Azure as The Internet for Things

WAZUG NL October 27th

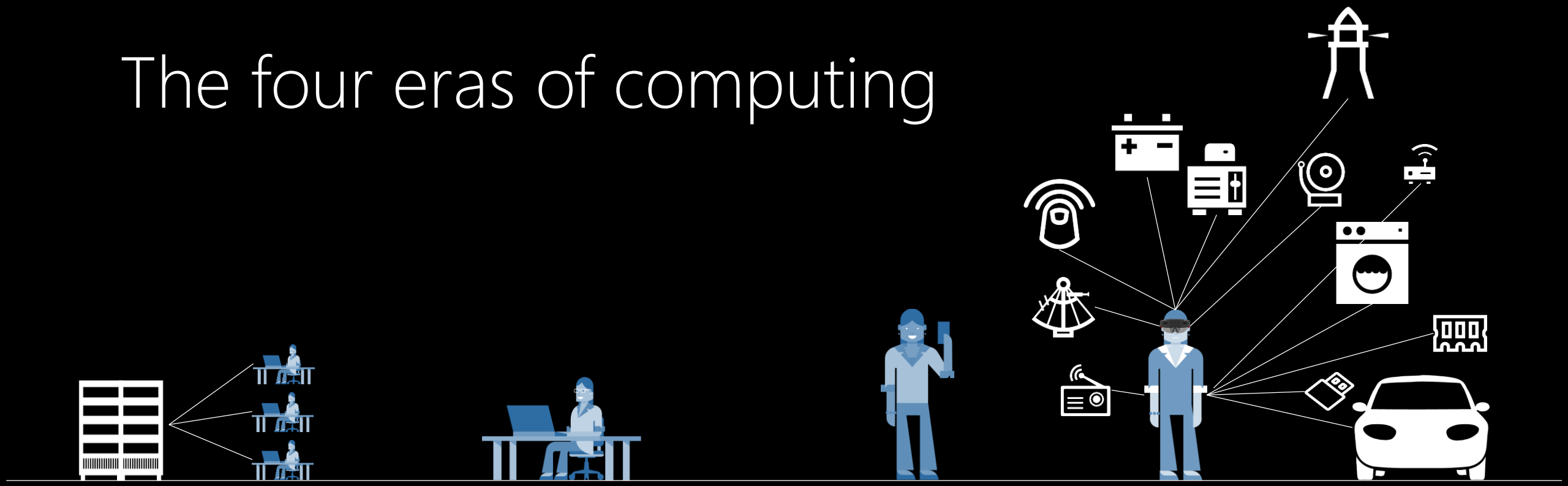
Valery Jacobs

Microsoft

Links mentioned/requested during the session:

- www.windowsondevices.com (Home base for Microsoft IoT content & W10 IoT Core)
- www.dx.com (for ordering devices, sensors and a whole lot more)
- www.iprototype.nl (local web shop for IoT stuff)

The four eras of computing



1960s

Mainframe era

one computer – thousands of users

1980s

PC era

one computer – one user

2000s

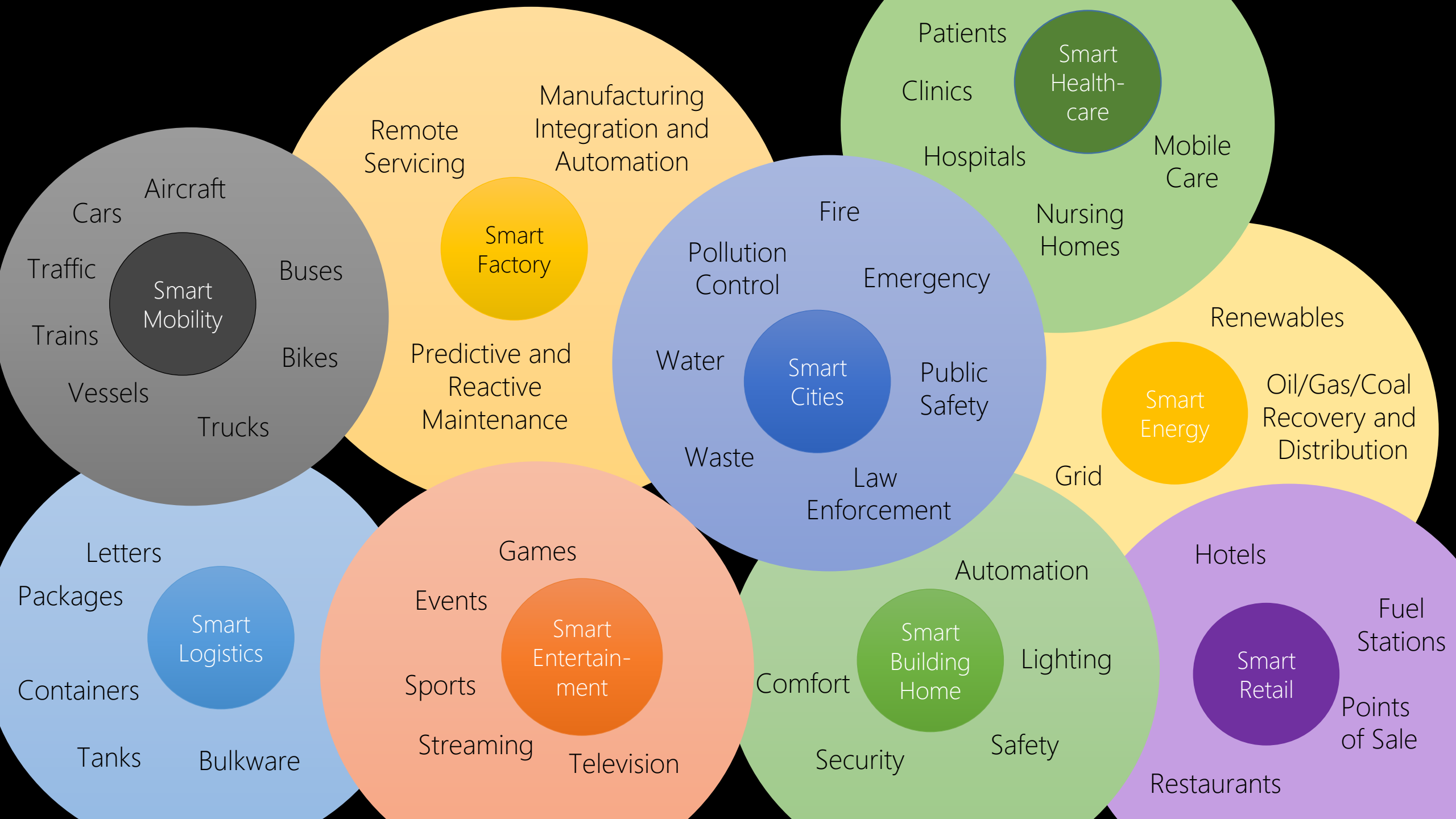
Mobility era

several computers – one user

2020s

IoT era

many computers – one to many users


Smart Mobility
Aircraft
Cars
Traffic
Buses
Trains
Bikes
Vessels
Trucks
Smart Factory
Remote Servicing
Manufacturing Integration and Automation
Predictive and Reactive Maintenance
Smart Health-care
Patients
Clinics
Hospitals
Mobile Care
Nursing Homes
Smart Cities
Fire
Pollution Control
Emergency
Water
Public Safety
Waste
Law Enforcement
Smart Energy
Renewables
Oil/Gas/Coal Recovery and Distribution
Grid
Smart Logistics
Letters
Packages
Containers
Tanks
Bulkware
Smart Entertain-ment
Games
Events
Sports
Streaming
Television
Smart Building Home
Automation
Comfort
Lighting
Security
Safety
Smart Retail
Hotels
Fuel Stations
Points of Sale
Restaurants

Internet of Things Landscape 2016

Applications (Verticals)

Personal

Wearables
WATCH, Samsung Gear2, pebble, moto g, LG, Tory Burch, HUAWEI, Misfit, WEEX, CAEDEN, MOTIV, textronics, D3O, ORION, Jewelbots, nymi, RINGLY

Fitness
JAWBONE, fitbit, TOMTOM, GARMIN, NIKE, UNDER ARMOUR, MISFIT, BASIS, mi, huami, Microsoft Band, ATLAS, mapmyfitness, RunKeeper, LUMO, amiigo, LifeBEAM, ATHOS, lark, senSoria, WHOOP, striiv

Health
Withings, kinsa, TELCARE, NeuroSky, halo, Thync, beam, QUANTTUS, proteus, Ginger.io, iHealth, EarlySense, XETHRU, nanowear, vessyl, beddit, sano, hello, CHRONO, eyeSmart, GLOBAL KINETICS, AdhereTech, AliveCor, PROPELLER HEALTH, Sensor, MyDx

Entertainment
SONOS, RAZER, doppler labs, ROLI, Narrative, soundhawk, peel, Electric Objects, meural, normal

Family
nucleus, ily, HALO, Glow, OWLET, Good Night Lamp, FiLIP, bellabeat, monbaby, ovuline, livescribe, LULLY

Sports
STRAVA, WILSON X, Babolat, PELOTON, X2, ZEPP, ARCCOS, INFOMOTION, recon, swingbyte, GAME GOLF, X-GEN FENCING, COMMON SENSORS

Toys
Hasbro, MATTEL, sphero, anki, sifteo, MAKIES, wonder workshop, UBOOLY

Elderly
Healthsense, INDEPENDA, Lively

Home

Automation
nest, LIFX, Honeywell, SAMSUNG, hue, CHAMBERLAIN, iDevices, belkin, wemo, icontrol, SAVANT, ecovent, ecobee, KASTA, SILVAIR, LIGHT SENTRY, Quirky, Lumen, view, LUTRON, ORVIBO, LEVITON, somfy, bluesmart, CITRIX, CBE, roost, tado°, KEEN

Hubs
nest, amazon alexa, INSTEON, iris, BOSCH, SmartThings, connect, iRule, Control4, ivee, wink, vera, prodea, NINJABLOCKS, Fluent, NEXIA, zonoff

Security
august, SCHLAGE, Kwikset, dropcam, canary, vivint, SimpliSafe, ring, XIWI, ALARM.COM, KeyMe, evercam.io, Lockitron, VIVO, BeON, camloan, LINEKEY, LATCH, cocoon, Seek, scout

Kitchen
June, nomiku, drop, SUPERMECHANICAL, pantry, MOMENTUM MACHINES, BREWBOT, innit, Sereneti

Sensing
netatmo, leeo, ambient, birdi, AWAIR, CUBESENSORS, wally HOME, sense, TRANSFORMAIR

Consumer Robotics
ALDEBARAN, jibo, iRobot, RobotsLAB

Pets
Whistle, Petnet, HACHIKO, Petcube, FitBark

Garden
EDYN, plantlink, BITPONICS, rachio

Trackers
tile, iotera, AthenTek, TrackR

Vehicles

Automobiles
INRIX, waze, AUTOMATIC, STREETLINE, dash, Zubie, navdy, Automile, vinli, Airbiquity, censio, OpenXC, CohdaWireless

Autonomous
Google Self-Driving Car Project, Apple, BMW, Audi, GM, TESLA, DAIMLER, UBER, cruise, Ford, QUANERGY, DELPHI, NOVARIANT, nuTonomy, Peloton, MobileEye, Valeo

UAVs
dji, 3DR, Parrot, Airware, LILY, CyPhy, SKYCATCH, SKYDIO, YUNEEC, DRONE BASE, DroneDeploy, HEXO+, DRL, SKY FUTURES

Space
BOEING, LOCKHEED MARTIN, AIRBUS DEFENCE & SPACE, SPACEX, BLUE ORIGIN, spire, PLANET, Orbital ATK, NANORACKS, GALACTIC, XCOR

Bicycles / Motorbikes
sobi, HAMMERHEAD, superpedestrian, gogoro, SKULLY, SKYLOCK

Enterprise

Healthcare
STANLEY Healthcare, AUGMEDIX, VERSUS, mc10, vitalconnect, NovaSom, mim, Senseonics, PEERBRIDGE, vivify, AIRSTRIP, Sotera, iRhythm, Monica, INFOBIONIC, TeleTracking, PneumaCare, PRISTINE, VivoMetrics, ORTHOSENSOR

Retail
RETAILNEXT, euclid, Theatro, PRISM SKYLABS, hiku, cloudtags, GIMBAL, PHUNWARE, NOMI, VARIABLE

Payments / Loyalty
PayPal, shopify, Square, Verifone, payleven, belly, coin, cantaloupe, acs, SHOPKEEP, ciright, LevelUp, DUALI

Smart Office
LogMeIn, CRESTRON, kisi, Robin, BUILDING ROBOTICS, CLEAN CUBE, XORA, eventboard

Agriculture
JOHN DEERE, adapt-N, Ag Leader, INFARM, pycno, ARGUS, DACOM, Smartfield, afimilk, Zed, ClimateMinder, SPENSA, SMART FARM, i-Linc

Infrastructure
WORLD SENSING, TACHYUS, mPrest, ELTAV, Smart Cloud, M2M communications, INCON, SMARTSTRUCTURES, LUMASENSE TECHNOLOGIES, SensorLogic, GROUNDMETRICS

Industrial Internet

Machines
CATERPILLAR, SIEMENS, BOSCH, GE, AUGURY, SIGHT MACHINE

Energy
Schneider Electric, Itron, enlighted, SolarCity, BAKER HUGHES, Trilliant, enevo, ENERNOC, Rigbelly, SMART GRID CLUSTER, OSIsoft, OutSmart, enbala, e-on, EnergyHub, lucid, SilverSpring, ENERGYSAVVY, HydroPoint, sensity, Blue Pillar, AutoGrid, Panoramic, PETRA SYSTEMS, Fat Spaniel

Supply Chain
Fleetmatics, Impinj, VILOC, OmniID, SkyBitz, SMARTDRIVE, Telogis, assetpulse, WEFT, HIGHTEK, TEGO, ZEBRA, asap SYSTEMS, PRECYSETECH, RF CONTROLS

Robotics
amazon robotics, ABB, CLEARPATH ROBOTICS, HARVEST AUTOMATION, rethink robotics, Boston Dynamics, KUKA, RobotEx, EMPIRE, LIQUID ROBOTICS, tempo automation, OPENROV

Industrial Wearables
GLASS, DAQRI, parsable, human condition, BITSTEW SYSTEMS, GUARDHAT, XOEYE, WEARABLE TECHNOLOGIES, wavelink, AUGMATE, APX

Platforms & Enablement (Horizontals)

Platforms

Software
xively, GE, Axeda, Jasper, Clemetry, Ayla Networks, ThingWorx, IFTTT, Numerex, seebo, M2M SPECTRUM NETWORKS, EVRYTHNG, wot.io, davra networks, ZATAR, covisint, AUTODESK SEECONTROL, PubNub, thingsquare, BSQUARE, greenwave systems, M2M SPECTRUM NETWORKS, WiSilica, innoPath, peoplepower, machineshop, IoT, arrayent

Full Stack
samsara, EUROTECH, Predix, HELIUM, Telit

Developer
electric imp, TESSEL, resin.io, Tessel, Particle, theThings.io, KONEKT, Wovyn, SensorCloud, NewAer

Analytics
splunk>, sumologic, STRATOSCALE, iobeam, KAAZING, TempoIQ, UPTAKE, glassbeam

Sensor Networks
placemeter, SAFECAST, SST, MotionLoft

Connectivity
SIGFOX, SIERRA WIRELESS, neul, FILAMENT, aeris, INGENU, VENIAM, KORE, intamac, skyroam, ARKESSA, senet, actility

Security
Symantec, gemalto, Bastille, inside SECURE, MOCANA, NEURA, SHODAN, escrypt, SecuriThings, CyberFlow ANALYTICS, OWASP

Open Source
KPA, ThingSpeak, iot eclipse.org, webinos, openHAB, nimbits

Interfaces

Virtual Reality
oculus, VIVE, PlayStation VR, Samsung Gear VR, OSVR, AVEGANT

Augmented Reality
Microsoft HoloLens, magic leap, Meta, SONY, blippar, zSpace, VUZIX View the Future, EPSON EXCEED YOUR VISION, Telepathy, PARACOSM

Other
amazon alexa, THALMIC, nod, EMOTIV, LEAP MOTION, SIXENSE, ivee, RYTHM, Omni, api.ai

3D

Printing / Scanning
3D SYSTEMS, Project Tango, intel REALSENSE, MakerBot, stratasys, occipital, OMC, VOLTERA, matterport, formlabs, DESKTOP METAL, VOXELJET, Carbon, BotFactory, shapeways, sculpteo, voodoo MANUFACTURING

Content / Design
Sketchfab, Thingiverse, GRABCAD, AUTODESK, BODY LABS, FLOORED, DASSAULT SYSTEMES

Building Blocks

Hardware

Processors / Chips
intel, QUALCOMM, TOSHIBA, TEXAS INSTRUMENTS, Atmel, ARM, NVIDIA, LG, SIEMENS, NXP, INEDA SYSTEMS, SILICON LABS, Movidius

Sensors
NXP, Atmel, TEXAS INSTRUMENTS, NATIONAL INSTRUMENTS, libelium, psikick, Qualtré, MEMSIC, VALENCELL, Petasense, XEROFY, skyetek, mCube, MOOG CROSSBOW, ThingMagic

Parts / Kits
ARDUINO, RaspberryPi, LittleBits, Octopart, XILINX, relayr, adafruit

Charging
uBeam, WiTricity, humavox, AMPY

Software

Cloud
Google Cloud Platform, CISCO, IBM Watson IoT Platform, Microsoft Azure, amazon web services

Mobile OS
iOS, android, Brillo, HomeKit, BlackBerry

Connectivity

Protocols
WiFi ALLIANCE, Bluetooth, ZigBee Alliance, XMPP, LoRa Alliance, MQTT, NFC, Z-WAVE, AMQP, M-Bus, oma Open Mobile Alliance, MiWi, X10, THREAD, HART COMMUNICATION FOUNDATION, BitX m2m data exchange, DDS, RFID, CoAP, RuBee
2G 3G 4G LTE 6LoWPAN LWM2M DDS LIDAR

M2M
intel, QUALCOMM, MARVELL, BROADCOM, SIEMENS, FreeWave, TEXAS INSTRUMENTS, Atmel, Laird TECHNOLOGIES, CISCO, MOTOROLA, Fibocom, goTenna, GainSpan, enocean, altair semiconductor, Weaved

Telecom
verizon, at&t, 中国移动 China Mobile, T-Mobile, Sprint, airtel, orange, Telefónica, China unicom中国联通, América móvil, US Cellular, vodafone

WiFi
eero, STARRY, BRCK, Open Garden

Partners

Consultants / Services
TDEO, Dragon Innovation, MESH SYSTEMS, PTC, pch, R/GA, 3D HUBS, TOMORROW LAB, ISL, makexyz, altiux, 8

Alliances
ALLSEEN ALLIANCE, oma Open Mobile Alliance, industrial internet CONSORTIUM, AIOTI Internet of Things Consortium, OPEN CONNECTIVITY FOUNDATION

Retail
amazon, Walmart, BEST BUY, THE HOME DEPOT, TARGET, LOWE'S

Manufacturing
FOXCONN, flex, SANMINA, JABIL, PEGATRON, Benchmark electronics, Celestica

Incubators
techstars, Highway1, HAX, LEMNOS Labs, BOLT

Funding
KICKSTARTER, INDIEGOGO, AngelList

FIRSTMARK

Things


Medication adherence

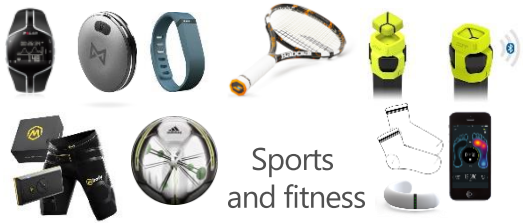

Health monitoring


Pet tracking


Behavior modification


Object tracking


Child and elder monitoring


Sports and fitness


Smart lighting


Indoor navigation


Beacons and proximity


Trip tracking and car health

HOME — **COMMUTE** — **WORKPLACE** — **COMMUTE** — **HOME**


Smart appliances


Food and nutrition tracking


Identity


Office equipment


Smart vending machines


Bike ride stats and protection


Sleep tracking

Air conditioning and temperature control


Environmental sensors

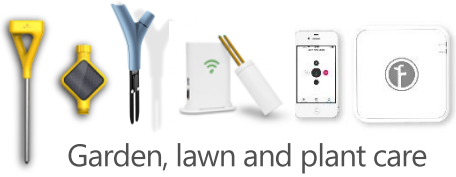

Information capture

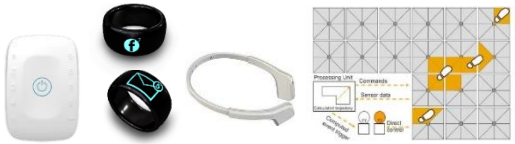

Control


Home security


Home automation


Leak detection


Garden, lawn and plant care


New devices and sensors


Entertainment systems

“Fragmentation is the enemy of IoT”

(Qualcomm, feb. 2016)

Cognitive services

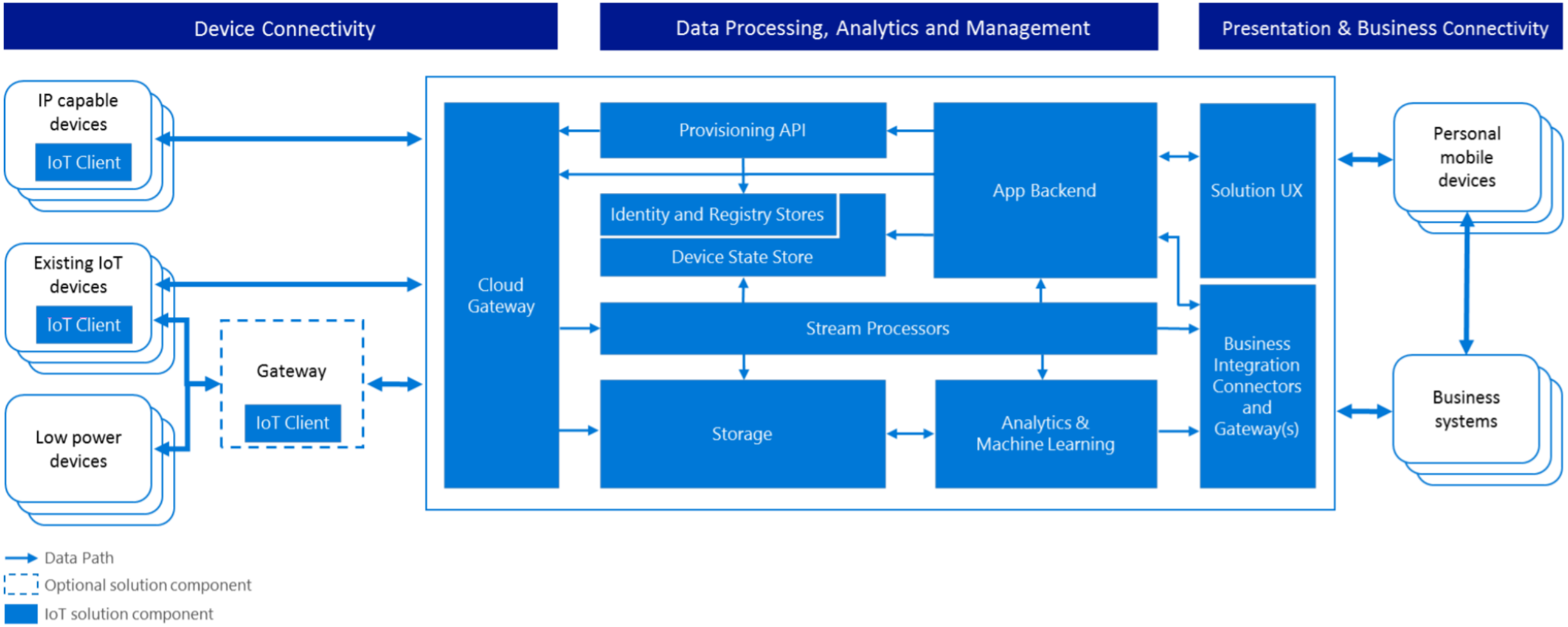
“Security is the enemy of IoT”

How hackers use IoT

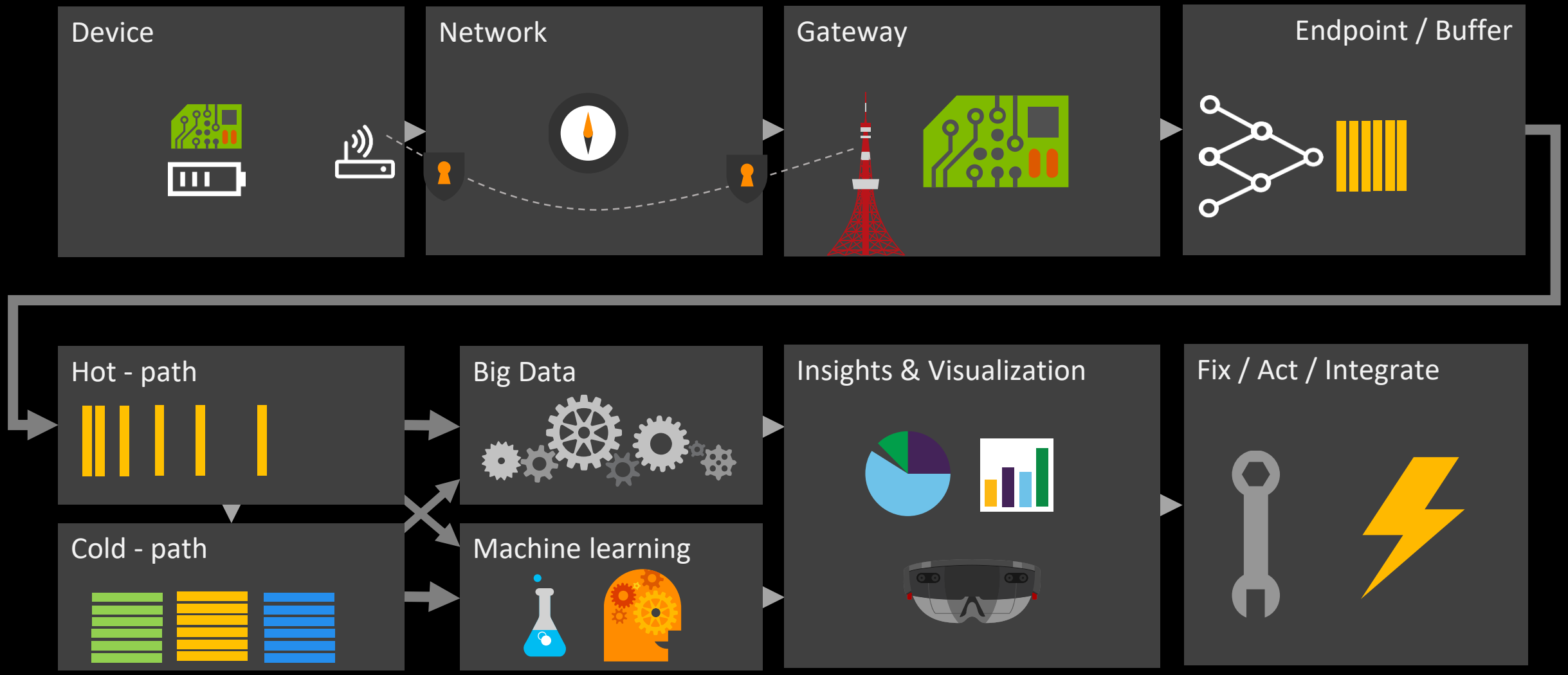
September 2016: DDOS Attack on DYN DNS Services

IoT Devices (IP Cameras) & home routers as sitting ducks

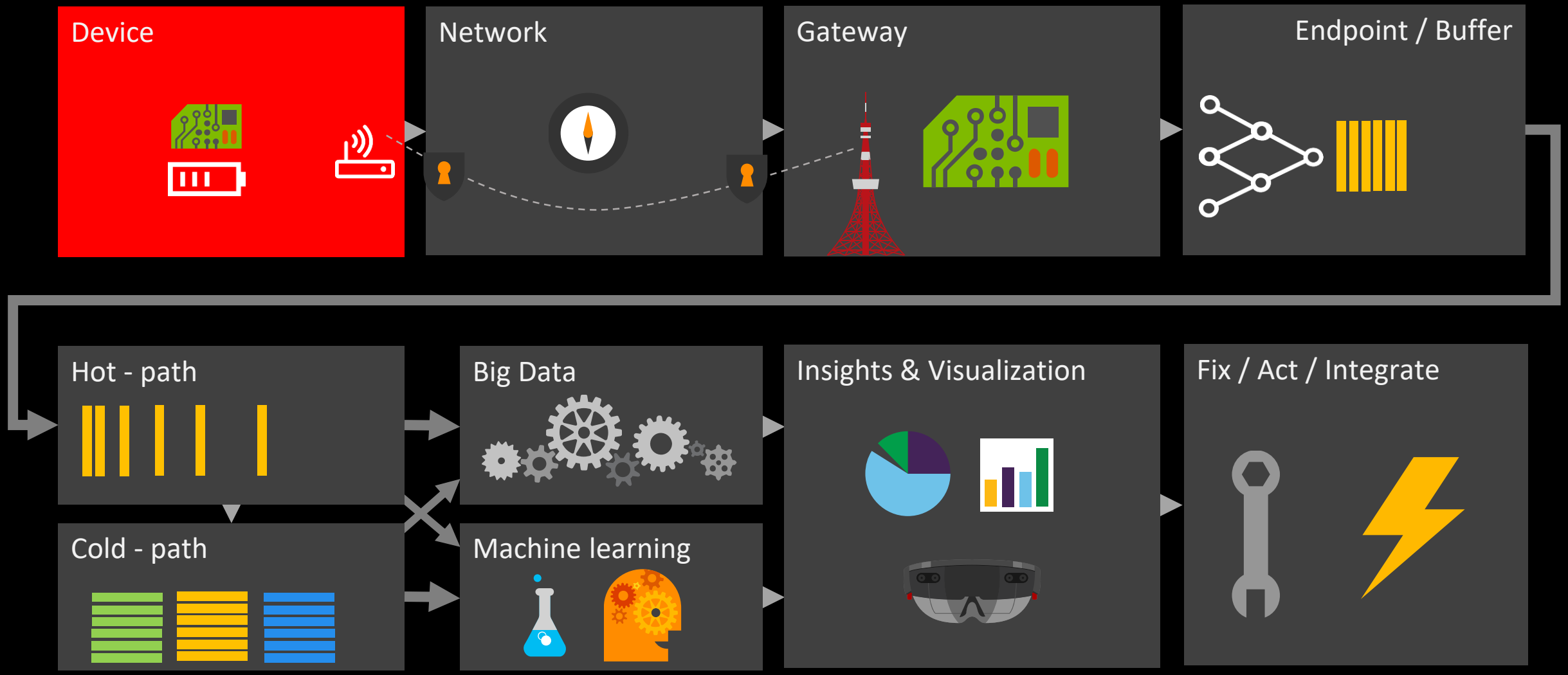
IoT Architecture

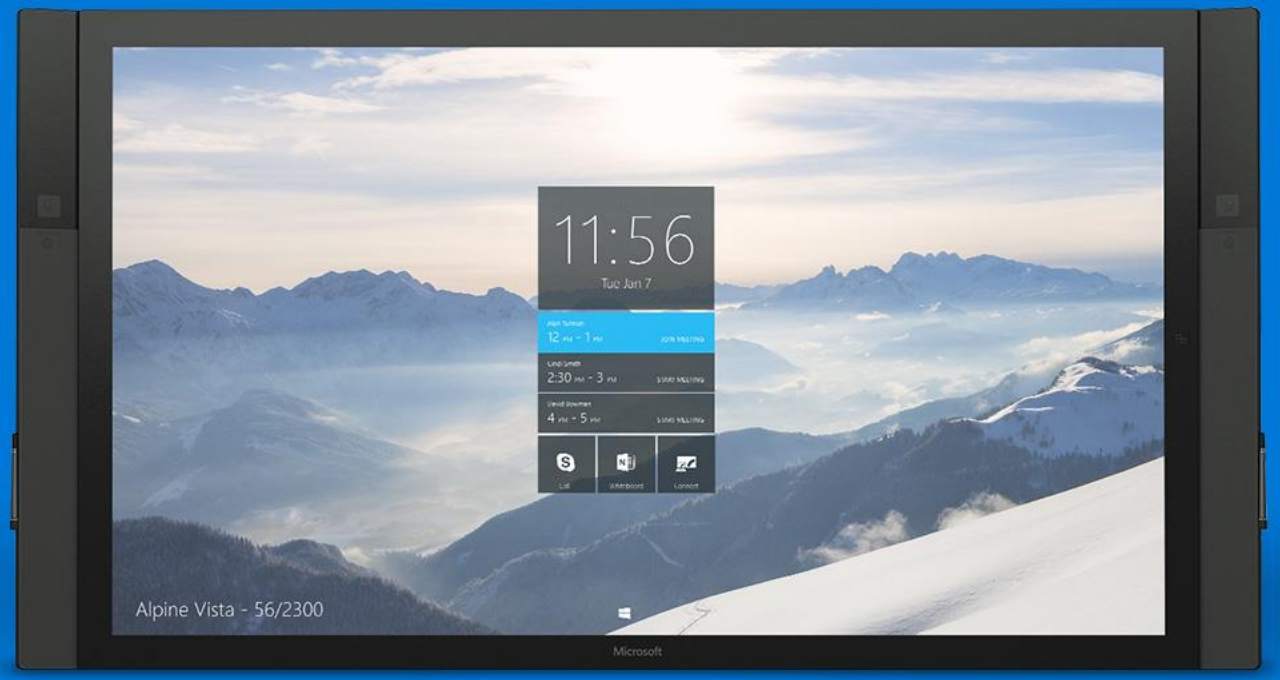


Session scope



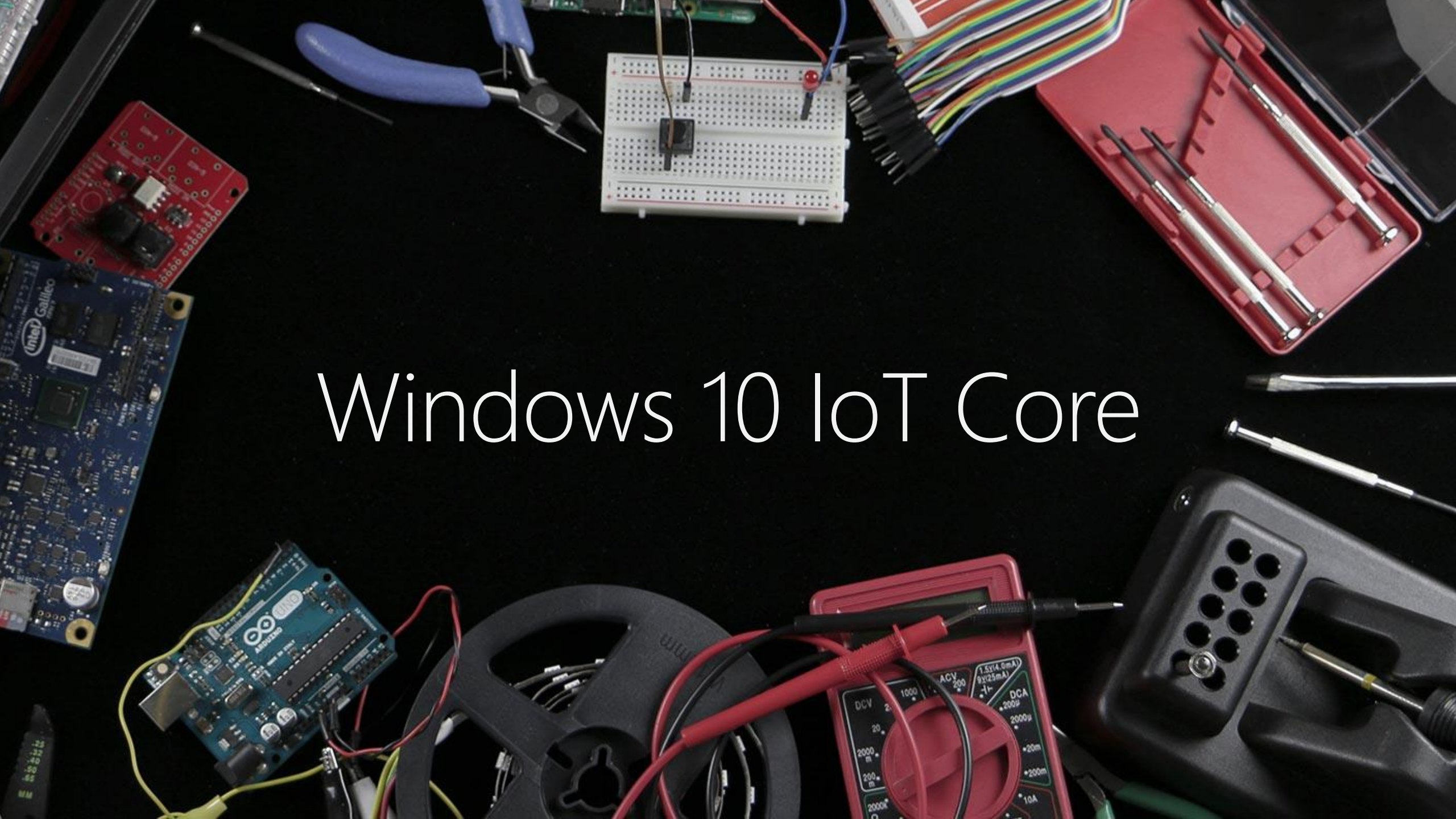
Session scope




11:56
Tue Jan 7
Alpine Vista - 56/2300
Microsoft

Windows 10


Pins
NETFLIX
FORZA HORIZON 2
Messages
Live TV
Xbox Music
Xbox Video


Windows 10 IoT Core

Demo:Windows 10 IoT quick peek

Azure IoT Starter Kits

Get started quickly

Raspberry Pi 2 Kit

Windows 10 and Raspbian

Samples in C and C#

Feather M0 Wi-Fi Kit

RTOS

Samples in Arduino IDE and C

Feather Huzzah ESP8266 Kit

RTOS

Samples in Arduino IDE and C

Intel Edison Kit

Linux Yocto

Samples in JavaScript (Node.js)

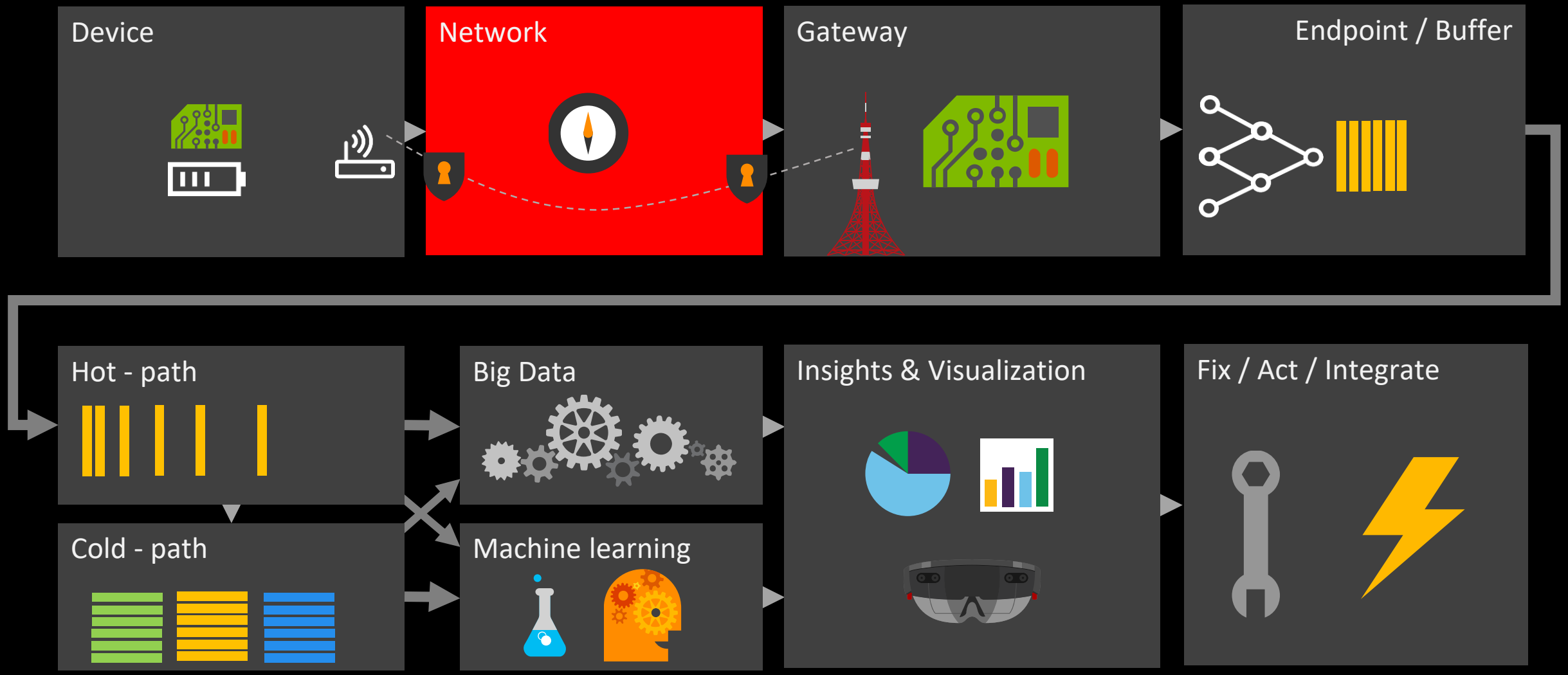
ThingDev Kit

RTOS

Samples in Arduino and C

Start today: http://azure.com/iotstarterkits

Session scope



IOT SECURITY

2000 Sewage treatment plant release ¼ million gallons of raw sewage

2003 Slammer Worm disables Nuclear power plant

Sobig virus shuts down train signaling in the US

Alarm failure causes power loss, impacting 50M people

2005 13 DaimlerChrysler plants shutdown due to Zotob Worm

2008 14-year old hacks tram system – 12 injuries

2009 Faulty sensor causes Metro collision – fatal

2010 Stuxnet disrupts 14 plants including uranium enrichment facility

2010 – 2014 150 Attacks on energy grids

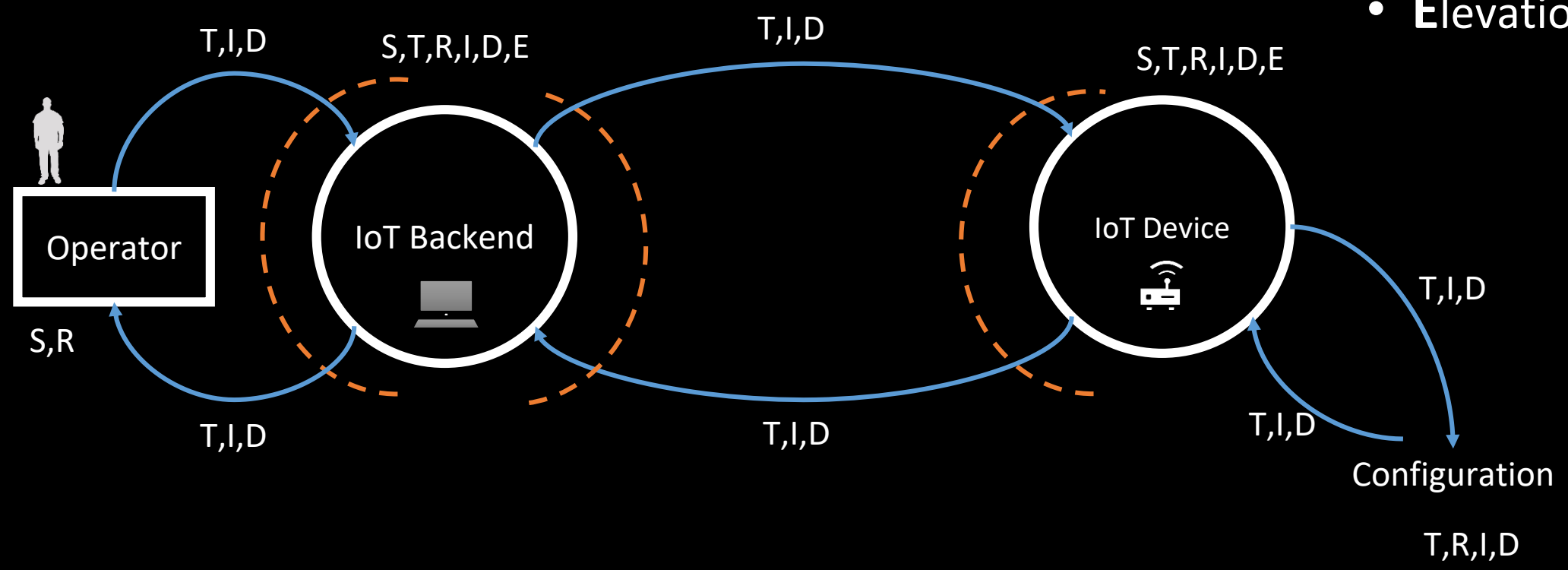
2014 Hackers attack German steel mill – melt down

2015 Consumers get both baked and frozen due to faulty thermostats

2016 ...more to come...

Threat possibilities

- **S**poofing
- **T**ampering
- **R**epudiation
- **I**nformation Disclosure
- **D**enial of Service
- **E**levation of Privilege



Demo: Shameless Shodan

TPM (Trusted Platform Module)

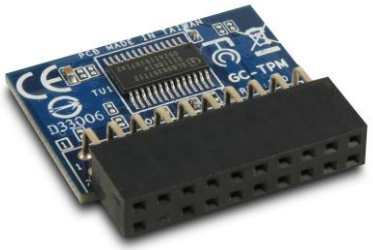
Generate, store, use, and protect cryptographic keys

Keeps private part of key pairs away from your/others code and OS memory

Supported on:

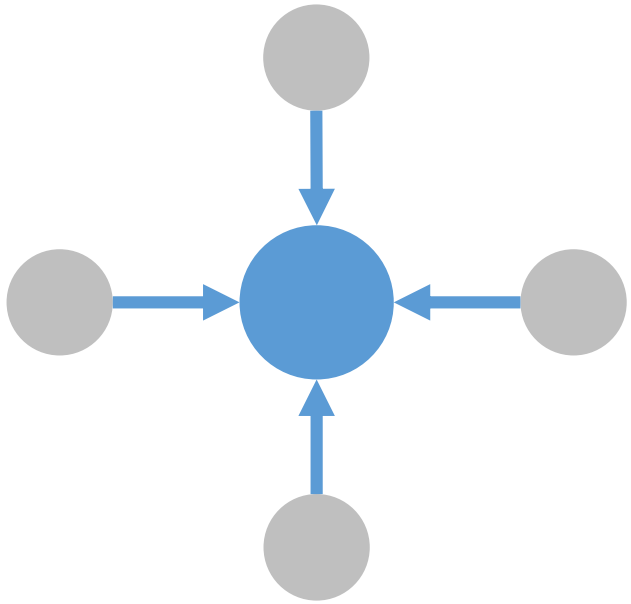
- Windows 10
- Windows 10 Mobile
- Windows Server 2016
- Windows 10 IoT Core (IoT Core)

Rpi 2/3 only support TPM emulator



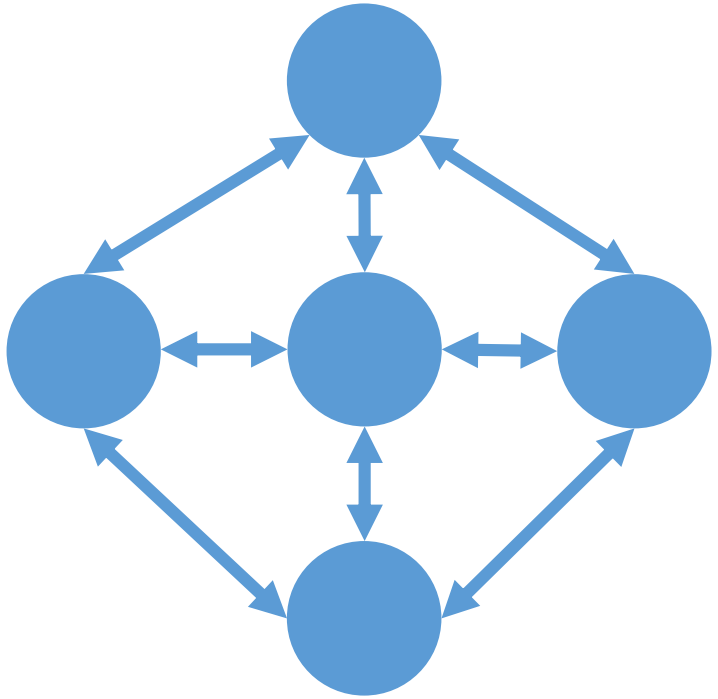
Blockchain & IoT?

Central Ledger



Trust one

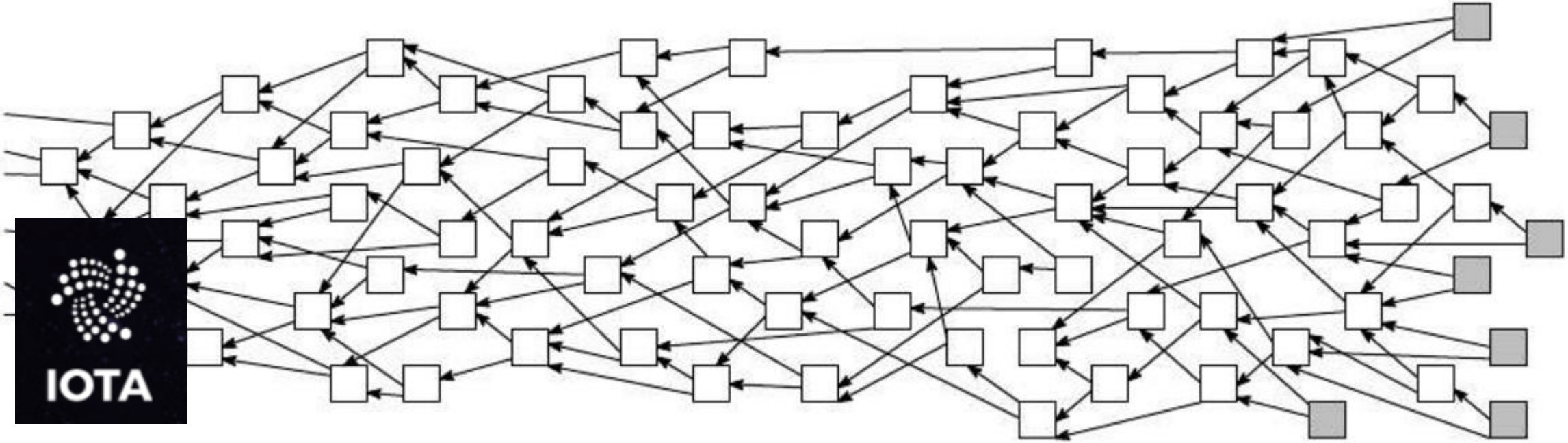
Distributed Ledger



Trust none

Tangle = Blockchain without blocks nor chain

Directed Acyclic Graph - Scalable – No transaction fees



Protocols

AMQP (Advanced Message Queuing Protocol)

reliability & interoperability

binary wire protocol

extensible

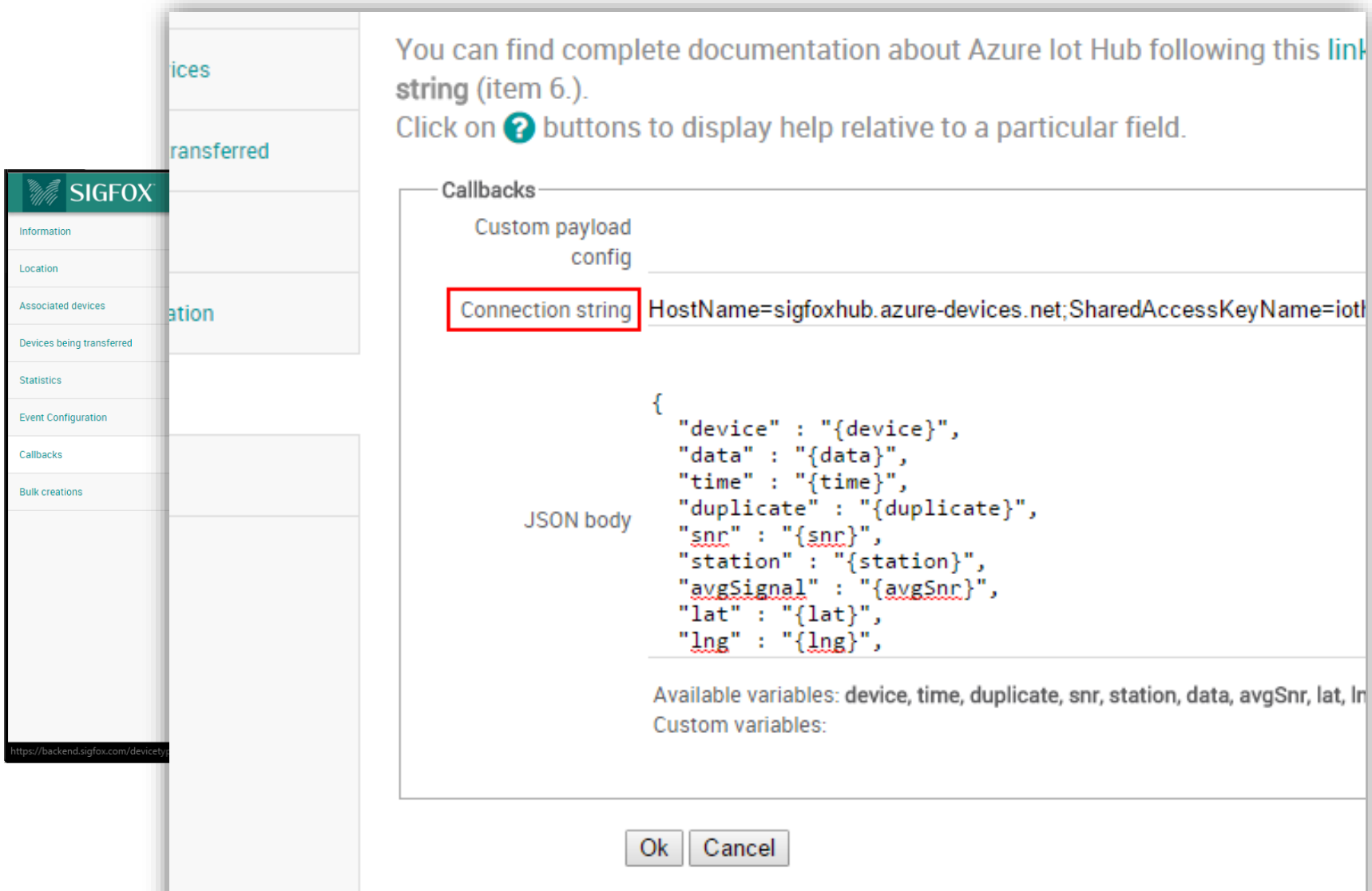
Protocols

MQTT (Message Queue Telemetry Transport)

- simplicity, less features
- ideal for smaller devices and low bandwidth
- widely adopted

SIGFOX + Azure

SIGFOX
One network A billion dreams



12 byte messages

< 140 per day

Multi year battery life

KMs of range

<10$ per device

7 million devices deployed today

Long Range Internet of Things (LoRa™)

10 Years

Sensor nodes can be very energy efficient with a lifetime of up to 10 years on a single battery.

10+ miles

Sensor nodes can communicate over long distances at data rates from 300 bit/sec up to 50 kbit/sec.

Billions

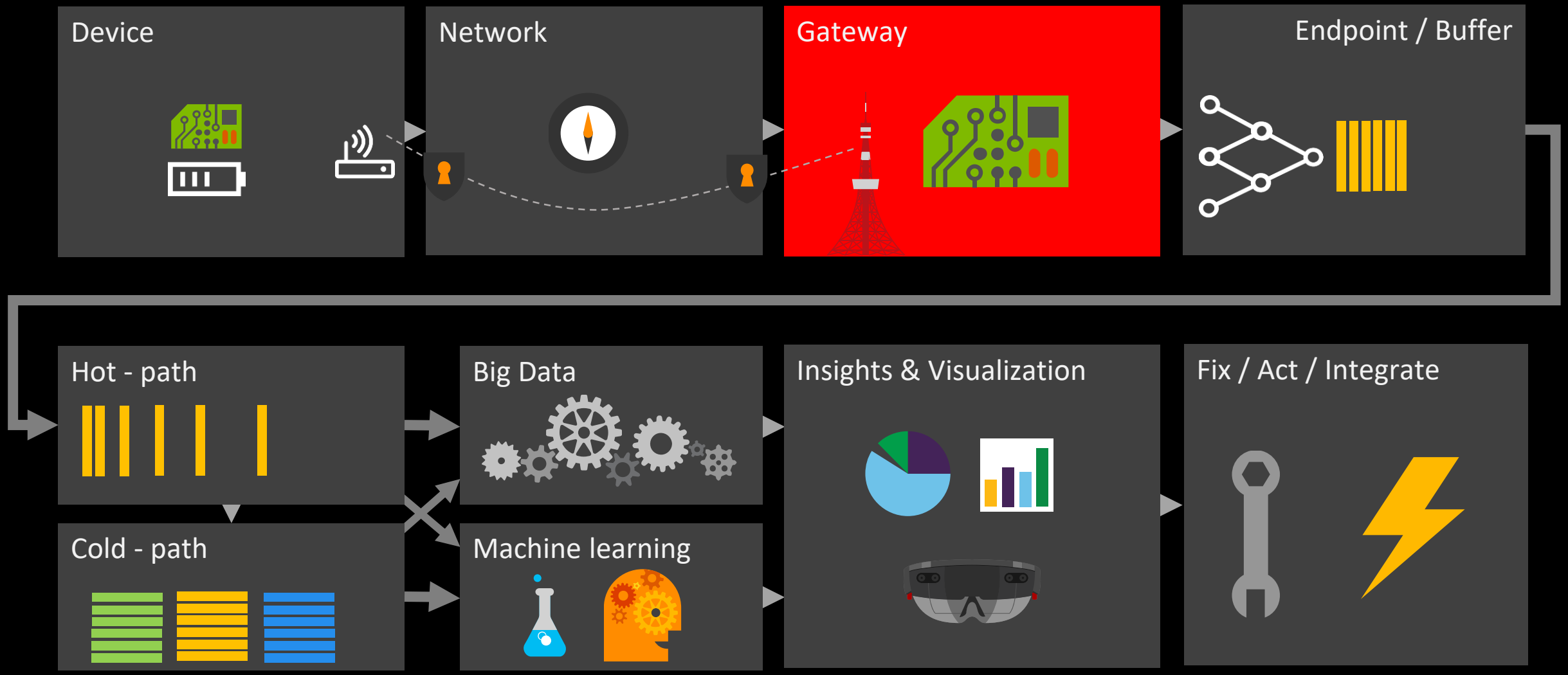
Highly scalable, connecting billions of sensors to millions of nodes.

AES128

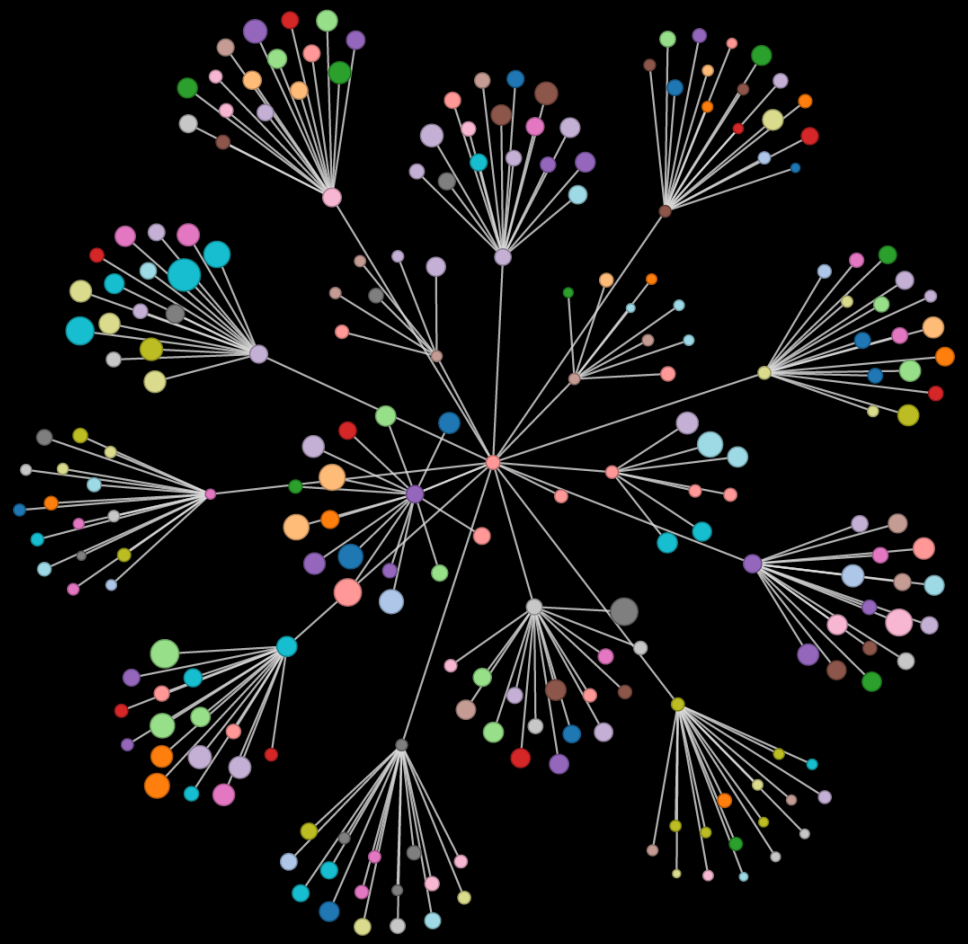
Makes tampering and eavesdropping virtually impossible.

DEMO: Coverage check

Session scope



Gateway topology



Fog computing

AKA Edge computing

Data handling/analytics/intelligence at the edge (in the field)

IoT Gateway SDK

IoT Protocol Gateway SDK

Open Fog Consortium

Azure IoT Gateway SDK

Connectivity bridge

Protocol bridge

Security bridge

Device proxy

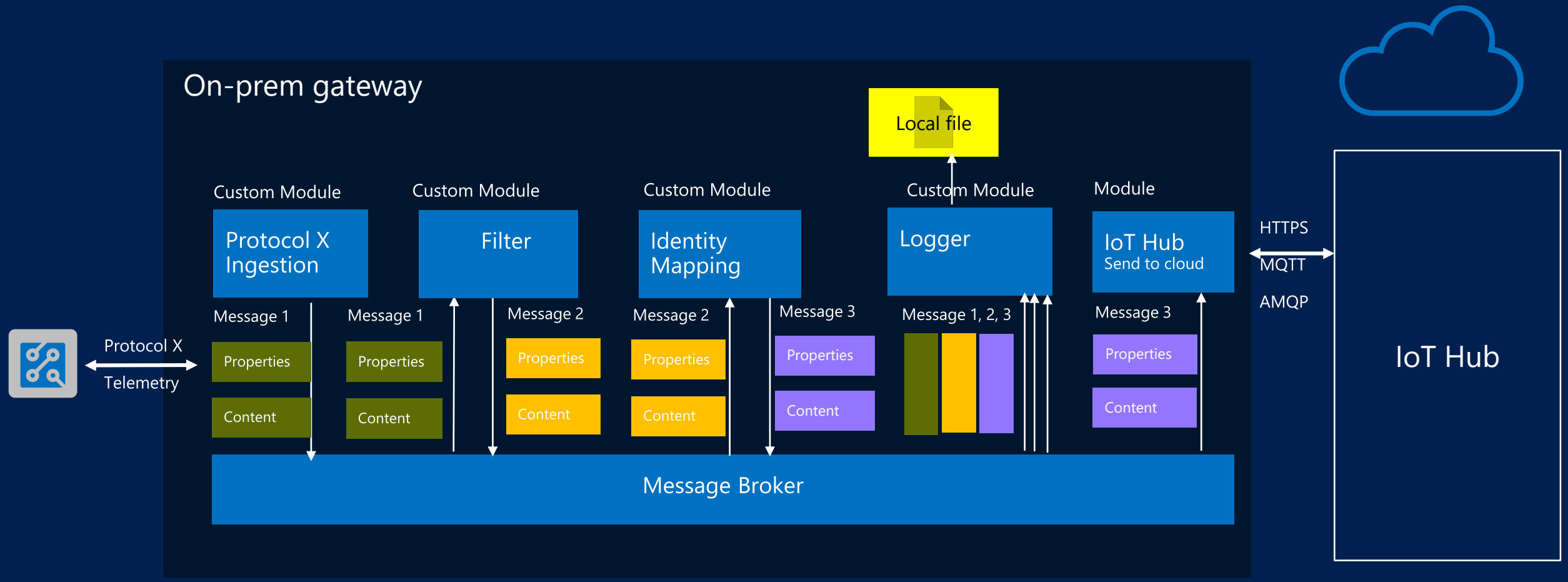
Azure IoT Gateway SDK

Can run in the cloud (VM, Role, Service Fabric, etc.)

Can run on-premises in a gateway device

Linux, Windows,… where C runs.

Azure IoT Gateway Architecture

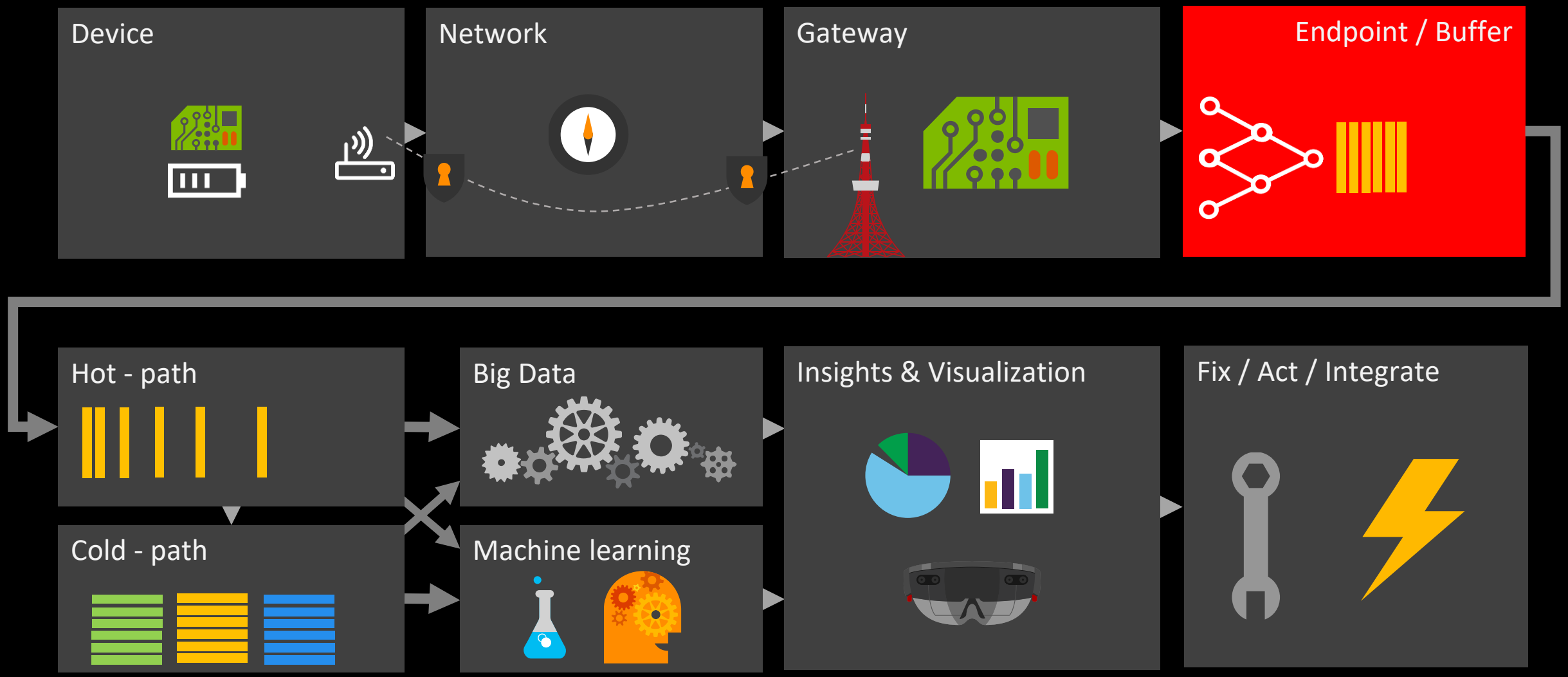


Out-of-the-box Modules or Custom (Today)
- BLE (Bluetooth Low Energy) Module
- Logger Module
- Identity Map Module
- IoT Hub Module

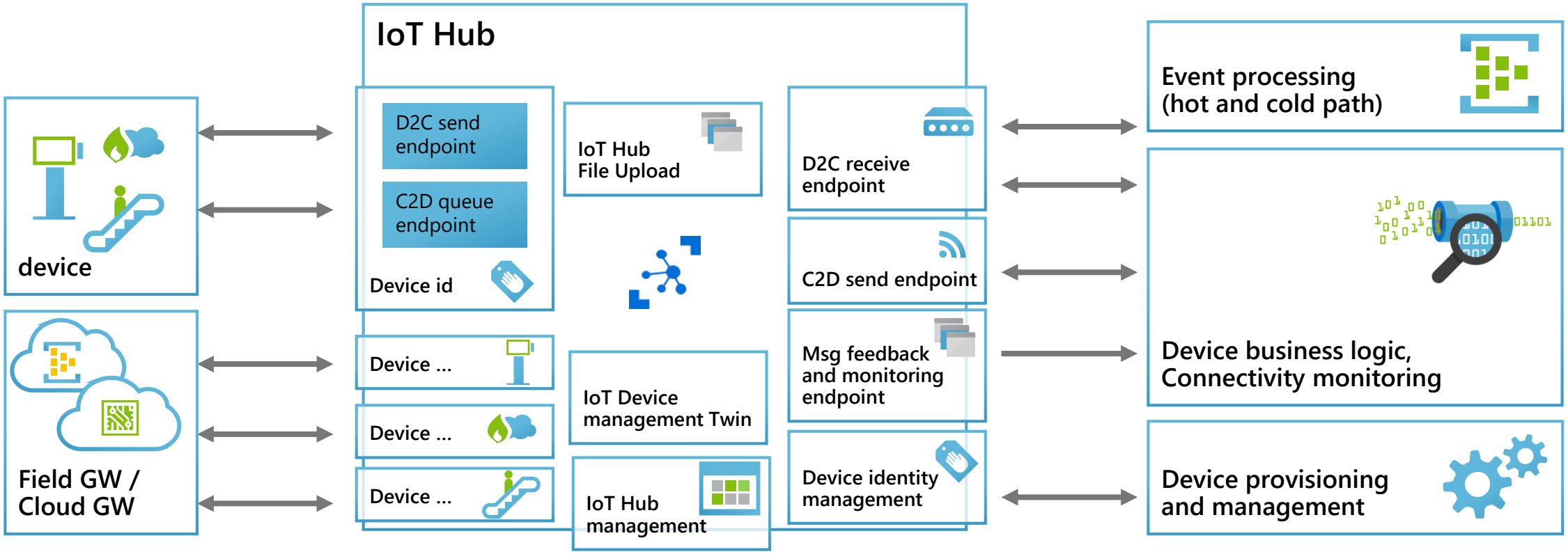
Sample (today)
- Simulated Device Module
- Hello World Module

Future Azure IoT Modules
- OPC-UA
- Modbus
- BACnet
- Filter (ASA)

Session scope



IoT Hub


IoT Hub
device
Field GW /
Cloud GW
D2C send
endpoint
C2D queue
endpoint
Device id
Device ...
Device ...
Device ...
IoT Hub
File Upload
IoT Device
management Twin
IoT Hub
management
D2C receive
endpoint
C2D send endpoint
Msg feedback
and monitoring
endpoint
Device identity
management
Event processing
(hot and cold path)
Device business logic,
Connectivity monitoring
Device provisioning
and management

IoT Hub vs Event Hubs

Area	IoT Hub	Event Hubs
Comm. pattern	D2C + C2D	D2C (and other event ingress)
Protocol	MQTT, AMQP (WS), HTTP/1, Azure IoT Protocol Gateway	AMQP (WS), HTTP/1
Security	Per device key or X509 certificate	SAS, No per device cred. or anti-spoofing included
Monitoring	Event subscriptions	Only aggregate metrics
Scale	Millions simultaneously connected devices	5000 AMQP connections. Partition support
SDK		.NET, C (AMQP, HTTP send)
File upload	File notification endpoint	Claim check pattern + provided storage key

IoT Hub vs Event Hubs

Area	IoT Hub	Event Hubs
Comm. pattern	FOR IOT DEVICE CONNECTIVITY SCENARIO's	FOR MASSIVE EVENT INGRESS IN INTER & INTRA DATACENTER SCENARIO's
Protocol		
Security		
Monitoring		
Scale		
SDK		
File upload		

COMPLEMENTARY TO

DEMO: Azure IoT Hub

Azure IoT Hub

TIER:

S1	Unlimited devices	400000 msgs/day	€42/mo

1 MB/Min/Unit **280** Msg/Min/Unit

= €42.17/MO

S2	Unlimited devices	6000000 msgs/day	€422/mo

16 MB/Min/Unit **4k** Msg/Min/Unit

= €421.65/MO

S3	Unlimited devices	300000000 msgs/day	€4,217/mo

814 MB/Min/Unit **208k** Msg/Min/Unit

= €4,216.50/MO

Event Hubs

Ingress

180 Millions of events × €0.024 Per million = €4.25/MO

Throughput

1 Throughput Units × 744 Hours × €0.013 Per unit/hour = €9.41/MO

Sub-total €13.66/MO

NOTE:
Maximum throughput units: 20. Up to 1MB per second of ingress events. Up to 2MB per second of egress events.

Azure IoT Hub Cost Calculator

Number of Devices

1,000

Messages per Day per Device

17,300

Message Size (bytes)

70

The calculated cost is for data ingestion only. It does not include related services that make up an IoT solution.

	IoT Hub S1	IoT Hub S2	IoT Hub S3	AWS	Event Hub Basic	Event Hub Standard
Cost						
Total Cost per Month	$2,200	$1,500	$5,000	$2,595	$25.53	$36.53
Total Unit Cost per Month	$2,200	$1,500	$5,000	$0	$11	$22
Total Message Cost per Month	$0	$0	$0	$2,595	$14.53	$14.53
Units Required	44	3	1	0	1	1
Cost per Device per Month	$2.2	$1.5	$5	$2.6	$0.03	$0.04
Max Devices per Unit (based on entered Message Count and Message Size)	23.12	346.82	17,341.04	0	4,994.22	4,994.22
Block Size (bytes)	4,096	4,096	4,096	512	65,536	65,536
Blocks per Message	1	1	1	1	1	1
Total Messages per Day per Device	17,300	17,300	17,300	17,300	17,300	17,300
Total Messages per Day	17,300,000	17,300,000	17,300,000	17,300,000	17,300,000	17,300,000
Total Messages per Month	519,000,000	519,000,000	519,000,000	519,000,000	519,000,000	519,000,000
Pricing Model						
Message Limit (max day/unit)	400,000	6,000,000	300,000,000	0	86,400,000	86,400,000
Unit Cost	$50	$500	$5,000	$0	$11	$22
Message Cost (per million messages)	$0	$0	$0	$5	$0.028	$0.028

IoT Hub High Availability & Disaster Recovery

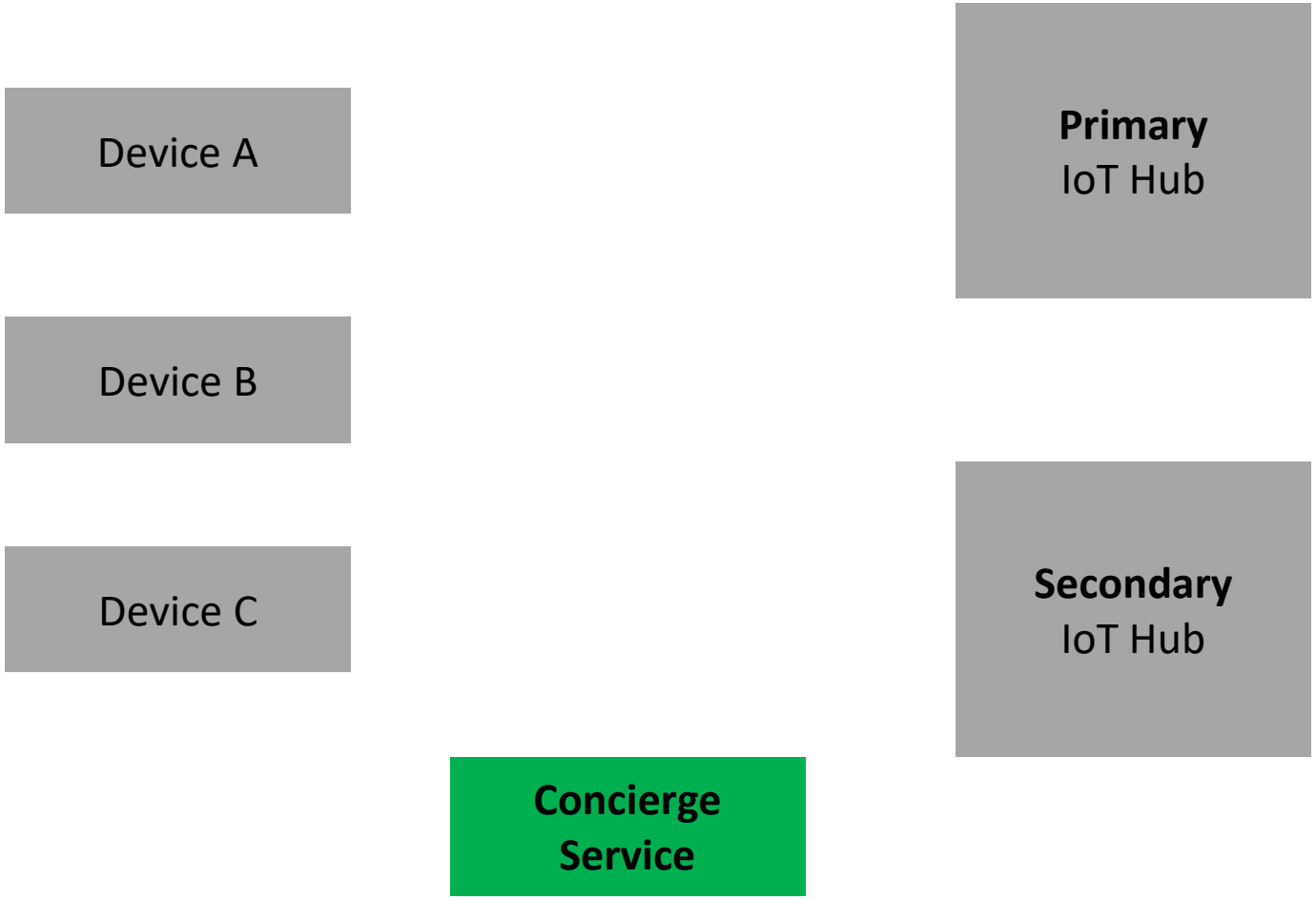
Self-initiated RTO of 2-26 hours

RPO on CName loss, Identity Registry (5min), Unread messages, C2D (5min)

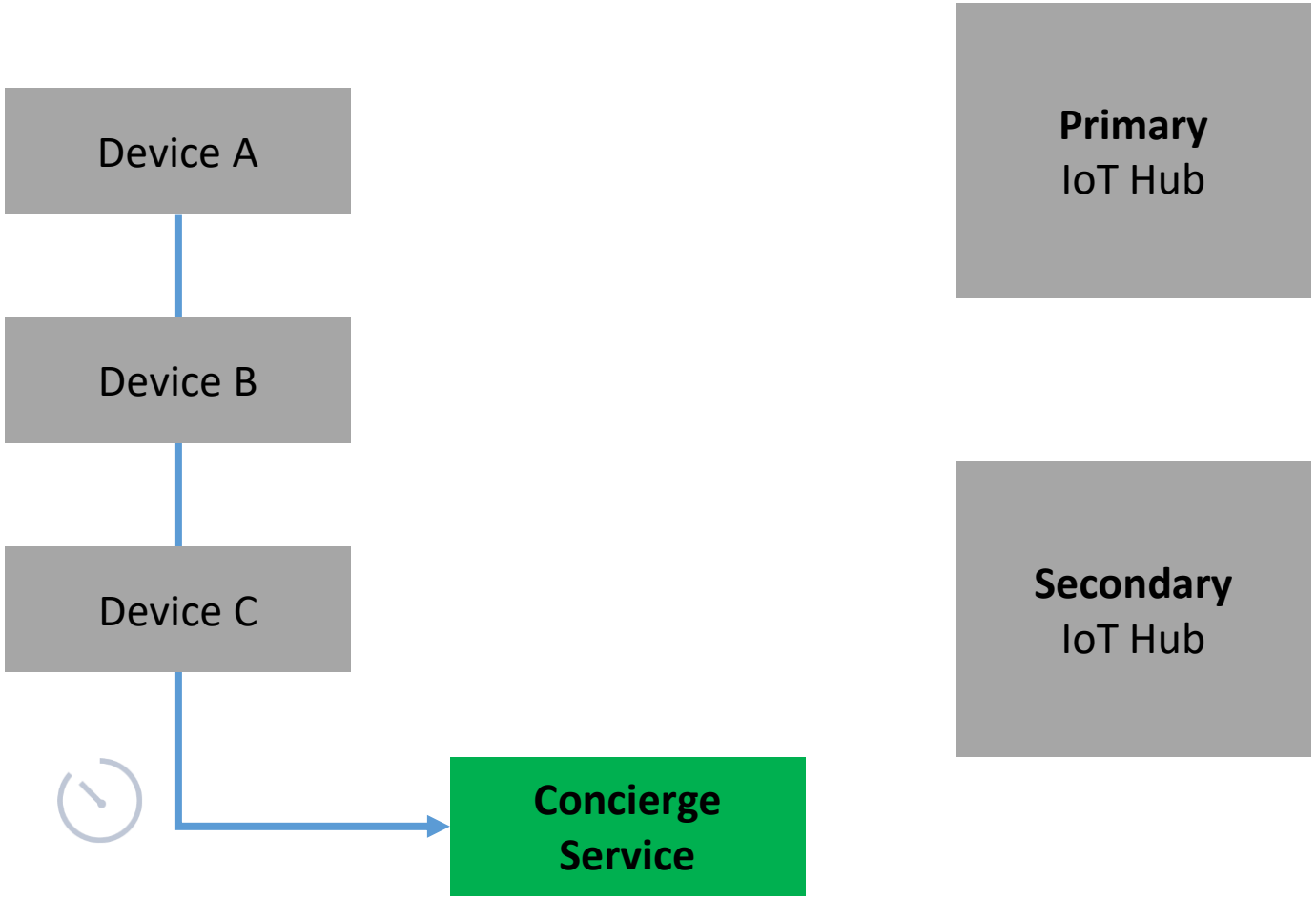
Regional failover practice:

- Provision 2nd IoT Hub in secondary region
- Implement *concierge service*

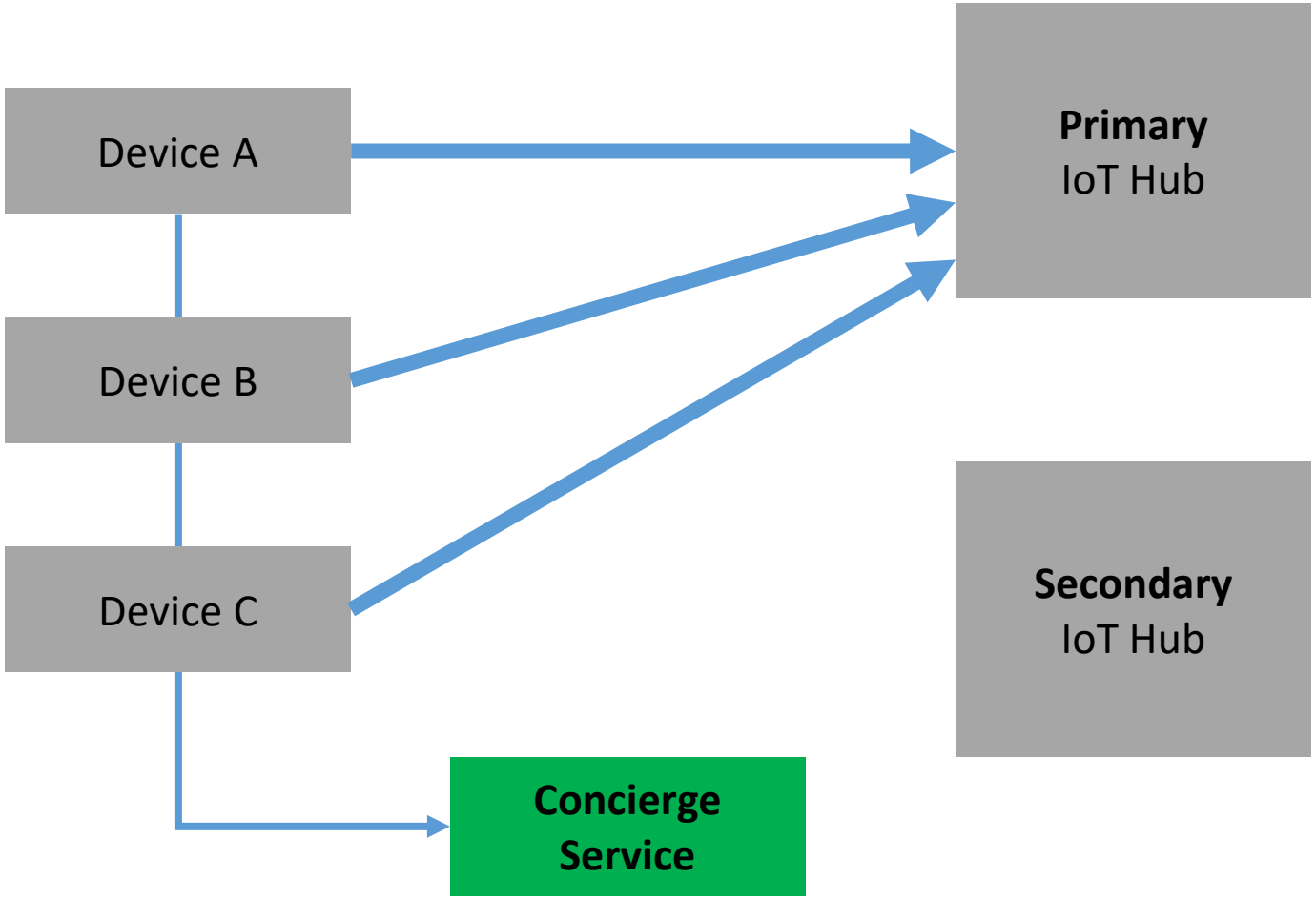
IoT Hub HA Concierge Service



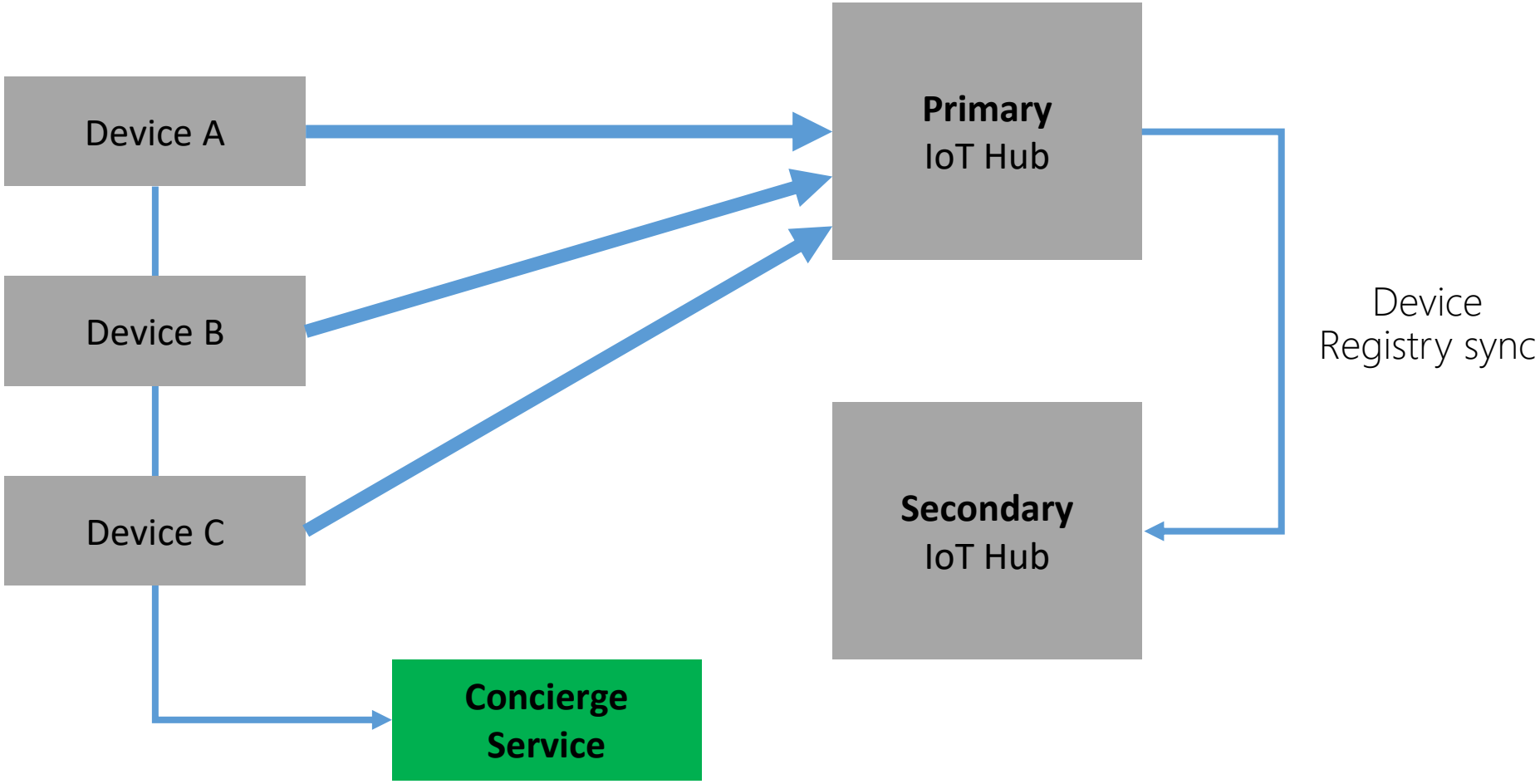
IoT Hub HA Concierge Service



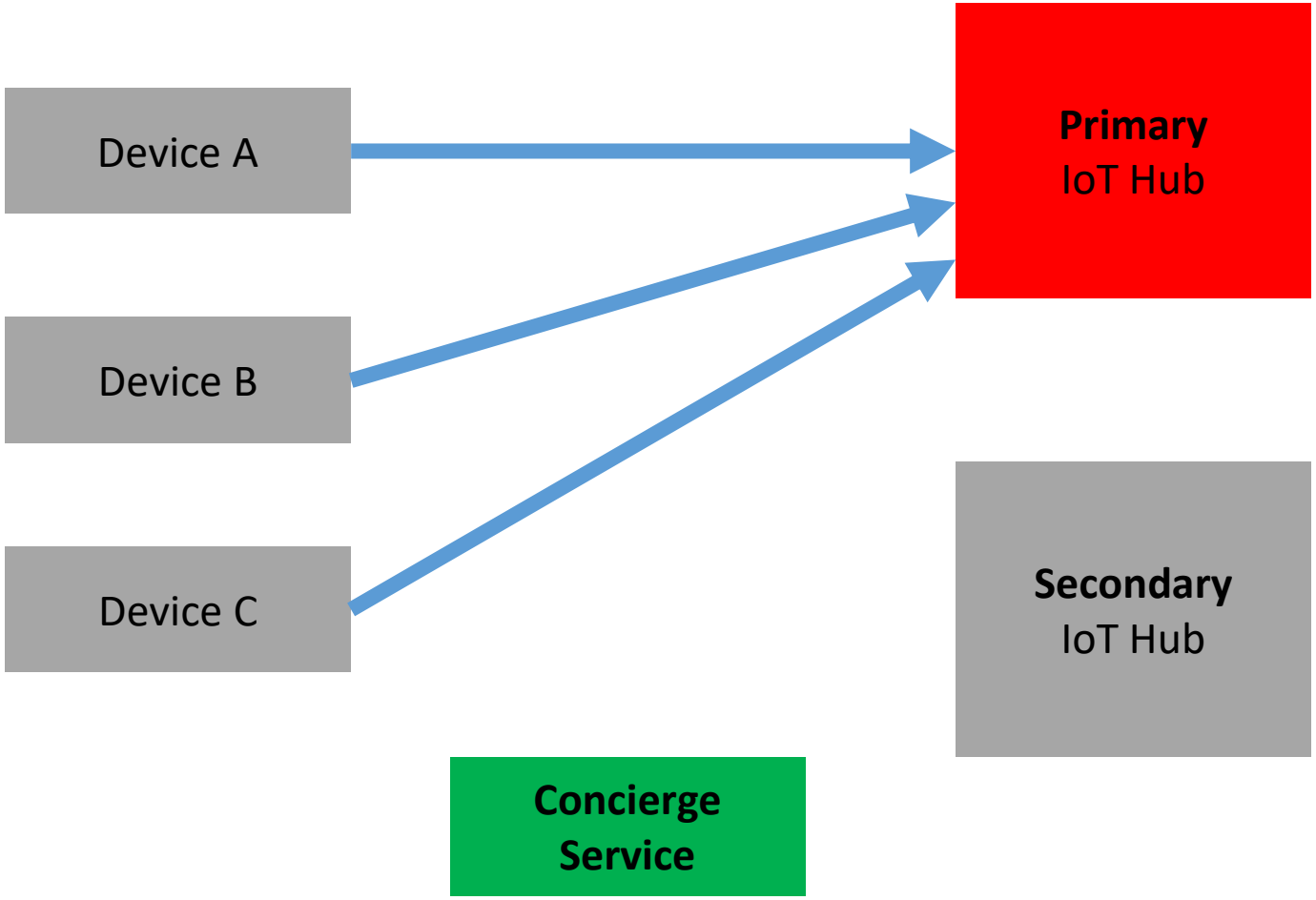
IoT Hub HA Concierge Service



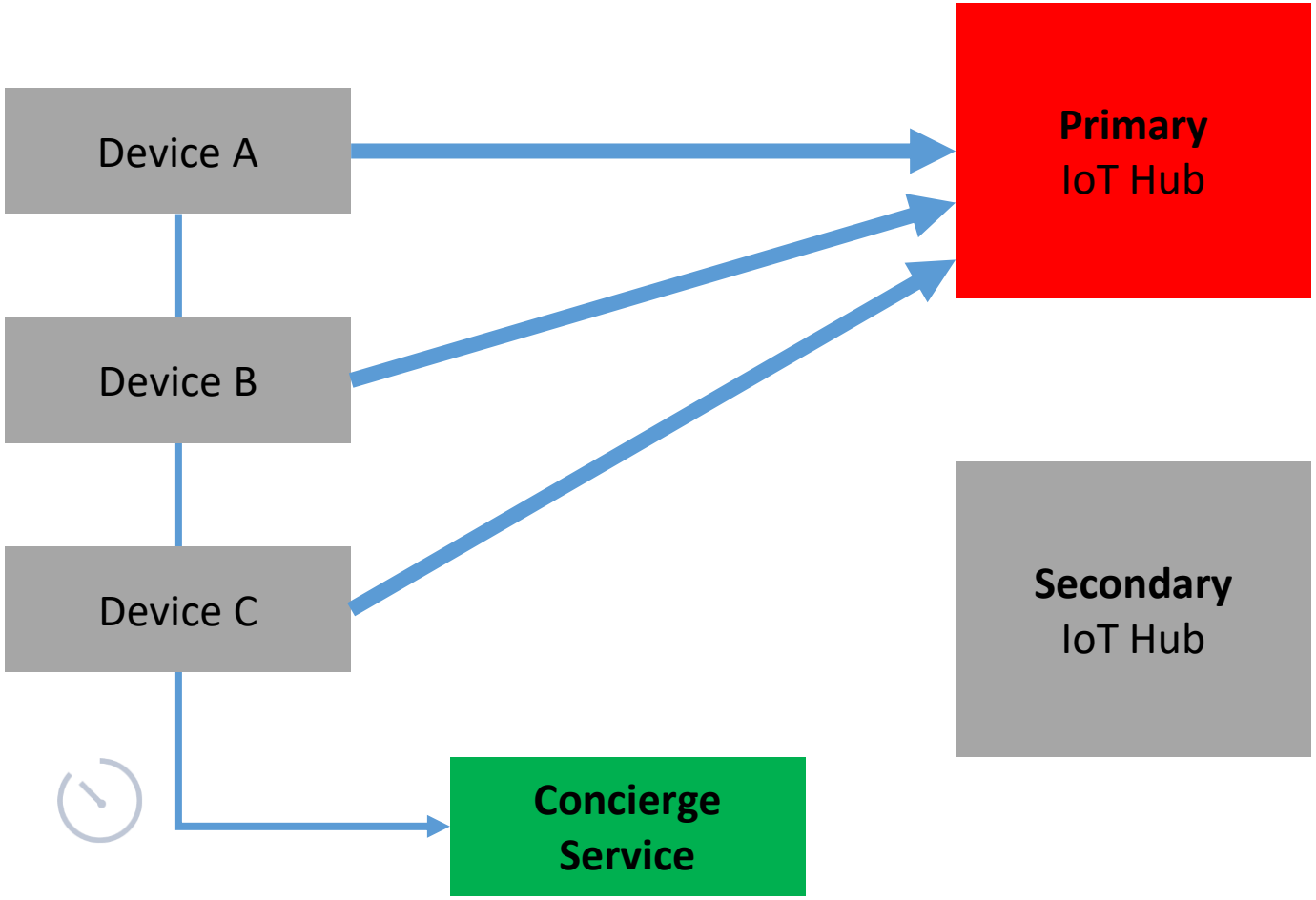
IoT Hub HA Concierge Service



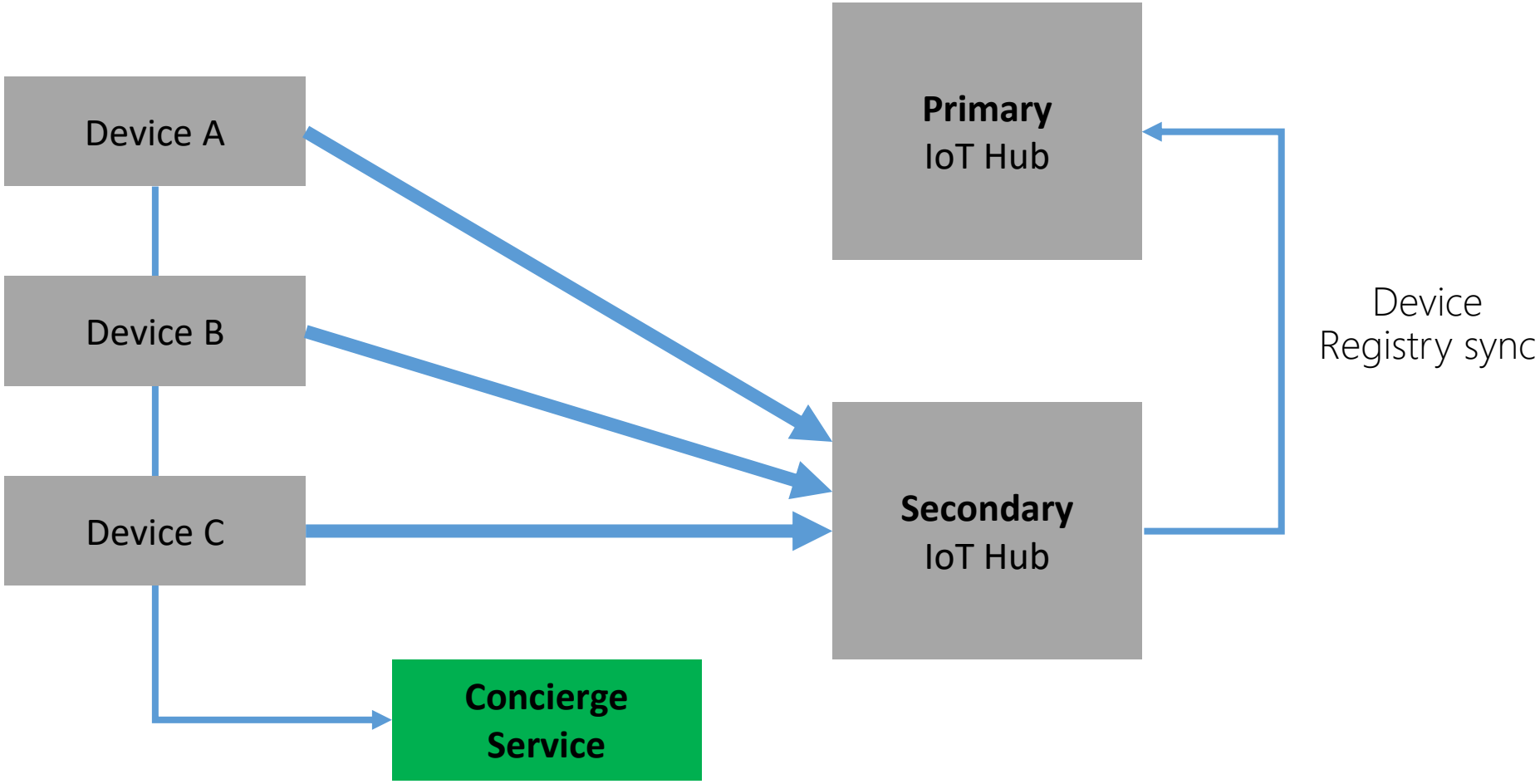
IoT Hub HA Concierge Service



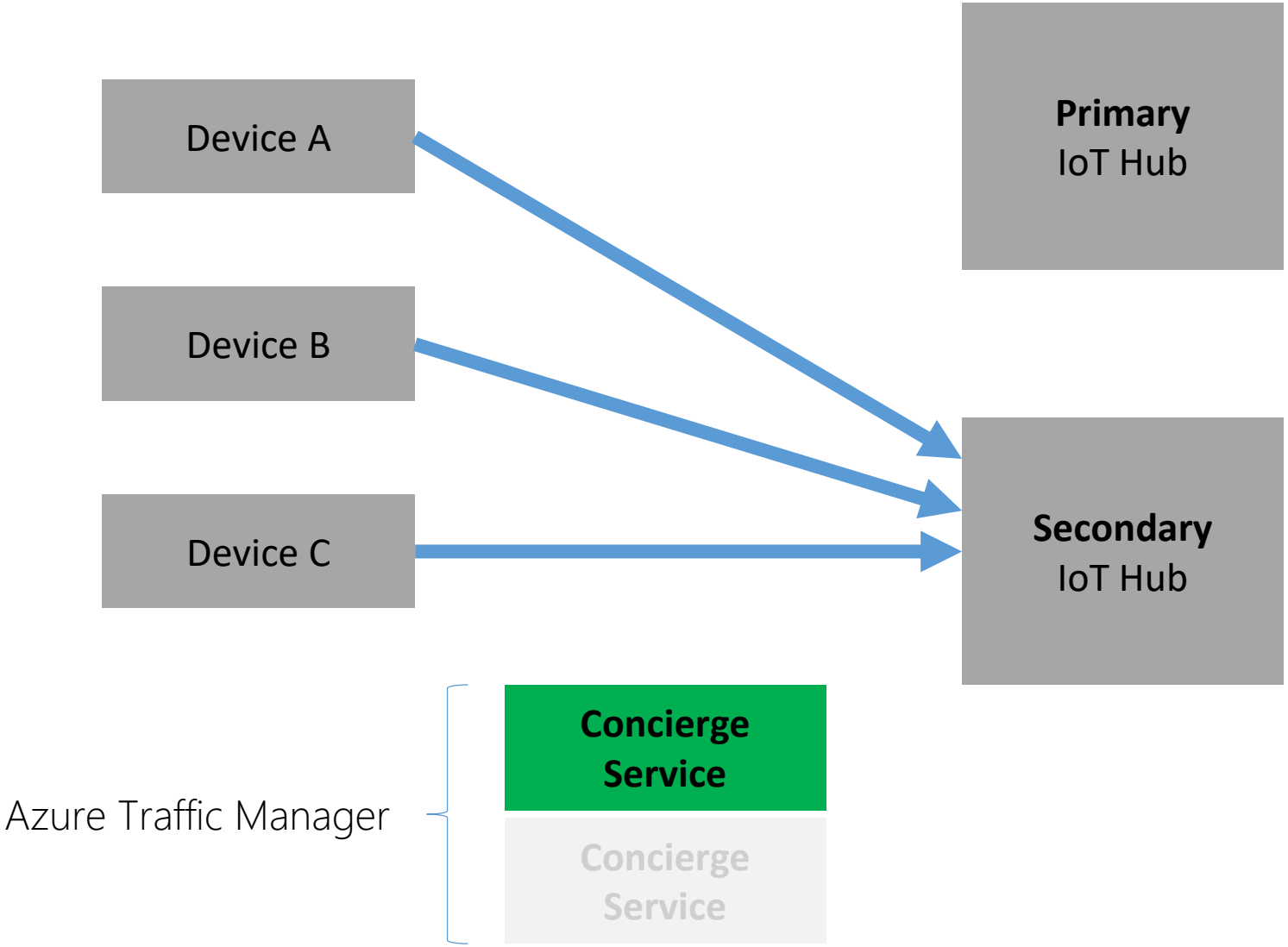
IoT Hub HA Concierge Service



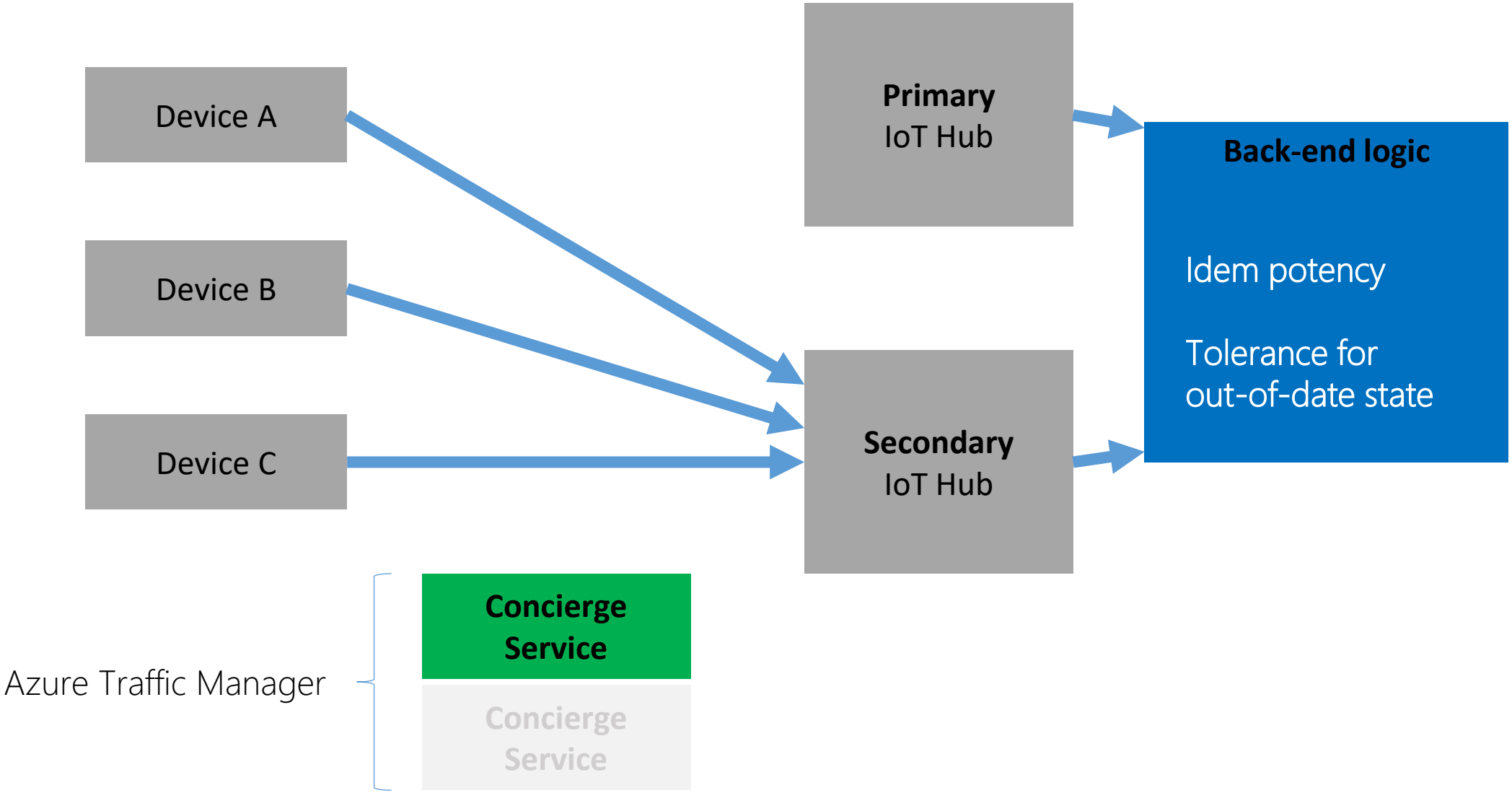
IoT Hub HA Concierge Service



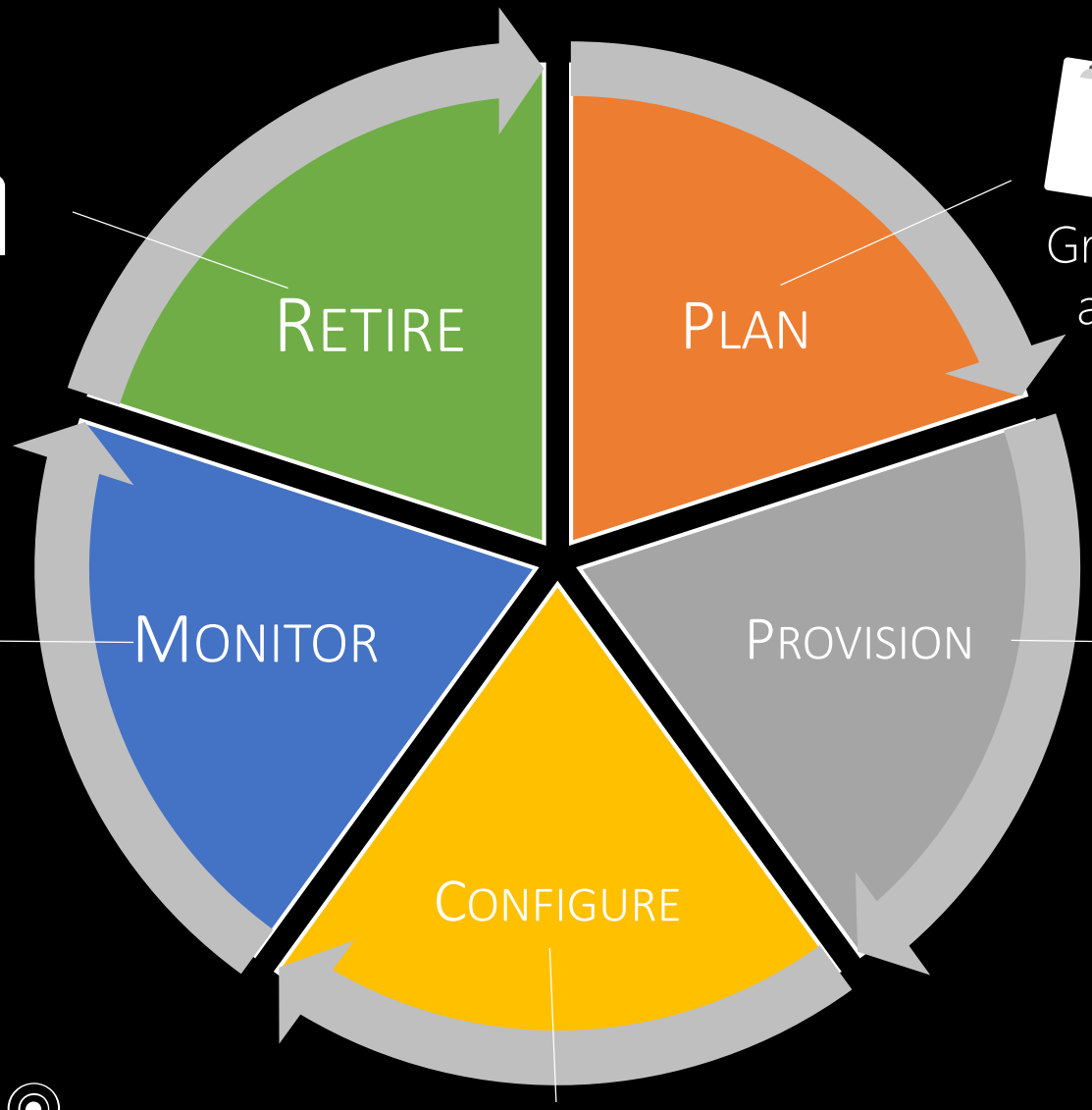
IoT Hub HA Concierge Service



IoT Hub HA Concierge Service



IoT Device Lifecycle



Replace or decommission devices after failure, upgrade cycle or service lifetime

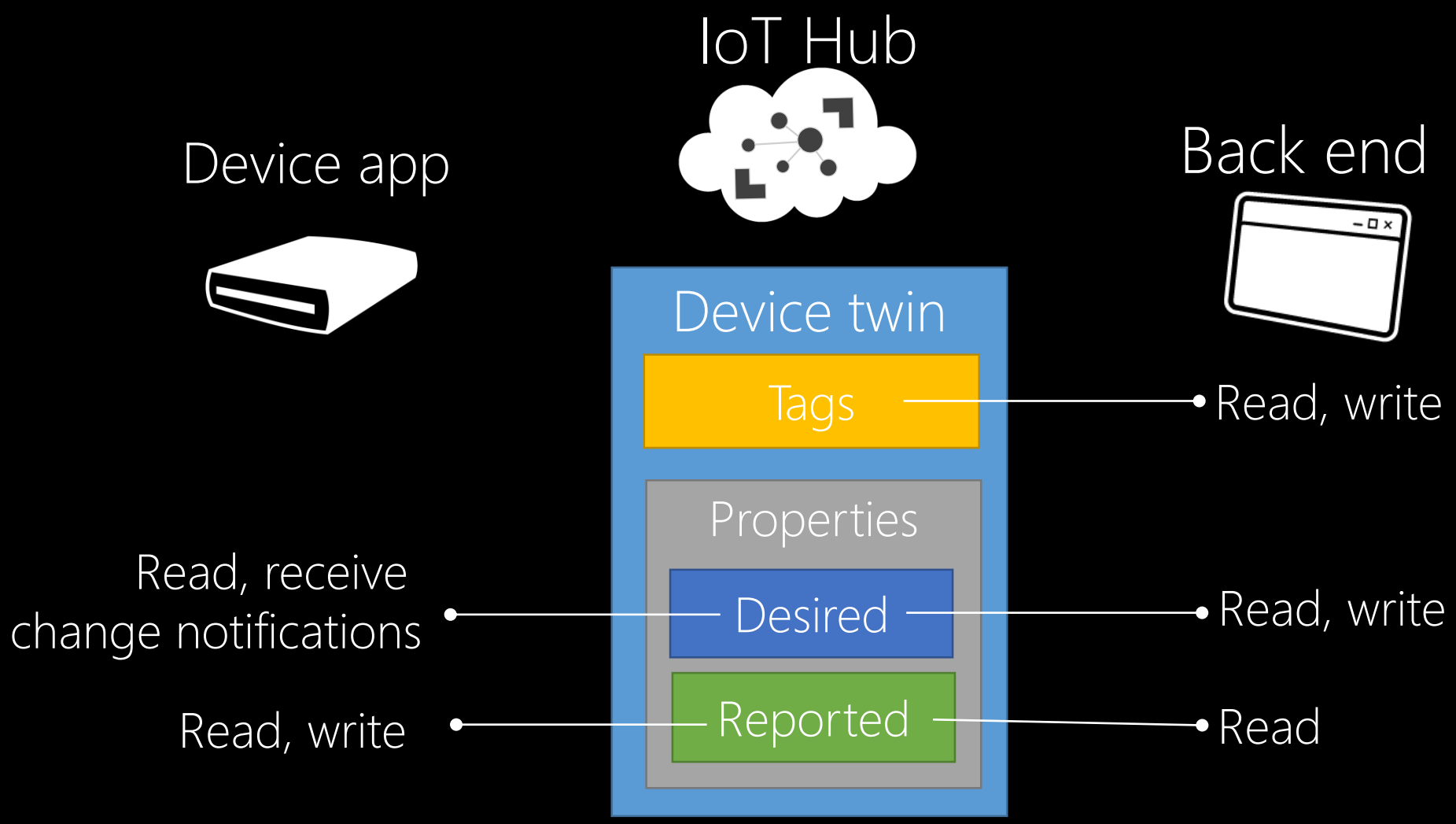
Group devices and control access according to your organization's needs

Monitor device inventory, health & security while providing proactive remediation of issues

Securely authenticate devices, on-board for management and provision for service

Provide updates, configuration & applications to assign the purpose of each device

Azure IoT Device Twin



Azure IoT Device SDK

Open Source

Everything is on GitHub, open source under MIT license

Cross-Platform Support

RTOS, Linux, Windows, iOS, Android

Multi-Language Support

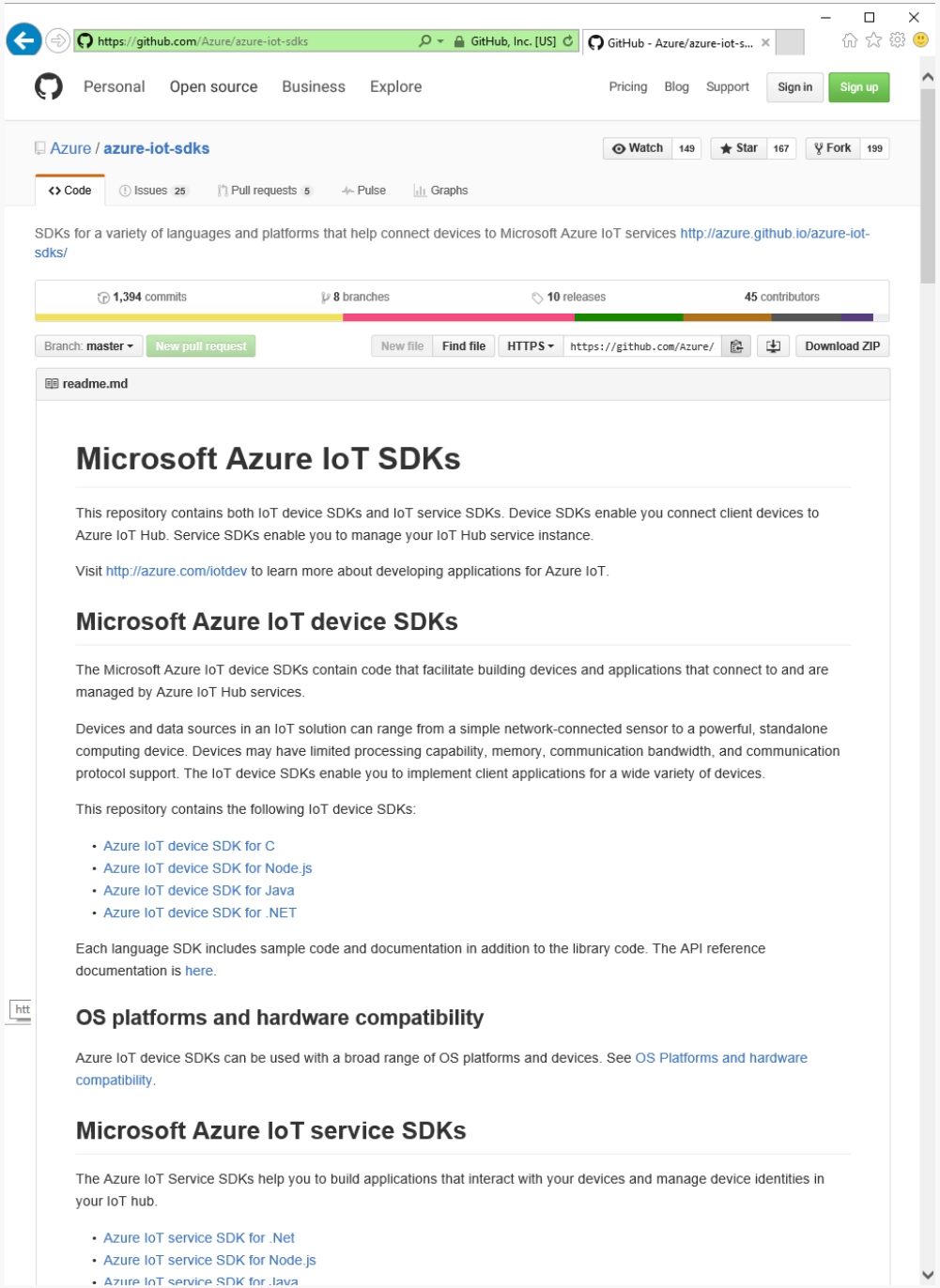
C, Node.js, Java, C#, Python

Xamarin Compatible

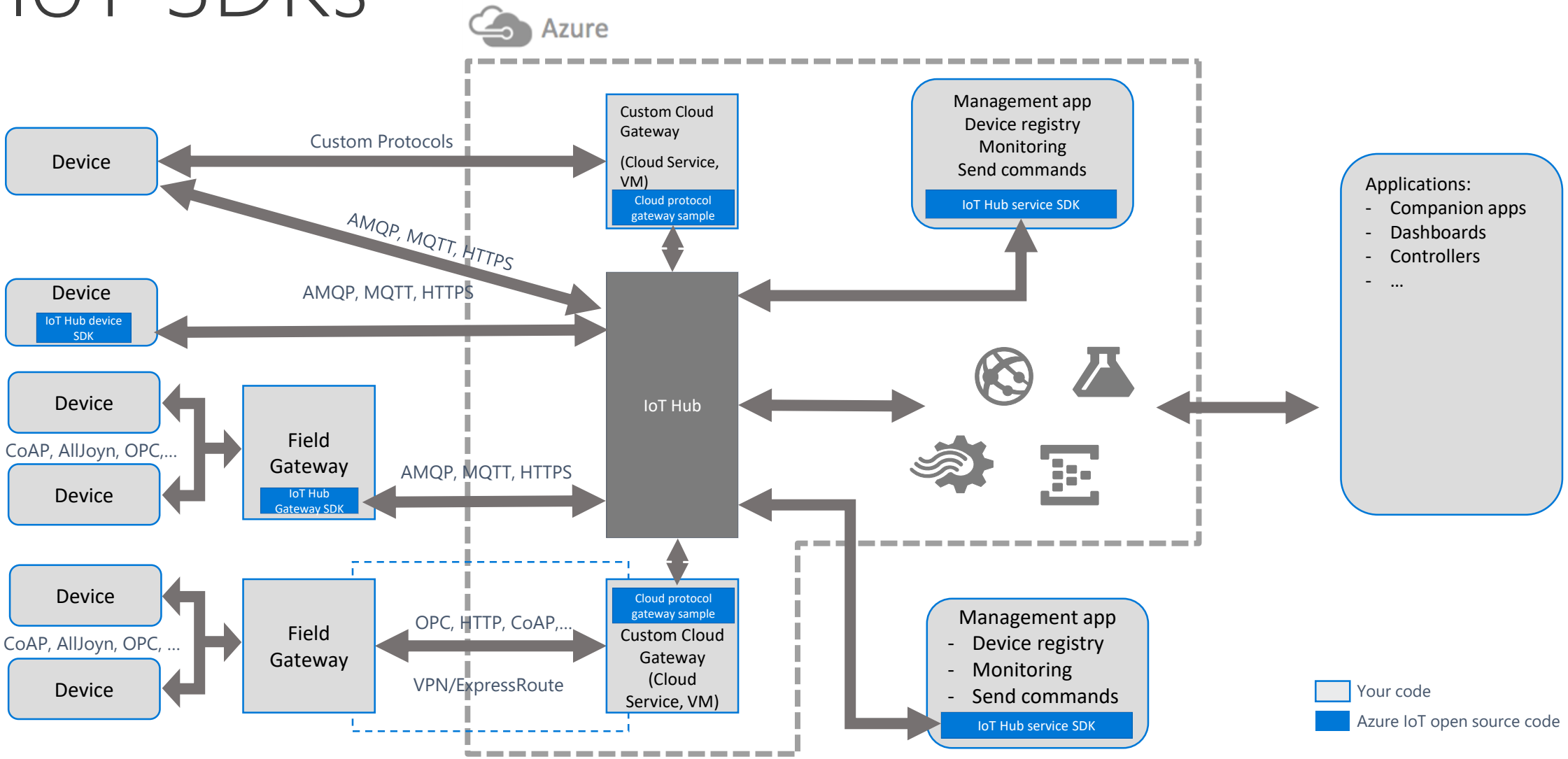
Includes Xamarin compatible libraries

Easy To Get Started

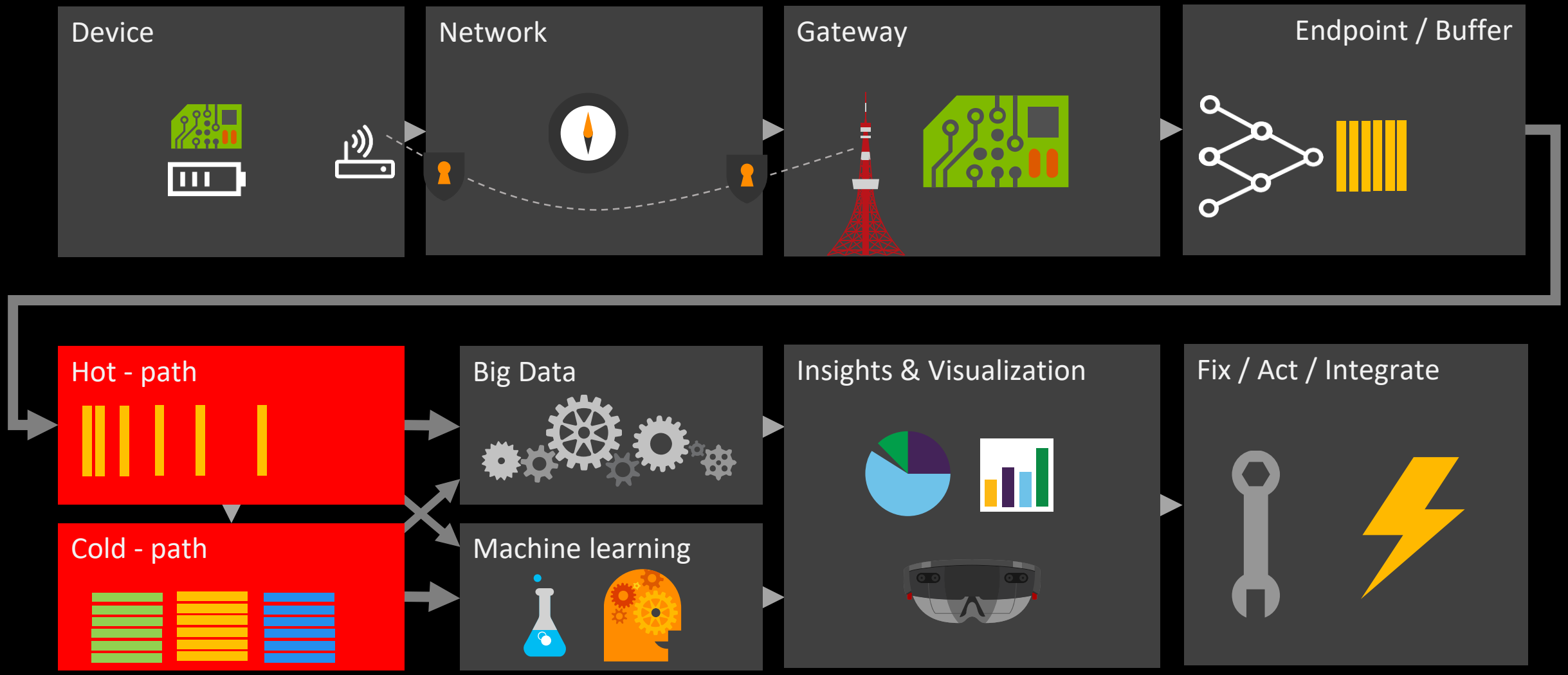
Samples, walkthroughs to get you started quickly



IoT SDKs


Azure
Device
Custom Protocols
Custom Cloud Gateway
(Cloud Service, VM)
Cloud protocol gateway sample
Management app
Device registry
Monitoring
Send commands
IoT Hub service SDK
AMQP, MQTT, HTTPS
Device
IoT Hub device SDK
AMQP, MQTT, HTTPS
IoT Hub
Applications:
- Companion apps
- Dashboards
- Controllers
- ...
Device
CoAP, AllJoyn, OPC,...
Device
Field Gateway
IoT Hub Gateway SDK
AMQP, MQTT, HTTPS
Device
CoAP, AllJoyn, OPC, ...
Device
Field Gateway
OPC, HTTP, CoAP,...
VPN/ExpressRoute
Cloud protocol gateway sample
Custom Cloud Gateway (Cloud Service, VM)
Management app
- Device registry
- Monitoring
- Send commands
IoT Hub service SDK
Your code
Azure IoT open source code

Session scope



Azure Stream Analytics

```
WITH [StreamData]
AS (SELECT * FROM
      [IoTHubStream]
    WHERE
        [ObjectType] IS NULL )

SELECT * INTO [Telemetry] FROM [StreamData]

SELECT
    DeviceId,
    AVG (Humidity) AS [AverageHumidity],
    MIN(Humidity) AS [MinimumHumidity],
    MAX(Humidity) AS [MaxHumidity],
    5.0 AS TimeframeMinutes
INTO [TelemetrySummary]
FROM [StreamData]
WHERE [Humidity] IS NOT NULL
GROUP BY
    DeviceId,
    SlidingWindow (mi, 5)
```

Azure Stream Analytics

Can pump data out of an Event Hub, IoT Hub or Blob storage

Query output options:

- SQL DB
- Blob Storage
- Table Storage
- Event Hub
- SB Queue & Topic
- DocumentDB
- Power BI
- Data Lake Store

Azure Stream Analytics

1 MB/s per streaming unit

50 SU's per job (or more via support)

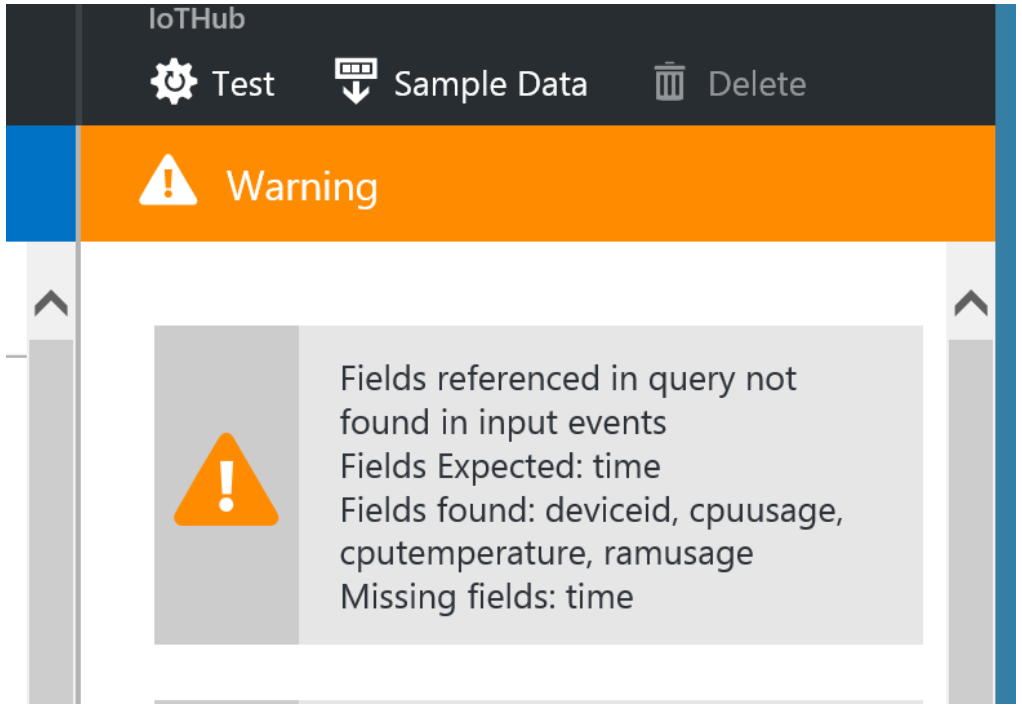
Can combine multiple Event Hubs

SQL-like query language

Azure Stream Analytics

Feature parity in new portal

Improved debug experience



Stream Analytics

Data processed

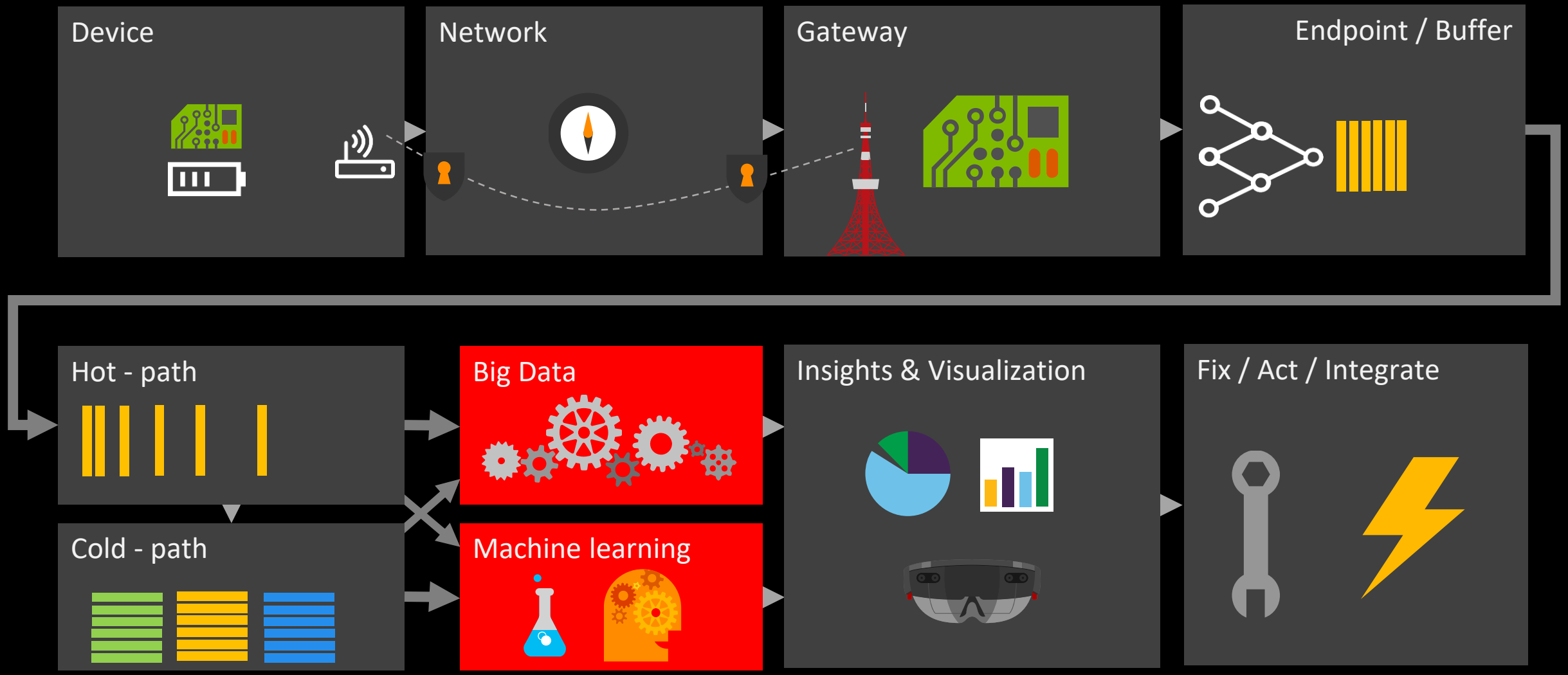
1 TB × €0.001 Per GB = €0.86/MO

Streaming units

2 Units × 744 Hours × €0.026 Units/Hours = €38.90/MO

Sub-total €39.76/MO

Session scope



Big Data Landscape 2016 (Version 3.0)

Infrastructure

Hadoop On-Premise
cloudera, Hortonworks, MAPR, Pivotal, IBM InfoSphere, bluedata, jethro

Hadoop in the Cloud
amazon web services, Microsoft Azure, Google Cloud Platform, IBM InfoSphere, CAZENA, altiscale, qubole

Spark
databricks, GridGain, TACHYON NEXUS

Cluster Services
amazon web services, kubernetes, HPCC SYSTEMS, docker, MESOSPHERE, CoreOS, pepperdata, StackIQ

NoSQL Databases
amazon DynamoDB, Google Cloud Platform, ORACLE, Microsoft Azure, MarkLogic, mongoDB, DATASTAX, AEROSPIKE, Couchbase, SequoiaDB, redislabs, influxdata

NewSQL Databases
SAP HANA, Clustrix, Pivotal, paradigm4, NUODB, memsql, splice machine, MariaDB, VOLTDB, citusdata, deepdb, Trafodion, Cockroach LABS

Graph Databases
neo4j, OrientDB, InfiniteGraph

MPP Databases
TERADATA, VERTICA, NETEZZA, Action, kognitio, EXASOL, dremio

Cloud EDW
amazon web services, Google Cloud Platform, Microsoft Azure, Pivotal, snowflake, WATERLINE DATA, Infoworks

Data Transformation
alteryx, talend, TRIFACTA, tamr, Paxata, StreamSets, Alation

Data Integration
informatica, MuleSoft, snapLogic, BedrockData, xplenty

Management / Monitoring
New Relic, APPDYNAMICS, amazon web services, actifio, Numerify, splunk>, DATADOG, rocana, DRIVEN, Anodot

Security
TANIUM, illumio, CODE42, DataGravity, CipherCloud, VECTRA, sqrrl, BlueTalon

Storage
amazon web services, Google Cloud Platform, Microsoft Azure, panasas, nimblestorage, COHO DATA, Qumulo

App Dev
apigee, CASK, Keen IO, Typesafe, DRIVEN

Crowd-sourcing
amazon mechanical turk, CrowdFlower, WorkFusion

Analytics

Analyst Platforms
Palantir, AYASDI, Quid, enigma, Digital Reasoning, ORBITAL INSIGHT

Analytics Platforms
Microsoft, guavus, Datameer, Bottlenose, interana

Data Science Platforms
context relevant, CONTINUUM ANALYTICS, DataRobot, Alpine, ARIMO, MODE, plotly, dataiku, nutonian, DOMINO, sense, yhat, ALGORITHMIA

Visualization
tableau, Google Cloud Platform, Qlik, looker, SISENSE, Roambi, YOOMDATA, datorama, CHARTIO

BI Platforms
Power BI, amazon web services, DOMO, salesforce, Wave Analytics, GoodData, birst, platfora, kyvos insights, atscale, ARCADIA, SISENSE

Statistical Computing
sas, SPSS, MATLAB

Log Analytics
splunk>, sumologic, kibana, CLOUD PHYSICS, loggly

Social Analytics
Hootsuite, NETBASE, DATASIFT, tracx, bitly, synthesio, simplereach

Real-Time
amazon web services, METAMARKETS, striim, confluent, DATATORRENT, dataArtisans

Machine Learning
Azure Machine Learning, amazon web services, H2O.ai, Dato, SKYTREE, DATARPM, rapidminer, deepsense.io, VISENZE, PredictionIO, glowfish

Speech & NLP
NarrativeScience, NUANCE, WolframAlpha, semantic machines, Gridspace, ARRIA, api.ai, cortical.io, maluuba, MindMeld, iDIBON, yseop

Horizontal AI
IBM Watson, Cortana, sentient technologies, VIV, vicarious, nervana SYSTEMS, nara, Numenta, HyperScience, SI SCALED INFERENCE, Descartes Labs, clarifai, DEXTRO, MetaMind, Geometric Intelligence

Search
hp Autonomy, ORACLE ENDECA, EXALEAD, Lucidworks, elastic, ThoughtSpot, MAANA, swiftype, Algolia, SINEQUA

Data Services
Mu Sigma, OPERA SOLUTIONS, EXL analytics, DATASCIENCE, BINGHAMTON VALLEY DATA SCIENCE, kaggle, datascope, DataKind

For Business Analysts
OrigamiLogic, ClearStory DATA, CIRRO, import.io

Web / Mobile / Commerce
Google Analytics, mixpanel, RJMetrics, BLUECORE, AMPLITUDE, granify, sumall, Airtable, retention SCIENCE, custora

Applications

Sales & Marketing
RADIUS, Gainsight, bloomreach, Zeta, EVERSTRING, livefyre, blueyonder, Lattice, kahuna, infer, SAILTHRU, persado, AVISO, sense, QUANTIFIND, ACTIONIQ, fusemachines, NGAGIO

Customer Service
MEDALLIA, ATTENSITY, CLARABRIDGE, CLICKFOX, STELLAService, NGDATA, Preact, DigitalGenius, appuri, Wise.io

Human Capital
gild, Connectifier, textio, entelo, hiQ

Legal
RAVEL, JUDICATA, Everlaw, Brevia, PREMONITION

Ad Optimization
AppNexus, criteo, MediaMath, OpenX, rocketfuel, Integral, theTradeDesk, Adgorithms, dstillery, LiveIntent, TAPAD, DataXu, Appier, MOAT

Security
CYLANCE, CounterTack, cybereason, AREA 1 SECURITY, ThreatMetrix, SentinelOne, Recorded Future, Guardian Analytics, FORTSCALE, sift science, Keybase, feedzai, SIGNIFYD

Vertical AI Applications
facebook, X., Clara, KASISTO, lumiata

Publisher Tools
outbrain, Taboola, quantcast, Chartbeat, yieldbot, Yieldmo

Govt / Regulation
Socrata, OPENGOV, FiscalNote, enigma, PREDPOL, mark43, OpenDataSoft

Finance
affirm, LendingClub, OnDeck, Kreditech, zest finance, LendUp, Kabbage, tidemark, INSIKT, uora, Dataminr, Lenddo, KENSHO, AIDYIA, iSENTIUM, Quantopian, sentient technologies

Education/ Learning
KNEWTON, Clever, declara, PANORAMA, knowre

Life Sciences
23andMe, PATHWAY GENOMICS, Counsyl, deep genomics, Recombine, KYRUUS, FLATIRON, zymergen, HealthTap, METABIOTA, ZEPHYR HEALTH, ovia health, Ginger.io, transcriptic, Glow, enlitic, AiCure, Atomwise

Industries
OPOWER, eHarmony, RetailNext, duetto, STITCH FIX, WorkFusion, BLUE RIVER, TACHYUS, SwiftKey, Seeq, FarmLogs, HowGood, celect, SIGHT MACHINE, statmuse, BOXEVER

Cross-Infrastructure/Analytics

amazon web services, Google, Microsoft, IBM, SAP, sas, 1010data, hp, Autonomy, VERTICA An HP Company, vmware, TIBCO, TERADATA, ORACLE, NetApp

Open Source

Framework
hadoop HDFS, hadoop map reduce, YARN, MESOS, Spark, TEZ, Apache Kafka, Flink, CDAP

Query / Data Flow
SLAMDATA, HIVE, APACHE DRILL, Google Cloud Dataflow

Data Access
cassandra, HBASE, accumulo, mongoDB, couchdb, SciDB, kafka, nifi, riak, OPENTSDB

Coordination
talend, ZOOKEEPER, Apache Zookeeper, Apache Ambari

Real-Time
STORM, Spark, APEX, Flink, TACHYON, druid

Stat Tools
R, ScalaLab, NumPy, SciPy

Machine Learning
mllib, mahout, Aerosolve, Apache SINGA, MADlib, Caffe, torch, CNTK, TensorFlow, FeatureFu, VELES, WEKA, DIMSUM, jupyter, DL4J

Search
elasticsearch, Solr, lucene

Security
Apache Ranger

Visualization
Zeppelin

Data Sources & APIs

Health
JAWBONE, GARMIN, practice fusion, fitbit, Withings, VALIDIC, netatmo, kinsa, Human API

IOT
UPTAKE, ThingWorx, helium, samsara, AUGURY, estimote

Financial & Economic Data
Bloomberg, DOW JONES, THOMSON REUTERS, S&P CAPITAL IQ, YODLEE, PREMISE, quandl, xignite, CB INSIGHTS, mattermark, StockTwits, estimize, PLAID

Air / Space / Sea
PLANET LABS, spire, WINDWARD, CRUISE, SKYCATCH, Airware, DroneDeploy

Location / People / Entities
acxiom, Experian, EPSILON, InsideView, GARMIN, foursquare, STREETLINE, esri, Crimson Hexagon, CARTODB, factual, PlaceIQ, CIRCULATE, placemeter, BASIS TECHNOLOGY, Sense 360

Other
qualtrics, panjiva, DATA.GOV

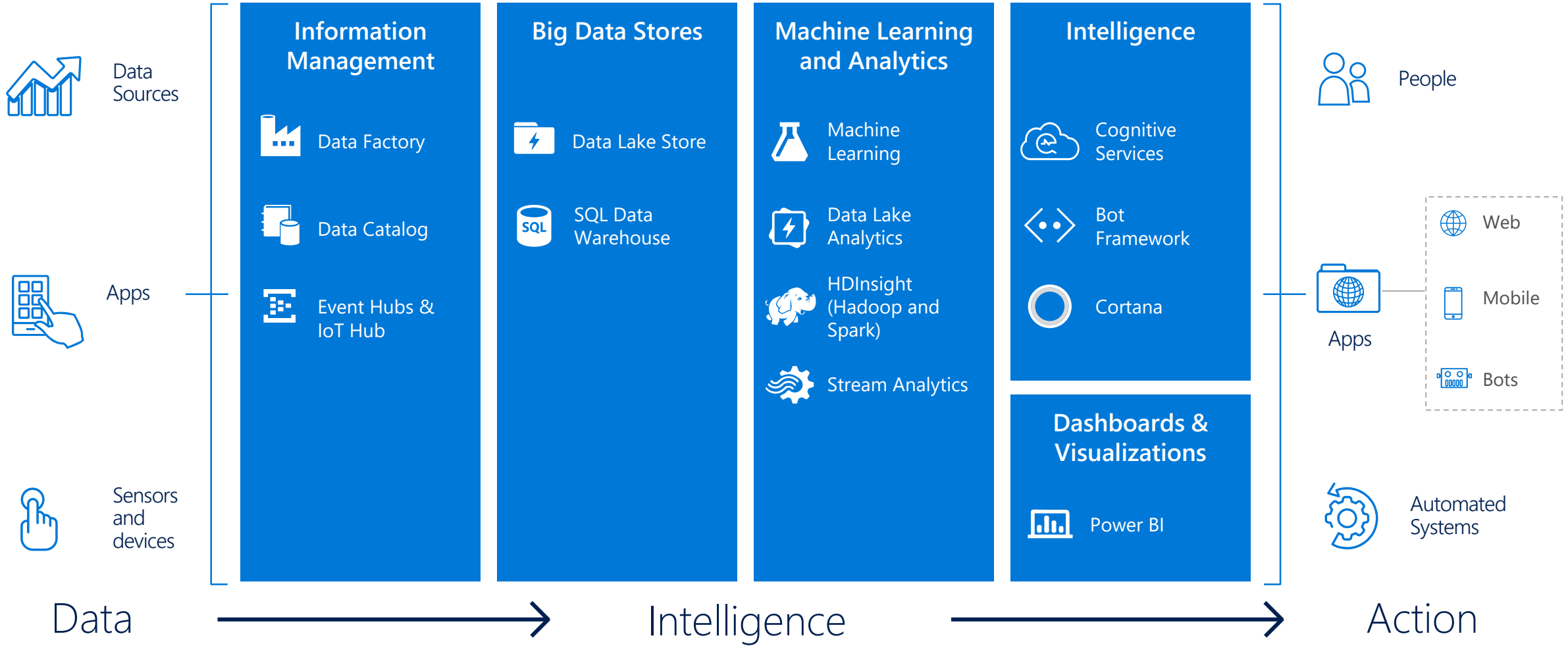
Incubators & Schools

GA, PLURALSIGHT, DataCamp, INSIGHT, DataElite, The Data Incubator, METIS

Last Updated 3/23/2016

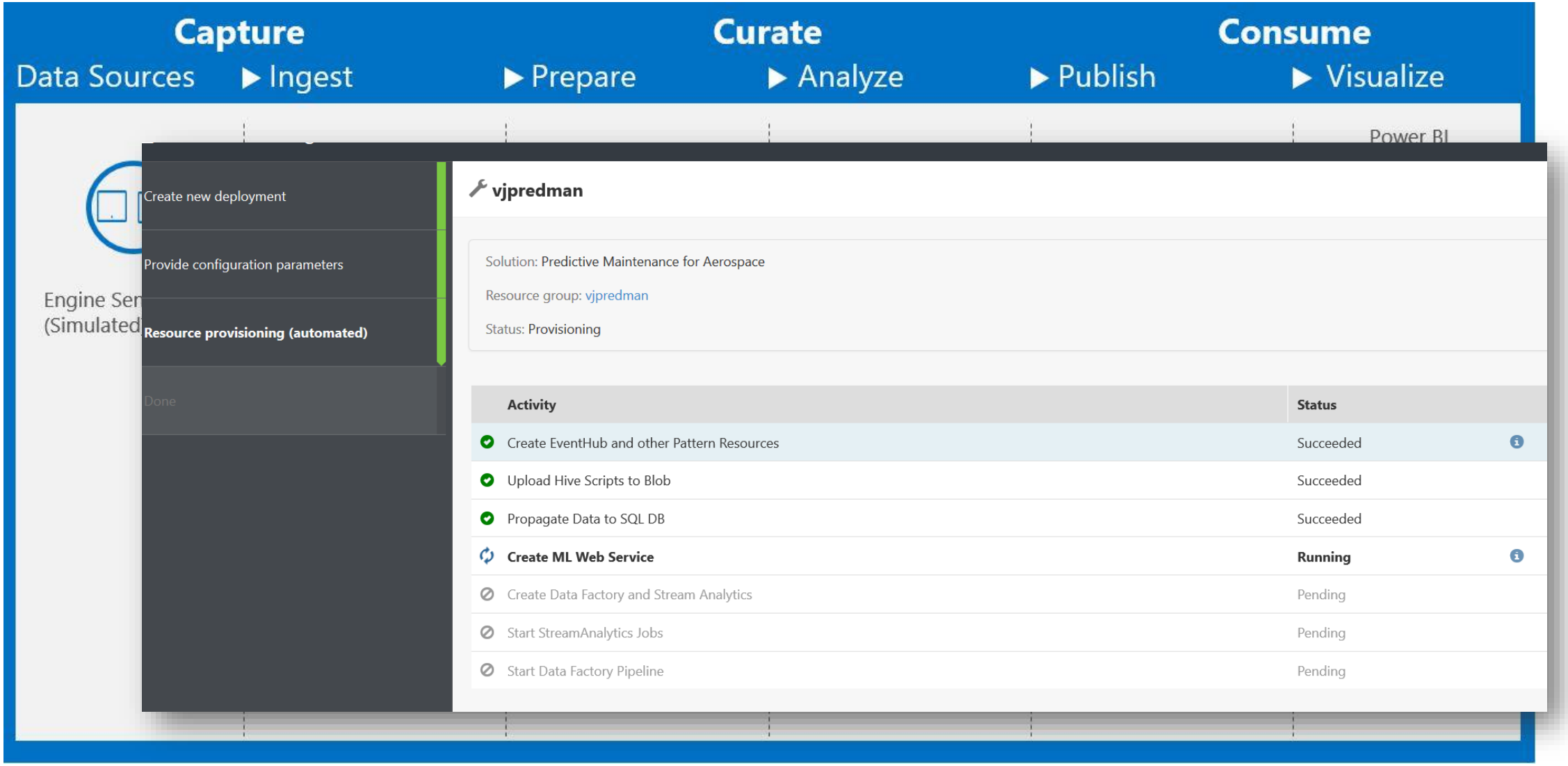
FIRSTMARK

Cortana Intelligence Suite



Cortana Intelligence

Deploy



Microsoft Azure Machine Learning

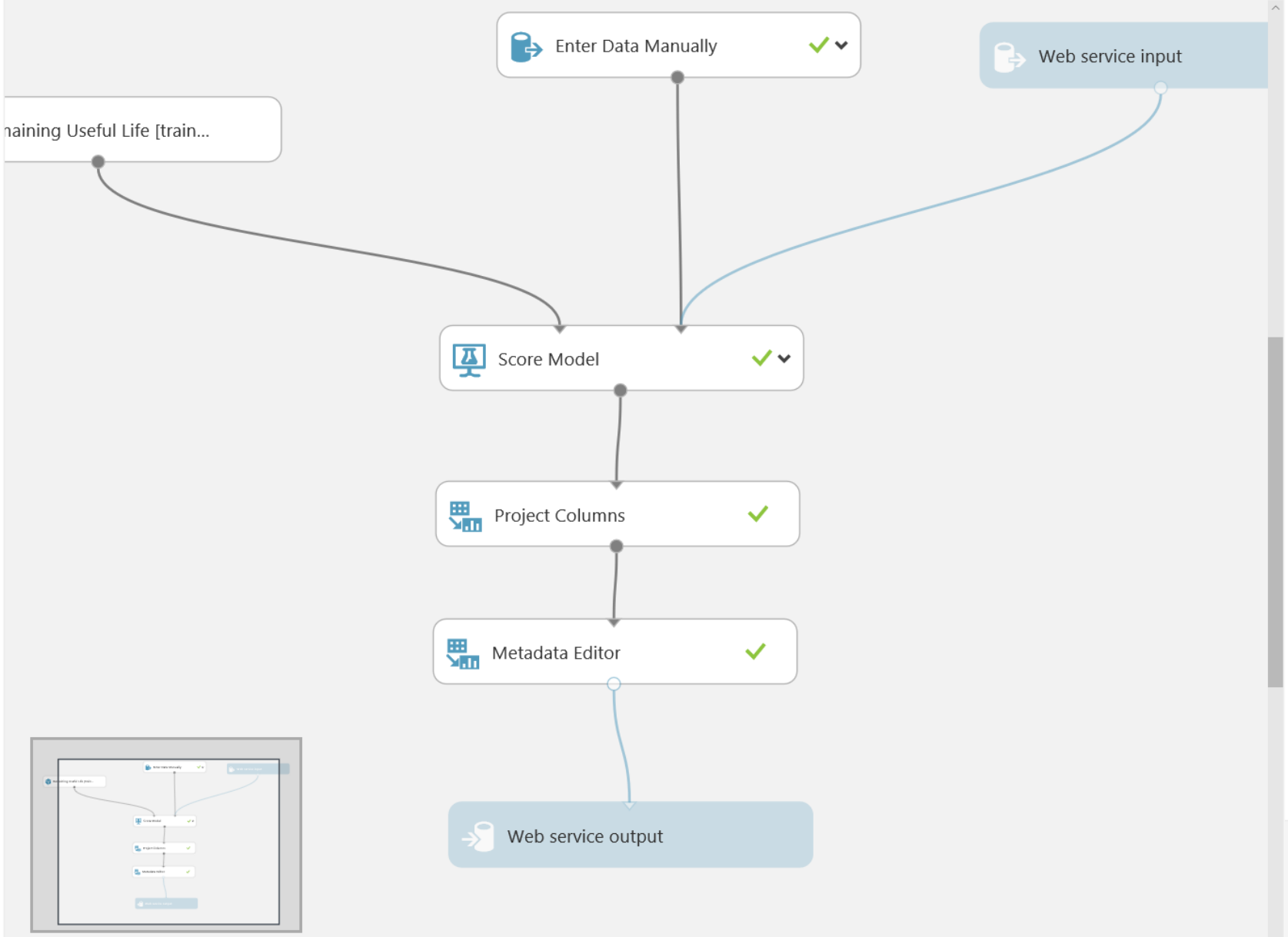
IoTTechDayPredictive

Search experiment items

- Saved Datasets
- Trained Models
- Data Format Conversions
- Data Input and Output
- Data Transformation
- Feature Selection
- Machine Learning
- OpenCV Library Modules
- Python Language Modules
- R Language Modules
- Statistical Functions
- Text Analytics
- Web Service
- Deprecated

Remaining Useful Life [Predictive Exp.]

Finished running



Properties Project

Experiment Properties

START TIME	4/13/201...
END TIME	4/13/201...
STATUS CODE	Finished
STATUS DETAILS	None

Prior Run

Summary

Enter a few sentences describing your experiment (up to 140 characters).

Description

Enter the detailed description for your experiment.

Quick Help

Next gen. computing for next gen. AI

CPU

Central Processing Unit:

Fixed architecture

Generic applications

Limited

performance

GPU

Graphical Processing Unit:

Fixed architecture

Fast in specific

tasks

FPGA

Field Programmable Gate Array:

Programmable

CPU

Can be VERY fast

HPU

Holographic Processing Unit:

Senses our environment

Renders holograms on top of it

NSP

Nurosynaptic Processors :

Learns

Understands

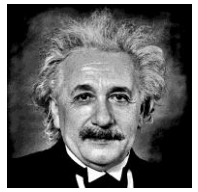
Neurosynaptic benchmark

NSPs

1 million

90 million

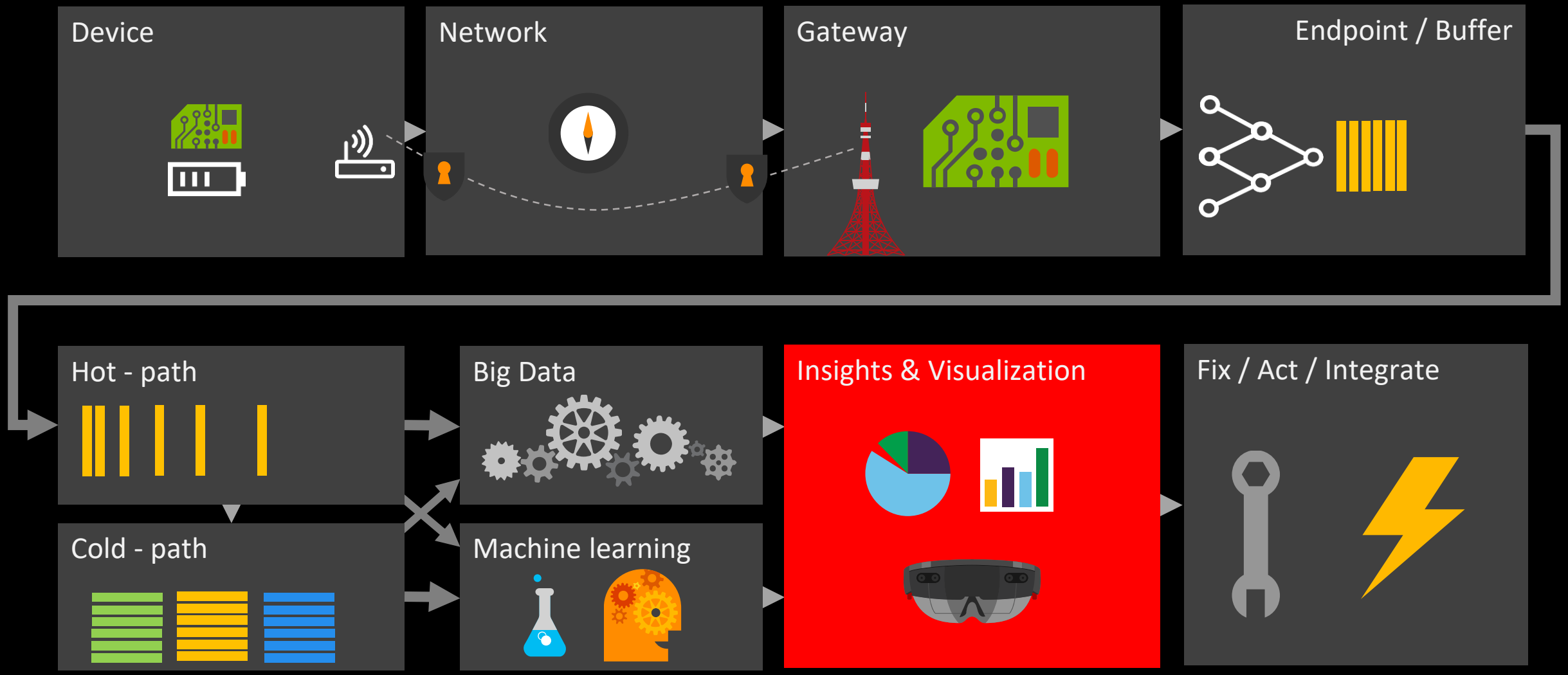
50 billion



100 billion

300 billion

Session scope



msit.powerbi.com/groups/me/dashboards/62d42a91-9854-4d11-832e-b3eaf82eefaa

Power BI

Supplier Quality Analysis Sample

SUPPLIER QUALITY ANALYSIS SAMPLE

Add widget Share

Ask a question about the data on this dashboard

How to ask

Total Defect Quantity

33M

Total Downtime Minutes

77K

Total Defect Qty
WITH NO IMPACT

17M

Total Defect Qty
WITH IMPACT

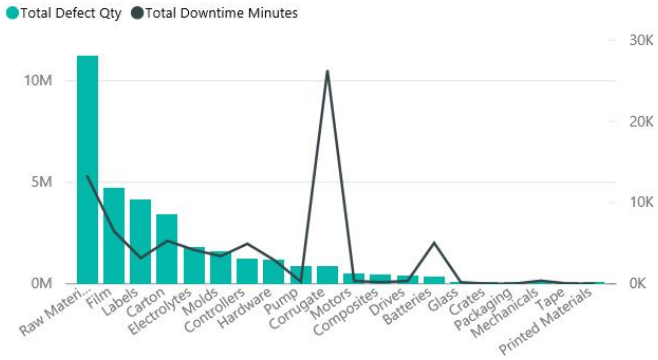
19M

Total Rejected Defect Quantity

20M

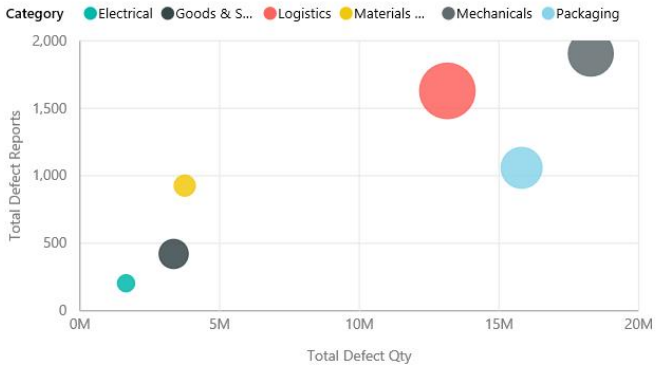
Total Defect Reports
BY PLANT, DEFECT TYPE

Total Defect Qty, Total Downtime Minutes
BY MATERIAL TYPE



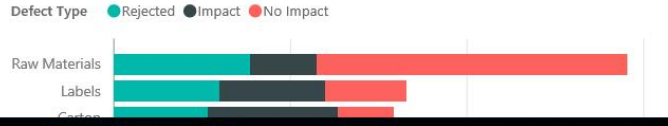
Total Defect Quantity
BY MONTH, YEAR

Total Defect: Reports, Quantity, Downtime Minutes
BY CATEGORY



Total Downtime Minutes
BY VENDOR, CATEGORY

Total Defect Quantity
BY MATERIAL TYPE, DEFECT TYPE



localhost:23895/Dashboard/Report?reportId=b1283c1c-c400-4a3d-8502-786e7aeefa64

Contoso

Home

Reports

RetailSample

CustomData

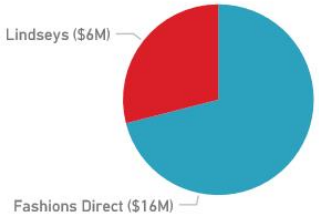
Reports > RetailSample

4

Emily Hart

Store Sales Overview

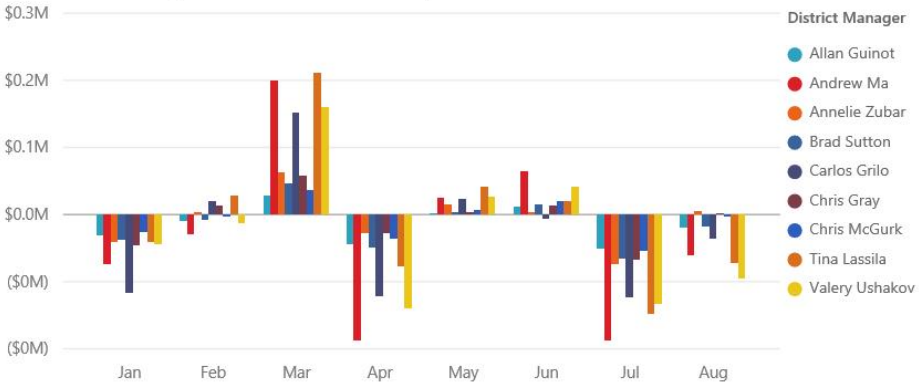
This Year Sales by Chain



10
New Stores

104
Total Stores

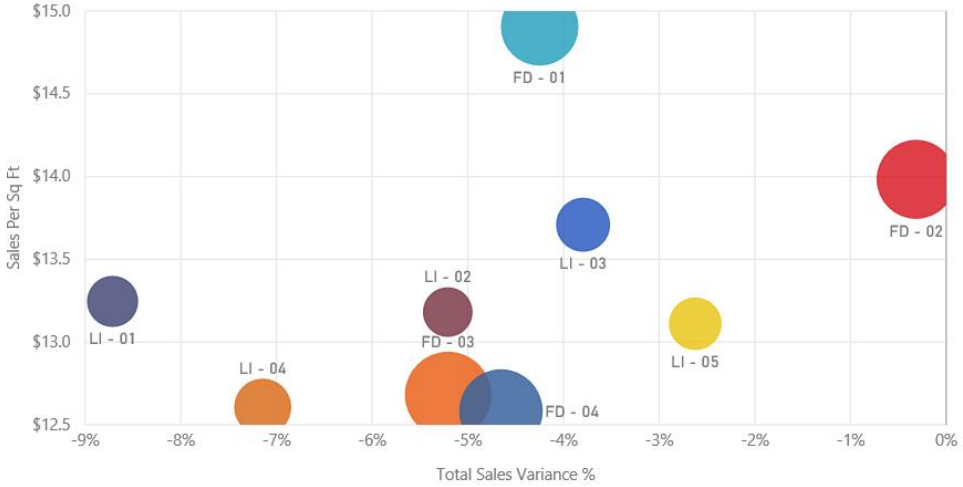
Total Sales Variance by FiscalMonth and District Manager



This Year Sales by PostalCode and Store Type

New Store Same Store

Total Sales Variance %, Sales Per Sq Ft and This Year Sales by District and District



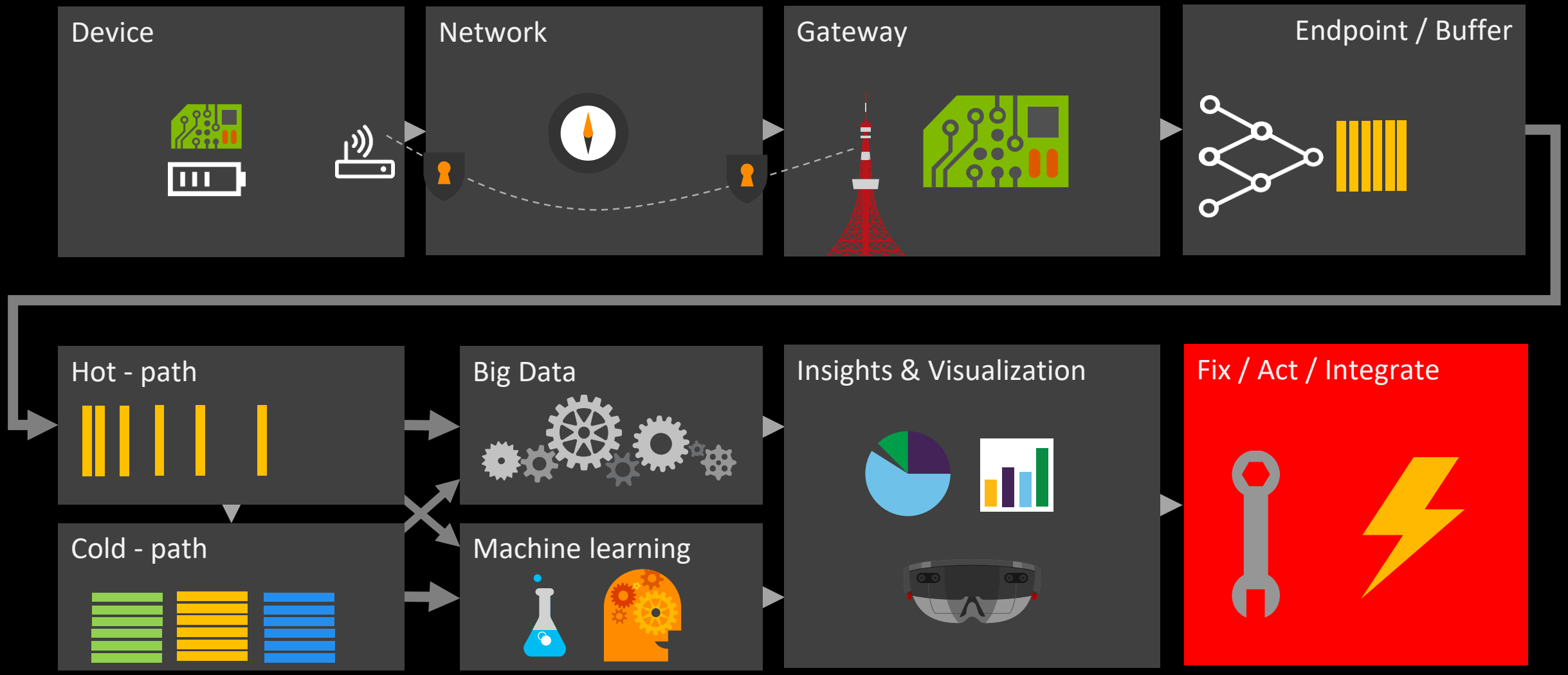
Filters

Overview | District Monthly Sales | New Stores | District Sales Report

Data Workshops

Aka.ms/bringyourowndata

Session scope



Azure IoT Suite

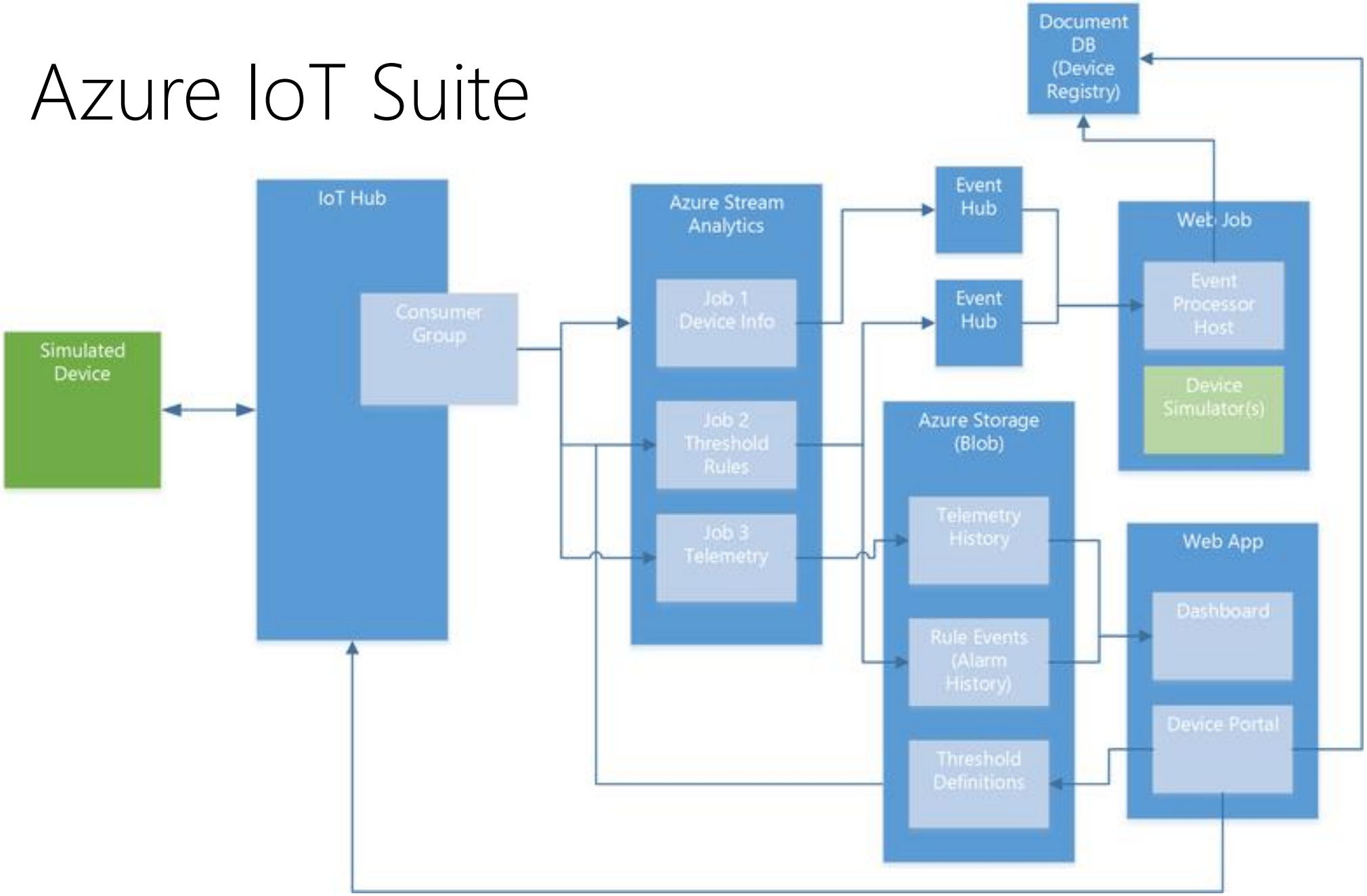
Sample of a ‘complete’ IoT solution

Meant to kick-start YOUR IoT project

Big footprint by default, tunable in every way

Code on GitHub

Azure IoT Suite




SMS
SALE
25
SEARCH
Microsoft

THANK YOU!

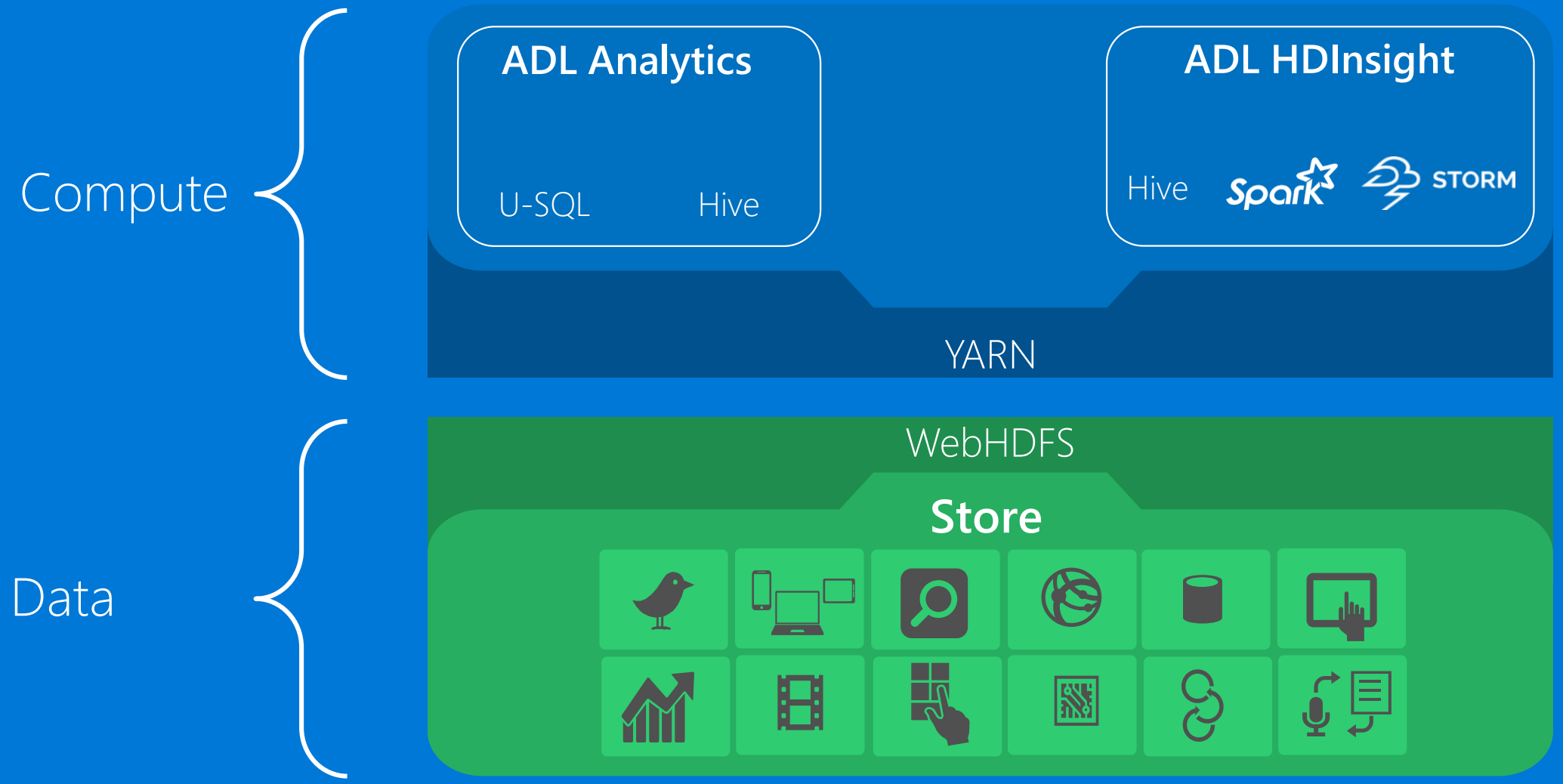
VALERY JACOBS

@VALERYJACOBS

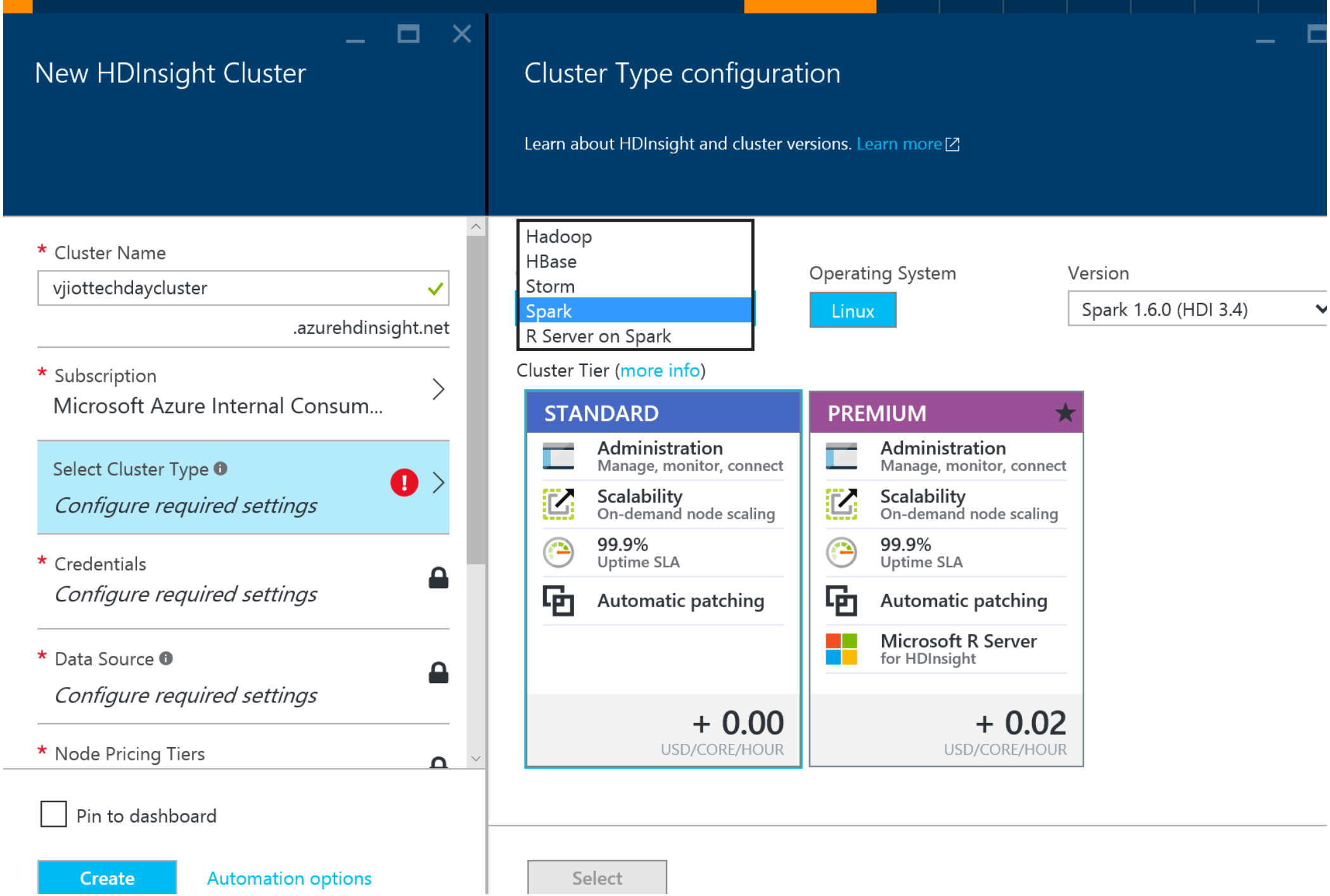
VALJAC@MICROSOFT.COM

Microsoft

Azure Data Lake (Store, HDInsight, Analytics)



HDINSIGHT WITH SPARK


New HDInsight Cluster
* Cluster Name
vjiottechdaycluster
.azurehdinsight.net
* Subscription
Microsoft Azure Internal Consum...
Select Cluster Type
Configure required settings
* Credentials
Configure required settings
* Data Source
Configure required settings
* Node Pricing Tiers
Pin to dashboard
Create
Automation options
Cluster Type configuration
Learn about HDInsight and cluster versions. Learn more
Hadoop
HBase
Storm
Spark
R Server on Spark
Operating System
Linux
Version
Spark 1.6.0 (HDI 3.4)
Cluster Tier (more info)
STANDARD
Administration
Manage, monitor, connect
Scalability
On-demand node scaling
99.9%
Uptime SLA
Automatic patching
+ 0.00
USD/CORE/HOUR
PREMIUM
Administration
Manage, monitor, connect
Scalability
On-demand node scaling
99.9%
Uptime SLA
Automatic patching
Microsoft R Server
for HDInsight
+ 0.02
USD/CORE/HOUR
Select

vjiottechdaycluster.azurehdinsight.net/jupyter/notebooks/PySpark/02%20-%20Read%20and%20write%20data%20from%20Azure%20Storag

jupyter 02 - Read and write data from Azure Storage Blobs (WASB) (unsaved changes)

File Edit View Insert Cell Kernel Help PySpark

Code CellToolbar

Create an RDD of strings

In [*]:
```
# textLines is an RDD of strings
textLines = sc.textFile('wasb:///example/data/gutenberg/ulysses.txt')
```

```
Creating SparkContext as 'sc'
```

Create an RDD of key-value pairs

In [ ]:
```
# seqFile is an RDD of key-value pairs
seqFile = sc.sequenceFile('wasb:///example/data/people.seq')
```

Create a dataframe from parquet files

Machine Learning

Microsoft Azure Machine Learning

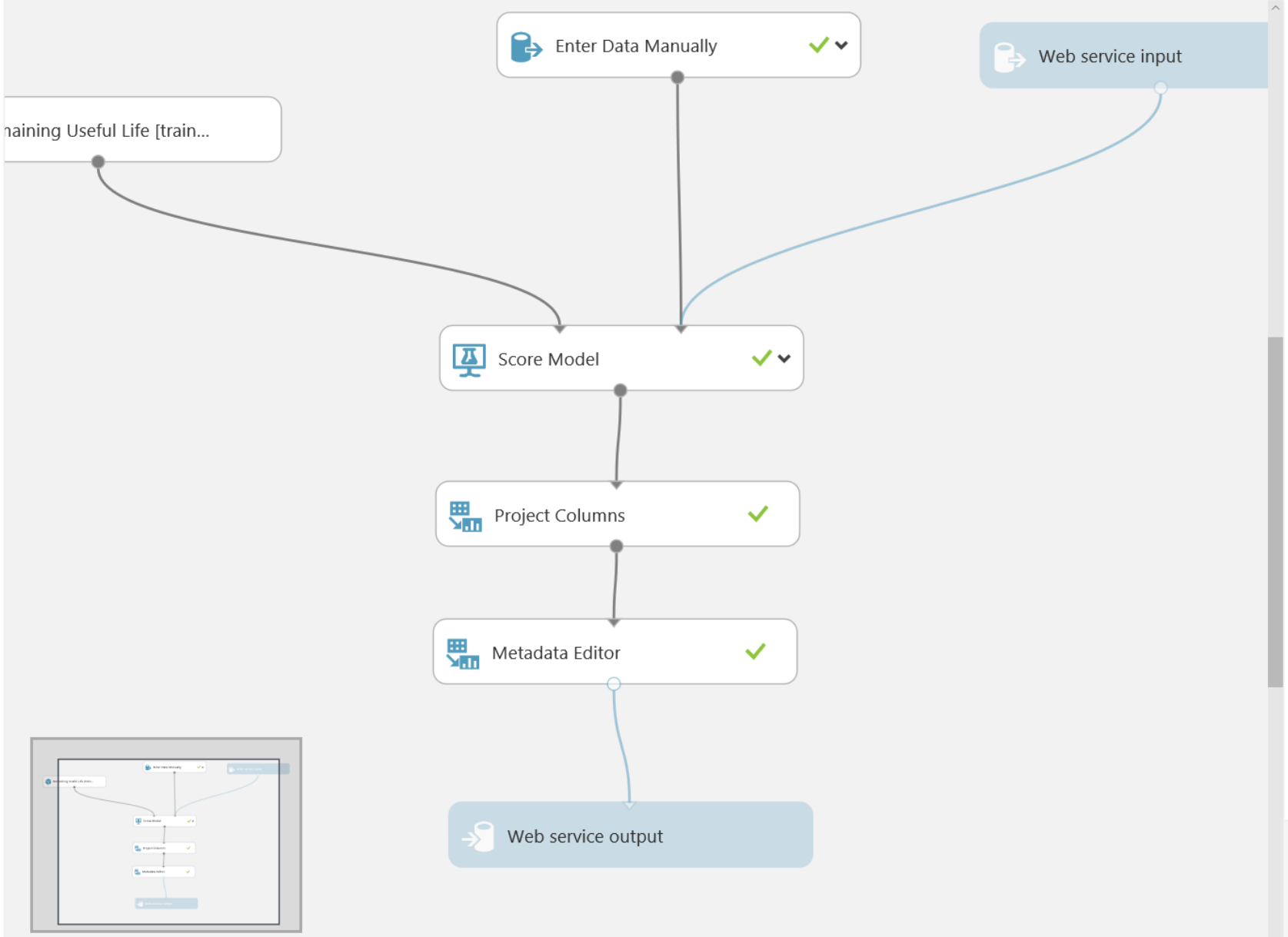
IoTTechDayPredictive

Search experiment items

- Saved Datasets
- Trained Models
- Data Format Conversions
- Data Input and Output
- Data Transformation
- Feature Selection
- Machine Learning
- OpenCV Library Modules
- Python Language Modules
- R Language Modules
- Statistical Functions
- Text Analytics
- Web Service
- Deprecated

Remaining Useful Life [Predictive Exp.]

Finished running



Properties Project

Experiment Properties

START TIME	4/13/201...
END TIME	4/13/201...
STATUS CODE	Finished
STATUS DETAILS	None

Prior Run

Summary

Enter a few sentences describing your experiment (up to 140 characters).

Description

Enter the detailed description for your experiment.

Quick Help

POWER BI

localhost:23895/Dashboard/Report?reportId=b1283c1c-c400-4a3d-8502-786e7aeefa64

Contoso

Home

Reports

RetailSample

CustomData

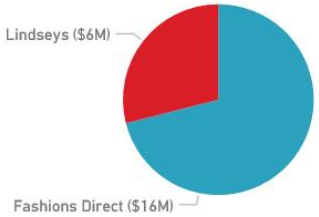
Reports > RetailSample

4

Emily Hart

Store Sales Overview

This Year Sales by Chain



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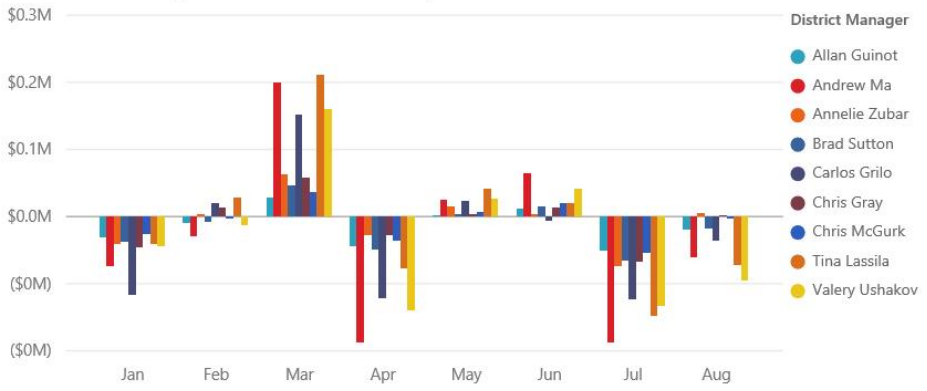

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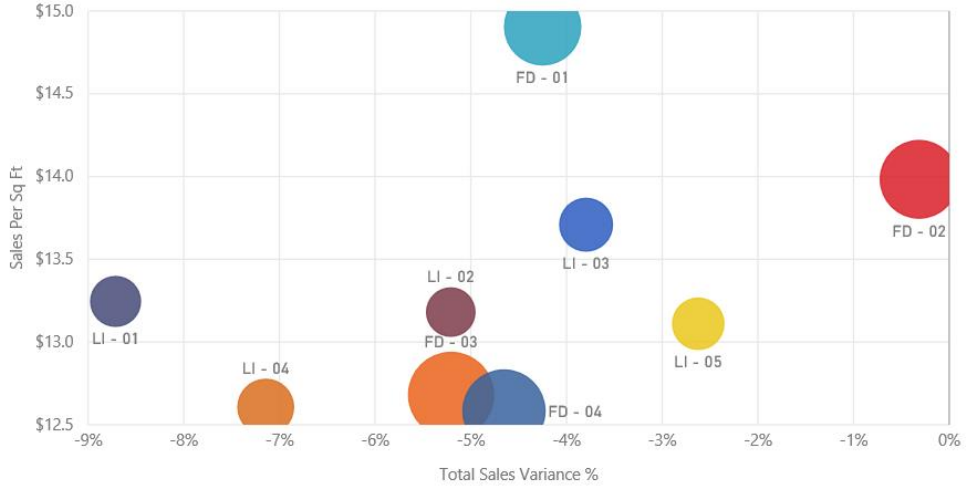

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