Building the Internet of Things

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Agenda

Overview of IoT Reference Model – Jim Green

Introduction to the Reference Model

Security, Interoperability, Scalability – Brian McCarson

HW and SW Features for an E2E Lockdown
Protocol Abstraction
Scaled Compute Intelligence

IBM Section – Mac Devine

Trusted Security
IoT Foundational Cloud Services
Real-time Analytics
Basic Premises

Devices
send and receive data interacting with the

Network
where the data is transmitted, normalized, and filtered using

Edge Computing
before landing in

Data storage / Databases
accessible by

Applications
which process it and provide it to people who will

Act and Collaborate

Standards based approaches are required to enable the IoT industry
IoT World Forum Reference Model

Levels

7. **Collaboration & Processes**
   (Involving People & Business Processes)

6. **Application**
   (Reporting, Analytics, Control)

5. **Data Abstraction**
   (Aggregation & Access)

4. **Data Accumulation**
   (Storage)

3. **Edge Computing**
   (Data Element Analysis & Transformation)

2. **Connectivity**
   (Communication & Processing Units)

1. **Physical Devices & Controllers**
   (The “Things” in IoT)
Internet of Things Reference Model Objectives

Levels

1. Sensors, Devices, Machines, Intelligent Edge Nodes of all types

2. Edge

3. OT

4. Event Based

5. Data in Motion

6. Real Time

7. IT

Query Based

Data at Rest

Non-real Time
Bridging IT and OT

Key Point:
IT – OT
Bridging IT and OT: Introducing IoT “Edgeware”

Device Control
- Configure (from the device provider)
- Status (from the device provider)

Device Interactions
- Discovery
- Addressing
- Protocol conversion

Middleware
- Listeners (Zigbee), brokers (MQTT)
- Event grouping / batch interactions

Data
- Normalize (standardize codes for the app)
- Filter (against pre-set criteria from the app)
- Expand (decode/expand cryptic codes)
- Aggregate (generate statistics)
- Notify/alert (to the app)

Combine the functions above
- Schedule (when to comm with the device)
- BPM (when multiple steps are needed)

Security
- Roles
- Privileges

An individual edge software function may serve many applications

Edge computing

Edge software can be sourced completely separately from the vertical application
Bridging IT and OT: Handling the Volume of Data

Key Points:
• IT–OT
• Decoupling

Issue: Devices may generate data faster than apps can ingest it

Levels

1. Edge
   Sensors, Devices, Machines, Intelligent Edge Nodes of all types

2.  
3.  
4.  
5.  
6.  
7. Center

Apps

Devices
Interoperability: Enable Edgeware and Applications from Different Vendors

Key Points:
• IT – OT
• Decoupling
  - Scalability
  - Agility
• Interoperability
The “Cache and Batch” Sequence Pattern
(decouple the application from the data capture)
Interoperability: The Next Step is Defining Interfaces, Prototyping, and Testing

Key Points:

• IT–OT Decoupling
• Scalability
• Agility

Center

Abstraction Layer

Edge
Sensors, Devices, Machines, Intelligent Edge Nodes of all types
Embracing Legacy Applications

Key Point:
• IoT Enablement of Legacy Applications

Levels

1. Edge
   Sensors, Devices, Machines, Intelligent Edge Nodes of all types

2.

3.

4.

5.

6.

7.
The Legacy Application Compatibility Sequence Pattern (use the existing DB and schema)
The Internet of Things and Analytics

Key Point:
• Enabling IoT Analytics
Sampling and Analytics Sequence Pattern

Time

Data Collection
Proxy and Streaming Inserts

Request

Reply

Edge software

Device Driver

Temporary storage

Relational data

Analytics

Application

Request

Reply

Request

Reply
Analytics Using Both OT and IT Data

Key Point:
- Integration with the Enterprise

Levels

7
6
5
4
3
2
1

Center

Edge
Sensors, Devices, Machines, Intelligent Edge Nodes of all types
Analytics on Mixed OT and IT Data Sequence Pattern

Data Collection
Proxy and Streaming Inserts

Data Integration / Virtualization

Application

Analytics

Request

Reply

Request

Reply

Request

Reply

OT data

IT Data

Edge software

Device Driver

Temporary storage
Key Point: An Open IoT Framework
The Complete IoT System

Key Points:
- Bridging IT & OT
- Decoupling
  - Scalability
  - Agility
- Interoperability
- Legacy Compatibility
- Analytics
- Integrated with the Enterprise

Next Steps:
- Interfaces
- IIC Prototyping

Levels

1. Edge
   - Sensors, Devices, Machines,
     Intelligent Edge Nodes of all types

2. Center

3. Edge

4. Edge

5. Center

6. Center

7. Center

Next Steps:
- Interfaces
- IIC Prototyping
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  Logical description with emphasis on abstraction layer

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IBM Section – Mac Devine
  Trusted Security
  IoT Foundational Cloud Services
  Real-time Analytics
Essential Tenets of Edge to Cloud IoT Solutions

- Infrastructure to Monetize HW, SW, and Data Management from Edge to Cloud
- Value Visualized by Broad Analytics Infrastructure from Edge to Cloud
- Data Normalization through Protocol Abstraction
- Automated Discovery and Provisioning to Ease Deployment of Edge Devices
- Security as the Foundation with Embedded HW and SW-Level Protection
HW ID: Immutable identification for each compute device to enable secure, automated provisioning.

Secure Boot: Kernel-level device image to enable secure device provisioning at OS/BIOS level.

White Listing: Secure image of allowable agents/applications for that specific device.
Unlocking Value thru Protocol Abstraction, APIs

Countless legacy systems require connecting to many disparate protocols. Abstraction layers can enable seamless ingestion of data from disparate sources so developers can create value across market segments.
Unlocking Value thru Protocol Abstraction, APIs

Abstraction layers can reside at the Edge Compute (aka: Gateway) level or the Network/Cloud Compute level of the IoT solution stack.
E2E Compute Scalability: Flexible Intelligence

Edge Compute (Gateway)

Network/Cloud Compute

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- Trusted Security
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Internet of Things is a realization of Smarter Planet

**Smarter Planet ...**

Our world is becoming **INSTRUMENTED**

30 billion RFID tags ... 2010

Our world is becoming **INTERCONNECTED**

~2 billion people on the Web ... 2011
... a trillion connected objects

All things becoming **INTELLIGENT**

15 petabytes of new information generated daily...
Internet of Things – Cloud Delivered Services

The model is based on “Information Flow”

SoftLayer Flow DataStream
Beta site up, running, and open for registration at https://fds.flow.net

IoT Foundational Services
Management
Center
Edge
Control Data Policy

Security – Trusted Computing

Industry Specific Apps and Plugins

Real-time Data (push)

Acquiring Data (pull)

Stream Dashboards App Builder

Flow Stream Processing Platform
Building a chain of trust from IoT Smart Devices to the SoftLayer Cloud

- **Trusted** computing environment
- **Controlled** VM distribution
- **Enhanced** IT compliance

<table>
<thead>
<tr>
<th>VM/Workload Policy Management</th>
<th>Virtustream, HyTrust; specify and define granular security policies and enforce these policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trusted Compute Pool (TCP)</td>
<td>Use virtualization management and orchestration software to create TCP (aggregation of trusted systems)</td>
</tr>
<tr>
<td>Intel TXT and TPM</td>
<td>Select Intel Trusted Execution Technology (TXT) for trusted platform launch with hardware-based root of trust</td>
</tr>
<tr>
<td>Server Isolation</td>
<td>Select bare metal server for server isolation</td>
</tr>
<tr>
<td>Geo Placement</td>
<td>Select SoftLayer Data Center in your country of choice</td>
</tr>
</tbody>
</table>

Protection against fraud and data breaches

Actors | Threats | Mitigations

**Threats**
- Web application vulnerabilities
- Exploits
- Man in the middle
- Password attacks
- Information gathering/data leakage/eavesdropping
- Rogue clients

**Protections**
- OS Integrity
- Authentication/Authorization
- Data Security
- Anomaly Detection
- API Sanitization and Privacy
- Secure Development/Delivery
- Security Design and Testing Services
IoT as a Composable Business

IoT end-end solutions
Connected appliance solutions, Smarter home solutions, ...

IoT Related Bluemix services
Rules, Push, Geo location, Analytics, Asset management, Predictive Maintenance, ...

Device Registration
Device Connectivity
Historian
Visual wiring

IoT Foundation Services

IoT SDKs

Devices & Gateways

REST APIs

Design & Engineer
things and applications addressing requirements, management and complex system design processes

App tips open community

Device recipe open community
IoT Foundation Services – Open SDN Services
IoT Foundation Services – Managed Data Services

Enables web and mobile developers to eliminate complexity through

A NoSQL data layer delivered as a managed service

Advanced indexing and querying capabilities

Speed and agility for the developer

Flexible consumption models

Massive scaling for number of users and read/write operations

IBM offers a full range of database services for cloud developers

- BLU Acceleration
- MapReduce/Hadoop
- SQL Database
- JSON database
- Mobile data
- NoSQL Database
Analytics must be performed at the right layer, at the right time & with the right actionable insights.
Real-time Analytics for IoT via Flow DataStream
Better outcomes driven by data, analytics, and business process optimization

Connect, Collect, & Command
a wide variety of devices with different patterns of data volume, variety and velocity

Operate
infrastructure safely and securely from rollout to production

Manage
the lifecycle of assets ensuring safe, reliable and predictive operations

Analyze & Optimize
information from across the lifecycle leveraging insight for action
EVANGELIZING
SMART CITY
TECHNOLOGY

ENTERPRISE PARTNERS

SMART CITY OPEN SOURCE COMMUNITY

IBM
SMART CITY HACKATHON WORLD TOUR

MAKER LABS

4X4 FUNCTIONAL SMART CITY MODEL
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Your input is essential in helping the IoTWF steering committee improve the quality of sessions for IoTWF 2015.

If you haven’t already downloaded the app, you can do so at customers.genie-connect.com/iotwf2014 on your mobile device.