Managing at the Edge with Kinetic

Jock Reed – Technologist / Dev Evangelist – Cisco DevNet
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Agenda

- Introduction
- State of IoT Fog and Edge Devices
- Kinetic Cloud Gateway management
- Compute and networking at the Edge
- Ease of Applications
- Conclusion
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Share Your Thoughts

Engage with the presenters and other participants to let us know what you’re thinking

Share Content

Look in this space for important content from the presentation to take away
Cisco IoT System

- A broad portfolio of IoT infrastructure technologies and products gives you deeper insights with analytics on IoT data
- Better secure your physical and digital assets and data
- Innovate by creating and deploying IoT applications from Fog to Cloud

Six Pillars
- Network Connectivity
- Fog Computing
- Security: Cyber and Physical
- Data Analytics
- Management and Automation
- Application Enablement Platform

Where does digital transformation actually happen? **By Who?**
## Cisco IoT System

### Connected Factory • Connected Train • City Safety and Security • Energy Distribution Automation • Connected Well

<table>
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<tr>
<th>Industrial Switching</th>
<th>Industrial Routing</th>
<th>Industrial Wireless</th>
<th>Field Network</th>
<th>Embedded Networks</th>
<th>Connected Safety and Security</th>
<th>Digital Media</th>
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<tbody>
<tr>
<td>IE 2000</td>
<td>CGR 2000</td>
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<td>5900 ESR, ESS 2020</td>
<td>Video Surveillance Manager and IP Cameras</td>
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<td>Software Router</td>
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<td>Positive Train Control</td>
<td>809H</td>
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</tbody>
</table>

### IoT Security

### Application Enablement [Fog Computing/IOx]

### Management
Cisco IoT System

SOLUTIONS
- Transportation
- Oil and Gas
- Manufacturing
- Service Provider
- City
- Defense
- Utility
- Public Safety

APPLICATIONS
- Application Enablement
- Fog Services
- IoT Connectivity
- Management and Automation

ECOSYSTEM
- Security

Interconnected services and solutions for various industries, including:
- City
- Defense
- Utility
- Public Safety
- Transportation
- Oil and Gas
- Manufacturing
- Service Provider
- City
- Defense
- Utility
- Public Safety
- Transportation
- Oil and Gas
- Manufacturing
- Service Provider

Cisco live!
Fog Computing Use Cases

Smart Transportation Systems

Integrating thousands of sensors and actuators in a vehicle with Fog computing

Roadside/Trackside/Riverside Fog nodes implement local applications to keep the infrastructure safe and efficient

Low latency, bandwidth efficiency and reliability of Fog sets the stage for autonomous vehicles

Oil and Gas Exploration, Production and Distribution

Drilling rigs use high performance Fog capabilities for Temp. Sensing (DTS) & Acoustic Sensing (iDAS)

Production wells and pipelines can be closely monitored and controlled by Fog resources

Even gas stations can benefit from Fog-based control, security, safety, and retail experience apps.

Preventive Maintenance

Sensor and actuator data stream aggregation

Analytics to detect impending failures

Taking low-latency action based upon dynamic sensor readings

Communication with Cloud based resources using limited bandwidth
Can’t run everything in the Cloud. There are latency, mobility, geographic focus, network bandwidth, reliability, security and privacy challenges.

Use layers of Fog Nodes. Applications can be partitioned to run at the optimal network level.

Can’t run everything in endpoints. There are energy, space, capacity, environmental, reliability, modularity, and security challenges.
# Need for Fog: Latency on a Log Scale

<table>
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<tr>
<th>Application Examples</th>
<th>Latency</th>
<th>Implementation</th>
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<tbody>
<tr>
<td>Big Data file download, Offline backup</td>
<td>100 s</td>
<td>Easy with Cloud</td>
</tr>
<tr>
<td>YouTube, Home automation, Video surveillance</td>
<td>10 s</td>
<td></td>
</tr>
<tr>
<td>Web search, Sensor readings</td>
<td>1 s</td>
<td>Challenging with Cloud</td>
</tr>
<tr>
<td>Interactive web site, Smart building, Analytics</td>
<td>100 ms</td>
<td></td>
</tr>
<tr>
<td>Virtual reality, Smart transportation, Games, Finance</td>
<td>10 ms</td>
<td>Impossible with Cloud – needs Fog</td>
</tr>
<tr>
<td>Haptics, Robotics, Real-time manufacturing processes</td>
<td>1 ms</td>
<td></td>
</tr>
</tbody>
</table>
Applications in Fog Computing

Fog Computing

• What is Fog Computing?
  • An application architecture design combining compute, storage, control, management, and inter-communication of edge devices and clients
  • Extension of the cloud down to the things
  • One of the pillars of the Cisco IoT System

• Why do we need another concept?
  • Fog refers to a unique problem domain
  • Fog addresses network issues of latency, bandwidth and operational issues of autonomous operation, in-flow data analysis, and management overload

Applications in Fog Computing

IoT Applications at the Edge

- Data Center and Cloud
- Core
- Edge
- Embedded and Sensors

*IoT PaaS Platforms*

- Application
- Application
- Application

*Controllers, Management Systems, Billing, Operations, etc.*

- Business Applications
- Analytics Applications

- High Latency
- Bandwidth Constrained
- Too Much Data
- No Local Control
- Disconnected Operation
- Unstable Links

- Business Applications
- Analytics Applications

**Applications in Fog Computing**

- IoT Applications at the Edge
  - Controllers, Management Systems, Billing, Operations, etc.
  - Application
  - Application
  - Application

- IoT PaaS Platforms
  - Business Applications
  - Analytics Applications

- No Local Control
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Applications in Fog Computing

**Transportation**
- What data is critical from a moving vehicle?
- How do you respond to data that is (literally) in motion?
- How do they work together?

**Agriculture**
- How much data does a cow generate?
- Or a field of crops?
- Does all of that data need to go back up to the cloud?

**Enterprise**
- What information is locked in dark assets in every building or campus?
- How do I connect to a legacy serial device?

**Manufacturing**
- How do you monitor people and materials in motion?
- What can be improved with real-time data at every step of the manufacturing process?
What is Cisco Kinetic?

A platform to manage and deliver data from sensors and devices to the cloud and applications.

Enables hosting of applications and services at the network edge across different hardware platforms.

Provides an compute platform.

Cloud Management of Gateways and Applications.
Why Cisco Kinetic?

• Distributed Compute
  • Run, manage and monitor applications within the Fog

• Secure Communications
  • Use IOS networking and security services

• Powerful Integration
  • Connect sensors to the cloud with IoT integration and middleware services

• Cloud management
  • Takes Cisco IOx and manages those elements for you.
Cisco Kinetic

Functional Elements: Message Brokering at Scale

Cloud Management
- Gateways
- Applications
- Network

Data Acquisition
- Device Protocol Normalization
- Data Ingestion at Scale
- Secure Multi-tenant Architecture

Data Management and Orchestration
- Data Transformation
- Policy based Data Management/Routing
- Complex Event Processing

Device Console
- Data observations
- Policy Management
- Device Health
- SDK/APIs
Where is Data Processed?

Traditional Approach – Taking Data to the Processing

IoT Device \[\rightarrow\] Data \[\rightarrow\] Processing

Taking Processing to the Data

IoT Device \[\leftrightarrow\] Fog Node \[\rightarrow\] Processing \[\rightarrow\] Data

Fog Node \[\rightarrow\] Processing \[\rightarrow\] Data

Fog Node \[\rightarrow\] Processing \[\rightarrow\] Data

Processing
Cisco IoT Data Connect

- **Cloud**
- **Edge and Fog (gateways, servers)**
- **Devices**

**Connectors** (e.g. MTConnect)

**Data**:
- Access, policies, transformation

**Data delivery engine** to move and view data

**Single plane of glass**
(Management of Gateways, Applications, Network)

**Data Pipeline**

**Kinetic**
Demo
Building a Kinetic Application
A Simple Python Application

- Project Structure
  - Python Code

- Deployment / Management
  - Package the Application
  - Verify a proper Cartridge is installed

- Operation
  - View it working
Using the Docker tool chain to generate IOx applications

1. Use docker tools and images
2. Generate required docker image
3. Write suitable package descriptor file
4. Use ioxclient wrapper command and point it to generated docker image and package.yaml
5. Generates IOx compatible app
Containers and Virtual Machines

Containers are isolated but share OS and where appropriate bins/libraries.
Containers are almost like Virtual Machines

• Containers have their own network interface (and IP address)
  • Can be bridged, routed... just like with Xen, KVM etc.
• Containers have their own filesystem
  • For example a Debian host can run Fedora container (and vice-versa)
• Security: Containers are isolated from each other
  • Two containers can't harm (or even see) each other
• Resource Control: Containers are isolated and can have dedicated resources
  • Soft & hard quotas for RAM, CPU, I/O...

Though…
• Apps in Containers share the kernel of the host OS (i.e. Linux guests only)
• Containers are light-weight, fast to start, allow for >10x density compared to VMs
Containers Are...

• A way to package up our applications and dependencies.
• A way to guarantee execution consistency and portability.
• A way to keep your applications isolated.
• A way to use your compute resources without the overhead of VM’s.
Containers Are not...

• **Microservices**
  - We hear containers and microservice used a lot together.
  - Microservices benefit from a lightweight packaging, distribution and deployment solution.
  - However, you can package anything into a container, including a badly written legacy app in some cases, using containers doesn’t magically make bad code better.

• **VMs**
  - Containers are purely user-space, if you need kernel extensions/modules or a custom kernel, containers probably aren't what you’re looking for.

• **Magic**
  - They bring their own nuances and require deployment consideration just like any other toolchain.
Demo
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You’re it!