Fast Innovation requires Fast IT
Building the Internet of Things
It’s Huge, but What Is It?

2010
12.5 Billion

2015
25 Billion

2020
50 Billion
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
Internet of Things 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)
The model is based on “Information Flow”
Internet of Things Reference Model Objectives

Levels

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

2. 

3. 

4. 

5. 

6. 

7. Center
   - IT
     - Query Based
     - Data at Rest
     - Non-real Time
   - OT
     - Event Based
     - Data in Motion
     - Real Time

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Bridging IT and OT

Key Point: IT – OT

Levels

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

Center

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
Bridging IT and OT: Handling the Volume of Data

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

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The “Cache and Batch” Sequence Pattern
(decouple the application from the data capture)
Interoperability: Enable Edgeware and Applications from Different Vendors

Key Points:
- IT – OT
- Decoupling
  - Scalability
  - Agility
- Interoperability

Levels:
- 1: Edge, Sensors, Devices, Machines, Intelligent Edge Nodes of all types
- 2: Abstraction Layer
- 3
- 4
- 5
- 6
- 7: Center
Acknowledgement to the IoT “Edge” Software Vendors
Interoperability: The Next Step is Defining Interfaces, Prototyping, and Testing

**Center**

**Abstraction Layer**

**Edge**

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

**Key Points:**
- IT – OT
- Decoupling
- Scalability
- Agility
- Interoperability
Key Point:
- IoT Enablement of Legacy Applications
The Legacy Application Compatibility Sequence Pattern
(use the existing DB and schema)
Internet of Things Reference Model

Levels

7
6
5
4
3
2
1

Center

Edge

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

Key Points:
- IT – OT
- Decoupling
  - Scalability
  - Agility
- Interoperability
- Legacy Compatibility
The Internet of Things and Analytics

Key Point:
• Enabling IoT Analytics

Levels

1. Sensors, Devices, Machines, Intelligent Edge Nodes of all types
2. 
3. 
4. 
5. 
6. 
7. Analytics
IoT Analytics Introduces New Complexities to Analytics

Key Issues:
• The velocity and volume of data may be huge
• In some cases, most of the data is unimportant
Analytics Using Both OT and IT Data

Key Point:
- Integration with the Enterprise
These “Sequence Patterns” Help Us Define the “Abstraction API”
Abstraction API

Application

Edge software

Device Driver

OT data

Analytics

IT Data

Sample Data

Data Collection / Proxy and Streaming Inserts

Data Abstraction

Data Integration / Virtualization

Data Accumulation

Edge Computing

Connectivity

Physical Devices

Key Point:
An Open IoT Framework
The Complete IoT System

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

Levels

1. Sensors, Devices, Machines, Intelligent Edge Nodes of all types
2. Edge
3. 
4. 
5. 
6. 
7. Center
Thank you.