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integrating your business

Get your geek on

The Internet of Things on the Microsoft stack

Nice to meet you

Sam VANHOUTTE

CTO

7 year - BizTalk V-TSP

1st year - Integration MVP

sam.vanhoutte@codit.eu

+32 474 849 993

@SamVanhoutte

be.linkedin.com/in/samvanhoutte/

2000 Belgium
2004 France
2013 Portugal

Microsoft BizTalk Server

Windows Azure

Focused on integration solutions

2012 & 2013

Partner of the Year

Award Finalist
Application Integration

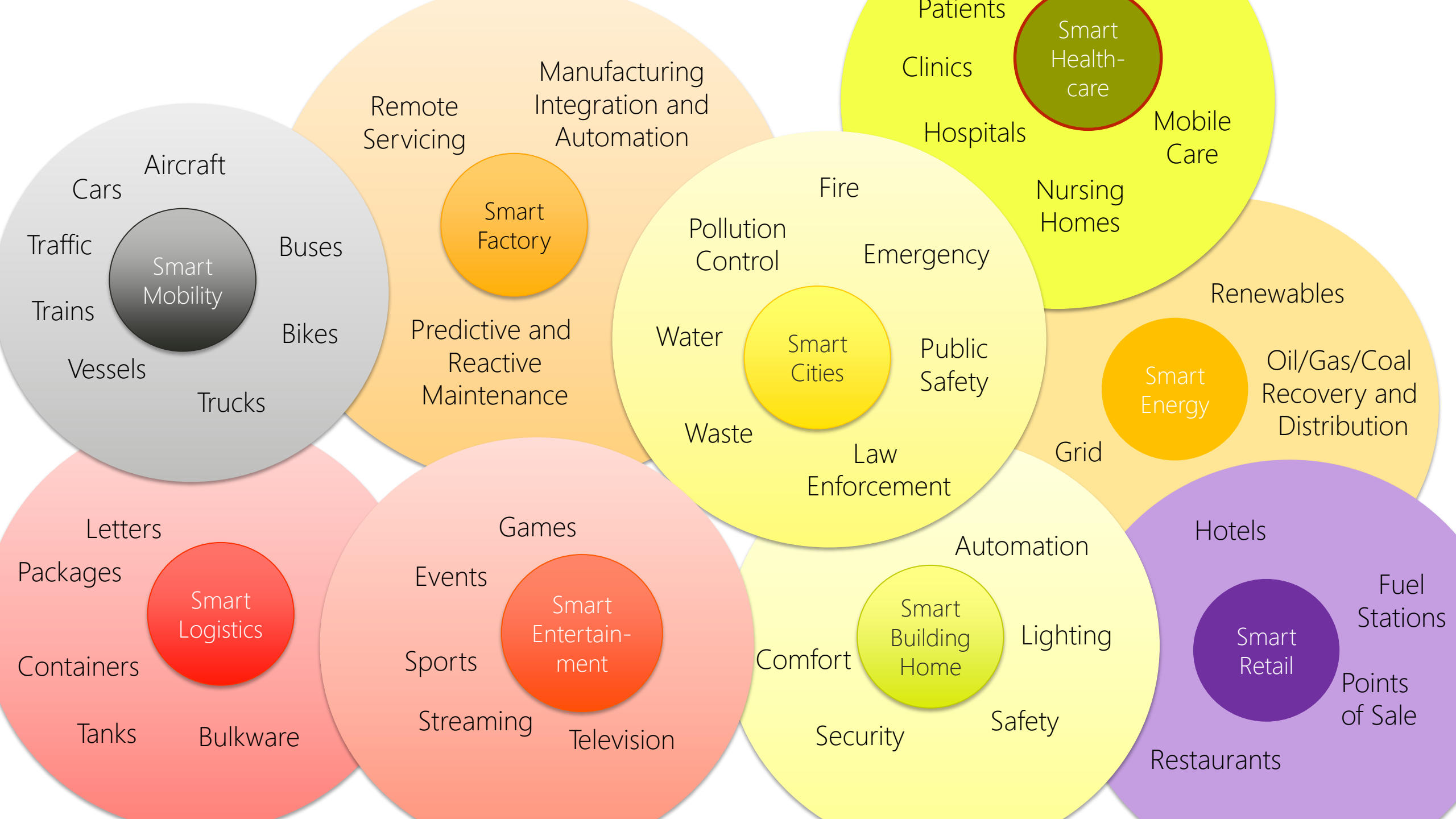
International Focus - HQ in BE

> 60 Active integration customers

e-news + SoMe

60 employees
> 50 consultants BizTalk certified

Thank you for your attention


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

Smart mobility - buses

- Central tracking of every trip and bus position.
- Control traffic lights remotely when delayed bus approaches
- Send alerts in case of delays, accidents or agression
- On-call buses possible for rural areas or off-peak hours

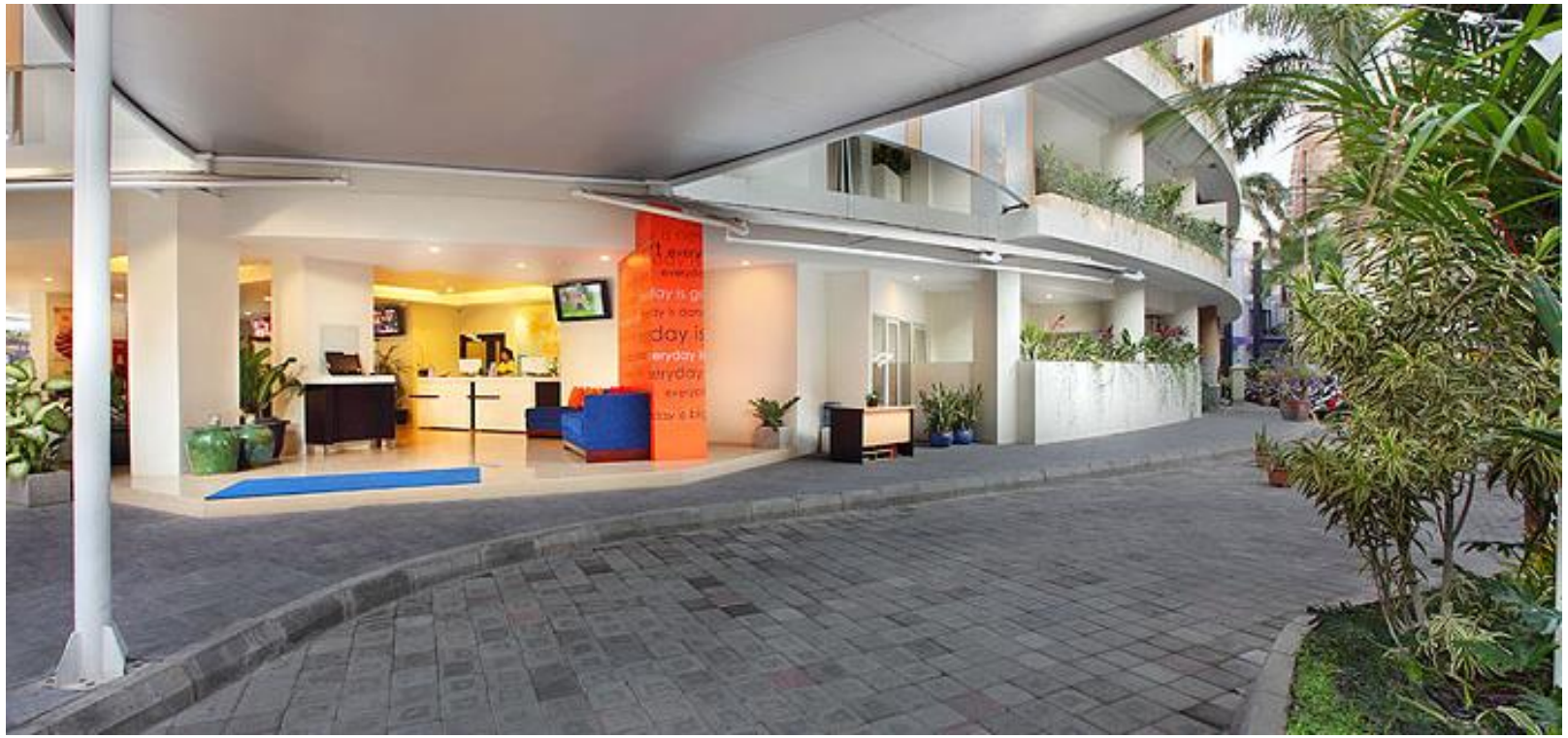
Smart & ecological travel - hotels

At check in, provide preferences (fridge, temperature) and arrival/flight nr.

Upon arrival (flight arrived, hour of arrival), enable lights, mood, temperature…

Measure and optimize energy consumption remotely.

Extra added-value services (mini-bar auto refill, towel service)



Solar energy & energy management

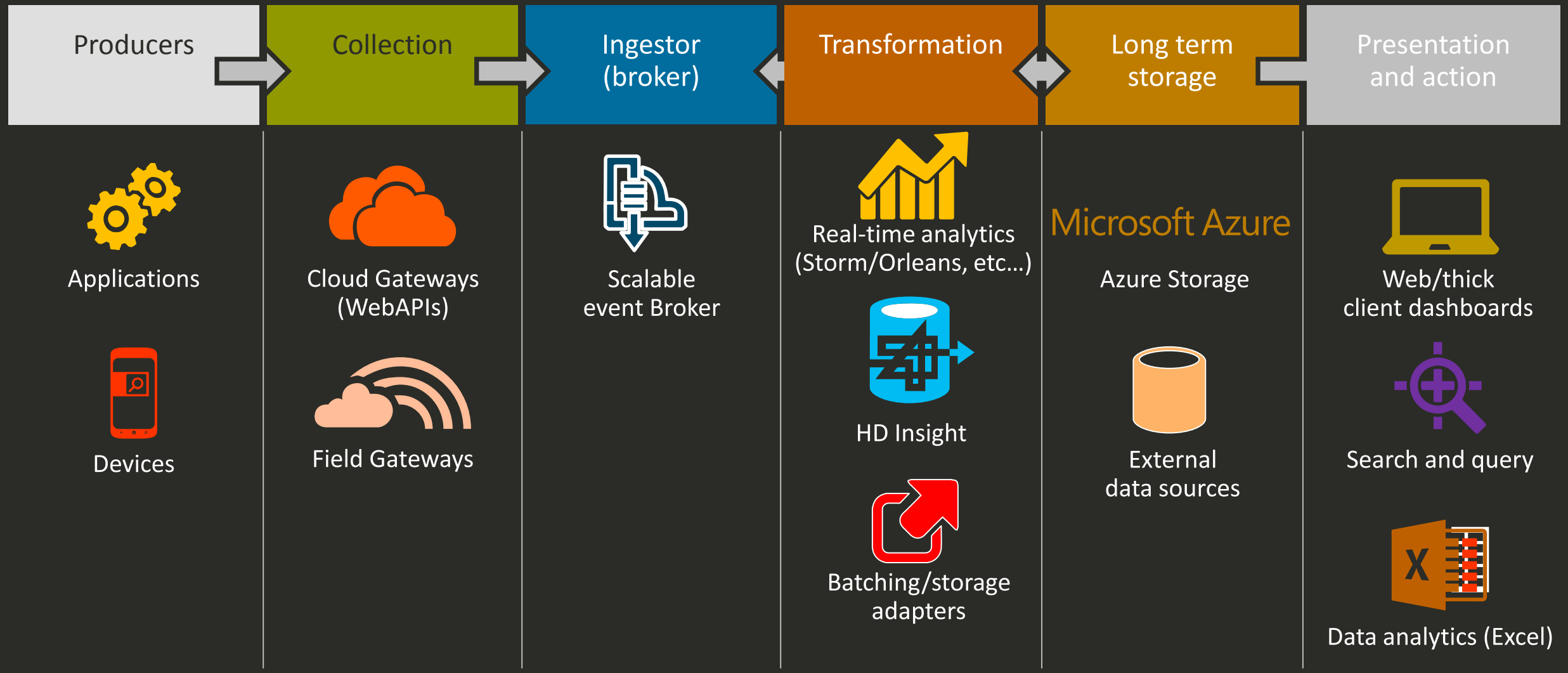
Telemetry data from solar panels
Weather forecast
Geo-location and solar-angle

Combine data to predict energy output and calculate efficiency.

Detect anomalies and react through customer support.
Offer portals and tooling

Handle energy overage for energy-flexible purposes (freezers, heaters, chargers…)

The IoT value chain



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The device side (producers)

Connectivity

	Mobility	Range	Power usage
Ethernet	Attached	-	-
WIFI	Mobile	150m	High
LTE	Mobile	30 km	High
Zigbee	Mobile	100m	Low
BLE	Mobile	50m	Low
NFC	Mobile	5cm	Low

Chosing the right protocol

- How powerful are the devices ? (CPU / battery-power)
- What's the network connectivity?
  - Reliable / intermittent
  - Costly or free
- What are the latency requirements for telemetry or command & control?
- What's the data volume?
- How many devices are to be connected?

Protocol standardization

	Patterns	Latency	Transport
AMQP	All	Higher	TCP
HTTP	Inquiries & telemetry	Medium	TCP
MQTT	Telemetry	Low	TCP
CoAP	Inquiry (req/reply)	Low	UDP
XMPP	Commands & Notifications	Low	TCP

Protocol preference

- AMQP
  - Well-established standard
  - Most flexibility in terms of messaging patterns
  - Highest throughput with advanced flow control
  - Bi-directional socket connection for low latency C&C
  - Same connection for telemetry & C&C
- HTTP is natively support by Service Bus
- MQTT
  - requires custom protocol gateway at this point
  - Allows for bi-directional socket connections
  - Lacks flexibility in messaging patterns & flow control

Steps to activate a device

Configure time & network settings

Activate device on gateway

Get gateway configuration

Security – key management

Give feedback – Status & diagnostics

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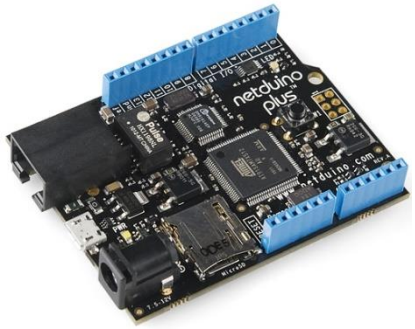
Device prototyping & development

Gadgeteer
GHI

.NET Micro Framework
Open source hardware
Open source software

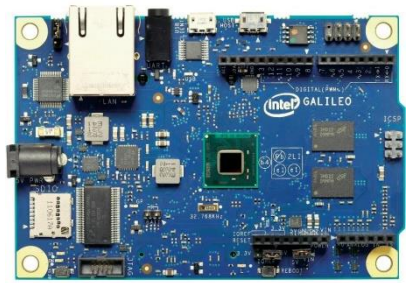


Netduino
Arduino

.NET Micro Framework
C on Arduino
Duino shield

Raspberry
PI

Linux (Raspbian)
Full featured
Powerful



Intel
Galileo

Supports Windows

Demo – Raspberry PI

Telemetry

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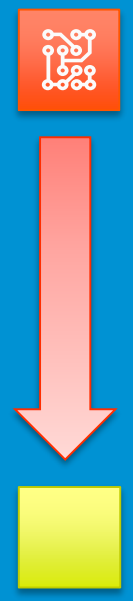
Service Assisted Communication

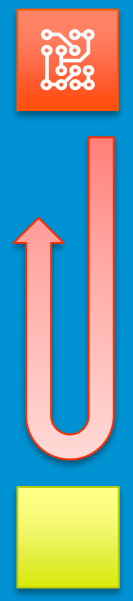
(collection & ingestion)

IoT Patterns



Telemetry

Information flowing from a device to other systems for conveying status of device and environment



Inquiries

Requests from devices looking to gather required information or asking to initiate activities

Commands

Commands from other systems to a device or a group of devices to perform specific activities

Notifications

Information flowing from other systems to a device (-group) for conveying status changes in the rest of the world

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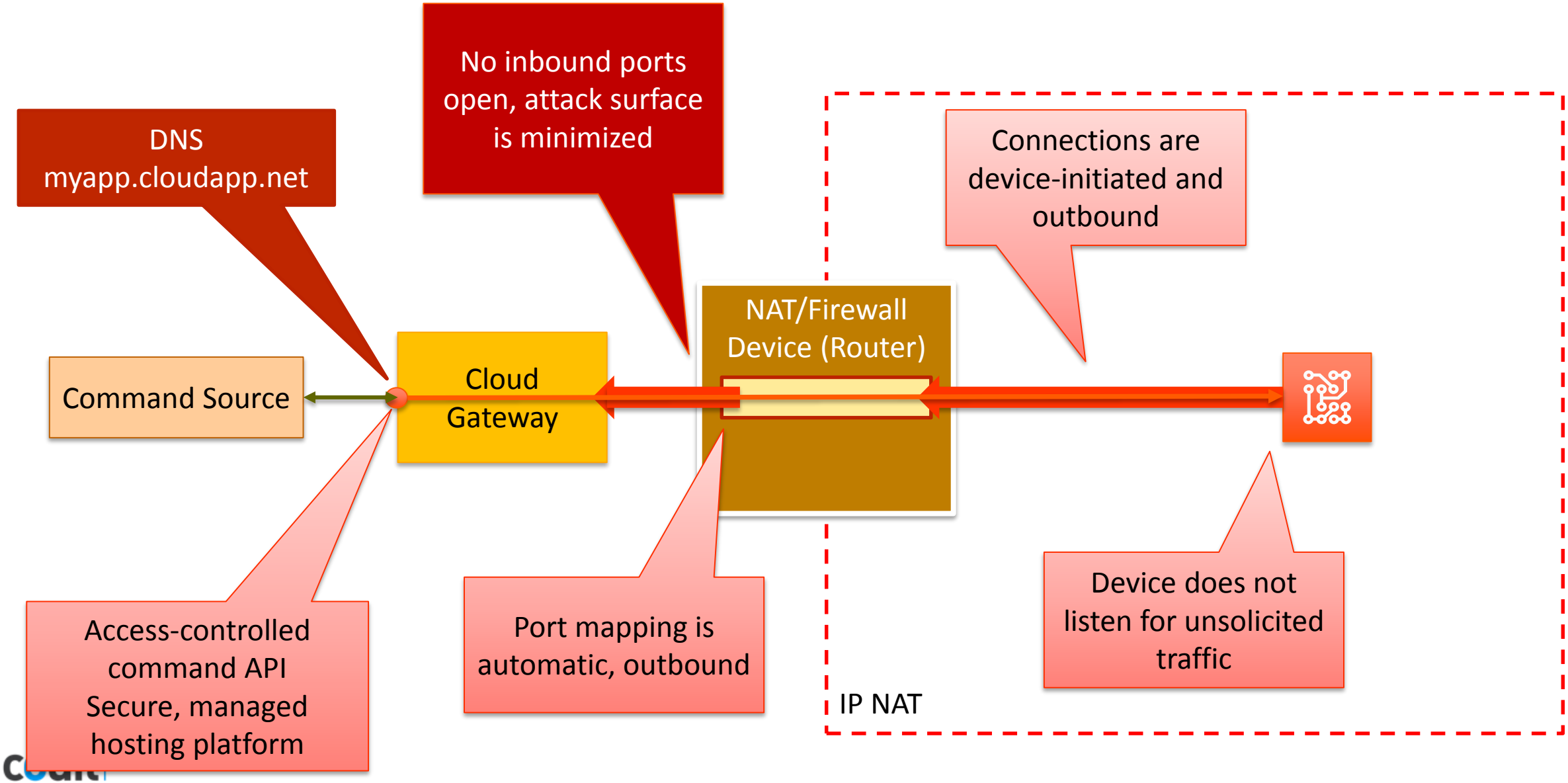
Traditional approaches

- VPN
- Device, acting as a server
- IPv6, an IP address for every device!

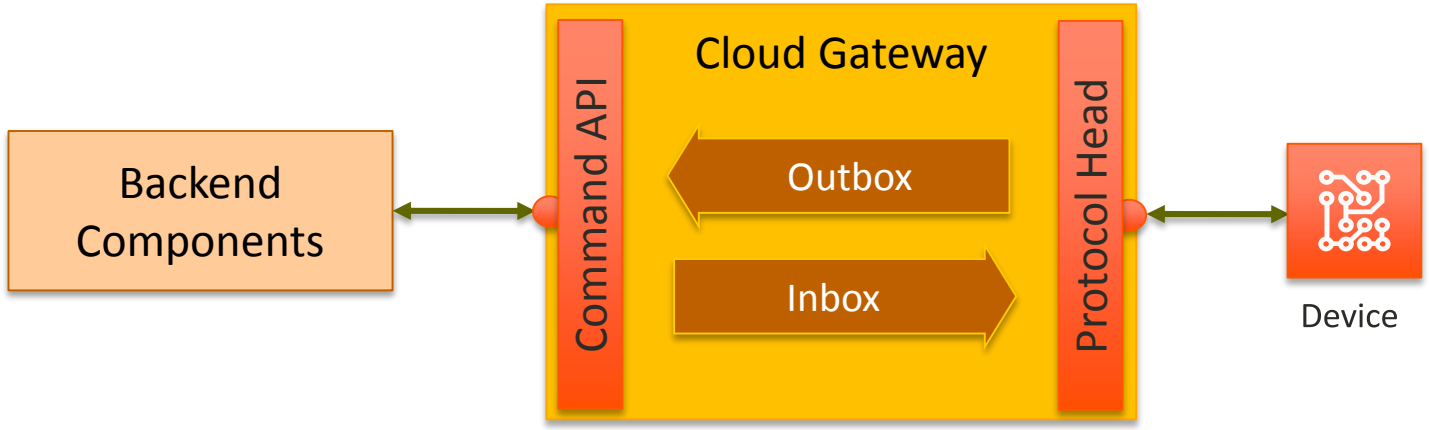
can & should be better !

Service-Assisted Communications



How it Works

- Devices connect via open standard protocols
  - AMQP 1.0 and HTTP supported natively by the Service Bus
  - MQTT, CoAP and others can be implemented via custom gateway/adapter model
  - Sockets secured via TLS (or a lightweight variant)
- Each device has a dedicated Inbox/Outbox on the Gateway
  - Device sends telemetry/alerts and routes service invocations via its Outbox
  - Device receives commands and queries from its Inbox
  - Correlated request/reply patterns can be implemented on top of these two messaging channels
  - The device knows, and has access to, only its own specific inbox/outbox endpoints (URI's)



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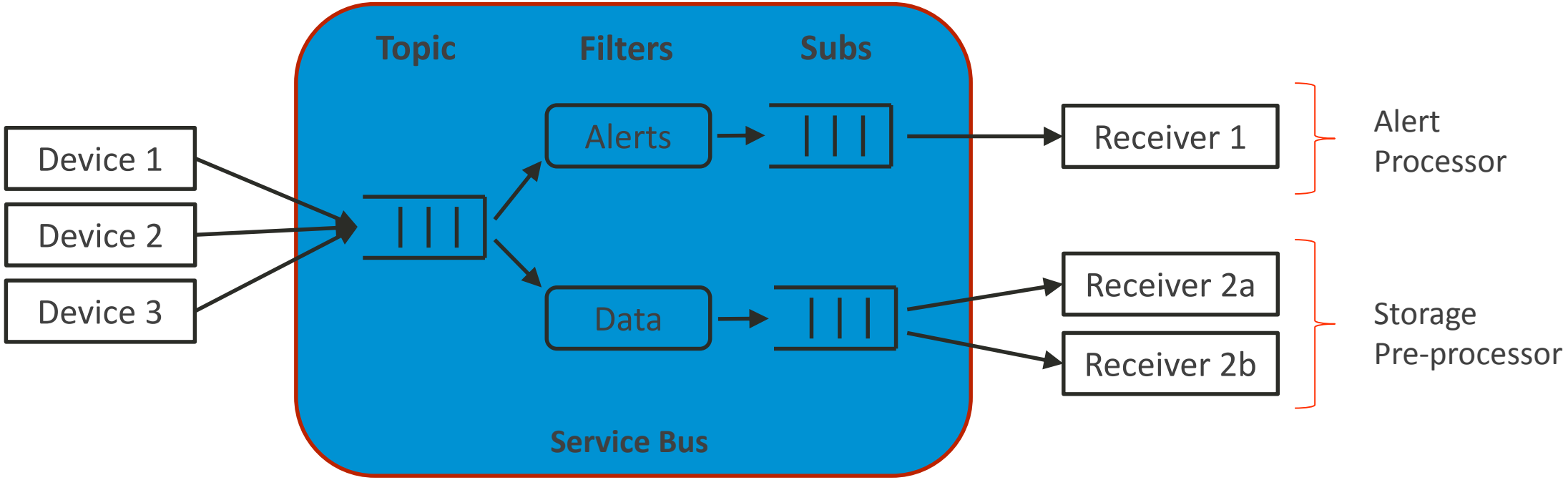
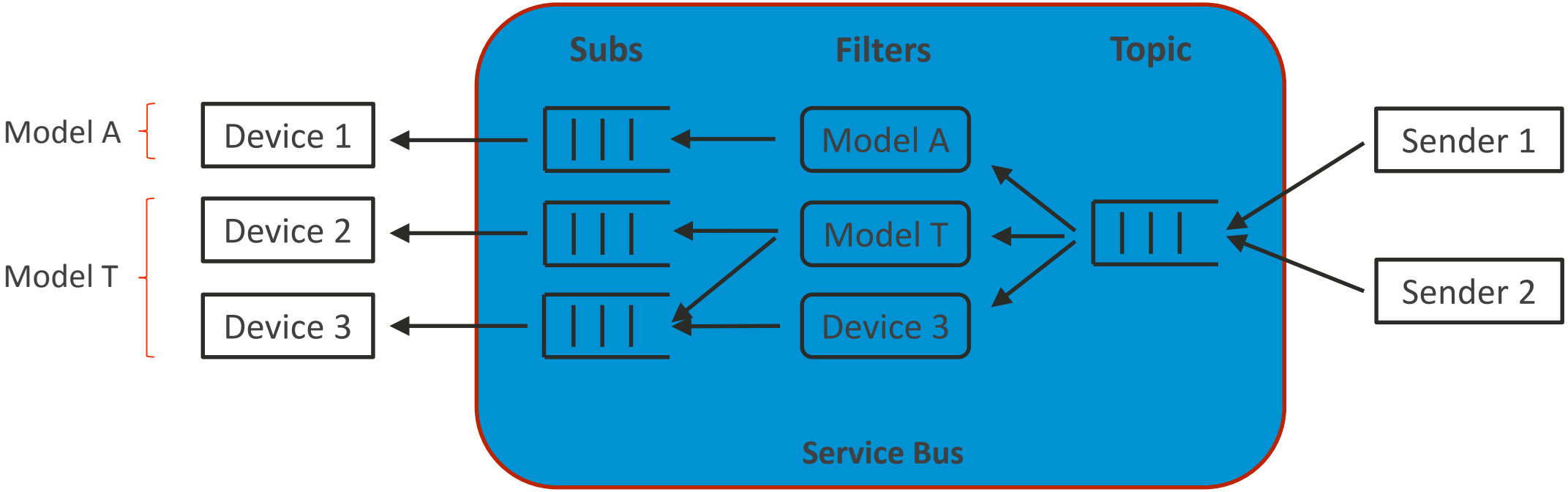
Telemetry Routing with the Azure Service Bus



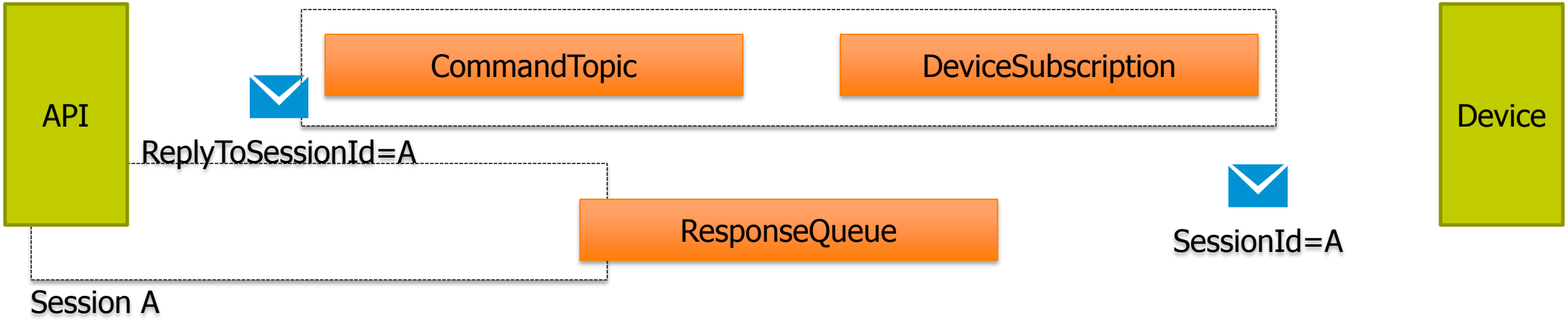
- Split the stream
- Enable parallel processing
- Implement different QoS levels
- Level and balance the load

Routing Commands with the Azure Service Bus



- Target individuals or groups
- Set delivery timeouts (TTL)
- Deal with spotty connectivity
- Traverse NATs/firewalls securely

Request-reply over service bus



Request – Reply pattern

Demo

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Service Bus EventHub (ingestion)

What do you need to handle this?

- An ingestion service that can
  - Support variety (> million concurrent devices)
  - Support velocity (> million events per second)
  - Support volume (> 100s of Tb of event processing)
- With
  - Buffering to handle variability
  - Durability
  - Low latency
  - Security
- And be affordable!

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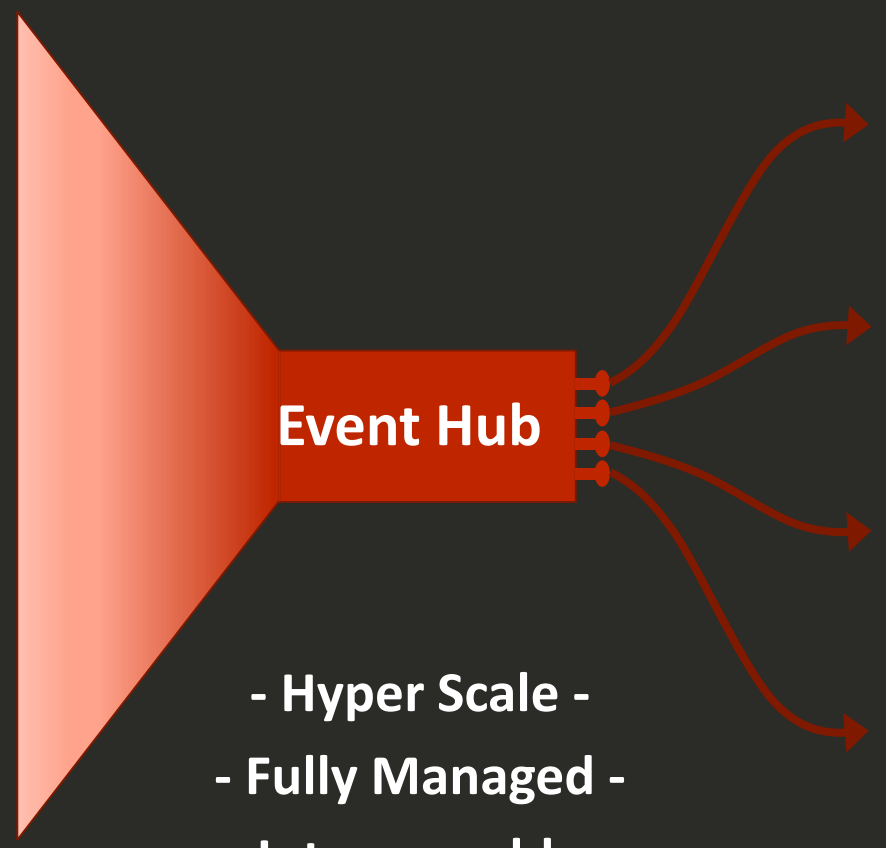
Event Hub – IOT at Scale

Event Sources



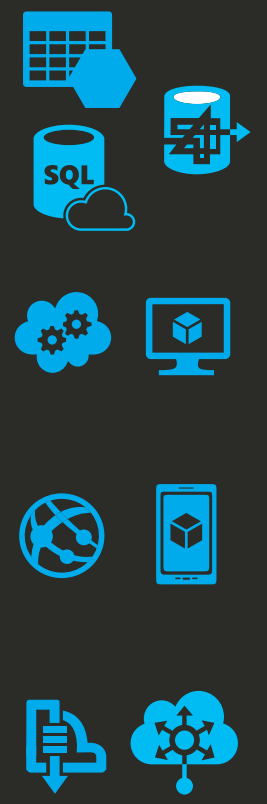
- Hyper Scale -

- Fully Managed -

- Interoperable -

- Secure -

- Cost Effective -



Storage & Analytics

Custom Code & 3rd Party Services

Web/Mobile User Interfaces

Integration Services

Cloud Services

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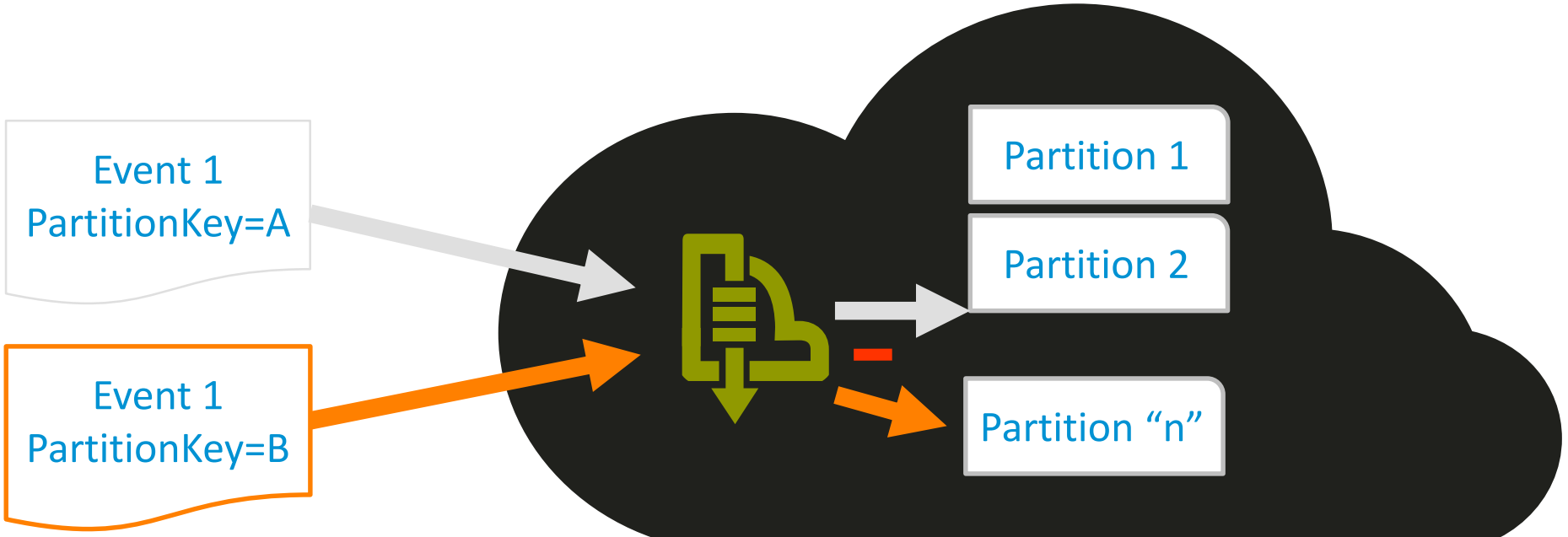
Event Hub publisher concept

- Every Event Hub has pre-defined number of partitions
- Every event has a partition key => mapped to one of the partitions



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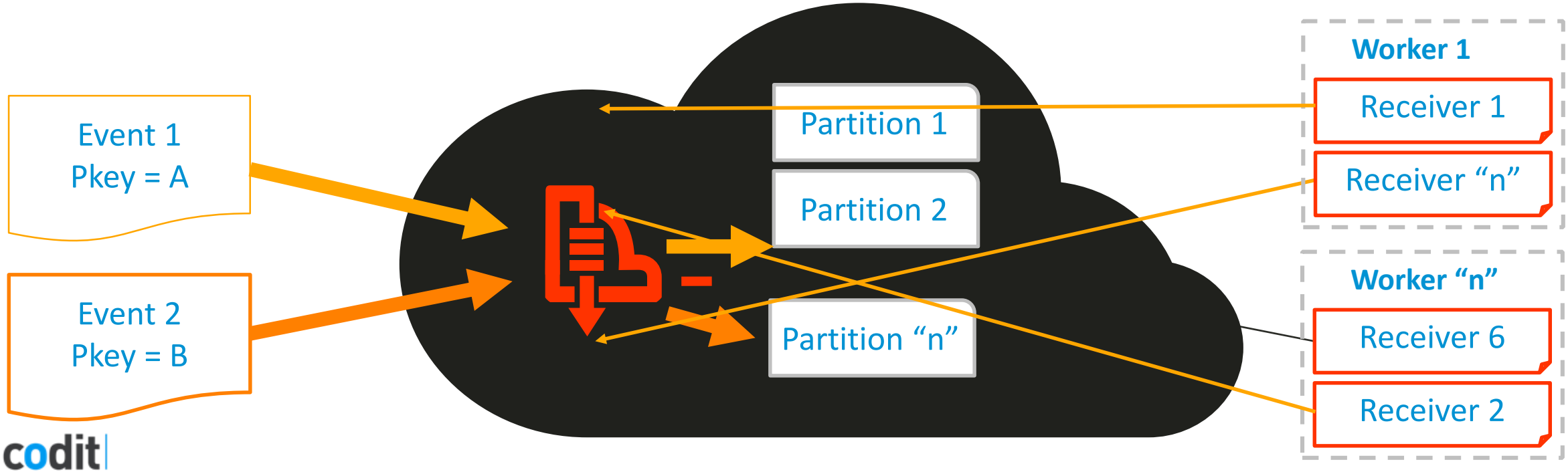
Receivers

- Keep cursors client side
- Buffered stream
- Event groups for pub/sub



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EventHubs

Conference attendees demo

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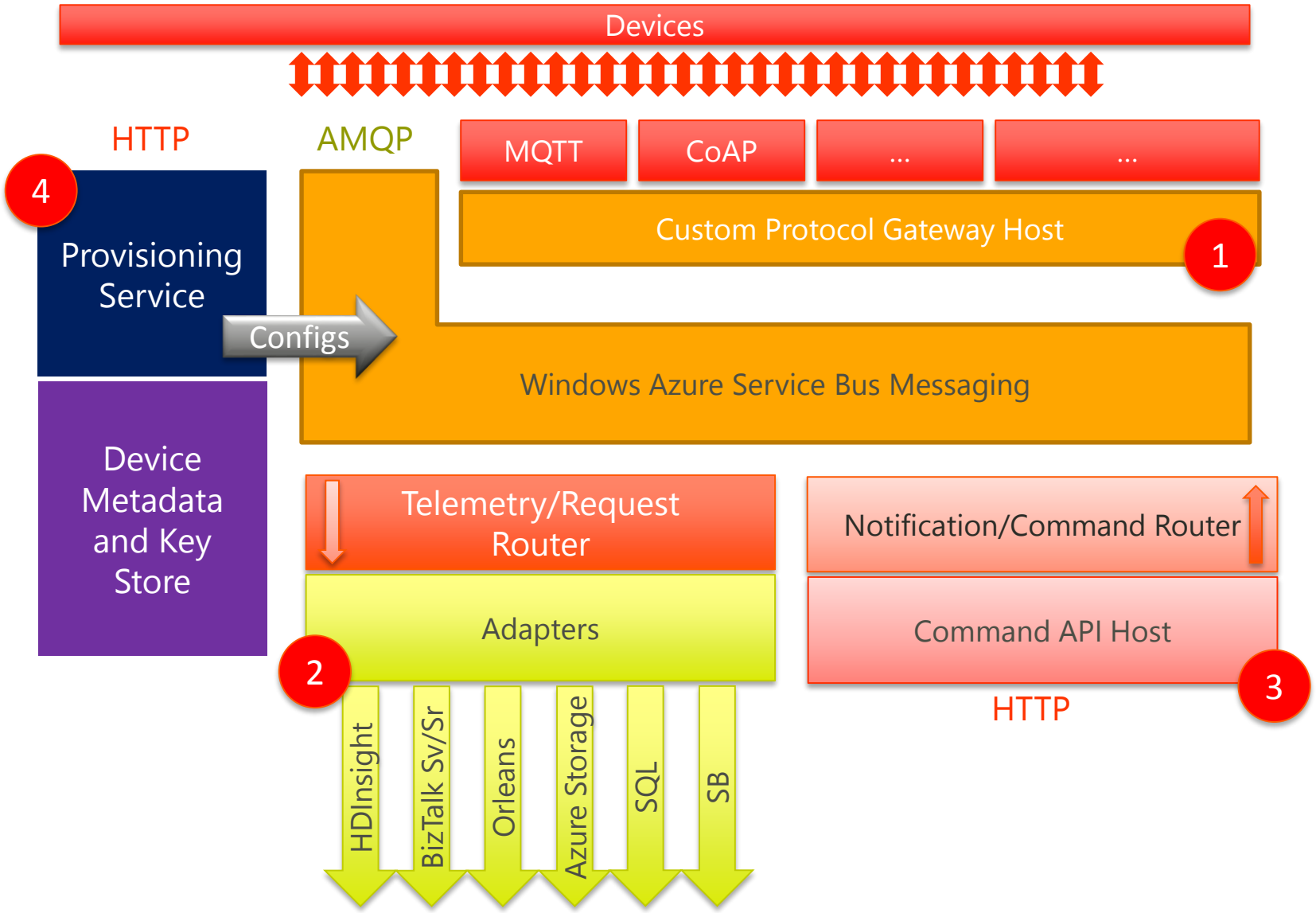
Project “Reykjavik”

An open-source reference architecture

- Device Addressing, Roaming, Sparse Connectivity
- High-Scale Gateway Implementation
- Device Communication Security
- Telemetry Routing for Data Analysis
- Reusable adapters for
  - Device Wire Protocols (CoAP, MQTT, OPC UA, etc)
  - Telemetry Sinks (HDInsight, SQL, Orleans, Cassandra, Twitter Storm, etc.)
- Telemetry ingestion funnel to any parallel "Big Data" and "Big Compute" initiatives

Reykjavik – Core Architectural Concepts

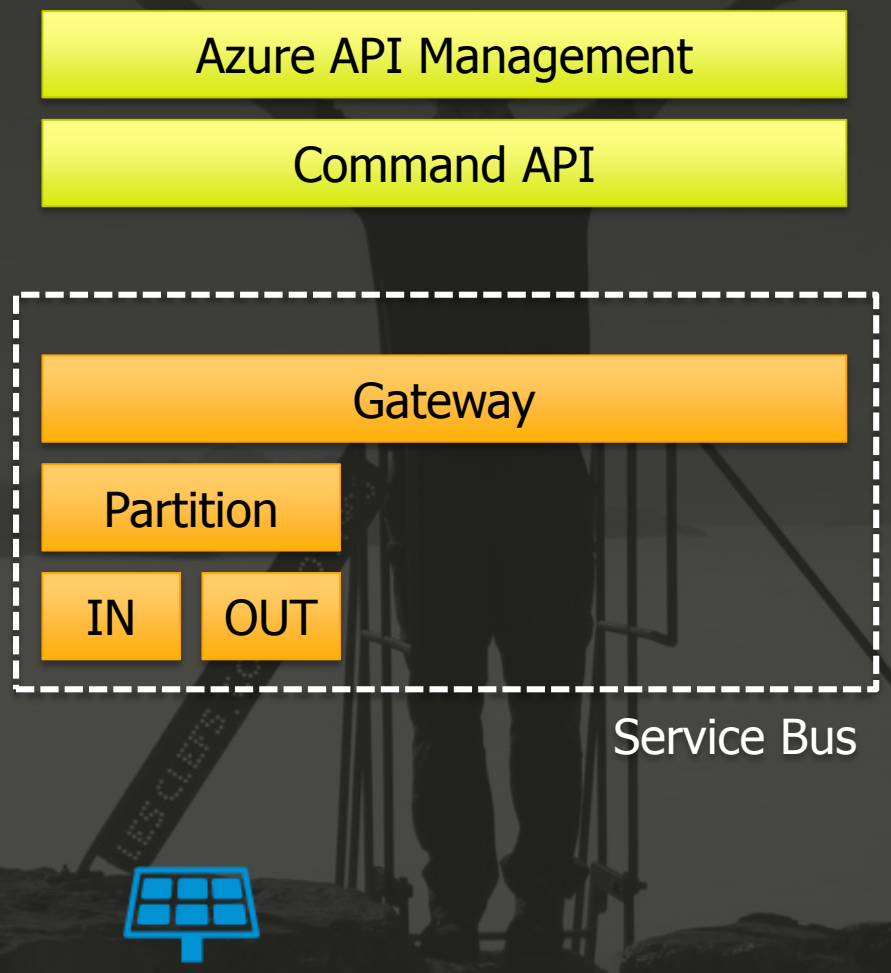
1. Custom Protocol Gateway
2. Telemetry Pump and Adapters
3. Command Gateway
4. Provisioning Service and Metadata Store



Demo – Solar Panel

Telemetry & commands

"Reykjavik"



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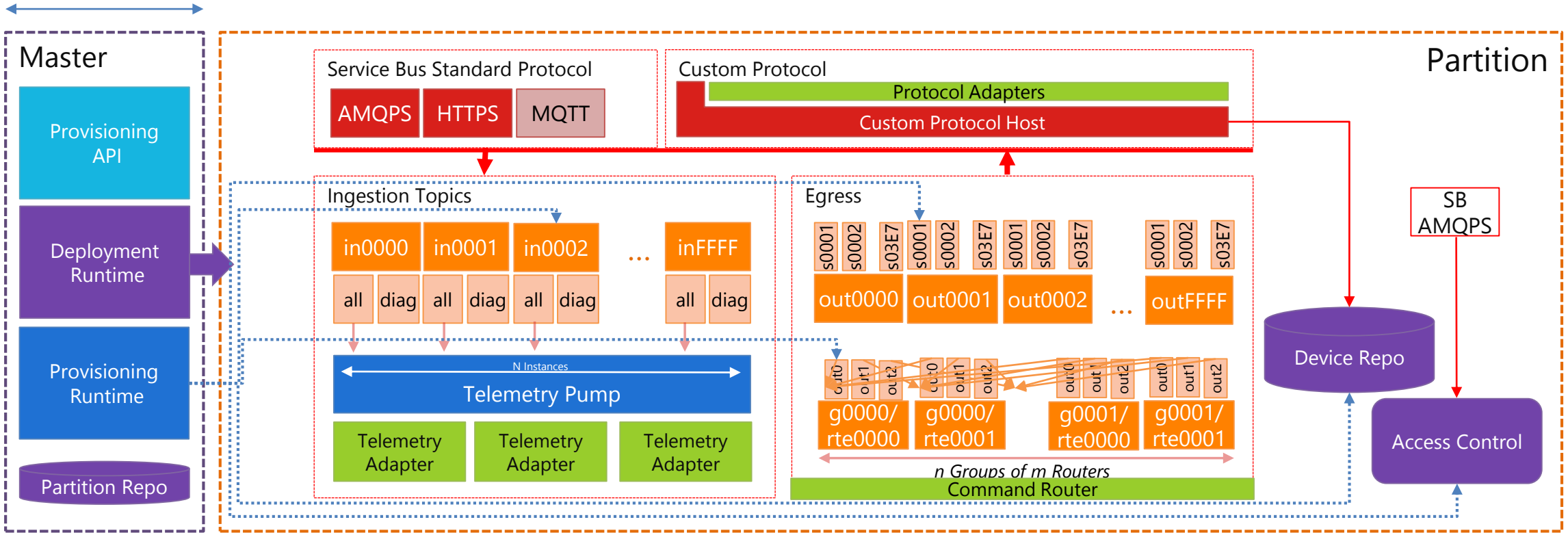
Partitioning for global scale

- System partitions, based on criteria
  - Legal, proximity, data volume, consumption
- Partitions are independent
  - can be moved between data centers
  - has known and defined set of devices
- Ingress topics for telemetry & events
- Egress topics for commands & notifications

Partition topology



Intelligent Systems Services

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Concepts

- A Microsoft Azure-based IoT eco-system
  - Out of the box agents
  - Device/alarm schemas
  - Event processing
  - Per device billing
  - Device registry
  - Rules engine

Microsoft & IoT

IoT initiatives

- Project “Reykjavik”
- Intelligent Systems Service (ISS)
- WindowsOnDevices.com
- Big Data (HDinsight)
- Machine learning & Project “Orleans”

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THANK YOU...

... AND NOW, QUESTIONS?
... OR DRINKS?