The Things Network & Azure IoT Platform

Or, how to connect remote devices to IoT Platforms

Trusted partner for your **Digital Journey**

Atos

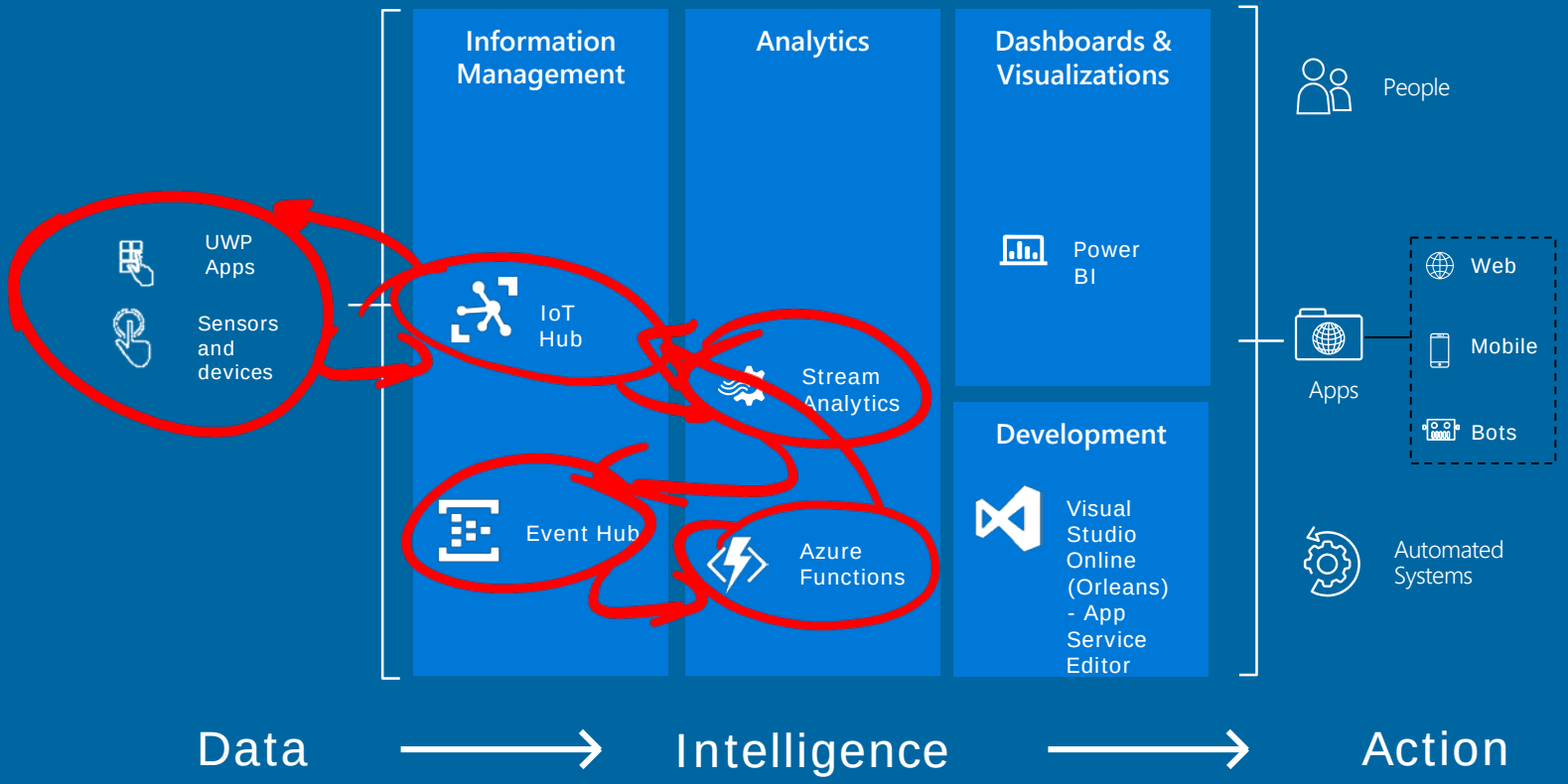
Sander van de Velde

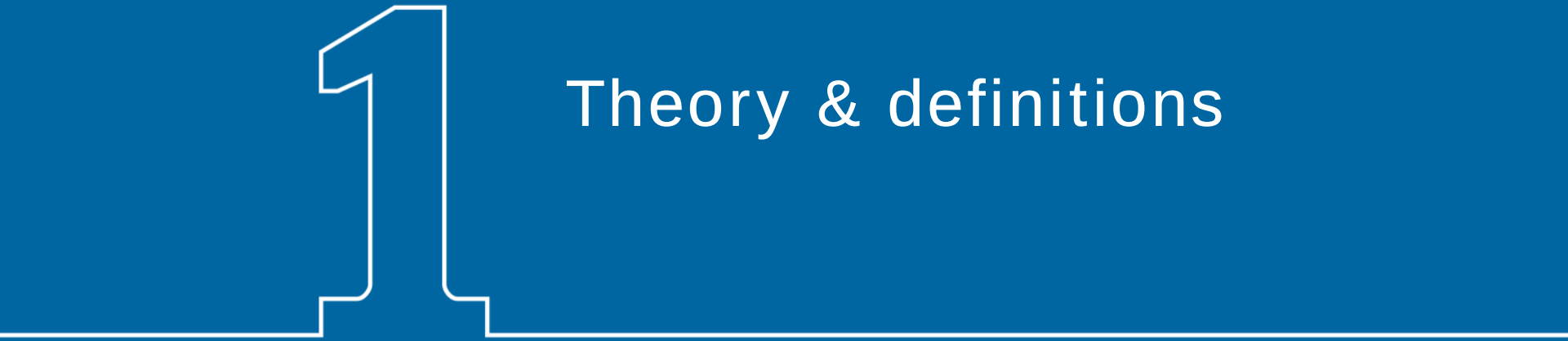
Member of the Microsoft Azure Advisory Board

Jan Willem Groenenberg

Member of the Microsoft Azure Advisory Board

The ‘complete’ solution





Theory & definitions

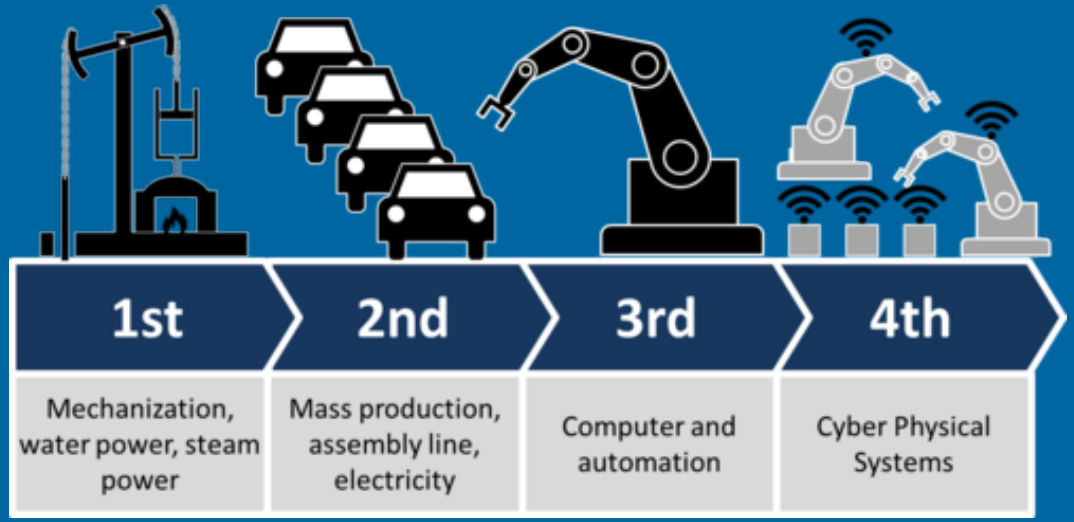
One of many definitions...

“The Internet of things is the internetworking of physical **devices**, embedded with electronics, software, **sensors**, actuators, and **network connectivity** that enable these objects to **collect and exchange** data”

https://en.wikipedia.org/wiki/Internet_of_things

Industry 4.0

From: hardware manufacturers delivering **silos**
To: general availability resulting **enterprise integration**



Why now?


Hardware is Cheap
Connectivity is Pervasive
Development is Easy
New Innovative Scenarios

IoT Platform

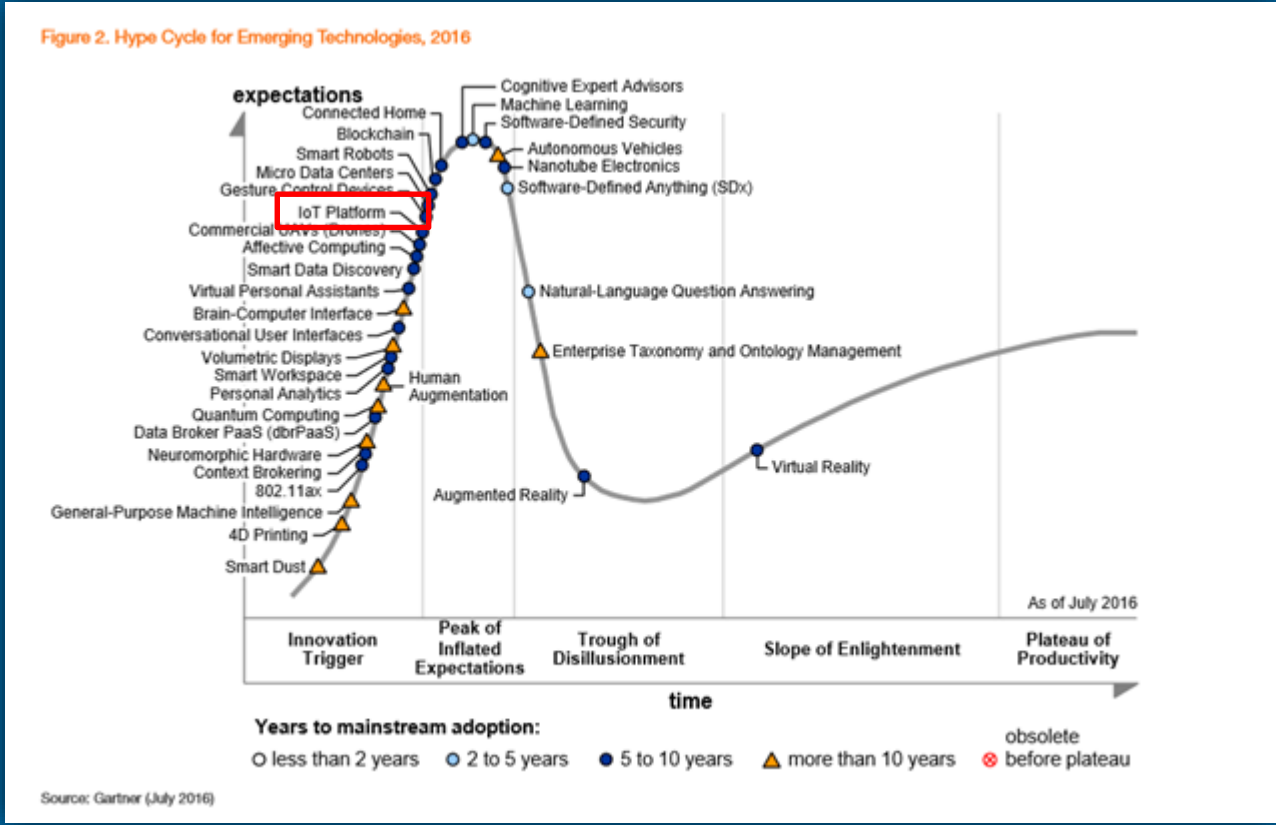
An Internet of Things (IoT) platform is **software** (suite and/or platform as a service [PaaS]) that facilitates operations involving **IoT endpoints** (sensors, devices, multidevice systems and systems of systems) and **enterprise resources**.

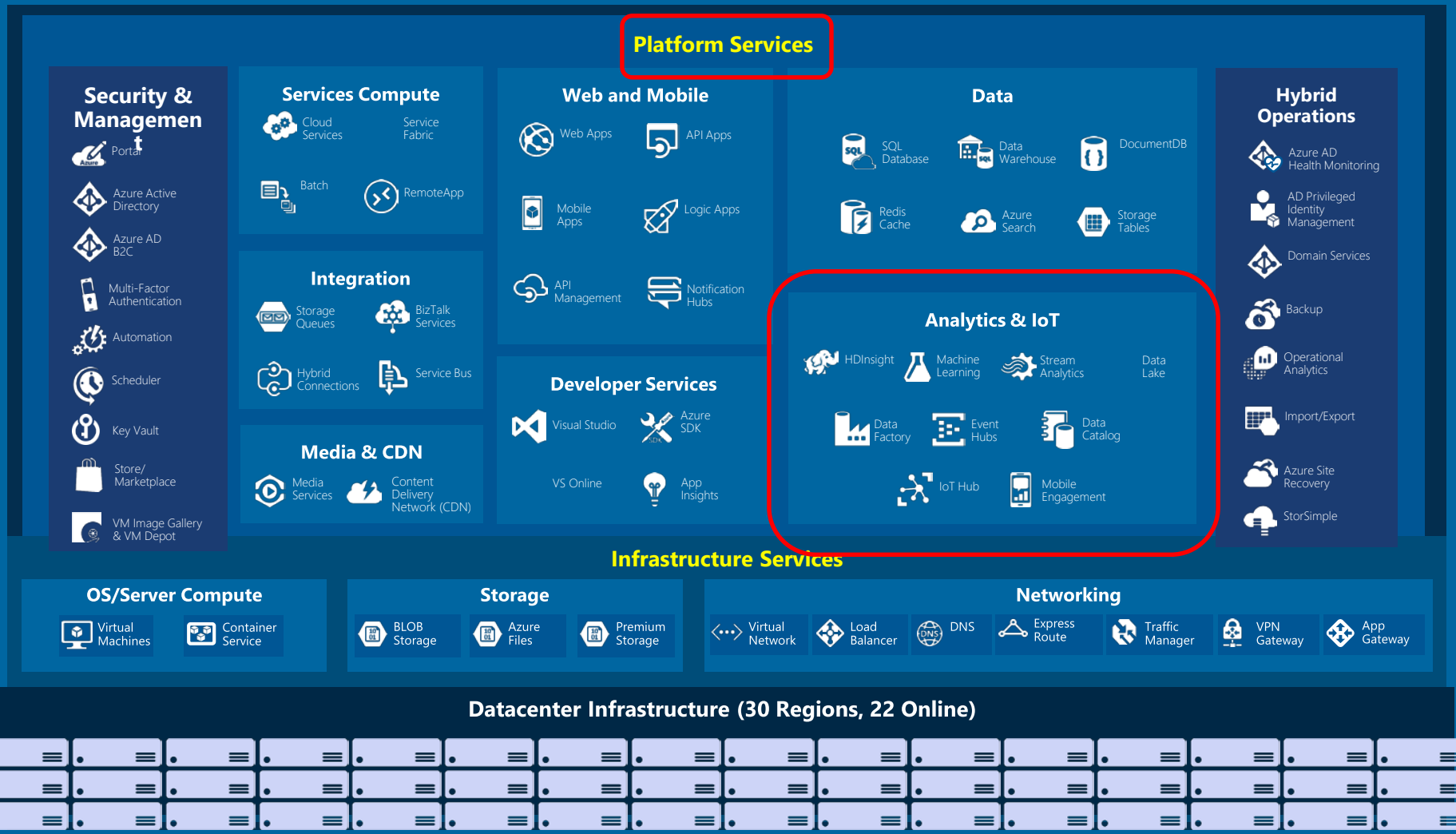
The platform **provisions and controls** IoT endpoints, **monitors** event streams, enables specialized **analysis** and application development, and **integrates** with back-end IT systems — all to support IoT business solutions.

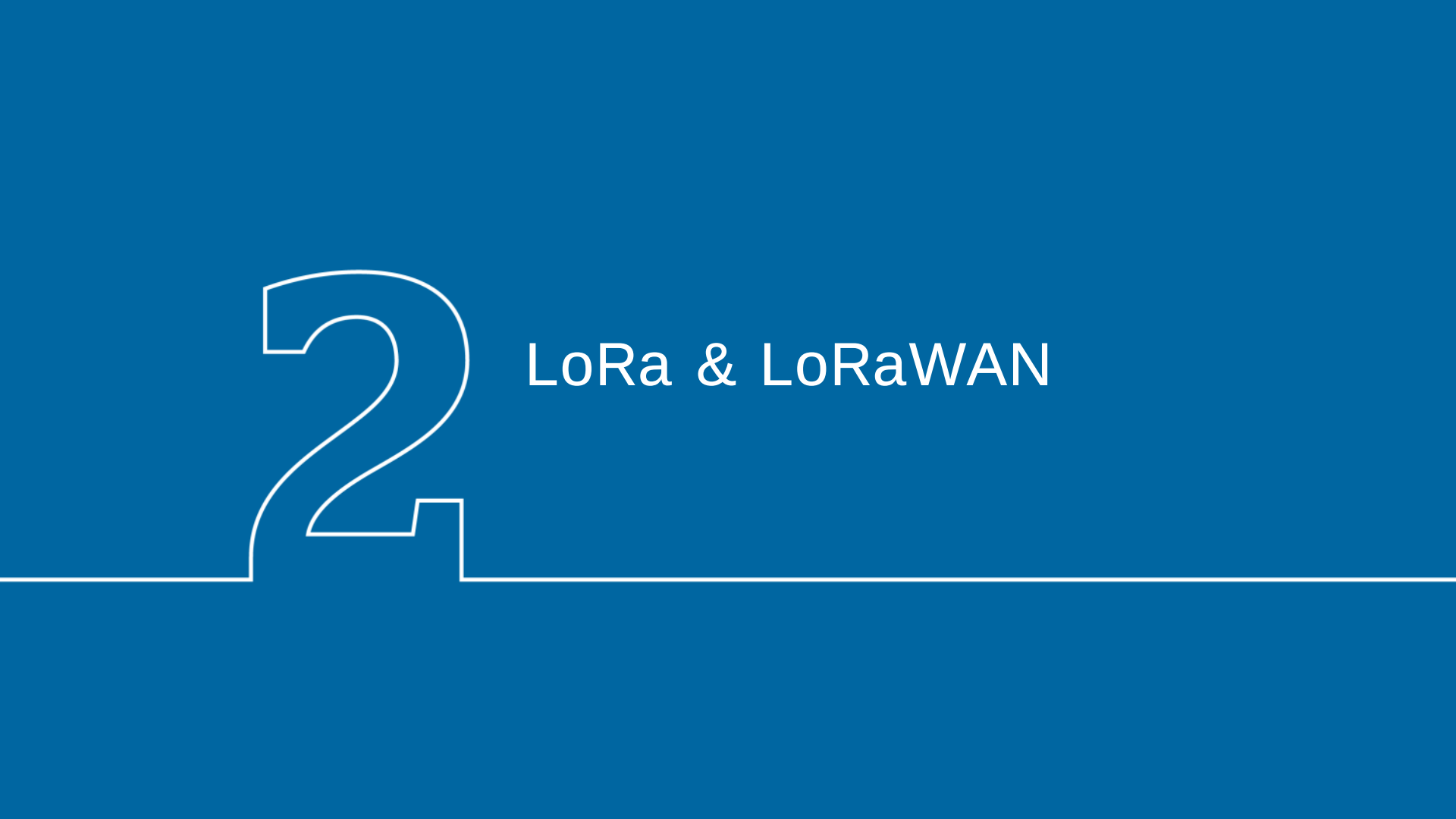
Its responsibilities may be distributed and fulfilled in part **in the cloud or near the devices**.

Gartner 2016

Gartner Hype cycle




Platform Services
Security & Management
Portal
Azure Active Directory
Azure AD B2C
Multi-Factor Authentication
Automation
Scheduler
Key Vault
Store/ Marketplace
VM Image Gallery & VM Depot
Services Compute
Cloud Services
Service Fabric
Batch
RemoteApp
Integration
Storage Queues
BizTalk Services
Hybrid Connections
Service Bus
Media & CDN
Media Services
Content Delivery Network (CDN)
Web and Mobile
Web Apps
API Apps
Mobile Apps
Logic Apps
API Management
Notification Hubs
Developer Services
Visual Studio
Azure SDK
VS Online
App Insights
Data
SQL Database
Data Warehouse
DocumentDB
Redis Cache
Azure Search
Storage Tables
Analytics & IoT
HDInsight
Machine Learning
Stream Analytics
Data Lake
Data Factory
Event Hubs
Data Catalog
IoT Hub
Mobile Engagement
Hybrid Operations
Azure AD Health Monitoring
AD Privileged Identity Management
Domain Services
Backup
Operational Analytics
Import/Export
Azure Site Recovery
StorSimple
Infrastructure Services
OS/Server Compute
Virtual Machines
Container Service
Storage
BLOB Storage
Azure Files
Premium Storage
Networking
Virtual Network
Load Balancer
DNS
Express Route
Traffic Manager
VPN Gateway
App Gateway
Datacenter Infrastructure (30 Regions, 22 Online)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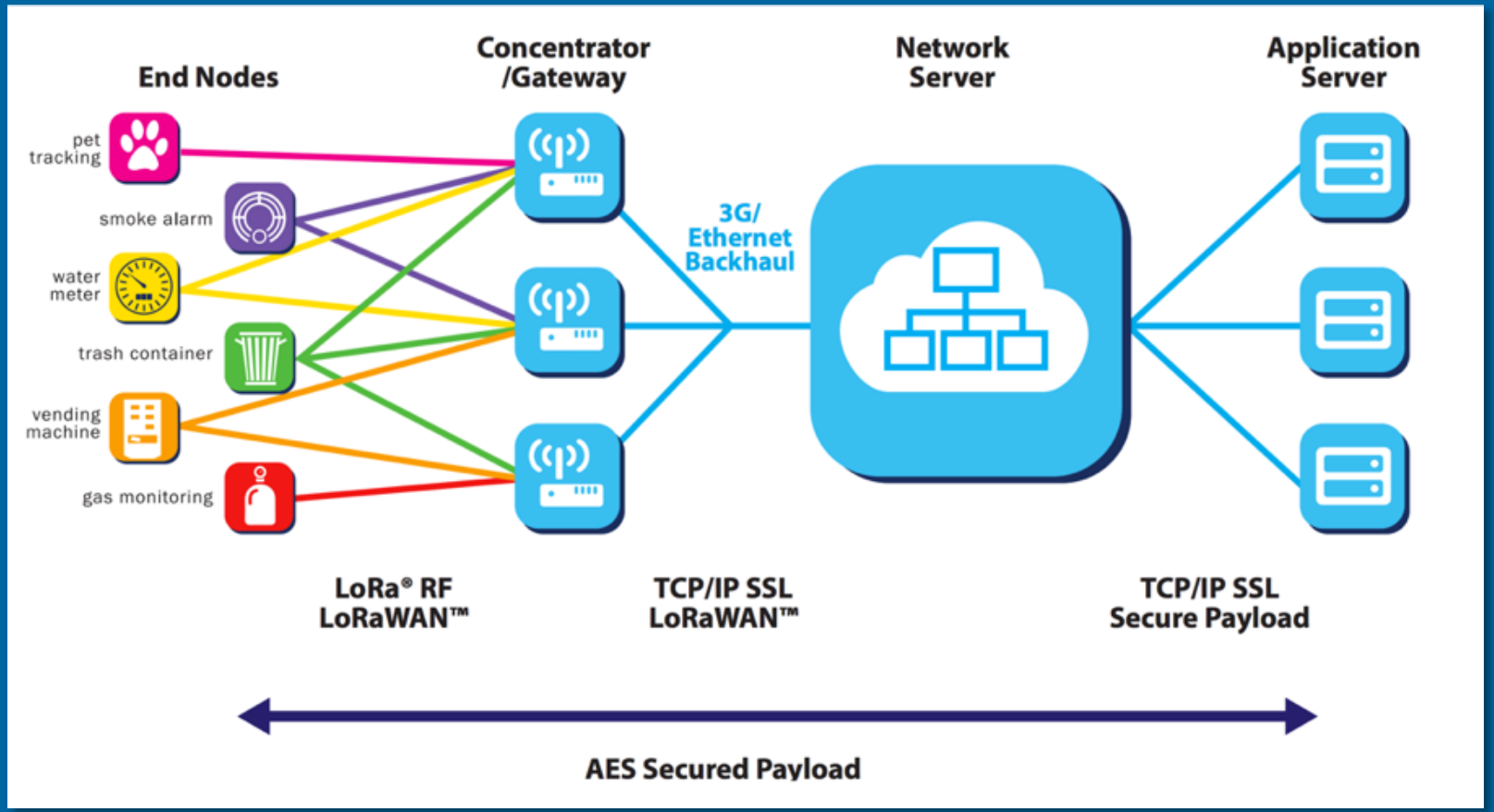
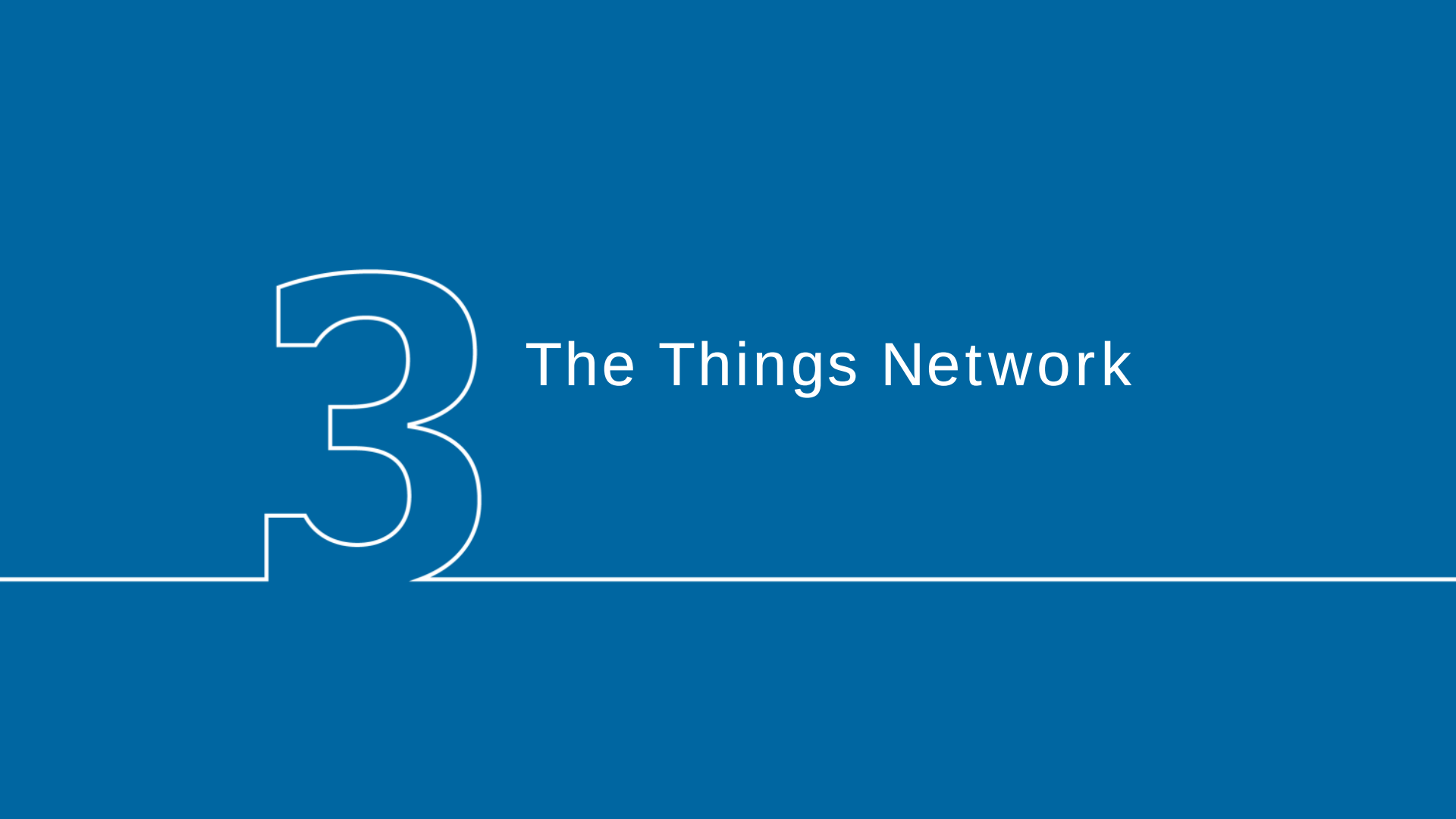
LoRa & LoRaWAN

LoRa & LoRaWAN



Compared to others

Parameter	WAVIoT	LoRa (LinkLabs)[1]	Sigfox[2]	LTE-M (exp.)	WiFi	Cellular
Minimum Data rate	**8+ bps**	150 bps	100 bps	64 kbps	High	High
Max Range, meters	**50 000**	10 000	10 000	5 000	100	Within coverage
Gateway sensitivity, dBm	**-154**	-137	-142	-123	-96	-114
Gateway antenna gain, dBi	**16**	9	9	16	8	14
Gateway cable loss, dB	2	2	6	2	2	2
Gateway mode	**Full Duplex**	Half Duplex	Half Duplex	Full Duplex	Full Duplex	Full Duplex
Nodes per gateway	**2 000 000+**	250 000	50 000	50 000	200	5 000
Node max output power, dBm	**26**	26	14	23	20	33
Max Link budget, dBm	**194**	170	159	163	122	159
Node bandwidth	**100 Hz**	125 kHz	100 Hz	192 kHz	20 MHz	200 kHz
Spectrum efficiency	**High**	Very Low	Low	High	High	High
Simultaneous demodulation capacity	8 192	8	25	64	13	64
Scalability	**High**	Very Low	Low	High	Limited	High
Minimum Node cost, USD	2	29	2	5	25	10
Battery life	**20+ years**	10 years	10 years	5 years	7 days	1 day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The Things Network

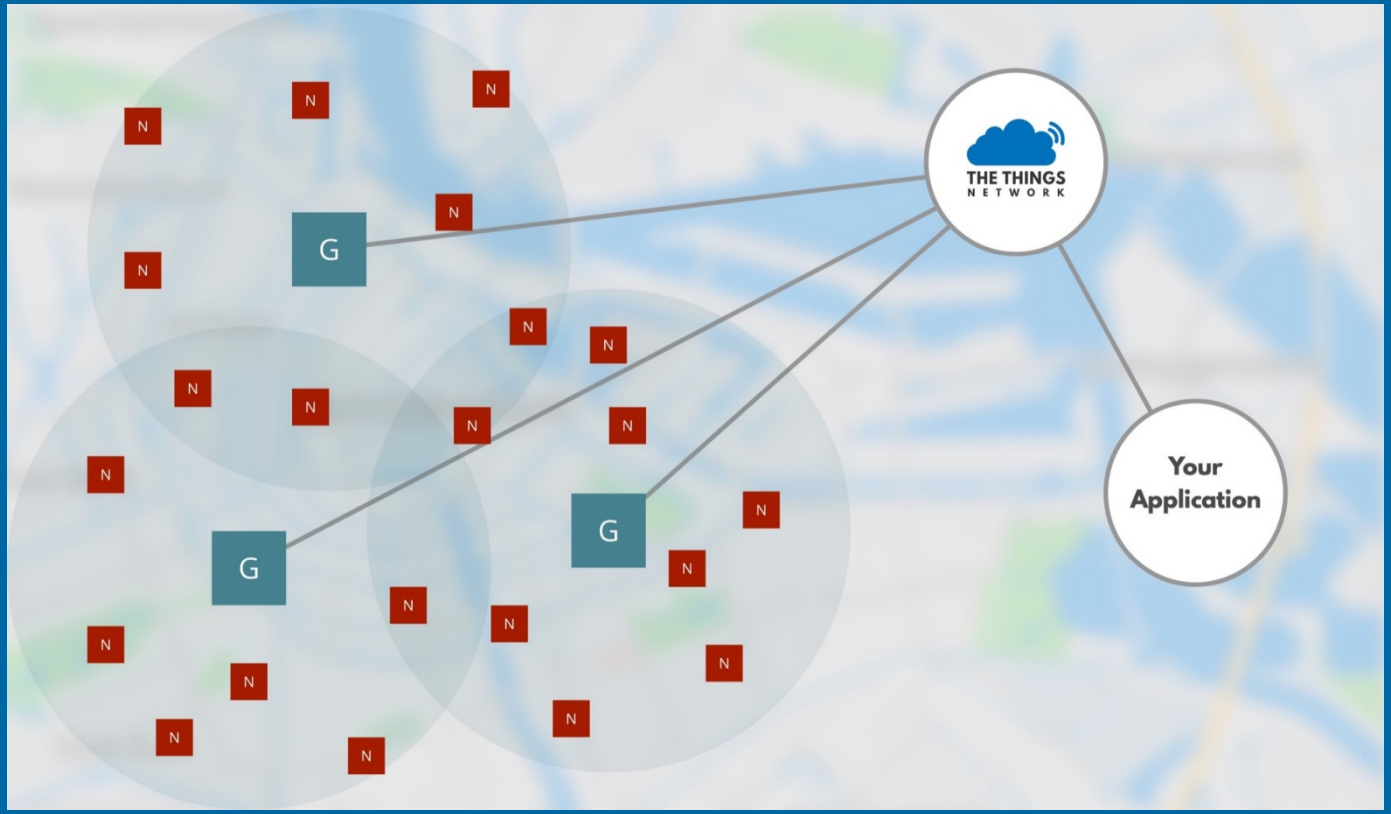
The Things Network

LoRa

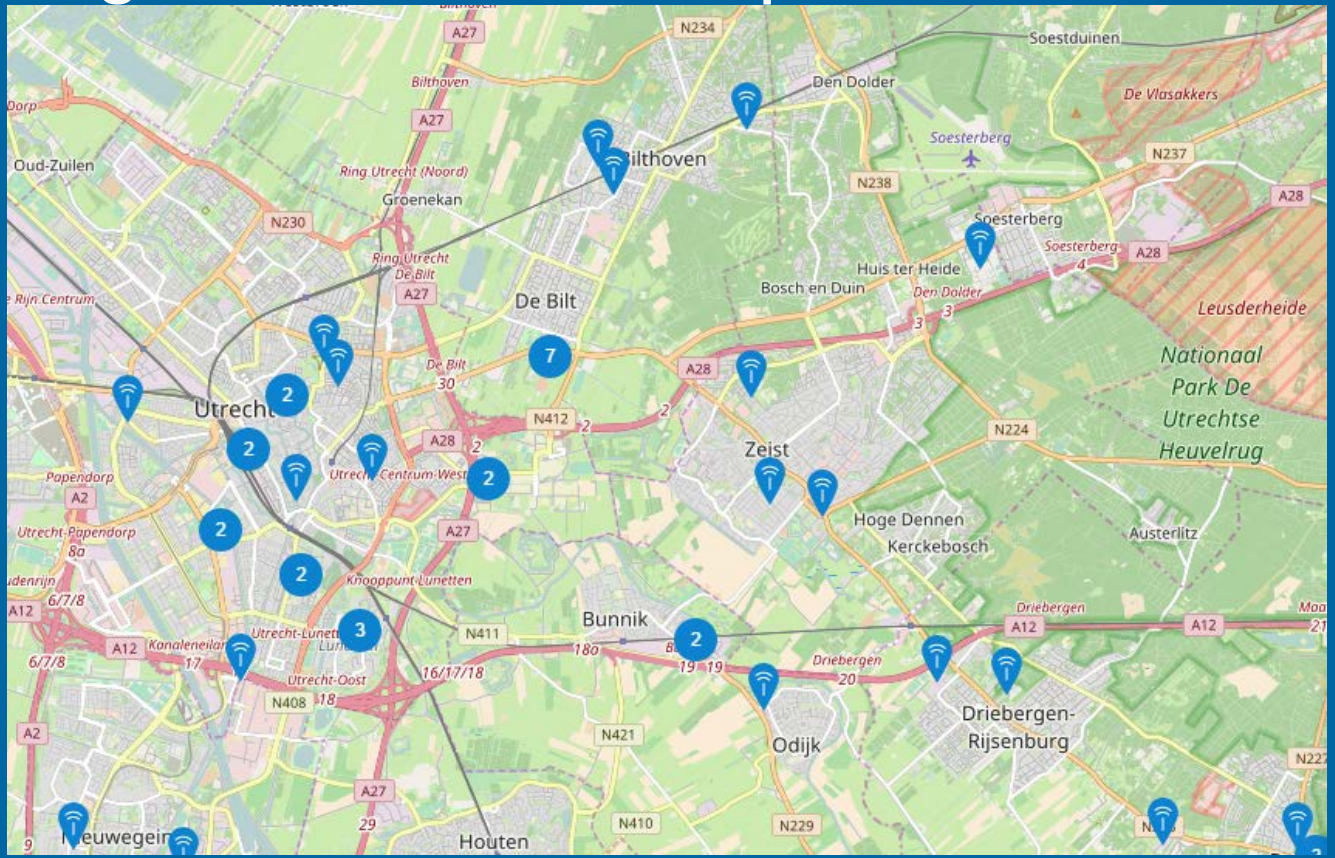
Long range communication
Low power
Uplink & Downlink

Low cost
Community driven provider
You need a network? You are the network!
Throttled!

The Things Network - Topology



The Things Network - Map

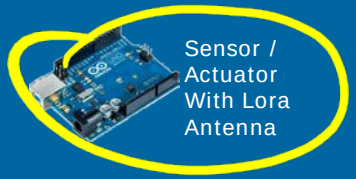


https://thethingsnetwork.org/map

The Things Uno

Starting with a device

TTN Local Gateway



Sensor / Actuator With Lora Antenna

THE THINGS NETWORK

TTN Backend

Information Management

IoT Hub

Event Hub

Analytics

Web Job TTN->IoTHub Bridge

Stream Analytics

Azure Functions

Dashboards & Visualizations

Power BI

Development

Visual Studio Online (Orleans) - App Service Editor

People

Apps

Web

Mobile

Bots

Automated Systems

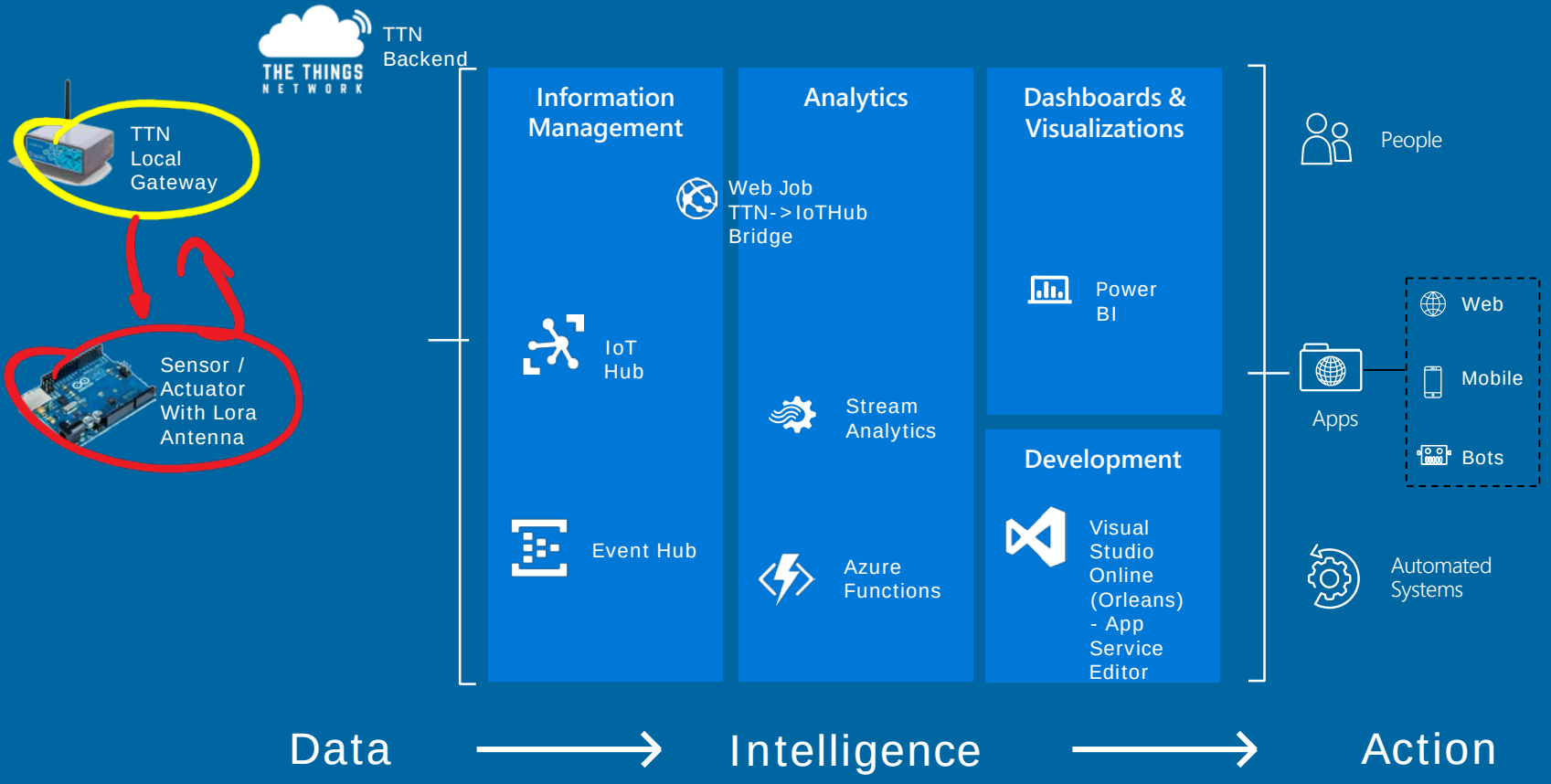
Data → Intelligence → Action

Demo

The Things Uno

Gateway & packet forwarder

Adding a dual packet forwarder



Demo

Dual packet forwarder with up- & downlink

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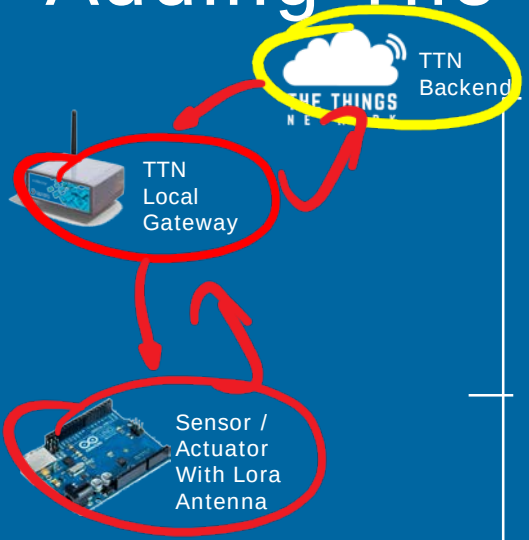
The Things Network cloud

Adding The Things Network



Information Management

- IoT Hub
- Event Hub

Analytics

- Web Job TTN->IoTHub Bridge
- Stream Analytics
- Azure Functions

Dashboards & Visualizations

- Power BI

Development

- Visual Studio Online (Orleans) - App Service Editor

- People
- Apps
  - Web
  - Mobile
  - Bots
- Automated Systems

Data → Intelligence → Action

Demo

The Things Network cloud

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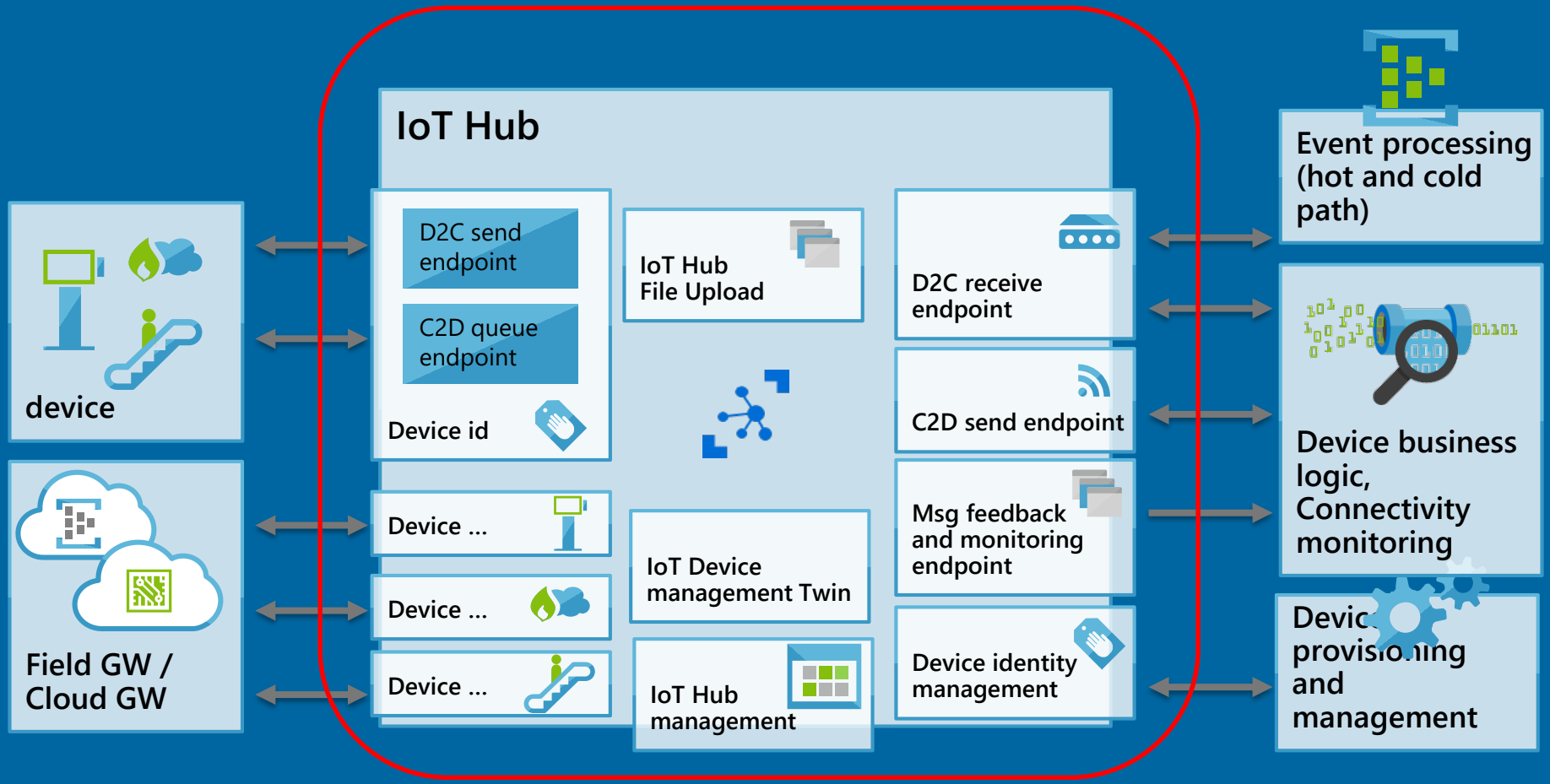
Azure IoT Hub

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

Demo

Azure IoT Hub

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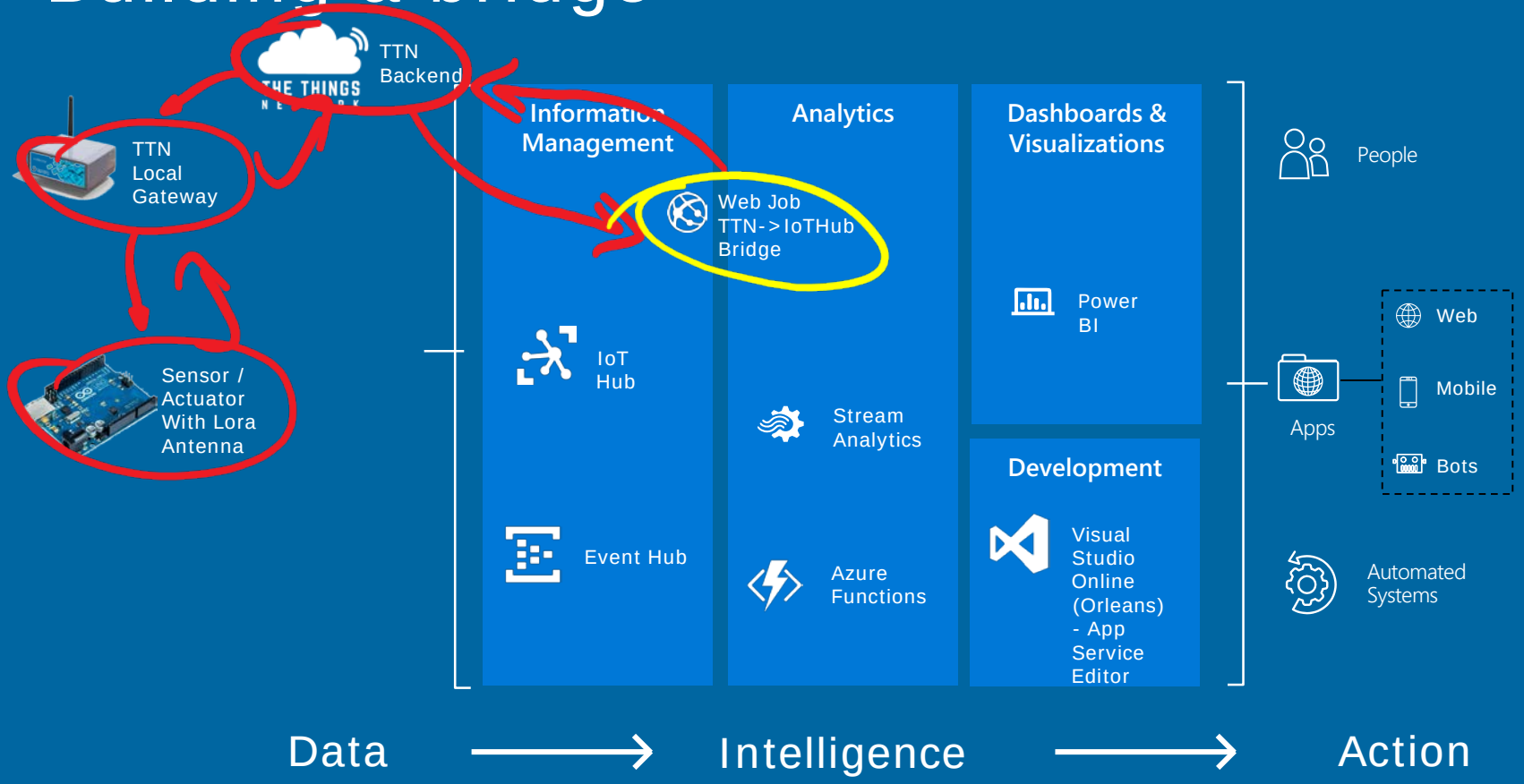
TTN – Azure bridge

Building a bridge

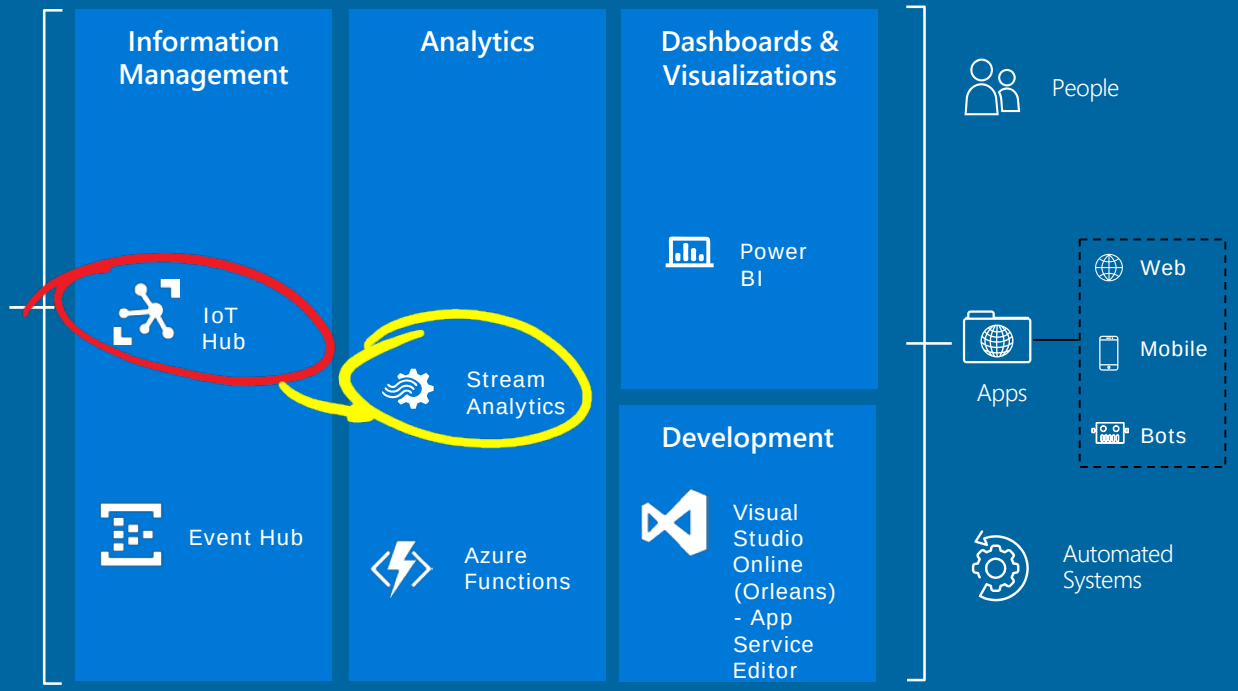


Demo

TTN – Azure Bridge in Node.js & C#

Stream Analytics

Stream Analytics Job



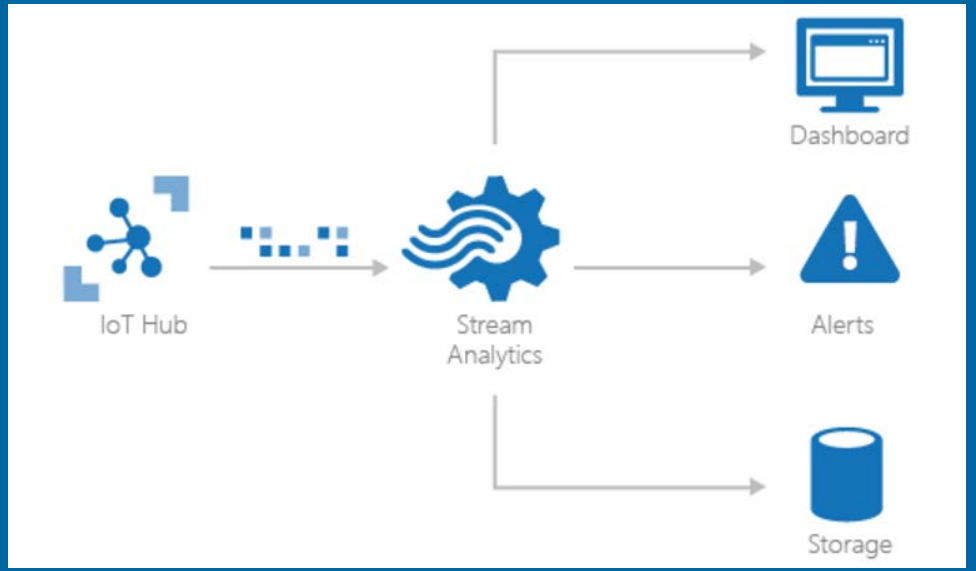
Stream Analytics Job

Stream Analytics makes it easy to set up real-time analytic computations on data streaming from devices, sensors, web sites, social media, applications, infrastructure systems, and more

Query input sources; Event Hub, IoT Hub, Blob Storage data stream or Blob Storage reference stream

Query; SQL-ish

Query output sinks:
Blob Storage, Table Storage, Event Hub, SB Queue & Topic, DocumentDB, Power BI, SQL DB or Data Lake Store

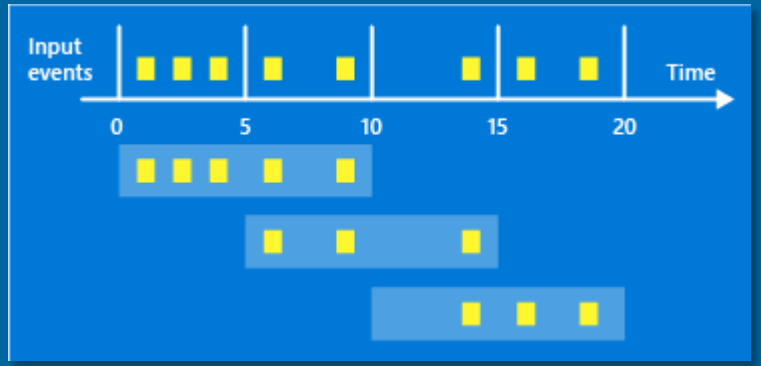


Stream Analytics example

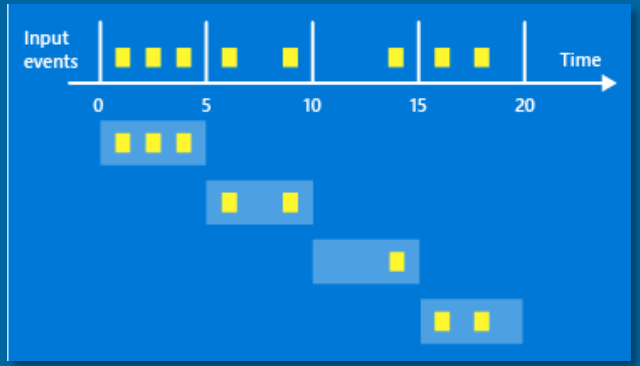
```
WITH [StreamData]
AS (SELECT * FROM
      [IoTHubStream]
    WHERE
        [ObjectType] IS NULL )

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)
```

Stream Analytics Temporal Query

Hopping window



Tumbling window



Sliding window

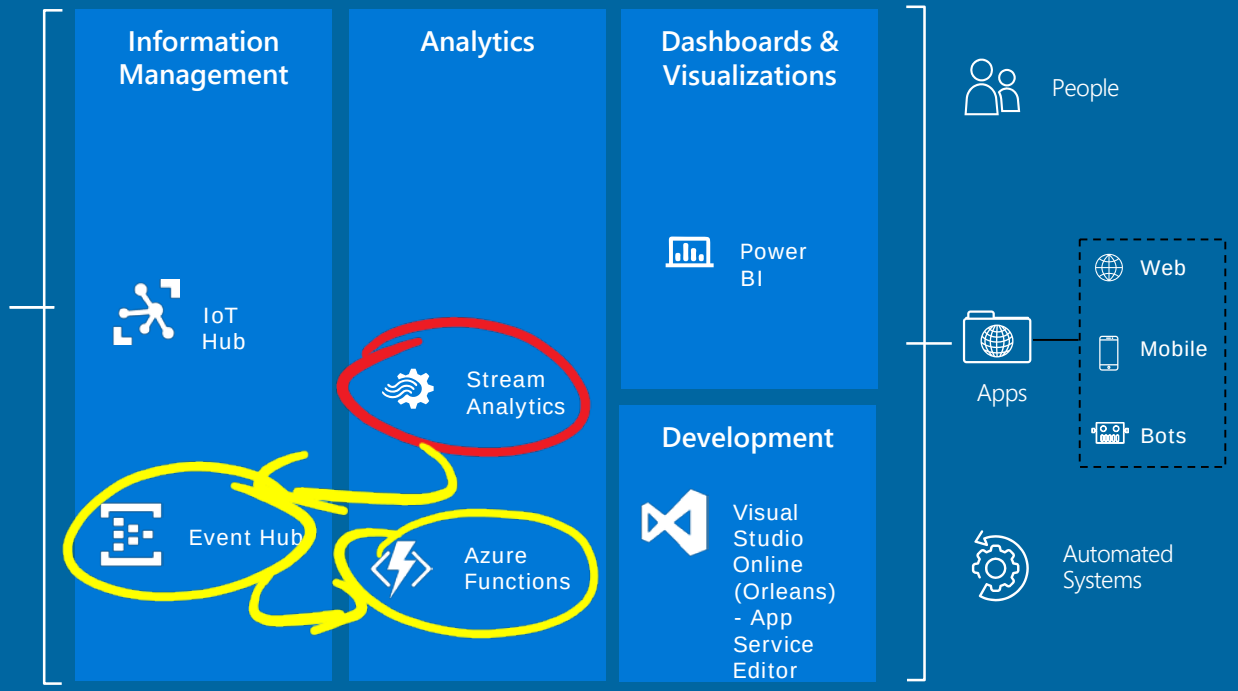
```
SELECT DateAdd(minute,-5,System.TimeStamp) AS WinStartTime,
System.TimeStamp AS WinEndTime, TollId, COUNT(*)
FROM Input TIMESTAMP BY EntryTime
GROUP BY TollId, SlidingWindow(minute, 5)
HAVING COUNT(*) > 3
```

Demo

Stream Analytics

Azure Functions

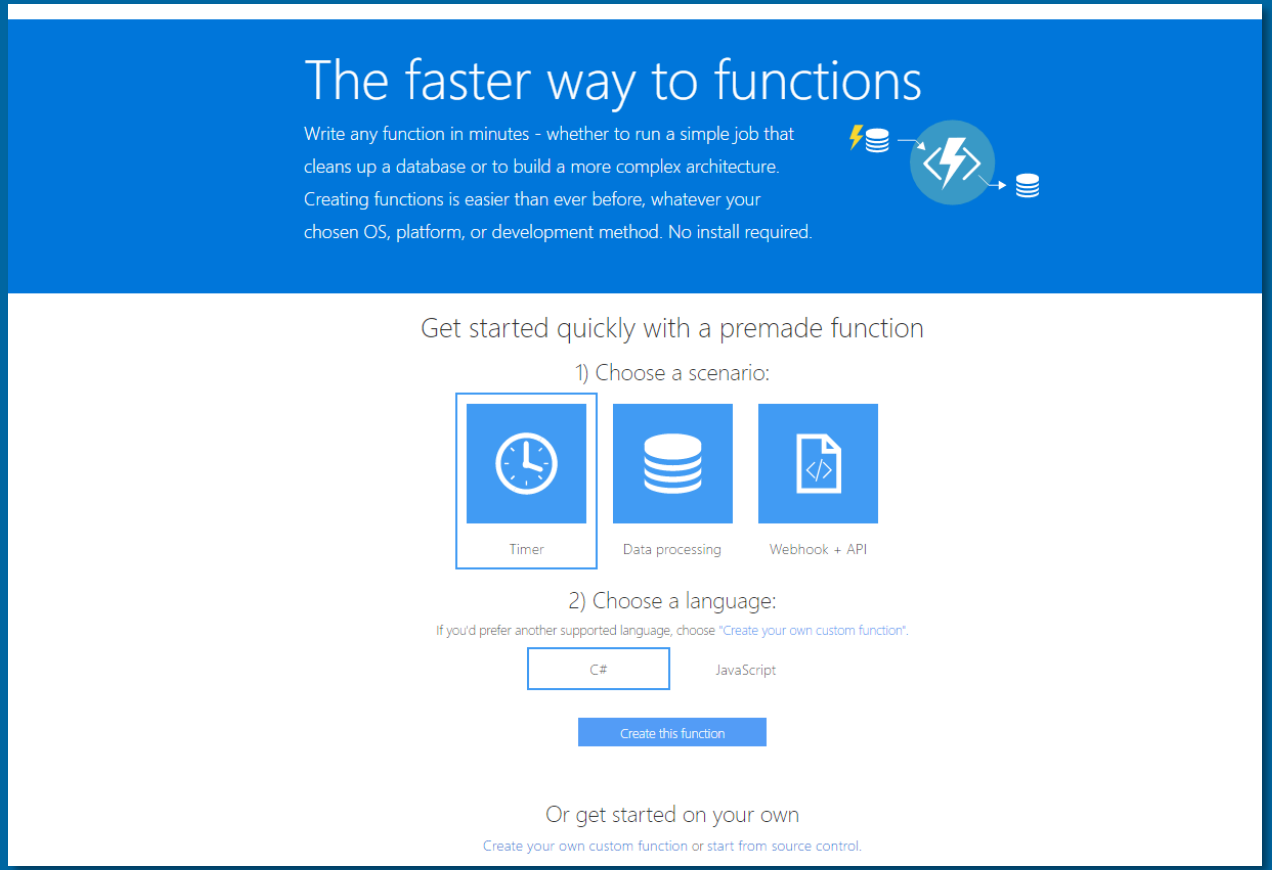
Streaming filtered data to Azure Functions



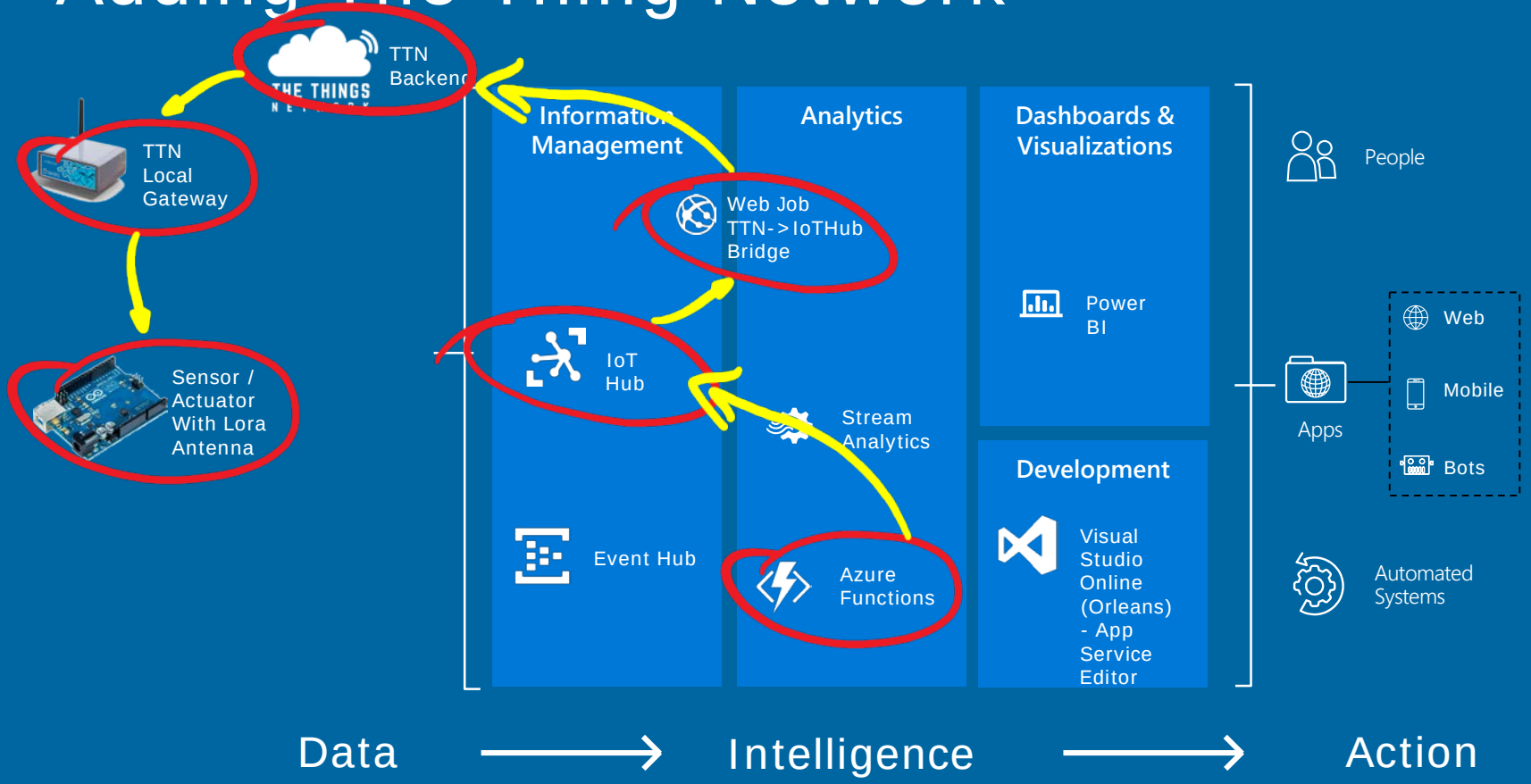
Demo

Azure Functions – receiving uplink messages

Azure Functions



Adding The Thing Network



Demo

Azure Functions – sending downlink commands

Resources for BYOL

Resources to do it yourself

- **The Things Uno** - https://shop.thethingsnetwork.com/index.php/product/the-things-uno/
- **Dual channel packet forwarder** - https://github.com/bokse001/dual_chan_pkt_fwd/
- **TTN – Azure Bridge (C#) –** https://github.com/sandervandevelde/TtnAzureBridge
- **IoT Device as UWP App –** https://github.com/sandervandevelde/uwp-iot-device
- **The Things Network & Azure IoT in unison workshop –** https://github.com/JeeWeetje/ttn-azure-workshop
- **Sander's blog -** http://blog.vandevelde-online.com
- **Jan Willem's blog -** https://jeeweetje.net

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Still any questions?

Thanks

For more information please contact:

Jan Willem Groenenberg
@JeeWeetje
M+ 31 6 10 97 78 39
janwillem.groenenberg@atos.net

Sander van de Velde
@svelde
M+ 31 6 30 53 15 51
sander.vandevelde@atos.net

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