.3.28 IfcLampType
- 7.4.3.29 IfcLightFixture
- 7.4.3.30 IfcLightFixtureType
- 7.4.3.31 IfcMotorConnection
- 7.4.3.32 IfcMotorConnectionType
- 7.4.3.33 IfcOutlet
- 7.4.3.34 IfcOutletType
- 7.4.3.35 IfcProtectiveDevice

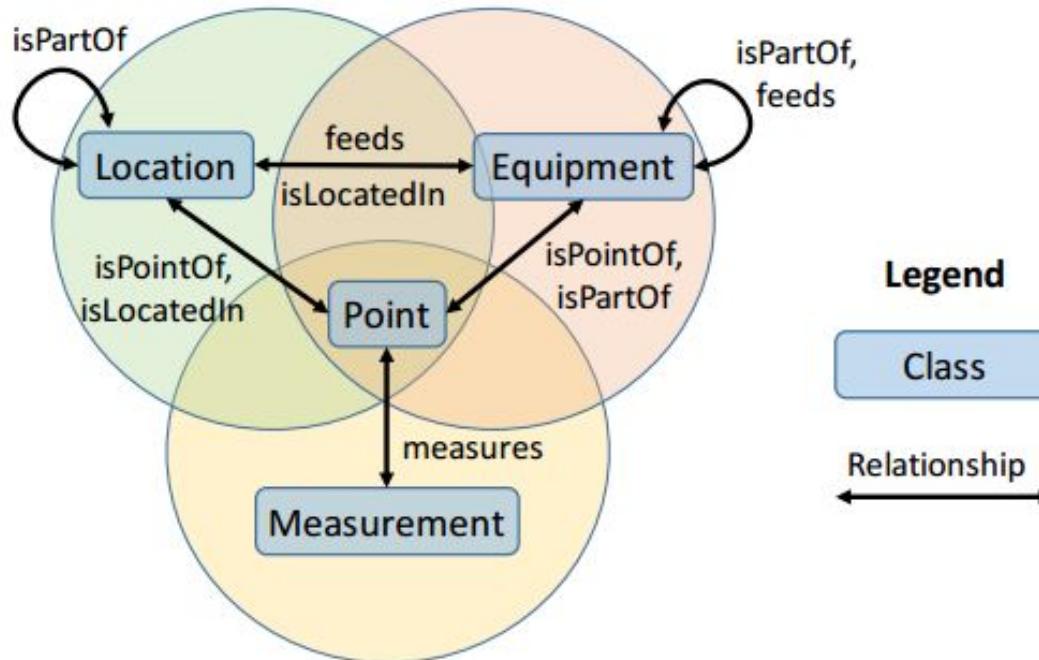
## D.2.1.5 IfcAirTerminalBox

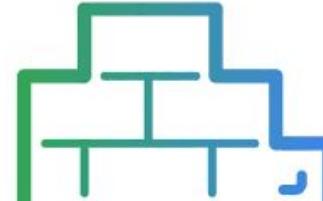


# Brick Schema

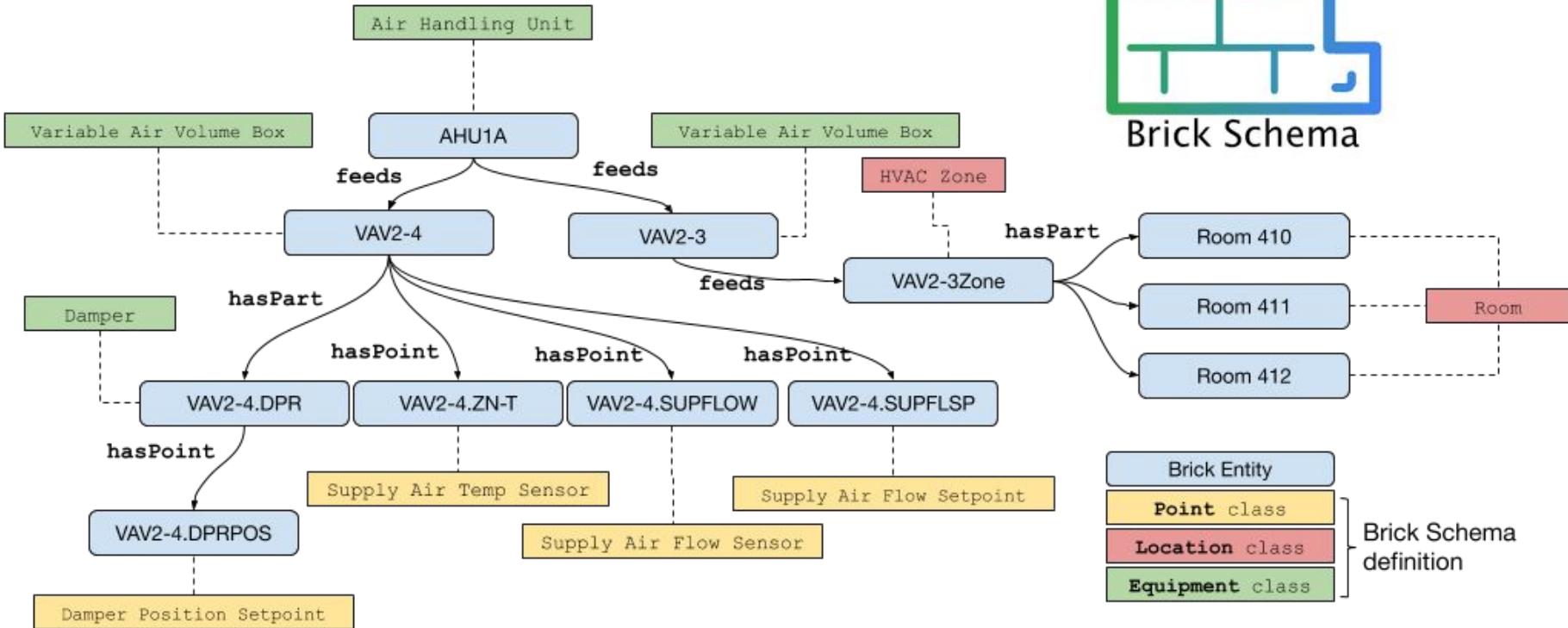


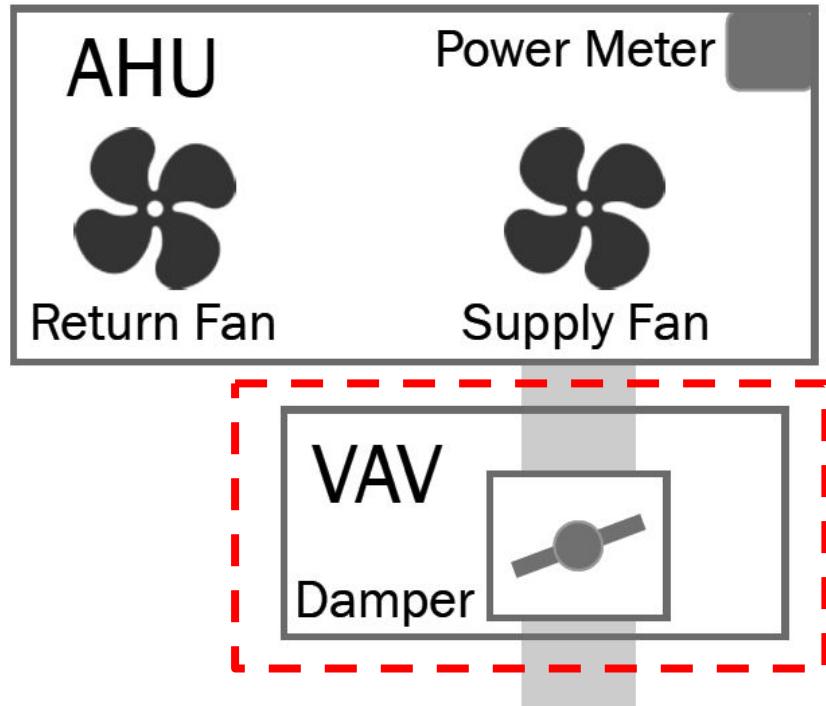
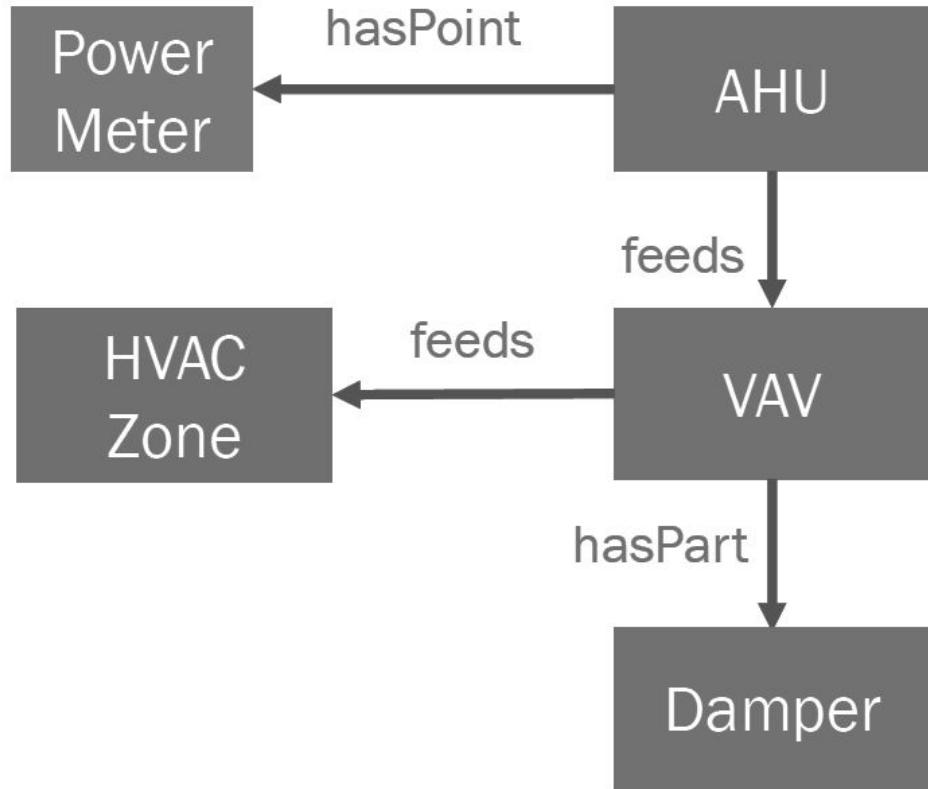
Brick

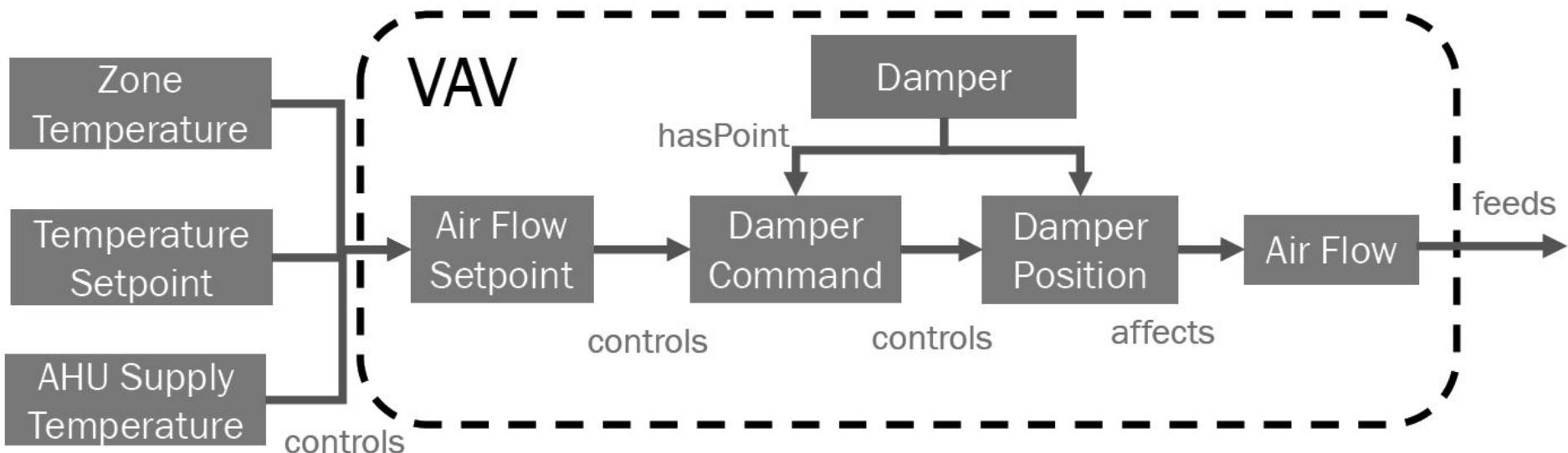
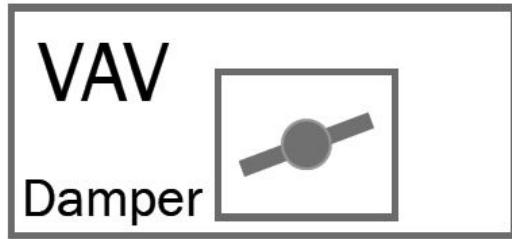




Brick Schema







```
@prefix ex: <example#> .  
@prefix brick: <https://brickschema.org/schema/1.1/Brick#> .  
@prefix unit: <http://qudt.org/vocab/unit/> .  
@prefix schema: <http://schema.org/> .
```

```
ex:TempSensor a brick:Air_Temperature_Sensor .  
ex:TempSensor brick:hasUnit unit:DEG_C .
```

```
ex:TempSetpoint a brick:Room_Air_Temperature_Setpoint .  
ex:TempSetpoint brick:hasUnit unit:DEG_C .
```

```
ex:FanControl a brick:Start_Stop_Command .
```

```
ex:Room101_Fan a brick:Fan .  
ex:Room101_Fan brick:hasPoint ex:TempSensor .  
ex:Room101_Fan brick:hasPoint ex:TempSetpoint .  
ex:Room101_Fan brick:hasPoint ex:FanControl .  
ex:Room101_Fan brick:isLocatedIn ex:Room_101 .
```

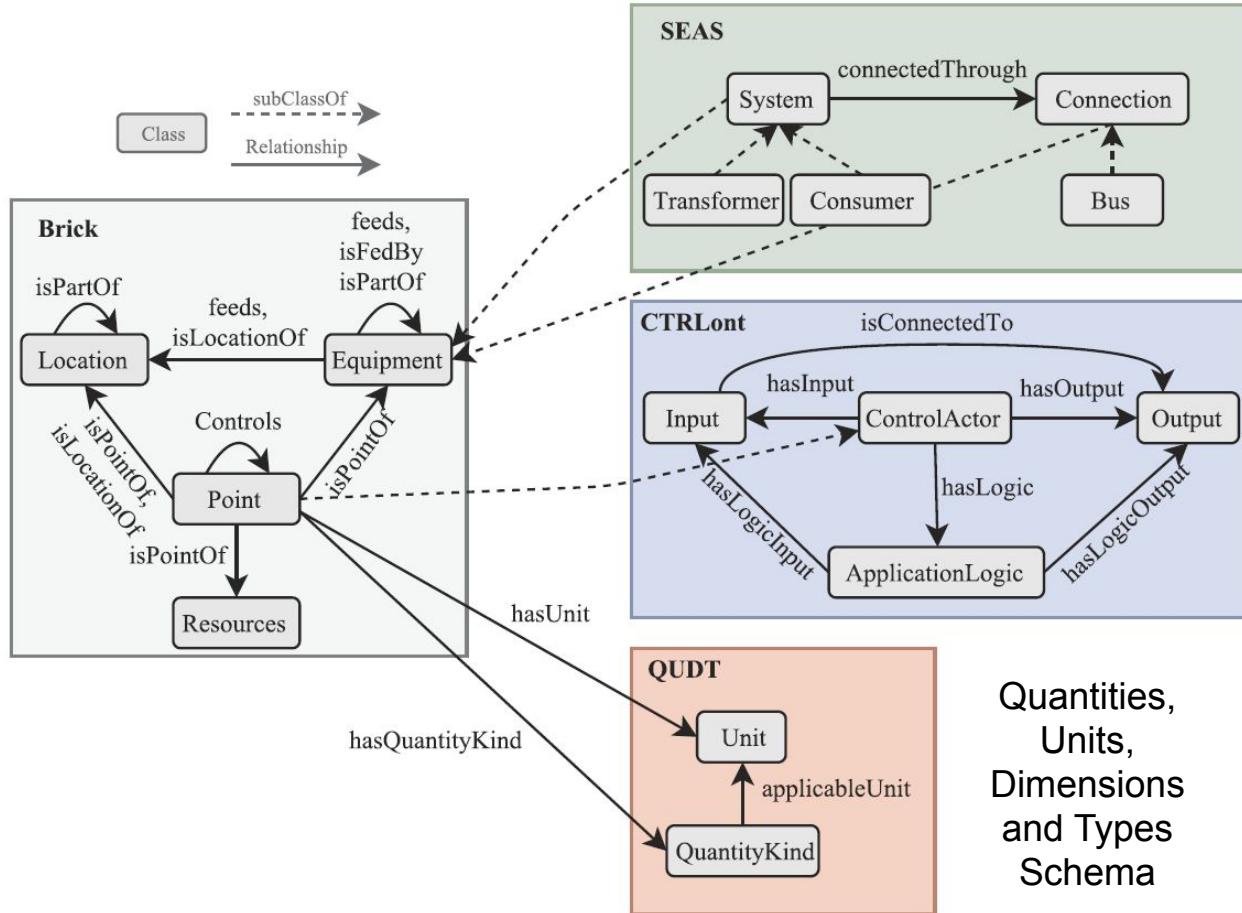
```
ex:Room_101 a brick:Room .  
ex:Room_101 brick:isPartOf ex:ExampleBuilding .
```

```
ex:ExampleBuilding a brick:Building .  
ex:ExampleBuilding schema:address ex:ExampleBuildingAddress .
```

```
ex:ExampleBuildingAddress a schema:PostalAddress .  
ex:ExampleBuildingAddress schema:addressRegion "DC" .  
ex:ExampleBuildingAddress schema:postalCode "20500" ;  
ex:ExampleBuildingAddress schema:streetAddress "1600 Pennsylvania Ave  
NW" .
```



# Domain ontologies

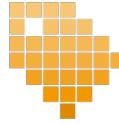


Energy  
System  
Schema

Control  
Logic  
Schema

Quantities,  
Units,  
Dimensions  
and Types  
Schema

# Project Haystack



# Project Haystack

Proprietary + Confidential

AHU1-SAT

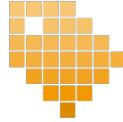
discharge, air, temp, sensor, point, unit:"°F"

ahuRef -> AHU-1

Point Name

descriptive tags

association tag

 Project Haystack

```
id: @TempSensor
dis: "Temperature Sensor for room 101"
point
siteRef: @examplebuilding
equipRef: @examplebuilding.room101.fan
air
temp
cur
sensor
kind: "Number"
unit: "°C"
```

```
id: @TempSetpoint
dis: "Temperature Setpoint for room 101"
point
siteRef: @examplebuilding
equipRef: @examplebuilding.room101.fan
air
temp
cur
sp
kind: "Number"
unit: "°C"
```

```
id: @FanControl
dis: "Control of the fan in room 101"
point
siteRef: @examplebuilding
equipRef: @examplebuilding.room101.fan
air
fan
cmd
cur
run
```

```
id: @examplebuilding.room101.fan
dis: "The fan in room 101"
equip
siteRef: @examplebuilding
air
fan
cool
```

```
id: @examplebuilding
dis: "White House"
site
area: 55000ft2
tz: "New_York"
geoAddr: "1600 Pennsylvania Avenue NW, Washington, DC"
geoStreet: "1600 Pennsylvania Ave NW"
geoCity: "Washington D.C."
geoCountry: "US"
geoPostalCode: "20500"
geoCoord: C(38.898, -77.037)
```

# Digital Buildings Ontology



## Digital Buildings Project

The Digital Buildings project is an open-source, Apache-licensed effort to create a uniform schema and toolset for representing structured information about buildings and building-installed equipment. A version of the Digital Buildings ontology and toolset is currently being used by Google to manage buildings in its portfolio.

The Digital Buildings project originated from the need to manage a very large, heterogeneous building portfolio in a scalable way. The project aims to enable management applications/analyses that are trivially portable between buildings. This goal is achieved through a combination of semantically-expressive abstract modeling, an easy-to-use configuration language, and robust validation tooling. Digital Buildings work has been inspired by [Project Haystack](#) and [BrickSchema](#), and maintains cross-compatibility and/or convergence as a long-term objective.

In creating the Digital Buildings project, we have considered the following:

- Human Readability
- Machine readability and interpretation
- Composable functionality

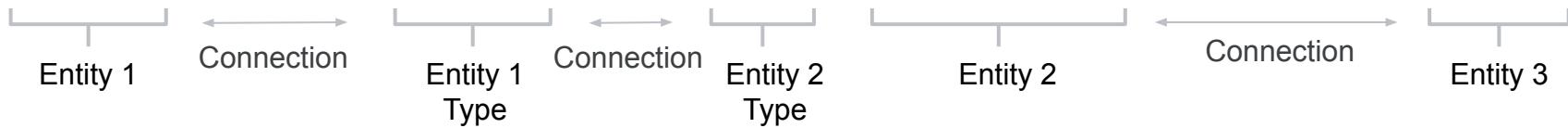
<https://google.github.io/digitalbuildings/>

Google

# Semantic Data and the DB ontology

- A DB smart building must be robustly machine readable. Semantic data makes this possible.
- In this model we:
  - Represent important information in globally consistent ways
  - Compartmentalize and hide unimportant differences between things that hinder generalization
  - Model the relationships between entities in the system to enable high level analysis and action

**VAV-001 is of type VAV\_DSP, is on FLOOR US-SVL-TC2-3 and is fed by AHU-001**



# DB Ontology components

- Subfields
- Fields
- [Equipment] types
- States
- Links
- Connections

# Subfields

- Analogous to tags in BRICK or Haystack
- Have very specific, well-defined definitions
- Are grouped into subfield types, where each subfield belongs to only one type
  - Aggregation
  - Descriptor
  - Component
  - Measurement Descriptor
  - Measurement Type
  - Point Type
- The set of subfields associated with a point make up its name.

Example subfields:

master: "Highest priority (or primary control) device, sensor, etc."

makeup: "Process of adding ("making-up") water that has been lost due to blowdown or evaporation."

medium: "Level of control or measurement; between high and low."

mixing: "Process of mixing substance."

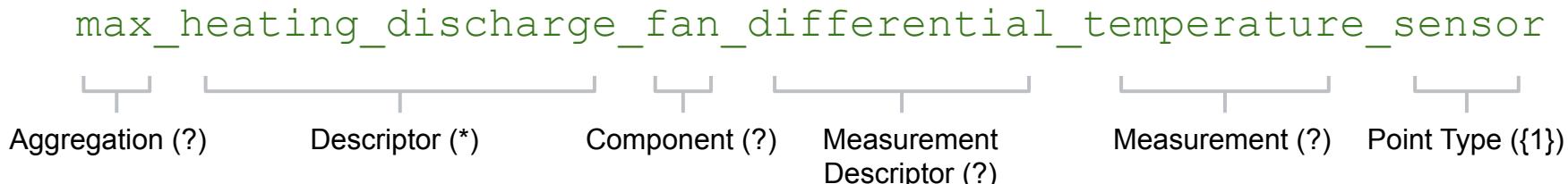
# Fields (what's in a name?)

max\_heating\_discharge\_fan\_differential\_temperature\_sensor

Aggregation (?)      Descriptor (\*)      Component (?)      Measurement Descriptor (?)      Measurement (?)      Point Type ({1})

- Self describing
  - Structured to encode dense meaning
  - Extensible in ways that create **implicit hierarchies and relationships between fields**

# Fields



- Must contain a minimum of point type and one additional subfield
- Requires measurement type unless it can be unambiguously implied
- Have meaning derived from the combined meaning of included subfields
- Should be sufficiently detailed to explain the context of the measurement or control
  - zone\_air\_temperature\_sensor > temperature\_sensor
- The majority of fields needed to describe building equipment have already been defined <[link to list](#)>
- MULTI-STATE values are defined for fields as well.

# [Equipment] Types

- Represent clearly defined concepts (device or otherwise) or sets of functionality
- Define specific sets of 0 or more points associated with the concepts
- Can be composed from individual fields as well as other types

## VAV\_SD\_DSP:

```
description: "Simple,  
cooling-only VAV."
```

```
is_canonical: true
```

```
implements:
```

```
- VAV
```

```
- SD
```

```
- DSP:
```

```
description: "Dual setpoint control (heating/cooling  
thresholds with deadband in between)."
```

```
is_abstract: true
```

```
implements:
```

```
- ZTM
```

```
uses:
```

```
- zone_air_cooling_temperature_setpoint  
- zone_air_heating_temperature_setpoint
```

## VAV:

```
description: "Tag for terminal  
units with variable volume control."
```

```
is_abstract: true
```

## SD:

```
description: "Single duct attributes  
for VAV with basic airflow control."
```

```
is_abstract: true
```

```
uses:
```

```
- supply_air_flowrate_sensor  
- supply_air_flowrate_setpoint  
- supply_air_damper_percentage_command
```

## ZTM:

```
description: "Zone temperature monitoring."
```

```
is_abstract: true
```

```
uses:
```

```
- zone_air_temperature_sensor
```

# Connections

- Define important relationships between entities in the model
  - Connectivity within an HVAC system
  - Device locations
  - Control between a switch and a light
- Current Relationships:
  - **CONTROLS**: think "switch and light"
  - **HAS\_PART**: For grouping entities together into a more complex entity
  - **FEEDS**: For media flow within a MEP system (air, water, current)
  - **HAS\_RANGE**: think "VAV to zone mapping"

AHU-001 **FEEDS** VAV-029

# Links

- Map a field from one entity to a different field in another entity.
- Use when the logical entity you need to represent doesn't strictly exist in the real system

\_CTRL-1234 :

uses:

- fan\_run\_status\_1
- fan\_run\_status\_2
- pump\_run\_status\_1
- pump\_run\_status\_2

CTRL-001 :

type: \_CTRL-1234

**has\_link:**

**FAN-001:**

**fan\_run\_status\_1:run\_status**

# Lunch!

# Future of BDNS

# Round table

Equipment reference naming discussion (Revit Conventions)

Smart Buildings Guide

Aligning BDNS and IFC to other Building Systems Ontologies

Potential collaboration between BDNS and other ontologies such as  
BrickSchema and Haystack

# Break!

# BDNS in BIM tools

IFC bSDD workflow alex.plenty@skanska.co.uk yamamoai@kajima.com

# Break!

# BDNS tools

Github automation j.gunstone@maxfordham.com

QR code generator Francesco Anselmo

QR code scanner Francesco Anselmo

Thank you!

# First point

  Lorem ipsum dolor sit amet, consectetur  
  adipiscing elit, sed do eiusmod tempor  
  incididunt ut labore et dolore magna aliqua

  Incididunt ut labore et dolore

  Consectetur adipiscing elit, sed do eiusmod  
  tempor incididunt ut labore et dolore magna  
  aliqua.

  Lorem ipsum dolor sit amet, consectetur  
  adipiscing elit, sed do eiusmod tempor  
  incididunt ut labore et dolore magna aliqua

## Second point

  Lorem ipsum dolor sit amet,  
  consectetur adipiscing elit, sed do  
  eiusmod tempor incididunt ut labore et  
  dolore magna aliqua

  Incididunt ut labore et dolore

  Consectetur adipiscing elit, sed do  
  eiusmod tempor incididunt ut labore et  
  dolore magna aliqua

XX%

Use this slide to show a major stat. It can help enforce the presentation's main message or argument.

# Final point

A one-line description of it



“This is a super-important quote”

---

- From an expert

This is the most  
important takeaway  
that everyone has to  
remember.

# Thanks!

Contact us:

Your Company  
123 Your Street  
Your City, ST 12345

[no\\_reply@example.com](mailto:no_reply@example.com)  
[www.example.com](http://www.example.com)

