Developing Interoperable Components for an Open IoT Foundation

Red Hat and Eurotech collaboration simplifies Internet of Things integration and accelerates implementations

Marco Carrer – CTO, Eurotech

James Kirkland – Chief Architect for IoT, Red Hat
IoT

Open.  Integrated.  Managed.
Open IoT

Open Source
Open Standards
Open Hardware
No Vendor Lock-in
Large Eco-system
Interoperability
Simple & Quick Prototyping
Higher Quality
Customers as Partners
Why open source?

Accelerate your business

Bring products to market faster
Expand to new and adjacent markets
Build end-to-end solutions
Why Open Source for IoT?

- Pressure to add value in shrinking timeframes
  - Decomposition of vertically-integrated value add
- Velocity of technology change outstrips staffing
  - Impractical / costly to sustain in-house platforms
- Interoperability trumps exclusive differentiation
  - More devices/protocols “outside” vs. “inside”
- Quest for quality w/o lock-in
  - Main reason for OSS deployment no longer cost
  - OSS defects:LoC provably lower than proprietary
  - Legacy platform differentiation shrinking / vanishing

http://www.slideshare.net/blackducksoftware/iot-and-open-source
Why Red Hat for IoT?

- Open source, open standards for IoT market
- Tight integration of IoT apps & data with enterprise platforms & services
- Iterate quickly with low risk, greater flexibility, security, scalability

OPEN – FLEXIBLE – ROBUST
Why Eurotech for IoT?

• One of the world top players in the global Embedded Computers market
• Behind the products & services of more than 20 Global 500 companies
• 20+ Years of experience in “M2M” and IoT systems
  – 20+ Years experience in OT / embedded / gateway hardware & software
  – 16 Years ago co-developed MQTT with IBM
  – 10+ Years experience with Java in embedded
  – 6+ Years history in M2M/IoT cloud platforms
• Strong vertical market competencies:
  – Industrial & Logistics
  – Transportation
  – Defense & Security
  – Healthcare & Medical
eclipse

Founded in 2012 by

EUROTECH

IBM

SIERRA WIRELESS™

2.3M lines of code
26 projects
250+ developers
1.3M annual visitors
Middleware for IoT Gateways

Started Dec 2013, first release Sept 2014

Code base donated by EUROTECH

Modular IoT Integration Platform

Started Oct 2016, first release May 2017

Commercially Supported Versions by EUROTECH:

Everyware Software Framework

MIDDLEWARE FOR IoT GATEWAYS

Everyware Cloud

IoT INTEGRATION PLATFORM
Contributions by Company in 2016

- Robert Bosch GmbH: 40.8%
- Eurotech: 19.4%
- Red Hat, Inc.: 18%
- IBM: 7.9%
- Intel Corporation: 5.5%
- Deutsche Telekom AG: 5.5%
- openHAB Foundation: 3.6%
- IVH SYSTEMS GmbH: 3.6%
- Sierra Wireless: 3.6%
- Centre National de la Recherche Scientifique (CNRS-LAAS): 3.6%
- University of Calgary: 3.6%
- Individuals & Others: 3.6%
Open Standards
Message Queue Telemetry Transport (MQTT)

- M2M Messaging Protocol
- Low Bandwidth / Low Power
- 2-way Communication
- Publish and Subscribe
-Hierarchical Topic Namespaces
- Data Payload Agnostic
- Device Initiated Connection
- Firewall-friendly
- SSL and Authenticated
- Large ecosystem
What messaging protocol(s) do you use for your IoT solution?

- HTTP: 60.1%
- MQTT: 54.7%
- CoAP: 26.7%
- In-house / proprietary: 18.4%
- HTTP/2: 16.8%
- AMQP: 15.0%
- XMPP: 10.3%
- Other: 7.1%
- Don’t know: 7.1%
- Proprietary vendor protocol (specify below): 4.9%
- DDS: 4.0%
- None: 3.6%
Integrated IoT

Integration @ Edge
Integration @ Data Center
End-to-end Modular IoT Solutions

Faster Innovation
Faster Time-to-Market
Integration @ Edge
Eclipse Kura / Everyware Software Framework (ESF)

Developer’s Productivity, Increasing Value, Minimizing TCO
Integration @ Edge
From Prototype to Production

Software portability across HW Platforms

Industrial IoT Gateways

Open Hardware
Integration @ Edge
Eclipse Kura 3 / Everyware Software Framework (ESF) 5

Connect to IoT Cloud Services
- Multiple Connections
- Message Routing
- Digital Twins

Develop IoT Edge Computing Apps
- Wires Data Flow
- SQL Database
- Full Java APIs

Connect to Field Devices
- Industrial Protocols
- Modular Drivers

- RS 232/485
- Bluetooth Low Energy
- USB
- CAN bus
- GPS/GNSS
- GPIO/I2C/PWM

- Everyware Cloud
- Eclipse Kapua
- AWS IoT
- Azure IoT

- Apache Camel

- Eclipse
- Everyware
- OMG
Integration @ Edge
Wires
Integration @ Edge
Transforming device data into actionable information
## Integration @ Edge

**Developer’s Experience**

<table>
<thead>
<tr>
<th>Emulate on PC</th>
<th>Deploy on Target</th>
<th>Cloud Managed</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Laptop" /></td>
<td><img src="image2.png" alt="Gateway" /></td>
<td><img src="image3.png" alt="Cloud" /></td>
</tr>
</tbody>
</table>

**Emulate on PC**
- Start developing your IoT/M2M application in the comfort of your PC.
  - Full Eclipse Integration
  - Target Platform Definition
  - Emulated Services
  - Run/Debug from Eclipse
  - Support Mac/Linux Hosts

**Deploy on Target**
- When you are ready, deploy your application on the gateway.
  - One-click Deployment
  - Eclipse Plugin
  - Remote Debugging

**Cloud Managed**
- Provision and manage your applications in field devices from the Cloud.
  - Remote OSGi Management via MQTT
  - Web-based Console
Integration @ Data Center
Eclipse Kapua / Everyware Cloud

IoT Devices and Gateways

- Cellular Connectivity / SIM Management Platforms
- Enterprise Integration Patterns
- Alerts & Notifications
- Data Management
- Business Intelligence
- Mobile & Enterprise Applications

- Device Connectivity (A-MQ)
- Message Routing (Fuse)

- Device Management
  - Real-Time Analytics
  - Storage
  - Device Provisioning
  - Device Batch Operations
  - Device Management Protocols

- Device Registry

- Security
  - Account Management
  - Access Control

- Administration
  - Device Mgmt Console
  - REST API

- Eclipse Kapua / Everyware Cloud

- IoT Devices and Gateways
Integration @ Data Center
Eclipse Kapua Core IoT Services

**Batch Jobs**
- Job Service
- Job Report Service

**Data Registry Services**
- Data Registry Service
- Data Storage Service
- Rules Service
- Data Usage Service

**Device Management Services**
- Configuration Management Service
- Deploy Management Service
- Bundle Management Bundle Service
- Certificate Management Service
- Provisioning Service
- Remote Command Service
- Remote Access Service
- Asset Management Service

**Device Registry Services**
- Device Registry Service
- Device Lifecycle Service
- Device Connection Service

**Foundation Services**
- User Service
- Account Service
- Authentication Service
- Authorization Service
Everyware Cloud
Administrator / Web Console
Open End-to-end Modular IoT Solution

Business Applications

IoT Cloud Platform

IoT Gateway

• Connectivity / Message Routing
• Device Registry and Management
• Data Management and Storage
• Event Management
• Application Enablement

• Communications/messaging
• Data pre-processing
• Real-time data analytics
• Real-time actions/rules
• Application Container
• Remote management

• Communications/messaging
• Data acquisition
Managed IoT

IT Management

OT Management

IT-OT Security
**IT Management**

OpenShift as a platform for IoT microservices

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**Red Hat Cloud Suite**

<table>
<thead>
<tr>
<th>System Management</th>
<th>RED HAT Satellite</th>
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<tbody>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Virtualization</th>
<th>Private Cloud</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED HAT Virtualization</td>
<td>RED HAT OpenStack Platform</td>
</tr>
<tr>
<td>VMware</td>
<td>Amazon Web Services</td>
</tr>
<tr>
<td>Microsoft Hyper-V</td>
<td>Microsoft Azure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Platform</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED HAT Enterprise Linux</td>
<td>RED HAT Ceph Storage</td>
</tr>
</tbody>
</table>

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OT Management

Device Management

- Device Provisioning
- Application Life-cycle Management
- Service Configuration Management
- Certificate Management
- Device Batch Operations
- Remote Access and Maintenance
1. Administrator creates a Provision Request
2. Device connects to the provision account and sends a provisioning message
3. Platform checks for a valid provision request for the device
4. Platform executes provision job sending the device:
   a. Platform certificate for secure communication
   b. New device configuration
5. The device applies new configuration and connects under target account
1. Gateway connected through MQTT
2. VPN connection to Gateway is requested
3. VPN connection from Remote Terminal is established and bridged to the Gateway
4. VPN connection from Gateway is established
5. Through ESF NAT and port forwarding, Remote Terminal can access devices connected to the Gateway subnet
IT-OT Security

Vulnerability Assessments and Penetration Tests

Cloud-level Security
- Integrated Certificate Management
- Validated Server Identity
- Tenant Isolation
- Role-based Access Control
- 2-factor Authentication

Device-level Security
- Unique Device Identity and Credentials
- Signed ESF/Application Code
- Encrypted Configuration and Storage

Secure Communication
- SSL/TLS Encryption w/ Hostname Verification
- Mutual Authentication
- Digitally Signed Messages

(*) addresses man-in-the-middle threat
Open. Integrated. Managed. IoT.

as simple as

Everyware IoT™
Everyware IoT Use Cases
Many Customers & Applications
Connected Product

Application:
• end users to remote control their own thermo-devices
• for technical assistance operators to perform remote diagnostics
• valuable data for R&D, Service, Marketing departments to develop & sell new products and services

Key Success Factors:
• Service-oriented business model
• Open and industry standards based
• ESF hardware abstraction, Java/OSGi
• Remote device & embedded app. mgmt.
• Real time data
• M2M / IoT know how in Eurotech
• Eurotech worldwide footprint
Predictive Maintenance

Key Success Factors:
- Flexibility of the platform
- Advanced Analytics and Pattern Matching at the gateway (Fog/Edge Computing)
- Multiple Cloud connections

Application:
- Failure Monitoring and Predictive Maintenance
- Smart sensor and analytics capabilities at the edge
- Powerful analytics and visualization solutions at the enterprise IT level
Remote Maintenance and Services

Application:
• Connect machines to the internet in a nonintrusive way
• Provide nurses with access to machine status
• Provide manufacturers access to machine logs
• Enable remote maintenance with less field visits

Key Success Factors:
• Open Standard Connectivity
• Device Provisioning
• Remote Access VPN
• Onboarding and Data Acquisition App
• Port/IP Forwarding
• Cellular Connectivity
Intelligent Data Logger

Application:
• On board diagnostics
• Data collection for optimization and predictive maintenance
• Remote access and maintenance
• Railway certified hardware with MVB interface
• On premise device management and data integration

Key Success Factors:
• Open Standard Connectivity
• Modular Field Access Drivers
• Data Flow Programming
• Portable IoT Edge Middleware
• On-premise IoT Cloud Platform
Tram Fleet Management Optimization

Application:
- Cloud based automatic passenger counting (APC) system
- Equip trams with Eurotech’s passenger counters and a gateway
- Real time planning of route, optimizing use of the fleet
- Application for Data Statistics, combining passenger counts, GPS positioning, door open/close events and other route information

Key Success Factors:
- Complete end-to-end solution
- Advanced PCN technology
- High accuracy
- Short development time
- Easily integration with web app
- Cost effective
- Scalable for future requirements
# Eclipse IoT Testbed

![Dashboard Image]

## Vehicles

<table>
<thead>
<tr>
<th>Vehicle ID</th>
<th>Route</th>
<th>ETA</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>truck-8</td>
<td>Raleigh, NC</td>
<td>May 5, 2017 2:56:08 PM</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Chicago, IL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>truck-9</td>
<td>New York, NY</td>
<td>May 5, 2017 8:25:41 PM</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Chattanooga, TN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>truck-6</td>
<td>Raleigh, NC</td>
<td>May 5, 2017 6:03:14 AM</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Omaha, NE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>truck-7</td>
<td>Showshoe, WV</td>
<td>May 5, 2017 3:41:33 PM</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Louisville, KY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>truck-10</td>
<td>Atlanta, GA</td>
<td>May 5, 2017 1:12:23 PM</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>New Orleans, LA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>truck-1</td>
<td>Raleigh, NC</td>
<td>May 5, 2017 1:12:56 PM</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>New Orleans, LA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Client Shipments

<table>
<thead>
<tr>
<th>Client Package</th>
<th>Route</th>
<th>ETA</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soylent (Antique Baseballs)</td>
<td>Atlanta, GA</td>
<td>Saturday at 6:36 AM</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Louisville, KY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geeks &amp; Co (Spare F-22 Parts)</td>
<td>Virginia Beach, VA</td>
<td>Sunday at 7:34 PM</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Louisville, KY</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Vehicle Tracking

![Map Image]

- Choose a shipment to view its telemetry.

## Package Telemetry

![Package Telemetry Image]

## Vehicle Telemetry

![Vehicle Telemetry Image]

![Functional Image]
For more information

• Go to [http://redhat.com/iot](http://redhat.com/iot) or [http://developers.redhat.com/iot](http://developers.redhat.com/iot)

• Go to [http://eurotech.com](http://eurotech.com) or [http://esf.eurotech.com](http://esf.eurotech.com)

• Go to [http://eclipse.org/kura](http://eclipse.org/kura)
• Go to [http://eclipse.org/kapua](http://eclipse.org/kapua)
• Go to [https://iot.eclipse.org/testbeds/](https://iot.eclipse.org/testbeds/)

• Come by IoT Pavillion
Thank You

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