

Real world Internet of Things with Microsoft Azure

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Agenda

- What is IoT?
- IoT Architecture
- IoT Architectural Components
- IoT in Practice: Demo
- Resources

What is the Internet of Things (IoT) ?

- The **Internet of Things (IoT)** is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and covers a variety of protocols, domains, and applications”

Source : [Wikipedia](#)

30
billion

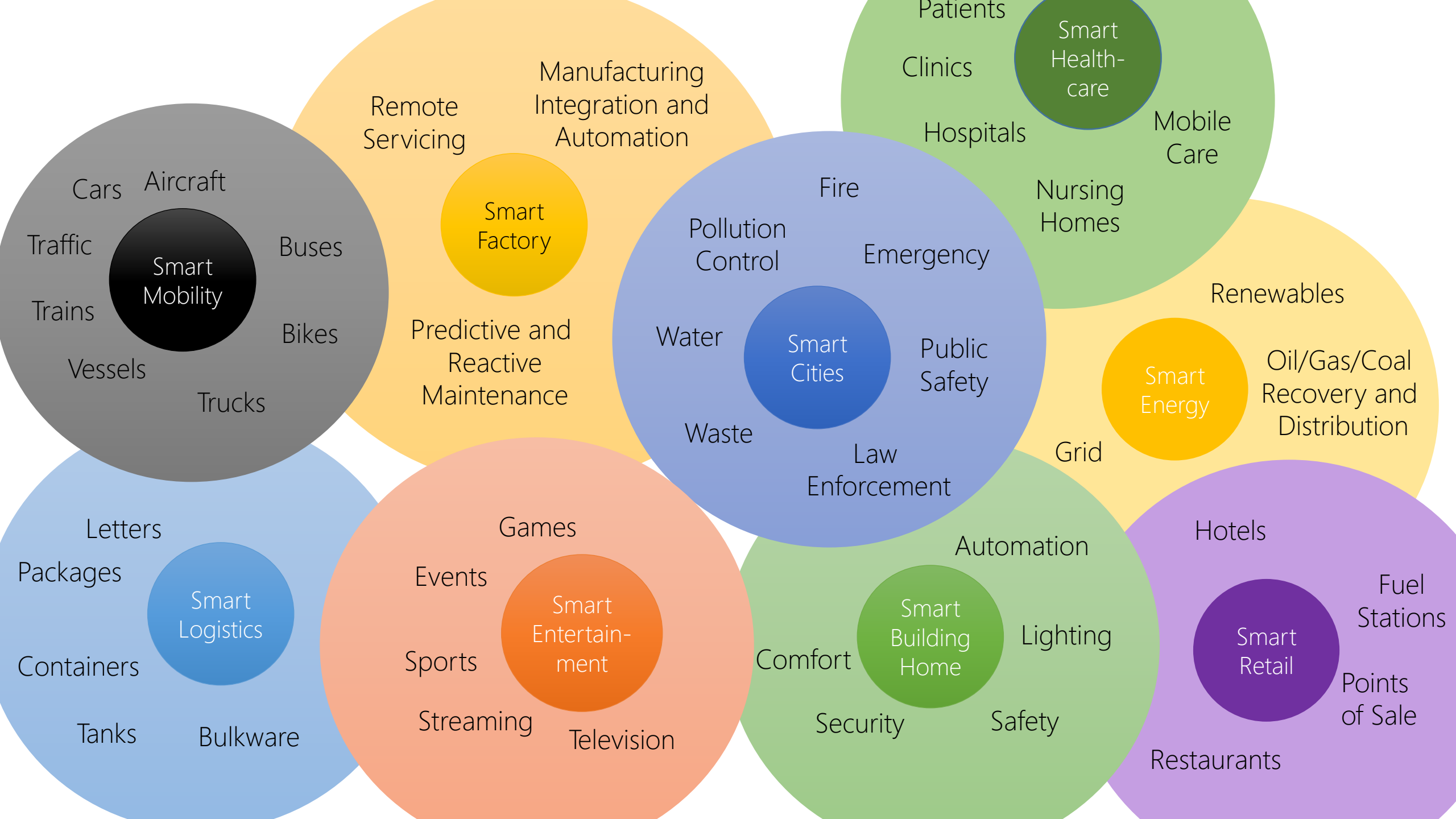
The number of connected (autonomous) things predicted to be part of the Internet of Things by 2020.

IDC, Worldwide Internet of Things (IoT) 2013-2020 Forecast: Billions of Things, Trillions of Dollars, Doc # 243661, October 2013.

\$7.3
trillion

The potential market size of the Internet of Things in 2017.

IDC, Worldwide Internet of Things Spending by Vertical Markets 2014-2017 Forecast," Doc # 246384, February 2014.



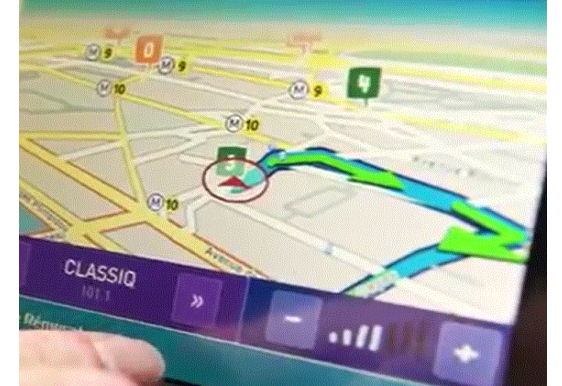
Running Scenarios

Medical: Patient Monitoring



- A number of patients are allotted to beds of many hospitals of a health care provider
- Wi-Fi capable devices continuously measure parameters such as heart rate, pressure etc.
- Nurses need to monitor thresholds.
- Doctors need to be alerted in some conditions.
- Management aggregated data on treatments
- Predicting possible disease outbreaks is critical to health authorities

Transport: Vehicle Tracking



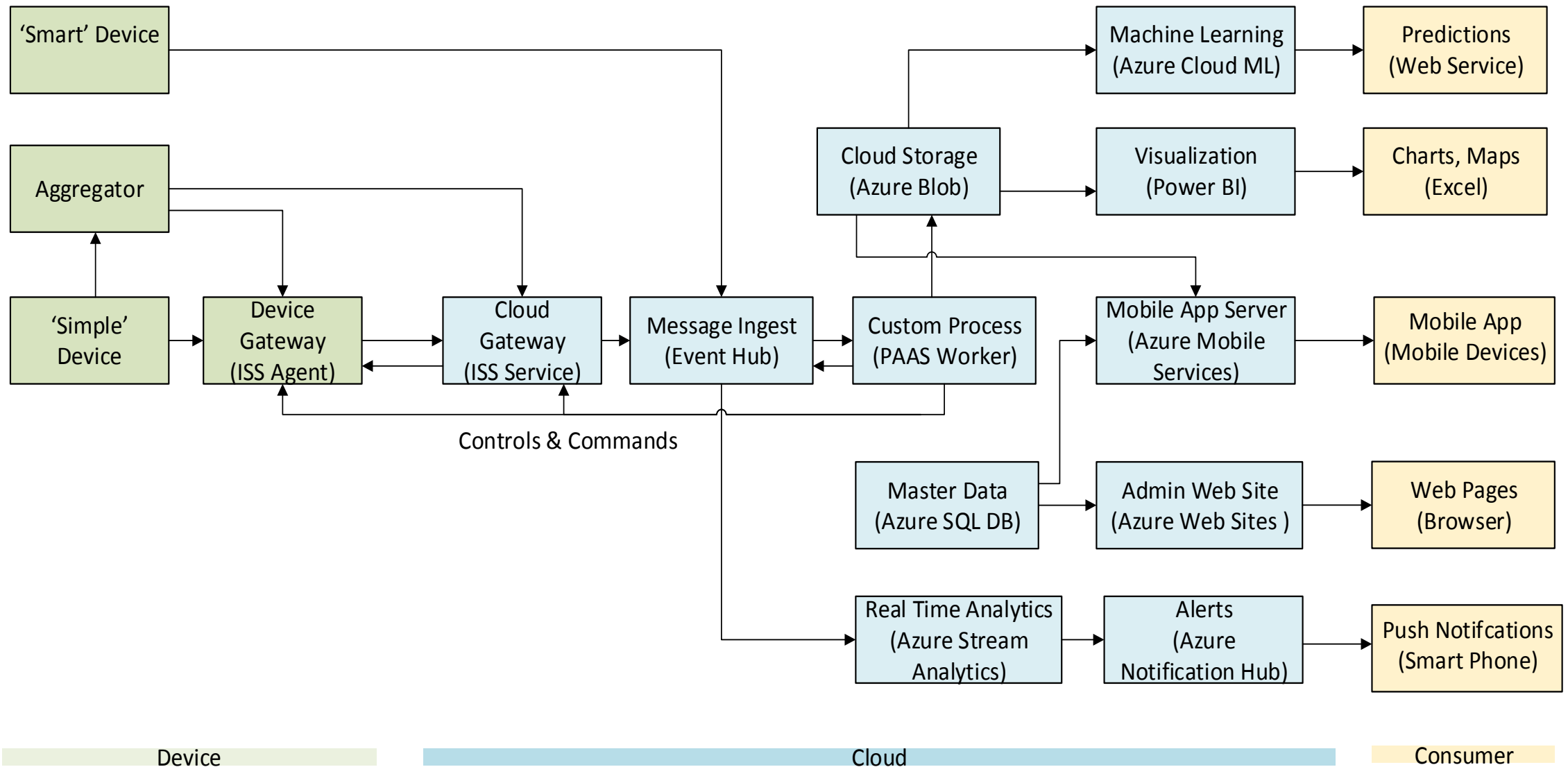
- A number of cars & buses of by a fleet company are gated-in/out by devices in depots.
- Vehicles have GPS trackers. Continuous geo-position maps are essential for tracking and theft prevention
- Over-speeding, is a matter of serious concern.
- Consumers need check the availability of vehicles and the nearest service station on cell phones.
- The city planning authority has sought data about traffic congestion factors

IoT Architecture

Architectural Principles

- Architect for the 3 Vs of IoT = Volume, Velocity, Variety
- Use high performance, specialized services = RAS
- Use Cloud based Services = Global Reach, HA/DR, Scale etc
- High Cohesion, Loose Coupling = Flexibility, Manageability
- Elasticity = Economy
- Services must Integrate = Co-operation

IoT Component Architecture

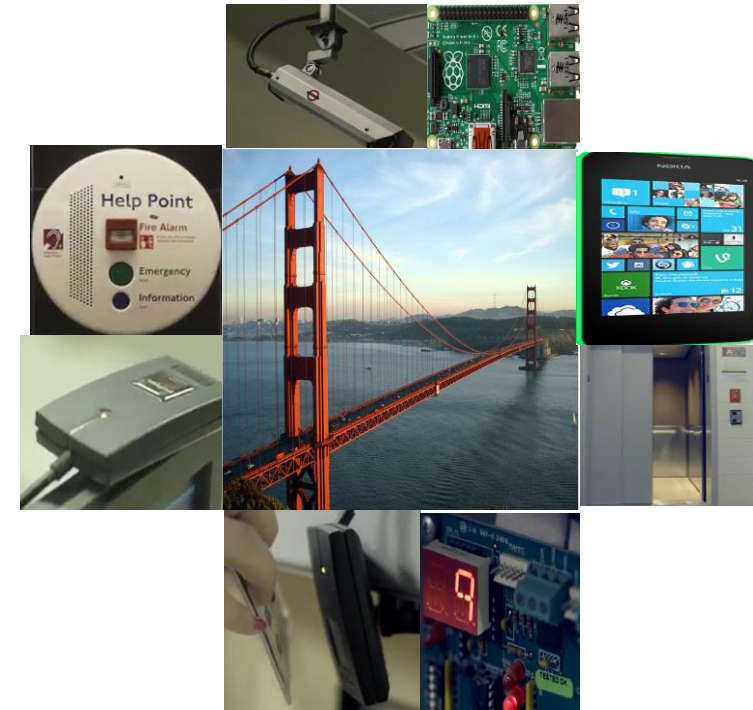


IoT Architectural Components

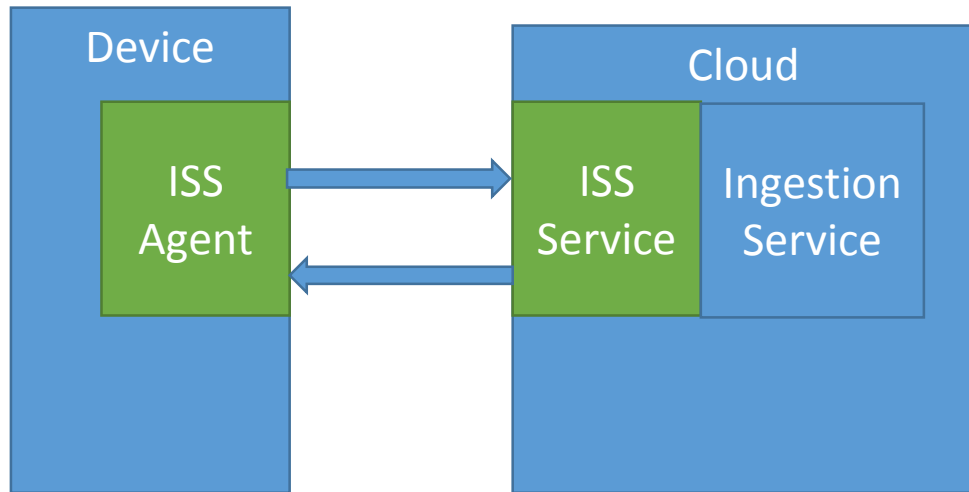
Field Gateway and Cloud Gateway



- Architectural Concerns/ Needs
 - Handle Variation: Device capability, Comm. Protocols
 - Efficiency: Filtering, Aggregation of Events
 - Special Needs: Offline Operations
- Architectural Component: Gateway
 - 'Heterogeneous' devices <-> 'Homogeneous' cloud
 - Field Gateway: A device-side bridge/adaptor
 - Cloud Gateway: A cloud-side bridge/adaptor
- Patterns: Proxy, Bridge Adapter



The Role of Azure ISS



- Other Options?

- Custom device/cloud gateways on PAAS worker roles

- ISS Agent

- Embeddable device Agent
- Library for different platforms

- ISS Service

- Registration, Management...
- Data Ingress
- Command and Control

IOT Examples

- Medical: Devices in a hospital: NF capability only
- Transportation: Gating devices in depots: poor internet connectivity

Event Ingestion

- Architectural Concerns
 - Events produced at high volume, rate and scale
 - Need to be distributed to multiple sinks
 - Retention, Security
- Arch. Component: Event Ingestion Engine
 - Allows event sources to push events at high scale
 - Allows event consumers to pull events at high scale
 - Security and manageability features
- Patterns: Hub-Spoke, Switch, Queued Messaging

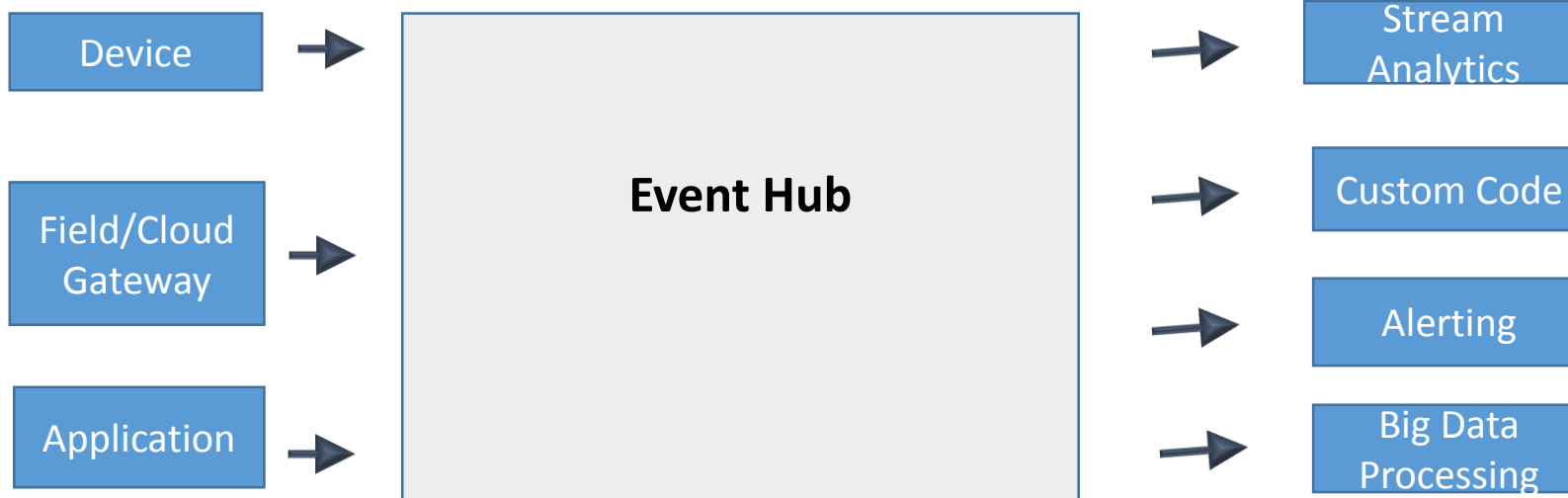
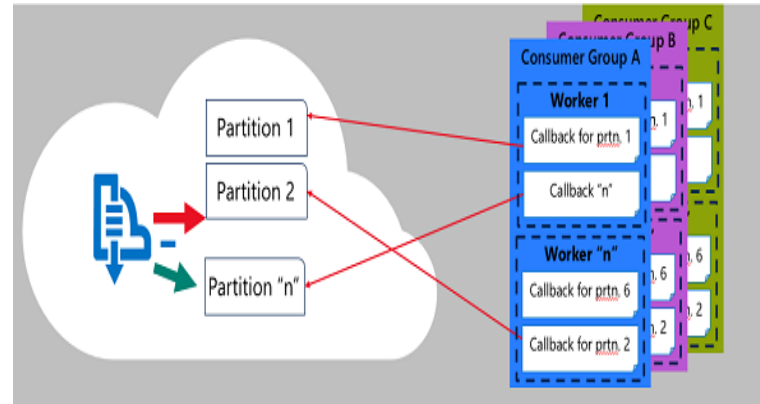
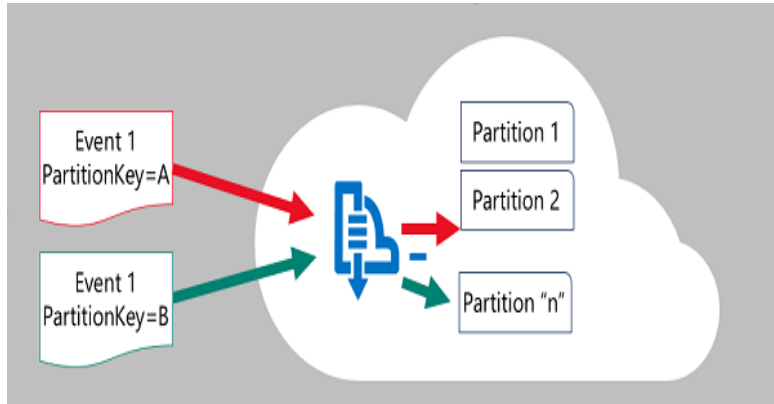
Volume



<https://www.fhwa.dot.gov/>



The Role of Azure Event Hubs



- Azure Event Hub
 - 1M events/sec
 - Scale by partition
 - Event Retention
 - Consumer Groups
 - Access Control
 - Integration

IoT Scenario Relevance

- Medical: 5 params/min, 400 beds
50 hospitals = 100,000 EPM
- Transport: Concurrent analysis,
alerting and mapping of GPS

- Other Options? Service Bus Topics and Queues

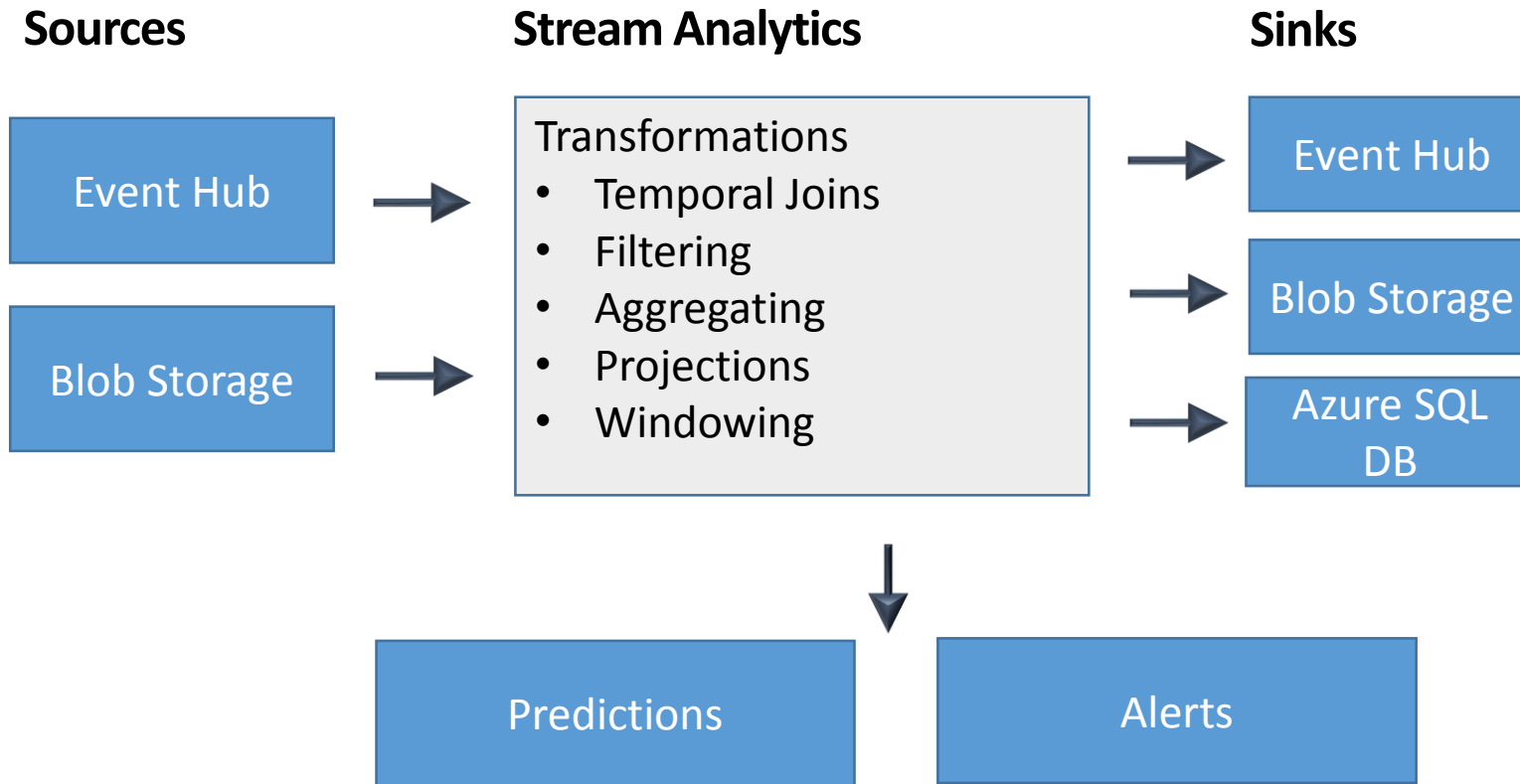
Real-Time Analytics

Velocity

- Architectural Concerns/Needs
 - Analyze Data In motion vs. Data at Rest
 - How many buses are there in a depot?
 - How many buses are passing through intersection X?
 - Obtain insights over time slices in real-time
 - Integration
- Architectural Component: Real-Time Analytics Service
 - Computes statistics on data over sliding time windows
 - High Performance, multiple data formats
 - Integration with ingestion, Storage, ML, Analytics etc.
- Patterns: Stream processor, Temporal analyzer, Event Correlator



The Role of Azure Stream Analytics



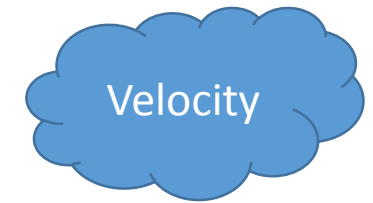
- Azure Stream Analytics
 - Job definitions in JSON
 - Flexible Input and output sources
 - Real-Time computations
 - Simple SQL style query

IoT Scenario Relevance

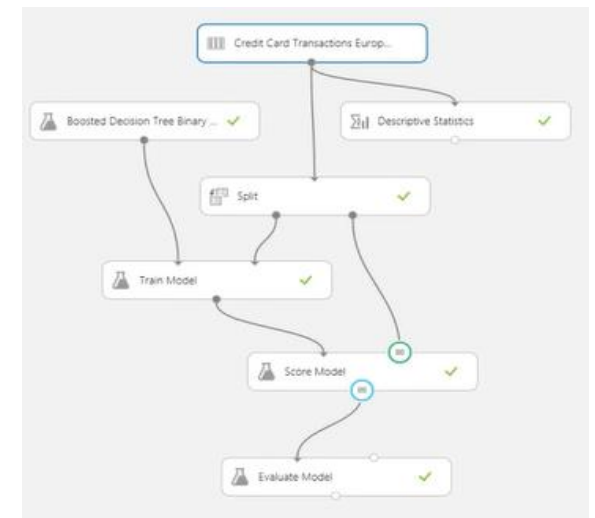
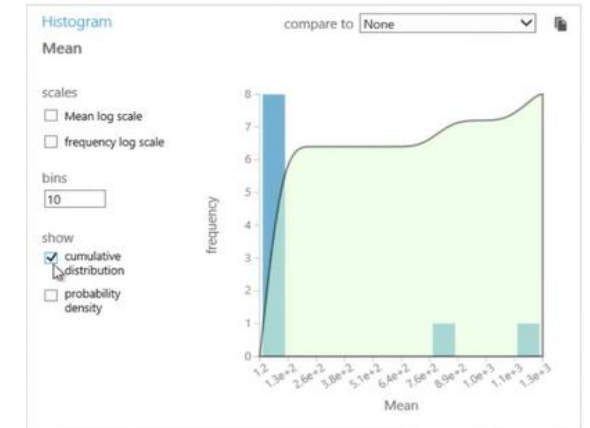
- Medical: Has a patient's avg. heart rate turned high/low?
- Transport: Is a vehicle over-speeding now?

- Other Options? Apache Storm on HDInsight

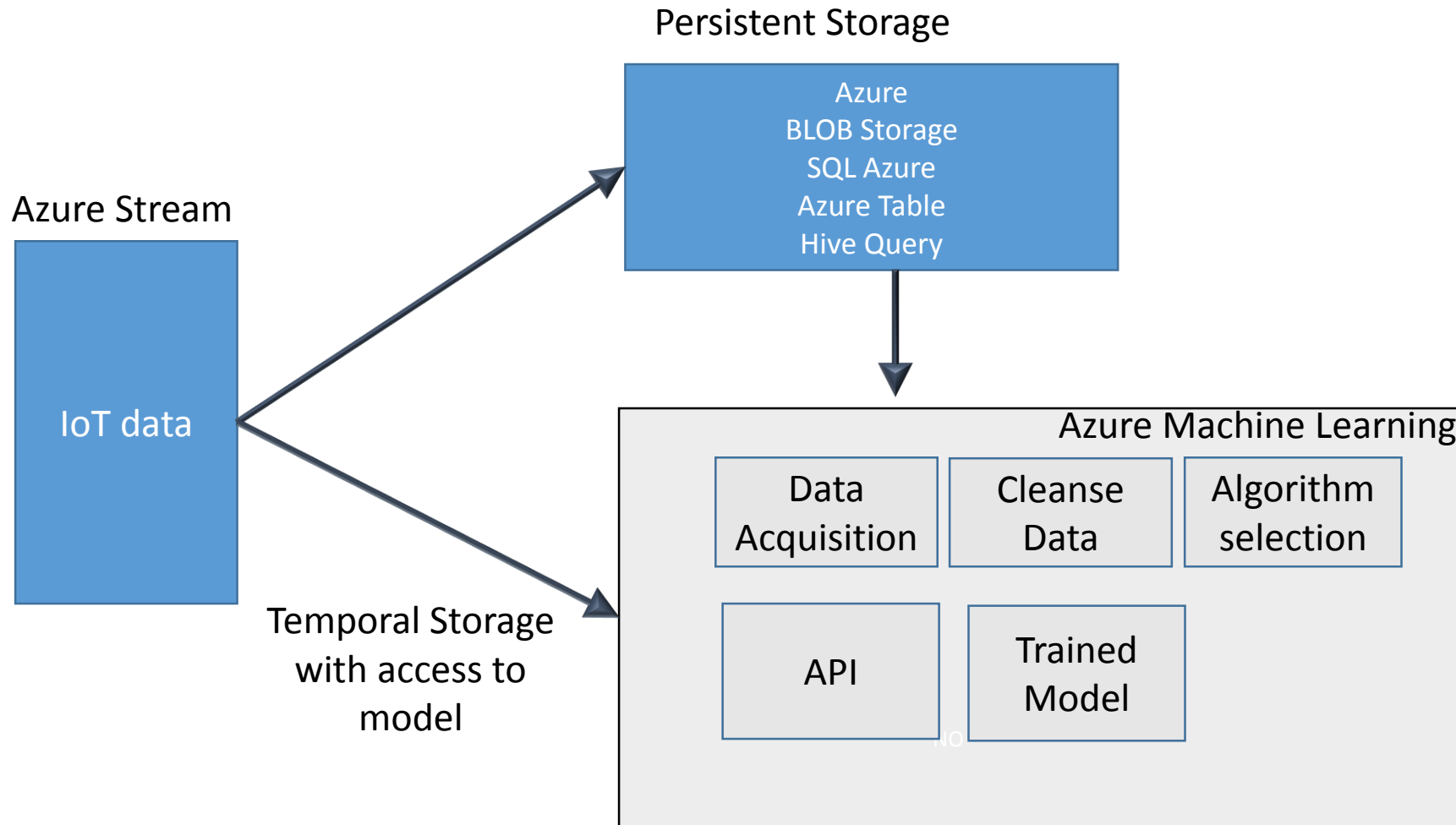
Machine Learning



- Architectural Concerns/Needs
 - Predict behaviors, trends, sentiments
 - “Learn at speed”
- Architectural Component: Machine Learning
 - Algorithmic prediction of future
 - Self Learning models
 - Integration with other components
- Patterns: Feedback systems, Neural networks



The Role of Azure Machine Learning



Azure ML

- Predictions, Recommendations, Inferences
- Integration with Azure Storage
- API access
- Web Service

IoT Scenarios

- Medical: Predict an epidemic using past data
- Transport: Predict traffic congestion at a point

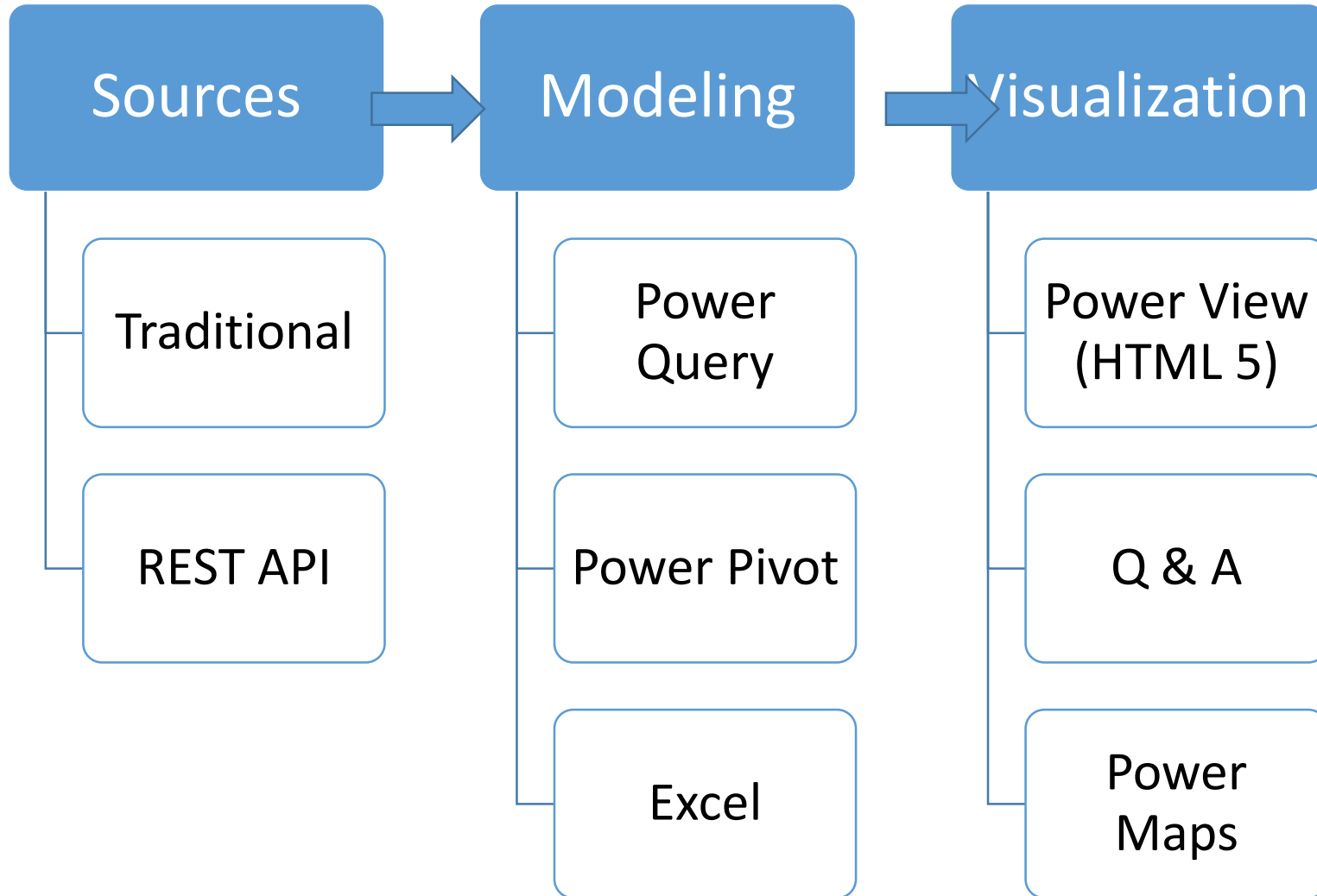
- Other Options? Mahout on Hadoop with HDInsight

Visualization

- Architectural Concerns/Needs
 - Decision makers to make sense of large volumes of data
 - Collective trend more important than the individual
 - Enable speedy decision making
- Architectural Component: Visualization Service
 - Maps, Graphs
 - Aggregates and drill downs
 - Interactivity, Q&A
 - Integration: Connectors
- Patterns: Decision Support Systems, Natural Language Queries, Interactive Visualization



The Role of Power BI



Power BI

- Geo-Spatial Maps
- Interactive Charts
- Type questions
- Scalable: Leverages O365
- Cross platform: HTML5

IoT Scenarios

- Medical: View disease outbreak by city/region/areas
- Transport: Drill down on congestion by time/condition

More Services Relevant to IoT

- Big Data Processing
 - Post-mortem analysis
 - Role of Azure HDInsight
- Web Sites
 - Administration, Registration
 - Role of Azure Web Sites
- Mobile Applications (Server Side)
 - Payment Integration, Finding your “nearest” service center etc.
 - Role of Azure Mobile Services

IoT in Practice: Demo

Resources

- [Microsoft and IoT](#)
- [Intelligent Systems Service](#)
- [Azure Event Hubs](#)
- [Stream Analytics](#)
- [Azure Notification Hubs](#)
- [Azure Machine Learning](#)
- [Azure Mobile Services](#)
- [Azure Web Sites](#)
- [Microsoft Power BI](#)
- [Intelligent Systems in health care – Video](#)
- [IoT in Transportation – Autolib Case Study Video](#)

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You'll also be entered into a daily prize drawing!

OPTION 1



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OPTION 2

A screenshot of a mobile application interface for feedback. The header reads "TechEd India 2014" and "feedback". Below that, it says "Session Sending Cross Platform Notifications us". Under "Session Rating *", there are four radio button options: "Very Good", "Good", "Okay", and "Bad". Under "Speaker Rating *", there are two radio button options: "Very Good" and "Good". At the bottom, there is a small upward-pointing arrow icon.

You can fill out evaluation of this session directly through the App

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Services in an IoT Architecture

- Gateway Service – Bridge devices with the cloud
- Event Ingestion Service – Event Sponge
- Real Time Analytics Service – Temporal Analysis
- Big Data Analysis Service – Post-mortem analysis
- Notification Service – Alert Dissemination
- Machine Learning Service – Insights and Predictions
- Mobile Service – Host Mobile App Backend
- Websites Service – Admin, Registration etc
- Visualization Service – Enable Decisions

IoT and the Cloud

- What does Cloud do for an IoT Solution
 - A variety of powerful services for IoT needs
 - Elastic Scale
 - Geo-Reach
 - High Availability, SLAs
 - Disaster Recovery
 - Open and Standard Access Protocols
 - Management and Monitoring

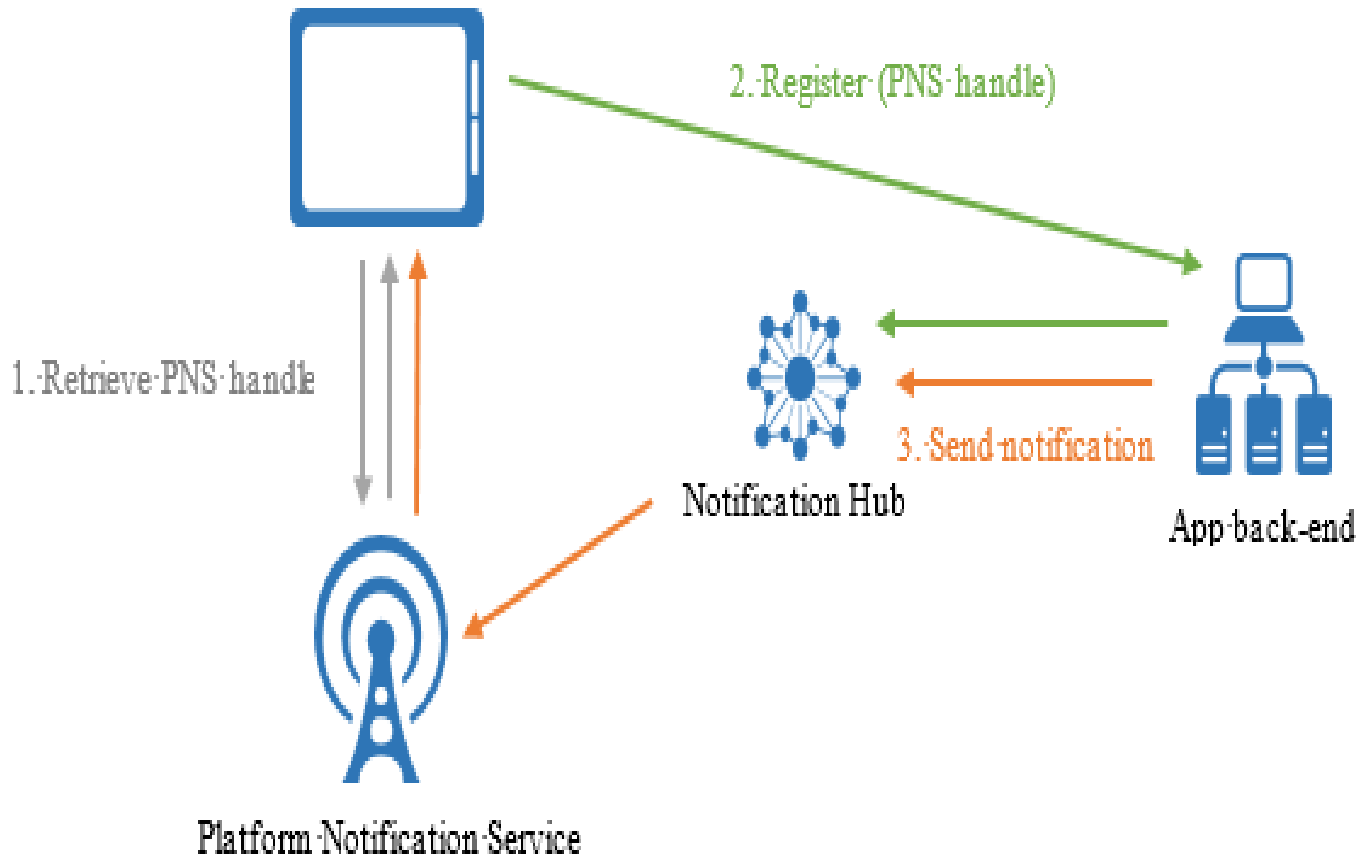
Notifications



- Architectural Concerns/Needs
 - Send notifications at high volume
 - Maintainability: Variety of devices and platform notification services
 - Manageability: Device Tokens, registries
- Architectural Component : Notification Service
 - High-scale, High-volume push
 - Multi-platform support
 - Targeting: Users, groups
 - Diagnostics: Notification outcomes
- Patterns
 - Push Service, One to Many Messaging, Unicast/Broadcast



The Role of Azure Notification Hub



Azure Notification Hub

- Notification logic becomes platform independent
- Single call simultaneous broadcast
- Elastic scale, regions, high volume
- Segmentation/personalization
- Security, Telemetry

IoT Scenario Relevance

- Medical: Push alert to doctor's phone if patient's parameter exceeds threshold
- Transport: Send alert to transport company owner if a vehicle over-speeds