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GBB, SSP IoT
Public Sector

Connected
Campus & School Experiences
The Internet of Things isn’t a technology revolution...
...IoT is a business revolution, enabled by technology
Waves of innovation have enabled the rise of IoT

Cloud
Globally available, unlimited compute resources

IoT
Harnessing signals from sensors and devices, managed centrally by the cloud

Edge
Intelligence offloaded from the cloud to IoT devices

AI
Breakthrough intelligence capabilities, in the cloud and on the edge
Azure IoT: Ready for the enterprise

Secure
End-to-end
From the endpoint, through the connection, to data, applications, and the cloud

Fast
Start in minutes
Preconfigured solutions for the most common IoT scenarios

Open
Connect anything
Any device, OS, data source, software, or service

Scalable
Grow effortlessly
Millions of devices, terabytes of data, on-premises, in the cloud, in the most regions worldwide

Recognized as a leader in Business Intelligence and Analytics Platforms
Recognized as a leading visionary for Internet of Things platforms

Built on the industry’s leading cloud
Hyper-Scale Azure footprint

38
Announced Azure regions worldwide
Hyper-Scale Capacity
3.5 Trillion Messages / Week

12
Azure IoT regions worldwide
We offer choice and flexibility to support the needs of all customers

Build the right solution to meet your needs

Azure IoT Suite
Preconfigured solutions on a **customizable PaaS** to accelerate common scenarios
For when you need a lot of control over your IoT solution

Microsoft IoT Central
A **fully managed SaaS** solution for IoT
For when you need to get started quickly with minimal IoT experience

Azure IoT Edge
Local processing for IoT devices
Securely distribute cloud intelligence to IoT devices quickly and at scale by using a single edge runtime
## Elements of Azure IoT Suite

<table>
<thead>
<tr>
<th>1. Connect and Manage Devices &amp; Gateways</th>
<th>2. Analyze streaming data</th>
<th>3. Integrate into business systems</th>
</tr>
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<tr>
<td>Preconfigured solutions</td>
<td>Real time analytics</td>
<td>Workflow integration</td>
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<tr>
<td>Devices &amp; Gateway</td>
<td>Data visualization</td>
<td>Push and broadcast notifications</td>
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<tr>
<td>Connect and control</td>
<td>Predictive analytics*</td>
<td>ID and access management</td>
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</table>

### 4. Secure IoT Infrastructure

- 

### 5. Customize IoT Architecture

* Only applies to Predictive Maintenance
Azure IoT Solutions big picture

**Device Connectivity & Management**
- RTOS, Linux, Windows, Android, iOS
- IoT Edge Gateway
- Protocol Adaptation

**Analytics & Operationalized Insights**
- **Cold Path Analytics**
  - Azure HDInsight, AzureML, Time Series,
  - Azure Data Lake, Data Lake Analytics
- **Hot Path Analytics**
  - Azure Stream Analytics, Azure HDInsight Storm
- **Hot Path Business Logic**
  - Service Fabric & Actor Framework, BOTS, AI

**Presentation & Business Connectivity**
- Power BI
- Logic Apps, BizTalk Services, Notification Hubs
- App Service, Websites
- Microsoft Dynamics
- Microsoft BizTalk Server
Preconfigured solutions
Remote Monitoring and Predictive Maintenance

Start quickly with preconfigured solutions

- Get started in minutes
- Modify existing rules and alerts
- Add your devices and begin tailor to your needs

Finish with your Internet of Things application

- Fine-tuned to specific assets and processes
- Highly visual for your real-time operational data
- Integrate with back-end systems
PCS: Predictive Maintenance azureiotsuite.com
What is behind IoT Suite preconfigured solutions

Devices
- Azure IoT SDK (OSS)
- Linux, RTOS, mBed, Windows, Android, iOS

C# simulator

* Machine Learning available with Predictive Maintenance only

Back end systems and processes

Azure IoT Suite Remote Monitoring and Predictive Maintenance*

- IoT Hub
- Stream Analytics
- Event Hub
- Storage blobs
- DocumentDB
- Web/ Mobile App
- Web Jobs
- Logic Apps
- Power BI
- * Azure ML

Web/ Mobile App

Web Jobs

Logic Apps

Power BI
Why the edge?

IoT in the Cloud
Remote monitoring and control
Merging remote data from across multiple IoT devices
Near infinite compute and storage to train machine learning and other advanced AI tools

IoT on the Edge
Low latency tight control loops require near real-time response
Public internet inherently unpredictable
Privacy of data and protection of IP
Life cycle management and configuration of edge device

Enable any service (Microsoft or third party) to offload intelligence to edge devices

Compose these services in solutions spanning edge and cloud

Declarative configuration of Edge

Manage edge configuration, from provisioning to decommissioning, without touching the device
Device Connectivity & Management

Telemetry Ingestion and Command & Control

Monitoring Rules & Triggered Actions

User roles and permissions

Dashboards, Visualization & Insights

Fully Hosted & Managed by Microsoft

Coming Soon: Microsoft IoT Central
Transform data into intelligent action

Data Sources
- Data Factory
- Data Catalog
- IOT Hub/Event Hubs

Apps
- SQL Data Warehouse, SQL DB, & COSMOS DB
- HDInsight (Hadoop and Spark)
- Stream Analytics

Sensors and devices
- Machine Learning
- Data Lake Analytics
- Cortana

Data
- Apps
- Automated Systems

Intelligence
- Web
- Mobile
- Bots
Microsoft Has a Comprehensive IoT and Analytics Offering

Customer equipment and devices

COLLECT
data from building equipment and third-party sources

Azure IoT Hub

TRANSFORM
data into a standardized format

Azure IoT Suite and Cortana Intelligence Suite

MANAGE
data as real-time streams and store as relational or non-relational datasets in highly-secure ISO-certified data centers

Azure Machine Learning, Stream Analytics, AI

ANALYZE and PREDICT
with machine learning and custom queries and algorithms

SQL, DW, HDInsight, Cosmos

VISUALIZE
through dashboards, reports, both in the office and while mobile

Power BI & Hololens

DECIDE and ACT
Using rules-based prioritization engines that help prioritize and monetize maintenance tasks

Azure IoT Hub
SAFETY & SECURITY

BUILDINGS & ENERGY EFFICIENCY

ACCESS, CONTROL & PAYMENTS

CONNECTED TRANSPORTATION

CONNECTED CAMPUS & SCHOOLS EXPERIENCES (CITYNEXT)

CONNECTED HEALTH

STUDENT SUCCESS ANALYTICS

STUDENT EXPERIENCE
ENERGY USAGE, FAULT DETECTION, PREDICTIVE DATA

BUILDING ENERGY EFFICIENCY
With smart buildings, schools and university campuses can save 10% or more through facilities management & energy efficiency.
What does it mean to have Smart Buildings?

- Reduce energy consumption
- Fault detection
- Reduce minor disasters
- Save money
- Go green
Microsoft deployed this solution in 2011 with our Partner ICONICS using Azure
and the system paid for itself in 18 months
The program was launched on Microsoft’s main campus

• 118 buildings
• 35,000 pieces of mechanical equipment
• 7 major building management systems
• Average daily consumption of 2M kWh of energy, producing about 280,000 metric tons of carbon emissions annually
Campus Dashboard
Created by ICONICS using Azure, Microsoft’s Cloud Offering
Snapshot of Building’s Energy Usage
Peak Load
## Fault Prioritization and Savings

<table>
<thead>
<tr>
<th>Date / Time</th>
<th>Tag</th>
<th>Prio</th>
<th>Fault Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/5/2015 1:22</td>
<td>92 Lab 4255 Damper Stuck Closed</td>
<td>3</td>
<td>$1,299</td>
</tr>
<tr>
<td>2/5/2015 7:54</td>
<td>92 Lab 2453 CCV Leaking</td>
<td>3</td>
<td>$1,067</td>
</tr>
<tr>
<td>2/5/2015 3:01</td>
<td>92 Room 3312 CCV Leaking</td>
<td>3</td>
<td>$707</td>
</tr>
<tr>
<td>2/5/2015 2:57</td>
<td>92 Lab 5453 Damper Stuck Closed</td>
<td>3</td>
<td>$246</td>
</tr>
<tr>
<td>2/5/2015 6:14</td>
<td>92 Room 4255 Unnecessary Mechanical Cooling</td>
<td>3</td>
<td>$198</td>
</tr>
<tr>
<td>2/5/2015 2:33</td>
<td>92 CHW High DP Setpoint</td>
<td>3</td>
<td>$120</td>
</tr>
</tbody>
</table>
The old way of optimizing facilities involves camping out in one building at a time for a period of weeks, tuning and fixing equipment. Efficiency peaks after this process but declines as the team moves on to other buildings, often not returning for a period of years.
In **4 years**, the system has saved Microsoft $4.5M (10%)  

In **10 years**, it is trending towards approximately $100M (18%) in energy savings since deployment.
Accenture created advanced analytical tools to help guide Chicago’s energy-efficiency efforts. By combining actual electricity and natural gas usage with building characteristics and demographics, Microsoft partner Accenture delivered a full picture of energy consumption and a precise analysis of opportunities for energy-efficiency improvements that can deliver annual energy savings of over $170MM.

Learn more

@MSFTCityNext Microsoft.com/CityNext
Arlington primary school’s energy management was transformed by cloud-based insights with a solution from Microsoft partner ICONICS. They reduced energy usage, increased equipment lifespan, and sped problem detection by 15%. As soon as the fault detection system was turned on, it revealed the school’s new chiller was running constantly, cycling every five minutes even at night to keep the school within a needlessly narrow, half-degree temperature range.

Learn more

@MSFTCityNext  Microsoft.com/CityNext
Applying MACHINE LEARNING to save energy

Carnegie Mellon University wanted to reduce energy usage and cut carbon emissions. The university leveraged the PI system from Microsoft partner OSIsoft in combination with Azure HDInsight and Power BI for better fault detection, diagnosis, and more efficient operations. They were able to detect equipment failures sooner and achieved a 30% reduction in energy costs.

Learn more @MSFTCityNext Microsoft.com/CityNext
Demos

Azure Gallery (https://gallery.cortanaintelligence.com/)
Azure Trial (https://azure.microsoft.com/en-us/free/?v=17.39&WT.srch=1&WT.mc_id=AID559320_SEM_i0yGeVjc&Inkd=Bing_Azure_Brand)
IOT Device Catalogue (https://catalog.azureiotsuite.com/)
Energy Management Architecture

Azure WebJob
- Runs jobs to get data from public source

Event Hub
- Stores Streaming Data

Stream Analytics
- processes events as they arrive in the EventHub

AML Model
- Web Service

Real-time Processing

Power BI Dashboard
- BI data stats

Hourly Prediction Updates

Send to Azure SQL for batch predictions

Azure SQL
- Contains Historical Arrival/departure Consumption & Weather Data

Azure Data Factory
- Pipeline invokes AML Web Service

AML Model Web Service BES endpoint

Get Data

Data Stream Job

Batch
Azure Machine Learning

EnergyDemandForecast-24hr-withT

Properties

Reader
- Data source: Azure SQL Database
- Database server name: ghdib7/ag5yw.database.windows.net
- Database name: EnergyForecastSQLDatabase
- Server user account name: energydemouser
- Server user account password: ********
- Accept any server certificate (insecure)

Database query:
```
1 select b.localTime as Timestamp, b.PTID, a.HourAvgL 
2 (select * from DemandHistoryHourly 
3 where convert(varchar(10),TimeStamp,10)="convert(v 
4 and PTID=61761) a 
5 right join
```

Quick Help
- Load data from sources such as the Web, Azure SQL database, Azure table, Hive table, or Windows Azure BLOB storage

Deploy Web Service
Apply realtime analytics
Emergency Notifications

- Create an alert for emergency situations including school evacuations and weather related school closings
- Rapidly deliver emergency alerts to all students, staff, faculty, and even parents instantly during these emergency situations
- Allow community members to check-in to confirm their safety or pinpoint problems with geolocation
Summon Help

• GPS-connected panic button phone apps and hardware

Quick Dispatch

• When an incident is reported, the system automatically finds the closest and most qualified person to respond.
Access Control

• Ensure the right people have access to the right spaces at the right times.
• Classrooms, academic buildings, dorms, labs, offices, equipment storage, and more
• No need for changing out lock cores
The University of Puerto Rico at Humacao was experiencing a spike in crime on campus. To ensure student safety, Microsoft partner INVID developed an emergency response app that allows students to report incidents, pinpoints their location, and dispatches the nearest security officer, reducing response times significantly.

Learn more

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The Safe City Solution, created by Microsoft partner Accenture, integrates advanced analytics into existing systems and sensors owned by different agencies in order to maximize situational awareness, streamline operations and enhance response to a wide spectrum of safety and security concerns.
The New York Police Department (NYPD) had to be up-to-date with the latest crime prevention and counterterrorism technology capabilities.

They worked with Microsoft to develop the Domain Awareness System. This system aggregates and analyzes public safety data in real time, providing investigators and analysts with a comprehensive view of potential threats and criminal activity.

The Domain Awareness System has helped the NYPD improve its response time and even prevent crimes.
In Madrid, Spain, the city’s emergency services was using an obsolete technology platform that couldn’t classify different types of emergency calls or scale to track emergency vehicles.

The city implemented the GEMMA emergency management system by Atos, a Microsoft CityNext partner. The system integrates the management of the city’s different emergency response infrastructures and provides interoperability across its various response agencies.

The has helped **reduce response times and enabled first responders to better prioritize** life-threatening emergencies.
Improve Student Success with Data from Other Campus Systems

**Examples**

**Student Engagement**
Use Access Control or Parking data to estimate student engagement as an early warning factor for performance.

**Effect of the Environment on Learning**
Use Facilities data such as CO2 levels, temperature, and noise level to see environmental effects on learning.
Government Study indicating harmful levels of CO2 in older buildings

CO2 Levels in Classrooms
Curriculum Integration
The business school integrated data analytics and Machine Learning into the curriculum in order to give students real world experience and help them develop skills that will help them be successful employees.

"...the biggest impact of Azure Machine Learning is that it gives students a sense that they’re connecting to the real world, and that’s very powerful." –Dr. Florian Zettelmeyer, Director

Learn more

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Conclusion

We are building the Future of Intelligent Business.

Connecting the Physical World to the Digital World.

Enabling all Companies to Realize the True Value that Digital Transformation can provide.