SEPTEMBER 2022

Project Haystack

ISSUE 11

connections

Journal of the Haystack Community - Solutions for Interoperable Device Data

Data. The Foundation of Smarter Buildings.

2022 Haystack Connect

Smart Data. Smart Devices. Smart Buildings. Smart Business.

September 13 - 15

September 28

October 12

November 9

• Haystack & DoE BENEFIT • Haystack Essentials eLearning Course • Virtual Metering with the Power of Haystack • Accelerating Integration and Collaboration with New Haystack Domain Modeler Tools • Making Technology More Accessible for Developers with Haystack Tagging • The Role of Semantic Modeling in Implementing Digital Twins for the Built Environment

www.project-haystack.org

DESIGO OPTIC OPEN BUILDING MANAGEMENT SOFTWARE

Unlock the power of critical building data

Desigo Optic sets a new standard in building management performance by streamlining engineering workflows more than 33%. Discover the power of instant integration using native Haystack tagging to optimize your building data for better insights.

usa.siemens.com/desigo-optic

SIEMENS

Powered by FIN Framework

CONTENTS

EDITORIAL

PROJECT HAYSTACK

CONTRIBUTED ARTICLES

WORKING GROUP UPDATES

CONTENTS *cont'd*

EVENTS

HAYSTACK CONNECT

NEW MEMBER PROFILE

MEMBER INTERVIEWS

TOOLS FOR DEVELOPERS & INTEGRATORS

SOCIAL MEDIA CURATION

DIRECTORIES

Building a Foundation for Smarter Buildings

by Robin Bestel, Managing Editor, Project Haystack Connections Magazine

Welcome to the 11th issue of the Project Haystack Connections Magazine. This issue, all 89 pages, once again demonstrates the importance of the work being done by the whole, worldwide Project Haystack Community.

For anyone in this industry, the accomplishments made this past year became more important to everyone as the foundation for building smarter buildings gets stronger and stronger.

The past year, and even in just the past few months since our last issue of Connections Magazine, Project Haystack has finalized Haystack 4.0 and launched the new **Project Haystack Developers** website, held our 5th biennial Haystack Connect Conference, albeit virtually, and Project Haystack was selected for funding under the DoE Building Technologies Office Energy Efficiency Frontiers & Innovation Technologies (BENEFIT) Funding Opportunity.

This issue features the full launch of Project Haystack's Haystack Essentials eLearning course. In collaboration with accredited eLearning training provider, Fantom Factory. We now have online interactive training on demand!

Brian Frank gives us an update on the organizaitons involvement in the Department of Energy's Building Technologies Office Energy Efficiency Frontiers & Innovation Technologies (BENEFIT) Funding Opportunity. The article is titled "Project BENEFIT and Reimagined Protos".

This issue also includes an extraordinary number of contributed articles. The work and support of the Haystack tagging methodology is growing more and more, especially internationally. Articles were submitted by contributors including Brainbox AI, Energosentrum Plus, Padi, Tridium, SkyFoundry, Lynxspring, J2 Innovations, Lynxspring, and 75F.

Rick Jennings of SkyFoundry provides a detailed update on the Working Group EV Charging, and Michael Lakhdar of Conserve It gives us an update on the VRF Working Group.

This issue also includes information on the all of the upcoming Haystack Connect 2022 conference dates, once again being held virtually between September and November, and we have a section with links to videos of past speaker sessions.

I hope you will join me in welcoming our newest Associate Members, Coster Group and Intellienergy Tech, to the Project Haystack organization and are featured in the section "**New Member Profiles**".

A new feature beginning in this issue is "Member Interviews". We held interviews with SkyFoundry and J2 Innovations, both long-time supporters and Founding Members of the Project Haystack organization. The interviews provide insight into how and why each are so involved and vested in the success of Haystack Tagging. Anyone interested in being interview should contact me.

Any and all suggestions about our Connections Magazine and **marketing.project-haystack.org** website can be sent to **robin@haystackconnect.org**.

I cannot thank everyone enough for all their effort and contributions to produce this largest-ever, 11th Issue of Connections Magazine!

Project Haystack

Founding Members

CLOCKWORKS ANALYTICS

Conserve it

J2 INNOVATIONS
A Siemens Company

legrand®

LYNXSPRING®

SIEMENS

SkyFoundry

Associate Members

75F

Accu Temp
Building System Integrators

ALLANDER ANALYTICS

ALTURA

Automated Logic

BAS SERVICES GRAPHICS

BRAINBOX AI

bueno
Built Environment Optimisation

BERNHARD CONNECT

buildingsIOT

CABA
Continental Automated Buildings Association

COSTER
PERSONAL AUTOMATION

e-Magic

EMA
ENERGY MANAGEMENT ASSOCIATION

Intellastar

intellienergy tech

INTELLIGENT BUILDINGS

KMC CONTROLS

KNX®

SWITCH AUTOMATION

TRIDIUM

WideSky

Yorkland Controls
ENVIRONMENTAL SOLUTIONS

Message from the Board Data and its Journey Continues

Project Haystack has recently celebrated its 10th anniversary. Over the years, this open-source community has progressed in every possible way - technologically, membership, sponsors, evangelists and ultimately by the number of buildings, assets and other infrastructure applying it in the real world.

As new Executive Directors take on our shared role, we are honored and excited to lead an organization that has pioneered the development of a meta data standard for the built environment and has lead the effort that has made Haystack the most deployed standard worldwide – today utilized in over 50,000 facilities worldwide.

The importance of this effort to society is clear. Data is fundamental to businesses. Data is essential to operating and managing our buildings and for them to become smarter. Data is now an irreplaceable asset. However how businesses handle and manage data, continues to evolve. And so does Project Haystack.

Along those lines, we have defined a few focus areas which we would like to progress the most:

- The ongoing advancement of the Project Haystack standard. This includes both the expansion in the number of applications, systems and devices described through the standard, but also the evolution of its ontology - where we have already made many good steps with Haystack 4
- The further off-the-shelf adoption of Project Haystack in systems and IoT devices. For that purpose, we want to progress the open-source tools and documentation which make it easier for anyone to leverage Project Haystack in their technology and products from the very beginning
- Continued dialogue with other standard bodies for interoperability. We believe that it requires continued effort to bring the different data standard initiatives together and work on solutions that make those interoperable in the real word
- Increased communication and education on Project Haystack. To achieve that, we are aiming to expand the number of channels to communicate with the community and our members. Further to that, we continue to invest in a range of trainings and documentation on Project Haystack to make the standard and its benefits more accessible
- Further expansion in EMEA, Asia-Pacific, Australia and beyond. While the Project Haystack standard originates from the US, it has already today spread across the globe. We would like to continue this expansion, also leveraging that the three of us originate from US, Europe, and Australia

We see this list as a good start, but even more so we are curious to find out from our members and the community, where they would like to see the focus, where they would like to contribute and what we might have missed. For this reason, and because we would like to introduce ourselves further to the community, we will over the coming months pursue a series of interviews, discussions, and workshops to get more input from the community. Take this as an invite to approach the three of us and help shape how Project Haystack evolves from here!

Haystack Connect 2022 and 2023

In 2021, amid the pandemic, we saw that holding Haystack Connect as a virtual event and making registration free reduced barriers to attendance. And with that, we had record attendance and were able to expand the worldwide reach of this event. So, in 2022, we will continue this success story. One of the differences for 2022 will be the days and times. Each day will consist of a 90-minute session, which we think is the perfect amount of time for attendees to focus and engage. We will still have three days in a row to start—that will be September 13-15. But instead of stopping there, we will continue the program with additional days including September 28, October 12 and November 9. If you have not done yet, register now!!

The virtual events have been great for Project Haystack. But there is also a need to get back to some of the networking and interactions that only an in-person event can provide. There is value to be had in both types of events and for us, we like the idea of these working in combination. This virtual series will help lead up to an in-person Haystack Connect which we target for May 2023!

New Members

Haystack benefits from so many different stakeholders, making this standard grow and flourish. One key group are our Founding and Associate Members. We are glad to see that the uptake of Project Haystack continues, also across the globe. Clockworks Analytics has stepped up to become a Founding Member. Intellienergy Tech, and Coster Group are our latest additions to the group of Associate Members.

As we like to say. A lot has been done, a lot more still to come! We are excited to go on this journey with this awesome Project Haystack community! We are excited to serve on the board and our doors are (virtually) always open to exchange, collaborate, discuss, and evolve this community together!

Keep making it happen!

Thank You.

The Project Haystack Board of Directors

Nick Gayeski, PhD, Co-Executive Director
Richard McElhinney, Co-Executive Director
Alex Rohweder, Co-Executive Director
Marc Petock, Executive Secretary

Nick Gayeski, PhD is the CEO and Co-Founder of Clockworks Analytics and a Co-Executive Director of Project Haystack. He is passionate about transforming the facilities industry by empowering facilities teams with technology to achieve massive positive impact in the built environment.

Richard McElhinney is the Vice President of Technology at Conserve It. Richard has over 25 years experience in product and solution development having worked globally with leading companies in the Smart Building Services space.

Marc Petock is Executive Secretary on the Board of Project Haystack and Chief Marketing & Communications Officer at Lynxspring, Inc. Lynxspring is a Founding Member of Project Haystack and leading developer and manufacturer of smart building technologies and solutions.

Alex Rohweder is a Co Executive Director of Project Haystack. Alex joined J2 Innovations in 2018 from Siemens and as CEO brings his passion and expertise in building automation software, corporate strategy, portfolio management and OEM sales to the company

Project BENEFIT and Reimagined Protos

Haystack4

Exciting new progress on semantic modeling and validation is currently underway within project **BENEFIT**. Building Technologies Office Energy Efficiency Frontiers & Innovation Technologies (**BENEFIT**) is a project funded by the US Department of Energy to bring new validation techniques and tools to the Haystack community. A small team composed of SkyFoundry, Clockwork Analytics, Switch Automation, and NREL has been working together since the beginning of the year.

The first phase of the project was interviewing community members to establish requirements. We found a widespread need for technologies that can help streamline and validate Haystack models of the built environment. Everyone struggles with problems around equipment types and their associated points. And importantly how those equipment/point models can be matched against application specific data requirements. Validation is not a one-size-fits-all problem, but rather must take into consideration the applications which will consume and process the data.

A solution to this problem is evolving to reimagine how Haystack protos can be used in more sophisticated ways to build and validate models. Currently protos are very simple templates of what sub-equip and points a given equipment type might contain. But we are architecting a new protos design as a "Haystack data-oriented type system". Essentially, we are imbuing protos with features found in type systems from computer science and programming languages. This includes features such as prototype inheritance, optional types, union types, and intersection types. This provides us with a powerful set of concepts to create model templates and validation constraints using the well-developed techniques from statically typed programming languages.

Next year we hope to unveil a crowd source repository of protos on project-haystack.org. This will allow anyone from the community to share protos which might include:

- templates for application specific controllers
- logical point grouping for equipment functions or equipment types
- application requirements for control, visualization, or analytics

With the new built-in features we are adding to protos, these crowd sourced models can be reused, extended, and enhanced in a modular way. This new repository of protos can then be leveraged by vendor tools to streamline model building and to validate existing models against desired application requirements.

We plan to share model details about our proposed design in the near future - stay tuned!

Brian Frank serves as the technical lead for Project Haystack, working with the Project Haystack community to curate domain models and technical specifications. He is also President and Co-Founder of SkyFoundry, a software company specializing in storage, analysis, and visualization of data from the IoT.

What's next in niagara4

Niagara is the platform that has defined open integration for smart buildings and the IoT. The next release of the Niagara Framework® continues to evolve Niagara's key tenents of visualization, rapid deployment, security, connectivity, certification and IT compliance.

Development Along 5 Key Dimensions

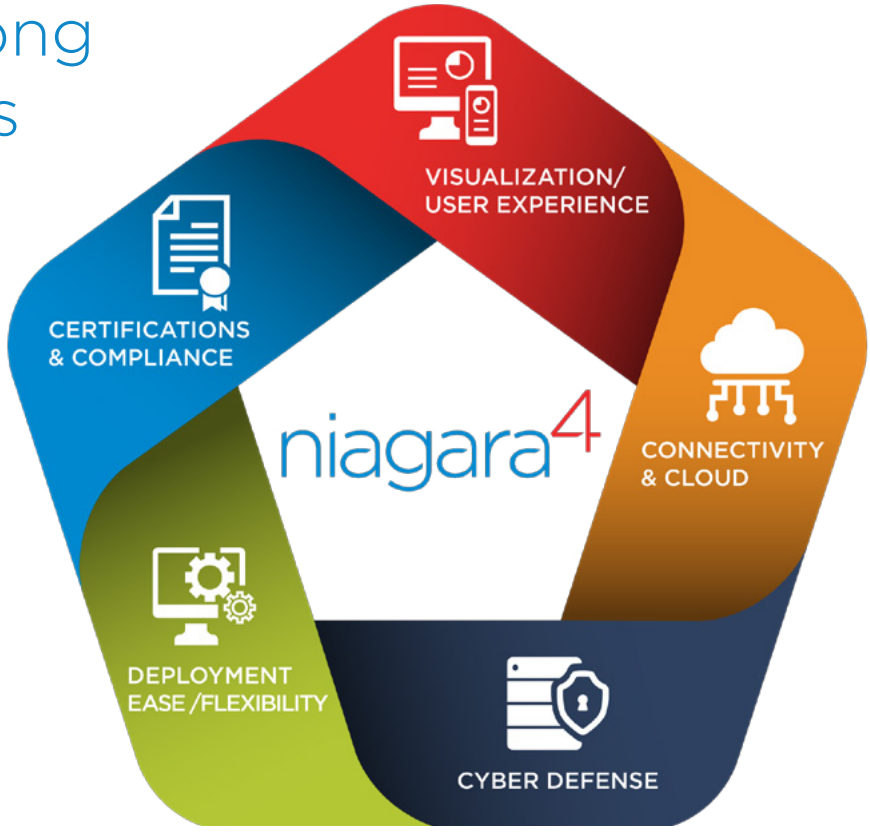
VISUALIZATION
WebWiresheet 2.0
HTML5 Niagara Point Manager View
HTML5 BQL Query Builder

CONNECTIVITY
MQTT - Azure Auth
HTTP Driver
MSTP Engine Optimization

CYBER DEFENSE
Updates to standards like TLS 1.3
New encryption keys

DEPLOYMENT
Internationalization support
Edge tools updates

CERTIFICATIONS
BACnet Protocol
FIPS-140-2
RMF accreditations



For more about the features in the lastest release of Niagara 4:
www.tridium.com/us/en/learn/about-us/niagara-timeline

TRIDIUM
www.tridium.com

Haystack 4 eLearning Course

"Project Haystack is proud to announce the arrival of our very first training course. In collaboration with accredited eLearning training provider, Fantom Factory, we now have online interactive training on demand!"

Project Haystack is pleased to announce the publication of the official eLearning Course, **Haystack Essentials**.

If you're new to the world of Project Haystack, this course will help you to understand both why and how to apply Project Haystack tags into built environment.

Starting at the very beginning, you'll learn all about the kinds of data tags you can use and where to reference them in the open source libraries. Using interactive exercises in the digital screens, you'll practice applying these tags into sample scenarios which increase in complexity.

Who Is It For?

The Haystack Essentials eLearning Course is designed for professionals across all experience levels to learn about Project Haystack from the very beginning.

If you're joining a new team, learning a new technology, consolidating your existing skills and knowledge, or perhaps you'd just like to know what Project Haystack is all about, this course will ensure you will cover ALL of the "essentials".

What Will I Learn?

You will gain a practical understanding of how to apply Project Haystack tags to a data model.

Your learning journey will start from the very beginning with the syntax and makeup of the tags themselves. As you explore the ontology of these tags, you will learn how Project Haystack applies inherent meaning through these tag relationships to harness the real power behind this modeling standard. In the latter part of the course, you will work through exercises requiring you to reference the Project Haystack developers website, **www.project-haystack.org**, as we guide you through applying tags to a range of equipment models.

By the end of the Haystack Essentials eLearning Course, you will gain the understanding and the confidence to apply richer meaning to your data models using Haystack tags and resources.

Haystack Essentials Syllabus

Module 1 - Introduction Haystack

Module 2 - Tag Kinds and Values

Module 3 - Navigating Haystack Libraries and Resources

Module 4 - My First Data Model

Module 5 - More Tagging Models

Module 6 - Course Revision and Assessment

Read the Full Curriculum here.

Learn more about Haystack Essentials in this promotional video: https://youtu.be/FcTT629Eg7o

Download the Brochure.

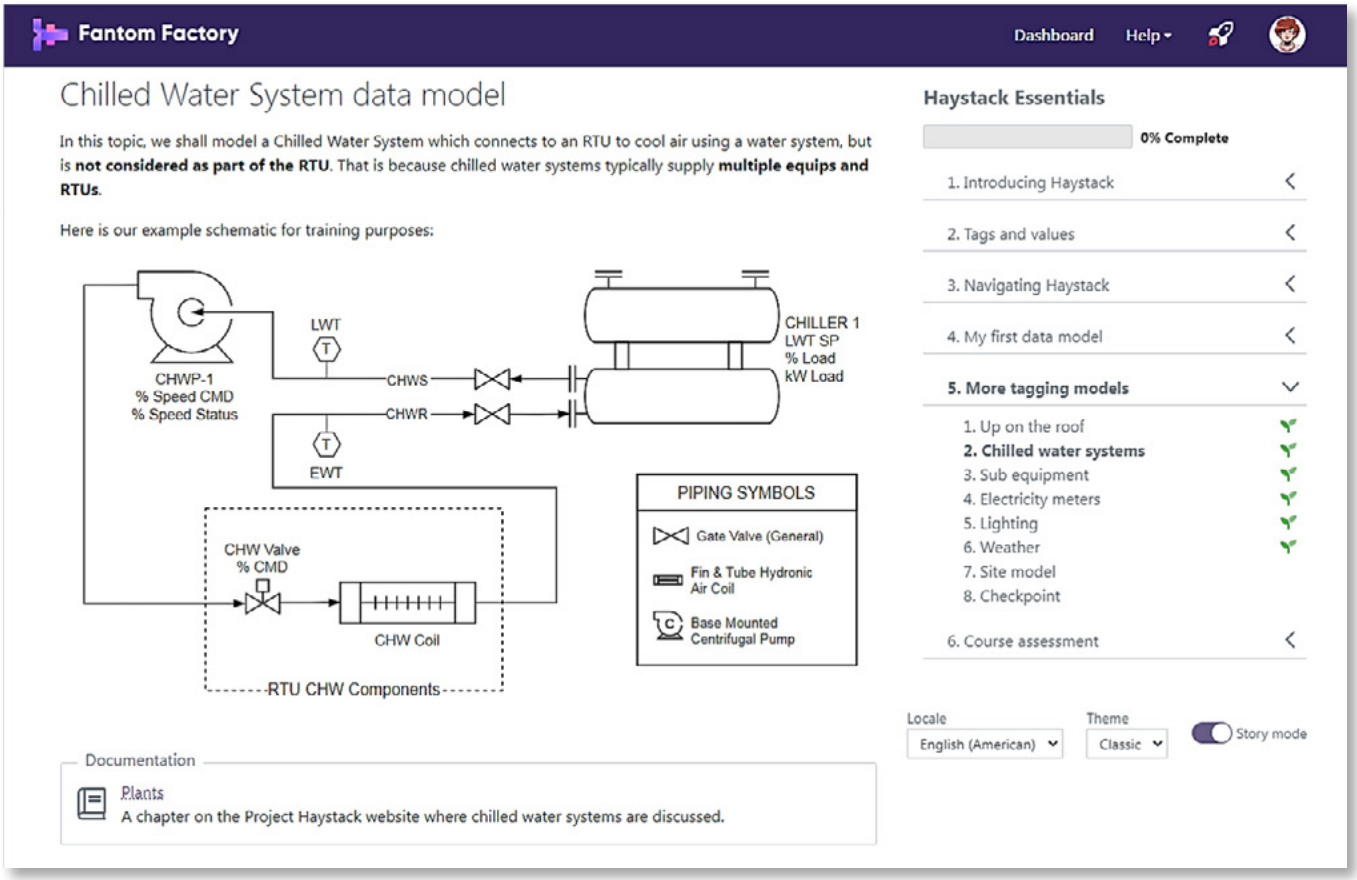
How Can I Take The Course?

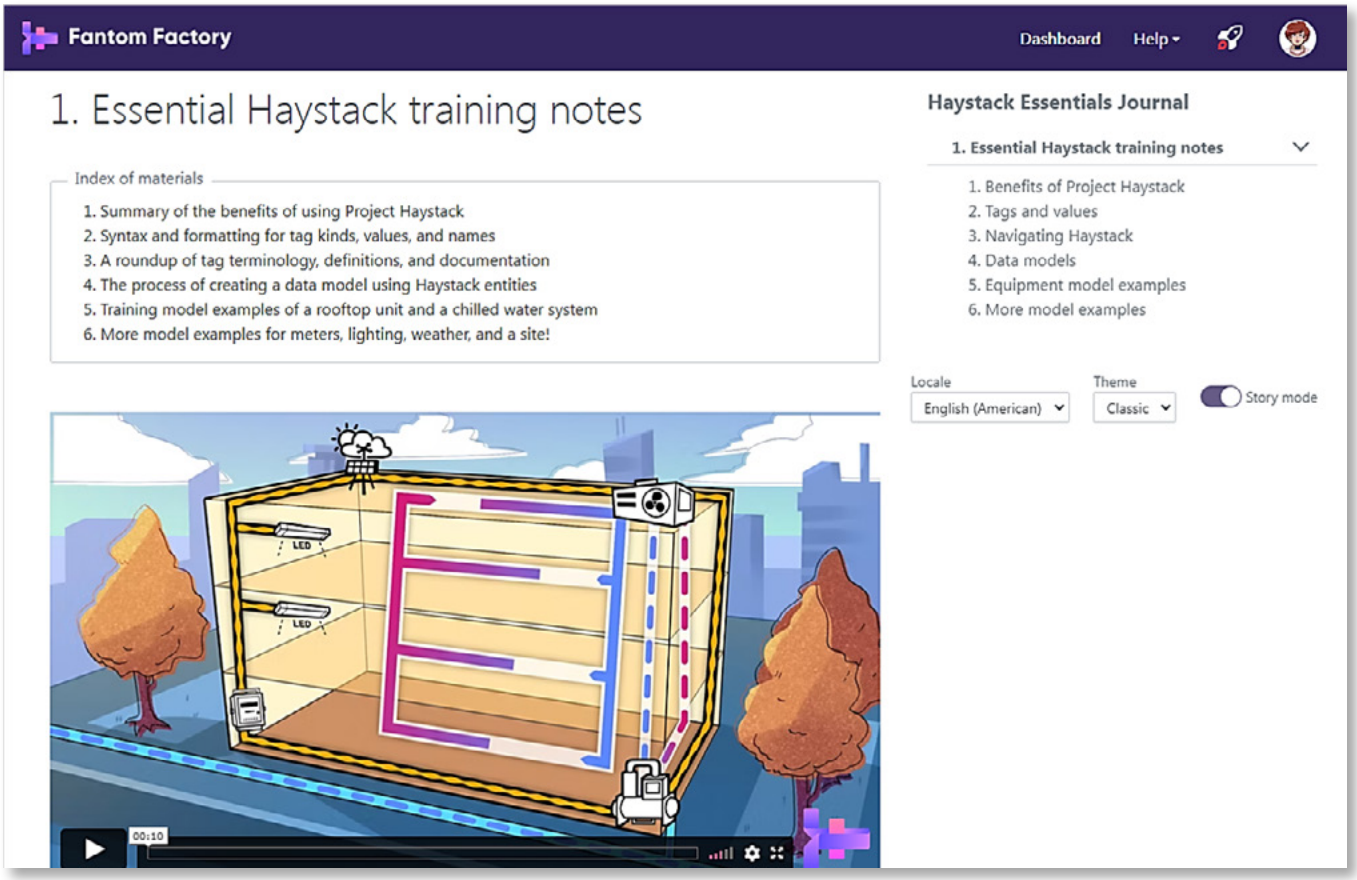
Online, at your own pace, in your own time, and from anywhere you choose!

Upon purchasing a seat to the course, you'll immediately receive an access code and some easy instructions on how to get started on the Fantom Factory eLearning Platform. It takes less than a minute to create an eLearning account and redeem your access code for this course.

Log in and out to resume the course at any time to suit your own schedule and to work through the 36 content pages, 6 detailed tutorial videos and around 90 interactive questions.

As accredited providers of training excellence, Fantom Factory offers digital certification which will award 12 accredited units/hours for this course towards Continued Education (or Continued Professional Development).





The Haystack Essentials Journal

After you complete the training, we automatically provide long-term access to the training notes and references in a handy JOURNAL accessible in your eLearning account.

How Much Is It?

The Haystack Essentials eLearning Course is priced at just $175 and is accessible on Fantom Factory.

Still not sure if this is for you? Well, we have good news! The first training module is available for FREE.

"**Module 1 - Introducing Haystack**" is available as a free trial course. Just use the access code HAYSTACK-INTRO or for more details, visit the Fantom Factory website.

Emma Eynon co-founded Fantom Factory to help make technology accessible to those who aspire to save our planet. She is passionate about training and communication, and has a wealth of experience in technical writing and content management systems.

Project Haystack's Role in Data Governance

LYNXSPRING®

"The role of Data Governance is to create uniform guidelines regarding data usage and describe how data is defined, and the rules and policies of how individuals and groups can access the data and the level of access they are permitted to have."

The amount of available data and its complexity has exploded within the built environment. Key to managing all this data is to have it structured, semantically compatible, and know what it means. This requires Data Governance. .

Governance is the system by which entities are directed and controlled. It is concerned with structure and processes for decision making, accountability, control, and behavior. Governance influences how an organization's outcomes are set and achieved, and how performance is optimized. The role of Data Governance is to create uniform guidelines regarding data usage and describe how data is defined, and the rules and policies of how individuals and groups can access the data and the level of access they are permitted to have.

We look at Data Governance within the built environment as the process of managing the access, exchange, usability, integrity, interoperability, and security of the data contained within the operational equipment, systems and devices in buildings and facilities. Effective Data Governance ensures that the data is defined properly and consistently, is organized and trustworthy, and does not get misused. This is increasingly critical as organizations face increased data privacy regulations and rely more on data analytics to help optimize building operations, manage them smarter and achieve improved (outcomes) which are?.

Data Governance is a core component of an overall data management strategy and consists of a set of standards and policies for governing data, as well as implementation and procedures including how the data is organized and who owns, controls, and has access to the data. Furthermore, it typically results in the development of common data definitions and standard data formats that are applied in all systems, equipment and devices boosting data consistency operational, management and compliance issues. uses.

While Data Governance is a core component of an overall data management strategy within an enterprise building and facility management and control system, organizations should focus on the desired (outcomes) of a Data Governance program. Which are?

Why does Data Governance Matter?

Without Data Governance, data inconsistencies in different systems across the building/facility might not get resolved. For example, device and equipment names may be listed differently within a facility and a portfolio of facilities. That could complicate data integration and system(s) interoperability and create data integrity issues that affect the accuracy of the data reporting and analytics applications. In addition, data errors might not be identified and fixed, further affecting analytics accuracy.

Building owners, operators, system integrators need to establish and follow Data Governance:

- To avoid inconsistent data silos within a single facility or a portfolio
- To agree on a universal data identification and definitions for a common, shared understanding and reference
- Ensure quality among all data sets
- Ensure analytic accuracy and reliability
- To implement and follow uniform procedures and policies that help prevent errors and misuse of the data
- Help ensure privacy, security, compliance, and regulations
- Identify and define responsibilities

What is Project Haystack's Role?

Project Haystack...

Haystack tagging is a key component of a Data Governance framework. As an open-source semantic data model schema, Haystack tagging enables data to be defined and shared across any system, any equipment, any application, or organizational boundary to advance the exchange, interpretation, and use of it. Haystack tagging harmonizes data by providing consistency and puts a unified definition to data and enables users to define their data better and manage the definition of data as an important asset. Haystack tagging also helps ensure the portability and interoperability of the data and that it can be trusted.

Marc Petock is Executive Secretary on the Board of Project Haystack and Chief Marketing & Communications Officer at Lynxspring, Inc. Lynxspring is a Founding Member of Project Haystack and leading developer and manufacturer of smart building technologies and solutions.

Niagara Haystack 4 Tag Dictionary

TRIDIUM

"A Haystack 4 tag dictionary will be introduced in Niagara 4.13, which is scheduled to be released in early 2023. This dictionary primarily uses the *defs.json* and *protos.json* files produced by Project Haystack to generate the dictionary's tags, tag groups, relations, and tag rules."

A Haystack 4 tag dictionary will be introduced in Niagara 4.13, which is scheduled to be released in early 2023. This dictionary primarily uses the defs.json and protos.json files produced by Project Haystack to generate the dictionary's tags, tag groups, relations, and tag rules. As new versions of these files are released, deployed dictionaries should be updatable in-place and without a module update from Tridium. An additional, customizable configuration file supplies tag rules that unlock some tagging convenience features in Niagara Framework®. For stations already tagged in Haystack 3, a new migration action will add Haystack 4 items that are equivalent to the Haystack 3 versions. This article will review the features of this new dictionary and discuss some of the design decisions that guided its implementation.

Importing Haystack 4

With the new Haystack 4 tag dictionary, most items come directly from the unaltered Project Haystack source files. This provides an improvement over Tridium's Haystack 3 tag dictionary which required some post-processing of Project Haystack sources to supply information necessary to Niagara. Formerly, updates from Project Haystack could not be added to the dictionary until Tridium packaged the changes in a new version of the haystack-rt.jar. Later, users were allowed to create and specify additional files to update their dictionaries, but that shifted the burden to them. Now, for the Haystack 4 dictionary, the haystack-rt.jar will be packaged with the latest versions of Project Haystack source files, and users can point to newer versions as they are published. There is a small set of items defined in a Niagara configuration file that, if necessary, can be customized by the user.

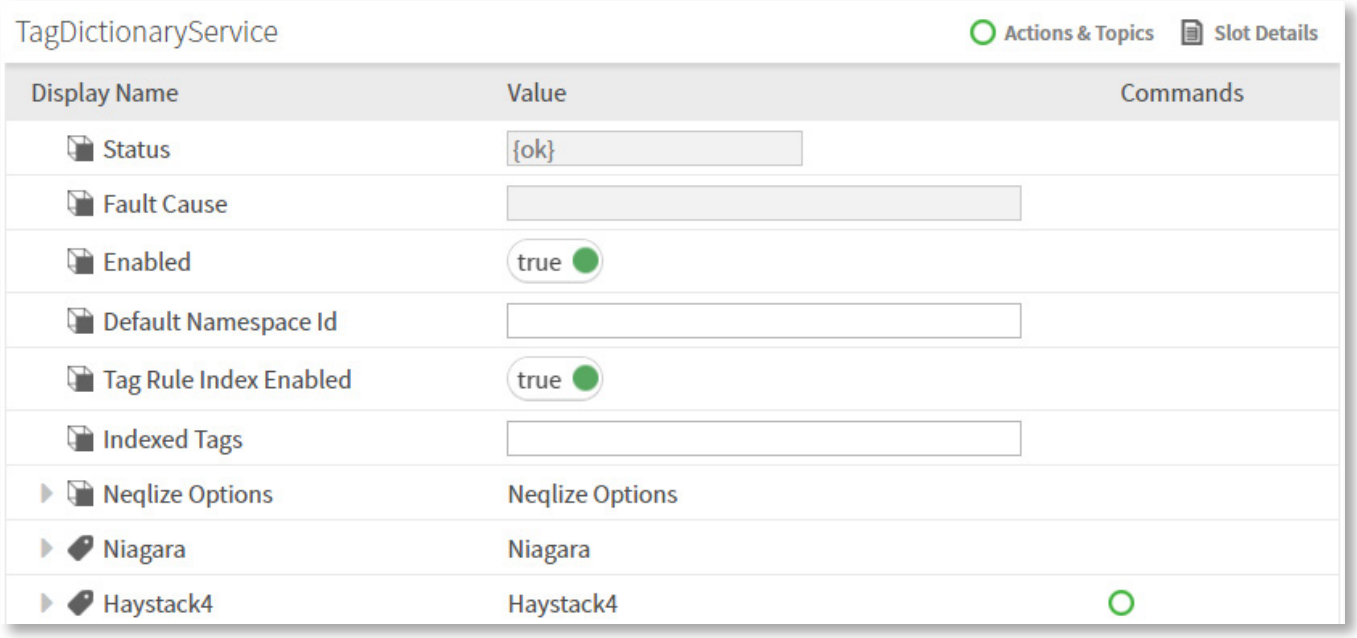


Figure 1. The Tag Dictionary Service with the new Haystack 4 Tag Dictionary.

Tags

All the tags in the Niagara Haystack 4 tag dictionary come from Project Haystack's defs.json file. Handling for subtypes of the ref and choice defs are described below. Most defs in the Project Haystack core library (lib:ph) are excluded except those that meet the following requirements:

- The entity or geoPlace defs
- Subtypes of entity
- Defs that are a tag on entity or geoPlace or one of their subtypes
- Defs listed in the Niagara configuration file: min, max, input, and output

For remaining defs, the supertype tree of each def is traversed and if a mapped Haystack 4 type is found, a tag of the corresponding Niagara type will be added to the dictionary. ***Table 1*** shows the mapping of Haystack 4 types to Niagara types and ***Figure 2*** shows some of the imported tag definitions.

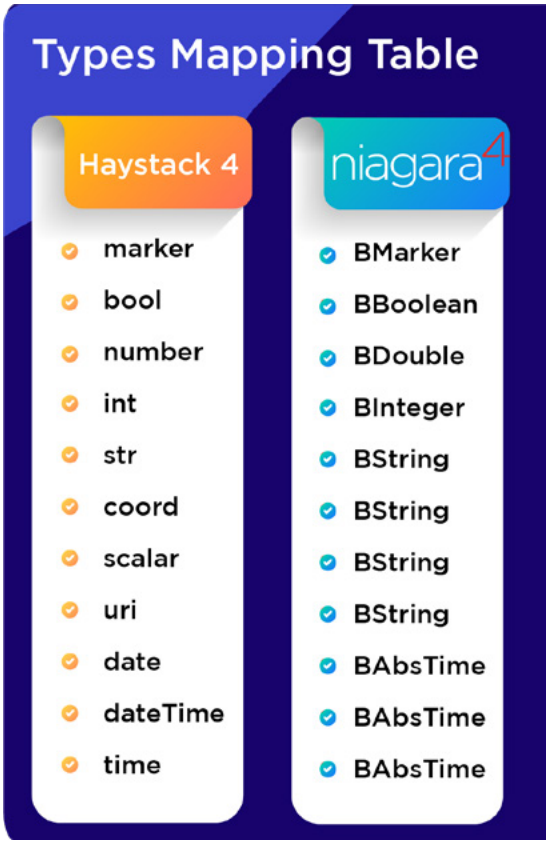


Table 1. Haystack 4 to Niagara Type Mapping.

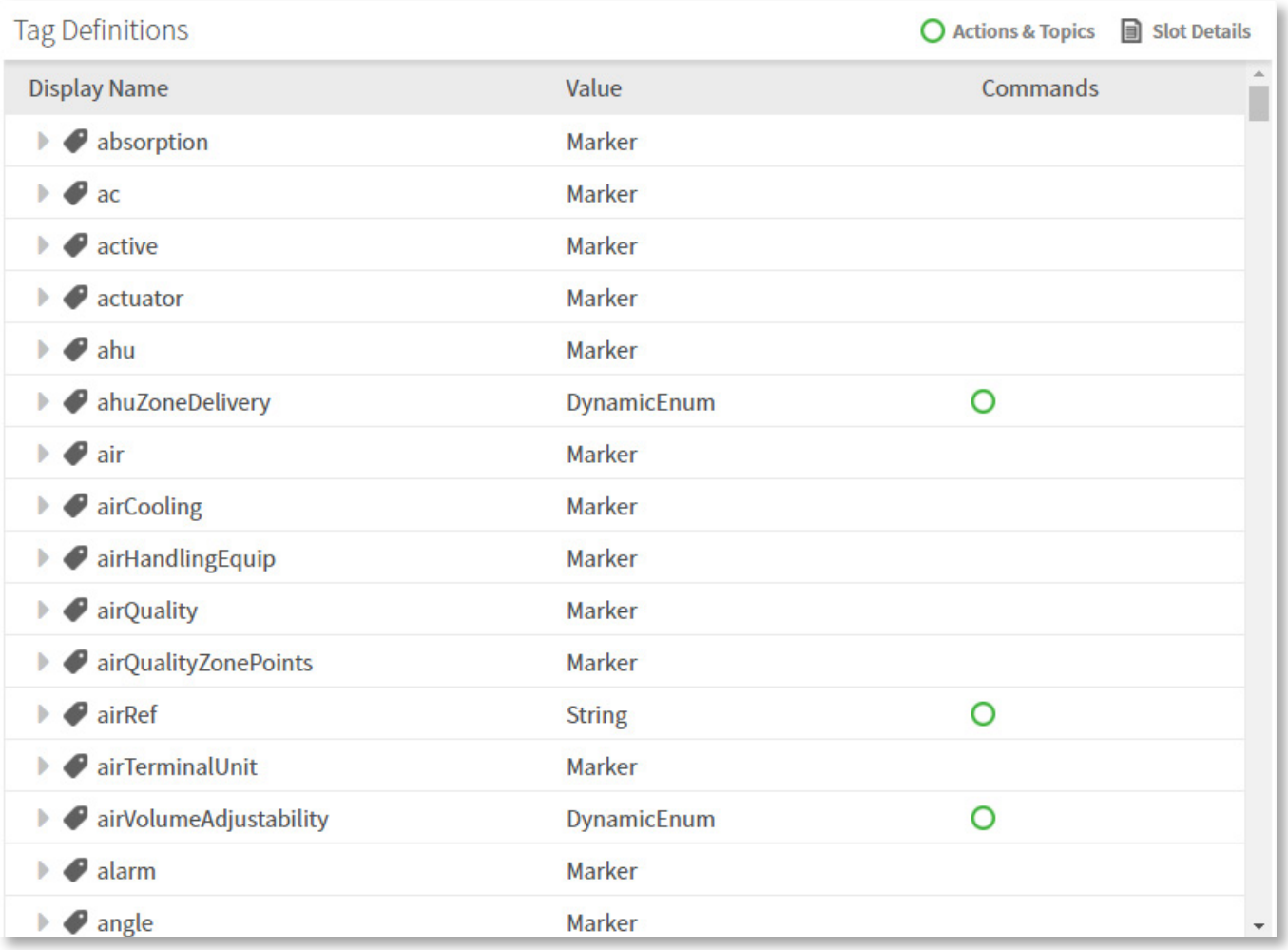


Figure 2. Haystack 4 Tag Definitions

Choice Tags

All of the choice values for a choice def subtype are added as separate tags in the dictionary. If a choice def has an "of" value, such as pipeFluid where "of" is the fluid def, the choice values are all descendants of that "of" def. Otherwise, the choice values are simply the descendants of the choice def. Only one of the choice values should be added to a component. To assist with this, the choice def is added as a BDynamicEnum tag with the choice values included in the value's BEnumRange. Tag rules are added to imply the corresponding choice value tag based on the selected enum value. For example, as shown in ***Figure 3***, if the pipeFluid tag on a component is set to "water," a water marker tag will be implied on that component.

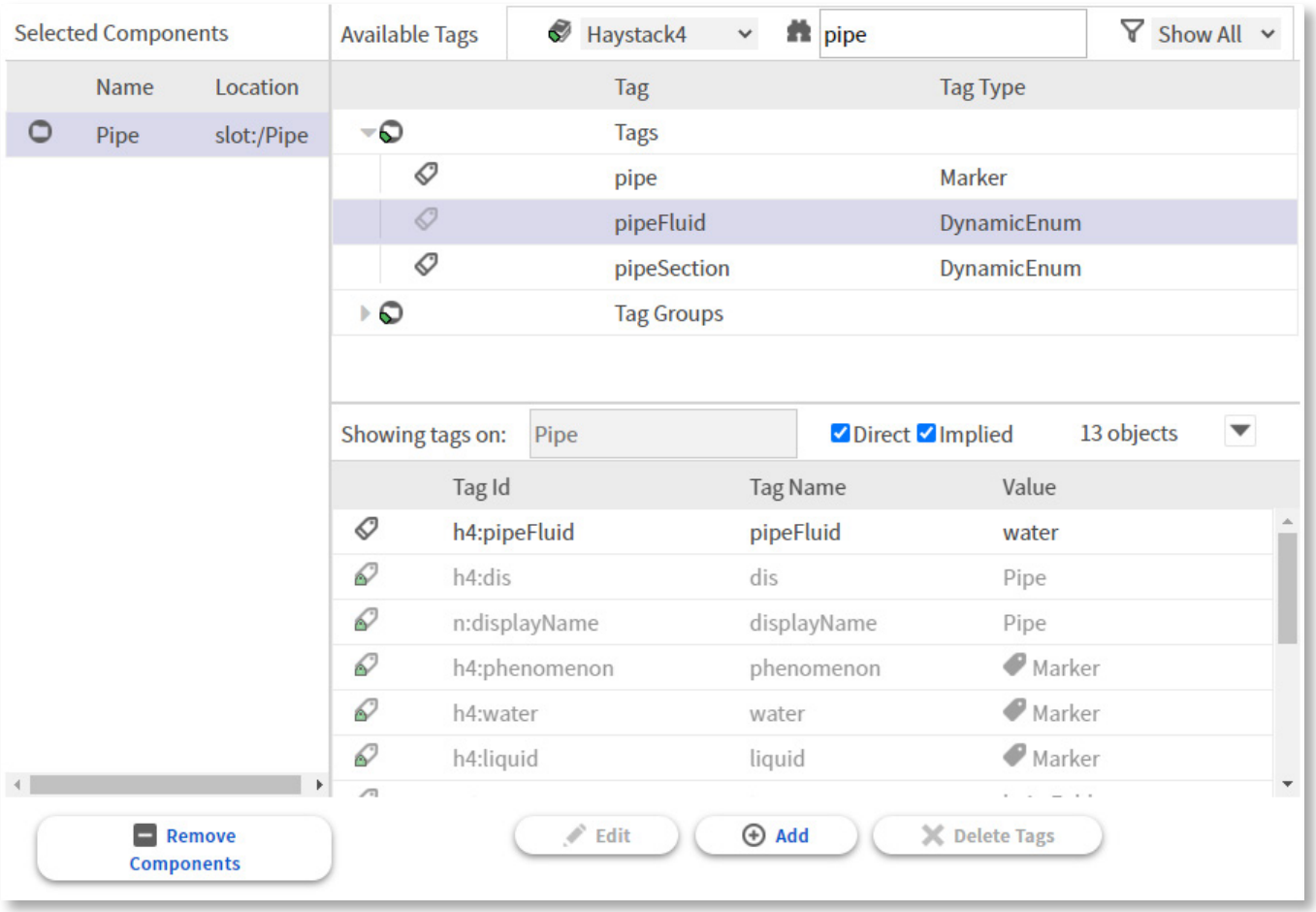


Figure 3. Adding a Choice Dynamic Enum Tag.

Tag Groups

The first set of tag groups in the Niagara Haystack 4 tag dictionary are derived from the conjuncts defined in the defs.json. For example, the co2-concentration conjunct becomes a co2Concentration tag group that contains the co2 and concentration tags. Some of these are shown in ***Figure 4***.

The next set of tag groups are created for all protos in Project Haystack's protos.json file that are not already a tag or conjunct. Some of these are shown in ***Figure 5***. For example, the "point" and "humidifier equip" protos are skipped because there is already a point tag and humidifierEquip conjunct tag group.

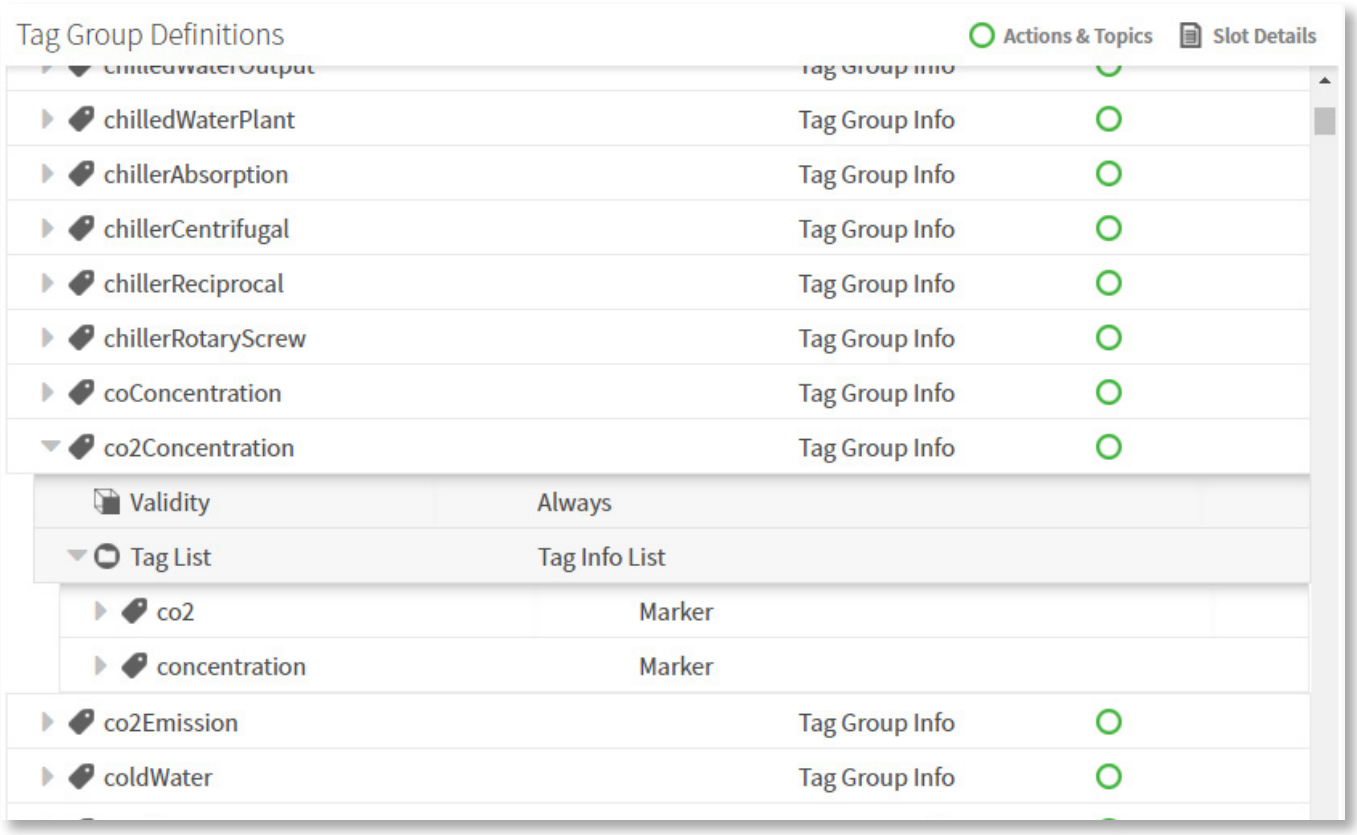


Figure 4. Conjunct Tag Groups.

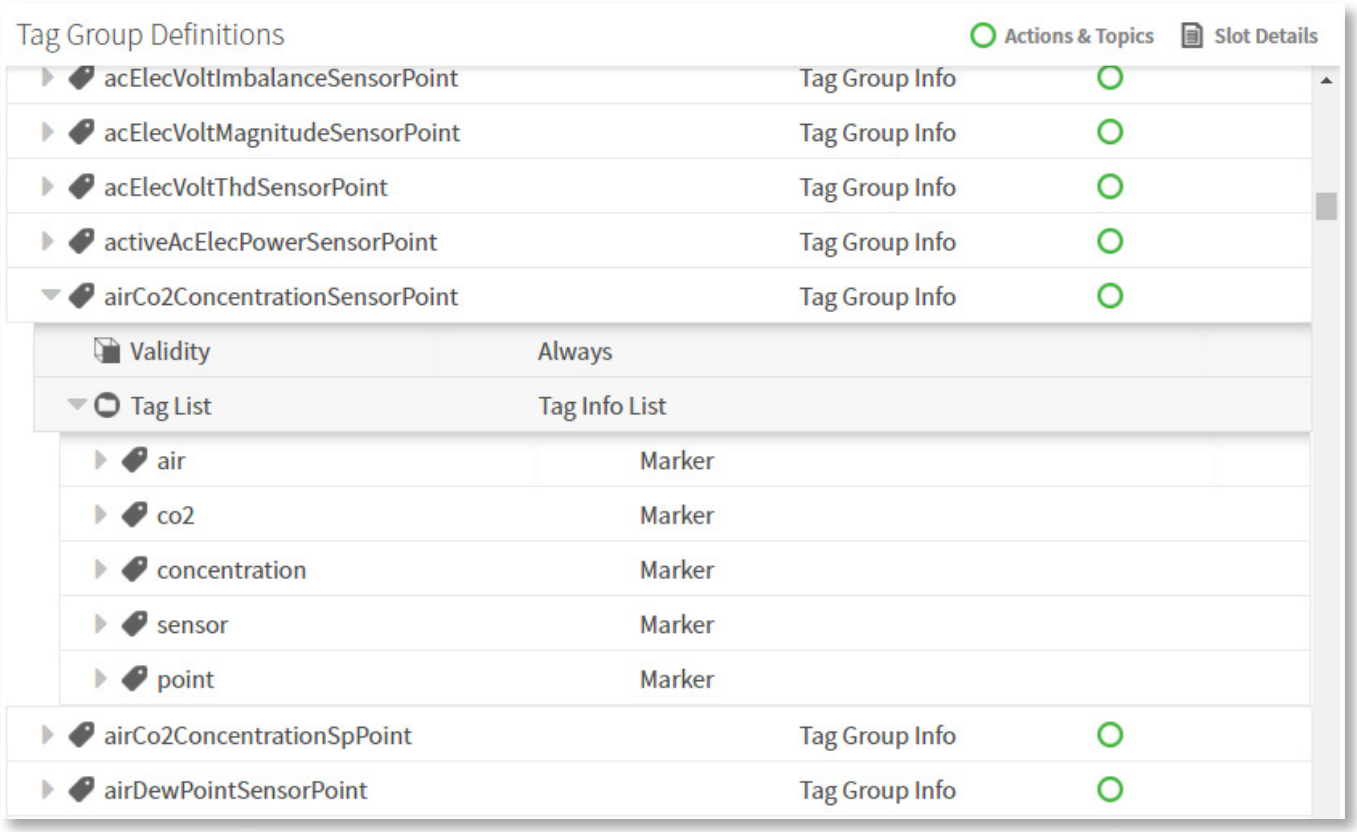


Figure 5. Proto Tag Groups.

Relations

For all defs that are a subtype of the ref def, a string value tag is added. These tags can be added directly to station components and their value manually set to the ID of the entity they refer to. If the ID of that referenced entity changes, the values of these ref tags must be manually updated. Alternatively, Niagara relations can be used. For ref def subtypes except for id, a relation is added to the dictionary as illustrated in ***Figure 6***. These relations are exported by the nhaystack service as ref tags with their value set to the ID of the relation endpoint.

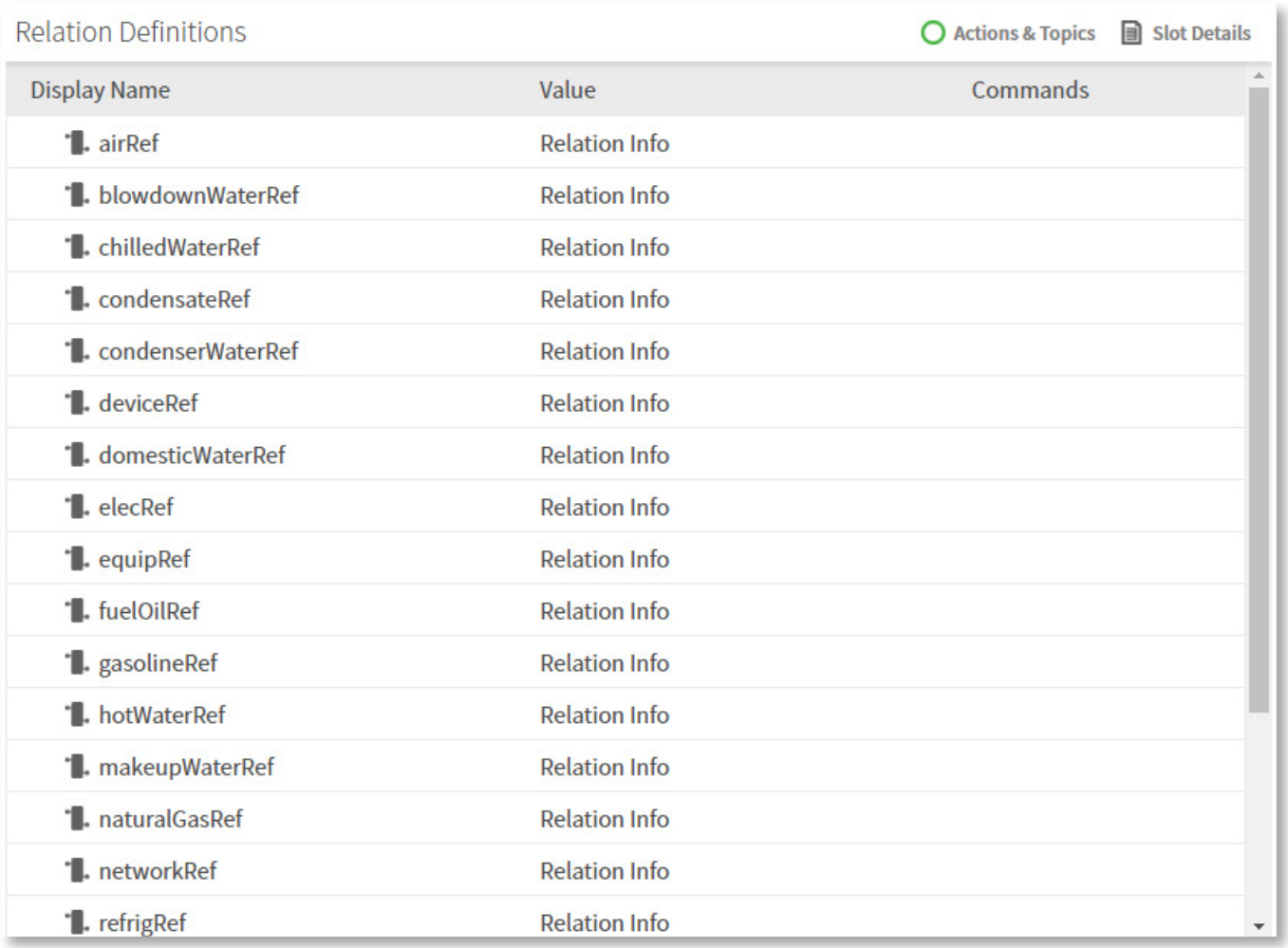


Figure 6. Relations.

The Niagara configuration file also defines tag rules that imply smart equipRef, spaceRef, and siteRef relations. The smart equipRef relation works exactly as the Haystack 3 version: an outbound relation is implied from non-null proxy points to a component ancestor with the equip tag; and inbound relations are implied from that ancestor back to the points. Unlike Tridium's Haystack 3 tag dictionary, the equip tag is not implied on all BDevices, so it will have to be added where appropriate.

If an equip component has a spaceRef relation to a space component, the smart spaceRef relation will imply outbound spaceRef relations from that equip's points to that space and will imply inbound relations from the space component back to those points. If an equip or space component has a siteRef relation to a site component, the smart siteRef relation will imply outbound siteRef relations from the sub-equips, sub-spaces, and equip points to that site and will imply inbound relations from the site component back to those items. ***Figure 7*** shows an automatically generated hierarchy based upon these implied smart relations.

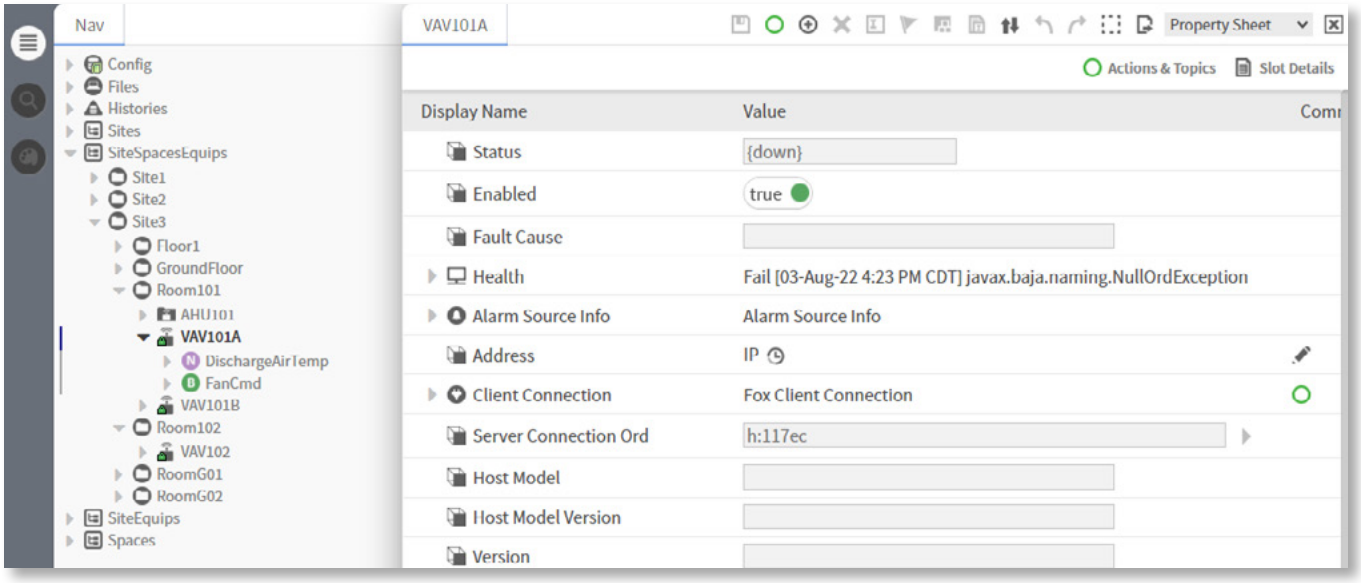


Figure 7. A Site Space Equip Point Hierarchy.

Tag Rules

Standard

Rules for the choice value tags are discussed above. These rules are automatically generated based on the choice values found in the defs.json file. Another set of rules is automatically generated based on the def type inheritance tree in Haystack 4. For example, water is a subtype of liquid, which is a subtype of fluid, which is a subtype of substance, which is a subtype of phenomenon. So, there is a tag rule that implies the liquid tag if a component has the water tag, a tag rule that implies the fluid tag if a component has the liquid tag (direct or implied), etc. Some of the rules based on this inheritance tree are shown in ***Figure 8***.

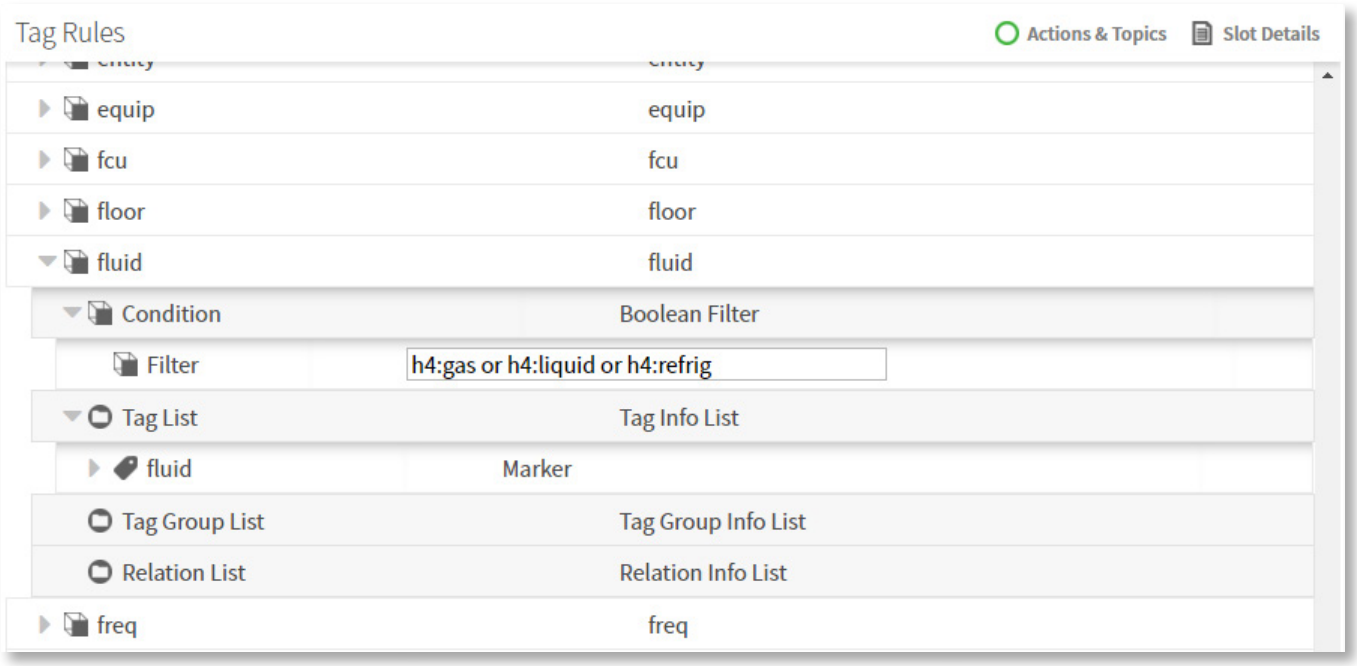


Figure 8. Inheritance Tree Tag Rules.

Custom

The Niagara configuration file defines some tag rules that unlock some tagging convenience features in the framework. Rules for the smart equipRef, spaceRef, and siteRef relations are discussed above. There are rules that imply simple tags based on the component's type such as the "point" tag on BControlPoints and the "bacnet" tag on BBacnetNetworks. There are rules that imply smart tags that derive their value from something else such as the unit tag whose value is based on the component's units facet. An alternate configuration file can be specified if the user would like a different set of tag rules and/or if they would like to change the tag types they imply. See ***Figure 9.***

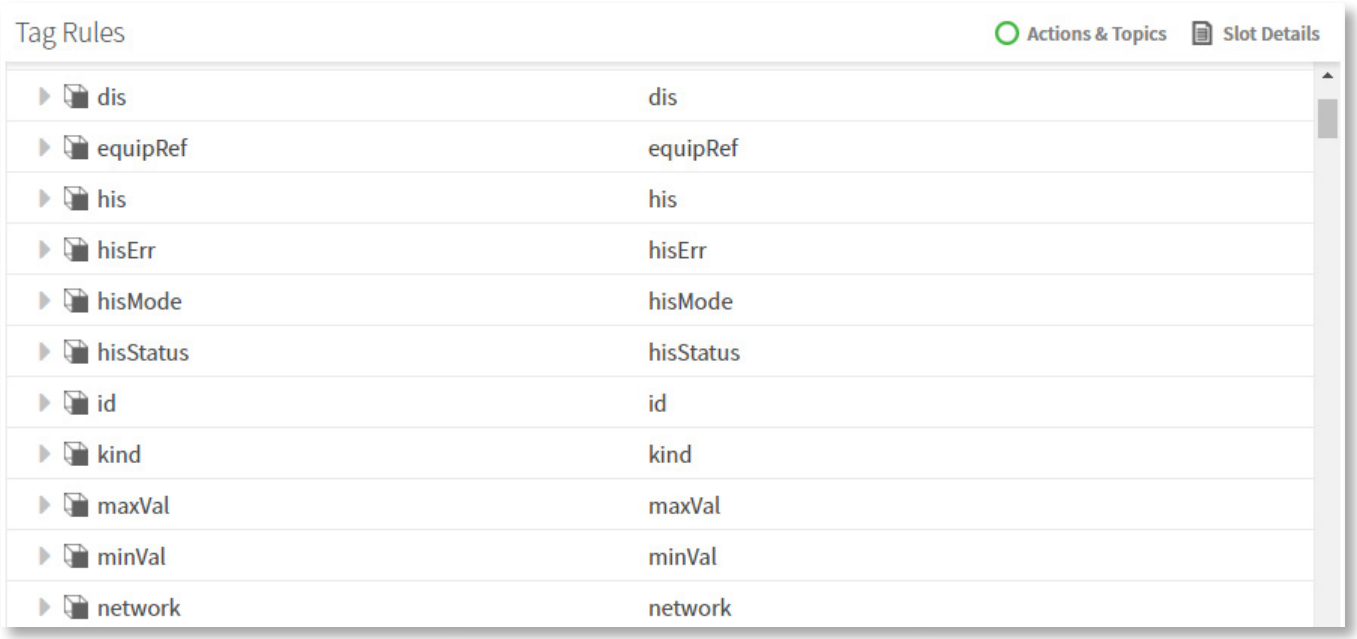


Figure 9. Custom Tag Rules.

Migrating from Haystack 3

The new dictionary includes an action that adds Haystack 4 equivalents for Haystack 3 tags, tag groups, and relations. The Haystack 3 items are not removed. The equivalent tags and relations are mostly copies of the Haystack 3 versions, with the distinction of the new dictionary's namespace, "h4". Some of these items required modifications as documented here: https://project-haystack.org/doc/docHaystack/Changes3to4. These modifications are captured in a configuration file packaged with haystack-rt. Users may create their own configuration file and specify that instead when invoking the migration action.

There were no exact equivalents for Haystack 3 tag groups. Some required only an additional "point" tag such as the Haystack 3 "dischargeAirTempSensor" group that results in adding the Haystack 4 proto "dischargeAirTempSensorPoint". Others required an explicit mapping such as "energyNetSensor" to "totalNetAcElecActiveEnergySensorPoint". Value tags are not included in Haystack 4 tag groups so "voltAnglePhaseSensorAB" is equivalent to "acElecVoltAngleSensorPoint" and a "phase" tag set to "AB". Finally, some Haystack 3 tag groups, such as "steamEnteringFlowSensor", could not be mapped and Haystack 4 equivalent tags are added for those tag groups' tags.

The migration action kicks off a job that logs the actions taken on each component in the station. An example of the job log is shown in ***Figure 10***. Any errors are also logged. Once the user takes action to correct these errors, they can re-run each job as required until the migration is complete.

Niagara Data Service

Tridium is excited to announce the first cloud-hosted offering of the Niagara Cloud Suite™, the Niagara Data Service. This service is currently in beta testing and provides users the ability to upload and store historical trends from Niagara Supervisors and JACE® controllers in a

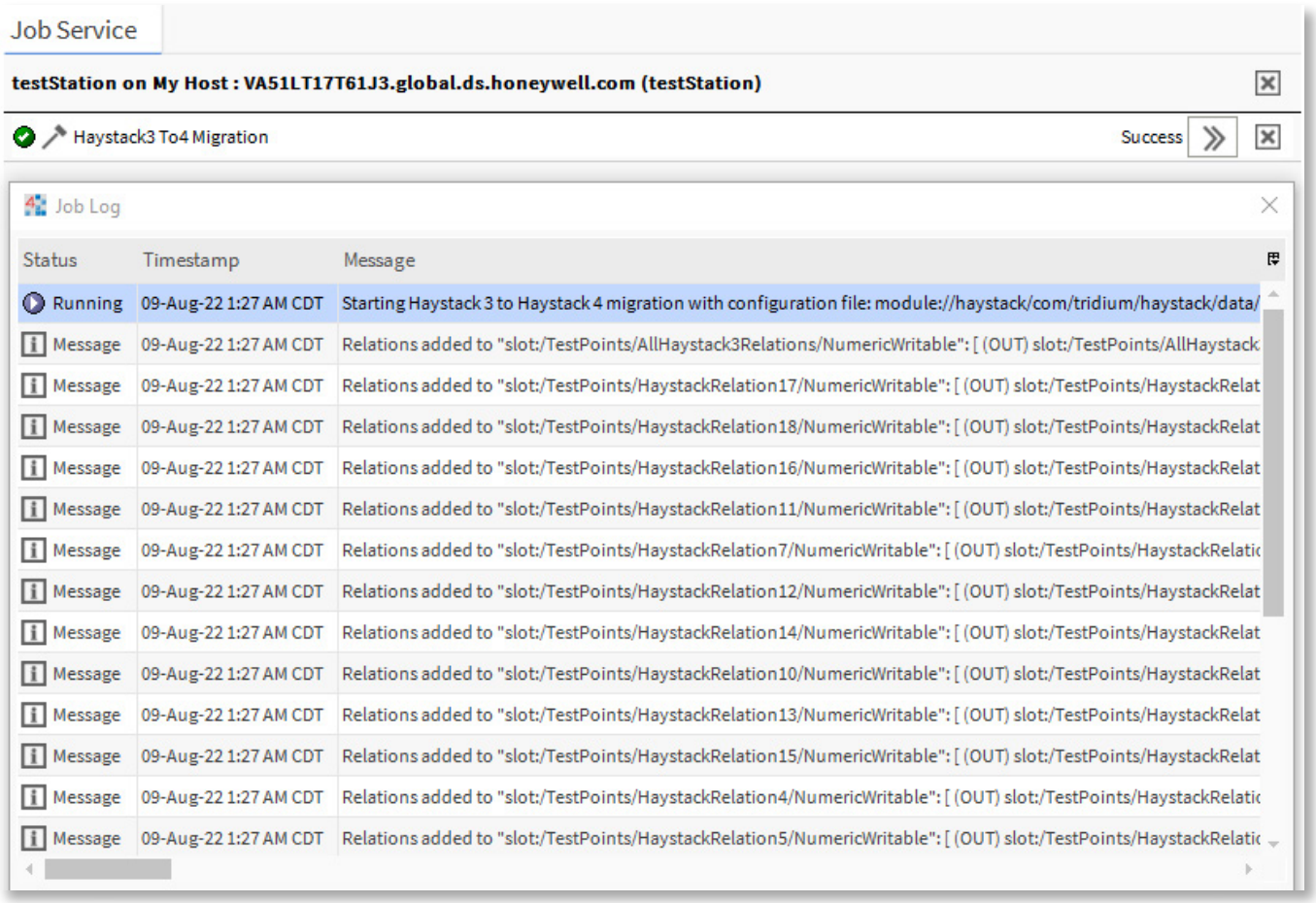


Figure 10. Migration Job Log.

scalable cloud environment, along with the semantic tags and other meta data contained in the associated semantic data model. The Niagara Data Service unlocks access to this data through APIs, which can then be used with Niagara partner-built dashboards, 3rd party applications, and business intelligence tools. We didn't stop there though, as we've also provided the ability to visualize this data using our cloud-native charting interface, giving users extra flexibility to view this data on demand.

By preserving the meta data from the model, Niagara Data Service delivers trend histories that are ready for down-stream ingestion by analytics applications and machine-learning algorithms. We believe that by unlocking access to this enriched data in a scalable environment, there will be a significant boost in the adoption of the Project Haystack on account of the value its specified ontology provides to the market.

Conclusion

We're excited to make the Haystack 4 tags, tag groups, and relations available in Niagara with this new tag dictionary. We hope the migration action will ease the transition from Haystack 3 and that it will be easy to keep this dictionary up to date as the ontology evolves. We look forward to getting this out to the community soon!.

Eric Anderson, a Software Engineer, has been working on tagging and tag hierarchies since he joined Tridium in 2015. Tridium created and continues to enhance the Niagara Framework®, an open platform that facilitates system integration and control.

FIN|STACK

FIN Framework

Simplify smart buildings, smart equipment and IoT with a cost-effective hardware platform for FIN Framework and FIN Stack software applications*.

The F200 Edge Controller is ideal for OEMs and distributors that require a bundled FIN hardware and software package for mid market applications such as schools, offices, hospitals and more.

Benefits include:

- Can be licensed up to 5,000 CAPs
- Can be licensed up to 1,000 HIS
- 2-port Ethernet switch with 2 LEDs per port
- 1-port Ethernet interface with 2 LEDs for WAN (internet access)
- 2 EIA-485 interfaces
- USB interface for 4G dongle**
- Rebrandable
- Remote access via FIN Edge2Cloud, without need for VPN

Scan to find out more or go to:
j2inn.com/f200

J2INNOVATIONS
A Siemens Company

*FIN Stack is available via distributors in North America and UK **4G dongle will require development of a custom connector depending on the OEM's specific requirements.

The Challenges of Multiple Electric Vehicles Charging

Energy Twin™

"Research and practical applications have shown that semantic data are essential, for example, for the scalability of fault detection and diagnosis systems. In the scope of Machine Learning, tags provide necessary information for coupling model data for mathematical models."

EVs have been experiencing a significant surge in demand in recent years. According to the U.S. Department of Energy, EVs and plug-in hybrid electric vehicles (PHEVs) sales almost doubled in 2021 compared to 2020.* This trend can also be observed in Europe, where data published by the European Environment Agency show an increase in registered EVs from 3.5% to 11% of all new car registrations.**

There are numerous challenges associated with EV charging - support for various communication protocols, equipment failure handling, and phase balancing, as well as complex issues such as multiple EV charging strategy optimization.

How can all of these issues be dealt with effectively? The key factor is avoiding vendor lock-in scenarios and focusing on interoperable solutions. Users should be able to easily compose their own solutions out of various components from various vendors. This article will focus on using AI to optimize EV charging strategies. However, AI can be used in EV charging optimization in various ways. In the vendor lock-in scenario, one will probably be assured that the provided solutions use "AI". Nevertheless, you do not only want to check that you are using AI; the goal is to be able to easily employ multiple AI components if they can improve your EV charging process. Similarly to HVAC, it is common to have various data management systems (SCADA for routine operation, FDD for experts, EMIS for energy optimization, etc.).

Using tags can significantly improve interoperability and assist this emerging market in quickly adapting to new technologies. This paper will demonstrate a specific problem associated with charging multiple EVs, which is common in office buildings. It is a nice example of an AI component that could be used as part of an EV charging solution. In order to provide an optimal charging strategy, the presented solution is based on a holistic approach that takes into account the energy model of the building itself. Therefore, one needs to connect information from multiple sources (EV chargers, weather station, main meter, building schedule). When using tags, this process can be completely automated. In other words, the use of tags can radically streamline the deployment process, especially for data-intensive solutions.

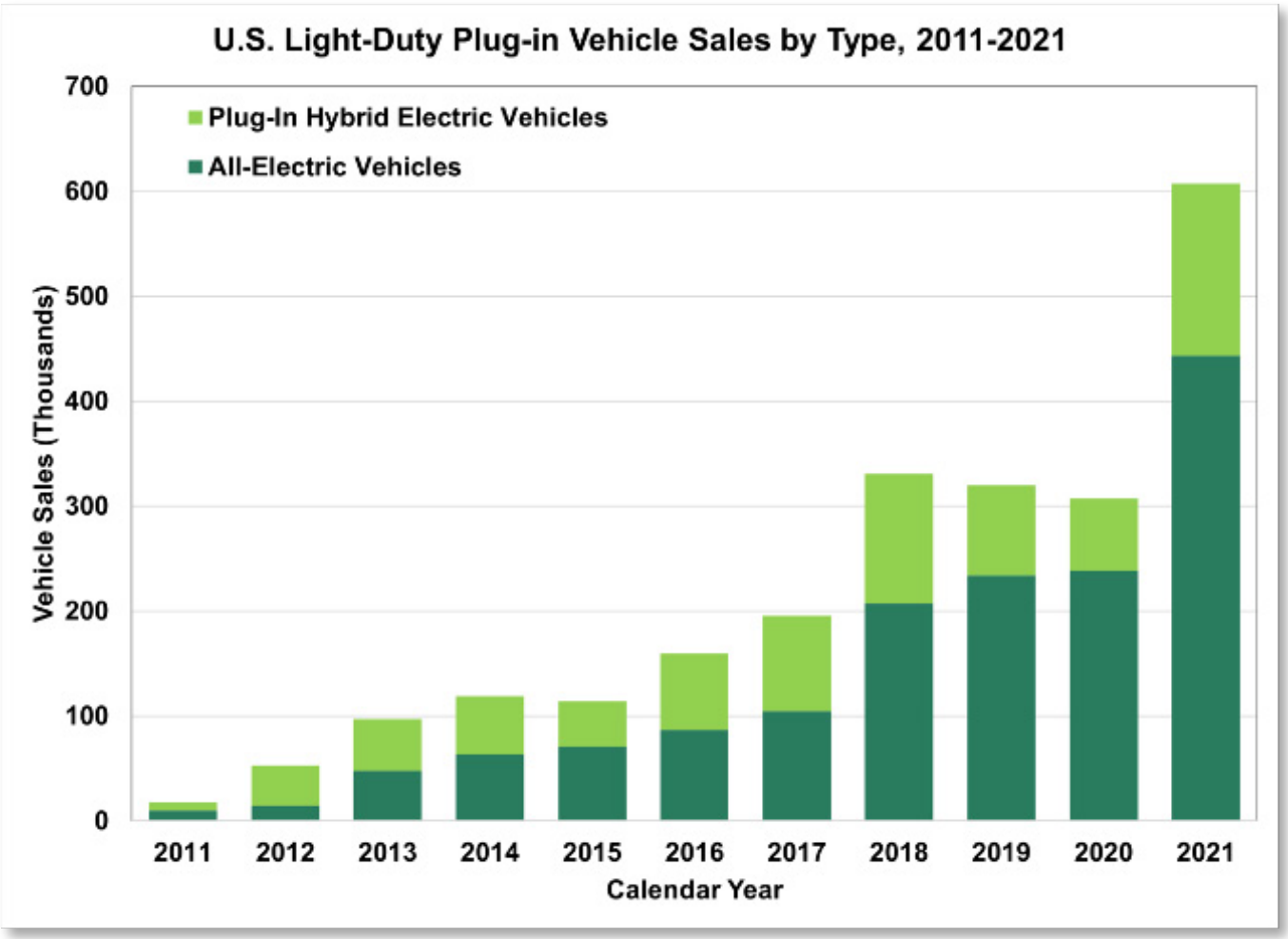


Figure 1. According to the U.S. Department of Energy, EVs and plug-in hybrid electric vehicles (PHEVs) sales almost doubled in 2021 compared to 2020.

Challenges Related to Multiple EVs Charging

We will discuss three particular challenges related to multiple EVs charging.

Challenge No 1 - Power Demand

Let's begin with a brief overview of EV charging before diving into charging multiple EVs. There are three EV charging levels: Level 1, Level 2, and Level 3. The higher the charging level, the more power is delivered to the EV, with different EVs charging at different rates at each level. Level 3 allows for a maximum output up to 350 kW. Note that 350 kW may be the peak demand of a middle size office building!

Commonly, EV chargers do not have a separate utility interconnection. They usually share the utility interconnection with the building, which means they have the same power demand. There are numerous power demand charge structures, but they all have one feature in common - the higher power demand -> higher electricity bill. Furthermore, the power demand charge is typically fixed for a longer period of time. As a result, a single failure, such as a concurrent start of power-intensive devices, can cost thousands of dollars for a long time period (up to 12 months). That is why one must carefully consider power demand when installing multiple EV chargers in an office building. There are straightforward (reactive) mechanisms that turn off EVs charging if the maximum power demand is about to be exceeded. In this article, we will demonstrate a more advanced solution based on prediction.

The predictive approach requires the knowledge of expected building electrical energy consumption. The electrical energy consumption of a building (e.g., HVAC, plug loads, ...) is not deterministic and is affected by a variety of factors. Obviously, there is higher power demand

during working hours and generally lower power demand during weekends. Power demand usually correlates with climate conditions, particularly air temperature and solar irradiance. It makes predicting power demand quite challenging. The scope of this article does not allow for a detailed description of energy modeling; however, more information on this topic can be found in the article "Tagged Data Analysis Using Machine Learning Methods" in Project Haystack Connections Magazine Issue January 2022.

Challenge No 2 - Variable Energy Price

Flat energy tariffs are becoming obsolete as the energy sector transforms and renewable energy sources are integrated. Nowadays, there has been a rise in the popularity of time-of-use tariffs when electrical energy price changes according to a predefined schedule. Especially for large customers, such as office buildings, variable electricity energy prices are available. Because these prices reflect spot prices, they are therefore not fixed. We can see very different electrical energy price profiles, especially in the last few months. In the simulations, we used the real-world electrical energy spot prices from the day-ahead market in the Czech Republic.***

The chart below shows an example of different electrical energy price profiles. These are the Thursday electricity price profiles from December 2021 to March 2022. Prices range between less than 50 EUR/MWh and more than 400 EUR/MWh. The shape of the profiles also varies a lot. Considering power demand and other constraints, it is clear that the straightforward if-then-based algorithms

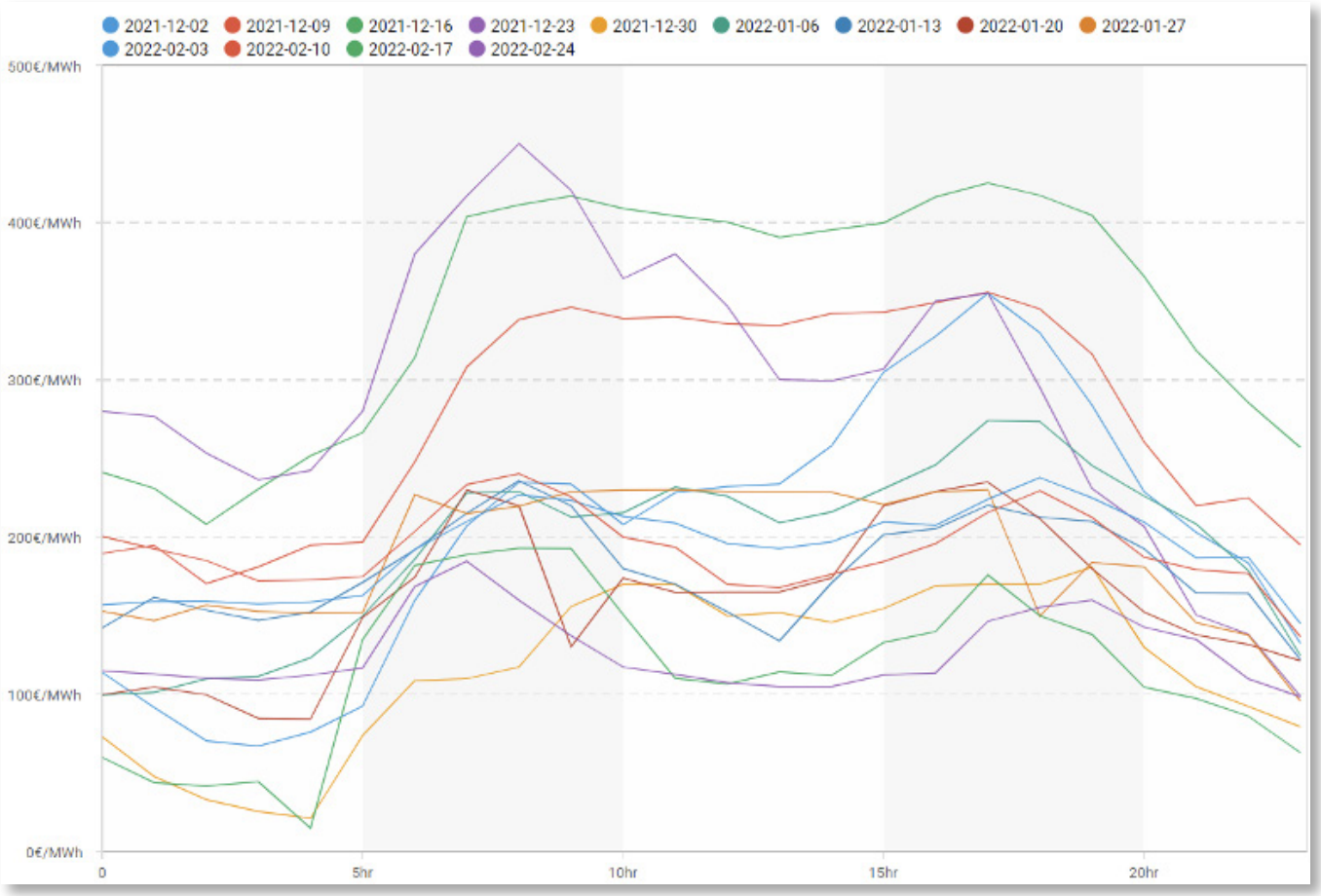


Figure 2. Example of real-world electrical energy spot prices from the day-ahead market in the Czech Republic.

are not suitable for purchase price optimization and one has to use more advanced techniques such as mathematical optimization.

EVs and any batteries, in general, can leverage variable energy prices and minimize purchase price when operated with respect to variable cost, i.e., charge when the energy price is low.

Challenge No 3 - Deployment and Scalability

The proposed solution can save a significant amount of money, as will be illustrated in the following section. However, labor-intensive deployment and maintenance processes can significantly decrease the attractiveness of such a solution. Semantic data is the solution to this issue.

For deployment of the solution, one has to capture connection among the following data:

- EV chargers' online data
- EV chargers' metadata (e.g., maximum charging power)
- EVs meta-data (e.g., current battery state)
- EVs charging power setpoints
- Site meter data
- Building schedule (occupied/unoccupied)
- Outdoor air temperature (solar irradiation, etc.)

Haystack tags can describe all these relations. Actually, these tags could already be defined because of fault detection, energy optimization, etc. Instead of the manual configuration of the whole system, one can simply relate it to tags. This is important not only for the initial installation but also for the maintenance of the installed solution.

Tagging convention for EVs is not finally defined in Haystack. But there is ongoing work on this topic within the EV Charging WG led by Rick Jennings. For details, see Rick's article in this issue of Project Haystack Connections Magazine.

Solution - "Tags to Matrices"

The aforementioned challenges combined cannot be optimally solved using straightforward techniques such as if-the rules. It requires the use of AI, more specifically, machine learning combined with mathematical optimization. The scope of this paper precludes detailed explanations of mathematical background; however, we can provide a basic concept.

First, the energy demand of the building has to be modeled using machine learning techniques. Using the model, weather prediction, and schedule, we can predict the expected electrical energy consumption of the building for the next 24 hours with up to 15 minutes time step. With each 15 minutes, we can formulate and solve a mathematical optimization problem that takes into account the following information:

- Building electrical energy consumption prediction
- Maximal power demand
- Electrical energy price profile (time of use, or prediction of variable energy price)
- Information about EVs (battery state, battery capacity, expected time of leave, and charge level)

Mathematical optimization aims to minimize electrical energy purchase price with respect to all constraints. Every 15 minutes, the mathematical optimization problem is solved. Output from the optimization is the optimal charging profile for each EV charger individually from "now" till the end of the day. These profiles are setpoints for individual EV chargers. The tricky part is that only the first setpoint (i.e., the setpoint for "now") is used. After the next 15 minutes, we will have an updated solution that considers updated electrical energy consumption prediction and, most importantly, updated information about EVs. For example, a new EV has arrived, which must be accounted for in the charging strategy as a whole.

The ultimate goal is to develop a solution that will automatically transfer Haystack tags into "matrices" and automatically set up the optimization problem. This is an open research problem that we are focusing on.

Simulation

In the last part, we will illustrate the concept by means of a numerical simulation. Three experiments will be presented, all with the same setup. At 8 a.m., eight EV cars arrive. For the sake of simplicity, each EV has the same properties:

- Initial battery state: 30%
- Expected departure time: 4 p.m.
- Requested battery state at time of expected departure: 90 %
- Battery capacity: 80 kWh
- Maximum charging power: 50 kW

The power load predictions are calculated using the Energy Twin model (https://energytwin.io). The model was identified using data from a real office building in Prague that uses electrical energy also for cooling. In all simulations, we use one hot September day, when cooling increases the total building power demand. On that particular day, electrical energy prices had a common shape with morning and evening peaks.

For the sake of readability, the simulation time step is one hour instead of 15 minutes. The simulation captures the result at 8 a.m., when eight EVs arrive. Note that in practice, the strategy would be updated each hour in order to take advantage of updated information, as discussed above.

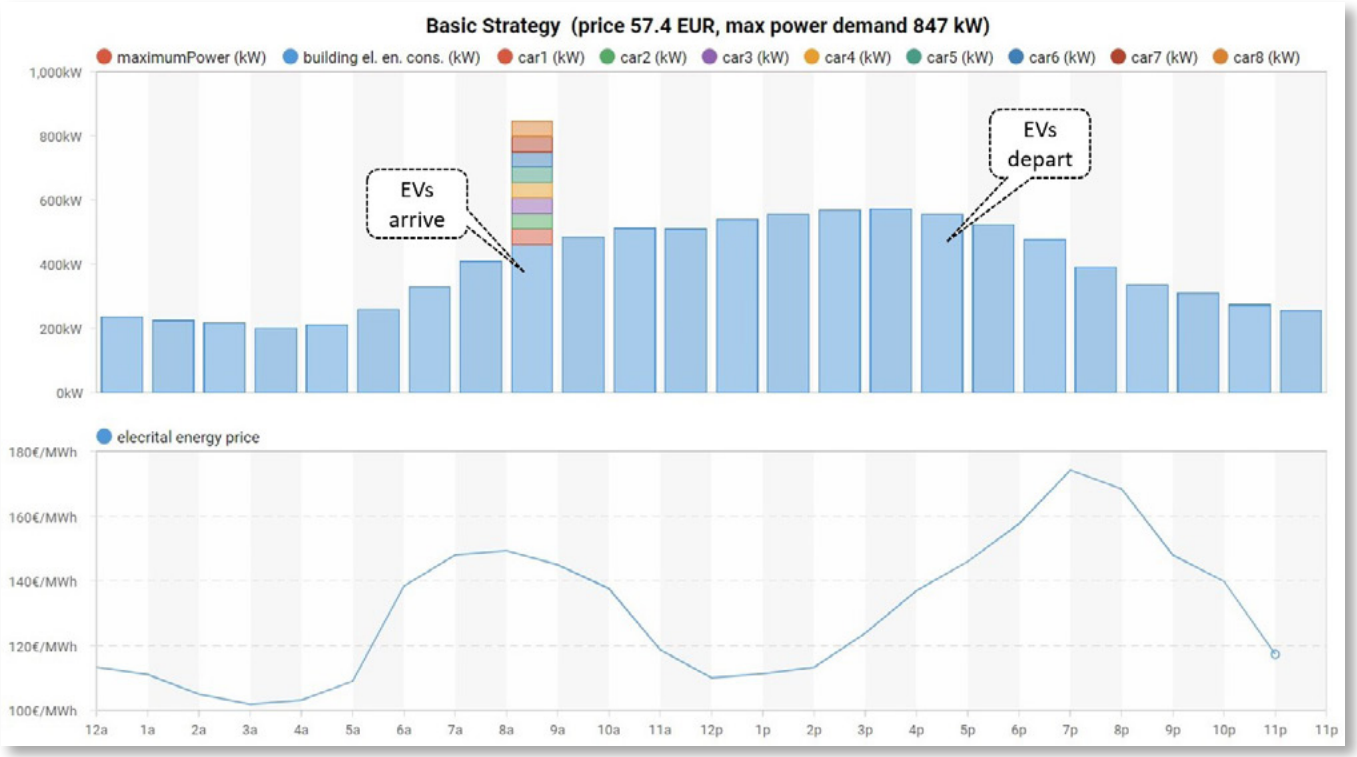


Figure 3. First Experiment - Basic Strategy: All EVs are charged within one hour using maximal charging power. In the top chart, the blue bars represent building power demand, the other bars are EVs charging power. The bottom chart depicts variable electrical energy price.

First Experiment - Basic Strategy

The first experiment is straightforward and reflects the current state when EVs are charged immediately after they are plugged in, i.e., at 8 a.m. (this strategy will be referred to as a "basic strategy").

With the current setup, all EVs can be charged within one hour using maximal charging power.

This strategy has two drawbacks: at first, the morning arrival time correlates with the morning energy price peak. Therefore, charging is quite expensive (57 EUR). The second drawback is high power demand.

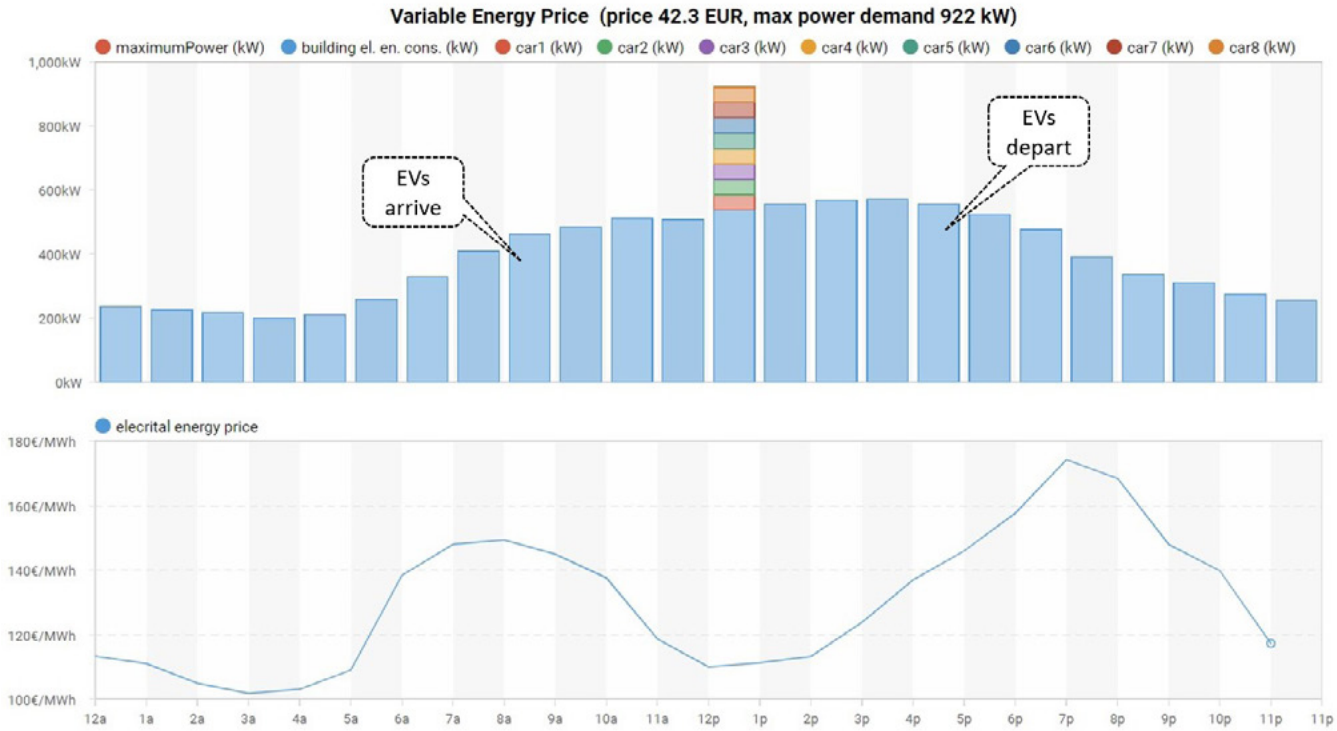


Figure 4. Second Experiment - Variable Energy Price: The mathematical optimization finds a solution with the lowest charging price. In the top chart, the blue bars represent building power demand, the other bars are EVs charging power. The bottom chart depicts variable electrical energy price.

Second Experiment - Variable Energy Price

In the second experiment, variable energy price is considered. The mathematical optimization finds a solution with the lowest charging price.

In accordance with common sense, EVs are charged before 4 p.m., when energy prices are lowest. When compared to the first experiment, the overall purchase price has decreased significantly (57 EUR vs. 42 EUR). However, there is still a high demand for electricity. Furthermore, the charging time overlaps with the cooling demand of the building's HVAC system, resulting in an even higher power demand than in the previous experiment. This drawback is resolved in the following simulation experiment.

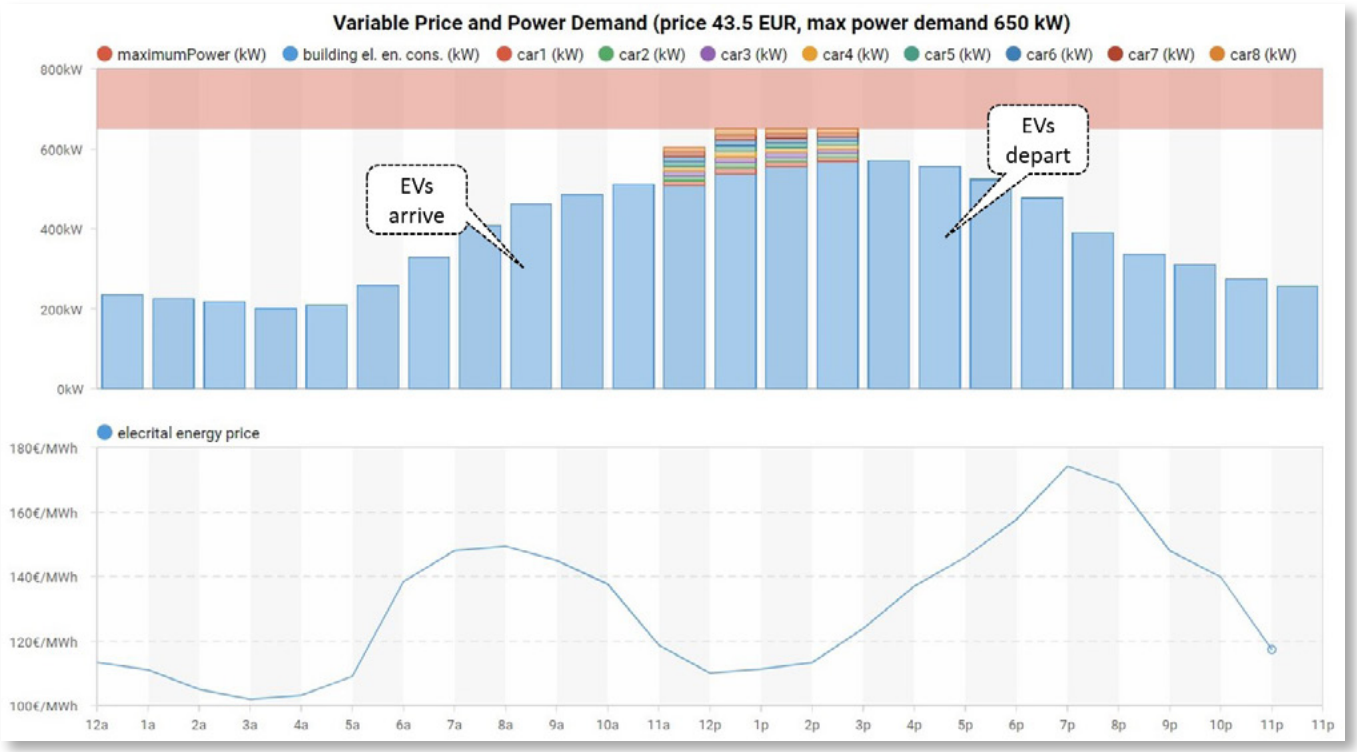


Figure 5. Third Experiment - Variable Price and Power Demand: Maximal power demand is also considered in mathematical optimization. In the top chart, the blue bars represent building power demand, the other bars are EVs charging power, and the red area indicates power demand constraint. The bottom chart depicts variable electrical energy price.

Third Experiment - Variable Price and Power Demand

In the last experiment, another constraint is introduced into the mathematical optimization problem formulation: maximum power demand of 650 kW. It means that the sum of predicted own building consumption plus all EVs charging power needs to be maintained below the maximum power demand threshold.

As a result, EVs are also charged during hours with slightly higher prices in order to spread charging into longer time spans and lower maximum power demand. The purchase of electrical energy increases only slightly (42.3 EUR vs. 43.5 EUR), but the maximum power demand is not exceeded. This strategy outperforms previous strategies, and the total electrical energy cost would undoubtedly be the lowest due to the lower distribution fee.

Conclusion

This article discussed some of the difficulties associated with charging multiple EVs. The proposed AI solution outperforms the conventional strategies; however, it is not the only solution to this complex problem available. There are alternative solutions that also outperform the currently used charging strategies. It is also important to note that these simulation results are only for demonstration purposes, and no general conclusions, such as expected monetary savings, should be drawn from them. When simulating different days with different energy price profiles and weather conditions, different results will be obtained.

Despite that, two general conclusions can be drawn:

- The optimization-based approach provides better results (in terms of price and power demand) than the basic strategy.
- The difference between the optimization-based approach and the basic strategy will be more significant with higher energy price variations.

Above mentioned challenges of multiple EVs charging will become more common and that is the reason why we are open to R&D collaborations such as pilot projects in order to adapt to the ongoing change in the energy sector.

*https://www.energy.gov/energysaver/articles/new-plug-electric-vehicle-sales-united-states-nearly-doubled-2020-2021

**https://www.eea.europa.eu/ims/new-registrations-of-electric-vehicles

***https://www.ote-cr.cz/en/short-term-markets/electricity/day-ahead-market?set_language=en)

Energy Twin is a trademark of Energocentrum Plus company.

Jan Široký is the leader of the Energy Twin team that is focused on the use of machine learning for energy and HVAC data analysis. He is working with semantic data in various practical applications such as HVAC fault detection or virtual power plant monitoring.

Virtual Metering with the Power of Haystack

BRAINBOX AI

"Virtual metering can supply information about the Inputs and the Outputs for any individual system or equipment without the need to install any additional meters (energy meters, flow meters, etc...)."

BrainBox AI is a Montreal-based company that controls heating, ventilation, and air conditioning (HVAC) systems of existing buildings through their BMS (Building Management System). The goal is to capture and store live data from the building, and to train artificial intelligent models to pre-emptively control the building's HVAC systems to optimize comfort, energy savings, and carbon footprint. The BrainBox AI solution is deployed in hundreds of buildings all with unique control system implementations and is manufacturer agnostic. The use of Haystack tagging ensures that we have a uniform pipeline of processing and classifying assets in a building. In recent years, the industry focus has strongly shifted towards becoming more energy conscious and efficient. The need for accurate metrics like energy consumption and instantaneous power demand has become essential to our daily operation, and it allows us to measure our impact on a building.

Virtual metering can supply information about the Inputs and the Outputs (***Figure 1***) for any individual system or equipment without the need to install any additional

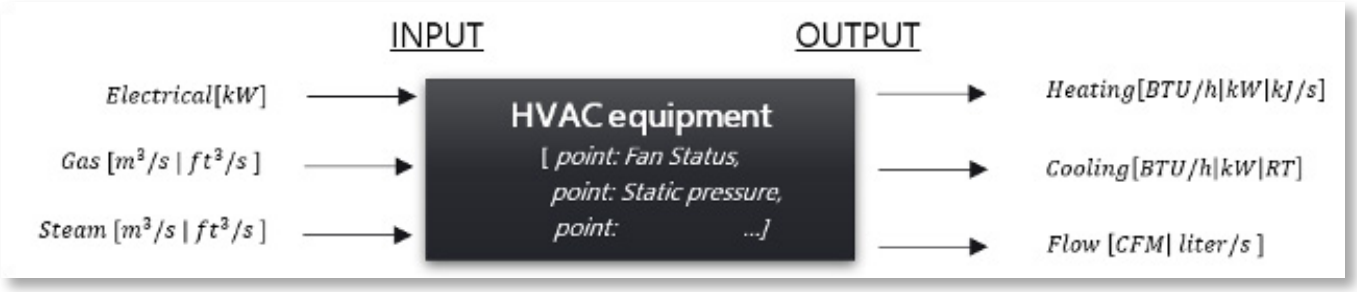


Figure 1. Black Box HVAC Equipment With Inputs and Outputs.

meters (energy meters, flow meters, etc...). This can be carried out by collecting information from the points monitored on the building network or BMS. The logged data from the points is then paired with additional information, other points, or physics and thermodynamic principles to determine the input consumption or the output generation. Today, the BrainBox AI team is focused on the Input side of this black box.

BrainBox AI has adopted a regular set of tags, proposed by Project Haystack, to map their buildings. The development of custom "power tags" allowed the team to seamlessly latch onto an existing standardized tag structure and implement these new tags for virtual metering purposes (***Figure 2***). In the case where power metering or amperage sensors are present, we can use the trending values directly. Otherwise, the combination of point trend logs (start/stop, modulation, etc...) and the technical specification or equipment nameplate can yield accurate results. This virtual metering information is also essential to our measures and verification process.

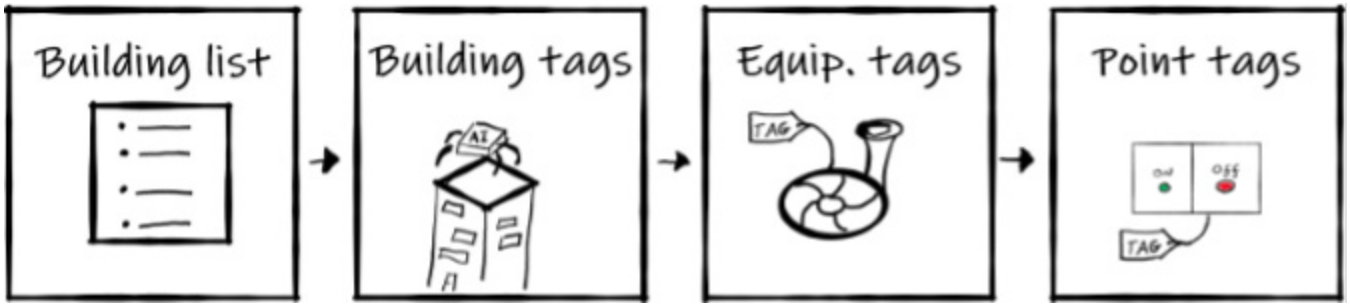


Figure 2. Power Pagging Process Pictogram.

In a simple use case, let's take a pump that has no variable frequency drive with ON/OFF controls and a 10kW nominal power consumption, as an example. ***Figure 3*** illustrates a simplified data structure with the implementation of standard tags alongside power tags.

By combining the semantic data that we have attributed, and the operating runtime logged from the pump, we can generate two important values (***Figure 4***):

- Instantaneous power demand for the building's HVAC equipment, by summing all the assets that are presently consuming power. This can be helpful in the case where a peak shaving strategy is to be implemented.
- The total monthly energy consumption for an individual unit can be obtained by multiplying the runtime in a month (or any other timeframe available to us) with the unit's power usage.

  *power usage [kW]*operating hours [h]= energy [kWh]*

With the development of our interface (***Figure 5***), the person in charge of mapping the building can rapidly populate relevant power information. As a result, the mapping engineer can catalog technical HVAC equipment parameters for future reference or on-the-fly modification. Furthermore, the interface acts as a validation layer to ensure the integrity of the meta-data and tags stored in our database.

```
192: {
        "tags": {
            "dis": "BOILER_06_P",
            "pump": "marker",
            ...
        },
        "points": {
            3023: {
                "tags": {
                    "dis": "P_SS",
                    "PowerInput": 10, # kW
                    "PowerInputType": "electrical", # Natural gas, steam ...
                    "Modulation": "binary", # 0-100%, multi-stage ...
                }...
```

Figure 3. Pseudo Data Structure Used Along With Standard Tags.

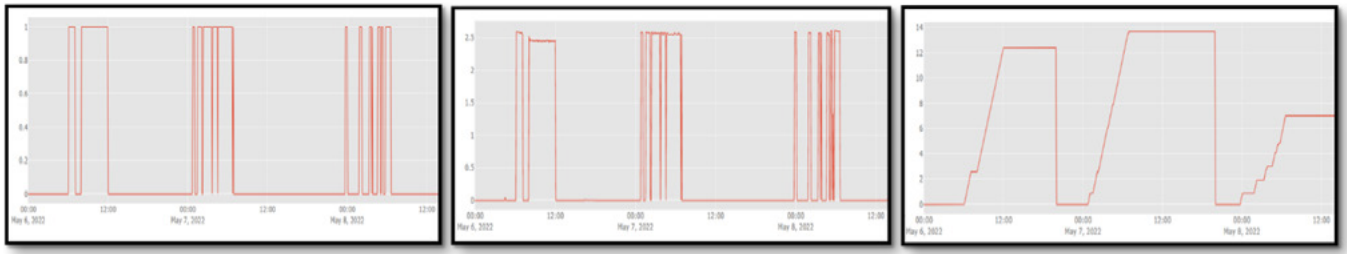


Figure 4. Pump Profile (left); Binary Modulation [ON/OFF] (middle); Power Demand [kW] (right); Energy Consumption per Day [kWh].

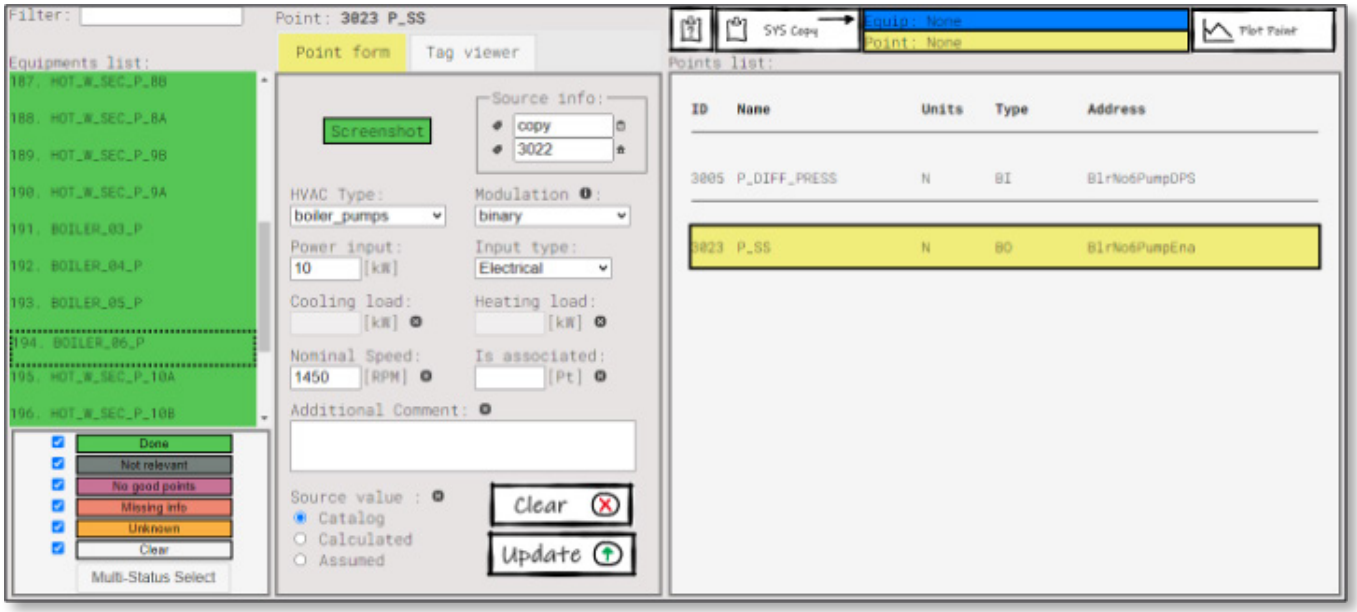


Figure 5. Needle UI for Power Tagging.

TL start date		Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22
Tuesday, October 12, 2021	VM [kWh]	391,892.93	729,400.65	623,088.82	780,492.47	490,972.14	335,543.87	609,738.85
	Bills[kWh]	1,984,981.71	2,062,152.35	2,121,276.23	2,271,378.53	2,122,146.97	2,297,868.01	2,085,094.92
	VM/Bills [ratio %]	0.20	0.35	0.29	0.34	0.23	0.15	0.29
Tuesday, October 12, 2021	VM [kW peak]	1,147.21	702.00	1,173.43	824.32	1,172.14	1,079.25	1,301.93
	Bills[kW peak]	3,185.39	3,433.36	3,266.82	3,587.04	3,305.19	3,655.45	
	VM/Bills [ratio %]	0.36	0.20	0.36	0.23	0.35	0.30	

Figure 6. Comparing Virtual Metering With Bills From A Site.

When the tagging is completed, our computational engine enables us to automatically fetch the proper power tags from the database and create the virtual metering data in real-time. This data can be consulted for specific equipment, system, or the entire site. This information (***Figure 6***) paired with the rates from the local utility provider can give us the total cost in the past and predicted costs in the future.

Virtual metering is dependent on the quality of the data we collect. Poor data integrity or data gaps can lead to inaccurate results, subject to their length and severity. Lack of information about the building, the lack of bills, incomplete assets lists, and other factors can all lead to incomplete analyses and results. Other technical challenges like the non-linear power usage of certain equipment, like chillers, can be challenging to correctly model without the right technical documentation. When the equipment with large energy consumption and non-linear behavior can be metered or modeled correctly, we can obtain a virtual metering baseline that can be as valuable as real metering since any future action will be relative to the current baseline.

Haystack tagging has enabled BrainBox AI to onboard and scale quickly while maintaining a uniform data structure for a large variety of buildings. The ability to integrate custom power tags without modifying our existing data structure has allowed us to generate virtual metering data with minimal technical overhead. A constant improvement in collection methods and the accuracy of historically aggregated data will enable us to get a better understanding of the building itself while improving comfort, operation, and reducing costs.

Pioter Agalakov is a data analyst and developer at BrainBox AI, a start-up company that specialized in implementing AI based HVAC controls for commercial buildings worldwide, allowing clients to optimize air quality, comfort, and energy use.

Interoperability Top to Bottom

PADI

"The Haystack community knows very well that semantic standardization is essential. Semantic standardization now allows us to turn data into value. But this is only the case if we have access to data."

Interoperability is a cornerstone of building automation. Interoperability has consistently been a driver of industry growth by scaling through standardization. Pneumatic controls came first, enabled by interoperability of pneumatic components from the 1950s. Early DDC systems were necessarily proprietary, enabling rapid innovations during the DDC wild west of the 1980s. The lack of DDC interoperability motivated the need to standardize network protocols leading to the "protocol wars" of the 1990s, pitting LON, KNX, BACnet, Modbus, and others against each other to vie for market acceptance. Today, unitary devices are mostly BACnet on MS/TP or IP, while larger controllers standardize on BACnet as the field network, and some flavor of IP northbound, all the way to the cloud.

Between standards for pipes, media, transport, and protocols, the lower layers of the stack are now interoperable. The desire for vendor lock-in, while not in the best interest for building owners, is still how many vendors plan their offerings, often at the same time espousing openness. Because lower layers have been standardized, vendors are looking further up the stack to applications and tools to achieve lock-in.

The Haystack community knows very well that semantic standardization is essential. Along with other semantic initiatives related to buildings as well as those in vertical industries, there is a clear understanding that tagging data and establishing the meaning and relationships between datasets are important in order to make use of data for analysis and decision making. Semantic standardization now allows us to turn data into value. But this is only the case if we have access to data.

Today, buildings are becoming a complex collection of systems necessary for them to be "smart". From traditional automation systems for HVAC, energy, lighting, to physical security, we now have a growing number of IoT systems monitoring and controlling faucets, IAQ sensors, enterprise systems, and everything in between. On top of that, many operational systems are emerging such as FM, maintenance, trouble tickets, visitor management, digital displays, and others. The current sustainability and social good imperative necessitates aggregation of data from these and other systems into a holistic view of a building. The focus on ESG exemplifies this trend.

We think of these systems as silos, because each represents a different function, provided by different industries that focus on a specific discipline. Vendors, practitioners, products, semantics, regulations, and practices of these silos are different by necessity–to deliver their specific value.

For practitioners in building automation spaces such as the Haystack community, these silos present two problems. First, each silo will typically have their ontology and schemes that are unlikely to align with HVAC. The temptation is either to try and change them to use "our" ontology, or for us to understand and use "their" ontology. Neither of these provide a practical scalable solution, especially since there are dozens, even hundreds, of silos to consider, each with their own intra-silo debates and issues. Another approach is creating an uber-ontology that we can all use; desiring world peace is probably an easier mission than this approach!

The second and most prescient problem is that while the BAS industry may not see the value of other silos, our customers–the beneficiary of our collective efforts, building owners, operators, and occupants don't see them as silos. To them, the collection and interaction of these systems is what they expect to make their building smart, each one is as necessary as the next. They want data from all of these systems to work together for their benefit. That is what they are paying for!

What this view drives home is the need for all systems in a building to be able to interoperate with others when there is a need for them to do so for the benefit of users, and for this to be accomplished without everybody having to become an expert in each silo. What we need is a mechanism that discovers and connects systems in a building that have complementary capabilities that enhance the building.

For over two years now, a group has been working on a mechanism called CNS/CP, also referred to as Connection Profiles. The group has now prepared a formal specification of this system as an Internet-Draft being submitted to the Internet Engineering Task Force (IETF).

Smarts						
	Purpose	Reducing Complexity	Single Sign On	ESG Dashboards	Maximizing Value of Systems	Provide Choice and Flexibility
	Operation	Facility Managers	Maintenance & Service Providers	Sustainability & Energy Managers	Property/Asset Managers	Other Operation Users
	Delivery	Sys Installers & Integrators	Consultants	Integrated Delivery Platform	Web, Mobile, VR, AR, etc.	Single Pane of Glass
	Apps	Analytics Apps	Modeling & Simulation Apps	Application Marketplace	AI, ML & Bots	Management Tools & Apps
	Exchange	Gateways & Middleware	Haystack	CNS/CP	Protocol Standards	Semantic Standards
	Data	Open Source Data	Data Providers (weather, etc.)	Data Warehouses	Data Store Ingress/Egress	Interoperable Data Repositories (IDL)
	Systems	BAS & HVAC	Lighting, Security, CCTV, etc.	Cyber Physical Systems	Energy Systems	IoT, IIoT Systems
	Physical	Small & Medium Buildings	Large Buildings	Campuses	Large Complex Assets	Smart Cities & Utilities

Figure 1. CNS/CP depicted on the Smarter Stack.

Here are some ways that CNS/CP can enhance your toolset:

- CNS/CP provides a standardized, named, use-case-centric semantic model of how two systems implement specific predefined capabilities.
- CNS/CP is designed to work with any and all protocols without the need to create custom drivers, gateways, or converters.
- CNS/CP is designed to work on the Internet as well as other types of private/public networks.
- CNS/CP enables System-of-Systems architecture defining their own cyber-secure realm. This removes the need for complex IP-to-IP security mechanisms.
- CNS/CP allows other systems to access and use data from systems that you install, thus increasing your value proposition.
- CNS/CP allows you to easily and securely access data in other systems related to the building.
- CNS/CP allows the systems in the building to change over time as the owner's needs demand over the decade-long life of buildings.

We invite you to review the specification and provide feedback, comments and suggestions. We are especially interested in exploring how this mechanism and Project Haystack can effectively enable interoperability at all levels of the information architecture.

View the CNS/CP specification here: **https://github.com/CNSCP/specification**.

Anto Budiardjo, CEO of Padi.io, is a veteran in the connected building space. Since 1989, he has led the development and promotion of building connectivity and integration technologies. Today he is focused on a new venture to bring system integration into the Internet era with an online integration and collaboration platform Padi.io.

A Business Case for Making Technology More Accessible with Haystack Tagging

J2 INNOVATIONS
A Siemens Company

"With an increasing demand and more legislation for better building efficiency (not just energy but beyond), the demand for holistically integrated, and data driven building management and optimization has rapidly increased. To set the foundation for holistic building management and optimization, the starting point is a normalized, contextualized, and IT friendly data basis."

Systems and devices within buildings have traditionally communicated via a variety of open and proprietary protocols (such as BACNet, Modbus, KNX, etc). Disciplines such as HVAC, power, and lighting are typically still automated in silos, but even within those silos integration and management is very limited. With an increasing demand and more legislation for better building efficiency (not just energy but beyond), the demand for holistically integrated, and data driven building management and optimization has rapidly increased. To set the foundation for holistic building management and optimization, the starting point is a normalized, contextualized, and IT friendly data basis. But what does this mean?

- Normalized to, for example, run trends, logic and analytics against a device or system, independent from the manufacturer.
- Contextualized to, for example, provide higher level information about a device such as its position in the building, manufacturing date, and date of installation.
- IT friendly to, for example, easily utilize modern big data and analytics engines, both in an edge and cloud environment.

To achieve this, a few powerful integration platforms have been established in the last few years. These platforms take in the different data from the Operational Technology (OT) devices and systems and normalize it towards a standard and IT friendly data model. Based on this normalized data, on the platform or outside those platforms, a variety of value adding software apps have been built, e.g., for advanced building management, energy analytics, space management, and asset diagnostics. These integration platforms either make use of an open-source data standard (such as Project Haystack) or utilize their own proprietary data standard.

While some of these integration platforms are easier to engineer and more powerful than others, they all have a significant amount of engineering required to integrate relevant systems and devices within a building into those

platforms. Not only is this work cumbersome, but often requires a trained (and increasingly rare) system integrator to do the job. This will impact the return on investment, and therefore creates a roadblock.

What if devices and systems in buildings could not only just communicate with other automation systems but also natively speak a higher-level open-source data standard such as Project Haystack? Those devices and systems could then easily communicate with higher level software applications for building management and optimization, without the previously needed cumbersome integration effort. Suddenly, for example, an AHU controller or even a small sensor would automatically communicate via Haystack to an enterprise energy analytics application that resides in the cloud.

This would drastically change the proliferation of modern building software applications, particularly in cost sensitive environments, by eliminating the initial integration effort. By eliminating labor, this results in both implementation, cost savings, and in turn can save more energy.

J2 Innovations has been focused on normalizing data into the Haystack Standard and further simplifying workflows to make systems more plug & play. We do understand that there would be an even simpler way if devices and systems spoke Haystack natively. Not only with our software, but the increasing number of edge and cloud software.

We therefore created two Haystack libraries:

- One in Typescript, one of the dominant software coding languages, focused on servers, edge controllers and web browsers.
- One in RUST, which, due to its small footprint, can run on unitary devices such as a thermostat or sensor.

With these tools, manufacturers of building automation systems and equipment can now easily make their own devices and systems speak Haystack natively, therefore providing their device data in the Haystack language, format, and technology.

As strong advocates of the Project Haystack community, we have decided to also make these libraries open source; to contribute to but also benefit from this ecosystem.

In conclusion, if you are a building automation system or equipment provider who would like to natively communicate via Haystack to higher-level software applications, the tools are open-sourced and ready to use.

Alex Rohweder is a Co-Executive Director of Project Haystack. Alex joined J2 Innovations in 2018 from Siemens and as CEO brings his passion and expertise in building automation software, corporate strategy, portfolio management and OEM sales to the company.

Accelerating Integration and Collaboration with New Haystack Domain Modeler Tool

"75F will host and maintain the Haystack Domain Modeler as a free tool. It is slated to be publicly available to anyone within the industry after the Haystack Connect event in September. Ahead of public availability, this article will describe the tool and how it ultimately enables a wider audience to take advantage of Project Haystack."

75F is eager to introduce an upcoming Project Haystack-based portal called the Haystack Domain Modeler, a tool and repository that will allow any member to contribute and reuse peer-reviewed, plug-and-play digital twin models of equipment for custom applications.

Think Github for Project Haystack with a spreadsheet interface. By creating an open-source tool for applying inheritance of Project Haystack definitions to specific device and equipment models, the Haystack Domain Modeler will allow anyone to create, apply, and share equip definitions across platforms. This new capability will revolutionize the integration experience for building professionals across the buildings industry, enabling faster and more affordable data standardization for varying equipment types and collaboration between companies.

75F will host and maintain the Haystack Domain Modeler as a free tool. It is slated to be publicly available to anyone within the industry after the Haystack Connect event in September. Ahead of public availability, this article will describe the tool and how it ultimately enables a wider audience to take advantage of Project Haystack.

Project Haystack and its Foundation have Never Been More Important

In smart buildings across the world, building systems are producing gigabytes of data every minute. This massive amount of data comes from various sources — HVAC equipment, energy management systems, lighting, metering, location analytics, water leak detection, and much more — pushing data engineering needs to the next level. In these times of data hubs, lakes, and oceans, data exchange and comprehensibility becomes a core need for all IoT OEM businesses to expand and collaborate.

Building spaces have vast, disparate systems that need experts who both understand equipment from various OEMs in this space and comprehend the siloed modeling of data across each of these systems. This can hamper exchange and comprehensibility needed for collaborative projects. Even metadata publishing is not sufficient for conversations across systems. This necessitates human intervention-based manual re-mapping of data prior to machine-to-machine communications across various systems.

This has been solved by various semantic integrations that can facilitate — or even automate — the communication between two data-producing systems. Project Haystack has eased many of the hassles that come with these data silos with its simple but very effective use of standardized tags and relationships across equipment in the building space.

Project Haystack is an elegant step forward in resolving data commonality for these semantic integration problems and has enabled foundational structures for collaboration. Although many data standards are available and applicable to Building Management System (BMS) spaces at different levels, Project Haystack stands out as the easiest to use and apply in this space.

Current Challenges with Custom Definitions and Collaboration

The use of a set of Haystack-defined models shows semantic interoperability challenges when they are created by different OEMs or system integrators (SIs). Among these challenges is the lack of consistency among Haystack users in defining equipment entities, thus preventing the automatic processing of information across these systems.

Tagging silos that exist within each Haystack system create multiple definitions of common equipment types, or several different combinations of terms used to refer to a single entity. Some of these may be misinterpreted depending on the knowledge, background and domain expertise of each expert analyzing the equipment and tagging it in their Haystack complaint systems.

Also, OEMs and SIs using Project Haystack have customization options for creating tags and points as per their design and use case. If the understanding and usage of common terms that translate into tags and points are different, the same tags and points can mean different things for different users. This makes it very difficult to maintain consistency across organizations. As a simple example, one OEM — or even teams within the same OEM — may define the temperature setpoint as User, Zone, Temperature, Setpoint, while another may define it as Desired, Zone, Temperature, Setpoint. Within their context, both are correct. However, this leads to difficulty in integration and automation across systems, as well as setting up a common M2M interface.

The Project Haystack community has collected some of the world's best domain experts and data engineers with building data performance experience into its organization. Having a common forum that standardizes the most common domain equipment through appropriate tagging and modeling allows for easy data exchange with systems that can reference the same tags, points, and equipment templates.

The Domain Modeler Tool and a Collaborative Step Forward

To aid in solving some of the outlined problems, 75F is introducing the Haystack Domain Modeler, a Project Haystack-based data modeling tool for creating mapped logical, physical, or conceptual data models of various equipment in the smart BMS space. It is meant to be the comprehensive repository for Project Haystack equips and a modeling tool for creating models specific for each physical equipment type needed.

Based on tags, point library, and the standardized domain models established in the tool, the models working as templates will help standardize all tagging across equipment added into the tool. It will normalize the nomenclature used across various equipment, be it in a Modbus, BACnet, or custom OEM-supported format.

The Haystack Domain Modeler community tool publishes models to standardize consensus-based equipment models to support data interoperability in a wide range of equipment manufactured by various OEMs. With various permissioned users in the system, a Project Haystack Review Committee will approve the tags and models that continuously come into the tool. These reviewers will continue the process for all tags, points, and models being added into the tool to ensure the integrity of the data contributed by various creators. And, with changelog auditing, any user can trace back all changes happening in the tool continuously.

While the Haystack Domain Modeler will become available for public use in September, 75F and Siemens company J2 Innovations are using the tool in their partnership to increase central plant efficiency.

In the companies' partnership together, 75F will leverage FIN and J2 Innovations' F200 Edge Controller to manage custom plant applications. 75F will then feed that data back into its cloud for a single-pane-of-glass management and analytics experience for the entire building.

The Haystack Domain Modeler tool will allow 75F and J2 Innovations to standardize these custom applications, which will ultimately become the default models within FIN for fast and seamless future integrations with 75F and digital twins. The benefits are not limited to 75F and J2 Innovations — once a model has been defined, anyone in the industry can reuse it.

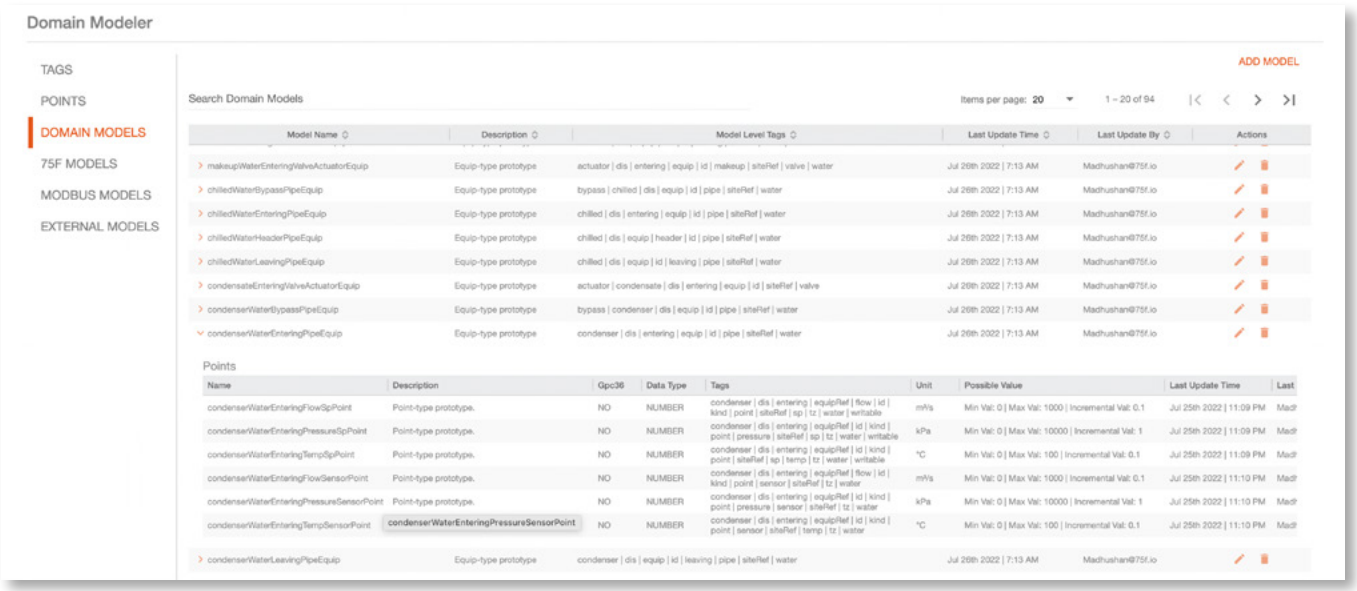


Figure 1. Example library of domain models. The Haystack Domain Modeler acts both as a tool to create custom definitions, and as a repository for definitions created by other users that may be reused as needed.

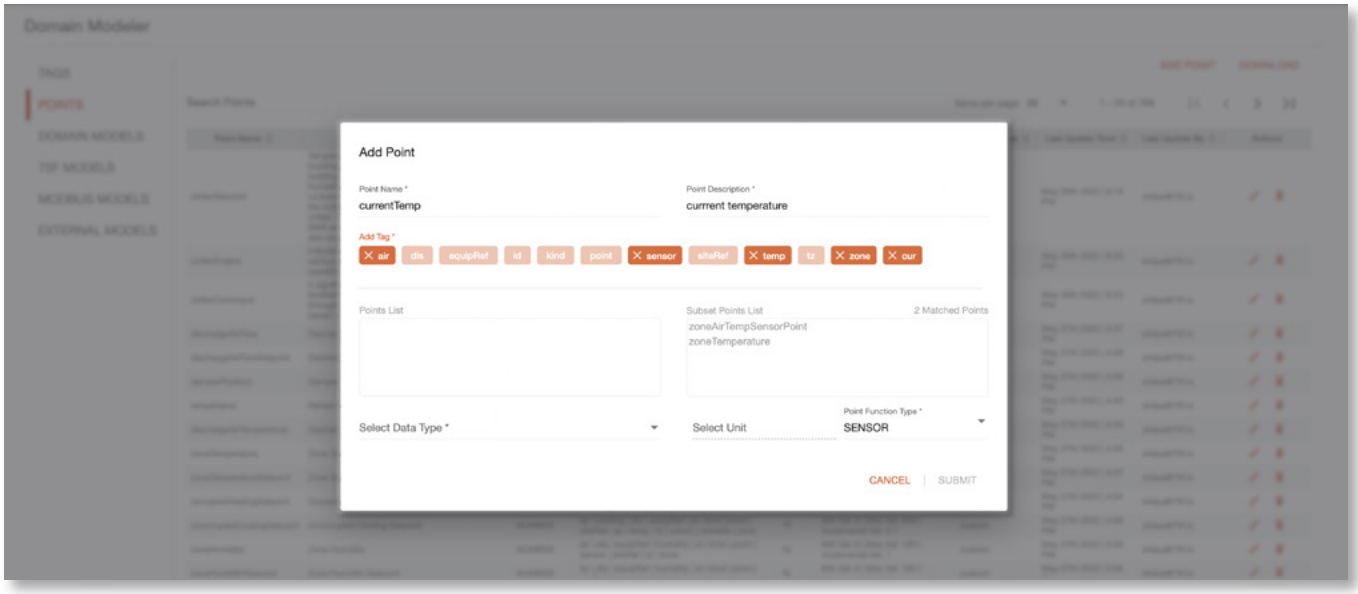


Figure 2. Adding points in the Haystack Domain Modeler. All community submissions undergo a peer review process to ensure the integrity of the data.

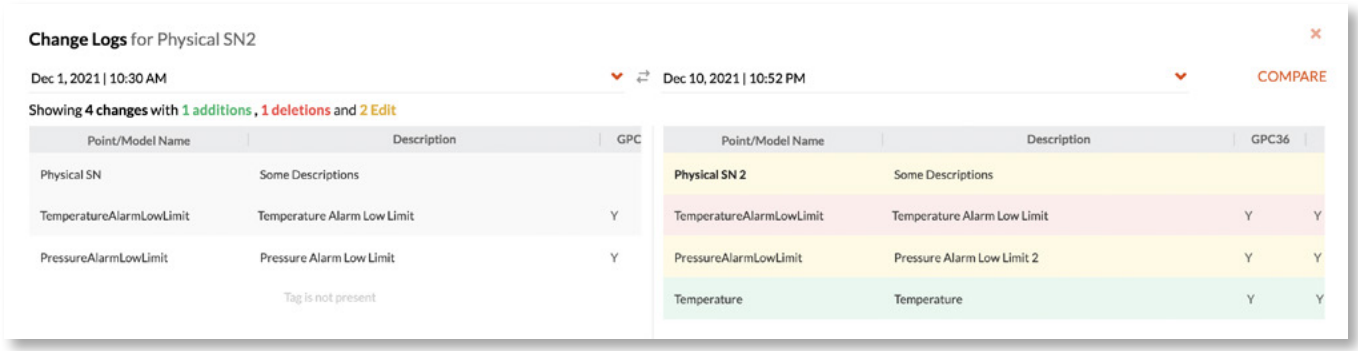


Figure 3. Adding Points.

Haystack Domain Modeler Features at a Glance

- A web-hosted portal that can be accessed by anyone in the Project Haystack community once they are confirmed users in the tool.
- Allows peer-reviewed base model definitions to be available as reference or download in standard file format (Trio, JSON, Excel and API). This lays the foundation for faster interoperability between various systems that use Project Haystack.
- Allows platform-level integrations with various strategic partners to be faster and more affordable with data model exchange following the same industry standardization.
- Version control and audit logs identify when a model was changed (or evolved) and by whom.

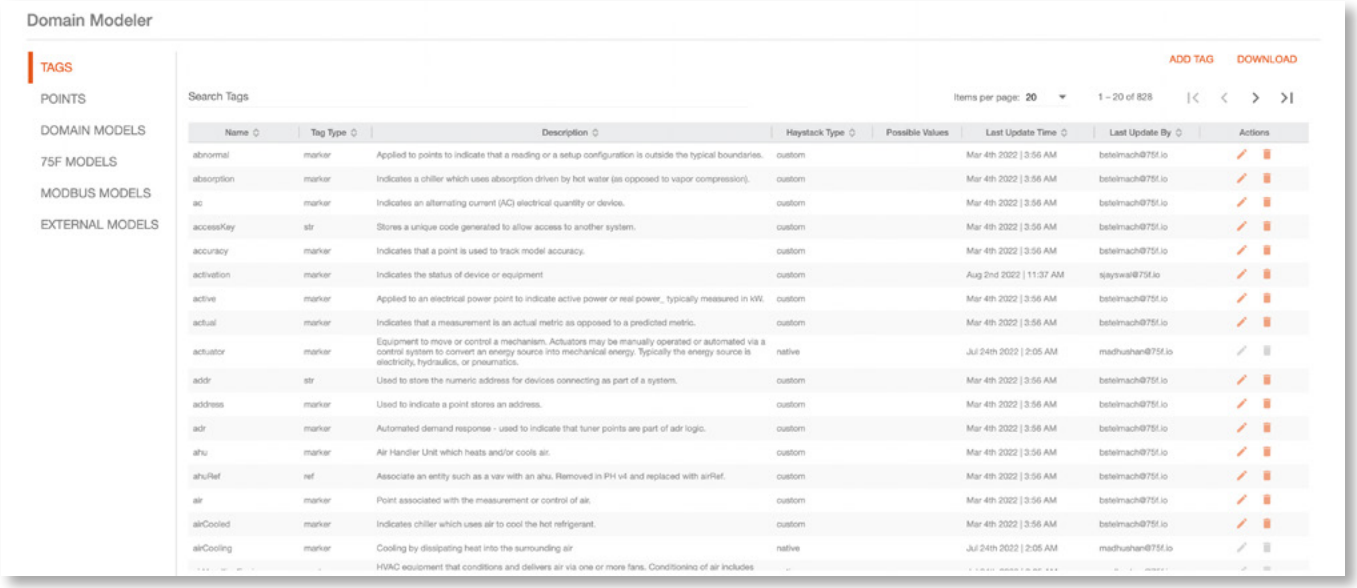


Figure 4. Domain Modeler Tags.

Conclusion

Project Haystack is a crucial foundation for making sense of buildings' overwhelming capability to generate data. The Haystack Domain Modeler aims to further this mission by:

- Presenting an opportunity to create peer-reviewed, plug-and-play digital twin models of equipment for custom applications, to be reused by anyone else in the industry.
- Creating a collaborative community that offers visibility into how other organizations are using Project Haystack.
- Ultimately enabling more efficient and affordable collaboration between IoT systems.

Finally, 75F asks for Project Haystack community members' help to make the Haystack Domain Modeler truly comprehensive. While our engineering teams have focused on HVAC equipment and applications, within this community is expertise in a wide range of building equipment and technologies. Come September, we invite you to contribute to this tool and help build a new context for modern buildings.

To help speed up adoption of Haystack, 75F and J2 are offering a free equipment modelling service to members. If members are not comfortable creating their own models, they can submit specific equipment details to a dedicated team that will create a model for the community.

Deepinder Singh co-founded 75F after designing some of the world's fastest core networks for service providers like AT&T, NTT and Verizon. With almost 25 years of experience in electronics and computing, he's brought a wealth of embedded products to the market. His goal in every endeavor is to simplify operational complexity and make products intuitive.

Shilpa Basappa is the Associate Director of Engineering at 75F. An accomplished engineering leader, product manager, and full-stack software developer, Shilpa has almost 20 years of experience in leadership and product development.

Making Technology More Accessible for Developers with Haystack Tagging

J2 INNOVATIONS
A Siemens Company

"With an increasing demand and more legislation for better building efficiency (not just energy but beyond), the demand for holistically integrated, and data driven building management and optimization has rapidly increased. To set the foundation for holistic building management and optimization, the starting point is a normalized, contextualized, and IT friendly data basis."

Making Haystack more accessible to developers is the best way to move our industry forward and solve the big challenges of our time. As a community, we need to get more developers interested in working with Haystack, and to do that, we need to make sure we're using standard, popular, well-known programming languages. At the same time, we need to continue to make smart building solutions that are easy for end users. In this article, I will share Haystack initiatives he has been leading to proliferate the standard, make it easier to use, and attract more developers to the community.

Accessibility is Key

In looking at the technology trends and the world's most popular programming languages, the working groups within the Haystack community have identified other ways to contribute to Project Haystack's accessibility. One such way has been by creating Haystack Core, an open-source software library written in TypeScript, that enables sophisticated applications to be built with ease and at speed. Haystack Core paves the way for a host of new solutions that can, for example, manage energy usage, and reduce carbon emissions while leveraging the latest technologies.

It is one of a number of libraries created by Project Haystack community Working Groups, of which Haystack Core is the core object model. There is also Haystack NClient, used for making Haystack-based network calls. Haystack React is used for building UI applications. There's also some useful TypeScript code generation tools used for working with Haystack metadata. Together, they make up a whole suite of software libraries that are all open source and documented on GitHub, making it easier for developers to pick up and use Haystack. It's this sharing of data and technology that enables the Haystack Community and its users to build forward.

Project Haystack is far more than just a tagging model or forum; there are source code and practical examples out there that are using the best breed of technology for the benefit of all. You know that saying, "A rising tide lifts all boats"? That's what the Project Haystack community is all about.

In 2020, J2 Innovations launched a new secure remote connectivity application called FIN Edge2Cloud, and this could not have been built without Project Haystack and the Haystack Core library as a foundation. In fact, all of J2 Innovation's new products use these open-source Haystack libraries. This is just one example of how the creation and use of open-source technology has allowed developers to build better products for their customers.

The Future of Haystack Technology

Members of an internal working group at J2 Innovations have recently made another major contribution to Project Haystack in a new library that will make Haystack accessible to even more developers: Rust.

The new Rust open-source library was created to expand the reach of developing software using project Haystack tagging. It complements the existing Haystack Core library which uses TypeScript and is geared towards more Cloud and Web centric applications - such as Web Applications and REST Services. The Rust implementation is well suited for embedded applications and will allow OEM vendors to create Haystack-based products in lower-level devices. For example, embedding a Haystack solution in a thermostat will now be possible utilizing the Rust services.

For the Love of the Industry

When you work in the building automation industry, you're not just exposed to one particular stack of technology, and you're not just making one thing, but something that touches so many different areas. This is why the openness of the Project Haystack standard is so important as it's not just one technology vendor ruling everything. Our future relies on developers being able to quickly and easily access the latest technology to start building Haystack solutions.

As a community and standard we are all building and contributing to meeting the huge challenges we face, including helping to solve climate change. What's not to love about that?

Download the Haystack Core Library.

Download the Rust Library.

Gareth Johnson is the Senior Cloud Architect for J2 Innovations. Gareth has been in the building automation industry for over 20 years and was formerly the Core Architect of Tridium's Niagara Framework.

The Role of Semantic Modeling in Implementing Digital Twins for the Built Environment

"Combining digital data that represents both the physical model of a building and the operational data produced by the equipment systems, sensors, meters, and devices that operate the facility is an essential requirement to achieve a digital twin. Normalization of that data into a common structure provides the basis for a range of digital twin applications."

One of the new technologies being applied in the built environment is referred to by the term "digital twin". The term conveys the concept of a digital representation of a facility presented in a software application. Representations can extend from the physical structure of a building to the operational data produced by the equipment systems and the energy and resource flows associated with those systems.

Perhaps the most familiar example of a digital twin is a 3D model of a building which allows a user to drill down into individual spaces showing the size and shape of the space, and even the finish materials and furnishings. The current state-of-the-art software takes those capabilities further to include live, operational data produced by sensors and equipment, e.g., space temperature, air quality, occupancy status, and energy resource use.

Bringing these diverse data sources together into a normalized data store or "layer" is a critical part of the process of implementing a digital twin.

Digital Twin – A Definition or Two

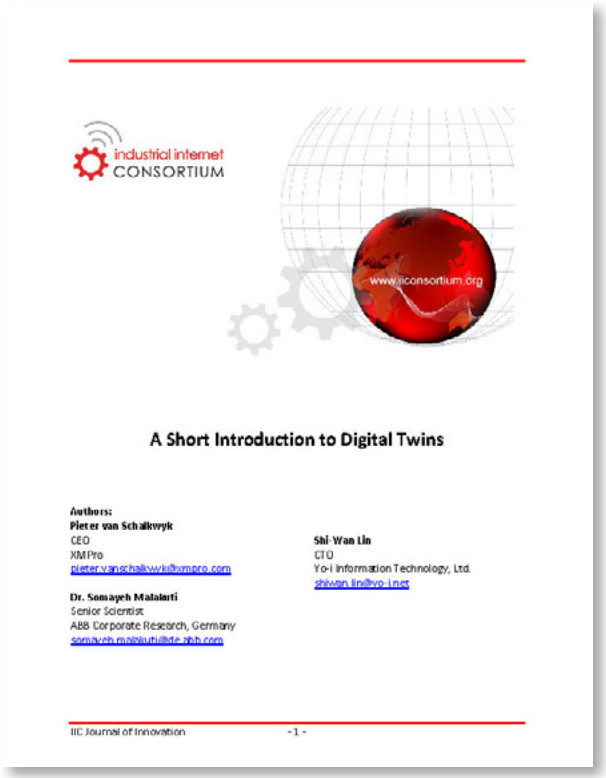
The Digital Twin Consortium™ offers this definition: A digital twin is a virtual representation of real-world entities and processes, synchronized at a specified frequency and fidelity. Source: www.digitaltwinconsortium.org.

"Bringing these diverse data sources together into a normalized data store or "layer" is a critical part of the process of implementing a digital twin."

The Industrial Internet Consortium (IIC) defines a digital twin as a formal digital representation of some asset,

process or system that captures attributes and behaviors of that entity suitable for communication, storage, interpretation, or processing within a certain context. The digital twin information includes, but is not limited to, combinations of the following categories:

- physics-based model and data
- analytical models and data
- time-series data and historians
- transactional data
- master data
- visual models
- computations



A-Short-Introduction-to-Digital-Twins

Combining Data from Diverse Systems and Sources

Combining digital data that represents both the physical model of a building and the operational data produced by the equipment systems, sensors, meters, and devices that operate the facility is an essential requirement to achieve a digital twin. Normalization of that data into a common structure provides the basis for a range of digital twin applications.

Even in modern buildings with "smart" devices, equipment systems are often siloed due to a variety of factors. Some examples:

- different systems use different protocols and data formats creating barriers to integration
- building automation system data is often not combined with utility rate data, which is essential to calculate actual energy costs
- in many cases, data comes from external websites via "web-services" requiring integration via API's (Application Programming Interfaces) –this involves some level of software development work, which can range from simple to complex
- software applications often utilize proprietary databases that do not provide documented "schemas" to describe the meaning of the source data in a standardized format, this creates a barrier to easily query and utilize data in other applications
- even the newest IoT devices and sensors are often "islands" with their own separate networks, user interfaces, communication protocols, and "closed" data repositories which are often available only via API's that require "pay to play" to access the data.

The reality is that no one system or data source has it all. To achieve a digital twin, we must combine data from diverse systems and contextualize it in a consistent manner so that it can be easily and reliably accessed by the applications that will provide the digital twin experience. To accomplish this goal, we need more than an aggregated storage repository that unstructured data is simply "poured" into, i.e., a "data lake". It is essential that the data combine descriptive "metadata" with the source data to provide the context to make it useful to other applications. This needs to be done using a standard metadata methodology that provides consistent, high-fidelity, semantic information that represents the meaning of the data.

A uniform method for applying metadata is an essential element of implementing a digital twin. For modeling of the physical attributes of a building, BIM is the industry standard. For modeling of the operational data associated with building equipment systems, Haystack is the most widely utilized standard. Deployed in over 40,000 facilities worldwide, Haystack enables the effective application of digital twins and other data-oriented applications needed to move the built environment forward to a more efficient and sustainable future

To learn more about Project Haustack, visit: **www.project-haystack.org**.

To learn more about the Digital Twin Consortium, visit: **www.digitaltwinconsortium.org.**

For more informaton about the Industrial Internet Consortium, visit: **www.iiconsortium.org**.

John Petze is a Co-Founder and Partner at SkyFoundry, a leading developer of software for analyzing smart facilities worldwide. SkyFoundry is a Founding Member of Project Haystack and John is an active member of the Board of Directors.

EV Charging Working Group Update

SkyFoundry

"There remains a challenge on how to cost effectively derive value from data generated from EV chargers. This is necessary to enable decision making that would lead to improved operational performance."

Countries across the globe have put together a roadmap to decarbonize our industries with the aim to preserve our beautiful planet for generations to come. Energy efficiency and electrification projects in buildings and other behind-the-meter applications have been in progress, which the Project Haystack community has actively contributed to over the past 10 years.

More recently the electrification of transportation has become fully underway and for the foreseeable future there is significant demand to deploy Electric Vehicle (EV) charging infrastructure required to recharge EVs. There remains a challenge on how to cost effectively derive value from data generated from EV chargers. This is necessary to enable decision making that would lead to improved operational performance.

Motivation

EV chargers are generally installed behind-the-meter and often within what is referred to as the built environment. Naturally Project Haystack offers a way for a site owner and their supporting organizations to streamline working with data generated from EV chargers and other equipment located behind-the-meter.

To be specific, Project Haystack's methodology for describing and interfacing with the referenced data ultimately would allow organizations deploying EV charging infrastructure opportunities to use that data to more effectively:

- Develop end-to-end EV charging solutions involving more than one single equipment type or manufacturer, software provider, or communication standard (i.e., BACnet, Modbus, MQTT, OCPP, OPC-UA, etc.)
- Coordinate schedulable loads to minimize Greenhouse Gas (GhG) emissions and electric utility costs while meeting other operational constraints
- Quantify harmonics generated on the customer's side of the point of common coupling to:
  - Associate with other data sources to find correlations
  - Compare to IEEE 519 and possible contract allowances
- Make associations between EV charging and other equipment data such as:
  - Opened/closed state of the circuit breaker directly feeding the EV charger and communication status with EV charger

    - Energy measurements from EV chargers and other site meters
    - Status of dry contacts on Surge Protection Devices and EV charger performance
- Define custom rules to calculate equipment Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR) metrics
- Perform monitoring, define custom rules to find events of interest, and calculate other key performance indicators
- Maintain high uptime for EV chargers at the lowest possible cost
- Select equipment with lowest anticipated total cost of ownership (TCO)
- Store asset and site records
- Share commonly understood datasets among team members and other organizations
- And more

Project Haystack brings opportunities to be creative using data to solve business challenges. From here is where the EV charger working group was born over the past several months!

Objective

The objective of the EV charger working group is to define the units, tags, and other metadata related to working with device data from Level 2 (AC) and Level 3 (DC) Electric Vehicle Supply Equipment (EVSE). Also, this working group will collaborate with the Labs Working group and look for opportunities to improve Project Haystack definitions for electric power distribution equipment.

Progress Report

The working group has recently formed and includes participants from around the world with various backgrounds in R&D, EV charger solutions, and building energy management systems.

There has been notable participation from members of this working group and others which has helped bring awareness to this initiative (in alphabetical order):

- Andy Abrams from EVauto offers a Niagara based EV fleet charge control system that bridges building and EV charging. As EV charging grows as a percentage building demand, analyzing usage will become critical to facility energy managers.
- Jan Široký (PhD) and the team at Energy Twin have performed work described in more detail in another article within this magazine related to EV charging strategy optimization
- Stephen Frank (PhD) is a researcher at NREL and has been very involved with this working group and other complementary working groups

There are others and I would like to thank everyone involved with this initiative for their contributions!

So far there has been one formal working group session where the below described draft equip model was the outcome. As an example, this diagram would indicate that an EV charging station that may charge up to two vehicles simultaneously would be modeled as having two EV chargers.

At the next working group session, tentatively scheduled for August 23, 2022, we plan to finalize the EV charger equip models and begin defining more model elements.

Stay tuned for more future updates! We continue to welcome anyone else who would like to participate in this working group. If you would like to participate in this working group, have any questions, or would like to learn more then please contact me directly.

Find our Working Group #987 at:
www.project-haystack.org/forum/wg.

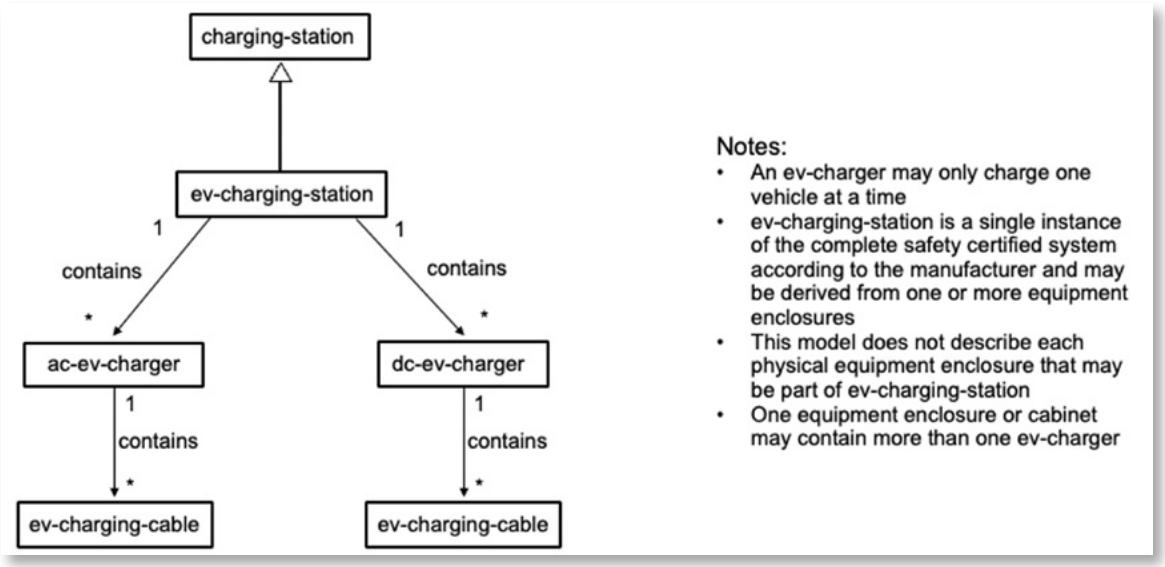


Figure 1. Draft UML Representation of EV Charger Equipment Model.

Rick Jennings, PE, is a Data Analytics Application Engineer at SkyFoundry and has nearly 10 years of electric power engineering experience involving nuclear propulsion systems, traction converters used in rail vehicles, data centers, and electric vehicle charging infrastructure.

VRF Working Group Update

"The VRF working group was initiated by a number of interested parties who did the initial work. I joined the working group in the latter stages to assist with the last little bits and challenges to close the loop, and I will be sharing my experience with you."

In this article I would like to give the readers an insight on the process of defining new entities within the Haystack semantic model. For this case, we will be looking at a VRF plant/system which we will go into further detail in the next section. We will be looking at the framework that Project Haystack provides and analyse what challenges lay ahead of growing a model that aims to enable the classification of the HVAC industry which in turn enables the new era of IoT.

As you may or may not know, the task of expanding the Project Haystack framework to accommodate the ever-growing new and old technology is generally undertaken by a working group (WG). A working group is a collection of individuals from diverse companies and backgrounds that volunteer to develop the Haystack Semantic model as a collaborative group. The VRF working group was initiated by a number of interested parties who did the initial work. I joined the working group in the latter stages to assist with the last little bits and challenges to close the loop, and I will be sharing my experience with you. Bear in mind that the current proposed solution is still in review and could ultimately be different in its final form.

What is a VRF System

The first step to be able to fit new equipment within the semantic model is to understand how it works and what its main components are. Note that a high-level understanding of the equipment is often sufficient and allows for a better general fit than to go in the nitty gritty and end up creating a too "fitted" model.

Variable Refrigerant Flow (VRF) is a HVAC technology invented by Daikin Industries, Ltd. in 1982 under the trademark VRV (Variable Refrigerant Volume). VRF systems are more complex versions of the ductless multi-split systems. They use refrigerant as the cooling and heating medium. This refrigerant is conditioned by one or more outdoor units and is circulated within the building to multiple indoor units.

The term Variable Refrigerant Flow refers to the ability of the system to vary and control the amount of refrigerant flowing to each of the indoor units. This variable flow is made possible using inverter compressors which allow the outdoor units to ramp up or down the refrigerant flow based on the needs within each individual space.

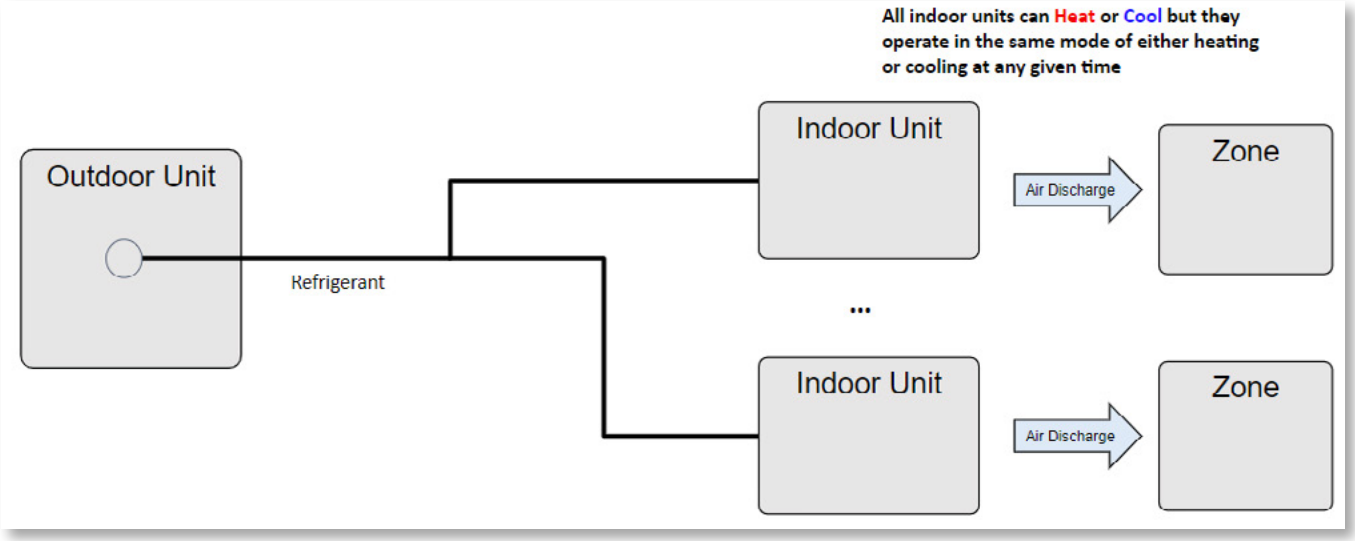


Figure 1. Simplified Diagram of a Heat Pump VRF..

There are 3 main types of VRFs: Cooling only, heat pump and heat recovery VRFs

Cooling-Only VRF: as the name indicates, it can only cool.

Heat Pump VRF: can reverse the refrigerant flow to provide heating. All indoor units connected to a heat pump system can use individual control and set points, but they operate in the same mode of either heating or cooling at any given time. (***Figure 1***)

Heat Recovery VRF: can provide simultaneous heating and cooling. All indoor units connected to a heat recovery system can not only can use individual control and set points, but they can also individually operate in heating or cooling mode at any given time with the help of branch selectors. (***Figure 2***)

Below are the main features we need to consider in our modelling:

- Refrigerant is the only material conducting heat
- Multiple indoor units per outdoor unit: multiple indoor units are connected to a single refrigerant circuit which can consist of one or more outdoor units.
- Ductless: VRF uses a complex system of refrigeration pipes

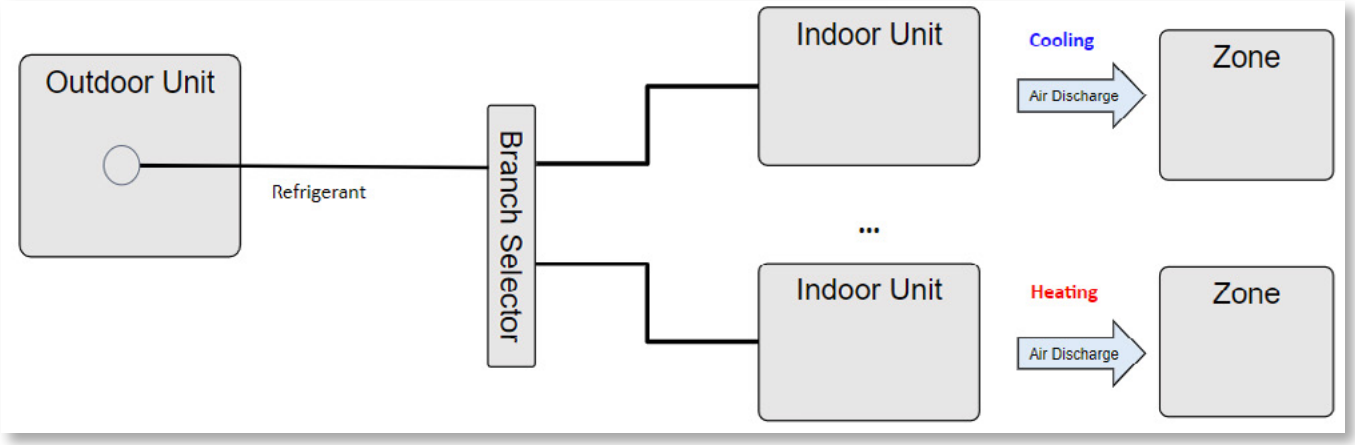


Figure 2. Simplified Diagram of a Heat Recovery VRF..

Understanding the Plant Layouts

Now that we understand the high-level functioning of VRFs, we need to get an understanding of the high-level plant configurations to enable us to fit this equipment model properly in the Haystack framework. Below are a number of diagrams exploring configurations.

In ***Figure 3*** we can see that, in terms of high-level configuration, the cooling-only and heat pump VRFs can be modelled in a similar fashion. The heat recovery VRF will need an extra equipment, being the branch selector, to show its configurations properly. Note that the refrigeration plant is used to group multiple outdoor units on a same refrigeration circuit.

Following elements can be discerned and will form the base of our further modelling.

- Outdoor units
- Indoor units
- VRF refrigerant plant
- Branch selectors

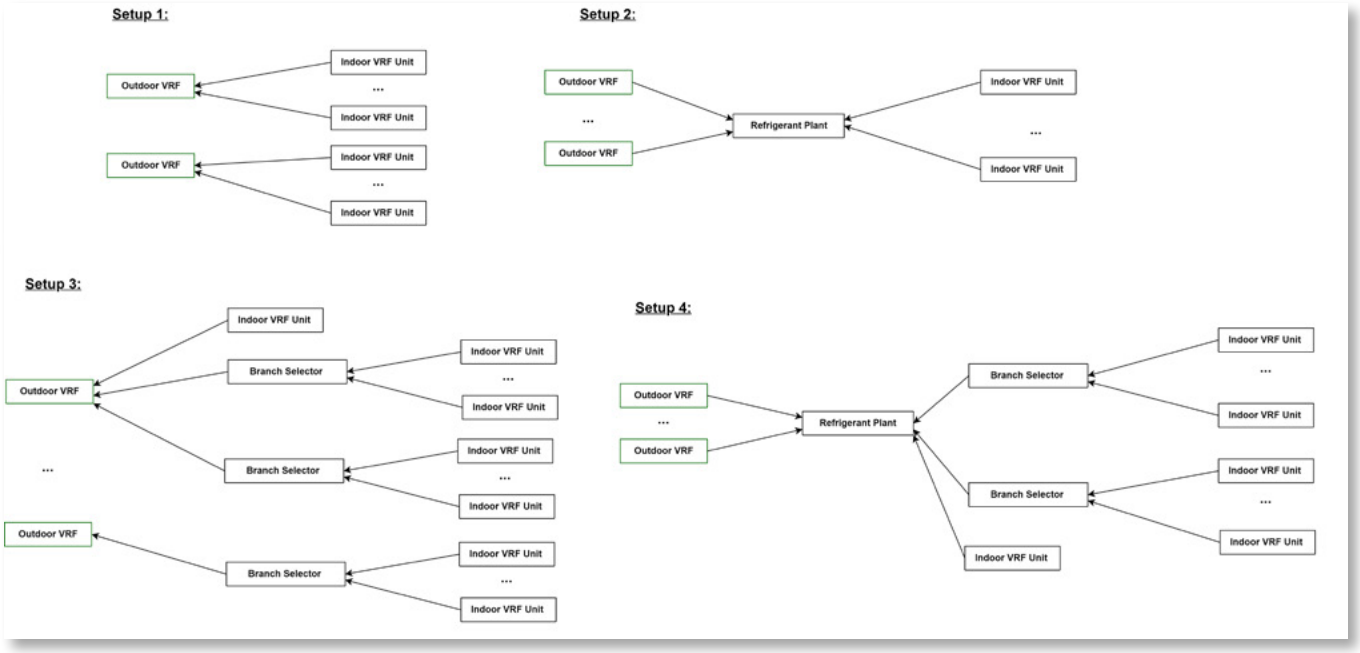


Figure 3. Plant Configuration Diagram.

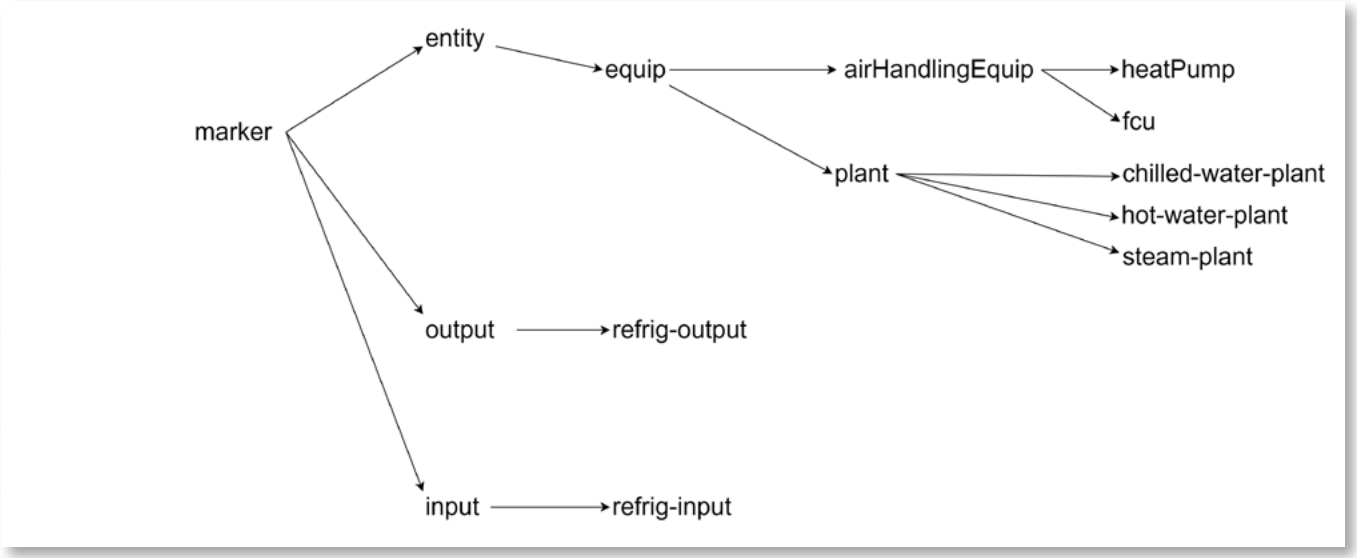


Figure 4. Current Taxonomy..

Haystack Taxonomy and How to Fit in New Equipment

How do we fit the VRF structure in the existing taxonomy?

To have a better view over the current Haystack taxonomy structure, in ***Figure 4***, I mapped it out so we can dig up the relevant elements to see how we can fit our new model more easily.

A few observations and remarks:

- As we know, there is a heat pump VRF type. Looking at the current Haystack structure we can see that the heat pump has already been defined as a type of air handling equip and will create an issue when defining the heat pump VRF.
- The current Project Haystack model does not have a refrigerant plant.
- Within the WG the idea was floated about the need of defining a new entity "system" to model a VRF system.

Current Solution Proposal

Figure 5 is the new taxonomy tree structure incorporating our proposed VRF model.

Let's dissect the diagram:

- As you can see, the heat pump has been removed from under the *airHandlingEquip* and placed under marker. The current heat pump definition would be replaced by a more generic one so that it can be used in our and other equipment models and the current *airhandlingEquip heatpump* would change to a more suitable name decided by the appropriate WG.
- We have added the following markers: *heatRecovery*, *indoorUnit* and *outdoorUnit*. Those will be needed to tag the VRF equipment correctly down the tree.
- The "system" entity is not used here. This so that we can remove the dependency of other WGs defining the new entity and aid the velocity of this proposal. And if it was to be added at a later stage, I believe it would not be very disruptive to the current structure.
- A new term, "*refrigerant plant*" has been added to accommodate plants with refrigerant only and a specific *vrf-refrig-plant* has been defined to enable to identify a group of outdoor units as the need for it was identified in the previous section.
- The 3 types of VRFs are defined as children of the *outdoorUnit*.

Lastly, in ***Figure 6***, each of the newly added terms will need to be defined by tags.

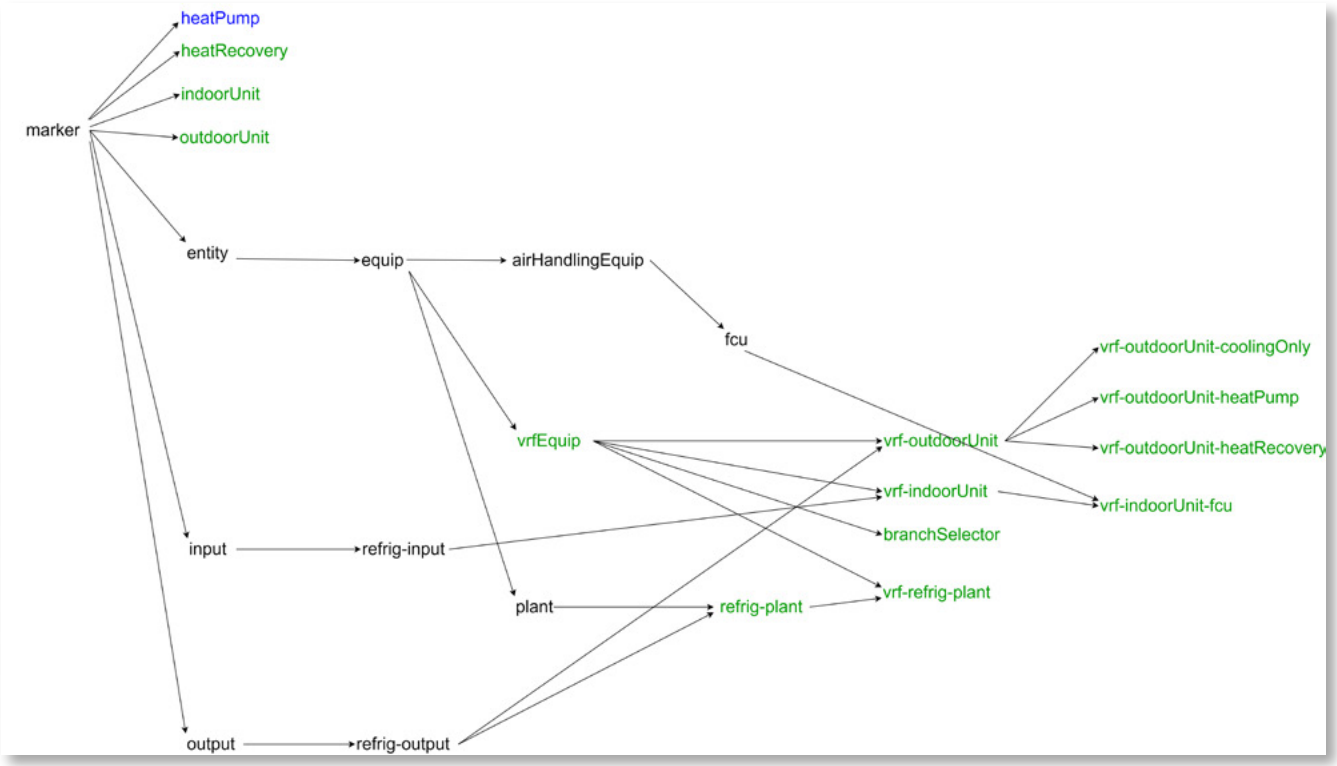


Figure 5. Proposed Taxonomy Changes..

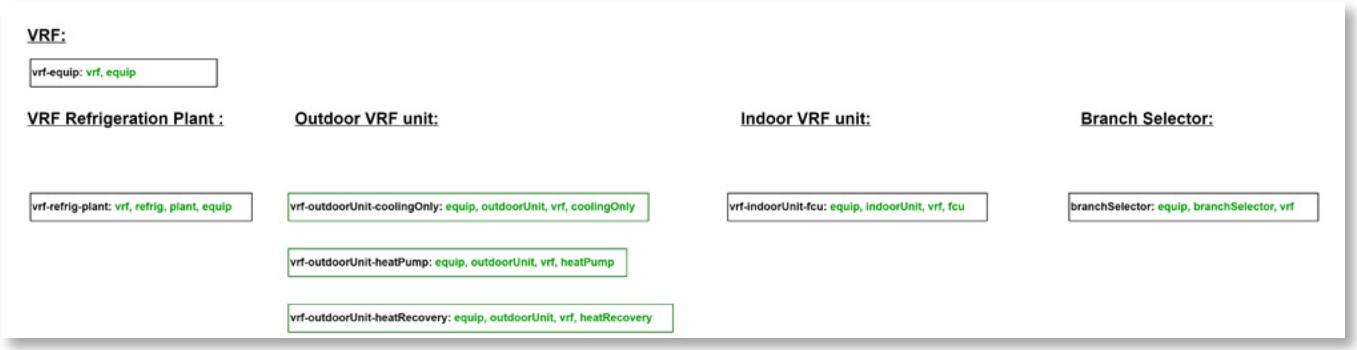


Figure 6. Tag Definitions.

Summary

Hopefully this article was able to provide an insight into the process of growing a semantic model aimed at making it easier to unlock value from the vast quantity of data in the HVAC industry and beyond. This process is important as it allows us to instrument and collect data about the energy usage of buildings and in turn, allow for analytic engines to provide valuable information such as:

- Early fault detection
- Preventative maintenance
- Root cause analytics
- Energy efficiency analytics

This ultimately contributes to the reduction in our carbon footprint.

Find our Working Group #916 at:
www.project-haystack.org/forum/wg

Michael Lakhdar is a Systems and Solutions R&D Engineer at Conserve It. Michael researches and tests new techniques and technologies to improve Conserve It's offerings, modeling equipment, and conducting energy-saving studies.

Tagging initiatives are made official by launching a Working Group with a defined proposal and good visibility. Join a WG now!

WG	Topic	Champion
#492	New Data Center Tag Working Group	Ron Snyder
#496	Lab/Fume Hood Working Group	Gabe Sandoval
#497	Chiller Plant Enhancements Working Group	Sean Stackhouse
#503	Access Security Working Group	Justin Tashker
#505	Refrigeration System Working Group	Nathan Rona
#506	Unitary Equipment Working Group	Eric Loew
#530	BIM/Haystack Working Group	Chris Renter
#595	Invitation to Project-Sandstar Working Group	Alper Üzmezler
#609	AHU Standing WG	Jay Herron
#667	Cybersecurity Working Group	F Gordy
#701	Data Center Tags	Jason Ganiatsas
#705	Lighting Systems WG	Jeremy Yon
#837	Haystack Labs Standing WG	Cory Mosiman
#916	VRF System WG	Yuya Saito
#982	Working Group for Level 2 AC and Level 3 DC EVSE	Rick Jennings

To learn more or to join a Working Group, visit https://project-haystack.org/forum/wg

Demand for Project Haystack participation is up at events around the world and community members have risen to the call.

Join the Project Haystack organization for Haystack Connect, where technologists and executives from smart buildings, smart cities, and the IoT talk about the value of data for increased asset and energy efficiency. Together, we will elaborate on the challenges of seamless data access and interoperability and how Project Haystack standard provides a solution.

Haystack Connect serves as a technical milestone for the dozens of working groups showcasing the progress they have made on the standard over the past year, as well as a milestone for industry leaders to review the benefits provided to the industry as a whole.

Taking place this fall, Haystack Connect 2022 is FREE for all attendees (registration required). The meeting kicks off with three consecutive days of programming September 13-15, followed by additional sessions on September 28, October 12 and November 9. Each 90-minute session, consisting of multiple speakers and presentations, will begin at 11:00 am and conclude at 12:30 pm ET.

Haystack Connect is organized and produced biennially by the Project Haystack Organization.

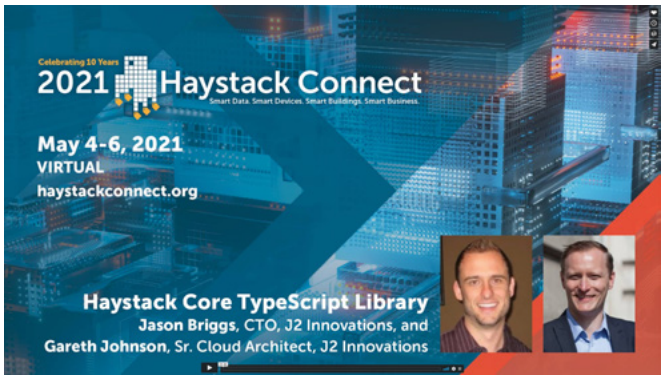
The event builds on the inspiration and mission of the community to address the challenges of making smart device data work seamlessly across applications of all types through the adoption of a standard approach to semantic modeling of equipment systems and their data.

Project Haystack has made registration for Haystack Connect 2022 FREE for all attendees.

And, for those who may have missed conferences in the past, all sessions and presentations were recorded and are available to view on Vimeo.


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Developer's View of Haystack 4
Brian Frank, Technical Lead, Project Haystack


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Haystack as Part of the
Solution to Climate Change
Omar Tabba, Vice President, Products & Solutions, BrainBox AI


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Haystack Core TypeScript Library
Jason Briggs, CTO, J2 Innovations, and
Gareth Johnson, Sr. Cloud Architect, J2 Innovations


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Ontology Alignment Project
Jon Schoenfeld, Director of Energy and Analytics, Buildings IOT


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Haxall – A New Haystack
Open Source Framework
Brian Frank, CEO and Founder, SkyFoundry


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Dynamic Integration in Digital Twins
Anto Budiardjo, CEO, Padi, Inc.


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Haystack in Practice –
Success Story for Coster Group
Alex Rohweder, CEO, J2 Innovations; Matteo Pierone,
Global Strategy Head & EMEA Professional Services Director,
J2 Innovations; Davide Manca, R&D Manager, Coster Group;
and Fabio Antoci, R&D Engineer, Coster Group


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Haystack in TwinWorX Digital Twins Solution
Eugene Woo, Chief Technology Officer, e-Magic Inc.


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Applying Haystack Tagging to Variable Refrigeration Systems
Yuya Saito, Associate, Innovation Program, Daikin Open Innovation Lab Silicon Valley (DSV)


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Applying Haystack 4 in a Residential Analytics and Control Application
Adam Wallen, Training Lead, SkyFoundry


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
WG#798 Haystack JSON Encoding
Gareth Johnson, Senior Cloud Architect, J2 Innovations, and Radu Racariu, Senior Programmer, J2 Innovations


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Haystack Benefits in the K-12 Education Market
Jamie Lee, Product Manager, Siemens Industry, Inc, and Steve Crowe, Integration Team Project Manager, Resolute Building Intelligence


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Haystack Labs: Prototyping Data Validation with Functional Point Groups and SHACL
Cory Mosiman, Software Engineer, PassiveLogic


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Analysis of Tagged Energy Data Via Machine Learning
Jan Široký, Head of Research Department, Energocentrum PLUS


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
PITCHFEST
Emma Eynon, Director, Fantom Factory
Anto Budiardjo, CEO, Padi, Inc.
Philippe Prados, Data Scientist/Architect, Engie Digital & OCTO Technology
Scott Muench, Vice President of Customer Experience, J2 Innovations
Jeremy Wolfe, Vice President Sales Americas, J2 Innovations
Jean-Simon Venne, Co-Founder and CTO, BrainBox AI
Shilpa Basappa, Associate Director of Engineering, 75F
Alper Üzmezler, Managing Partner, BAS Services & Graphics, LLC


Celebrating 10 Years
2021 Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.
May 4-6, 2021
VIRTUAL
haystackconnect.org
Tridium's Haystack Tag Dictionary
Eric Anderson, Niagara Software Engineer, Tridium

Haystack Connect
Smart Data. Smart Devices. Smart Buildings. Smart Business.

Past Conference Websites

Haystack Connect 2013
Haystack Connect 2015
Haystack Connect 2017
Haystack Connect 2019
Haystack Connect 2021

The Newest Associate Member Companies Joining the Mission

COSTER
PERSONAL AUTOMATION

For more than 50 years Coster Group has been designing and producing systems for the automation and energy efficiency in buildings.

They offer complete solutions, including wireless, for monitoring electrical, thermal and water energy and all the main environmental parameters for the efficient management of buildings and production processes.

Every automation system requires perfect integration with the actuators and measuring devices: valves, actuators, sensors, meters and metering devices. Coster Group offers a complete catalogue of field devices to meet any design requirement.

OPEN INTEGRATION

SIMPLICITY AND INTEGRATION

The Coster Groups WebGarage platform and devices feature WEB-based architectures, allowing customers to manage their systems fully remotely.

Based on Haystack standards, it supports and integrates the most widely used communication protocols.

WebGarage can be inserted at the controller level (Linux) and can run at the server level or in the cloud (window, Linux, or MacOSX). It guarantees computer security thanks to the remote connection that does not require a VPN.

To learn more aboaut the Coster Group, visit:
www.costergroup.eu

Intellienergy Tech® is an Italian company that designs and produces remote control and monitoring solutions and systems for smart buildings and smart cities.

Customer care, intuition and continuous research have led Intellienergy Tech® to become a leading Italian Company in the sector of Building Management Systems and Smart Lighting; its customers include some of the most important national and international groups dedicated to energy efficiency. Buildings in major Italian Cities are managed by Intellienergy Tech® systems, with over 25 thousand systems installed and over a million of control points.

Vision

Research is the driver of progress, the development of individuals and society as a whole.

When there is research and development, there is a company focused on its own present, on the market, opportunities, the future and past, determined to learn from mistakes (own ones and those made by others) and present itself every single day on the market, with new ideas and proposals that give it a competitive edge and improve its capacity for adaptation. Engaging in research and development requires inquisitiveness, the determination to give it your all, weigh up your strengths, believe in yourself and your resources. This is the vision of the founding shareholders of Intellienergy Tech® and its team, who profoundly believe that new knowledge can be concretely applied in everyday life and be useful for ensuring economic well-being and improving quality of life.

The ability to monitor air quality and environmental comfort is a fundamental step towards the improvement of facilities we occupy and interact in every single day, so as to save energy.

To learn more aboaut the Intellienergy Tech, visit: **www.intellienergy.it**.

Project Haystack Member Interview with SkyFoundry

With John Petze, Co-Founder and Partner, SkyFoundry

What is your involvement in Project Haystack?

As one of the Founding Members, SkyFoundry has been involved with Project Haystack from its inception in March 2011. Our work at SkyFoundry focusing on analytics for the built environment highlighted a critical need for a standardized approach for meta data to describe the data generated by equipment systems and smart devices. Initial conversations with industry participants resulted in the launch of Project.Haystack.org as an open source, community-driven initiative, and publication of the first generation of the Haystack standard, which was a consensus driven vocabulary of tags to be applied to equipment systems and their data.

How do you apply/use Haystack Tagging?

Haystack is the foundational data modelling approach utilized by our SkySpark software. SkySpark is designed to take in multi-structured data from diverse systems and devices and normalize it into a unified format for presentation, analytics and to deliver that data to other applications. The comprehensive implementation of Haystack throughout SkySpark makes this possible.

What challenges has Haystack helped you meet?

The reality is that most operational data produced by existing devices and equipment systems has poor semantic modelling - that means that a manual, labor-intensive process is required to add descriptive information to the data before value creation can begin. And with the explosion of new IoT sensors and devices we often find that there is no commonality in the way they provide data. Because SkySpark is used to bring together diverse data from a wide range of systems for analytics and fault detection, the normalization or "contextualization" of that data is a fundamental need, which we have chosen to address with a standard that is open to all.

What savings has using Haystack provided to you/your customers?

The process of applying analytics and other similar software applications requires that data have some level of semantic modelling to describe its meaning and its relationship to equipment and devices. Utilizing the Haystack standard means that the "data-description" effort is done once and thereafter the data can be used by other applications with minimal additional effort. This applies to adding new analytics rules and algorithms in our SkySpark software or enabling SkySpark to act as an "Independent Data Layer" to deliver that fully described data to other external applications. Implementing Haystack dramatically reduces the costs associated with analysing, visualizing, and deriving value from operational data.

What is your involvement in the wider Project Haystack community?

SkyFoundry's involvement started with the initial launch of the effort in 2011. At that time, we donated all of the work we had developed as a starting point for a standard meta data methodology including the initial vocabulary of tags. We recruited participants from around the world to join the effort. As the community developed, we helped established a formal 501C non-profit trade association and were initial members of the Board of Directors. We remain as a Board member and an active contributor to the continued advancement of the technology through participation in Working Groups, as well as educational and marketing efforts to drive awareness. SkyFoundry also contributes open-source tools that make it easier to implement Haystack in projects and products. One of the most recent contributions was the announcement of the Haxall.io project. Through Haxall, SkyFoundry has open-sourced proven software components that streamline development and reduce the cost of creating IoT devices for the built environment (BIoT). Haxall provides a full suite of Haystack APIs to model, encode, and query data using the Haystack 4 ontology. We believe this will directly help to accelerate the transition to data-driven, intelligent buildings. More information on the open-source Haxall initiative can be found at this link: https://haxall.io

What are your hopes for the future of Project Haystack?

The last decade has proven that a meta data standard is critical to the adoption of the IoT and smart building technologies. Haystack has proven is leadership both in technology, community participation and adoption in thousands of real-world projects. Just as the IoT is still growing and advancing and maturing, however, the work of the Haystack organization will continue. We see this in new Working Groups addressing applications like EV Charging, Variable Refrigeration Systems, GhG and Carbon reporting and others. And we see a strong desire by the marketplace for a single unified standard that brings together related efforts that have been initiated by other organizations tackling the need for meta data standards. Haystack continues to promote collaboration and unification of these efforts. Only by working together will we collectively achieve the future vision of "data that just works" across all systems and applications.

Project Haystack Member Interview with J2 Innovations

With Alex Rohweder, CEO, J2 Innovations

What is your involvement in Project Haystack?

As one of the Founding Members, J2 Innovations (J2) has been involved with Project Haystack from the beginning in 2011. As a start-up at the time, the J2 founders came together with others to create a not-for-profit association to develop an open and IoT friendly data standard for smart buildings, based on tagging.

How do you apply/use Haystack Tagging?

We utilize the Haystack tagging standard and data models in every aspect of our FIN Framework software platform and its Application Suites. The technology starts with normalising device data and creating relationships between devices in a Haystack-based database. The user experience and control logic are dynamically linked using tags as well. Applications such as commissioning, plug-n-play wizards, and apps around building management and analytics all are powered using tags.

What challenges has Haystack helped you meet?

The first challenge is that creating smart buildings and equipment is labor-intensive. Tagging makes the provisioning process faster and reduces implementation costs. Another challenge is that customers have too much data and it's difficult to make sense of this data to make improvements and create efficiency. By 'tagging' the data using the Haystack standard, partners and their customers can easily analyze, visualize, and get value from their operational data. Project Haystack based tagging is therefore a key ingredient of our technology FIN Framework.

What savings has using Haystack provided to you/your customers?

Semantic tagging saves time, money, and resources through a variety of means as described in our White Paper, The Strategy and Pay-offs of Metadata Tagging. One of the major benefits is that equipment graphics can be automatically generated, and control logic can automatically bind to equipment, dramatically reducing engineering effort and lowering the cost of intelligent building projects.

What is your involvement in the wider Project Haystack community?

Our involvement with the community started with participating on the Board of Directors and we continuously support and contribute to the Haystack Connect events and the magazine. We are also active through the community Working Groups. In addition, we contribute with open-source tools that make it easier for community members to leverage Haystack in their own products. Recently, we provided two open-source Haystack libraries, one based on Typescript, and one based on Rust.

What are your hopes for the future of Project Haystack?

With the 10-year anniversary of Project Haystack last year, the standard has flourished and J2 are proud to support and participate for the benefit of the industry, and ultimately for our planet. However, we believe that this is only the starting point of the Project Haystack journey; a key driver for future growth will be the increasing number of BMS, BAS and IoT products which are equipped off-the-shelf with Project Haystack based tagging to further proliferate cross product integration in buildings and related infrastructure.

The Project Haystack community develops and freely offers a range of reference implementations to enable product manufacturers and application developers to quickly implement Haystack tagging and communications in their products.

Wiki

Haystack Wiki: Source for docs, and tag definitions

Java

Haystack Java Toolkit: Light weight J2ME compliant client and server implementation

Niagara

nHaystack: New Updated Niagara module to add Haystack tagging and Niagara REST API for AX and N4

C++

Haystack CPP: C++ Haystack client and server implementation

DART

Haystack DART: Client library for Dart programming language

Node

Node Haystack: node.js client/server implementation

Python

pyHaystack: Python client implementation

Check out these documents and audio resources to quickly come up to speed on Project Haystack tagging benefits and the methodology.

Download — Detailed Reference Implementation Document. "Implementing Project Haystack: Applying Haystack Tagging for a Sample Building."

Download — Harbor Research White Paper with technical overview. Defines the concept of tags, breaking down and explaining the essential data elements.

Listen — Audio Stream of "Making Internet of Things Device Data Just Work!" a Memoori webinar featuring John Petze and Marc Petock on Project Haystack.

Open — REST API Description. Explains simple mechanism to exchange tagged data over web services

Download — Haystack Guide Specifications. Now available in English, French, Chinese, Japanese and Turkish.

Download — CABA White Paper that outlines how to use Haystack tagging in applications related to buildings, energy, and facility management.

Want to get involved in the Project Haystack open-source community? There are a number of ways and levels of involvement.

Contribute your expertise: Participate in the Project Haystack open forum discussions.

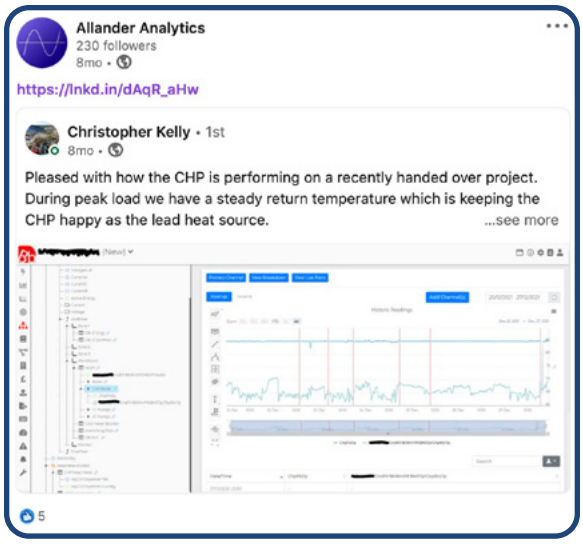
Join a Working Group: Project Haystack has members working together on developing tag sets and resolving other challenges related to particular topics. See the list of active Working Groups that you could join today here.

Become a Member: Project Haystack Corporate Associate Memberhip has many advantages. Email us to learn more at info@haystackconnect.org.

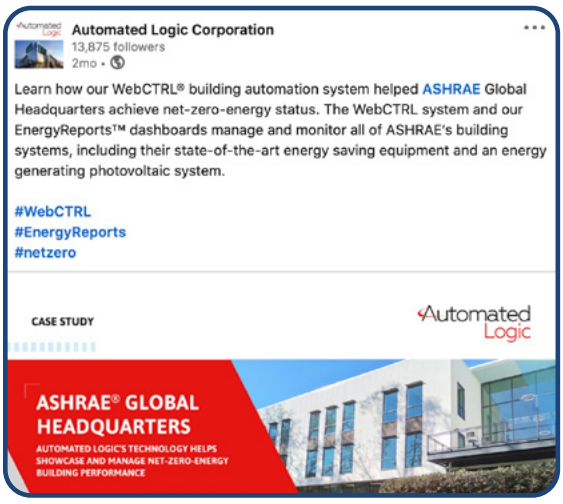
Social Media Curation

Here is some of the information shared by Project Haystack members on Facebook, Twitter and LinkedIn. Follow them to learn about Haystack-enabled recent projects, products and practices.

Projects

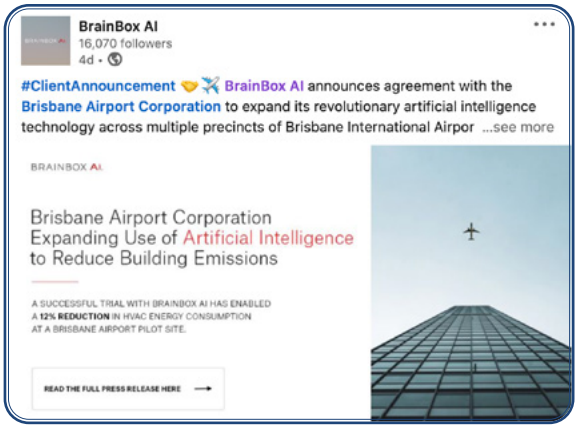


Helping to prevent Covid-19 in schools and save on building costs.



Helping ASHRAE Global HQ acheive net-zero energy status.

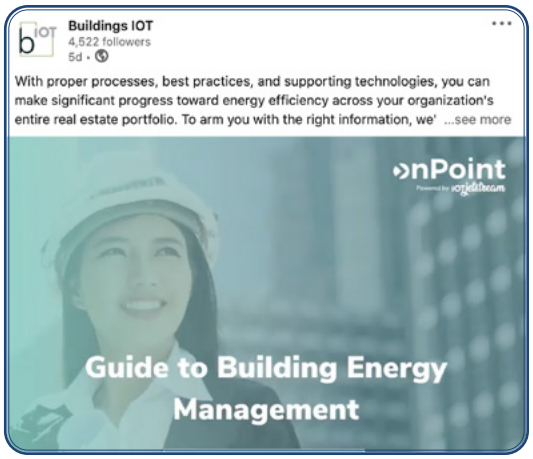
Completed a fifth major new construction project this summer.



Agreement announced to expand AI technology to reduce building emissions..

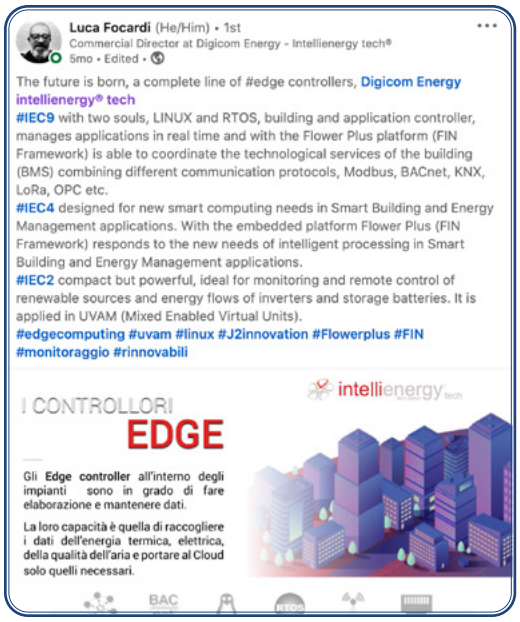
Their newest case study.

Practices

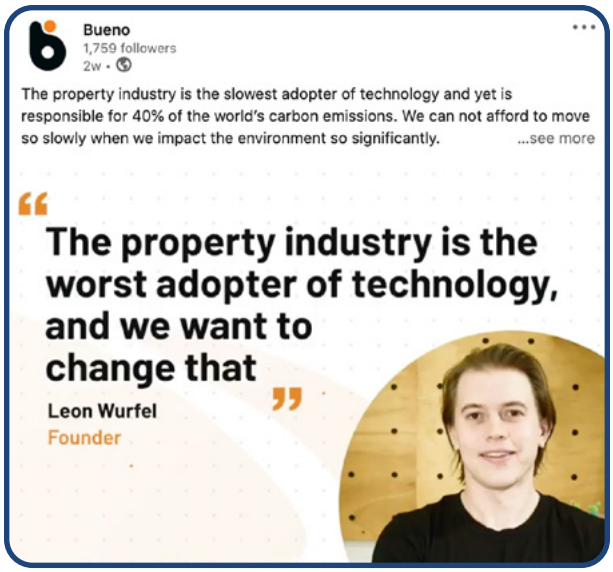


A guide to Building Energy Management.

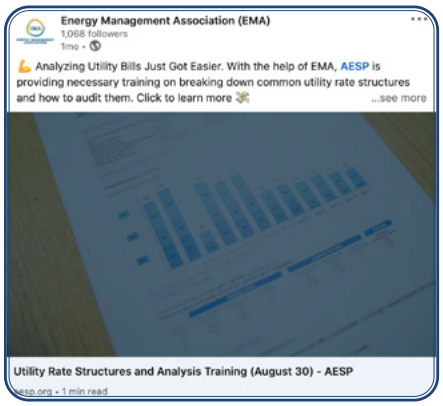
Legrand's ambition to reduce the environmental footprint of its products.



Changing edge computing.



Who's the slowest adopter of new technology?



Analyzing Utility Bills just got easier.

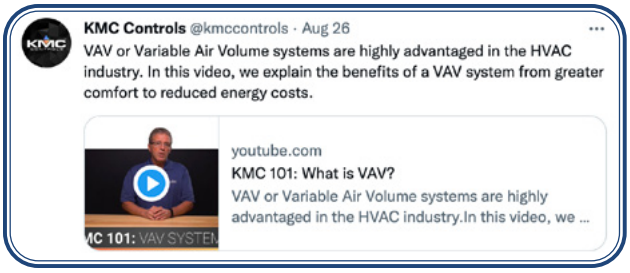
Products

Giving smart buildings a giant leap into the future.

Meet the new JENEsys Edge VAV Controller.

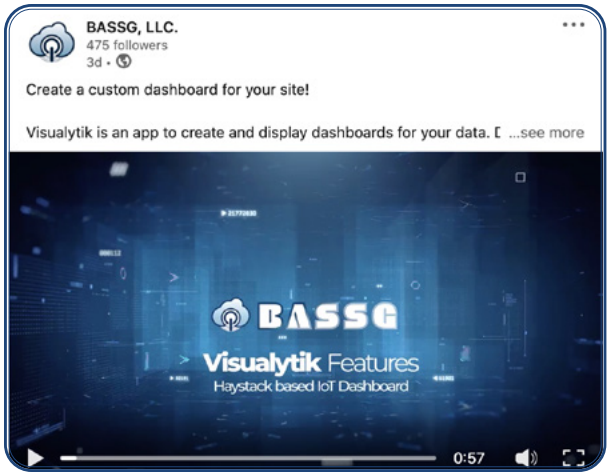
Take the Niagara 4 Advanced Technical Certification Program.

J2 Innovations joins forces with 75F.



The benefits of a VAV system from greater comfort to reduced energy costs.

Products

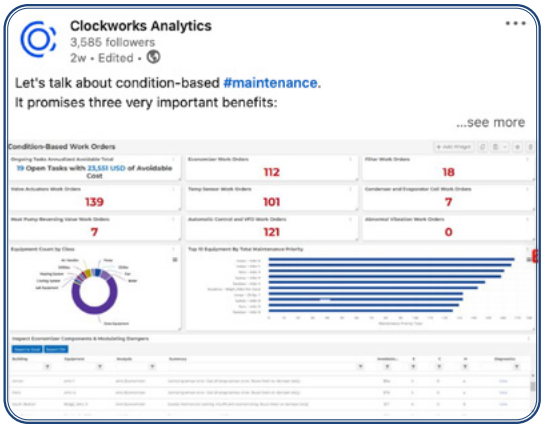


Create your own custom dashboard!

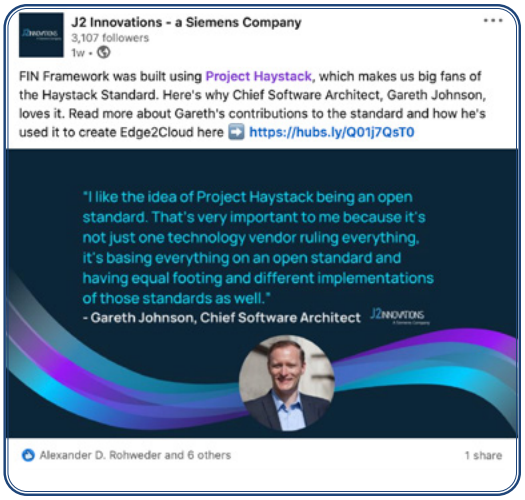
The CTRLSpecBuilder specification tool.

The Tosibox 500. Build your new IoT solution.

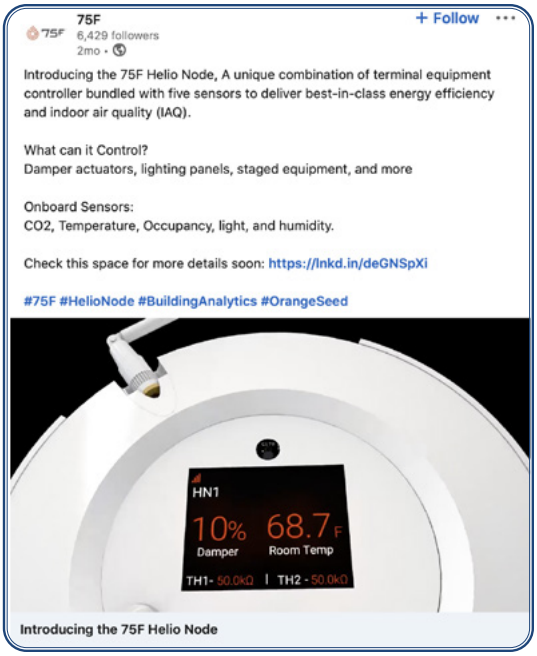
The new Wireless IP Interface for KNX.



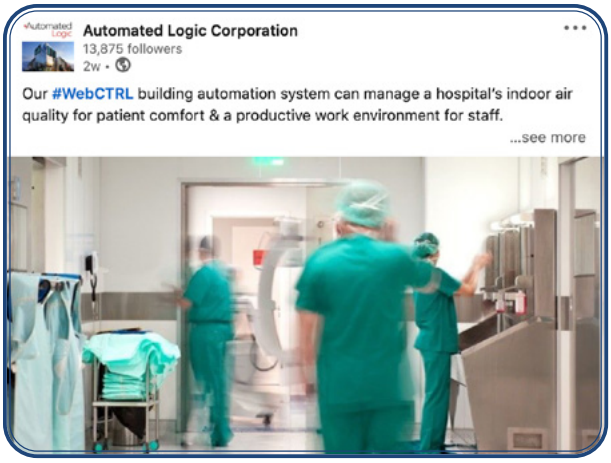
Now we're talking Condition-Based Maintenance.



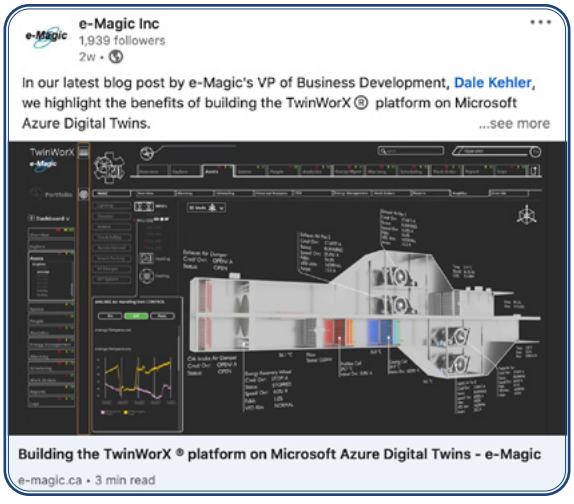
FIN Framework built using Project Haystack.



Say hello to the 75F Helio Node for better IAQ.

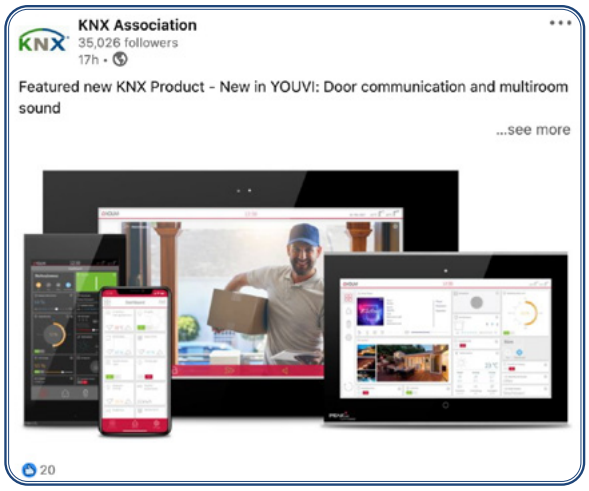


Their WebCTRL BAScan manage hospital IAQ for patient comfort.



Building the TwinWorX platform on Microsoft Azure Digital Twins.

In stock! Siemens Building Control Products.



New in YOUVI: Door communication and multiroom sound.

Project Haystack

connections

Become an Advertiser

The Project Haystack Connections Magazine advertising program is a cost-effective way for companies that provide complementary products and services to reach the growing and dynamic Project Haystack Community. This community is at the very forefront of intelligent buildings and the IoT. Haystack Connections is a premier advertising vehicle to reach this prime audience. With 8,000+ known readers, it is an incredibly cost-effective advertising opportunity. For rate info, email: **robin@haystackconnect.org**.

Members

Founding Members

CLOCKWORKS ANALYTICS

The Clockworks Analytics HVAC Fault Detection and Diagnostics (FDD) platform plugs into existing BMS and metering systems and analyzes thousands of data points to prioritize the building issues related to energy performance, indoor air quality and equipment operation. Our unique information model goes beyond simple fault detection by identifying the relationships between issues, diagnosing the root cause, and providing clear recommended actions. Clockworks' analytics-based monitoring allows you to proactively address building health issues, save energy and avoid reactive failures tomorrow.

Conserve It

Conserve It was founded in 2007 with a focus on centrifugal chiller efficiency systems. Over time it has diversified into complete HVAC&R plant management including monitoring, reporting and controls, energy performance contracting, energy management consulting and distribution of industrial and building automtion products and sensors from leading international suppliers worldwide. Conserve It provides a range of unique products and services in this area.

J2 INNOVATIONS
A Siemens Company

J2 Innovations are creators of FIN Framework, a next-generation software framework for smart buildings, smart equipment and IoT applications. Natively based on Haystack tagging, FIN can integrate, control, manage, analyze, visualize, connect, and can be embedded on a controller, gateway, HMI or server. FIN Framework offers OEMs, System Integrators, and end user solutions that are faster, easier, and better.

legrand®

As a leader in electrical and digital infrastructure solutions for all types of buildings, Legrand helps enhance everyday life for its customers. Legrand's Eliot program (Electricity and IoT) is speeding the deployment of Legrand's connected devices and accelerating the evolution of connected buildings. Eliot is powering development of new Legrand products for the benefit of private and professional users alike.

LYNXSPRING®

Embracing open software and hardware platforms, Lynxspring develops and manufactures innovative edge-to-enterprise solutions. We enable better building automation, better energy management systems, better control systems and specialty machine-to-machine and IoT applications. Deployed in billions of square feet of commercial buildings across North America and beyond, Lynxspring's smart solutions simplify integration and interoperability, and help connect your smart building's data.

Founding Members

SIEMENS

Siemens Smart Infrastructure transforms building productivity, comfort, and energy efficiency. We change how people live and work with solutions that deliver the highest level of comfort, safety, and energy efficiency in an intelligent way. Siemens delivers solutions for buildings of all sizes and complexities to make smart buildings real.

SkyFoundry

SkyFoundry's mission is to provide software solutions for the age of the "Internet of Things". Areas of focus include building automation and facility management, energy management, utility data analytics, remote device and equipment monitoring, and asset management. SkyFoundry products help customers derive value from their investments in smart systems.

Associate Members

75F designs and manufactures the world's leading IoT Building Management System, an out-of-the-box, vertically-integrated solution that is more affordable and easier to deploy than anything on the market today. The company leverages IoT, Cloud Computing, and Machine Learning for data-driven, proactive building intelligence and controls for HVAC optimization. 75F's mission is to improve occupant productivity through enhanced comfort and indoor air quality — all while saving energy.

Accu-Temp Systems is committed to delivering safe, comfortable environments for its customers. It leverages tools like secure mobile devices, cloud computing and advanced analytics. It offers systems integration services that help building owners protect their investment in existing direct digital controls, extending their useful lifetime while enjoying next-generation access and control.

Allander Analytics designs and develops industry-leading energy management and data visualization software. Our Building Book platform enables users to model, analyze and report on the energy consumption of their buildings. Using the latest technologies and the power of the cloud, we provide real-time analytics alerting customers to anomalies and opportunities within their data.

Altura Associates is a professional services firm that goes beyond the traditional consulting model. Our team works closely with our client organizations to develop programs that offer immediate and lasting impacts, build capacity, and drive long-term value. The team combines expertise in mechanical/electrical engineering, energy management, environmental science, and financial analysis.

Automated Logic is a global provider of high-performance, integrated building management solutions that make buildings smarter, more energy efficient, and more comfortable. Automated Logic's worldwide network of authorized partners includes over 230 field offices, with proven experience in building automation, energy management, and controls. It is also part of Carrier Global Corporation (NYSE: CARR), a leading global provider of healthy, safe, and sustainable building and cold chain solutions.

BASSG is an innovator in building automation technology and BAS analytics delivery. Its BASSG branded in-house developed easy-to-deploy, multi-system software tools reduce BAS implementation and facility management energy costs. BASSG also has multiple distributorships and can be a one-stop provider for everything-BAS at unbeatable value.

Associate Members

BRAINBOX AI

BrainBox AI is at the forefront of the green building revolution with its unique technology combining artificial intelligence and cloud computing to create a fully autonomous commercial HVAC solution. BrainBox AI overlays deep learning algorithms on existing HVAC functionality to automate the modulation of each component, reducing a building's total energy spend by up to 25% while improving occupant comfort by 60%. The solution leverages AI to predict building energy consumption at a very granular level and enables our autonomous HVAC system to operate the building pre-emptively.

bueno
Built Environment Optimisation

BUENO Systems is the Australian leader in data and information driven operational property services. BUENO delivers superior data related and technology driven services based on fault detection, optimization and business intelligence that simplify their clients operations and enhance their effectiveness across all building sectors and building information systems.

BERNHARD CONNECT

BuildingFit creates unique solutions for clients to ensure a proper fit between SkySpark® and their team. We do this through site construction, analytics, custom programming, SkySpark® Apps, reports, training, SkySpark® Licensing. BuildingFit is a SkyFoundry endorsed SkySpark Essentials provider.

buildingsIOT

At Buildings IOT, we're changing the way the built environment understands, reacts and adapts through technology. Our software and services increase the longevity of building assets, improve the comfort of building occupants and help building owners achieve greater efficiency. We develop and deploy cloud-based building analytics software, we implement complex Integrated Building Management Systems, we design and install controls systems, we maintain building assets and we provide IT managed services. We excel at all of our efforts because we know buildings.

COSTER
PERSONAL AUTOMATION

Coster Group offers the best for efficient management of building systems: from controllers for heating plants to the development of "custom-made" BMS. Our approach has always been to integrate technologies and building management to ensure an efficient, and at the same time, healthy living environment without ever sacrificing the simplistic use of our systems. Our in-house R&D team enables us to respond quickly to market demands for innovation. We can proudly say that we are among the companies most actively supporting the transition to sustainable and environmentally friendly buildings in accordance with the 2030 Agenda.

CABA™
Continental Automated Buildings Association

The Continental Automated Buildings Association is an international not-for-profit industry association dedicated to the advancement of integrated technologies for homes and buildings. The organization supported by an international membership of over 300 organizations involved in the design, manufacture, installation and retailing of products relating to home and building automation.

Associate Members

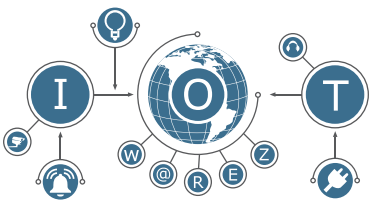
e-Magic Inc. specializes in providing expertise and software for the design, development, and integration of large scale industrial IoT and Azure Digital Twins solutions globally Applications include Centralized Operations, Smart Buildings, Facilities and Cities, Smart Manufacturing, Industrial production and AI for prediction and optimization. Our solutions have been installed in a wide range of industrial sectors including: buildings, facilities, manufacturing, utilities, mining and metals, cement, oil and gas, food and beverage, chemical, petrochemical and pulp and paper.

EMA is a trade association dedicated to providing education, training, and certification in the field of building and facility energy efficiency. Its Energy Management Professional certification (EMP) has achieved accreditation by ANSI and is recognized by the Department of Energy's Better Buildings Workforce® program.

Intellastar Technology is at the Intersection of Smart Buildings and Smart Grid. The InferStack Software Platform is deployed in Servers and T-Star Field Devices, communicates over Intellastar Connect Cellular Data Service, to provide a complete technology to deliver Smart Buildings and Smart Grid solutions.InferStack connects to the in-building systems to provide Energy Monitoring and Analysis, Analytics for Fault Detection and Diagnostic, Control for Plant Optimization--all features to make a smart building and reduce energy consumption and waste.

Intellienergy Tech® is an Italian company that designs and produces remote control and monitoring solutions and systems for smart buildings and smart cities. Customer care, intuition and continuous research have led Intellienergy Tech® to become a leading Italian Company in the sector of Building Management Systems and Smart Lighting; its customers include some of the most important national and international groups dedicated to energy efficiency. Buildings in major Italian Cities are managed by Intellienergy Tech® systems, with over 25 thousand systems installed and over a million of control points.

Intelligent Buildings, a nationally recognized smart real estate advisory services company, provides planning and implementation of next generation strategy for new buildings, existing portfolios and smart communities. Their work includes "The Smartest Building in America", the largest energy analytics project in North America, the smart buildings standards for the U.S. and Canadian governments, conception and management of a Clinton Global Initiative and the recently released Intelligent Buildings CyberSafe service.



IoT Warez develops custom software that helps technologies communicate together. From state of the art data centers to environmentally conscious facilities, our software development team is capable of building solutions that connect anything and everything. IoT Warez offers a suite of hosted software options that provide customized solutions. Our platform-as-a-service connects multiple brands of software into one platform that can be remotely managed from a smart device.

Associate Members

KMC Control is an American manufacturer of open, secure, and scalable building automation solutions. From secure hardware devices to smart and connected software, KMC delivers embedded intelligence and optimized control.. It is committed to providing industry-leading Internet of Things-enabled automation solutions with leading tech suppliers to increase comfort, convenience and to help reduce energy usage.

KNX Association represents KNX technology now used in applications for lighting and blind control, security systems, HVAC, monitoring, alarming, water control, energy management, smart metering as well as household appliances, audio/video and more. KNX provides a single, manufacturer-independent design and commissioning tool (ETS), with a complete set of supported communication media and configuration modes. It is approved as a European and an International standard.

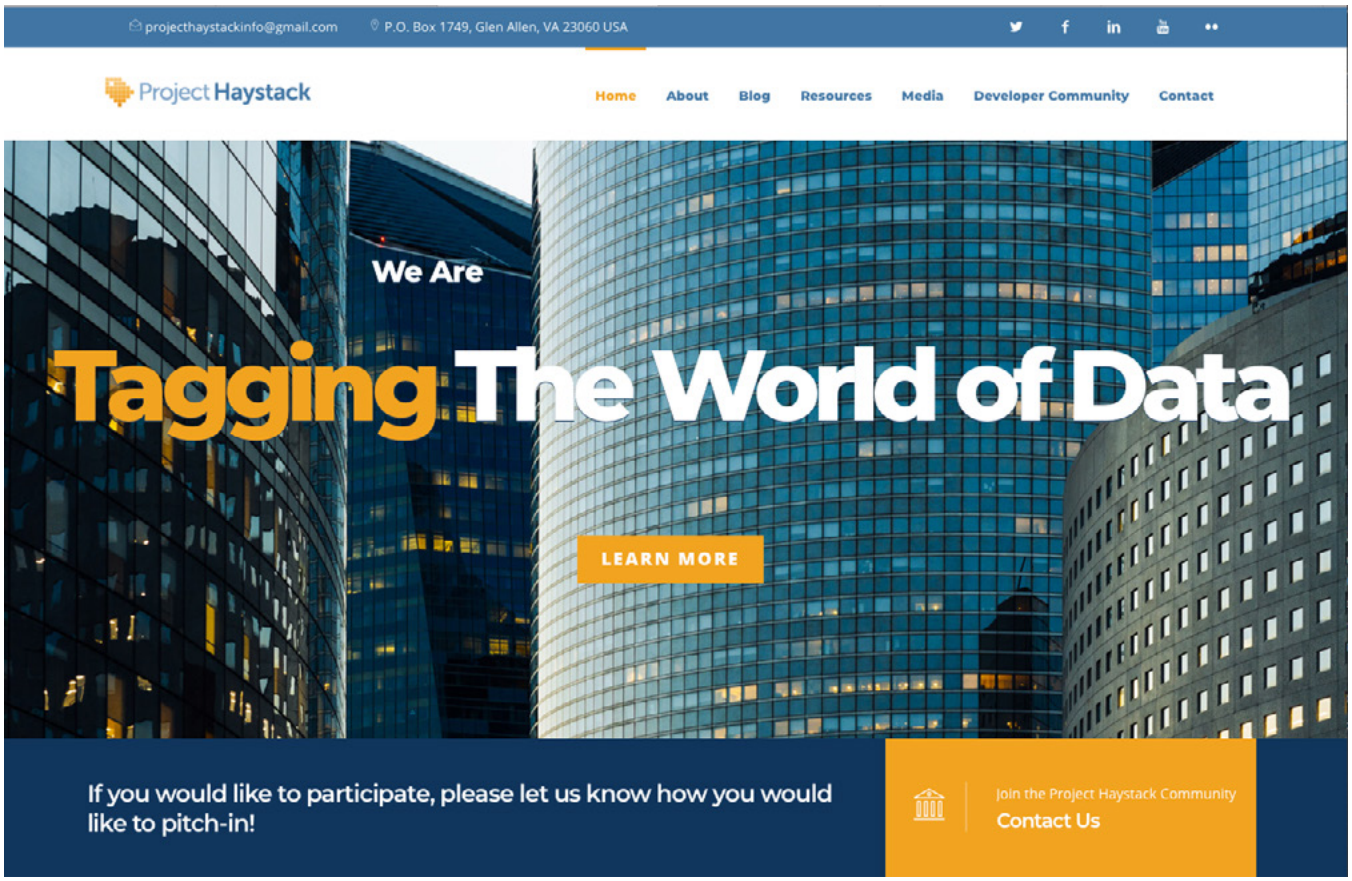
Technology and big data are transforming the way the world lives, works and plays. But building management hasn't changed; it's still riddled with archaic spreadsheets, inaccessible data, clunky architecture and silos. It's time to improve the way we manage buildings. Switch Automation is leading that charge. Our smart building Platform combines deep insight and robust tools that help you monitor, benchmark and optimize building performance.

Tridium is a world leader in business application frameworks - advancing truly open environments that harness the power of the Internet of Things. Our innovations have fundamentally changed the way people connect and control devices and systems. Our products allow people and machines to communicate and collaborate like never before. They empower manufacturers to develop intelligent equipment systems and smart devices for enterprise and edge assets.

Through the implementation of WideSky®, we aim to unlock the value of your energy, environmental and building data. Our scalable, intelligent solutions can improve profits and sustainability of your business. The qualified and experienced WideSky team has decades of operational and information technology experience. Coupled with our partner network, we can implement future-proofed, well-supported solutions tailored to your business on a global scale.

Yorkland Controls has roots in distributing and warehousing heating control products such as Flame Safeguard and Burner and Boiler Management Systems, and has expanded into new markets including Building Automation, Lighting, Security and Energy Services. It works to promote the advantages of controls to the industries and markets that it serves and to demystify available technology for its customers.

For all the latest Project Haystack marketing activities visit marketing.project-haystack.org.



Project Haystack

www.project-haystack.org