Introduction to Eclipse IoT

August 2019
The combined markets of the Internet of Things will grow to about $520 billion in 2021, more than double the $235 billion spent in 2017.

Source: Bain & Company, 2018
Top IoT developer concerns

Security 38%
Connectivity 21%
Data Collection & Analytics 19%

Top three concerns remain the same as last year, with Connectivity moving into second place.

Standards, Performance and Privacy increased in importance.

The Eclipse IoT portfolio is uniquely positioned to address all three developer concerns.

Source: Eclipse IoT Developer Survey 2019
Top developer concerns over time

Source: Eclipse IoT Developer Survey 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
“What is my IoT device actually doing?”

“What will happen when my device will not be supported anymore?”
Open source: the solution

> Proven to be the most viable way to deliver complex platform software
> Encourages wide scale industry collaboration
> Accelerates innovation through joint development
> Enables rapid adoption and innovation from a committed community
> Drives open standards for maturity and interoperability
> Fosters an open ecosystem to maximize adoption and monetization
Our Impact: Open Innovation at Scale

**Competition Layer**
Commercial Adopters focus resources on rapidly building differentiating features

**Collaboration Layer**
Technology Producers jointly define roadmap and build core capabilities

**Governance Layer**
The Eclipse Foundation provides an open, vendor-neutral platform to enable collaboration

Requirements & Use Cases
Value Line
Product-Ready Technologies

$10 billion of shared investment to date
The Eclipse IoT community is the open source center of gravity for the Internet of Things.
The Eclipse Foundation - By the Numbers

370+ Projects
275+ Members
1550+ Committers
195M+ Lines of Code
30 Staff Members
10+ Working Groups
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

<table>
<thead>
<tr>
<th>Protocol or standard</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>MQTT</td>
<td>Paho, Mosquitto</td>
</tr>
<tr>
<td>Sparkplug</td>
<td>Tahu</td>
</tr>
<tr>
<td>CoAP</td>
<td>Californium</td>
</tr>
<tr>
<td>LWM2M</td>
<td>Wakaama, Leshan</td>
</tr>
<tr>
<td>DDS</td>
<td>Cyclone</td>
</tr>
<tr>
<td>DTLS</td>
<td>TinyDTLS</td>
</tr>
<tr>
<td>PPMP</td>
<td>Unide</td>
</tr>
<tr>
<td>W3C Web of Things</td>
<td>ThingWeb</td>
</tr>
<tr>
<td>oneM2M</td>
<td>OM2M</td>
</tr>
<tr>
<td>OPC-UA</td>
<td>Milo</td>
</tr>
</tbody>
</table>
Sustained Growth

NEW PROJECTS
Since April 2018
9

RELEASES
Since April 2018
16
Our mission

To provide a forum for individuals and organizations to build and promote open source software, open standards and open collaboration models needed to create a scalable and open Internet of Things.
IoT Working Group Member Organizations

Strategic members

BOSCH  Invented for life
Red Hat

ADLINK
AZUL SYSTEMS
CA Technologies
Calypso Networks Association
CANONICAL
Cirrus Link
Cloudera

COMPEX
CONTACT Software
DB
DC² square
edgeworx
ENGINEERING KNOWAGE
fortiss

GENERATIVE SOFTWARE
HUAWEI
IBM
InQuireLabs
Inductive automation
influxdata
Innoompract
Intel

itemis
kxnetecs
LAAS-CNRS
THE LINUX FOUNDATION
mam
microEJ
Nokia

SAP
SIEMENS
SIERRA WIRELESS
V2COM
## Eclipse IoT Ecosystem

<table>
<thead>
<tr>
<th><strong>OEMs</strong></th>
<th><strong>Software Vendors</strong></th>
<th><strong>IoT HW Manufacturers</strong></th>
</tr>
</thead>
</table>
| ● Achieve **interoperability** in **Industry 4.0** thanks to open source technology  
● Enable **on-premise** deployments of IoT platforms  | ● Provide **commercial support** for Eclipse IoT technologies  
● Promote the value of open IoT ecosystems through **testbeds**  | ● **Device Management**  
● Establish Eclipse IoT projects as **reference implementations** of IoT standards (e.g. LWM2M)  |

### Examples

- **Bosch**  
*Invented for life*

- **Siemens**

- **Red Hat**

- **Canonical**

- **InfluxData**

- **Cloudera**

- **Contact Software**

- **Azul Systems**

- **Sierra Wireless**

- **Eurotech**  
## Eclipse IoT Ecosystem

<table>
<thead>
<tr>
<th>Telcos</th>
<th>IT Services Companies</th>
<th>Research Institutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Promote IoT cloud interoperability through open standards (ex. OneM2M)</td>
<td>● Provide <strong>support and services</strong> around Eclipse IoT technology</td>
<td>● Partner with Eclipse IoT member companies on IoT research projects (ex. Smart Cities)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● <strong>Disseminate</strong> the results through Eclipse IoT projects</td>
</tr>
</tbody>
</table>

### Examples

- **Telcos**: Orange
- **IT Services Companies**: itemis, V2COM
- **Research Institutes**: LAAS-CNRS, list.ecepostech
New Case Study

Validated by Industry Leaders

“No company can realize the IoT on its own... Within the Eclipse Community, through the contribution of many IoT developers, tools and standards are created on an open platform that many companies can benefit from for their IoT applications.”

Stefan Ferber
CEO, Bosch Software Innovations

Governance & Process
IP Management & Licensing
Community Development
Infrastructure
From Idea to Solution the Eclipse Way
The Idea

I want to install **sensors** on the machines we sell to offer a preventive maintenance **service** to our customers.

**Business drivers:**

- Improve customer satisfaction
- Better utilization of field technicians
IoT Functional Concerns

### SECURITY
- Field protocols
- IoT protocols
- Remote Management
- OS / RTOS

### MODELS
- Remote Management
- Communication
- OS / RTOS
- Field protocols
- IoT protocols
- Network Management

### TOOLS
- Remote Management
- Application Enablement
- Analytics
- Message Routing
- Data Management
- Device Management
- Device Registry
- OS / PaaS

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CONSTRAINED DEVICES

EDGE NODES / GATEWAYS

IOT CLOUD PLATFORM

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# Architecture: High-Level View

<table>
<thead>
<tr>
<th>Hardware and sensors</th>
<th>Constrained device application</th>
<th>Edge Node / Gateway</th>
<th>Cloud Application</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Gather and interpret sensor raw inputs</strong></td>
<td>Edge Application</td>
<td><strong>Primary aggregation and analytics</strong></td>
</tr>
</tbody>
</table>
Architecture: Detailed View

- Constrained device application
  - Communication
    - IoT protocol
  - Hardware Abstraction Layer (HAL)
  - OS / RTOS
- Hardware and sensors
- Edge Application
- Edge Node / Gateway
- Cloud Application
Architecture: Detailed View

Constrained device application

- Communication
  - IoT protocol
- Hardware Abstraction Layer (HAL)
- OS / RTOS
- Hardware and sensors

Edge Application

- Connectivity
  - IoT protocol
- Application Runtime
- OS / RTOS
- Edge Node / Gateway

Cloud Application
Architecture: Detailed View

Constrained device application
- Communication
  - IoT protocol
- Hardware Abstraction Layer (HAL)
- OS / RTOS

Hardware and sensors

Edge Application
- Connectivity
  - IoT protocol
- Application Runtime
  - OS / RTOS

Edge Node / Gateway

Cloud Application
- Connectivity
- Message Routing
- OS / PaaS
The basic solution: MQTT
The basic solution: DDS

Constrained device application

Communication

Eclipse MRAA + UPM
Eclipse Kiso

FreeRTOS, Zephyr...

Hardware and sensors

Edge Application

Connectivity

Application Runtime

OS / RTOS

Edge Node / Gateway

Cloud Application

Message Routing

OS / PaaS
Where Eclipse IoT Projects Fit

**CONSTRAINED DEVICES**
- Communication
  - Field protocols: LoRa, NB-IoT, Zigbee
- Hardware Abstraction Layer (HAL)
- OS / RTOS: FreeRTOS, Zephyr

**EDGE NODES / GATEWAYS**
- Application Runtime
  - Java, Jakarta EE, Node.js
- IoT protocols: LoRa, NB-IoT, Zigbee
- Network Management: MQTT
- OS / RTOS: Linux, Windows

**IOT CLOUD PLATFORM**
- Application Enablement
  - ditto
- Connectivity
- Analytics
- Data Management
- Device Registry
- Device Management
- Message Routing
- OS / PaaS

**TOOLS**
- Vorto
- Mita

**MODELS**
- MRAA
- UPm
- Kiso

**SECURITY**
- Mika

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Often used together

Gateway runtime and Cloud Platform
Tightly integrated components
Java / OSGi application runtime

Message routing, digital twins, device description and device management
Modular components
Integration through microservices
Pick your own runtime

Projects that are built and integration tested together
In Short

- IoT drives real outcomes and will grow to about $520 billion in 2021.
- Open Source is the solution since it encourages collaboration and accelerates innovation.
- Eclipse IoT is the open source center of gravity for the Internet of Things.
- Our community is still growing 38 projects and 43 member organizations are just the beginning.
> Learn about our projects by visiting [iot.eclipse.org/projects](https://iot.eclipse.org/projects)

> Try our technology

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

> Follow and engage with us on social media: [@EclipseIoT](https://twitter.com/EclipseIoT)

> Attend an Eclipse community event or join our [Virtual IoT Meetup](https://www.eclipse.org/iot-meetups)

  > [Eclipse Con Europe 2019](https://www.eclipse.org/eclipsecon/europe/2019/)
  > Ludwigsburg, Germany - October 21 - 24, 2019
Thank you!