

## ***The Coming M2M Revolution: Critical Issues for End-to-End Software and Systems Development***

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- M2M Landscape
- M2M Market Dynamics
- Industry Observations
- System Design for end-to-end M2M solution
- Software Application Management using Java/OSGi
- M2M Deployment Success Stories
- Summary

# M2M (Machine to Machine) Landscape

## ■ M2M definition

A world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in the business process and personal lifestyle.

*M2M market to be worth \$290 billion by 2017: report*

*“Sensors, microprocessors and wireless technologies that once cost hundreds of dollars are now available for as little as the cost of a cup of coffee.”*

*“The disruptive potential of a connected world”*

**‘telehealth’ – holds the potential to change the way many of us receive medical care, states a new report by healthcare sector experts**

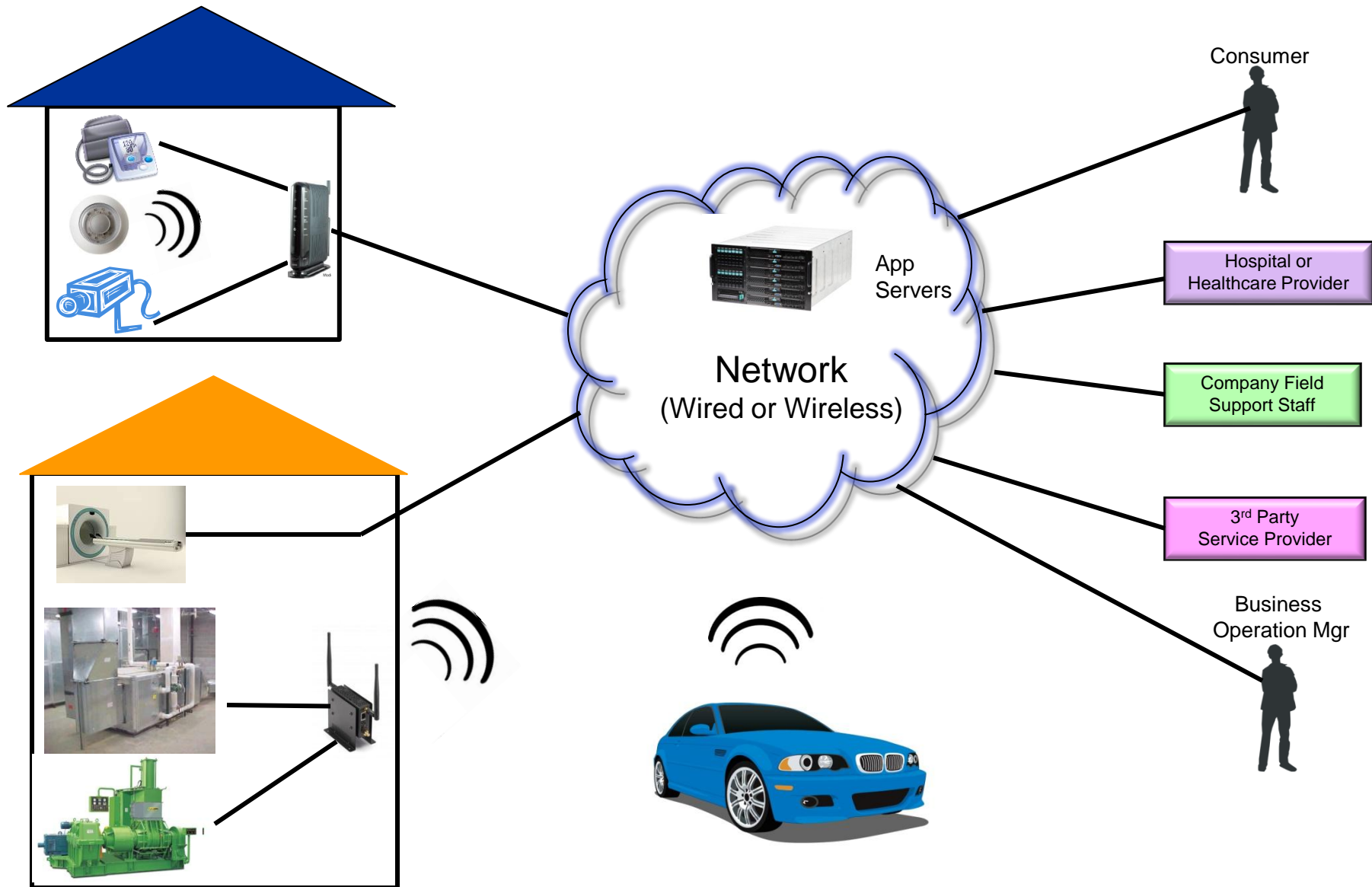


## ■ Continual pressure on companies to look at M2M technology solutions to:

- Reduce operational costs
  - Remote product management
  - Increase availability and uptime
- Improve product performance
  - Long term statistical data of product quality issues
  - Gain competitive advantages
- Implement new product and service models
  - Grow revenues
  - Service contracts, SLAs
- Assimilate data to make informed business decisions
  - Real time access to information for providing tactical business insights
  - Repository of information to provide strategic insights to business planning



# Enabling M2M solution



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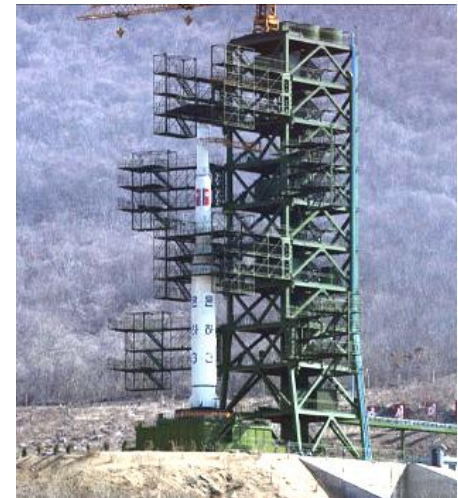
- Size , Growth, and Technology is driving an expected Revolution

- 50+ Billion connected devices anticipated 2020\*
- Processing power continues to increase within these devices allowing for enhanced intelligence
- Increasing number of ways to effectively interconnect Machines/Devices/Equipment to an end users, cloud, and business applications

\* Source Ericsson



- However, realization of these benefits are not occurring today because:
  - Complete or end-to-end solutions are inherently complex and costly to design, develop and deploy
  - Solutions that are deployed today can be a combination of technologies that are stitched together and thereby not able to evolve or adapt easily



# Market Growth Areas

Total Devices Shipped by Venue - Worldwide

(millions)	2011	2012	2013	2014	2015	2016
<b>Industrial</b>	45.85	71.30	110.65	151.87	202.95	266.53
<b>Buildings</b>	32.91	42.83	59.99	87.07	126.33	183.24
<b>Retail</b>	11.36	15.29	20.76	28.28	40.16	55.80
<b>Transportation</b>	18.40	24.90	33.69	44.05	57.44	73.69
<b>Professional IT</b>	229.82	272.73	323.72	365.84	408.11	419.58
<b>Healthcare</b>	12.20	17.32	24.36	32.90	44.52	60.15
<b>Homeland Security</b>	18.95	26.01	36.73	49.14	65.88	85.94
<b>Resources</b>	49.74	79.13	123.78	171.09	230.59	305.76
<b>Residential</b>	234.51	293.95	374.57	459.82	512.25	564.80
<b>Consumer IT</b>	229.72	271.94	326.94	367.89	410.89	454.52
<b>Mobile Telephony</b>	1,249.40	1,290.20	1,472.40	1,447.90	1,775.80	2,157.71
<b>Total</b>	2,132.85	2,405.59	2,907.58	3,205.86	3,874.91	4,627.72

→ Digital Signage included

→ Medical Devices included

→ Smart Grid included

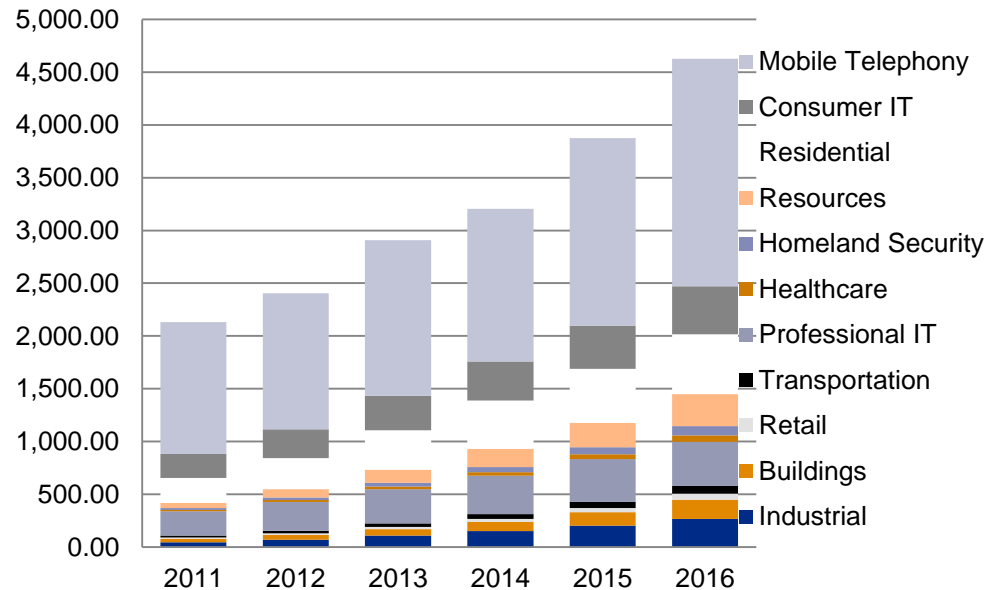
→ Home Gateways included

Total Devices Shipped by Venue - Worldwide

## Number of Networked Devices Shipped per year Forecast

Harbor Research Estimates

(millions)	2011	2012	2013	2014	2015	2016
<b>Wireline</b>	348.50	426.26	525.67	637.81	740.39	846.22
<b>WWAN</b>	73.92	104.82	145.40	175.88	212.85	245.98
<b>WLAN</b>	425.83	529.37	675.99	813.80	959.97	1,115.37
<b>WPAN</b>	35.20	54.94	88.12	130.48	185.90	262.44
<b>Total</b>	883.45	1,115.39	1,435.18	1,757.96	2,099.11	2,470.00

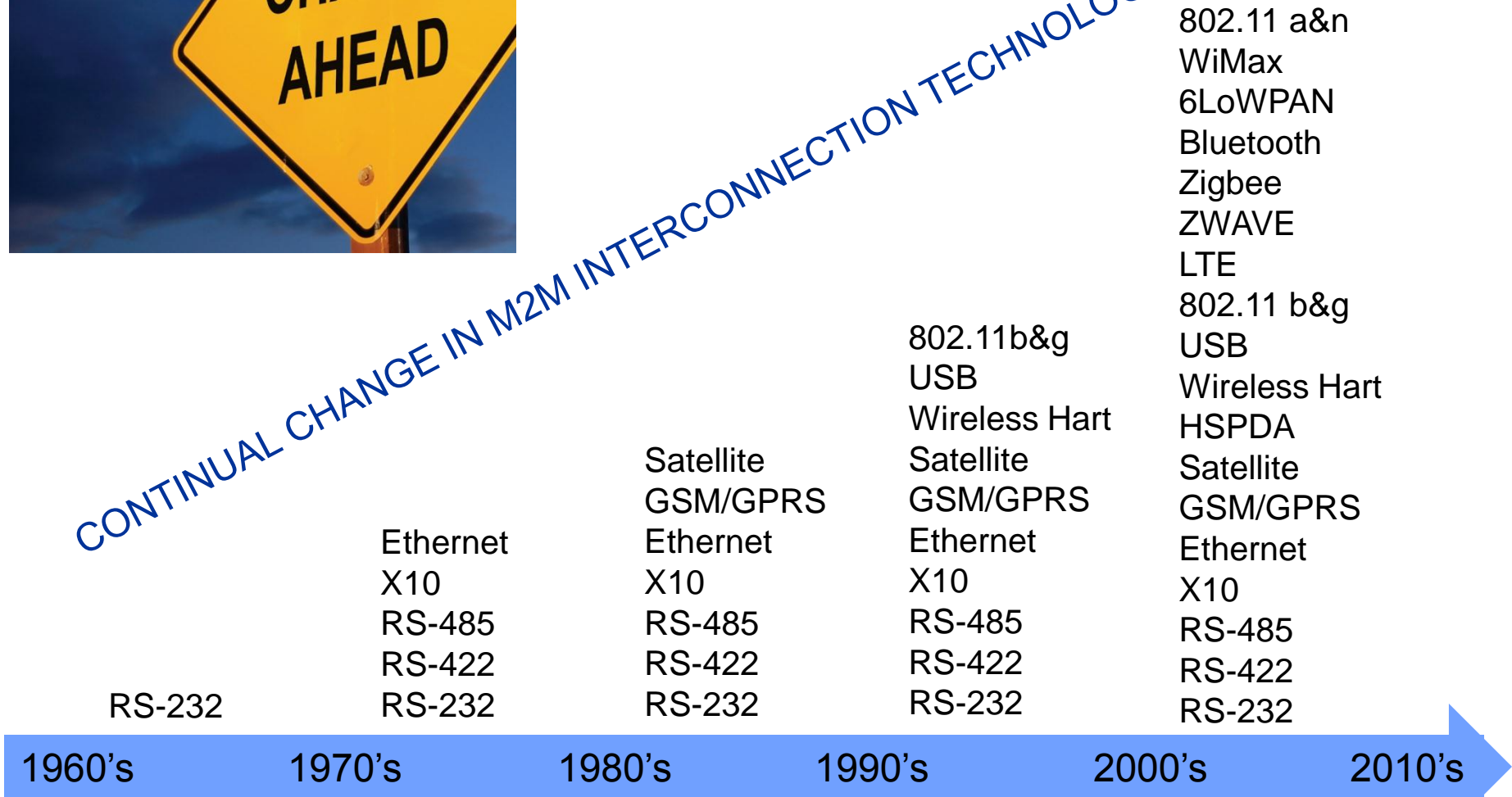




# M2M Networking Technology Introduction

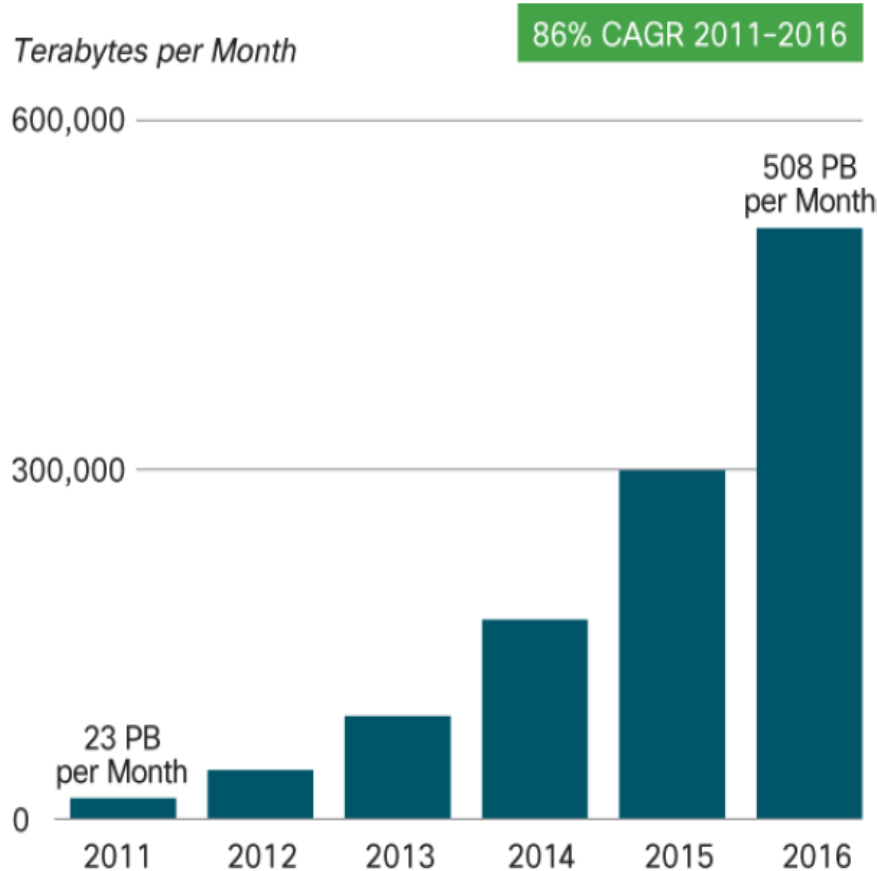


CONTINUAL CHANGE IN M2M INTERCONNECTION TECHNOLOGIES



# Data from "Things" Grows 22x

Figure 14. Machine-to-Machine Traffic to Increase 22-Fold Between 2011 and 2016



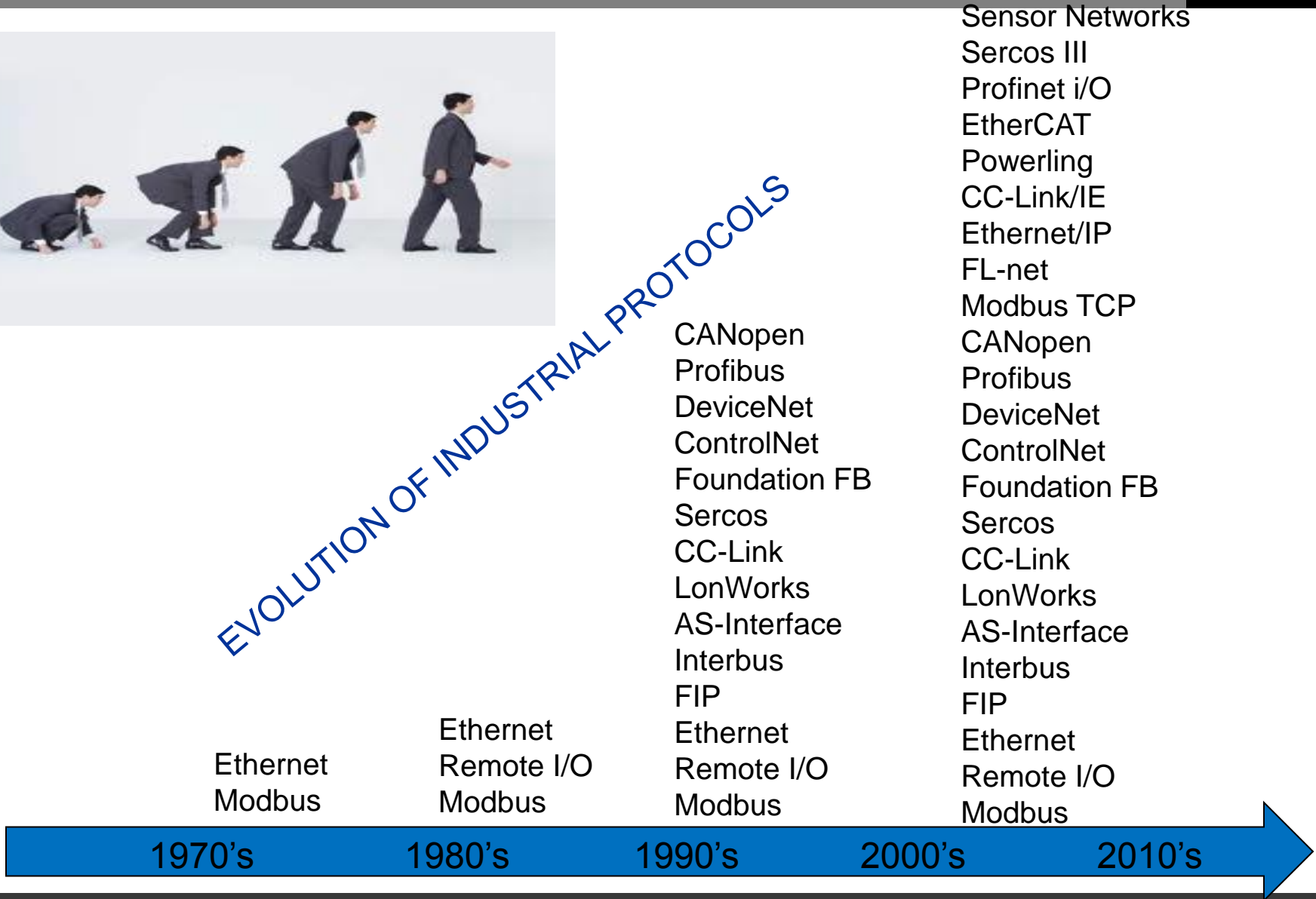
"Soon we will have more than 10 million vehicles connected and that will lead us to 1 petabyte of data volume per day," said Mario Muller, BMW vice president of IT infrastructure."

Source: Cisco VNI Mobile, 2012

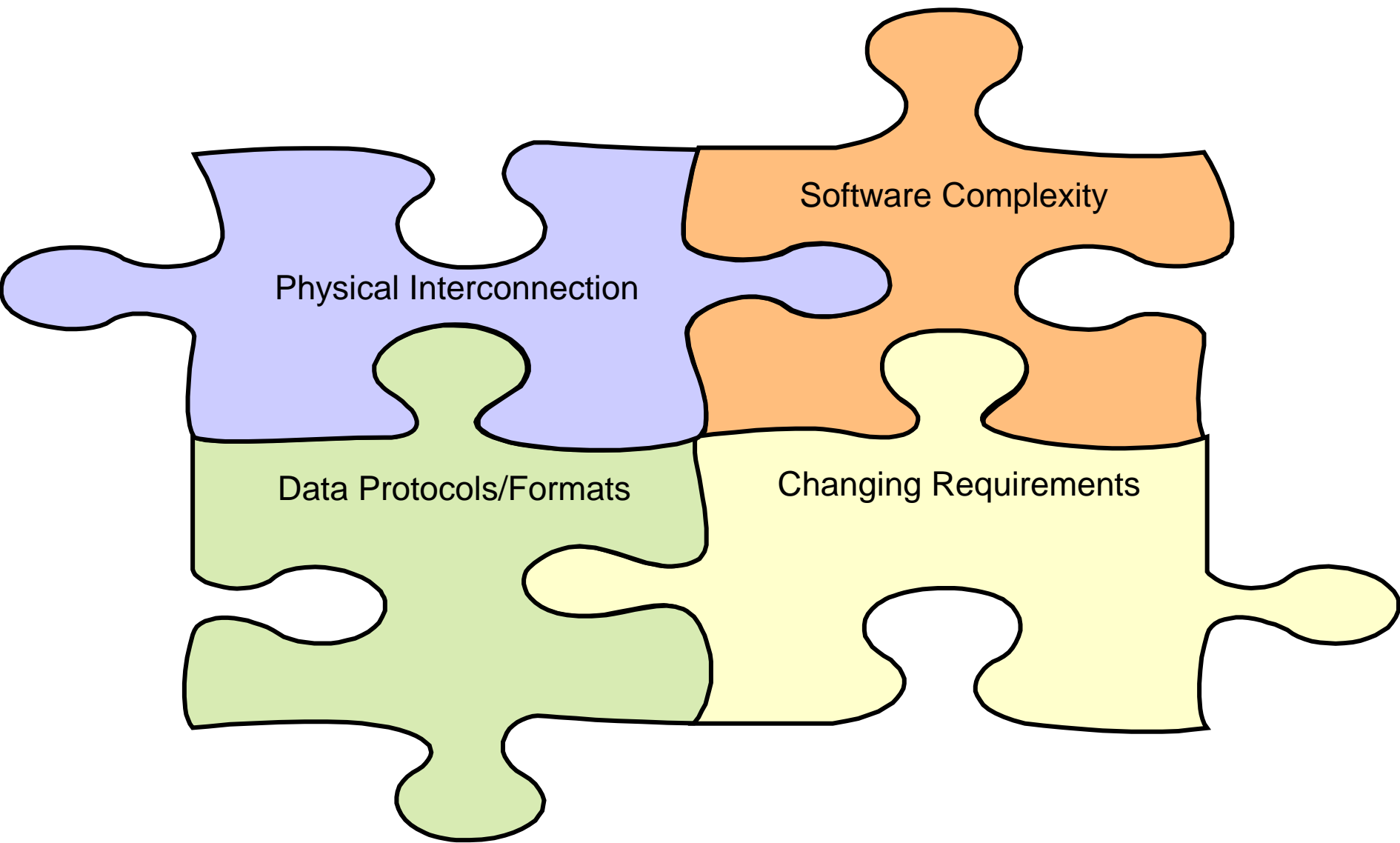
# Data Protocols Continue to Evolve



EVOLUTION OF INDUSTRIAL PROTOCOLS



# ***Putting the Pieces Together for M2M Systems***



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# ***Building an Embedded System (As Part of an End-to-End Solution)***

## ■ What's keeping CXOs awake at night?

### • Current Observations:

- “We have been studying M2M forever.... There is no perfect solution”
- “The ROI for developing and deploying solutions is built on overly aggressive assumptions”
- “We’ve interviewed scores of consulting firms who all have a their own way of how to develop a solution”
- “My competitors are making announcements about launching M2M solutions”



### Experience Tells me:

- “M2M solutions don’t look like typical IT projects”
- “ I’ve seen these types of projects (with proprietary interfaces and dependencies) and still remember how challenging they become to complete”
- “No proposed solution in the market is a great fit for my business objectives”

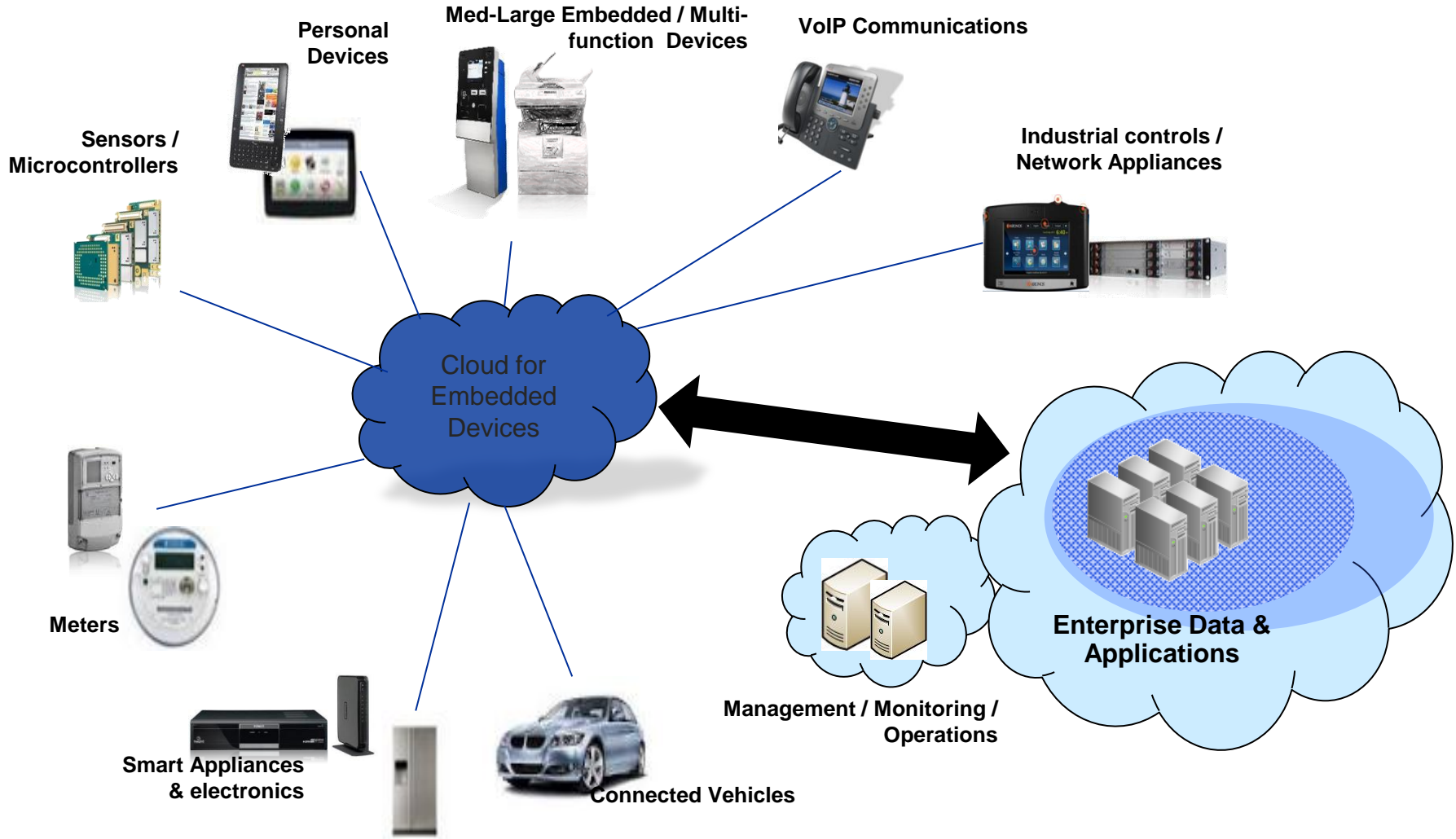
# ***Issues Facing Companies Designing or Investigating an M2M Solution***

- Historically, M2M designs are typically designed and developed to minimize initial deployment costs
  - Keeping system costs low, software is developed with lower level languages to minimize processor and memory resources required
    - Productivity advantages of higher level languages are not realized
  - After the initial M2M solution deployment, adapting to changes or required business driven modifications becomes time and cost prohibitive thereby changes cannot be accommodated incrementally
- Pervasiveness of industry specific technology (H/W and S/W)
  - For machine or gateway designs, specialized hardware, industry certifications, specialized or proprietary interfaces are required
  - Tendency for end users to be locked into a specific hardware design(s) which drives software design
- Manageability of the M2M solutions are typically manually intensive
  - Upgrades to software/firmware is typically a manual process which will likely require remote dispatch of technical staff
  - Automated tools are not readily designed into M2M products/applications such that troubleshooting problems are a difficult and lengthy process and requires specialized skill sets

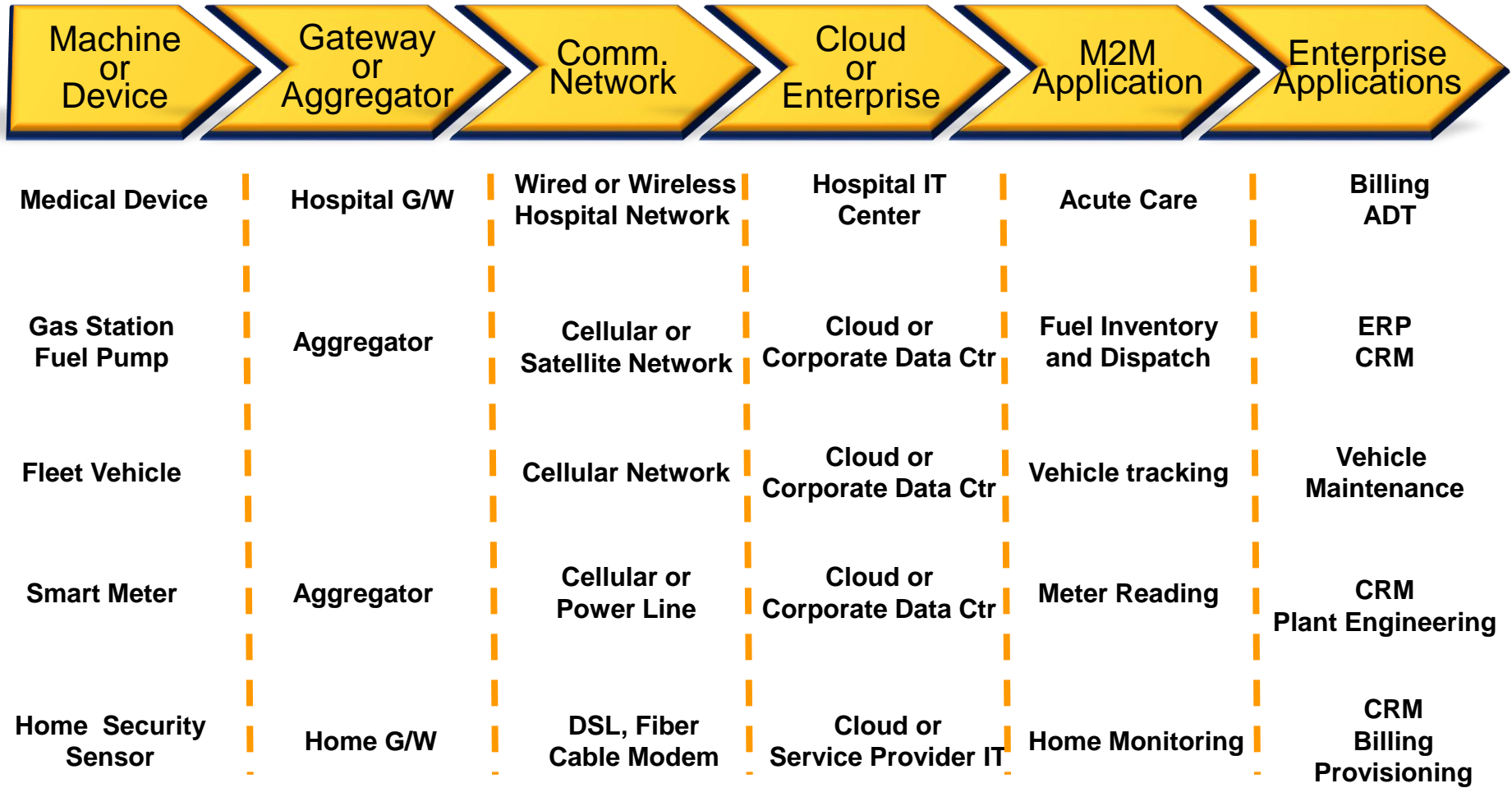
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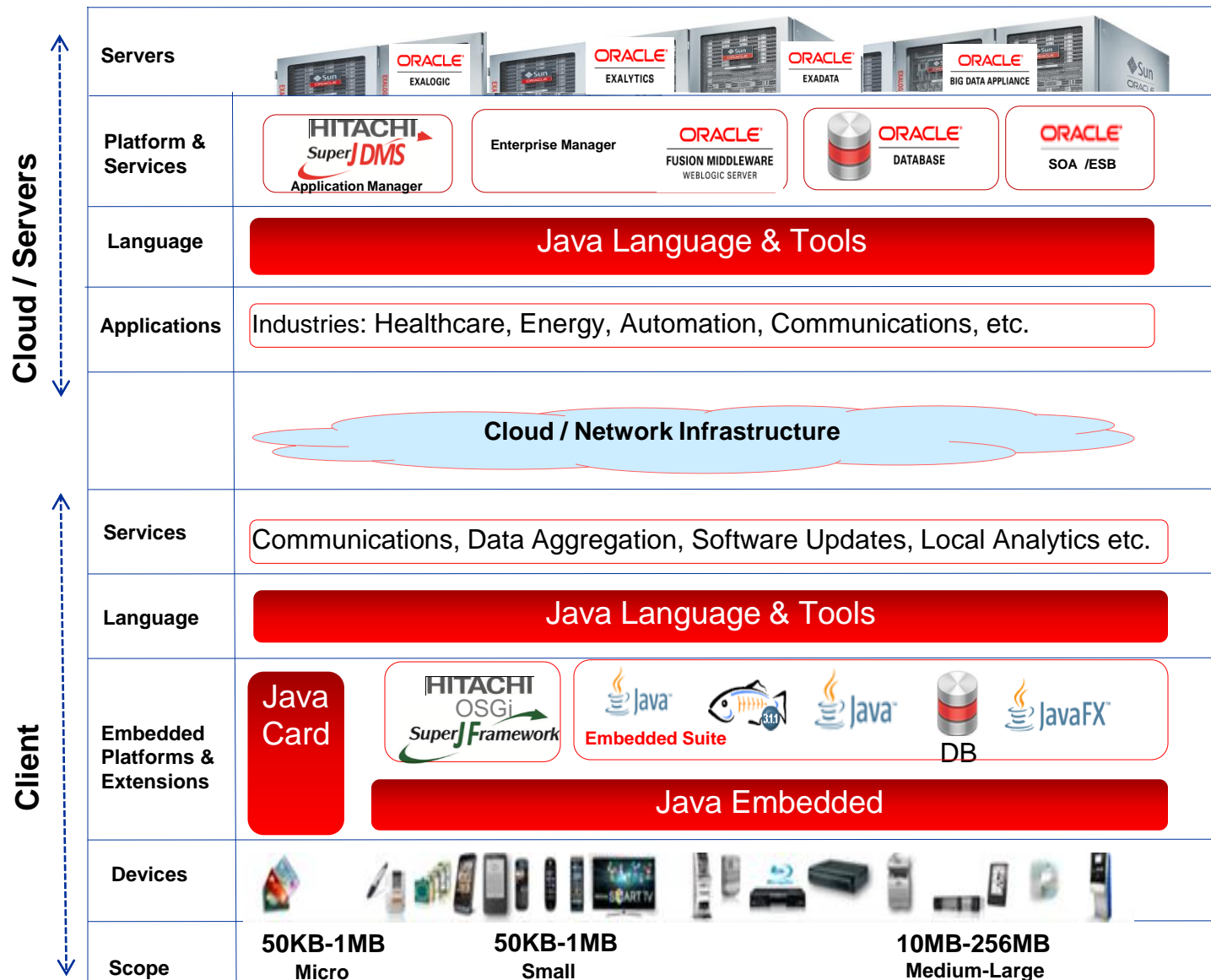
# Devices Feed Data into Cloud and Integrates with Enterprise Applications



# The Path to Make Data Actionable



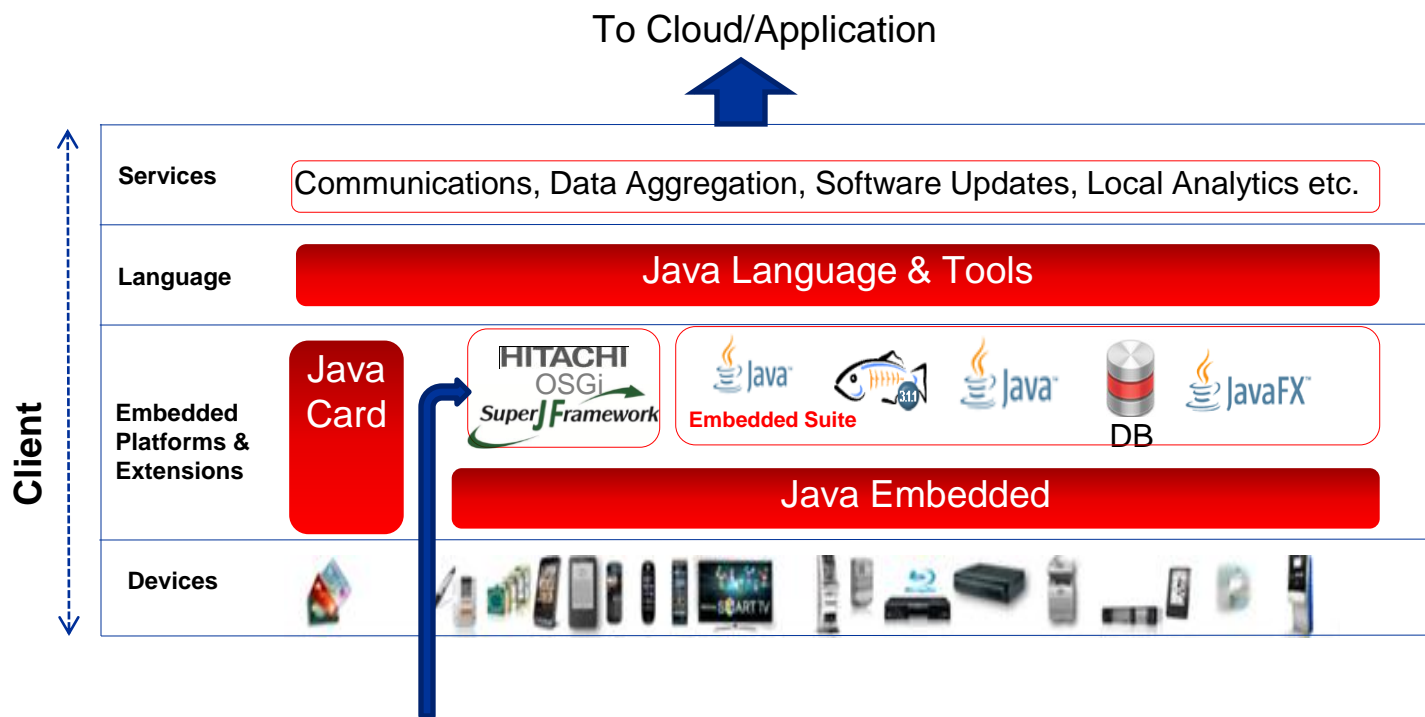
# A Complete M2M Platform



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- **OSGi** (Open Services Gateway initiative)
- Delivered by OSGi Alliance
  - Originally for embedded devices, set top boxes
- Architecture for **modular** application development in Java
  - Breaks applications into “modules” or “bundles”
- Can install, uninstall, start, stop, or upgrade each bundle **dynamically** without restarting process

# OSGi, Application and Service Enablement



The OSGi Alliance is a worldwide consortium of technology innovators that advances a proven and mature process to **assure interoperability of applications and services** based on its **component integration platform**.



## OSGi Alliance provides ...

- Specifications
- Reference Implementation
- Test Suites
- Certifications

# ***What does OSGi provide for M2M***

- Using Java as the underlying foundation, provides portability of business driven M2M applications and services
- Enables higher level language efficiency by providing a dynamic discovery of services & APIs
- Drives a structured use of software so that modularization of the M2M software platform and applications can be achieved
- Through portability and structured design criteria, allows for an easier methodology for software re-use
- Access to large community of Java developers and 3<sup>rd</sup> party software components
- Makes possible a “platform”, where business critical applications and services are remotely manageable

## Device/CPE

Application(s)  
(incl. diagnostics)

Native  
Program  
(Linux  
Applications)

Linux Kernel

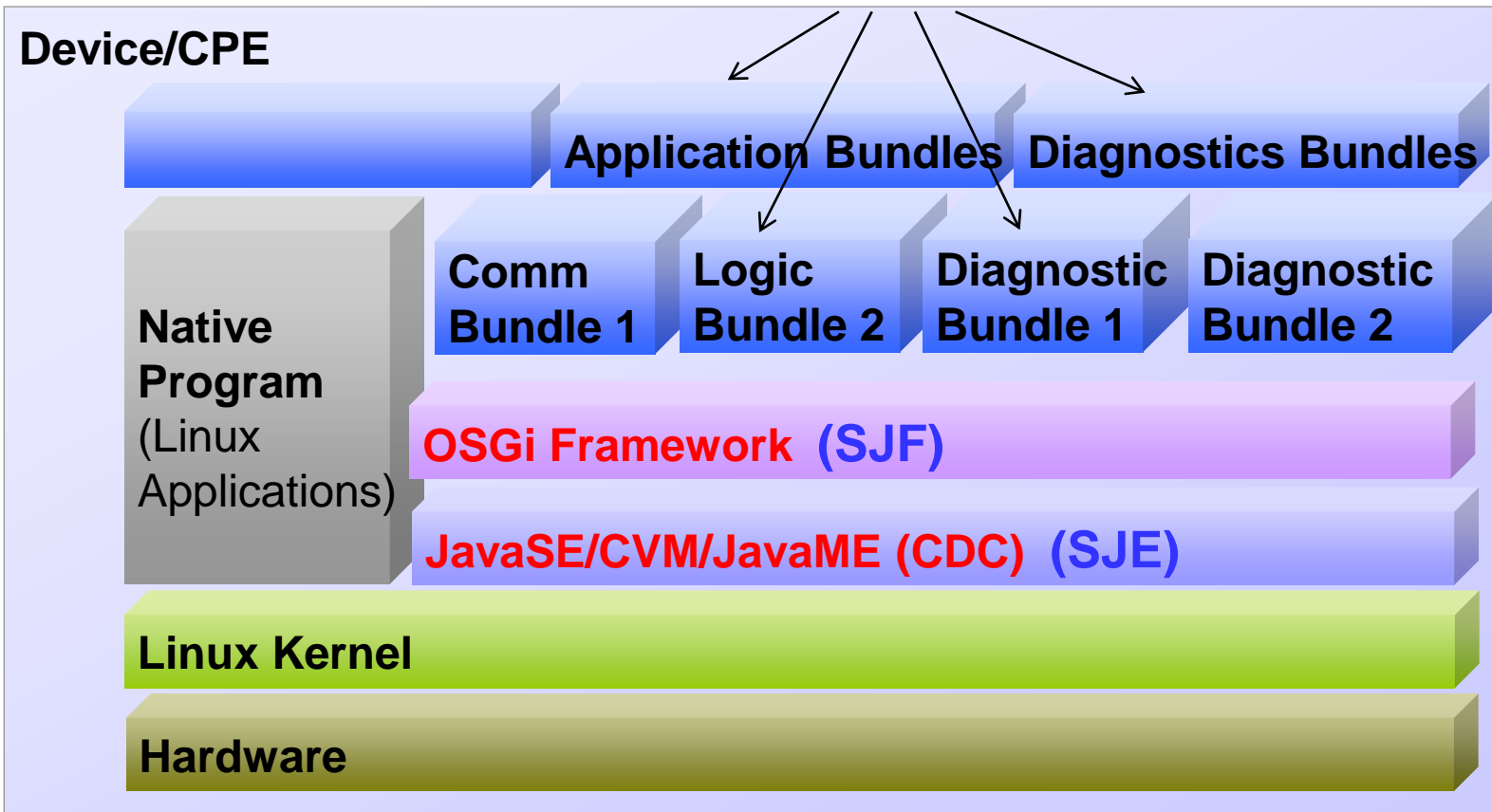
Hardware

- Applications tightly coupled to the Native Program/OS/CPU complex
- Any change in “App” likely causes requirement for firmware upgrade (disruption of basic device operation)
- Complicated process to support additional applications (same limitations above magnify; inefficiency arises if design of all apps is not highly coordinated)
- Running the same application on another device requires re-writing all or major portions of the app (porting, time to market)



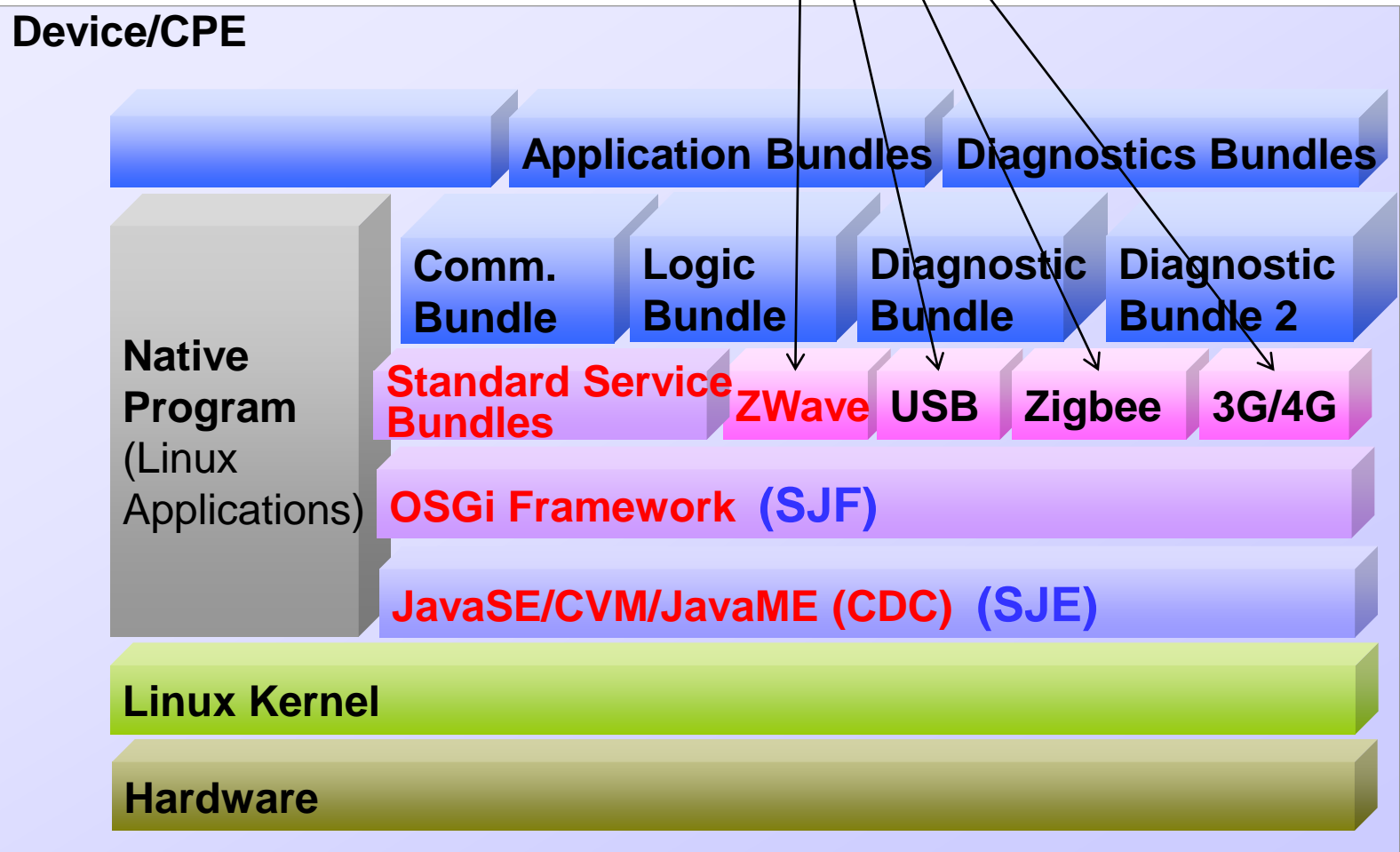
# “Multi-App” Device Implementation

- OSGi & Java enable app platforms with modular, flexible, device independent benefits for M2M applications
- Multiple apps developed by different teams or companies operating independently and potentially cooperatively on the same device

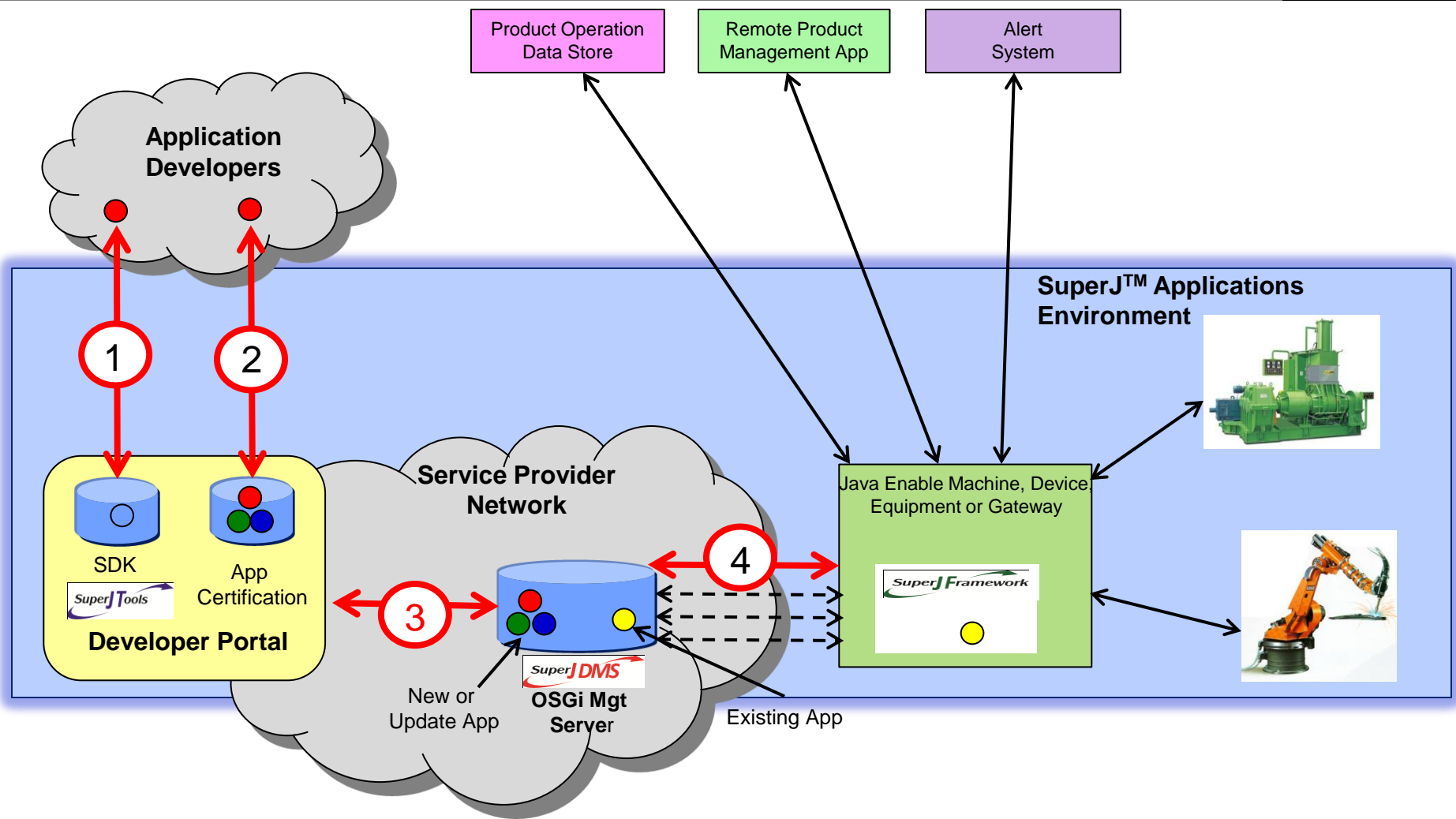


# Shared Utilities/Services Implementation

- OSGi can provide “utility” or “services” as optional shared resources used by one or more apps (this is one aspect of Hitachi’s value-add to OSGi)

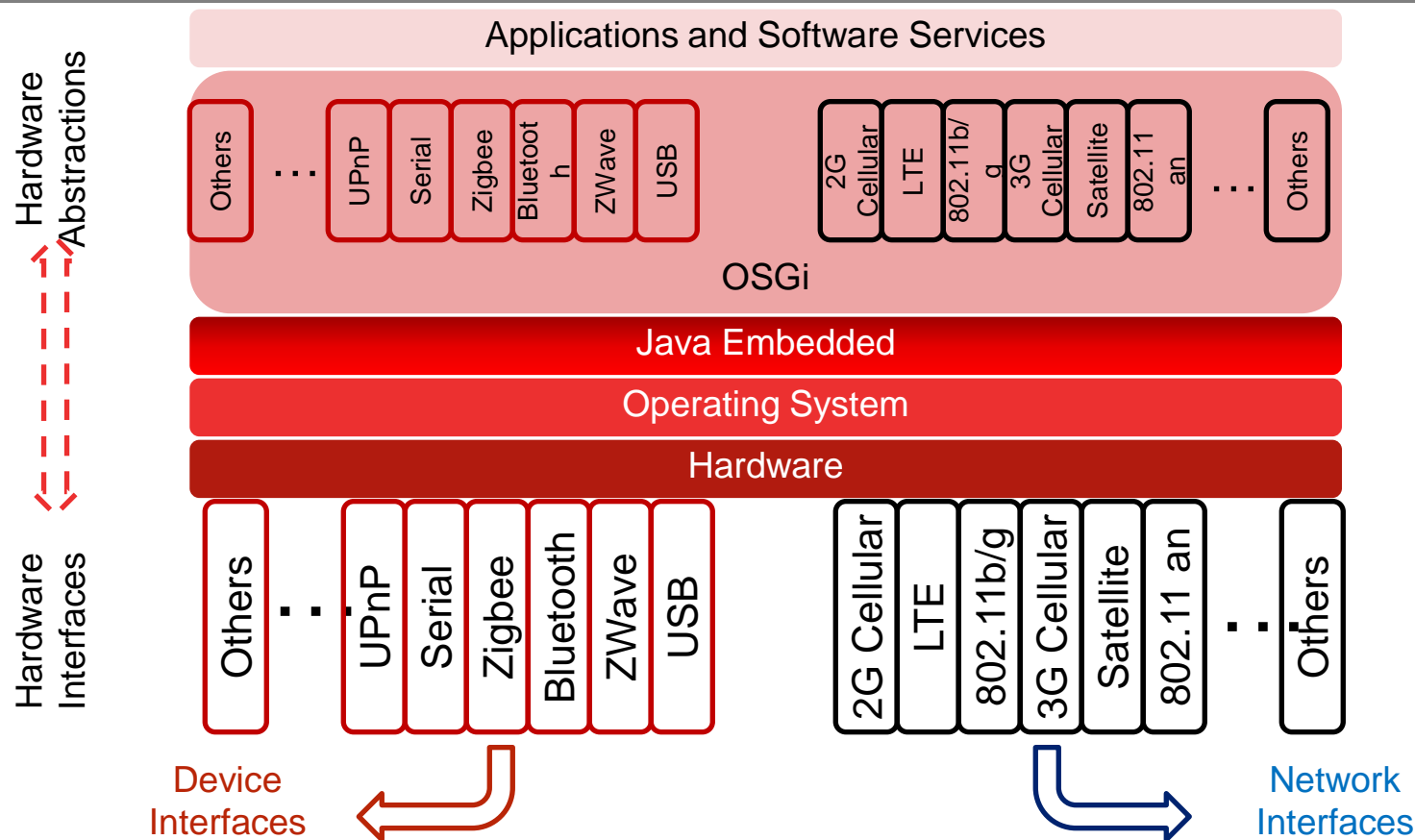


# Dynamic Software Application Ecosystem



- |  |   |
|--|---|
| <b>1 Developer uses SuperJ Tools to create app</b> | <b>3 Administrator accepts app into platform</b>                |
| <b>2 Developer issues candidate app</b>            | <b>4 Mgt Server dynamical deploys, undeploys , or stops app</b> |

# How OSGi Abstraction Layers Work



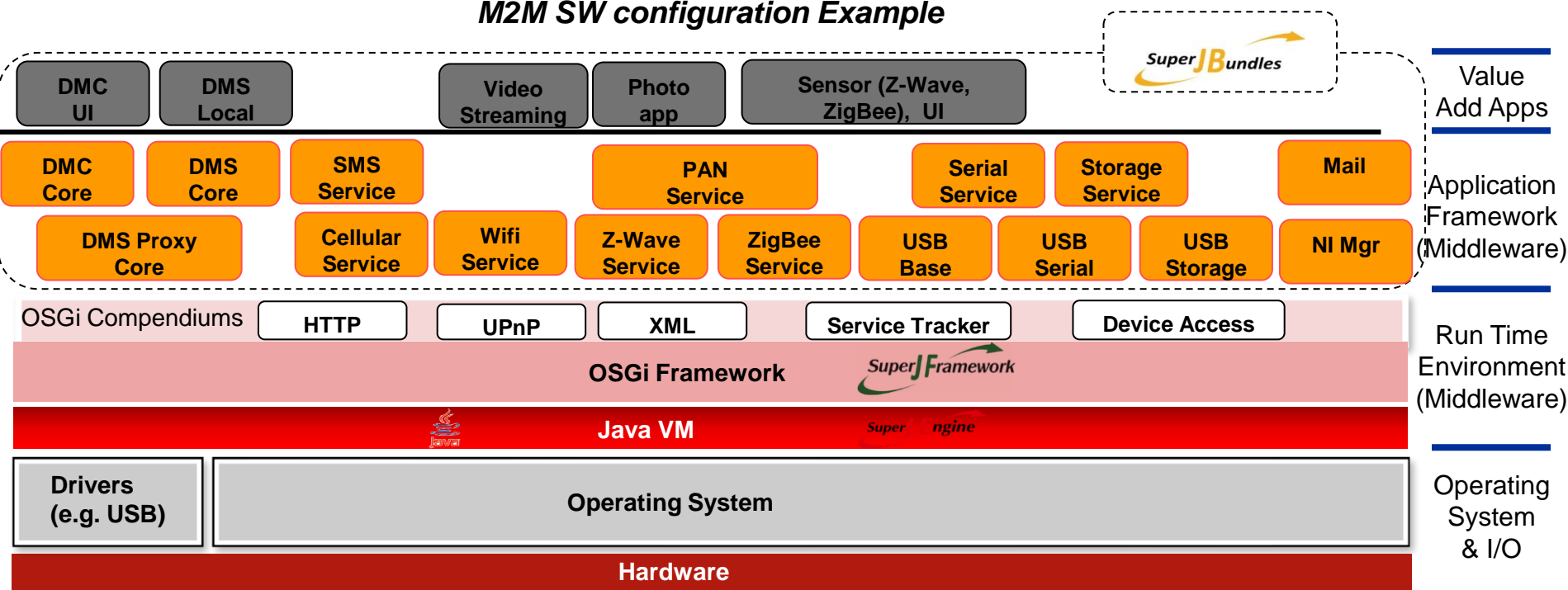
## Benefits

- Quickly writing software applications for M2M data gathering
- Software application portability to different machine types
- Easily accommodating changes in hardware and Interfaces

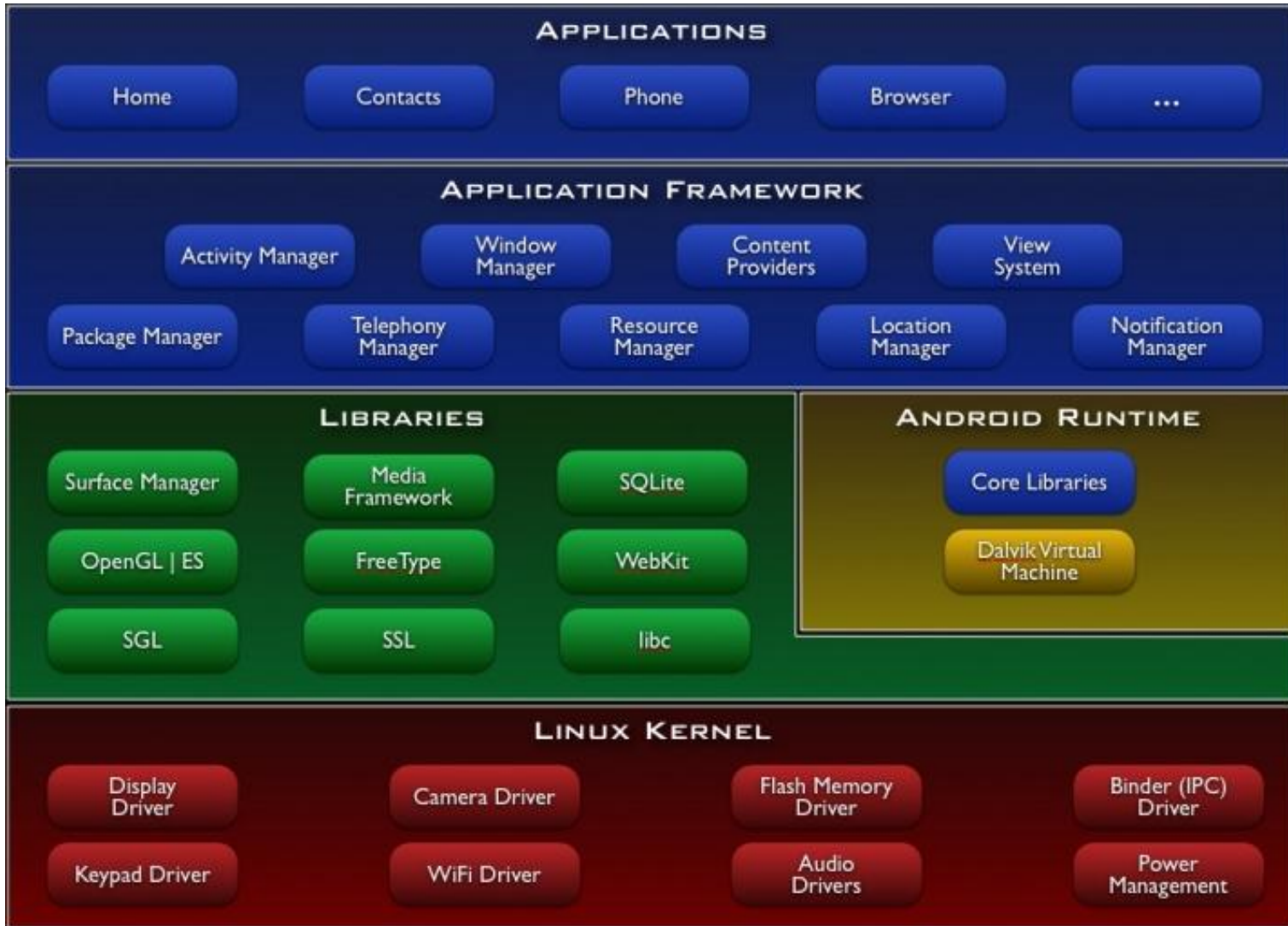
# S/W Architecture for Enabling and Management of M2M Applications

- Provides common bundles to promote applications.
- Development of common bundles/services to expose specific device functions
- Development of Common bundles/services to abstract protocols
- Added value for application developers

## M2M SW configuration Example



# Android for Smart Phones with Middleware Enablement



Value  
Add Apps

Application  
Framework  
(Middleware)

Run Time  
Environment  
(Middleware)

Operating  
System  
& I/O

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# M2M for a Large Package Delivery Company

- Initially launched vehicle tracking for better efficiencies of routes, tracking efficiencies, and re-routes
  - Knowing where the trucks are in real time
  - Optimizing route/driver efficiencies
- Discovered accident claims were being impacted by boxes falling into the driver compartment
  - Door sensor technology was implemented
- Creating additional savings by measuring duration of vehicle idle times at delivery locations
  - Measured the time it takes to turn off the engine after a complete stop
  - Measured the ignition on/off for scheduled maintenance





# M2M for a Gasoline Distributor and Retail Sales



- Implemented system to monitor fuel levels for gas station in the Western US
  - Ensuring timely delivery of gasoline
  - Monitoring levels to determine an problems with gasoline leading from underground tanks
  
- Added Data from truck terminal billing
  - Correlated truck gasoline loading information to truck route deliveries
  - Uncovered areas of fraud
  - Improved efficiencies of matching loading and delivery
  
- Created new ways to optimize cost efficiencies
  - Ability to keep station tank levels at most revenue efficient way based on gas price trends



- Introductions
- M2M Market Dynamics
- Issues facing companies embracing M2M
- End-to-End Software architecture
- Why Java for an end-to-end M2M solution
- OSGi framework for handling changes in M2M designs
- **Summary**

- M2M Technology/Solutions are poised to provide significant business value users who can
  - Everything connected quickly, reliably, and securely
- Java is the leading embedded platform
  - Any market, any device, any size
  - Secure, reliable, largest base of developers
- OSGi provides Software Application Flexibility
  - Application Lifecycle Management
  - Abstraction of physical interfaces
- Oracle and Hitachi offers a **‘Device to Data Center’** platform leveraging Java to enable productivity, agility, scalability and security.
  - Leading to a “Configurable” M2M Solution

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