Make Linux the Cornerstone of Your Digital Building with Eclipse VOLTTRON

August 2019
Characteristics of an IoT Solution

- **Long lifespan**: Spans multiple years, if not decades
- **Heterogenous**: Nobody can deliver an end-to-end solution alone
- **Constraints**: Power, compute, environmental and many others
- **Connectivity**: Connectivity is a given, but stability and reliability are not
“How energy efficient is my digital building? ”

“Will my digital building integrate with the smart grid? ”
Eclipse VOLTTRON

> VOLTTRON is a software platform for distributed sensing and control applications

> VOLTTRON is not a protocol
  • A protocol, such as SEP2.0, DNP3, can be built into the platform for use by applications
  • VOLTTRON supports industry standard protocols

> VOLTTRON is an open source project at the Eclipse Foundation, with an active community for support and development

> VOLTTRON runs on Linux!
<table>
<thead>
<tr>
<th></th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects</td>
<td>370+</td>
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<td>Members</td>
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<td>Committers</td>
<td>1550+</td>
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<td>Lines of Code</td>
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<td>Working Groups</td>
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We provide a collaborative environment for the world’s leading Java ecosystem players to advance open source enterprise Java technologies for the cloud.

We enable industry leaders to collaborate on an end-to-end IoT architecture that is secure, flexible, and fully based on open source and open standards.

We provide leading automotive OEMs, their suppliers, and partners with a sustainable, transparent, and vendor-neutral platform to collaborate on open technologies and standards.

The Eclipse IDE is the critical development environment for more than 4 million active users. Our community is innovating on the next generation of cloud native developer tools.
Eclipse IoT Community

3.9M lines of code

38 projects

350+ contributors

40 member companies
# Protocols & Standards

## Protocol or standard
- MQTT
- Sparkplug
- CoAP
- LWM2M
- DDS
- DTLS
- PPMP
- W3C Web of Things
- oneM2M
- OPC-UA

## Projects
- Paho, Mosquitto
- Tahu
- Californium
- Wakaama, Leshan
- Cyclone
- TinyDTLS
- Unide
- ThingWeb
- OM2M
- Milo
IoT Working Group Member Organizations

Strategic members

BOSCH
Invented for life

EUROTECH

Red Hat

ADLINK

AZUL SYSTEMS

BREDEX

technologies

Calypso
Networks Association

CANONICAL

list

Cirrus Link

cloudera

COMPEX

CONTACT Software

DB

DC
to

development

edgeworx

ENGINEERING
KNOWLEDGE

Edwards

Inductive
Automation

influxdata

Innoqpract

fortiss

GENERATIVE
SOFTWARE

HUAWEI

IBM

IncQuery Labs

inductive

auto

LAAS-CNRS

THE LINUX
FOUNDATION

m4m

MICROEJ

NOKIA

openHAB
Foundation

orange

SAP

SIEMENS

SIERRA WIRELESS

V2COM

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Eclipse VOLTTRON: Key Benefits and Primary Use Areas

> 3 Key Benefits:

  • Cost-effective - Open source software and can be hosted on inexpensive Linux-based computing resources
  • Scalable - Can be used in one building or fleet of buildings
  • Interoperable

> 3 Primary Use Areas:

  • Building Efficiency - To help control building energy system performance
  • Building-Grid Integration – To support “beyond demand response” approach and integration of distributed energy resources to grid
  • Transactive Control
Eclipse VOLTTRON Ecosystem
Platform Overview
Message Bus Framework

Message bus is responsible for moving data from one endpoint to another. It allows agents to communicate with each other using:

- Publish/Subscribe mechanism
- Remote Procedure Call mechanism

Message bus framework supports ZeroMQ and RabbitMQ message queue libraries. Can support other message queue libraries in the future:

- Actual application code is decoupled from message bus
- Easy switch between different type of message bus. Application/agent code remains unaffected.
- Allows VOLTTRON instances running on different types of message bus to communicate with each other
- Proxy agent acts as bridge between local and remote message bus
RabbitMQ based VOLTTRON

Agent_A
VIP ID:
“agent_a”

agent_a VIP queue
Binding Key:
“volttron1.agent_a”

Message:
Destination Routing Key:
“volttron1.agent_b”
Pika properties:
Type: “rpc”
“user_id”: “volttron1.agent_a”
Body: message arguments

Topic Exchange

Agent_B
VIP ID:
“agent_b”

agent_b VIP queue
Binding Key:
“volttron1.agent_b”

Message:
Destination Routing Key:
“volttron1.agent_a”
Pika properties:
Type: “rpc”
app_id: “volttron1.agent_b”
“user_id”:
“volttron1.agent_a”
Message_id: message id
Body: message return result

Alternate Exchange (Fan out)

Router/Bad Message Handler
Historian Framework

- Framework handles collecting data from the message bus for storage
- Simplifies creating specific instance
  - Setup
  - How to store data
  - How to retrieve data
- Maintains a cache until data stored
- Numerous supported databases with more being contributed
- Data can also be sent to cloud services or another VOLTTRON instance
Driver Framework

- Framework simplifies process. Fill out methods for:
  - Setup
  - Reading values
  - Sending commands

- Growing list of existing interfaces

- Flexible options for collection rate and organization of sensor points

- User edits configuration files, no need to code for different devices
Eclipse VOLTTRON Security

> Platform hardening guidelines for securing underlying Linux system

> Multi-platform Message Bus
  • Encrypted communication between VOLTTRON instances
  • Authorization required for agents to communicate with the VOLTTRON message bus
  • Pub/sub topics can be restricted to authorized agents

> Platform Security and Monitoring
  • Access to VOLTTRON instances restricted to approved hosts
  • Alerts can trigger emails to administrators
  • Monitor and alert on pub/sub topics for interruptions and unexpected values

> Agent Security
  • Role based access to agent capabilities. Restricted access to configuration store
  • Agents execute in separate process from platform
Applications

> AFDD – Automatic Fault Detection and Diagnostic
> AFDDVis – Visualization for AFDD results
> AirsideRCxAgent - Air-side HVAC Auto-Retuning Diagnostics
> DrivenMatlabAgent – Integrates MATLAB code with VOLTTRON platform
> EconomizerRCxAgent - Application to detect and correct operational problems for AHUs/RTUs.
> ILCAgent – Intelligent Load Control Agent
> WBE – Whole Building Energy
> Transactive Market Service
> Economic Dispatch
Application demo

Link to VAV-Thermostat
> Learn about our projects by visiting
  [iot.eclipse.org/projects](https://iot.eclipse.org/projects)

> Try Eclipse VOLTTRON!
  [https://volttron.org/](https://volttron.org/)

> Subscribe to the [Eclipse IoT newsletter](https://www.eclipse.org/newsletter/subscribe)

> Follow and engage with us on social media: @EclipseIoT

> Attend an Eclipse community event or join our [Virtual IoT Meetup](https://www.eclipse.org/events/community/)
  - [Eclipse Con Europe 2019](https://www.eclipse.org/events/conferences/2019/)
  Ludwigsburg, Germany - October 21 - 24, 2019
Thank you!