IoT Power Session

IoT Bogdan Doinea
Systems Engineer

19 Oct 2016
Heroes

Harap Alb

Superman

Star Wars
Information Management: A Proposal

Abstract

This proposal concerns the management of general information about accelerators and experiments at CERN. It discusses the problems of loss of information about complex evolving systems and derives a solution based on a distributed hypertext system.

Keywords: Hypertext, Computer conferencing, Document retrieval, Information management, Project control
An optimized Internet for human-generated data

What can we achieve with this?
Human-generated data is changing immense paradigms.
Human-generated data is changing immense paradigms
Machine Learning – the road to AI

19 Octombrie 2016 | București, România
What comes next?

3x More Machine Data than Human Data by 2020
The Challenge of IoT: Evolving the Internet to incorporate and integrate Machine-Generated Data
How Cisco addresses this:

**Big/Massive amount of Machine-Generated Data**

**Massive amount of things, each producing a small amount of Data**
Integrating Big/Massive Machine-Generated Data on the Internet (of Things)

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Cloud
Levels

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

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

5. **Data Abstraction**
   (Virtualization, Federation, Caching)

4. **Data Accumulation**
   (Storage)

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

2. **Connectivity + Fog Computing**
   (Communication & Processing Units)

1. **Physical Devices & Controllers**
   (The “Things” in IoT)
Fog Application Dev Software Model

Traditional Approach – Take Data to the Processing

IoT Device → Data → Processing

Take Processing to the Data

IoT Device → Data → Fog Node → Data → Cisco Parstream → Data → Processing

Cisco Connect
IoT System – Fog, App SDK, Management, Security Integrated

Fog-Ready Secured Network Infrastructure

- IR 809/829, CGR 1120/1240, C819
- IE4k Concept app hosting ISR4k, etc.

Fog Director - Fog Application Management

Fog Application Framework

IOx

- IOS Application Framework
- Linux Application Management
- IOx Services

Developer Toolkits and SDK

Partner ecosystem
**Interface Specifications**

- 4G / LTE (w/ GPS) + 802.11 b/g/n Wi-Fi (2.4 / 5 GHz)
- with Dual SIMs
- Ethernet: 4 GE LAN (w/ POE) + 1 GE WAN
- Serial: 2 x RJ-45
- Networked USB (HW ready- future SW release)
- Motion detector (HW ready- future SW release)

**Power Specifications**

- 6-30 VDC power supply options
- 30 W available for POE
- Automotive grade power supply

**Form Factor Specifications**

- IP-54 rating
- Compact form factor
- Fixed configurations- Panel / DIN rail / Door mount
- Extended Temperature range
Interface Specifications
4G / LTE (w/ GPS)
Ethernet: 2 x 10/100 routed ports
Serial: 2 x RJ-45
Networked USB (HW ready- future SW release)
Motion detector (HW ready- future SW release)
Digital Alarm Input (HW ready- future SW release)

Power Specifications
9-60 VDC power supply options

Form Factor Specifications
Compact form factor: Tentative dimensions: 5” x 6.25” x 1.25”
Fixed configurations- Panel / DIN rail / Door mount
IP-30 rating
Extended Temperature range
Product: **ES200 - SCADA Visibility and Automation in sub-secondary stations.**
- Smart RTU implemented on the IR809, with Eximprod Group

**ES200 – Product Highlights**
- One-box solution for both RTU and Router
- Secure Connectivity with on-demand IPSec tunnels to Dispatcher
- Compatibility with any SCADA dispatcher
- SCADA Visibility
Product: **ENEF** – improving energy efficiency in your Process Network by 15-25% (savings can go up to 1M$/year)

Includes Energy Auditing, Continuous Monitoring and Efficiency/Optimization Measurable Actions
Oil Use-Case: Monitoring a Refinery
Reduction in Defects
49%
Defect rate down from 4.9% to 2.5%

Reduced Downtime
48%
Unplanned downtime down from 11% to 5.8%

New Product Introduction
23%
New product introduction cycle time reduced from 15 to 11

OEE Improvement
16%
Average OEE improved from 74% to 86%

Improved Inventory
35%
Inventory turns increased from 14 to 19

Reduction in Energy Use
18%
Annual energy cost down from $8.4M to $6.9M

The Real Economic Value is Immense
SCADA/Industrial NGFW

Rule

alert tcp $104_CLIENT any -> $104_SERVER $104_PORTS (flow: established; content:"\[68\]"; offset:0; depth:1; pcre:"/\[S\]<[5]\[x2D]\[x2E]\[x2F]\[x30]\[x64]\[x65]/iAR"; content:"\[06\]"; offset: 8; depth: 1; msg:"17: SCADA_IDS: IEC 60870-5-104 – Suspicious Value of Transmission Cause Field"; classtype:bad-unknown; sid:6666617; rev:1; priority:2;)

Alert

[Classification: Potentially Bad Traffic] [Priority: 2]
09/09-14:06:10.462288 10.50.50.105:40734 -> 10.50.50.75:22
TCP TTL:64 TOS:0x0 ID:60033 lplEn:20 DgmLen:60 DF
http://2.2.2.2:1234/abc 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
Cisco Stealthwatch Behavioral Analysis and Anomaly Detection
- Network Segmentation
- Incident Response
- Insider Threat
- Targeted Attack
- Zero Day Malware Propagation Internally
- Slow Network – investigation
- A Simple-Web Interface to work with

Real-Time Communications Security Architecture

Security for Systems with Real-Time Constraints
Integrating a Massive amount of things on the Internet (of Things)

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Use-Cases that are interesting

- Smart water/gas metering
- Public lighting
- Smart building
- Smart parking
- Assets Tracking
- Smart Agriculture, i.e. leak detection and irrigation
- Water level and flood management
- Fault management
- Security services, i.e. Smoke detectors
- Smart energy and fast demand response
- Waste management
- Traffic management
LoRa Alliance – Have created the LoRaWAN Standard
LoRaWAN— for local, integrated, secure sensor networks

Backhaul

Long Range

Pub/Priv outdoor WiFi

Pub/Priv Outdoor WiFi

Cellular Backhaul

Short Range

Smart Home

RF Mesh

RF Mesh

Smart Building

Medium Range

RF

Serial WiFi

Wearables

Wearables

RF Mesh

PLC

Wearables

RF Mesh

PLC

Industrial

Agriculture Mining etc..

Smart Grid

Connecting the Unconnected

LPWA Approach

Pub/Priv Outdoor WiFi

WiFi

2G

3G

Wireless HART

Connecting the Unconnected
<table>
<thead>
<tr>
<th>Technology</th>
<th>2G</th>
<th>3G</th>
<th>LTE</th>
<th>WIFI</th>
<th>Zigbee</th>
<th>Wireless Hart</th>
<th>802.15.4g</th>
<th>LoRaWAN</th>
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<tbody>
<tr>
<td>Long Range</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Limited (1.5 Km)</td>
<td>Yes (10s Km)</td>
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<tr>
<td>Tx Current Consumption (3V)</td>
<td>30mA to 400mA</td>
<td>500 to 1000mA</td>
<td>600 to 1100 mA</td>
<td>19 to 400 mA</td>
<td>34mA</td>
<td>28mA</td>
<td>~ 35mA</td>
<td>20-70mA</td>
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<tr>
<td>Topology</td>
<td>P2P</td>
<td>P2P</td>
<td>P2P</td>
<td>P2P/Mesh</td>
<td>Mesh</td>
<td>Mesh</td>
<td>Mesh</td>
<td>Hub and Spoke</td>
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<tr>
<td>Standby Current Consumption (3V)</td>
<td>0.35 mA</td>
<td>1.2 to 3.5mA</td>
<td>1.5 to 5.5mA</td>
<td>1.1 mA</td>
<td>0.003mA</td>
<td>0.008mA</td>
<td>~.005mA</td>
<td>0.005mA</td>
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<tr>
<td>Operating Life on battery (2000mAh)</td>
<td>4-8 hours (A)</td>
<td>2-4 hours (A)</td>
<td>2-3 hours (A)</td>
<td>4-8 hours (A)</td>
<td>60 hours (A)</td>
<td>8-10 years</td>
<td>Variable</td>
<td>10-20 Years</td>
</tr>
<tr>
<td>A=Active I=Idle</td>
<td>36 days (I)</td>
<td>20 days (I)</td>
<td>12 days (I)</td>
<td>50 hours (I)</td>
<td>60 hours (A)</td>
<td>8-10 years</td>
<td>Variable</td>
<td>10-20 Years</td>
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<tr>
<td>Module Cost</td>
<td>$12</td>
<td>$35-$50</td>
<td>$40-$80</td>
<td>$5-$8</td>
<td>$6-$12</td>
<td>NC</td>
<td>$3</td>
<td>$2-$5</td>
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<tr>
<td>Spectrum Costs</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No (Unlicensed)</td>
<td>No (Unlicensed)</td>
<td>No (Unlicensed)</td>
<td>No (Unlicensed)</td>
<td>No (Unlicensed)</td>
</tr>
</tbody>
</table>
LoRaWAN End-to-End Architecture

- **LoRaWAN™ Devices**: Certification program by LoRa Alliance
- **Gateway**: Semtech HW reference design Version 2.0
- **Network Servers**: MAC decaps, Security, Network/Radio management, Message scheduling, ZTD etc...
- **Application Servers**: Platform for ASP e.g., Parking, Air quality, Meter reading

**RF**

**Backhaul**

**Roaming (LoRaWAN™ 1.1)**

**API**

**Application Servers**

**Network Servers**

**Gateway**

**LoRaWAN™ MAC**

**IP Tunnel**

**IP Transport**

**App Data**
LoRaWAN Deployment Architecture

- **Power source**: Cisco® IR809
- **Enclosure or Ground cabinet**
- **GPS antenna** (optional)
- **4G antennas** (if cellular backhaul)
- **Main and Diversity Antenna Feeder RF Cable x 2**
- **Lightning arrestor x 2**
- **LoRaWAN™ Interface Omni Antenna x 2**
- **LoRaWAN™ Interface GPS Antenna and cable**
- **Ethernet PoE+ cable**
- **PoE+ Injector and 10kV surge protector**
- **Cisco Interface Module for LoRaWAN™ Ethernet backhaul**
Cisco LoRaWAN Interface Module adds LoRaWAN Gateway services to Cisco® IoT routers
- IR809, IR829, CGR 1000 (future)
- Based on Semtech reference design version 2.0, ready for geo-location feature set (software upgrade in Q4 CY16)
- Carrier and industrial grade: IP67 rating, PoE+ power, GPS, main and diversity antennas,…

Cisco LoRaWAN Interface Module fully supports LoRaWAN 1.0.1 specifications
- 868 MHz and 915 MHz SKUs – regional profiles through Thingpark LoRa Network Server
- LoRaWAN devices class A, B and C
- Full integration with Actility Thingpark LoRa Network Server

Enables flexible topologies – one to multiple Cisco LoRaWAN Interface modules on IR800

- New Cisco IOS® Software “Virtual-LPWA” interface management and Cisco IoT FND 3.1 support
- 16 LoRaWAN Channels
Any uplink demodulated by a gateway is time-stamped with an accuracy better than 30nsec; also adds RSSI, SNR tags.

When an uplink is received by at least 3 gateways, the position of the transmitter can be estimated by TDOA (Time Difference of Arrival).

No Time Of Flight measurement is required.

Any LoRaWAN™ frame (1.0 or later) can be time-stamped, hence, located, without modification.
Creating a Community of Software Developers who Leverage Cisco Technology in Their Work

Enabling a Robust Developer Ecosystem

Engineering Platform APIs | SDKs and Tools | Developer Support | Community Management

To Build Compelling and Innovative Apps

http://developer.cisco.com
Overview

• Fog Computing Model – Cisco IoX and Fog Director
• Utilities Use-Case: SCADA Visibility and Automation with Eximprod
• Energy Use-Case: Energy Efficiency with Quartz
• Other markets currently piloting: manufacturing, oil&gas
• IoT Security with ISA3000 and Cisco Stealthwatch
• LoRa = Radio IoT for Enterprise and SP
• DevNet