Powering Dynamic M2M Event Processing with OSGi
Dynamic Complex Event Processing and OSGi

6/12/2014
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Powering Dynamic M2M Event Processing with OSGi

Dynamic Complex Event Processing and OSGi.

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Powering Dynamic M2M Event Processing with OSGi

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1. The Vs of Big Data
The Vs of Big Data

- **Volume**: How fast data is produced and processed to meet demand.
- **Variety**: Includes structured tables, documents, email, metering data, video/audio, stock ticker data, and more.
- **Velocity**: Ability to respond once a problem or opportunity is detected.

Growing volumes of data and how much data needs to be processed within a time window.
The missing “V” of Big Data

Extracting VALUE from VIABLE Data
WHERE It Matters and WHEN It Matters
Rise of The Intelligent Device
Key Elements of Connected Intelligence

1. **Intelligent Devices**
   Always-on devices connected to variety of sensors and running multiple software applications

2. **Real-Time Analytics**
   High-frequency data analysis for instant decision making and automation of information flows

3. **Big Data**
   Integration of data from connected devices with enterprise applications and historical data
Dynamic Predictive Analytics

• Local analytics and business rules are controlled by global analytics
  – In-flight data analytics on the device
  – Near real time response on the device

• Global Analytics for the Big Patterns
  – Big Data post processing
  – Discover Hidden Patterns/dependencies

• Dynamically Adjust the Rules
  – Update new rules to the local device
  – Enhances the devices local analytics

• Rinse and Repeat
Transportation Example

1. Location tracking (LBS)

2. Route monitoring (Time of day optimization)

3. Passenger Counter

4. Fraud detection (Passenger counter, camera, fare collection)

5. Camera (Normal operation, local storage; emergencies such as Amber alert, streaming to emergency authorities)

6. Vehicle diagnostics (Sensors throughout vehicle)

7. Digital signage (Information and advertising - Location aware)
Powering Dynamic M2M Event Processing with OSGi

Dynamic Complex Event Processing and OSGi.

2. Complex Event Processing
Intelligence Is Real-Time, Event-Based Analytics

Complex Events Processing enables real-time business insights from edge devices

- Communication Events
- Machine Events
- Security Events
- Environmental Events
- Business Logic Events
Complex Event Processing (CEP)

• Event-driven Architecture
• A generic data management infrastructure for processing in-flight data before data is potentially stored to deliver results in near real-time
• Programming language for defining rules
• It allows users to Aggregate/Correlate/Enrich/Detect Patterns in high speed streaming data
Complex Event Processing (CEP)

Data/Msg. Feeds

CEP Application Container

Data Feed Adapters

Process Events (CEP)

Listener/SINK: User Code (Plain Java)

Data Feed Adapters

Process Events (CEP)

Listener/SINK: User Code (Plain Java)
• Events generated at sources

• Adaptor captures event and sends it into the Event Processing Network
Event Processing

- Events processed in flight
- Merging multiple event sources and types
- Data enrichment by accessing external data sources (e.g. databases)
Event Dispatch

- Processing produces events
- Adaptor receives event and sends it into the downstream clients
3. Dynamic Complex Event Processing
Dynamic Environment

• Devices do not operate in a static environment
• Inputs change
• Knowledge is gained from analytics
• Additional systems want to receive the output
Dynamic Behavior

• Our Complex Event Processing engine needs to be dynamic
• Ability to change behavior without stopping the flow
• Allow a higher level system to change the processing rules
Enter OSGi

- Dynamic Modular System for Java
- Mature Lightweight Application Framework
  - Ideal for embedded environments
- Supports Module Lifecycle
  - Install/start/stop/uninstall/upgrade
  - Remotely manageable
  - Versioning
- Services Model
  - Advertise and discover services
  - Modules are dependent on service not implementation

Powered by OSGi Alliance
OSGi Deployment Environment

OSGi Management System & Repository

Remote Device

Data/Msg. Feeds

OSGi - CEP

Data Feed Adapters
Process Events (CEP)
Listener/SINK: User Code (Plain Java)

OSGi Framework
Java

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Dynamically Changing Behavior

Deployed System. Happily processing...

OSGi Management System & Repository

Remote Device

OSGi CEP

<table>
<thead>
<tr>
<th>Data Feed Adapters</th>
<th>Process Events (CEP)</th>
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Dynamically Changing Behavior

The Data Inputs Change
Dynamically Changing Behavior

Update the adaptor

OSGi Management System & Repository

Remote Device
Dynamically Changing Behavior

Process the Events Differently

OSGi Management System & Repository

Data/Msg. Feeds

Data Feed Adapters

Process Events (CEP)

Listener/SINK: User Code (Plain Java)

Remote Device
Dynamically Changing Behavior

Forward to additional locations for processing

OSGi Management System & Repository

Remote Device
Dynamically Changing Behavior

Happily processing again…

OSGi Management System & Repository

Remote Device

Data/Msg. Feeds

OSGI CEP

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How OSGi and Java enables smart data on M2M aggregators and gateways.

4. Demo
Example: JavaOne IoT In Motion
The Components
The Components

• OSGi based
• Continuous Query Language (CQL) for defining rules
  • http://www.oracle.com/us/technologies/java/embedded/event-processing/overview/index.html?ssSourceSiteId=opn

• Arm Based Linux platform
  • http://www.raspberrypi.org/

• USB hardware devices
  • Open and inexpensive
  • http://www.phidgets.com/

• Hitachi’s OSGi Framework
Dynamic Behavior In Action

Start reporting temperature changes below ambient temperature

```
192.168.1.3 - PuTTY

Attention!!!! Temp Changing:
Ambient Temp: 23.8125
Probe Temp: 12.1953

----------------------------------
LCD: line 0 [Amb Temp: 23.7813 C]
LCD: line 1 [Therm Temp: 8.5368 C]
----------------------------------

Attention!!!! Temp Changing:
Ambient Temp: 23.7813
Probe Temp: 8.5368

----------------------------------
LCD: line 0 [Amb Temp: 23.7813 C]
LCD: line 1 [Therm Temp: 5.6788 C]
----------------------------------

Attention!!!! Temp Changing:
Ambient Temp: 23.7813
Probe Temp: 5.6788
```

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Dynamic Behavior In Action

Change the rules and redeploy remotely
Dynamic Behavior In Action

Now reporting temperature changes above ambient temperature

```plaintext
---
Attention!!! Temp Changing:
Ambient Temp: 23.8594
Probe Temp: 25.7484
---

---

Attention!!! Temp Changing:
Ambient Temp: 23.8672
Probe Temp: 26.3546
---

---

Attention!!! Temp Changing:
Ambient Temp: 23.8672
Probe Temp: 25.8299
---
```
END

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6/12/2014

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Human Dreams. Make IT Real.
HITACHI
Inspire the Next
Appendix
2012

3 006 477 107 200 GB added to the “digital universe”
~30% of it generated by machines

2020

42 949 673 000 000 GB – 15 x increase
42 % will be generated by devices

According to IDC’s “Digital Universe in 2020“ study published in December 2012
What Happens in an **Internet Minute**?

- 639,800 GB of global IP data transferred
- 204 million Emails sent
- 47,000 App downloads
- 583,000 In sales
- 135 New mobile users
- 1,300 New mobile users
- 6 New Wikipedia articles published
- 100+ New LinkedIn accounts
- 277,000 Logins
- 2+ million Search queries
- 30 Hours of video uploaded
- 1.3 million Video views
- 3,000 Photo uploads
- 20 million Photo views
- 61,141 Hours of music
- 320+ New Twitter accounts
- 100,000 New tweets

And Future Growth is Staggering

Today, the number of networked devices = the global population
By 2015, the number of networked devices = 2x the global population
In 2015, it would take you 5 years to view all video crossing IP networks each second

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Variety

Web and Social Media
- Clickstream Data
- Twitter Feeds
- Facebook Postings
- Web Content

Machine-to-Machine
- Smart Meters Readings
- RFID Readings
- Oil Rig Sensors
- GP Signals

Big Transaction Data
- Healthcare Claims
- Telecommunication Call Details Record
- Utility Billing Records

Biometrics
- Facial Recognition
- Genetics

Human Generated
- Call Center Voice Recording
- Email
- Electronic Medical Records