(A)l at the Edge

Unlocking New Opportunities in IoT

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Agenda

Intelligence at the Edge?
Overview of the Azure IoT Edge framework & ecosystem
AI at the Edge?
Demos!
What do these scenarios have in common?

- Predictive maintenance
- Speech recognition
- Smart retail
- Workplace safety
- Smart city
- ...
Edge is hard

SECURITY PRIVACY
Secured provisioning
Secured communication
Confidential computing

CONNECTIVITY
Limited or expansive bandwidth
Unreliable networks
Offline mode

HETEROGENOUS HARDWARE
Hardware architecture
Operating Systems

DEVOPS CI/CD
Build & deployment pipelines
IoT application pattern + edge intelligence
Edge intelligence enabled with Azure IoT Edge

- Video Camera
- IoT Edge runtime
- Azure IoT Hub
- Container Registry
- Workload description
- Custom Code (data transform)
- Azure Cognitive Services (insight)
- Custom Code (action)
- Device deployment & management

Diagram showing the integration of Azure services with IoT Edge runtime.
Basic Azure IoT Edge functionality

- Create workloads which can include high value AI
- Target workloads at the correct type of device
- Run those workloads locally on the edge gateway, in a disconnected manner
- Monitor the health of the workloads

- OPEN SOURCE!

https://github.com/Azure/iotedge
Azure IoT Edge security

- Security is critical for IoT devices
- Azure IoT Edge has an industry leading security framework
  - Secure boot
  - Secret storage
  - Correct workload
  - Encrypted communication
  - Secure execution (public preview)
  - Security monitoring
Enabling intelligent edge spectrum

Azure IoT Edge requirements

- Hardware sizing depends on workload
- Flexible architecture – ARM or AMD64
- Linux and Windows
- OCI compatible container runtime

Certify and add your device to our Device Catalog: http://aka.ms/certfaq
Azure IoT Edge features

**Open**
- Open source
- Moby-based container runtime, compatible with Docker containers
- Azure IoT Edge Marketplace for Edge modules

**Secure**
- Zero-touch provisioning of Edge devices at scale with Device Provisioning Service
- Security framework provides end to end security and support for variety of hardware-based root of trust
- Trusted computing via Open Enclave

**Intelligent**
- Services onboarded
  - Azure Machine Learning
  - Azure Stream Analytics
  - Custom Vision
  - Blob storage
  - RedisEdge
  - SQL Server on Edge
  - Alleantia Industrial GW
  - Aveva IoT Edge HMI
  - Codit Nebulus
  - Swim Enterprise
  - ... and more in the marketplace

**Enterprise ready**
- Scaled deployments with Automatic Device Configuration Service
- Use existing coding skills (C, C#, Node, Python, Java)
- Development tooling in Visual Studio and VSCode
- Multi-person development tools for CI/CD using VSTS
AI at the Edge?
Telemetry

- Predictive maintenance

Sound

- Speech

Vision

- Camera as a Sensor
- Workplace safety
- Smart retail
- Smart city
Telemetry

Sound

Vision

Predictive maintenance

Speech

Camera as a Sensor

Asset configuration

Workplace safety

Smart retail

Smart city
Built-in Anomaly Detection with Azure Stream Analytics at the Edge

- Unsupervised models for inline learning and real-time scoring
- Easily invoked with simple function calls within query language
- 5 types of anomalies detected:
  - Spikes and Dips, Slow positive/negative trend, Bi-level change
Telemetry

Predictive maintenance

Asset configuration

Sound

Speech

Vision

Camera as a Sensor

Workplace safety

Smart retail

Smart city
Online and offline bots available in private preview

Online Cortana skills

Cortana SDK

IoT Edge

http://aka.ms/CortanaSDK

Your own bot, offline

Speech-to-text

LUIS

Text-to-speech

IoT Edge

http://aka.ms/speechcontainerspreview
More containers from Cognitive Services

Custom Vision
https://www.customvision.ai

Now supports exporting object detection models!

Face detection
& Face recognition

Text recognition

http://aka.ms/visioncontainerspreview
Telemetry

Predictive maintenance

Asset configuration

Sound

Speech

Vision

Camera as a Sensor

Workplace safety

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...
Examples of Vision-capable Edge Devices

Vision AI Dev Kit
Intel Movidius
Nvidia Jetson
Nvidia Tesla
Databox Edge (Intel FPGA)

Light Edge

Heavy Edge

https://catalog.azureiotsolutions.com/
# 3 Paths to get an AI Model

<table>
<thead>
<tr>
<th>Persona</th>
<th>Use existing model</th>
<th>Customize a model</th>
<th>Build your own</th>
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<tbody>
<tr>
<td>Application developers</td>
<td>Application developers with no AI knowledge</td>
<td>Application developers with little AI knowledge</td>
<td>Data scientists</td>
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<td>Data scientists</td>
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<td>Services</td>
<td>- Edge marketplace</td>
<td>- Custom cognitive services (ex: Custom vision (public</td>
<td>- Azure Machine Learning</td>
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<td>- Text analytics (public preview)</td>
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<td>- Custom Code</td>
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<td>- Face detection (public preview)</td>
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<td>- OCR (public preview)</td>
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<tr>
<td>When</td>
<td>- Existing solution can be re-used</td>
<td>- Existing model can be re-used with your custom data</td>
<td>- Need to stay in full control</td>
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<td>- Have custom needs that cannot be</td>
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<td>approaches</td>
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2 architectures each with their trade-offs

Separate containers
Non real-time applications

- Simplicity
- Modularity
- Reusability (Edge/Cloud)

- Performances
- Cognitive Services

One modular container
Real-time applications

- Performances
- Modularity

- Complexity
- Nvidia Deepstream
DEMO

Image recognition using IoT Edge and Nvidia Jetson Nano
### Events from Belt 1 - Belt 16

<table>
<thead>
<tr>
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<th>Event</th>
<th>Time</th>
<th>View</th>
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<td>Belt 13</td>
<td>Ok</td>
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Manage your data

- Telemetry (AI model output):
  - Store and forward upstream via the edgeHub
  - Bring your own database to **store** and **query** locally

- Large files (images, videos):
  - Use a local blob store (same REST API as the cloud)
  - Use a storage gateway like Databox Edge
    - Automatically syncs your data
Get started now!

http://aka.ms/iot-edge
https://github.com/Azure/iotedge

- Check out our Vision AI DevKit
  https://aka.ms/visionaidevkit
  Join our workshops this afternoon in 204B!

- Intelligent Edge Hands-on Lab
  https://github.com/Azure/IntelligentEdgeHOL
Azure IoT Edge resources

- **Documentation** – docs.microsoft.com
  https://docs.microsoft.com/en-us/azure/iot-edge

- **Bugs** – IoT Edge OSS project GitHub issue page
  https://github.com/azure/iotedge/issues

- **Feature** requests - Azure IoT Edge User Voice forum
  https://feedback.azure.com/forums/907045-azure-iot-edge