

Leveraging Computational Power at the Edge: IoT / M2M Solutions with Informix in the IoT Gateway

Architecture and Building Blocks
for the Internet of Things

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BREAKING THE IT/OT
COMPLEXITY BARRIER.
NOW!



Presentation Table of Content

- Legal Stuff - Disclaimer
- Anatomy of IoT (Solutions) with a focus on Utilities / Smart Energy
- Java/OSGi based OT Architecture & Building Blocks
- Processing Power & Informix at the Edge of the OT Infrastructure
- Integrating into the IBM Enterprise IT World
- Example Use Cases
- Conclusions, Summary

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Anatomy of IoT Solutions

Introduction, Overview,
with a Focus on Utilities / Smart Energy

Robert Andres

Good Reasons for IoT ...

What Businesses and Organizations should consider:

- **Become more efficient**
 - Actions based on real data from the field
 - Avoid cost & downtime - preventive maintenance
- **Improve products and services**
 - Discover new ways to serve your customers
 - Increase customer satisfaction
- **Open up new business opportunities**
 - Transform your business
 - Find additional revenue streams
- **Increase agility**
 - Fast Time-to-Market – move faster than your competition
 - Enable small things to make a big impact
- **Build the ability to scale**

The Internet of Things

Is Changing the Energy Sector Added Value Chain

Market forces require the transformation of the energy and utilities industry value chain

Consumer role in energy management / conservation is increasingly important



Increasing attention to climate change and environmental concerns



Changes driven by growth in renewable generation and distributed resources



Aging asset performance with increased expectations for reliability and workforce productivity



Changing demand dynamics vs. pressure for reliability

The Internet of Things

Is Changing the Energy Sector Added Value Chain

Data explosion

In the utilities industry, the number of connected devices – participants in the “Internet of things” – is growing exponentially:

45%

Compound annual growth rate, 2010-2015



Cost and pricing pressures

By 2050, the Electric Power Research Institute estimates that the average electric bill will probably go up by about 50 percent if the smart grid *is* deployed.

ca. 400%

is the expected increase in the average electric bill if the smart grid *is not* deployed

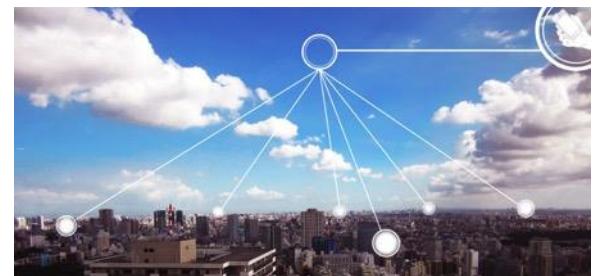


Increasing consumer expectations and concerns

>50% of surveyed consumers with an opinion expect smart grid technologies will lower total household costs for energy use. But . . .

49%

of consumers were concerned that erroneous smart meter readings would result in overcharges



The Internet of Things Is Changing the Energy Sector Added Value Chain

Intelligent Things enable new use cases while the utility transforms to new energy-related services

Applying business analytics to data collected from smart meters and other devices to gain insights for better business decisions and automation.



Load Profiling

Detection of Energy Theft

Event Tracking and Trending

Distribution Network Planning

Demand Response Program Evaluation

Grid Loss

Data Collection Analysis
Modeling New Rate Programs

Outage Analysis

The Internet of Things

Legacy & Existing OT Solutions – With a new Spin ...

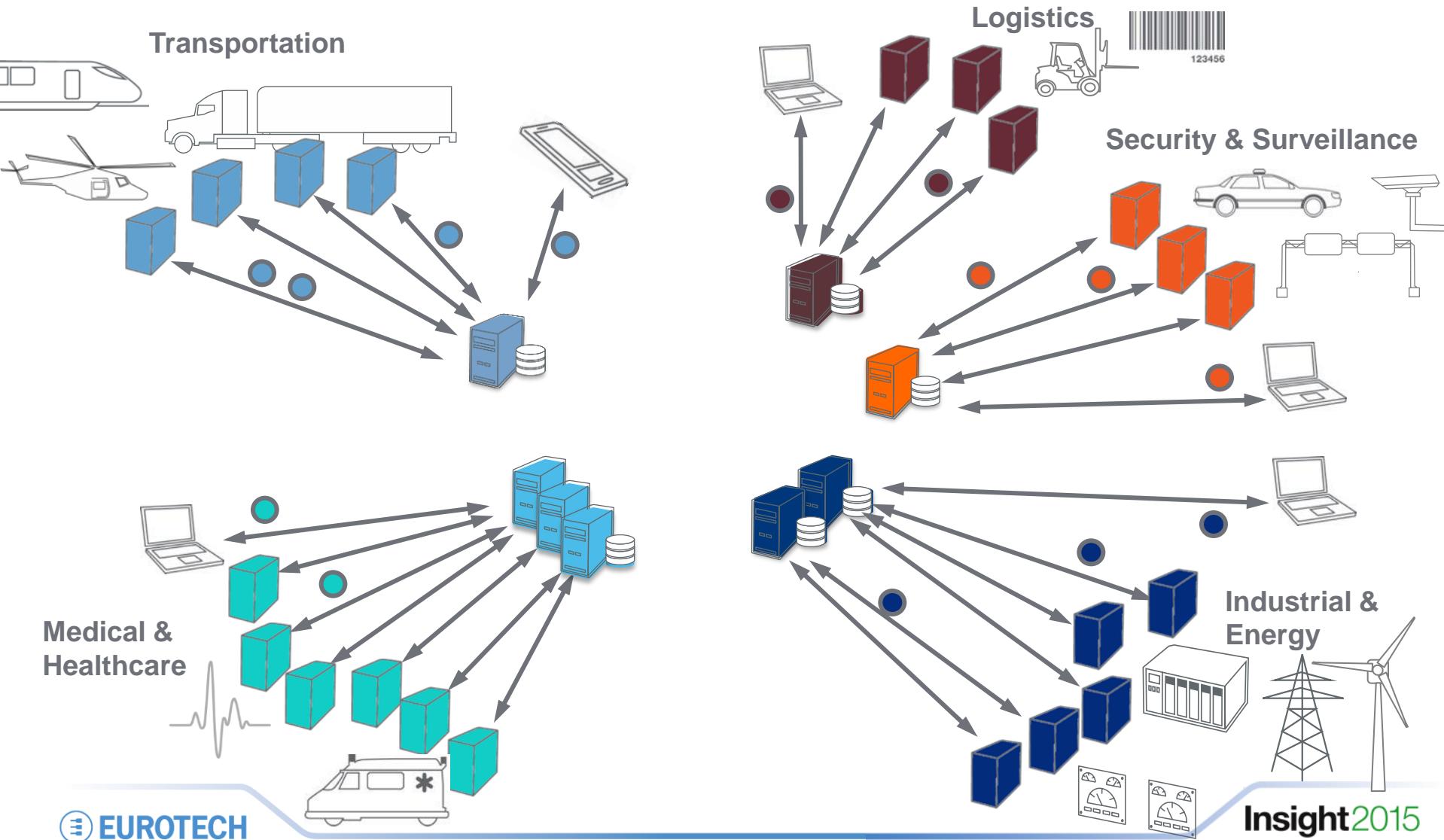


Distributed Systems



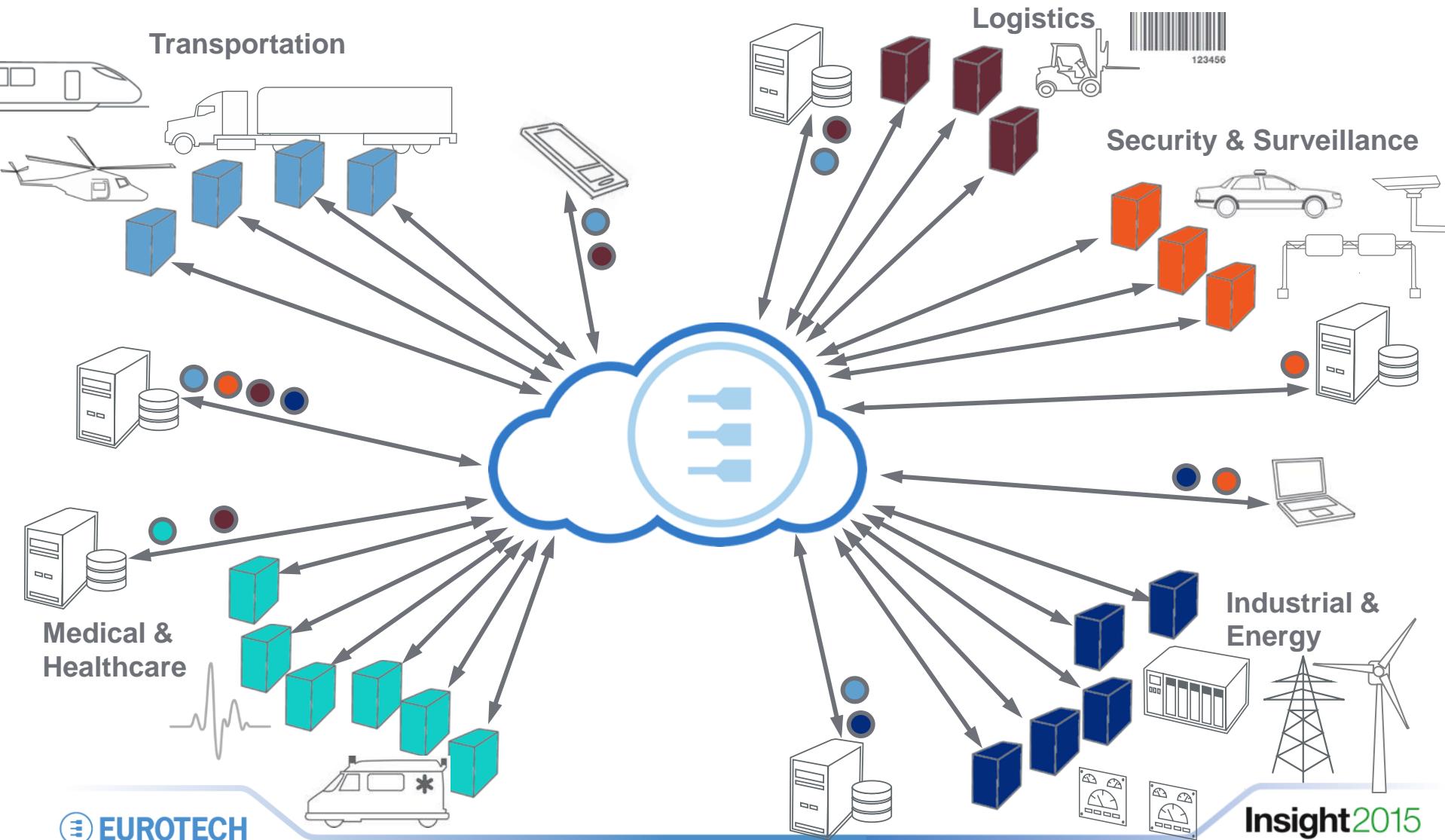
The Internet of Things

Monolithic OT Solutions – „Traditional M2M“



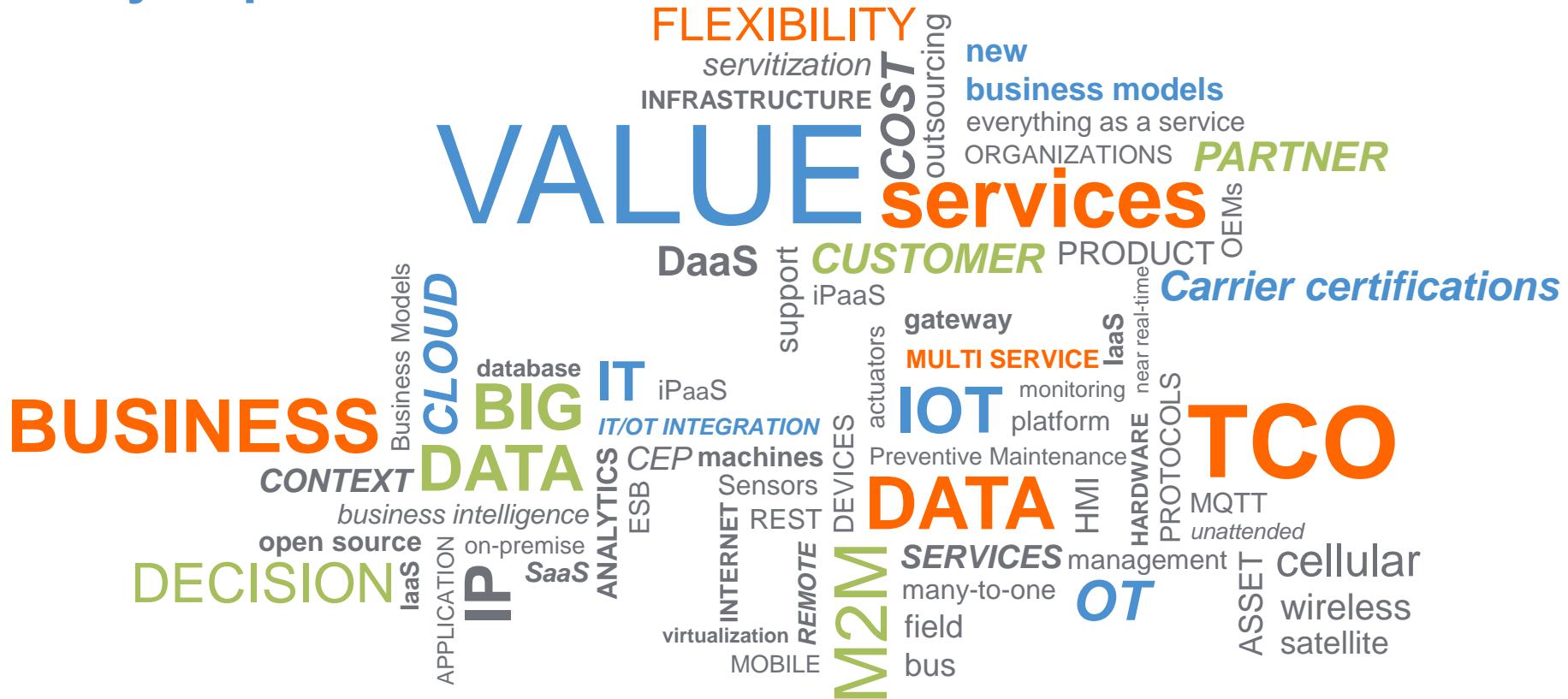
The Internet of Things

Decoupling Producers & Consumers of Data = M2M 2.0



The Internet of Things

Many Aspects...



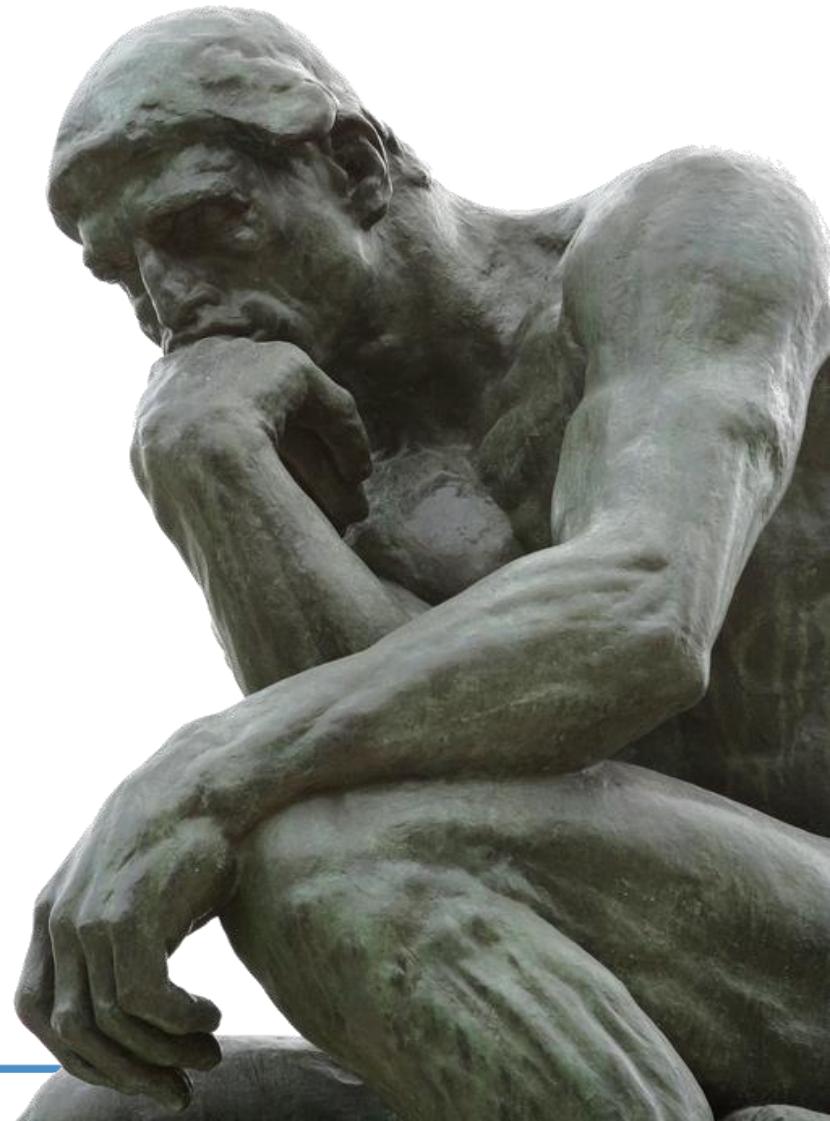
... require **seamless integration** between the Things in the field and the applications **without creating dependencies**

The Internet of Things

Transitioning from a Product to a Service Economy

Re-Thinking

- Products
- Value Add
- Business Model
- Business Processes
- Technological Approach



The Internet of Things

Challenges and Perceived Barriers

Many challenges are seen and perceived as sound reasons for not implementing IoT / M2M solutions now:

- Complex technology
- Specific know-how required
- Infrastructure required
- IT/OT challenges
- Security
- Regulatory issues, certifications
- Confusing messages, information
- Interoperability of solutions



**Perception:
overwhelming
and expensive**

The Internet of Things

Major Industry Trends lead to M2M 2.0 and a Commoditization of Distributed Systems

- Powerful embedded systems
- Of the shelf, purpose built HW
- Virtualization technology
- Enterprise IT
- Cloud computing
- Open & Industry Standards



**Commoditization of
distributed systems**

The Internet of Things

B2B M2M Market Segmentation / Devices

- Lowest **cost per node**
- **Single-purpose** devices
- **Performance optimized** coding
- Static software
- **Embedded approach** necessary
- Edge **connectivity and translation**
- Data communication centric

Single Purpose /
Single Service
M2M Devices

“Embedded /
Telemetry
Model”

- Lowest **cost per service** / TCO
- **Multi-service** systems
- **Abstracted coding** (Java, OSGi)
- Dynamic code
- **IT centric** approach feasible / required
- Edge **computing and aggregation**
- **Control and service centric**

Multi Purpose /
Multi Service
M2M Devices

“Distributed Systems
Model”

The Internet of Things

Evolution: M2M 2.0 = IoT

- Performance **constraints**
 - Hardly any standards
 - **Human resource constraints** (C++)
 - **Expensive**, limited communication
 - **Monolithic** approach
 - **Single-purpose** devices
 - **Hardware-defined** systems
 - **Store-and-Forward** communication
 - **Operations-centric** approach
- **Powerful** embedded **systems**
 - Open and industry **standards**
 - **No HR constraints** (Java)
 - **Inexpensive**, available **communication**
 - **Systemic & platform** approach
 - **Multi-service** systems
 - **Software-defined** systems
 - **Real-time** data and communication
 - **IT-centric** approach

“Old M2M”

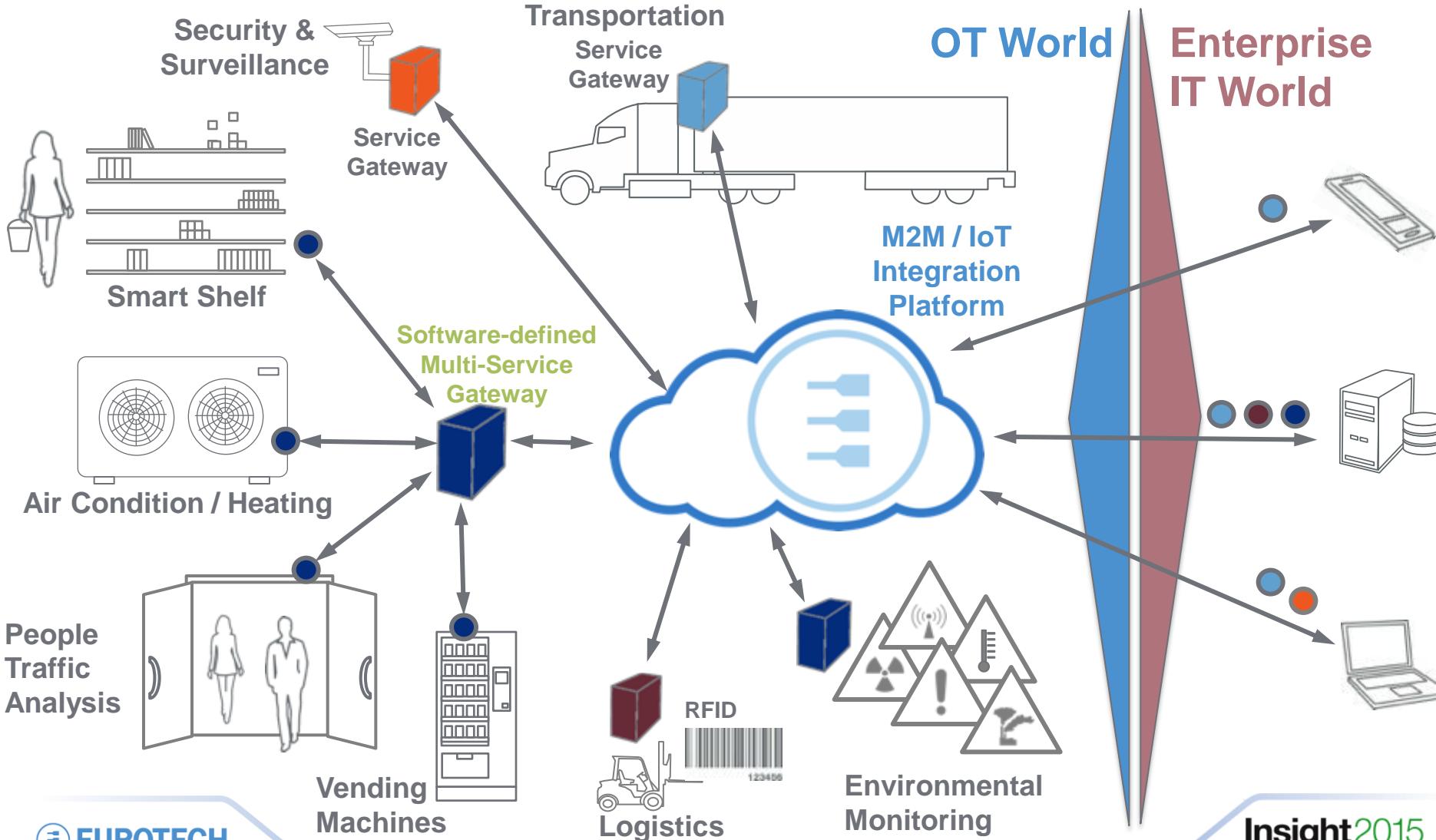
“Embedded /
Telemetry
Model”

M2M 2.0 = IoT

“Distributed Systems
Model”

The Internet of Things

Many Data Producers, Data Consumers, Services



The Internet of Things

M2M Distributed Systems Fundamental Aspects

It is all about **encapsulating the complexity of M2M** distributed systems to:

- **Reduce** development **time and risk**
- Ensure optimum **investment protection**
- Leverage world-class, proven architectures, protocols and technology
- **Reduce** dramatically the **TCO** of distributed device infrastructures
- **Rapidly implement** innovative, new business models and processes

And:

- **Preserve and extend the customers value proposition**

The Internet of Things

Preserve and Increase Value

Most Customers try to develop / have developed a unique value proposition:

- Often this value proposition has to be reflected in **flexible** functionality / **code at the edge** of the IoT infrastructure
- **Flexibility** / programmability **at the edge** is key

A **Java/ OSGi-based Stack** in the **software-defined edge** ensures:

- **Investment protection** (HW & SW)
- **Fast time-to-market**
- More **deterministic development**
- Largely **reduced cost and effort** / TCO

Java/OSGi based OT Architecture & Building Blocks

**M2M / IoT Solutions based on Software-
Defined Gateways and Remote Device /
Embedded Application Management**

Robert Andres

The Internet of Things

Overview, Positioning the Eurotech IoT / M2M Portfolio

Application Layer



Application Infrastructure Layer

M2M Integration Platform

M2M Integration / Application Enablement / Device and Application Management Platform

System Infrastructure

Public Cloud

Private Cloud

Aggregators & On-Premise Platforms

Communication Infrastructure

MQTT
paho

SIM Card & Communication Infrastructure Management

Optimum M2M / IoT Protocols

Field Infrastructure

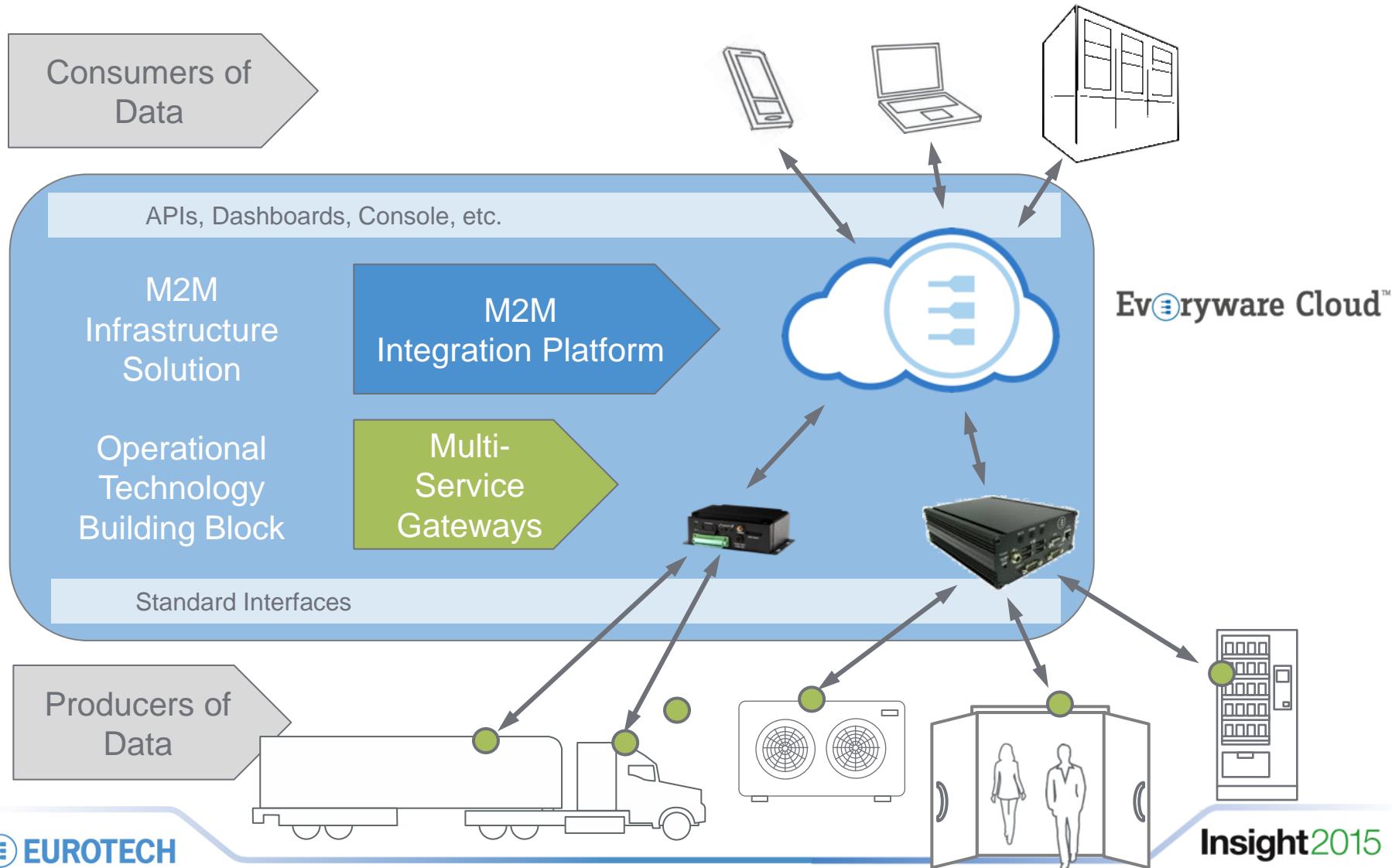
Device HW

Device, Gateway, OS, Security
Device Application Framework Certifications, etc

Sensors, HMIs, Actuators, etc.

The Internet of Things

Distributed Systems Architectural Overview



Eurotech IoT Approach

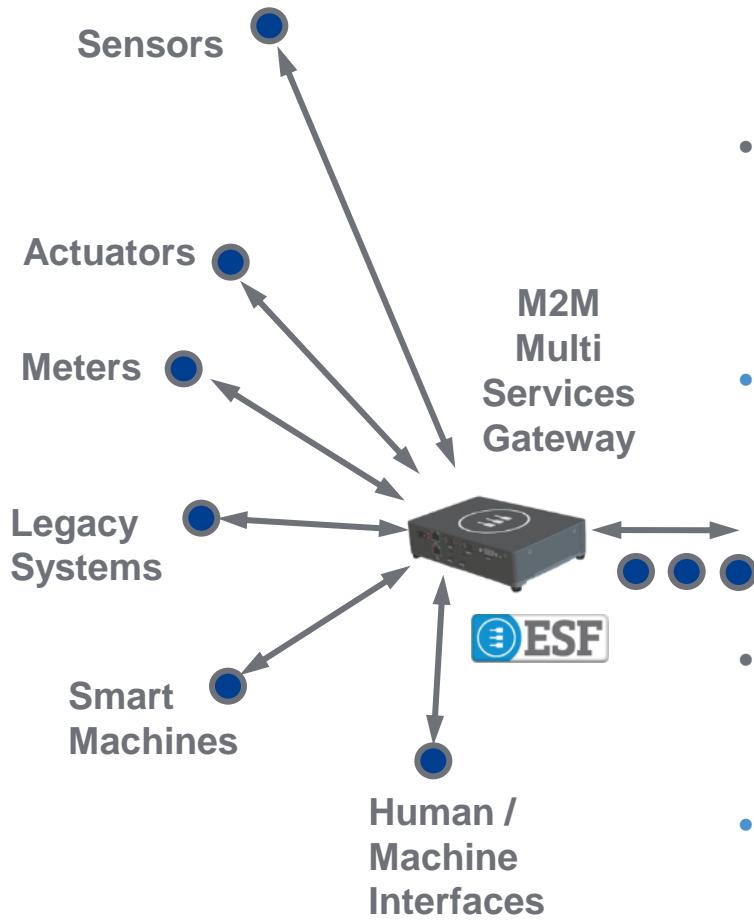
Distributed Systems / M2M Fundamental Building Blocks

- **IT centric, cloud based M2M connectivity platforms** as building blocks for enterprise IT
- Implementation of “**Enterprise Service Bus architectures**” to allow an easy integration of different device data systems and applications
- **Multi Service Gateway approach** to integrate and consolidate data streams and future proof investments
- **IT centric application development** to implement business logic in smart edge devices / service gateways
- **Off the shelf purpose built devices** designed to meet vertical market value propositions



Multi-Service Gateway Approach

Software Defined Automation & Integration at the Edge



- **Multiple** business relevant tasks **are** addressed and **technically consolidated**
- Data delivery using a **open protocol** effectively **decoupling data providers and data consumers**
- **IT centric device application development** using **Software Frameworks** to implement business logic in smart edge devices / multi-service gateways
- More **efficient bandwidth utilization** – carrier cost optimization
- **Off the shelf purpose built devices** designed to meet vertical market value propositions

Eurotech M2M / IoT Hardware Portfolio

General-purpose and Purpose-built Devices

General-purpose Multi-service Gateways	Purpose-built Multi-service Gateways	Purpose-built Scalable Edge Nodes
		

Eurotech M2M/IoT Hardware Portfolio

Mounted Mobile Devices / ReliaCELL



Industrial-grade Rugged Mountable
Cellular w/ GPS option Module

Key Features:

Cellular Connectivity :

- 2G GSM
- 2.5G 1xRTT
- 3G HSDPA/UMTS A
- 4G LTE



Rugged— Sealed to IP65 rating with simple mounting to any flat surface

Ready to Deploy— Certified and carrier approved

Zero Certification Cost— Reduce costly product certifications

Easily Migratable – Change technologies and carriers without need to re-certify, modify or implement any product changes

GPS Capability— Several models support GPS functionality

Key Markets:

- M2M / IoT
- Transportation / Logistics
- Rugged / Industrial
- Mobile / Fleet
- SCADA / Telemetry
- Intelligent Solutions

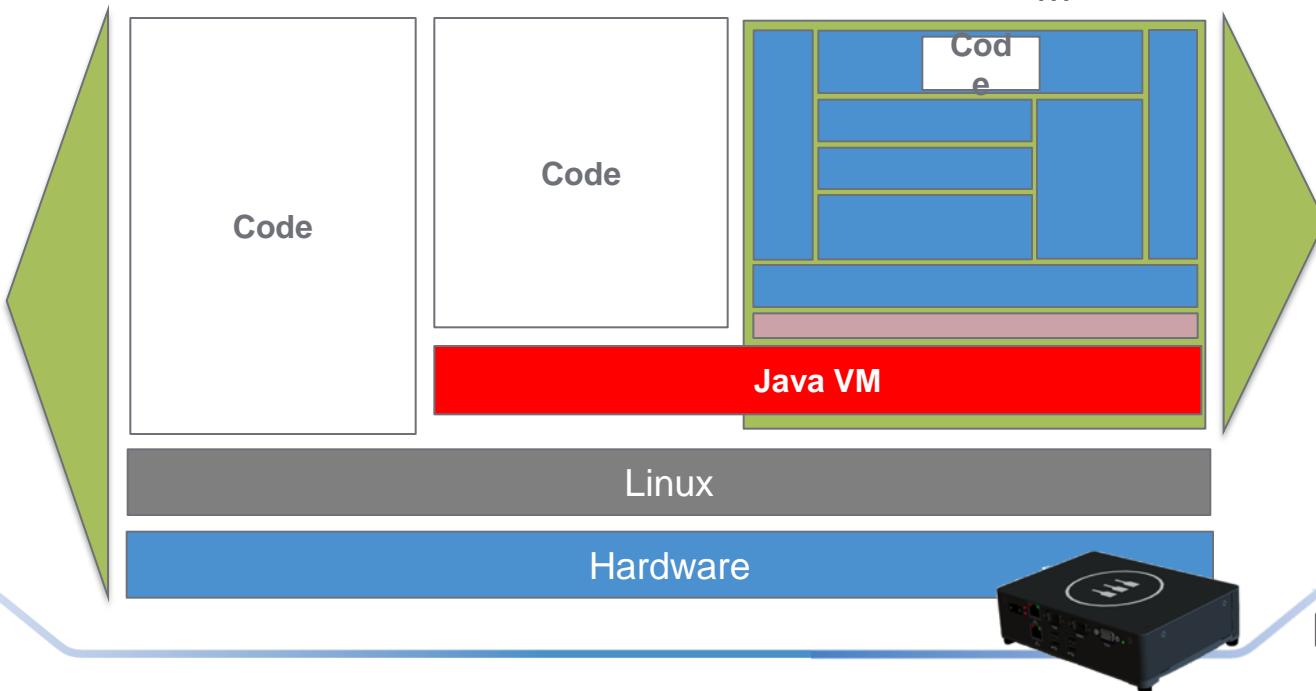


Multi-Service Gateway Approach

ESF / Kura – Solid Software-defined Gateway Foundation

Increasing Value / Minimizing TCO

- Reduced effort
- Shorter Time-to-Market
- More deterministic development
- Investment protection
- Increased SW quality
- Integrated Device Cloud features
- Device SW management
- Device Abstraction
- ...



From Prototype to Deployment

Efficient Development & Investment Protection

Software portability
across HW Platforms

Industrial
M2M/IoT
Gateways



Open Hardware

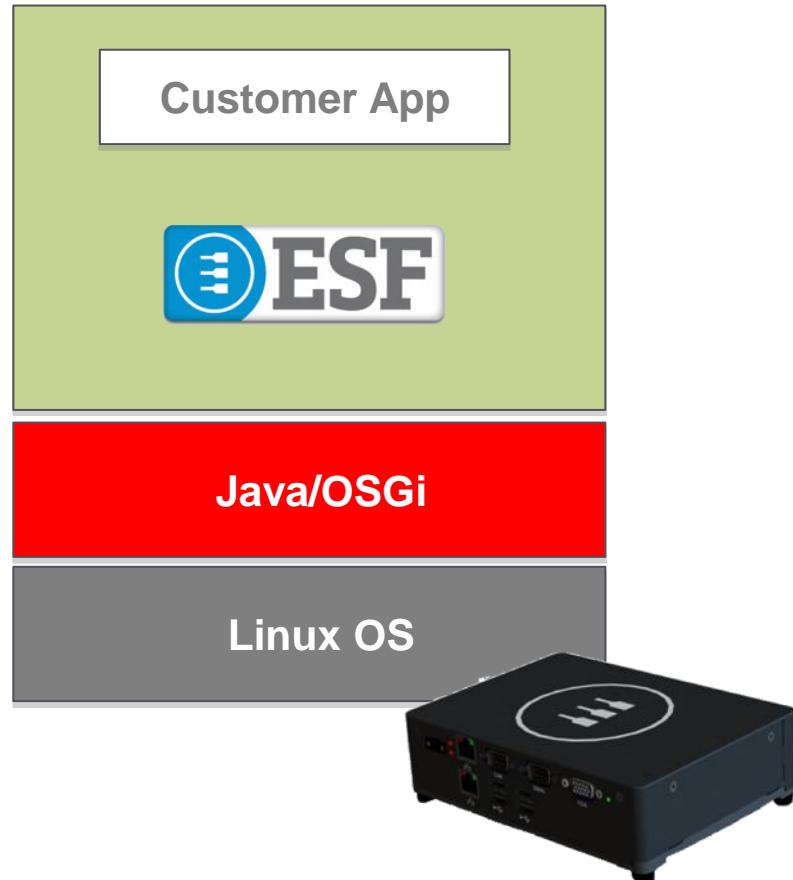


Everyware Software Framework (ESF)

What is ESF?

ESF is an OSGi-based Application Framework for M2M Service Gateways that simplifies the design, deployment and remote management of embedded applications.

- Cohesive and integrated app environment
- Modular software components
- HW abstraction layer
- Field protocol libraries
- Cloud connectivity
- Remote app and device management
- Local app and device management
- Built-in Security
- Development tools



Everyware Software Framework

Powered by Eclipse Kura

Open Sourced at Eclipse Kura



Extended and Commercially supported
on Industrial Hardware by Eurotech

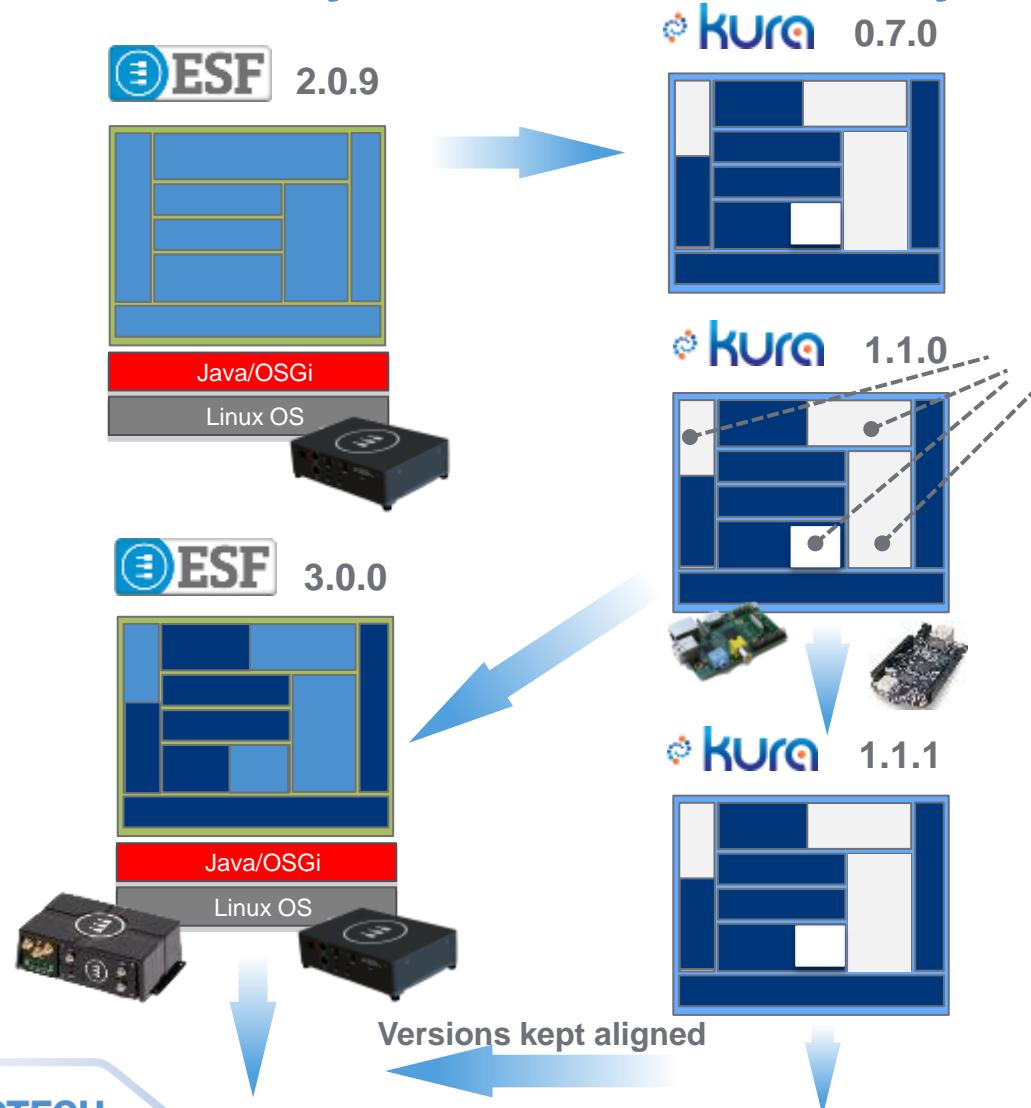


- Modular software components
- Manage cloud connectivity
- Network configuration and administration
- Support for different protocols
- Remote management and access
- Integrated development environment
- Application portability



Multi-Service Gateway

ESF & Kura – Synchronized Delivery



ESF has Kura at its Core.

ESF-only elements:

- Commercial support
- Advanced Security
- Everyware Cloud Remote Management
- Everyware VPN
- Diagnostics
- Field protocols
- Bundles for specific vertical applications

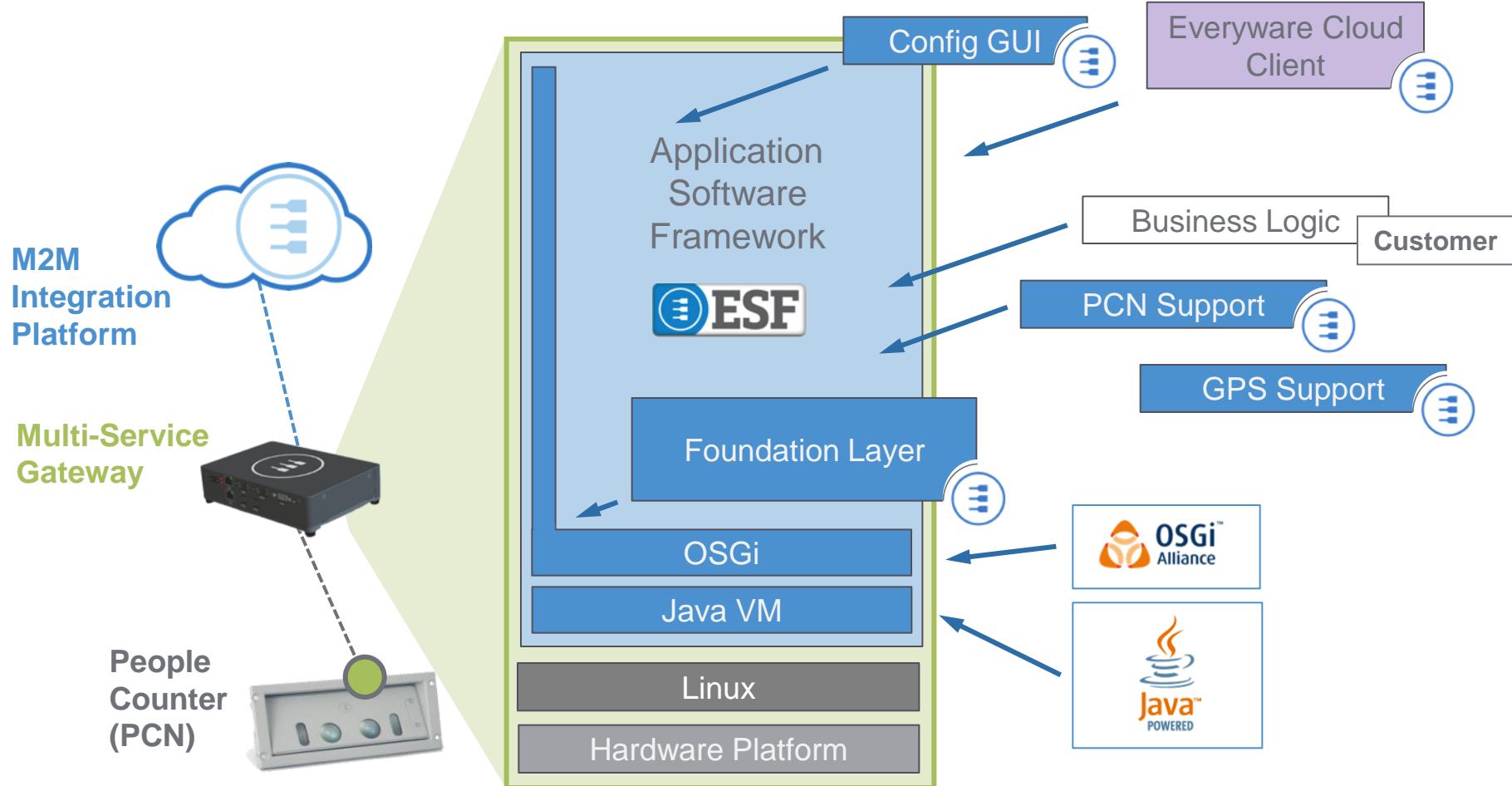
ESF Developer's Experience

Designed from ground-up for developers

Emulate on PC	Deploy on Target	Cloud Managed
		
<p>Start developing your M2M application in the comfort of your PC.</p> <ul style="list-style-type: none">• Full Eclipse Integration• Target Platform Definition• Emulated Services• Run/Debug from Eclipse• Support Mac/Linux Hosts	<p>When you are ready, deploy your application on the gateway.</p> <ul style="list-style-type: none">• One-click Deployment• Eclipse Plugin• Remote Debugging	<p>Provision your application to field devices from the Cloud.</p> <p>Manage your application configuration and lifecycle from a Cloud infrastructure. No more field visits!</p> <ul style="list-style-type: none">• Web-based Console• REST API Integration• Smart Alerts

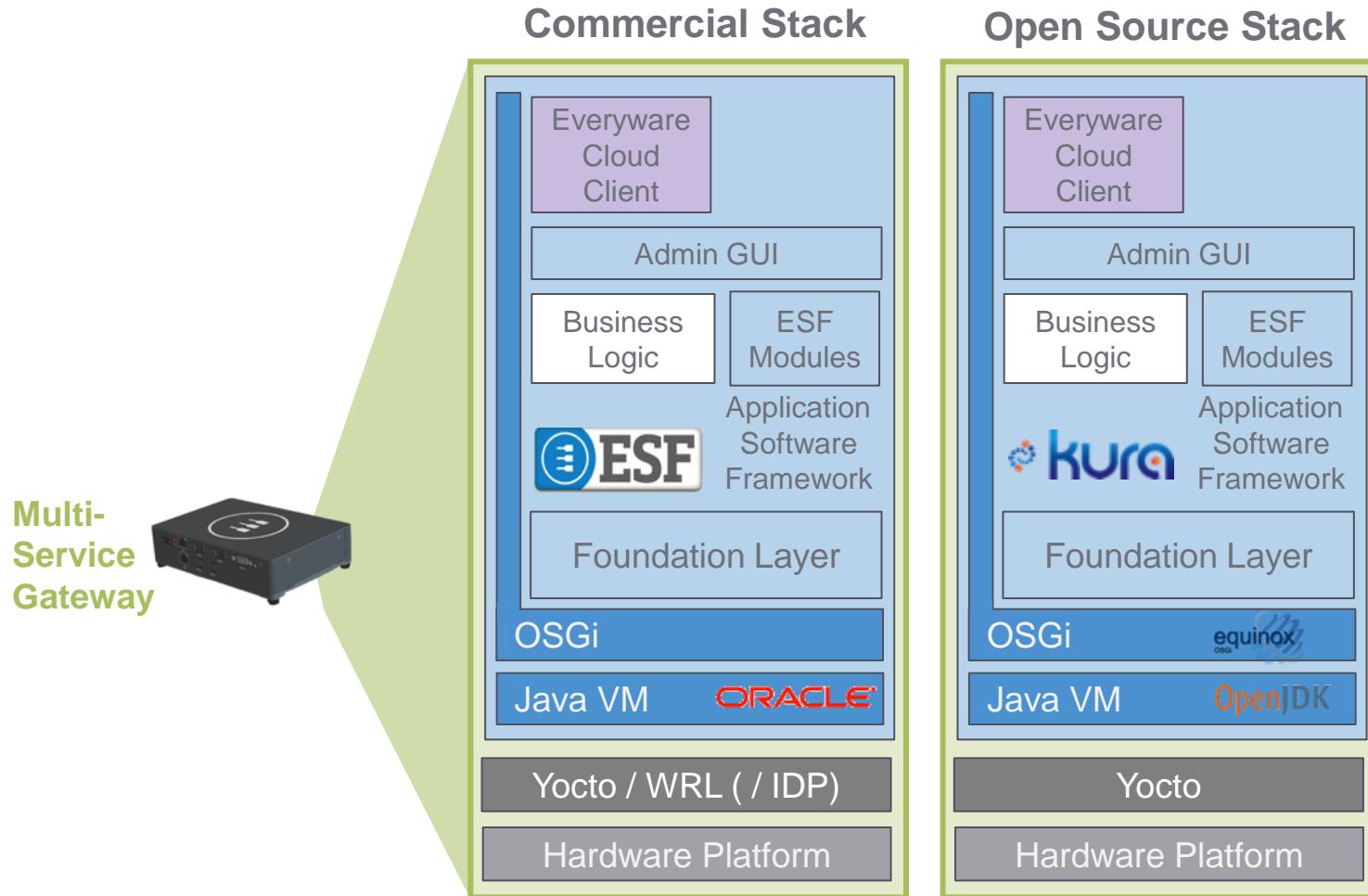
Multi-Service Gateway Approach

Maximum SW Development Flexibility



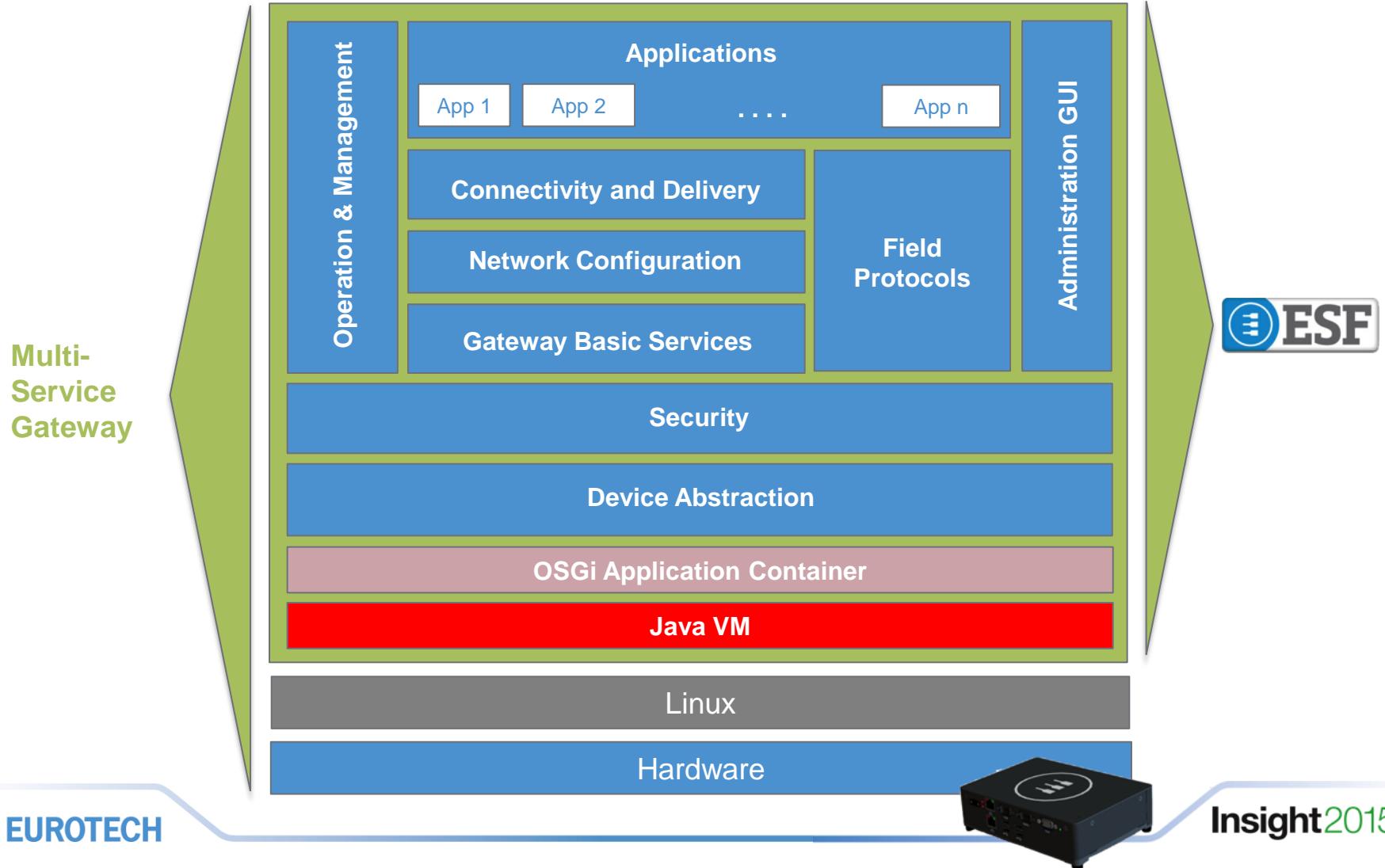
Multi-Service Gateway Approach

Maximum SW Development Flexibility

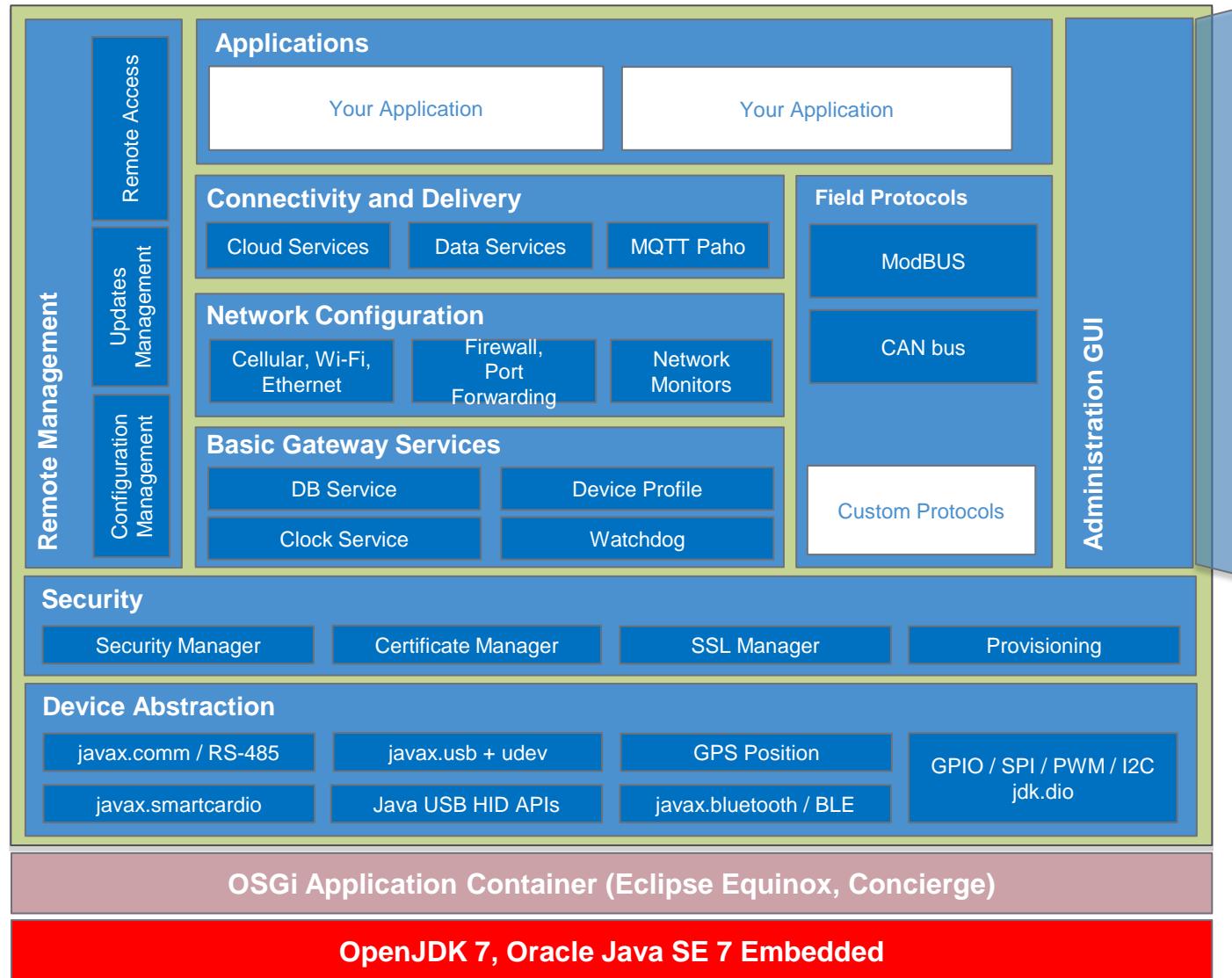


Everyware Software Framework (ESF)

Functional Overview

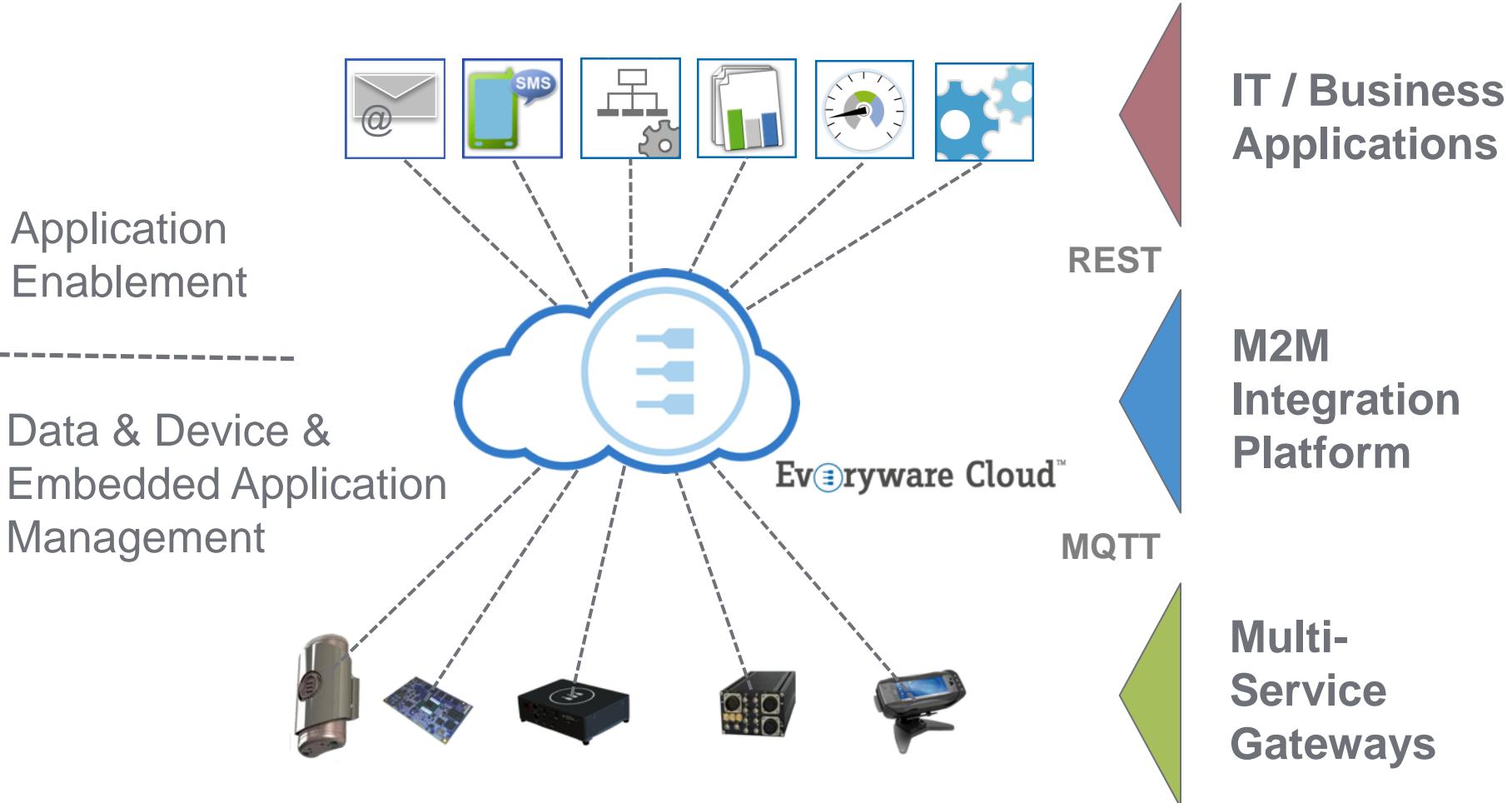


ESF Under the Covers



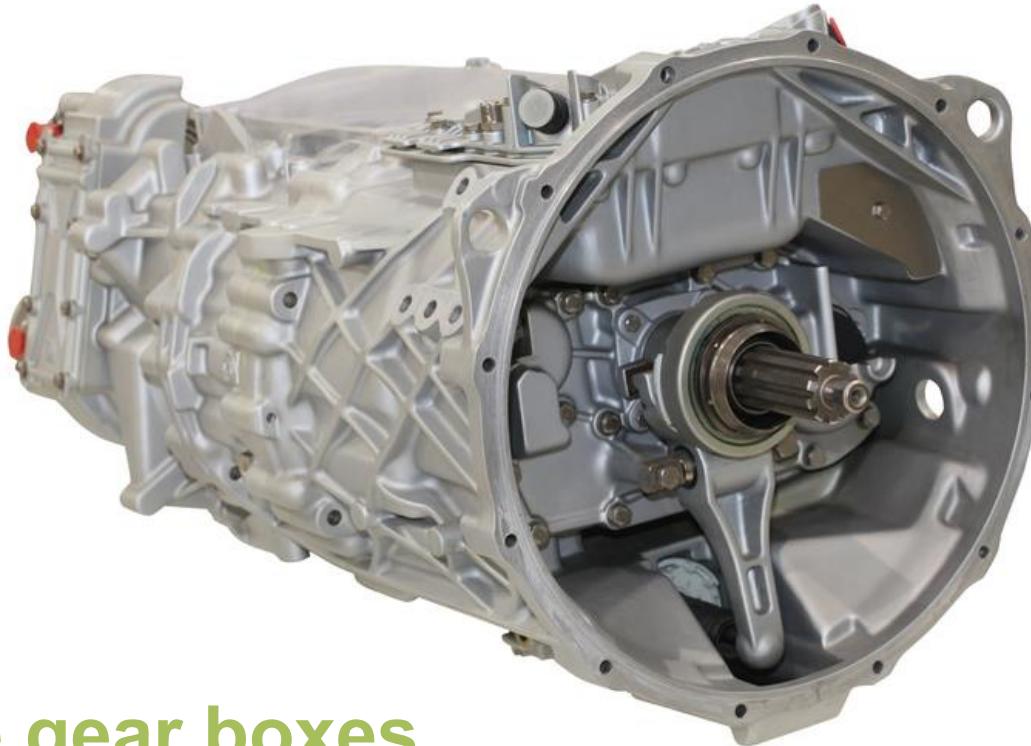
M2M Integration Platform

Positioning the Everyware Cloud Platform



Encapsulating Complexity

... when you need transmission gears,
are you building them from scratch?

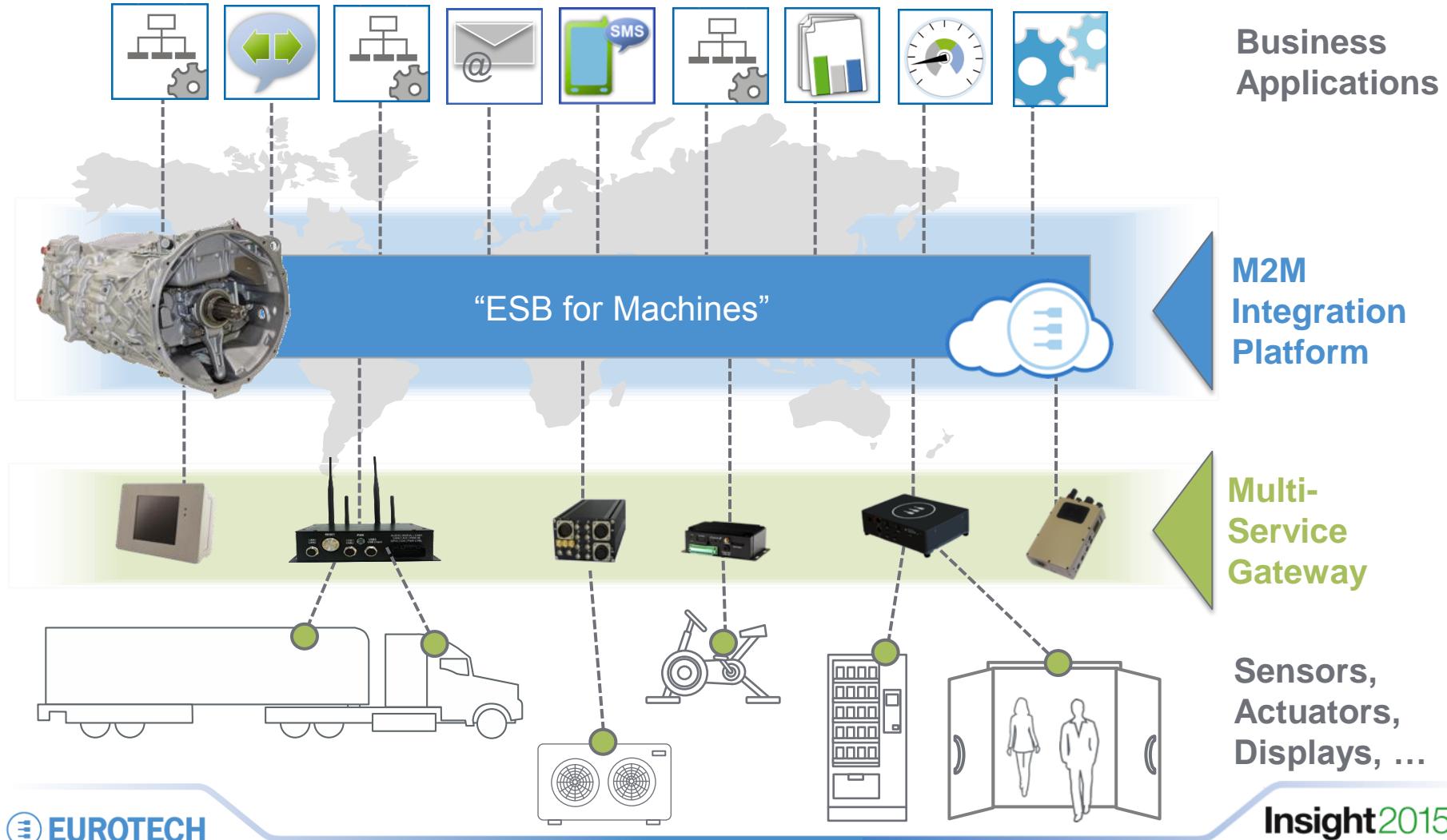


No, you use gear boxes...

Of the shelf products from experienced suppliers !

Encapsulating Complexity

Everyware Cloud = Gearbox for the Internet of Things



M2M Integration Platform

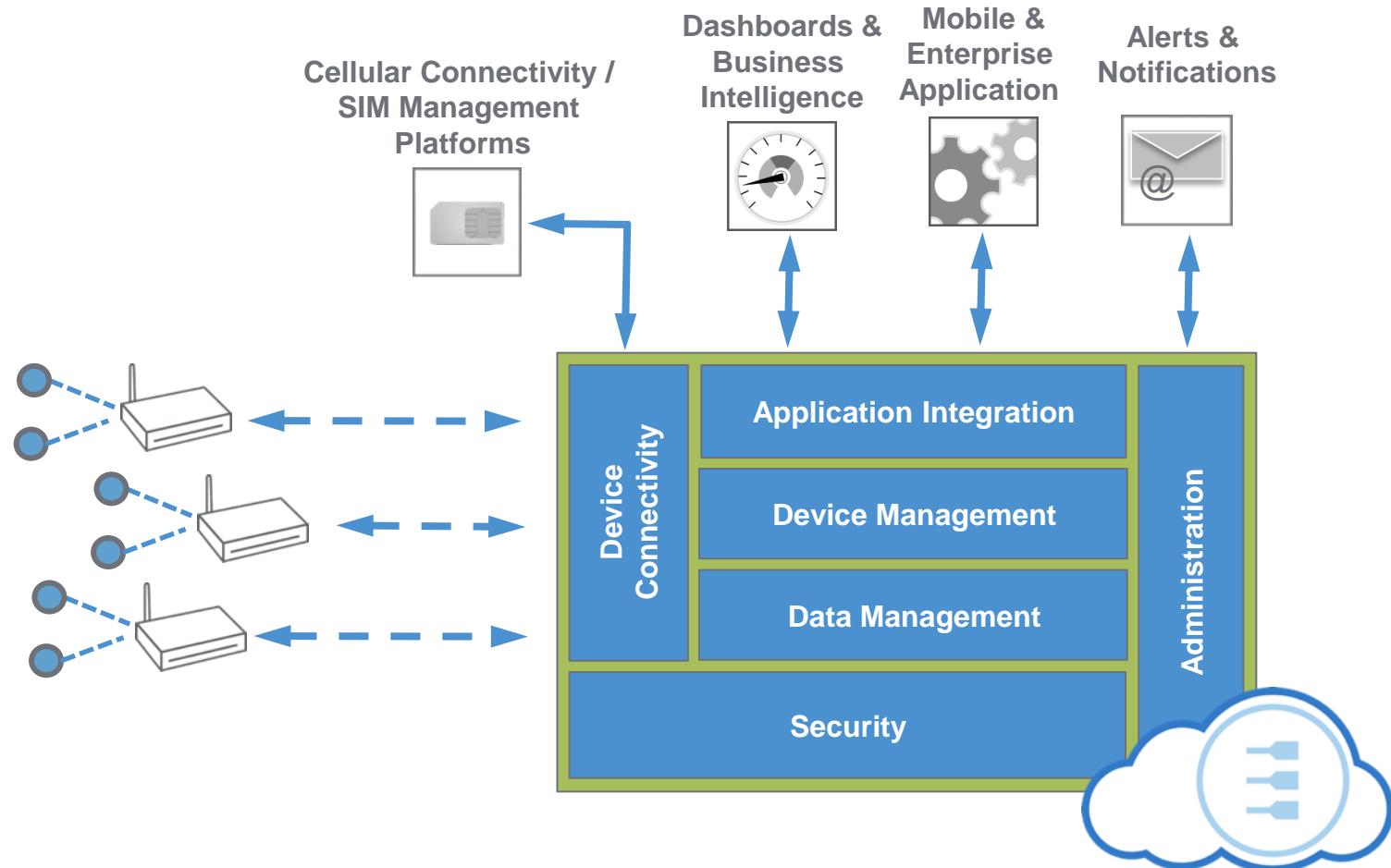
What is Everyware Cloud?



- Everyware Cloud **is about Device Data, about M2M**: It has been built from ground-up to provide an infrastructure that is specialized in optimum device data communication, collection, analysis and management.
- It is an **Integration Platform**: Everyware Cloud is designed to act as an intermediate system between the distributed devices and the applications making use of the data coming from these devices. Any communication certainly is two-way in nature allowing also applications to control and manage the devices when required.
- Everyware Cloud is conceptually like an **Operating System for the Internet of Things** enabling the transfer of device data independent of any other language, platform or OS to and from Enterprise applications

M2M Integration Platform

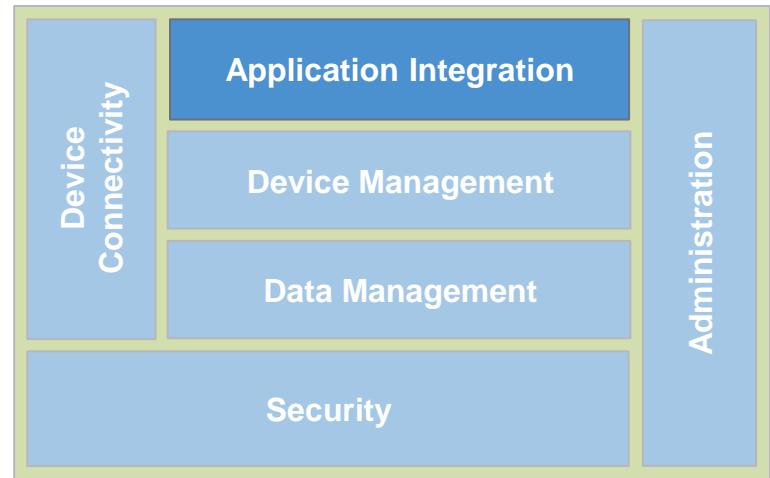
Everyware Cloud Functional Overview



M2M Integration Platform

Application Integration / Integrating with the IT World

- Easy to use REST APIs
- Encompass all platform functionality
- XML and JSON formats
- HTTP/MQTT Bridge for Device Control
- Real-Time REST/Comet APIs
- Real-Time WebSockets
- Google Chart Tools Native Support
- Various data export options / formats
- MQTT
- Extensive Documentation
- Complete sample code
- Rich Example Library

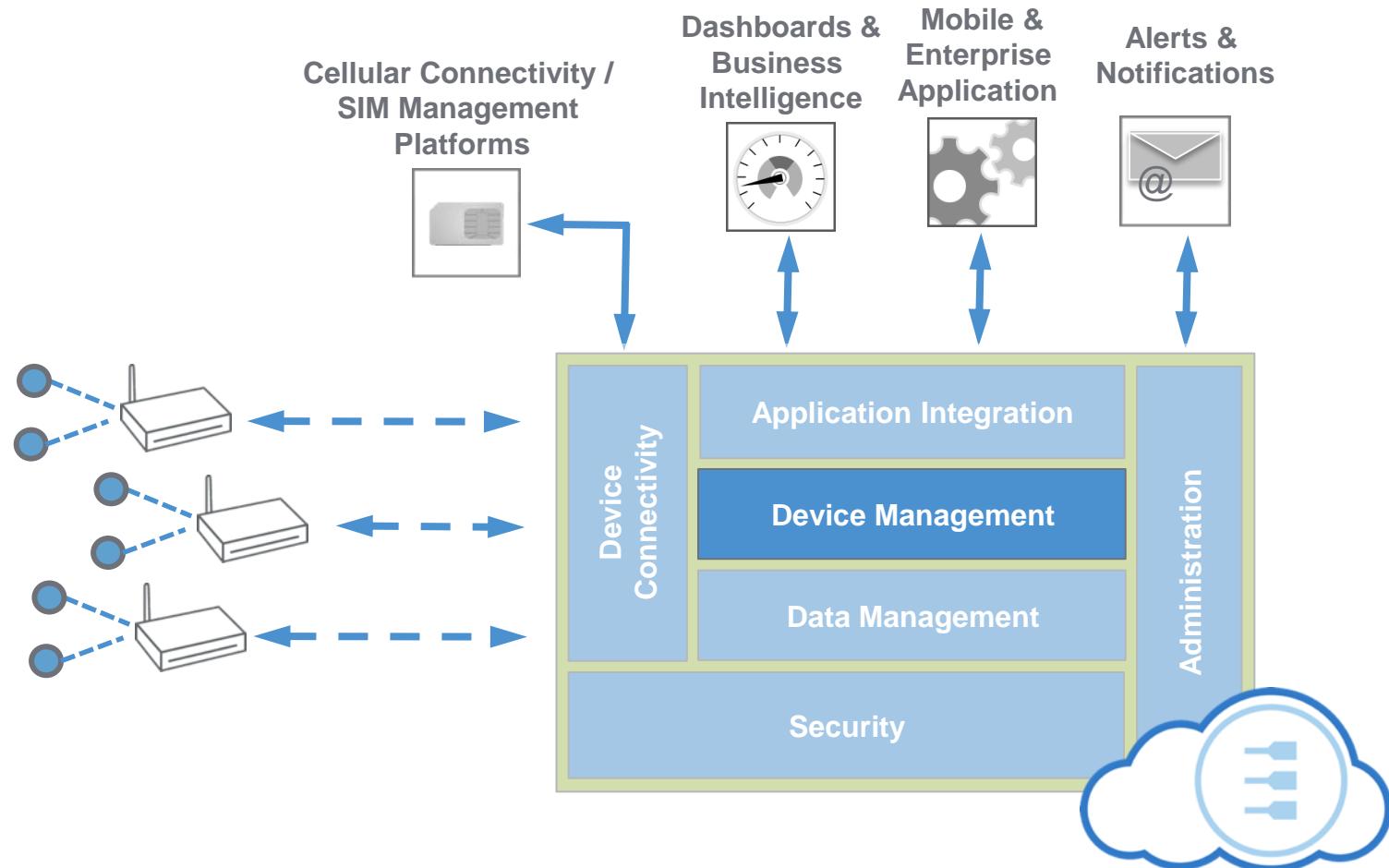


REST API



M2M Integration Platform

Device Operation & Management



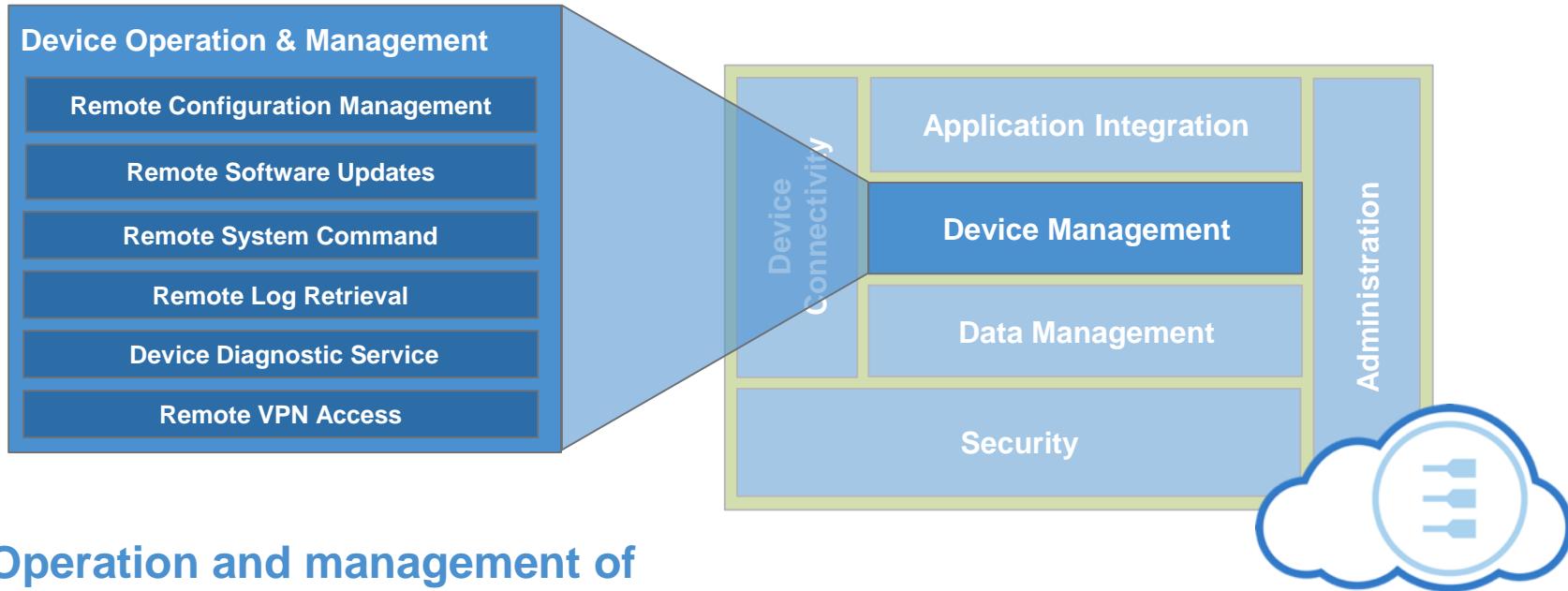
M2M Integration Platform

Device Operation & Management

- The **operation and management** of the distributed devices in the field is **one of the major challenges** and cost factors of M2M / IoT solutions or infrastructures
- It is a **substantial part of the TCO** of an M2M / IoT solution
- The management of configurations and other software components on the remote device needs to be provided in a way easily to be **integrated into** the enterprise **IT**
- The **logging and monitoring** of vital data from the distributed systems for is essential for a secure, healthy and efficient operational infrastructure
- The **life-cycle management of the applications** / business logic on the device is becoming increasingly important where multiple over time changing services have to be provided by the gateway in the field
- Transparent and **secure remote access** for troubleshooting and problem solving

Everyware Cloud Device Management

Overview



- **Operation and management** of the distributed **devices** in the field
- Management of device **configurations** and other software components
- **Logging and monitoring** of vital data from the distributed systems
- **Life-cycle management** of applications / business logic on the device
- Transparent and secure **remote access** to the remote devices

Everyware Cloud Device Management Overview

Everyware Cloud™

Welcome, edcguest. [Logout](#)

Account: edcguest

- Overview
- Devices
- Rules
- Data by Topic
- Data by Asset
- Settings

Devices

Table Map

Refresh Live Export Delete

Status	Client ID	Display Name	Model	Last Report Date	Uptime
●	AAAAAAA	DevEmulator	DevModelName	Today 2:29:07 PM	2692130
●	F0-DE-F1-C4-53-DB	DevEmulator	DevModelName	Today 6:30:03 PM	4176897560

Page 1 of 1

Profile History Configuration Command Packages

Execute: cat /var/log/syslog

```
Jan 16 08:44:06 vespone rsyslogd: [origin software="rsyslogd" swVersion="5.4.6-10+deb7u1"] Jan 16 08:45:01 vespone CRON[28052]: (root) CMD (command -v debian-sa1 Jan 16 08:47:59 vespone anacron[27086]: Job 'cron.daily' terminated Jan 16 08:47:59 vespone anacron[27086]: Normal exit (1 job run) Jan 16 08:55:01 vespone CRON[28156]: (root) CMD (command -v debian-sa1 Jan 16 09:05:01 vespone CRON[28168]: (root) CMD (command -v debian-sa1 Jan 16 09:15:01 vespone CRON[28199]: (root) CMD (command -v debian-sa1 Jan 16 09:17:01 vespone CRON[28202]: (root) CMD (cd / && run-parts --ref Jan 16 09:25:01 vespone CRON[28283]: (root) CMD (command -v debian-sa1 Jan 16 09:35:01 vespone CRON[28327]: (root) CMD (command -v debian-sa1 Jan 16 09:45:01 vespone CRON[28341]: (root) CMD (command -v debian-sa1 Jan 16 10:53:01 vespone CRON[28364]: (root) CMD (command -v debian-sa1 Jan 16 10:55:01 vespone CRON[28364]: (root) CMD (command -v debian-sa1 Jan 16 10:57:01 vespone CRON[28449]: (root) CMD (command -v debian-sa1 Jan 16 10:57:01 vespone CRON[28455]: (root) CMD (cd / && run-parts --ref Jan 16 10:57:01 vespone CRON[28500]: (root) CMD (command -v debian-sa1 Jan 16 10:35:01 vespone CRON[28601]: (root) CMD (command -v debian-sa1 Jan 16 10:45:01 vespone CRON[28696]: (root) CMD (command -v debian-sa1 Jan 16 10:55:01 vespone CRON[28960]: (root) CMD (command -v debian-sa1 Jan 16 11:05:01 vespone CRON[29174]: (root) CMD (command -v debian-sa1 Jan 16 11:11:23 vespone dhclient: DHCPREQUEST of 192.168.3.171 on wlan0 Jan 16 11:11:23 vespone dhclient: bound to 192.168.3.171 -- renewal in 1037 Jan 16 11:11:23 vespone NetworkManager[945]: <info> (wlan0): DHCPv4 sta Jan 16 11:11:23 vespone NetworkManager[945]: <info> address 192.168.3.171
```

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Everyware Cloud™

Welcome, edcguest. [Logout](#)

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- Overview
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Table Map

Refresh Live Export Delete

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●	F0-DE-F1-C4-53-DB	DevEmulator	DevModelName	Today 6:30:03 PM	4176897560
●	edcguest-device-client	MultiBrokerIT	MultiBrokerIT	Today 11:02:51 AM	18046

Page 1 of 1

Profile History Configuration Command Packages

WatchdogService

CloudService

The CloudService manages the connection with the Everyware Cloud Platform. Its configuration parameters are used to determine the MQTT broker and the credentials to be used to connect to the platform. Upon a configuration change, the current connection will be closed and reopened with the new configuration.

* mqtt.account:	edcguest
Name of the Everyware Cloud account.	
* mqtt.broker-url:	mqtt://broker-stage.everyware-cloud.com:1883/
URL of the mqtt broker to connect to, for example, mqtt://broker-sandbox.everyware-cloud.com:1883/ or mqtt://broker-sandbox.everyware-cloud.com:8883/.	
* mqtt.username:	edcguest_broker
Name of the user within your account to connect as.	
* mqtt.password:	*****
Password of the user within your account to connect as.	
mqtt.client-id:	
Device identifier. The identifier has to be unique within your account. If left empty, this is automatically determined by the client software as the MAC address of the main network interface.	

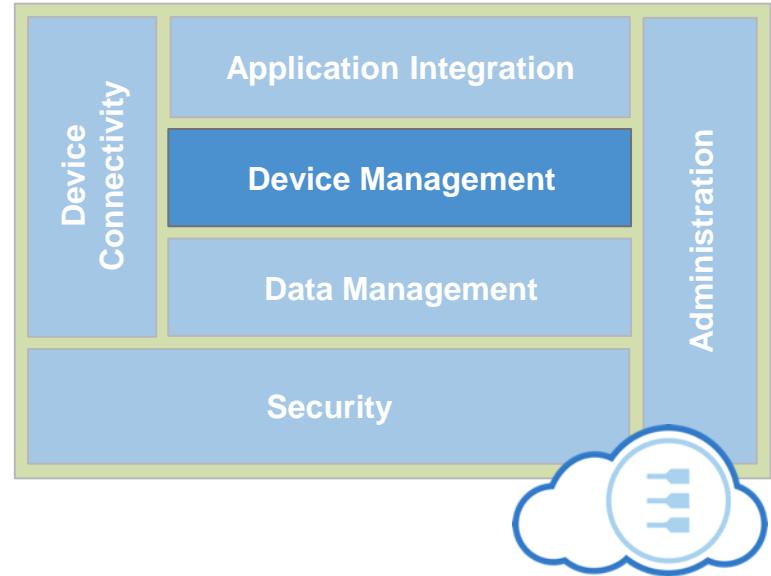
Components Snapshots

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Everyware Cloud Device Management

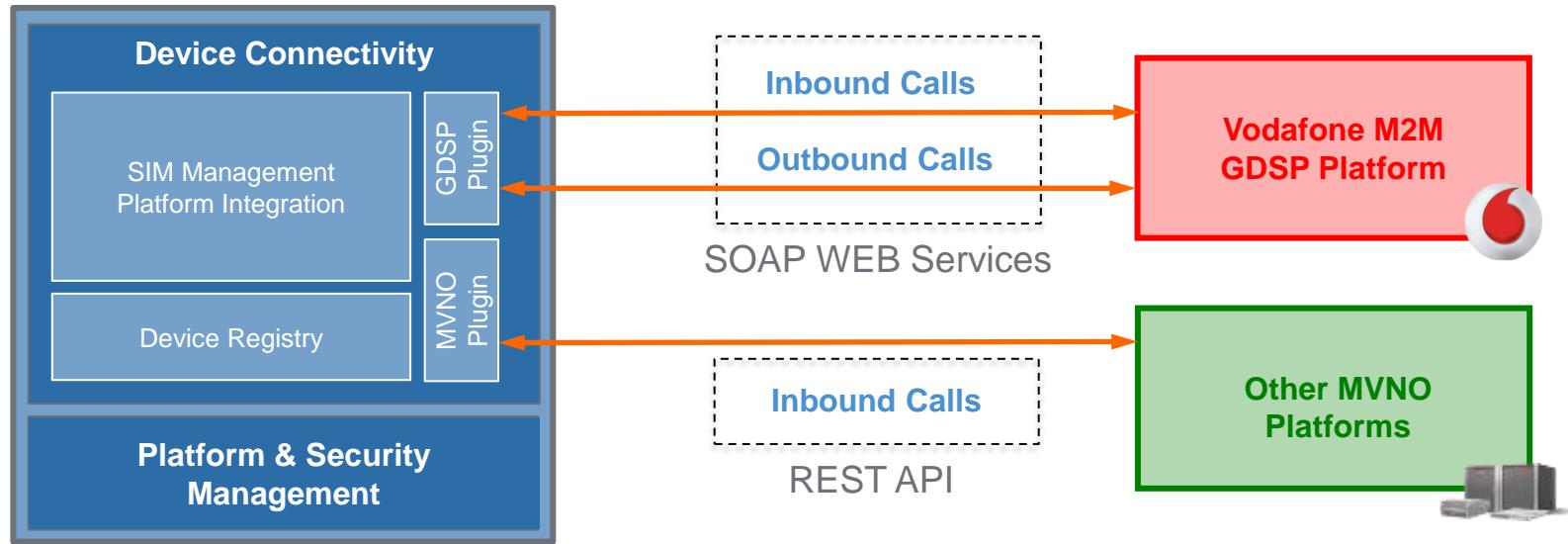
Software / Embedded Application Management

- **Device Provisioning**
 - Provisioning of Device Configuration with Account Affiliation
- **Embedded Application / Bundle Management**
 - Bundle Start/Stop
 - Incremental Software Updates
- **Service Configuration Management**
 - Configuration Updates
 - Management of Snapshots and Rollbacks
- **Remote Management**
 - Remote Command Executions, VPN
 - System Monitoring and Diagnostics for CPU, MEM, ...
- **Device Batch Operations**
 - Scheduled Device Management Operations on Single/Group Devices
 - On-reconnect Device Management Operations



Everyware Cloud Connectivity Management

Managing SIMs & Cellular Communication Infrastructure



Connectivity Management:

- Device Registry maintains association between Gateway Device and its SIM (ICCID, IMSI)
- Manage SIM Groups
- Automatic SIM Status Synchronization

Inbound Calls:

- Send SMS
- Send Wakeup SMS
- SIM Session Status
- Localization

Outbound Calls:

- SMS delivery for Transport fallback
- Notify Session Events
- Updated SIM data

Everyware Cloud Security

Overview (Subset, Examples) EC 4.0

Device to Cloud to Application Security Architecture

- X.509 Certificate based authentication
- Integrated PKI / Certificate management

Security “in the Cloud” (IoT / OT Platform)

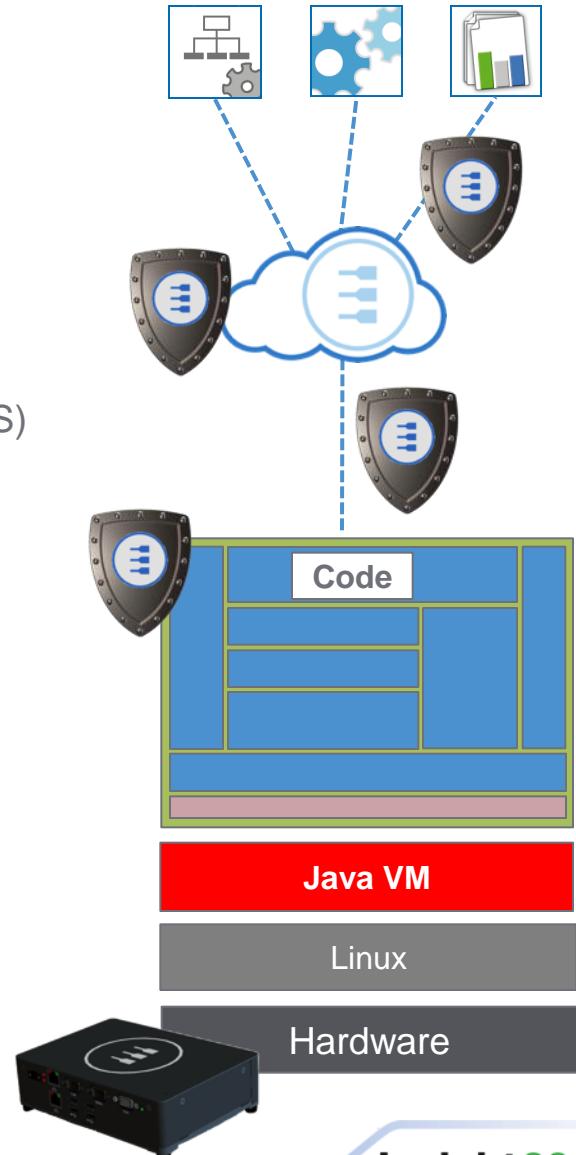
- Allowed traffic is secure and authenticated
- Application / Interface servers: no ports open other than 443 (HTTPS)
- Secure cloud infrastructure
- Signed Code / secure execution environment

Securing Device to Cloud (Communication Security)

- Allowed traffic is secure and authenticated
- Broker / infrastructure / perimeter defense
 - Firewalling
 - All in-bound ports other than Broker ports are closed
- Everyware VPN service

Securing the Device

- Firewall
- OSGi / Signed Code / secure execution environment
- Secure Boot



M2M Integration Platform

System Infrastructure Options

Application Service Layer

SaaS

Application Infrastructure Service Layer

PaaS

System Infrastructure Service Layer

IaaS

M2M Integration Platform



System Infrastructure
(Servers, Storage, Networking, OS)



On-Premises 19" 1U Appliance

Everyware Server

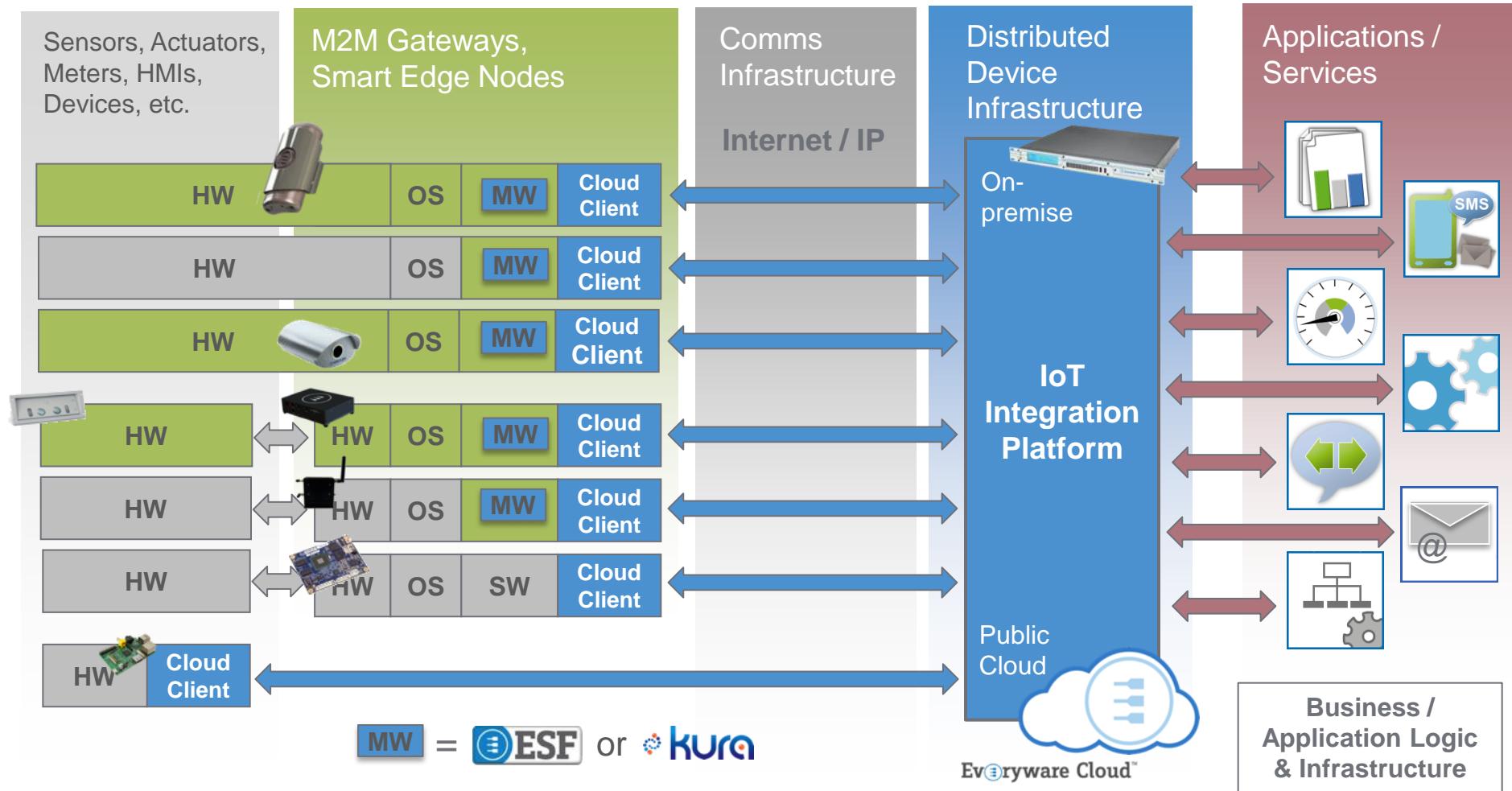
System Infrastructure Services (IaaS)



Everyware Cloud

M2M Integration Platform

Typical Edge-Node, Gateway, Smart Sensor Scenarios



Processing Power & Informix at the Edge of the OT Infrastructure

The Role of Databases in Smart Edge
Devices and the Features that make
Informix a Perfect Choice.

Robert Andres

Computational Power at the Edge

Advantages of Processing and a Database at the Edge

- Database related operations at the edge are:
 - Sorting
 - Aggregation
 - Duplicate elimination, data cleansing
 - Local storing of data
 - Data delivery at specific times
 - Statistical calculations
 - Analytics
 - Responses to events in real-time
- **Some things** that can be done in the cloud **can be better done at the edge**, only the scale is different

Informix Embed at the Edge

Advantages of having a Database at the Edge



Informix database software incorporates design concepts that are uniquely suited to the challenges in today's embedded device's:

- Extremely **high levels of performance** and enterprise reliability
- Distinctive **capabilities in data replication** and scalability
- **No administrative overhead**
- **Easily embedded** in a device
- Install **footprint** and memory required as low as 64 MB
- Hands-free administration
- Built-in support for **time series and spatial/GIS data**
- **Analytics** built into the database
- Supports **JSON/BSON and SQL** apps simultaneously in the same database
- **Scales-out** across multiple devices

Informix Embed at the Edge

Advantages of having a Database at the Edge



- Informix is **proven technology** as an embedded database. Providing a **small footprint** with a **fully featured** enterprise database server.
- **Built in autonomics** with self healing, self configuration and automation with the DB scheduler.
 - Automated space provisioning
 - Automated Memory Management
 - Dynamically tuned Engine parameters
- Embedding Informix in consolidation devices on the edge of the network of IoT allows for:
 - Complex store and forward capabilities with transformation and aggregation
 - Informix times series data approach reduces local resource constraints and improves performance in applications like smart metering
 - Business decisions made on the edge, closer to the producer of the data

Informix at the Edge

IBM Informix Strengths for Time Series and Geospatial Data



- In traditional time series table approach each row contains one record which results in billions of rows in the table.
 - All data is indexed for efficient lookups
 - Data is appended to the end of the table as it arrives
 - Meter ID's are stored in every record

Meter_ID	Time	KWH	Voltage		CoIN
1	1-1-11 12:00	Value 1	Value 2	Value N
2	1-1-11 12:00	Value 1	Value 2	Value N
3	1-1-11 12:00	Value 1	Value 2	Value N
...
1	1-1-11 12:15	Value 1	Value 2	Value N
2	1-1-11 12:15	Value 1	Value 2	Value N
3	1-1-11 12:15	Value 1	Value 2	Value N
...

Informix at the Edge



IBM Informix Strengths for Time Series and Geospatial Data

- In the Informix time series data approach each row contains all the data for a single meter, data append to end of the row
 - Data is not indexed, only the meter ID column is indexed
 - Data on disk is clustered by meter id and kept ordered by time
 - Meter IDs stored once rather than with every record
 - Timestamps are not stored on disk, but are calculated by position in series
 - Missing intervals are marked with a placeholder

Meter_ID	Series
1	[(1-1-11 12:00, value 1, value 2,..., value N), (1-1-11 12:15, value 1, value 2, ..., value N), ...]
2	[(1-1-11 12:00, value 1, value 2,..., value N), (1-1-11 12:15, value 1, value 2, ..., value N), ...]
3	[(1-1-11 12:00, value 1, value 2,..., value N), (1-1-11 12:15, value 1, value 2, ..., value N), ...]
4	[(1-1-11 12:00, value 1, value 2,..., value N), (1-1-11 12:15, value 1, value 2, ..., value N), ...]
...	...

Informix times series data approach reduces local resource constraints and **improves performance** in applications like **smart metering**

Performance Benchmark

SQLite and Informix Embed on Intel Quark

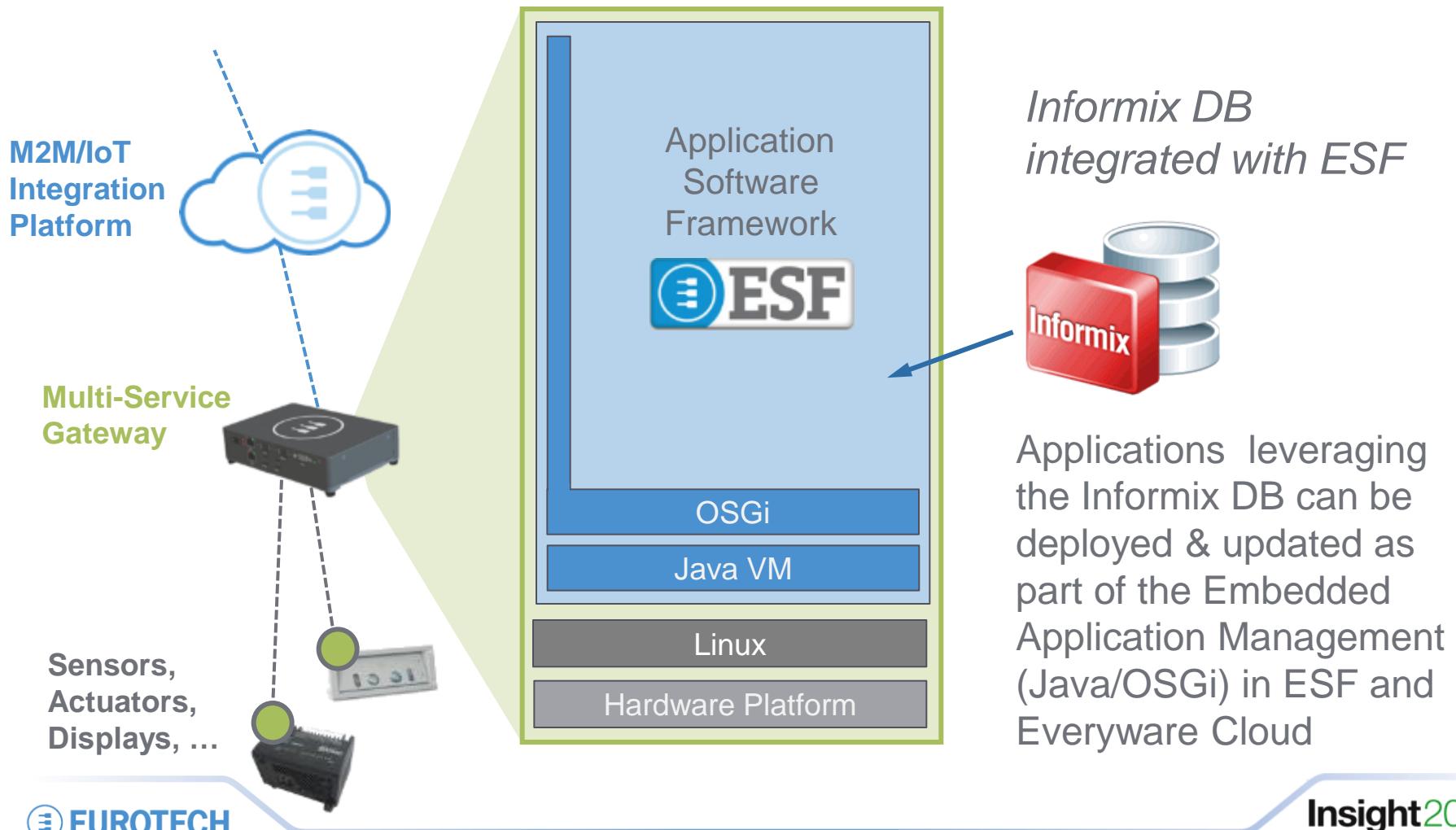


A performance benchmark performed by IBM on Intel reference hardware showed the following results:

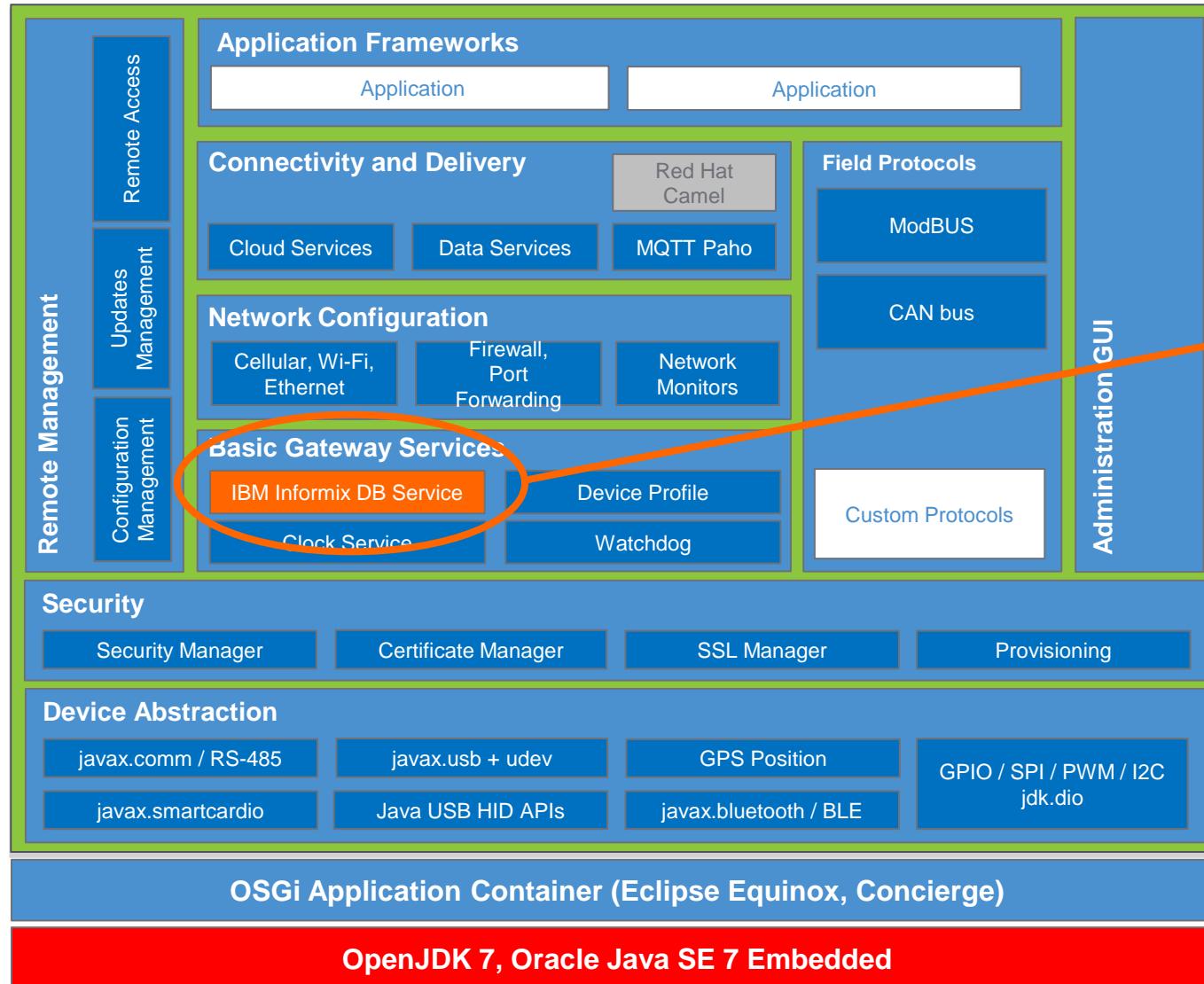
Test cases	Informix	SQLite
Data loading – high-speed performance (records per second)	950 / 1050 (DK100 / DK50)¹	700 (Average) ²
Storage space that is required for 1 day of data	275 MB	1200 MB
Aggregation query (seconds)	2 secs	4-25 secs
Moving average (seconds)	25 secs	259200 ³ secs
Missing interval search (seconds)	2 secs	14-30 secs

1. The two figures for data loading with Informix reflect a slight difference in performance between the DK100 and DK50. DK100 had more running components causing a drop in performance vs DK50
1. Data loading with SQLite had significant variations in load performance as the database size increased.
2. The moving average result for SQLite is a projected figure that is based on a partial result after 10 minutes.

Multi-Service Gateway Approach w. IBM SKU with Informix as the Central Database in ESF



Multi-Service Gateway Approach w. IBM



SKU with Informix as the Central Database in ESF

Integrating into the IBM Enterprise IT World

**Brief Overview, Combining the IBM
Enterprise IT World with OT-centric
Capabilities of Eurotech**

Robert Andres

Informix at the Backend / Cloud

Backend / Cloud Requirements



- The **volume of data** that must be stored can be **a real challenge**:
 - Companies are already planning to store data for billions of devices
 - No single server is large enough
 - Millions of records must be stored each second
 - Data can be coming from 1000's of different locations
- Data from a **variety of device types** must be stored and analyzed
 - Different devices types generate different kinds of data – time series, spatial, text which makes analytics difficult
- **Sensitive data** must be **protected**
 - There may be medical, automotive, personal electronics, etc... all stored in the same cloud

Informix at the Backend / Cloud

Why use a database in the IoT backend?



- Databases like Informix are well suited to **managing the huge volumes of data from devices**
- Customers want to be able to browse and analyze their data
 - 1000's of concurrent users
 - Reports need to be run on the device data
 - Billing, dashboards, trend analysis, aggregation, duplicate elimination, data cleansing, correlation, prediction, etc...
- Archiving for **compliance and auditing**
- Enhances security via **multi-tenancy**
- **High availability** and transparent failover required
- Numerous **well known APIs** for application development

Informix at the Backend / Cloud

Why Informix?



Informix database software incorporates design concepts that are suited to challenges in IoT, resulting in extremely high levels of performance and availability, distinctive capabilities in data replication and scalability, and no administrative overhead.

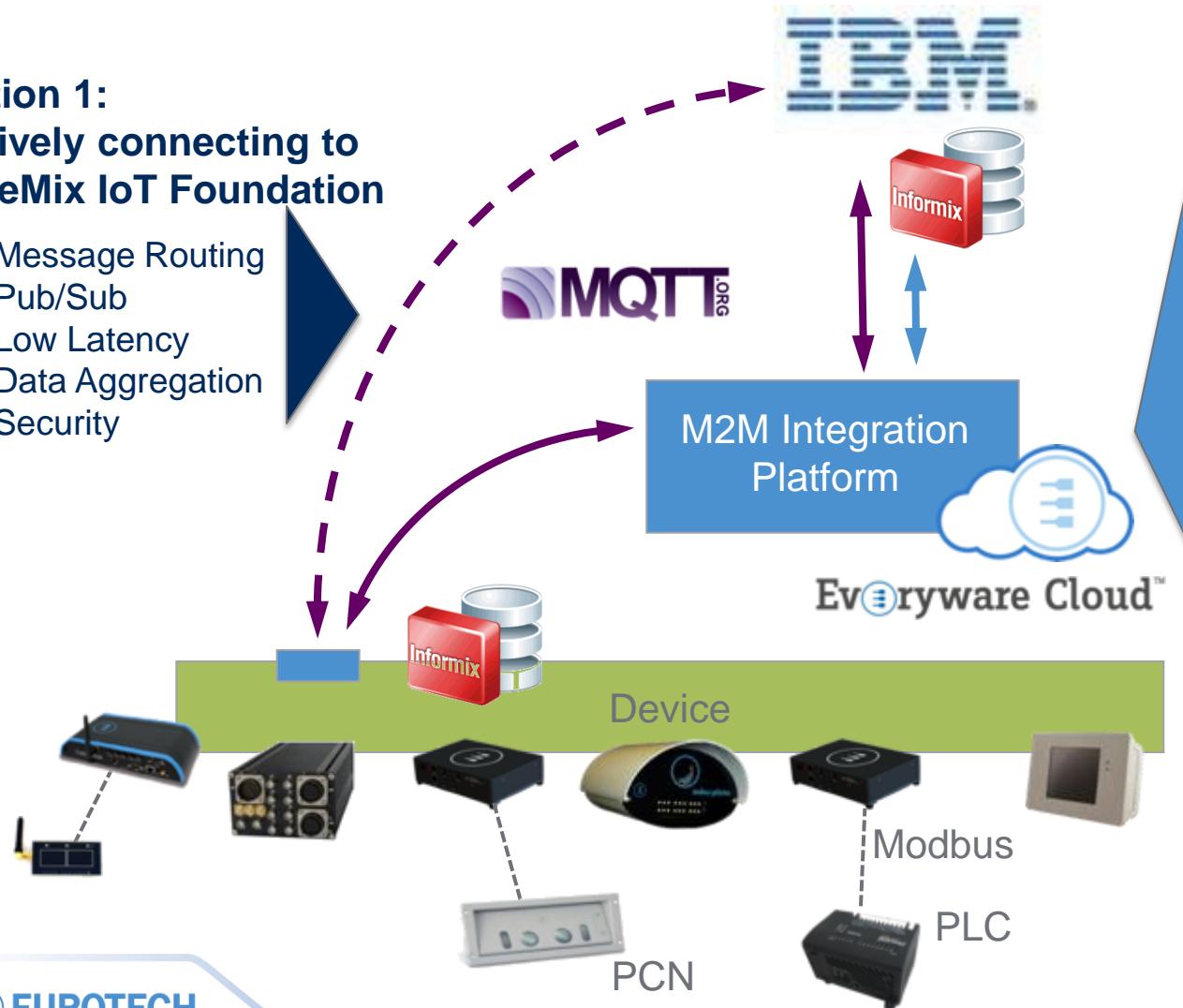
- **Integrates with IBM products** such as MessageSight, Infosphere Streams
- Runs in the cloud on Softlayer or Bluemix etc.
- **Hands-free** administration
- Specialized **high performance** support for **time series and spatial/GIS data**
 - Continuously load millions of records per second
 - Analytics orders of magnitude faster than other databases
- Supports **JSON/BSON and SQL apps simultaneously**
- Scales-out across multiple servers

IT/OT Integration

IBM / Eurotech Integration / MQTT

Option 1: Natively connecting to BlueMix IoT Foundation

- Message Routing
- Pub/Sub
- Low Latency
- Data Aggregation
- Security



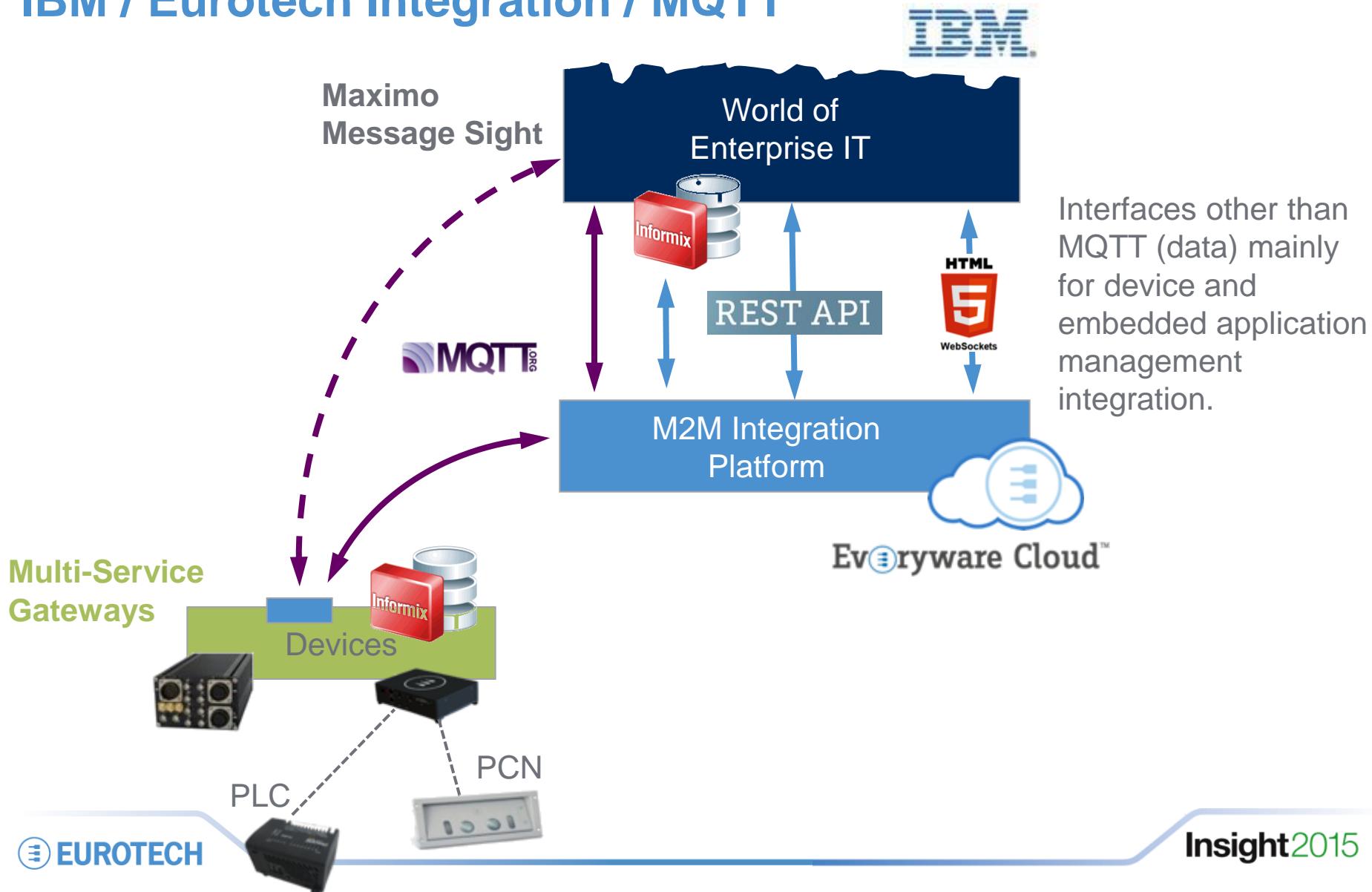
Option 2: Leveraging Everyware Cloud

- Device Registry
- Device Management
- Device SW Lifecycle Management
- Device Provisioning
- Device Remote Access
- Device Security
- Device Monitoring
- Device Connectivity
- Integration with SIM Management Platforms (Vodafone, Jasper, Arkessa)

Multi-Service Gateways

IT/OT Integration

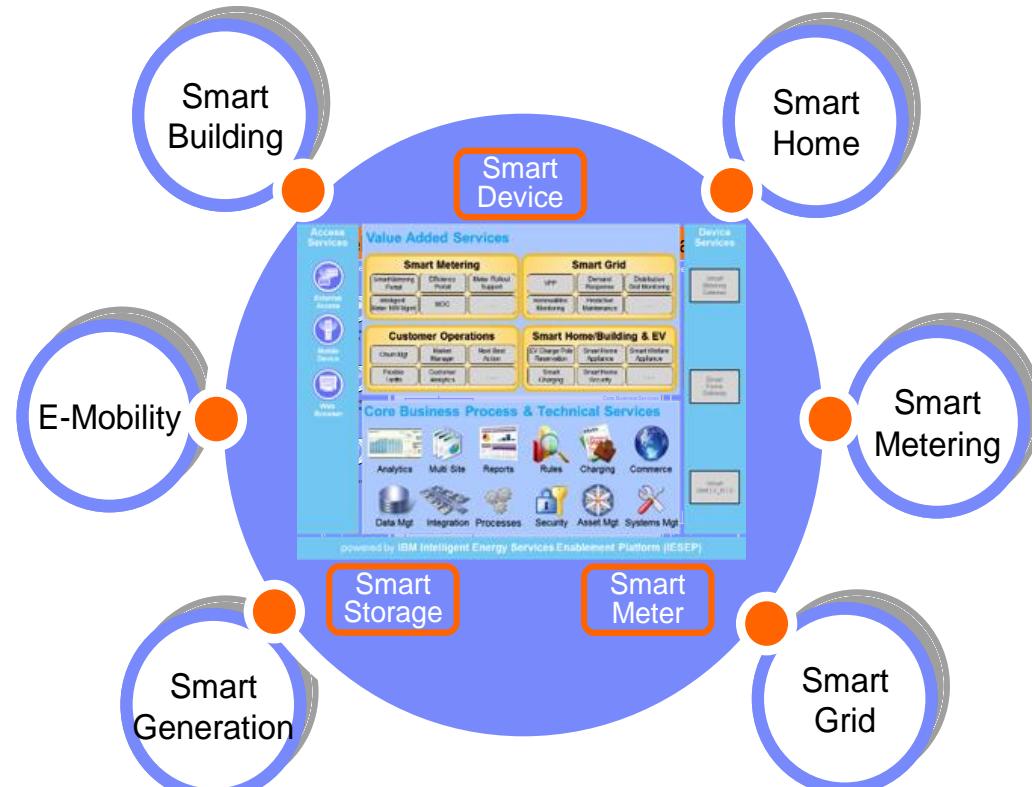
IBM / Eurotech Integration / MQTT



IT/OT Integration

IBM / Eurotech Integration / Example IESEP

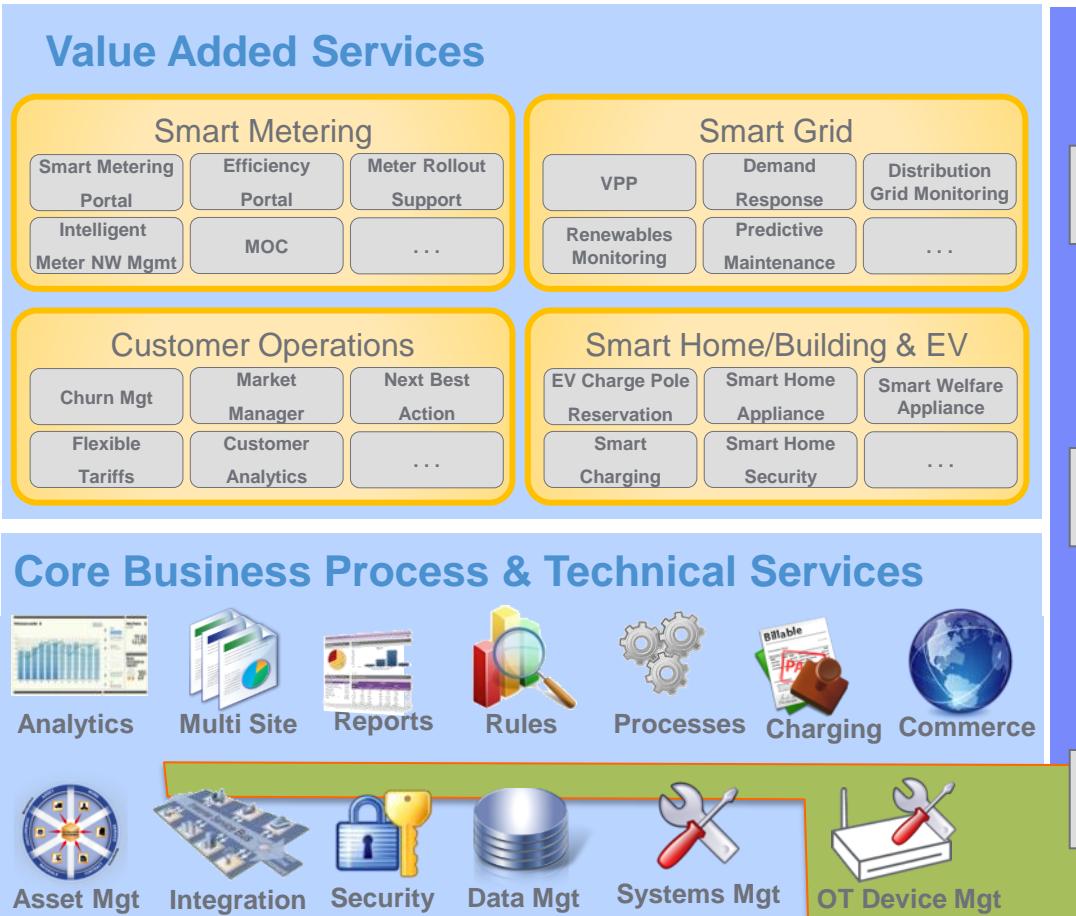
A platform in the backend, such as the **Intelligent Energy Services Enablement Platform (IESEP)**, needs to be equipped with capabilities to deploy and manage the IoT Services.



A Java/OSGi based OT architecture and infrastructure, such as the combination of **Eurotechs Everyware Software Framework** for software defined IoT devices **with Everyware Cloud**, is an essential core service to deploy and manage the IoT service elements in the field.

IT/OT Integration

IESEP, and how Eurotech can add Value



powered by IBM Intelligent Energy Services Enablement Platform (IESEP)



Eurotech IoT Offering:

Integrated, modular M2M / OT / IoT Building Blocks

- M2M/OT Hardware
- Device Middleware
- IoT / M2M Integration Platform

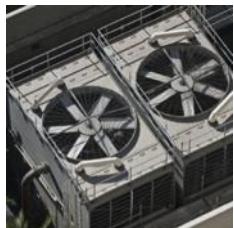
Use Cases

Examples for
M2M/IoT Projects and Design Wins

Robert Andres

The Internet of Things

Many Customers & Applications



Vertical Market Example Use Case

Use Case: Wind Turbine Monitoring

Application:

The customer monitors and services wind turbines globally, mainly on coasts.

The design required cellular capable devices with Zigbee interfaces to minimize cost and group the service across aggregators.



Product:

ReliaGATE 50-21



HW / SW
Development
Services

Key Success Factors:

- ➊ Global product
- ➋ Zigbee support
- ➌ Eurotech software knowledge and experience
- ➍ Flexible HW platform
- ➎ Cloud device management

Vertical Market Example Use Case

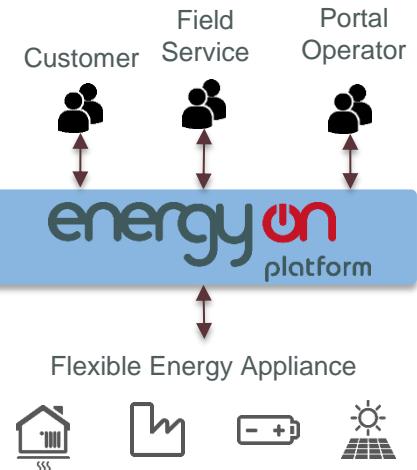
Use Case: Preventive Maintenance and Virtual Power Plant

Application:

The EnergyON platform provides a data and process hub for energy-related services and operative asset management.

Core element of the end-to-end solution is the bi-directional communication to all kind of sensors and actuators for active remote monitoring and control of various systems in a building.

The solution enables energy suppliers as well facility service providers to offer value-added services around buildings.



Product:

ReliaGATE 50-21



SW
Development
Services

Key Success Factors:

- ➊ Pay-per-use business model
- ➋ Comprehensive tool for service and asset management
- ➌ Maintenance cost reduction
- ➍ Increase availability and reliability for customers
- ➎ Improve quality assurance of existing SLA
- ➏ Readiness for virtual power plant

Vertical Market Example Use Case

Use Case: Boilers & Heaters

Application:

The customer a leading company in the global market for heaters and boilers required an IoT solution that would allow them to develop and offer new services. One goal is for end users to remote control their own thermo-devices but also for technical assistance operators to perform remote diagnostics. In addition valuable data for the R&D, service, marketing departments of the Customer to develop & sell new products and services.



Product:

3rd Party HW



SW
Development
Services

Key Success Factors:

- ⌚ Service-oriented business model
- ⌚ Open and industry standards based solution
- ⌚ ESF hardware abstraction, Java/OSGi
- ⌚ Remote device & embedded applic. management
- ⌚ Real time data
- ⌚ M2M / IoT know how in Eurotech
- ⌚ Eurotech worldwide footprint

Vertical Market Example Use Case

Use Case: Public transport power stations protection

Application:

The stack 104 is used in power distribution substations in railways application for protection purposes

The stack 104 monitors current and voltage of the substation and controls the circuit breaker

The customer (SECHERON – Switzerland) has chosen the Stack 104 from Eurotech for its high level of modularity.



Product:

STACK 104



Key Success Factors:

- ④ Modularity
- ④ Rugged design
- ④ Long life product
- ④ Local Eurotech support

Vertical Market Example Use Case

Use Case: Retail Energy & Asset Management

Application:

The customer required a programmable Intel cellular platform for monitoring of refrigeration units at grocery stores for energy and asset management application.



Product:

ReliaGATE 50-21



Key Success Factors:

- ESF
- Started with Helios... software portability
- Eurotech software knowledge and experience
- Flexible hardware platform
- Looking into EDC for long term storage

Vertical Market Example Use Case

Use Case: Environmental Monitoring

Application:

Several cities were looking for a solution that would allow them to do effective constant environmental monitoring as part of their civil protection and environmental protection plans and services. The main data monitored in real time: temperature, humidity, CO, CO₂, NO₂, NO, O₃, SO₂, H₂S, VOC, electromagnetic emissions and nuclear radiation (α , β , γ).

Data is transferred via different transports (including 3G, WiFi) using Internet connections in real time to control centers and different applications. Alarms and measurements can be made accessible to the population through Web and mobile applications.



Product:

Smart Environmental Sensor



Key Factors:

- Short time to market due to EDC approach
- Turnkey complete solution including dashboards, alarms
- Compact, rugged enclosure
- Very good price / performance

Vertical Market Example Use Case

Use Case: Industrial Air Conditioning System Monitoring

Application:

The customer, a leading manufacturer of industrial grade air conditioning (chiller) systems was looking for a solution that would allow them to monitor constantly the status of deployed Air Conditioning Chillers world wide. The main data monitored in real time: pressure, temperature, power consumption, efficiency

Data should be transferred via different transports (including 3G, Ethernet, WiFi) using Internet connections in real time to operations (and R&D).



Product:

ReliaGATE 50-21



Key Factors:

- 🕒 Short time to market due to EDC approach
- 🕒 Modbus / PLC support in ESF
- 🕒 Flexible powerful hardware platform

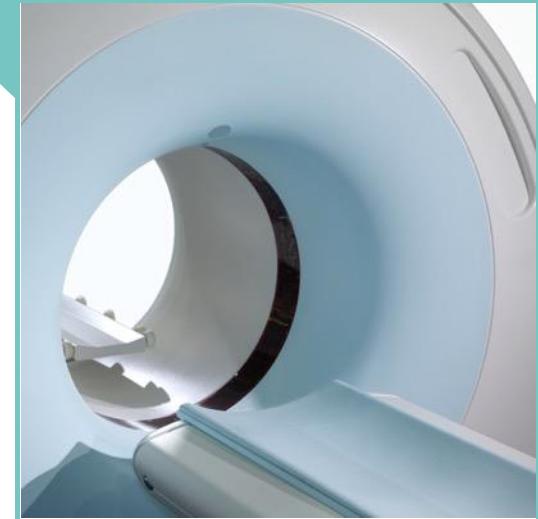
Medical & Healthcare Applications

Use Case: Remote Device Monitoring & Management

Application:

The customer manufactures sophisticated medical equipment that is deployed internationally in hospitals and clinics. Typical deployment situations make it difficult to do remote monitoring and maintenance because of the security requirements on the customer side.

With Eurotech's M2M/IoT building blocks a solution is implemented that overcomes the typical security and network issues and enables besides management access, applications for data collection and analytics. One example is preventive / predictive maintenance for the distributed medical devices.



Product:

ReliaGATE 10-20 &
ReliaCELL



**HW / SW
Development
Services**

Key Success Factors:

- ➊ Flexible HW platform
- ➋ Wired, wireless and cellular connectivity
- ➌ Internationally deployable (ReliaCELL) solution
- ➍ Everyware Software Framework on the Multi-Service Gateway simplifies app development on the device
- ➎ Everyware Cloud as Integration Platform for Data and Device Management including Everyware VPN
- ➏ Eurotech M2M/IoT knowledge and experience

Vertical Market Example Use Case

Use Case: Transportation / Train

Application:

Washington Metropolitan Area Transit Authority was looking for a maintenance wear leveling asset management solution for their public transit infrastructure.

The application required a rugged on board computer to capture wheel revolutions per vehicle and to connect wirelessly to an IBM asset management system. When the wheels have a certain amount of wear, WMATA will perform preventive maintenance to improve safety for their passengers.



Product:

DynaCOR 10-00



**HW / SW
Development
Services**

Key Success Factors:

- ➊ Rugged design and rail rated
- ➋ Eurotech proven rail experience
- ➌ IBM partnership
- ➍ Pulse counter input
- ➎ Wireless capabilities
- ➏ Networking capabilities

M2M / IoT Applications

Use Case: Connected Fitness Equipment

Application:

The customers run a chain of fitness clubs/ centers and were looking for ways to provide more value for their customers and to get more efficient in operating the infrastructure and equipment. The goal was to integrate data from the fitness equipment not only for preventive maintenance (repair proactively, less down-time, improve customer satisfaction) but also to collect data that allows to offer new individual services to the customers (personal fitness data) and to analyze usage rates (compare to other locations within a club or in different facilities, add equipment where demand is high).



Product:

ReliaGATE 50-21



HW / SW
Development
Services

Key Success Factors:

- ➊ Flexible HW platform
- ➋ Wired and wireless connectivity
- ➌ CSAFE protocol between equipment and Gateway
- ➍ Everyware Software Framework on the Multi-Service Gateway simplifies app development on the device
- ➎ Eurotech software knowledge and experience

Vertical Market Example Use Case

Use Case: Vending Machine

Application:

A vending machine vendor was looking for a reliable communication system (M2M Gateway) capable of collecting vital data from the vending machines and to transfer securely that data into business intelligence applications with the goal to optimize maintenance and operations.

The Eurotech offering allowed the maintenance team to implement preventive maintenance procedures, improving the availability of the vending machines. The remote management capabilities of the overall solution (including Everyware Cloud) ensure flexible extension and updating of the distributed systems in the field.



Products:

ReliaGATE 10-10



**HW / SW
Development
Services
Support**

Key Success Factors:

- ➊ Short time to market for the system
- ➋ Everyware Cloud near real time data collection and aggregation
- ➌ Everyware Cloud and ESF remote management features
- ➍ Reduced risk (total implementation)
- ➎ Reduced Time-to-Market
- ➏ Robust, small footprint M2M gateway with all required I/O

Conclusions, Summary

One Page, Speed Dating Slide

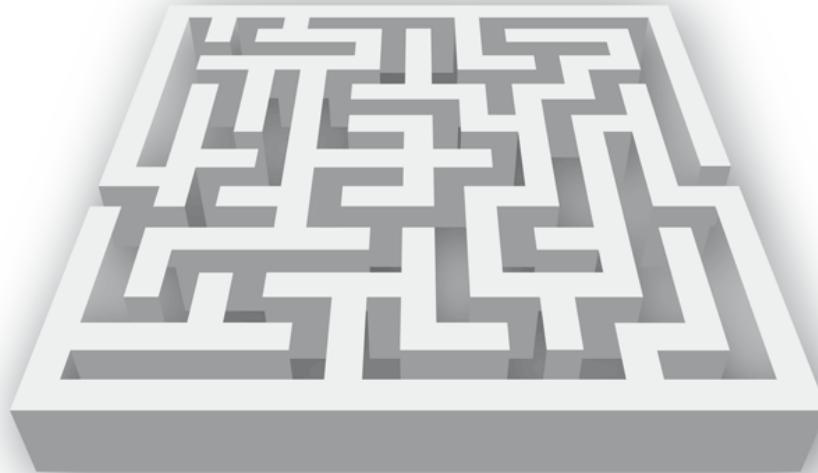
Robert Andres

Computational Power at the Edge

Conclusions, Summary

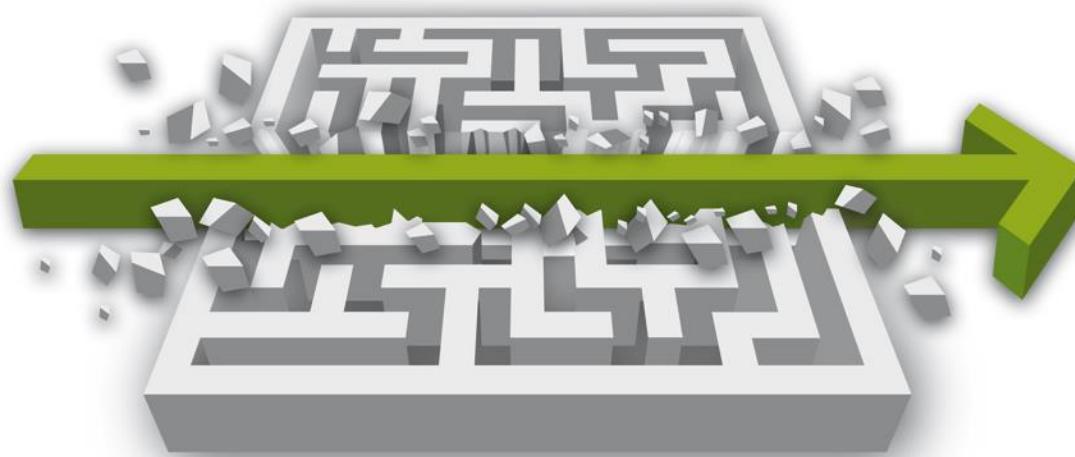
- The concept of a **Software-defined Gateway** or Multi-Service Gateway **is very powerful** and an essential element in IoT solutions. The ability to program smart edge devices (including gateways) in a **secure execution environment in Java/OSGi** on abstracted hardware offers substantial benefits to companies that need their value proposition extended to the IoT edge.
- **Informix** database technology at the edge does provide significant benefits, including **improved performance** for time series and spatial/GIS data
- Different from “traditional” M2M or telemetry like approaches the Software-Defined Gateway does **require dynamically changing and updating of device software** including the application life cycle management. Remote **device** and embedded application **management is a significant part of the TCO** of an IoT solution. The use of M2M/IoT Integration Platform capabilities is improving overall cost and time-to-market for IoT solutions significantly.
- There is a magnificent and powerful **IT** world that the **OT** world with Software-Defined Edge nodes need to be **seamlessly and securely integrated** with.

What is Driving IoT Adoption?



Solving the Complexity Problem !

Device to Cloud. Now !



Could This Get Any Easier? ®

Thank You!

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