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ConnectorIO Building Management System

ConnectorIO vs. Traditional BMS

Summary

This document answers the following frequently asked questions about the solution provided by **ConnectorIO** and compares it to traditional building management systems found in **commercial** and **industrial properties**.

What you will learn?

1. What is a building management system (BMS) and how an efficient BMS could help increase the building's sustainability?
2. What are the technical and organizational challenges created by traditional BMS systems?
3. How ConnectorIO answers these challenges, how it compares to a traditional solution?
4. What are the technical differences between ConnectorIO and a traditional BMS?
5. What exactly is ConnectorIO, how it's built, what it needs to run, how much does it cost?
6. What advantages can you get from investing in the ConnectorIO solution instead of a typical BMS system and infrastructure required by it?
7. And you will learn more about us - the ConnectorIO company.

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Introduction to Building Management Systems

Building Management Systems are computer-based control systems that are used in buildings to collect data from the technical systems, such as heating, ventilation, air-conditioning (HVAC), lighting and so on.

BMS installation

Building Management Systems usually control the technical systems within the building by executing a set of preset schedules. For example: switching the lights off between 8 PM and 6 AM. The **more sophisticated** control is needed, the more **complex schedules** have to be.

The BMS system has to be **tuned** for the maximal performance **during the commissioning** of the system. This process requires the physical presence of multiple parties:

- **vendors** responsible for the installation of each mechanical or electrical device that has to be plugged into the BMS,
- BMS **operators** and/or **programmers** for fine-tuning the system.
- the **tenant**'s representatives (eg. project managers from the **facility management** team).

The next phase is **fine-tuning** of the BMS system to adjust to **equipment changes** (eg. when different air-conditioning equipment is being installed or a floor need to be renovated and the occupants are being **relocated** to different rooms).

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What is the #1 challenge in all buildings right now?

The most important challenge in the coming years will be **improving the commercial and industrial building's sustainability by reducing their overall energy consumption**.

How the #1 goal can this be achieved?

1. Covering the buildings in **plants**.

2. Reducing the building's **energy consumption**.

We focus on the latter and here's why:
- there's a lot about the modern building's technical systems that could be **improved**.

Systems linked to a BMS, especially HVAC and lighting can represent **up to 70%** of the building's **energy consumption**.

According to Wikipedia:

*"Building management systems are most commonly implemented in large projects with extensive mechanical, HVAC, and electrical systems. Systems linked to a BMS typically **represent 40% of a building's energy usage; if lighting is included, this number approaches to 70%**. BMS systems are a critical component to managing energy demand. Improperly configured BMS systems are believed to account for 20% of building energy usage, or approximately 8% of total energy usage in the United States." (source: Wikipedia)*

Hence the need to optimize the energy usage of these systems is crucial to save money on energy bills and reduce the building's **environmental footprint** by lowering its **CO_2 emissions**.

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Typical BMS Problems and Challenges

Optimizing and keeping a BMS system **up-to-date** is a key challenge to make **energy savings** and adapt to changes which usually occur in time (climate changes, office occupancy changes, floor rearrangements, and renovations, system maintenance staff availability).

There is a constant demand for better system's tweaking but it is impossible without a **two-way communication** between the devices and one **centralized BMS solution** which can aggregate data from all major mechanical/electrical devices.

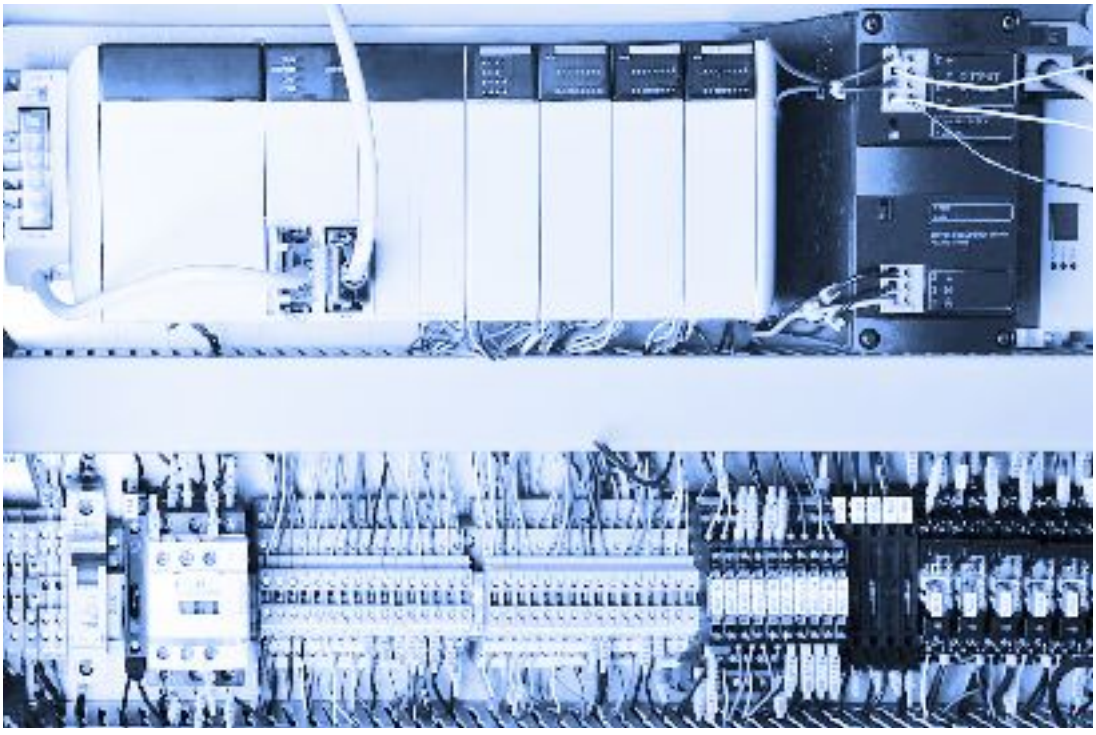
For the **technical property/facility management** team the following challenges related to the effective use of the building management system will arise over time.

The BMS Operator's and Manager's challenges:

- ➔ Project management challenge:
  - to design procedures allowing to **adapt quickly and effectively to changes** in space usage and changes in technical elements of the technology eco-system.
- ➔ System sustainability challenge:
  - to provide an **ongoing system optimization** as the tenants, building staff, and climate all change over time.
- ➔ Big data analysis (system complexity tracking) challenge:
  - to be able to **account for changes** in a complex property such as a commercial or industrial building with multiple floors, zones, and devices;
  - to **track** as many factors as possible at once and **visualize** all this data in one place, eg. tracking one parameter such as the temperature is not enough, you have to be able to track temperature, humidity, A/C flow and possibly external weather conditions all at once to optimize the building's energy consumption.
- ➔ System maintenance challenge:
  - to establish the simplest possible **change management** procedures which do not require multiple parties to be present in one physical place at the same time;
  - to **record the statuses** of the equipment and any alterations that are made to the BMS;
  - to **track changes** and **re-evaluate the results** after a certain period of time for further tuning and optimization.

Real-life problems:

- The BMS schedules are usually rarely updated and remain based on the floor arrangement and occupancy patterns at the time of the commissioning.
- No easy method for verifying the BMS schedules effectiveness exists, unless the data from all systems could be aggregated in one place and visualized.
- Operators might be overly conservative while programming the BMS.
- Maintenance periods may alter the BMS's original parameters and cause the system to deviate from its optimal settings.
- The climate changes and the floor occupancy also changes over time - usually every two years a major change occurs.
- The BMS is usually not directly accessible by the Tenant (it might be located in the basement of a multi-storey building with restricted access).
- Altering the BMS settings requires **qualified technician's assistance** and involves **costs** which cannot be directly justified (as no system efficiency tracking is available).
- Usually, the records of changes within the BMS system parameters are kept by the technician/operator and not recorded elsewhere. No tracking for this data is available.
- Blurred control over the data expiration schedules – **how much data** is actually **stored**?



A modern electric cabinet allowing energy consumption metering.

Traditional BMS infrastructure and its limitations

Traditional Building Management System architecture limitations

Infrastructure element	Traditional Building Automation System architecture
Point-to-Point connections	Executed using hardware gateways + programming in a “static” manner.
Gateways	
Basic gateways (system couplers)	- $$$ expensive (hundreds EU), - combines only 2 standards, - standards coupling needs to be programmed before operation using industry-specific design tools + firmware update - gateways operate in a distributed way - passive element, limited communication between gateways.
Gateways with a webserver	- $$$$ more expensive than the basic solution, - still lots of programming done outside the gateway
BMS updates	When replacing a single device unit with a newer model the gateway needs to be reconfigured or replaced to match the new hardware parameters.
Response time for data output	Depends on technical parameters of chosen system hardware elements (eg. controller, gateway). - the **least responsive element** (hardware or firmware) of the system is the **bottleneck** of the whole system solution, - the performance of the entire system has to be defined during the BAS design stage and cannot be easily altered in case of change to single elements of the system (the impact on the whole system should be taken into account), - the software/firmware should be chosen for the specific case. - readings are prioritized over two-way communication (output over input).

What is ConnectorIO?

ConnectorIO is a **Building Automation Software** that allows you to integrate HVAC systems, media meters, or smart sensors in a single control system, optimize it with **smart automation** and generate system efficiency and building's sustainability **reports** for the property managers or owners.

ConnectorIO's goal

Our mission is to **reduce the building's environmental footprint by efficiently managing the systems within.**

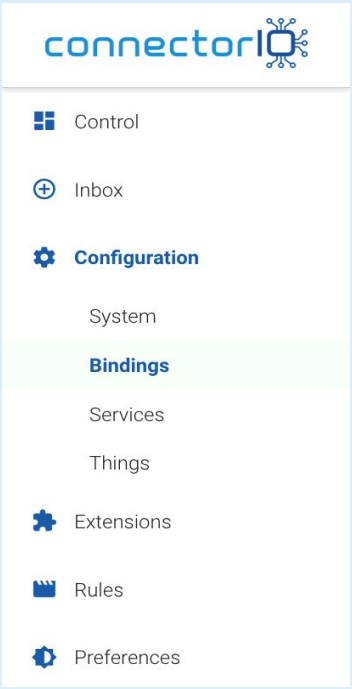
We serve **commercial** (eg. offices, hotels, etc.) and **industrial** properties (factories, logistic halls).

What can be automated with ConnectorIO?

We combine and integrate the following systems:

- Heating.
- Ventilation.
- Air-conditioners.
- Lighting.
- Media consumption meters, such as water, gas, electricity, heat, and cooling.
- Cable installations and actuators.
- Motion and presence sensors, access control.
- Weather information.

ConnectorIO enables automation through **intelligent rules** and **dependencies** between systems. This allows for efficient use of energy by these devices and systems.

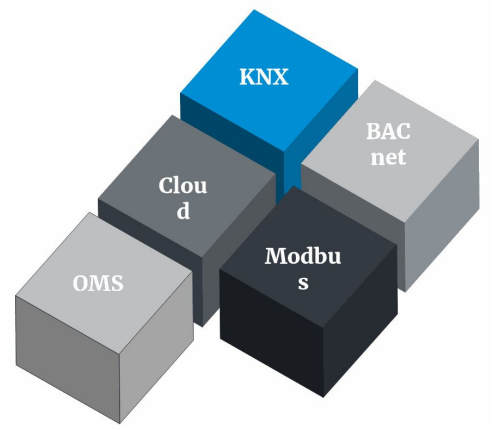


We provide the ability to **monitor** and **visualize** data from these devices, **data cloud-backup** and an intelligent device **optimization** based on operation patterns analyzed in real-time on big-data.

How is ConnectorIO different from a traditional BMS?

ConnectorIO's approach is different in a way, we are offering an **open system** not tied to a specific connection type or device communication protocol (BACnet, ModBus, LON etc.).

Technically speaking, *Connectorio's idea is quite basic in its form. We offer an intelligent software hub solution which can be embedded on various hardware configurations, provides a unified way of handling 3rd party devices, plus constitutes a communication bridge with the external world and cloud infrastructure.*



How is ConnectorIO built?

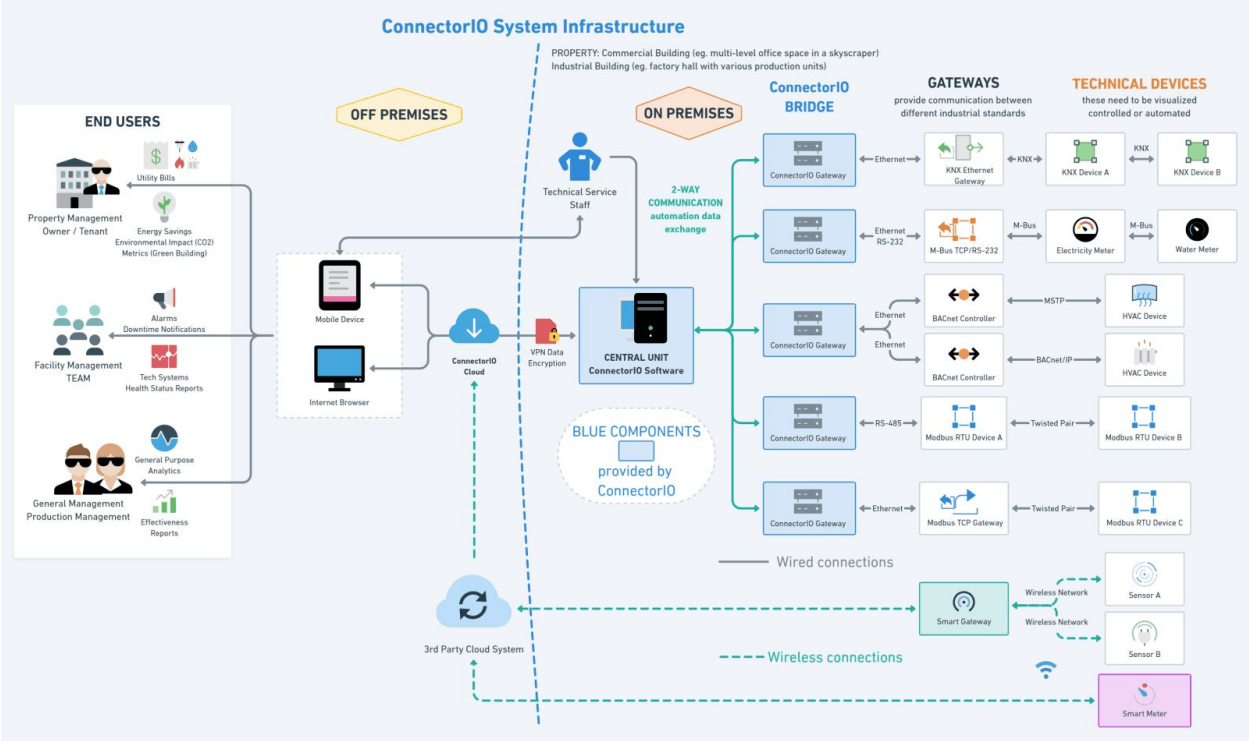
ConnectorIO requires one **Central Unit** to be installed on-premises and **ConnectorIO bridges** or "gateways" to connect the different devices. Our system's infrastructure is presented in the infrastructure model below.

The ConnectorIO Bridge - Connection with a physical system which allows to group devices and tracks their availability.

We believe that "gateways" are going to be widely used in the long run as they provide a few key functionalities such as:

- Decentralization of solution.
- Customization of configuration.
- Local security handling.
- Adapters for simplified devices.

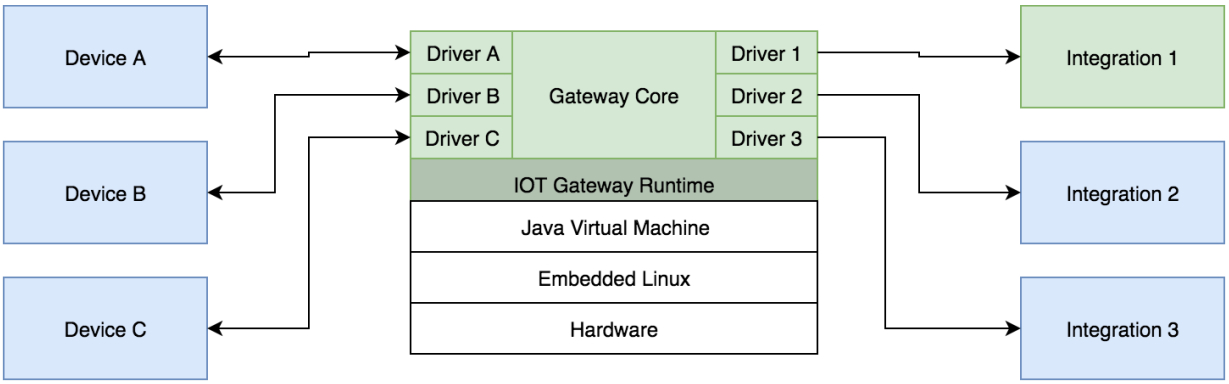
ConnectorIO’s infrastructure model



How are different communication standards and devices integrated into ConnectorIO.
For bigger image - click here (**external link**, internet connection required)

Central Unit’s internal architecture and key component

The most efficient component of the software is a **smart program bus** that allows connecting devices from various manufacturers, working in communication standards such as:
- KNX, BACnet, Modbus, OMS and wireless standards.



ConnectorIO’s software internal architecture and system’s logic.

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ConnectorIO vs. Traditional BMS

ConnectorIO and traditional Building Management System comparison table.

Feature	Traditional BMS	ConnectorIO
Controller	Closed - dedicated to 1 or 2 defined standards	Open - not tied to a specific communication protocol. Limited only by the physical interfaces. Device auto-discovery possible in the case of some communication standards.
Data streams (input/output)	Limited	Configurable, all available channels can be used if necessary
Gateways - basic (system couplers)	- $$$ expensive (hundreds EU), - combine only 2 standards, - standards coupling needs to be programmed before operation using industry-specific design tools + firmware update - gateways operate in a distributed way - passive element, limited communication between gateways.	- changes in the configuration of the edge device are moderately simple, - no direct physical interaction with the edge device is required - changes can be applied through the network
Gateways - with a webserver	- $$$$ more expensive than the basic solution, - still lots of programming done outside the gateway	
Operation	Only local - on-premises. Cloud connection possible but limited to functions programmed in device-specific controllers.	Local or Cloud - on or off-premises
Cloud solution	Limited, not flexible: - limited to device model and firmware update compatibility. - usually only mainstream providers available or vendor-specific cloud systems.	Not limited, flexible: - works with different mainstream and non-mainstream cloud providers.
System device updates	Costly and Complicated - demands controller's firmware reprogramming or hardware update and intervention of multiple vendors (integrators, BMS	Relatively easily, no need for physical intervention.

	operators) on-premises.	
System operator competences	Highly skilled professionals needed.	IT intervention required.
Data storage capabilities	Data is usually stored in an SQL database on a physical storage device located on-premises.	Data can be stored locally or in the cloud.
Stored data range	Limited - usually limited to “trend logs” available from the controller’s registers and then copied to the SQL database	Not limited, can be re-programmed, re-defined.
Data retention time	5-60 mins, 1 day, 1 week, 1 month - limited by the capacity of local BMS data carrier, - data is being averaged, - data subject to “blurring” of the extreme values, - in case of hardware changes, the storage should be replaced as well.	Depends only on the resolution of data probing by device and the storage capacity. - could be milliseconds and up to months/years of stored data in case of cloud storage.

ConnectorIO’s hardware requirements

ConnectorIO needs one **central computer** system where the software’s engine is installed and collects the data, visualizes it and performs automation tasks.

Hardware required to run ConnectorIO’s Software

Feature	**Central Unit** computer hardware requirements
Processor	2-4 core processor, with 2 threads. recommended: 64-Bit architecture processor with support of floating-point numbers (hard-float). A more efficient processor is required when the frequency of data readings needs to be more granular (eg. a reading every millisecond).
RAM (operating memory)	minimum 2GB, recommended 4GB
Disk drive	minimum 4 GB, recommended 8 GB type: eMMC or SSD used for data buffering tasks in case of network connection issues **SD cards** are **not recommended** due to data integrity problems during power failures and lower lifetime

Communication ports	Depends on the systems that need to be integrated. Serial ports: eg. RS-232 and/or RS-485. Ports' voltage: to be specified. Wired connections: 2-3 cords/line (3 for ground).
Network communication	Twisted-pair wiring - traditional Ethernet network cable. Number: depends on the number of devices to be controlled. More ethernet ports needed if more addresses, masks, and subnets are required.

The cost of implementation

Minimum installation cost:

- a control device including a license.

Service cost:

- a subscription fee based on the amount of integrated data points and the sampling frequency of the data.

Is it for you? - The Benefits of implementing ConnectorIO

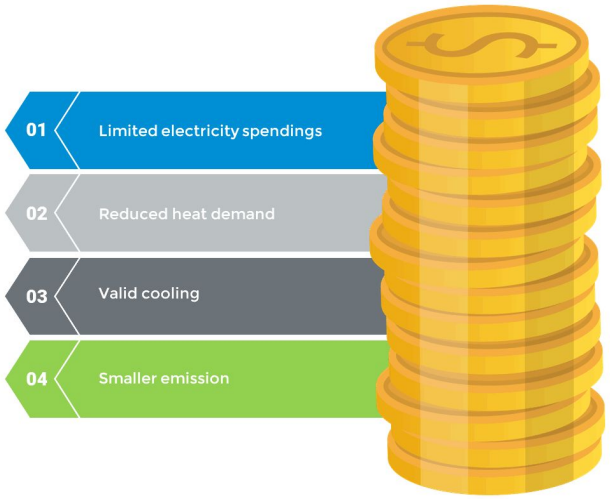
Since now you know how ConnectorIO compares to a traditional building management system, it is a good time to ask yourself the most important question - “Is it for me? How my company can benefit from this?”.

1. **Less lights = less overhead**
   Devices and lights are turned on only when necessary and not when left turned on.

2. **No heating for empty rooms**
   Places which are not occupied require a smaller amount of heat. Upon reasonable calculation adjustment of heating can be made.

3. **Cooling people not furniture**
   Rooms left empty for a long time should automatically limit the demand for cooling as this cold air serves no one but furniture.

4. **Green building.**
   The ongoing trend of emission reduction forces real estate and facility management to seek for savings. With all above it's not only possible but profitable.



Verified reduction of energy consumption

- Reduction of energy costs - depending on the nature of the property, savings reach from **20 to 30%** and more with fine-tuning of the system.

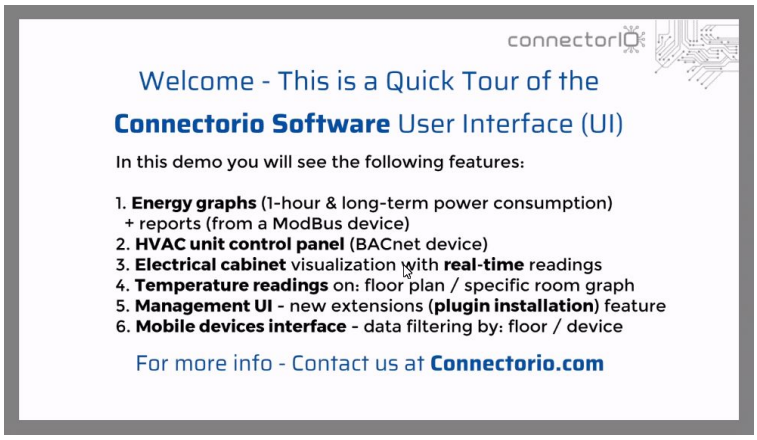
Direct technical benefits

- Centralized device service and control of work parameters in one unified user interface that provides the ability to visualize data, export and store data in the cloud.
- Increase in the frequency of billing / measuring cycles.
- The ability to securely store data in the cloud.
- Remote access and supervision of integrated systems.

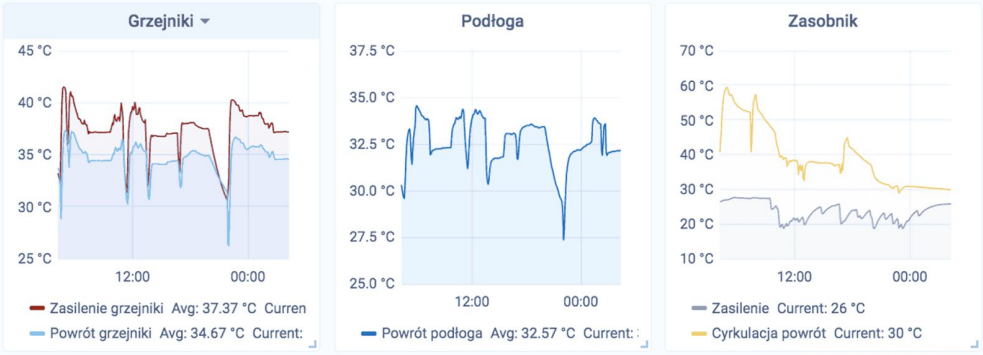
Connetorio’s User Interface overview

Video presentation

Here is a link to the **user interface demo** on the internet - connectorio.com/UIdemo-as.



Data visualization options



Our system enables you to visualize these types of graphs:

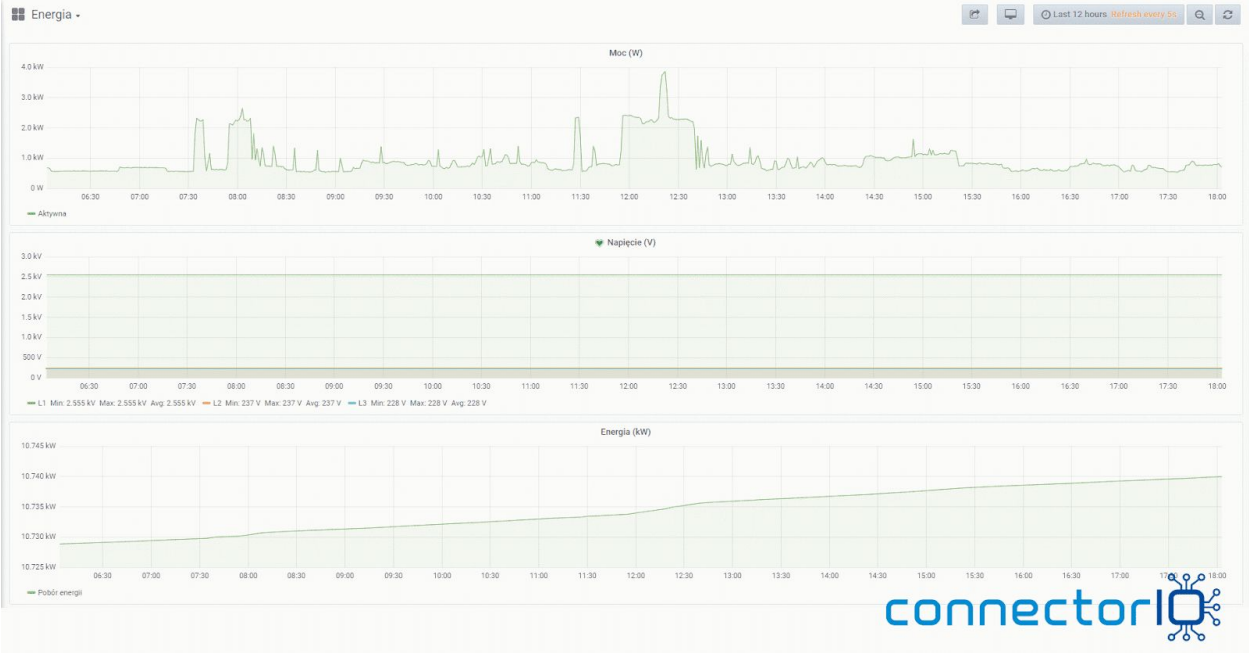
- Electricity graphs (link-1, link-2, link-3, link-4),
- Electric energy meters (link), and electric boards (link).
- Gas consumption (link-1, link-2).
- Temperatures (link-1, link-2, link-3).
- Water valves and filters.
- Air flows and HVAC unit sections (link).

- Floor plans with superposed data (link).
  ... and more **custom-made** graphs and visualizations designed for you.

Other system features related to data visualization:

- Filtering by: building, floor, pre-defined zones, and filtering by device types.
- Data export to .json/.csv format (link).

Here's a sample display from electrical units with Power (W), Voltage (V) and Energy (kW/s).



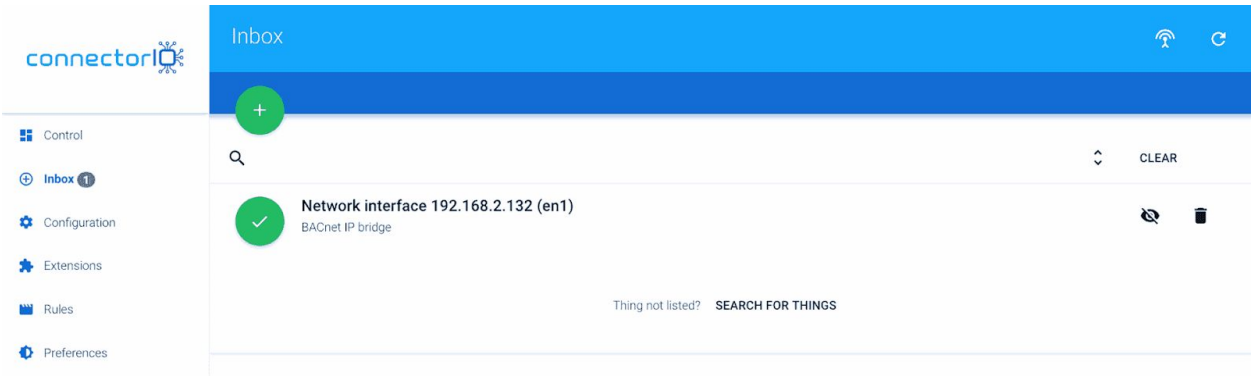
Extensibility - Adding new devices and Software plugins

The ConnectorIO's user interface is **easily customizable** and extensible through **additional plugins**.

With these extensions you can add new features, like new **communication protocols**: wired or wireless for recently added devices.

Device auto-discovery

New devices are **automatically scanned** and **auto-discovered** in the system through the Inbox functionality (provided that the communication protocol of the device allows it).



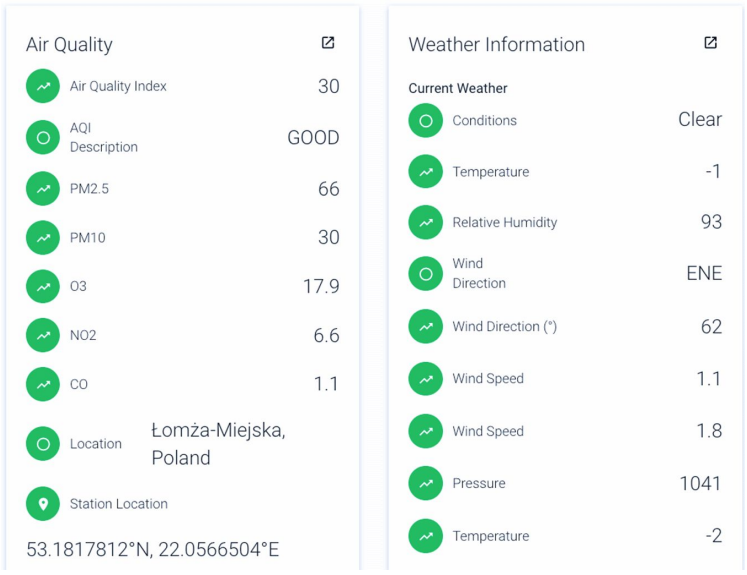
Device auto-discovery feature and scanning of data channels (link to large image).

- Standard devices which can communicate back are recognized and listed in "Inbox".
- The process is fully automatic, the end user is responsible for accepting of elements.
- The scanning process can be started and repeated multiple times.

Device Control Panel

In the main control panel users can do the following:

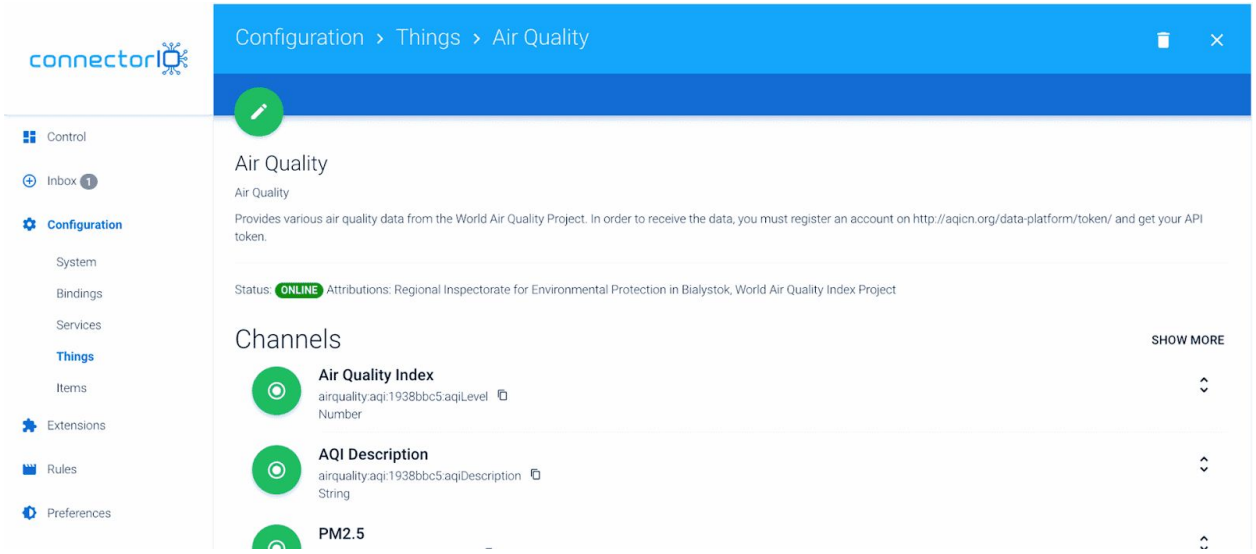
- Users can see the state of inputs and outputs grouped by device.
- In the case of writeable inputs, it's possible to switch them manually.



(link)

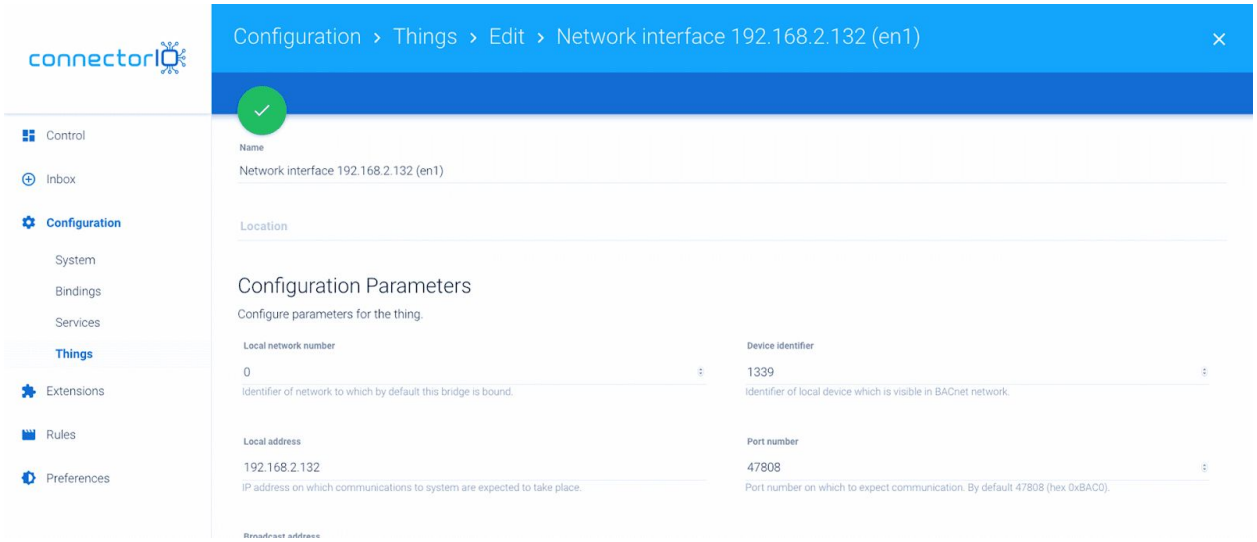
Device Channels

- Each device has multiple channels which can be linked or not.
- If the appliance needs only a few there is no need to track all of them.



Device management

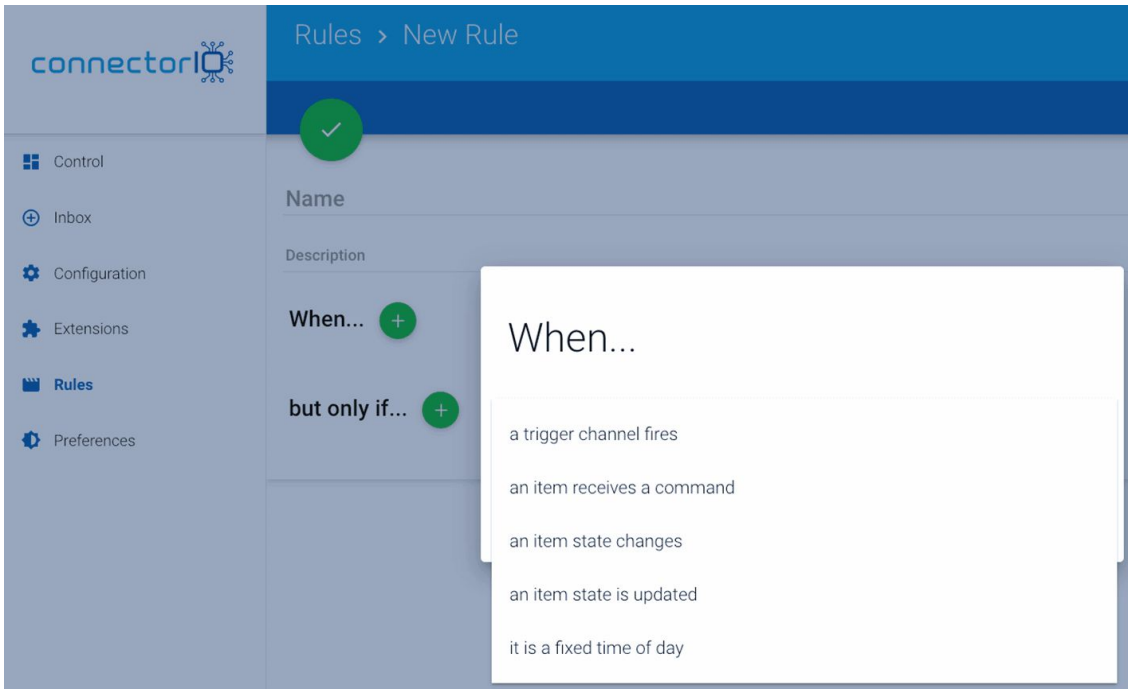
- In case of changes every device and its settings can be edited to match new configuration.
- There is no need to reconfigure anything but eg. IP address.



Device configuration and management menu (link to large image).

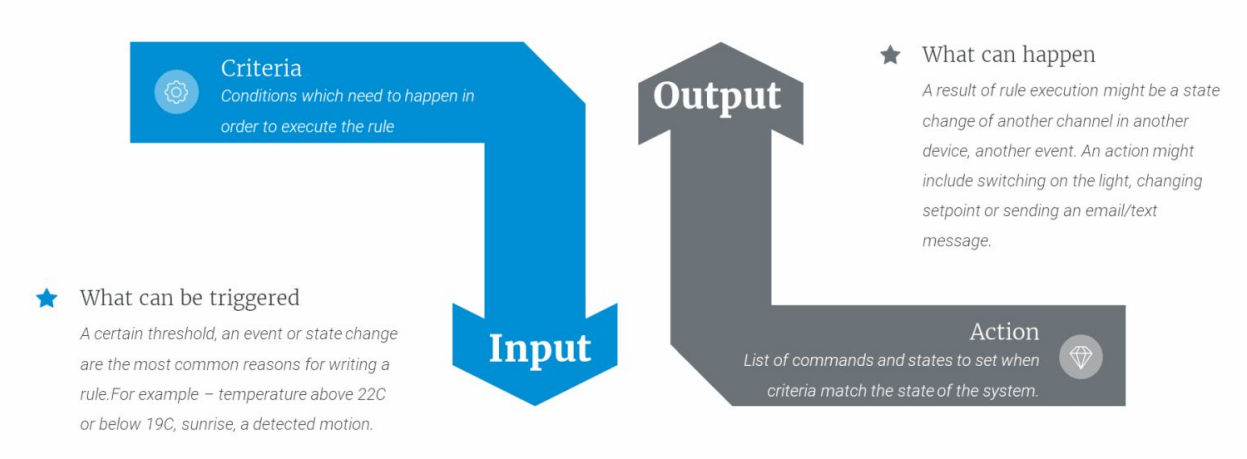
Automation

The system automation is applied by defining a set of rules and interaction between the devices.



Possible rules (link to large image).

The rule engine



The rule engine - automation definition (link to large image).

About our Company

Our company is based in Poland and has been registered as *Connectorio Sp. z o.o.* in Warsaw. You can learn more about us on our website: connectorio.com/about-us.

Who are we?

We are a proptech startup - we disrupt the **property market** by introducing innovative **software solutions** for traditional problems.

Our team consists of **engineers** with IT knowledge, civil-engineering and automation background.

Connectorio's expertise

Connectorio's experience is entirely based on Open-Source and middleware. Over the past 10 years, our primary focus was this. We have spent the last 8 years working with customers who used open source boosted by our knowledge to build bespoke products. Our expertise lets telecoms, insurance, banks, and other businesses to grow faster and deliver a better experience for their customers.

Our company's goals

Our goals are defined by **three axes**:

1. Collecting valuable device's data and making it profitable for our Clients.
2. Increasing the commercial and industrial building's energy efficiency by optimizing the technical systems within them.
3. Reducing risks and costs for our Clients (both environmental and related to the security and maintenance of the technical systems).

Our mission statement

We help commercial and industrial property managers reduce energy consumption in their buildings by offering an easy-to-use visual software which tracks, measures and intelligently adapts the HVAC+lighting (devices) energy consumption by adjusting it to the actual needs of each office in real-time. We believe that by doing this we can help significantly reduce the carbon footprint of our metropolises, making our planet cleaner, thus reducing energy bills and technological risks.

Why we use Open-Source based solutions?

The contemporary software is composed of multiple components and many of them are based on open-source software (**OSS**). Thanks to the use of the open-source code, companies are able to deliver their complete software solutions faster by basing parts of the solution on OSS.

A significant number of open-source projects are useful as utilities but quite often they provide little value as stand-alone solutions and have to be combined together with other components to show real power.

Having a vast community of talented programmers to reach-to, when necessary is an added benefit for us and for our clients.

Key Takeaways

1. The #1 challenge in commercial and industrial buildings is improving the sustainability and your organization can achieve that by optimizing the energy use of HVAC and lighting systems alone.
2. ConnectorIO helps you achieve this goal by offering a way to centralize all the technical systems in one single place and offering a two-way communication between devices which allows to optimize the energy efficiency of technical systems within the building.
3. The implementation of ConnectorIO is cost-efficient, allows to backup all the device data into the cloud and visualize it not only on-premises on desktop and mobile devices, but also off-premises eg. in a distant property management office.
4. Energy savings amount to 20-30% minimum.
5. ConnectorIO is extensible with the use of plugins and scales-up with time as you connect more and more systems to the centralized User Interface.

Materials & Resources

Reading Rainbow Tip: When choosing supplementary materials and resources for your lesson plan (books, videos, etc.), try to put yourself in the shoes of your students. Find resources that ENHANCE your lesson and make your instruction an inviting learning experience for your class!

a. ConnectorIO User Interface demo video on vimeo:
   - https://connectorio.com/UIdemo-as
b. ConnectorIO Cloud solutions page:
   - https://connectorio.com/cloud-solutions-data-export/
c. Description of common industrial communication standards that work with ConnectorIO:
   - https://connectorio.com/common-industrial-standards/
d. More about ConnectorIO's software architecture:
   - https://connectorio.com/connectorio-software-for-beginners/
e. ConnectorIO device management interface
   - https://connectorio.com/connectorio-user-interface/
f. Wikipedia page for "building management system":
   - https://en.wikipedia.org/wiki/Building_management_system