

# Machine-to-Machine Communication (M2M) Devices, Networks, and Applications (DNA)

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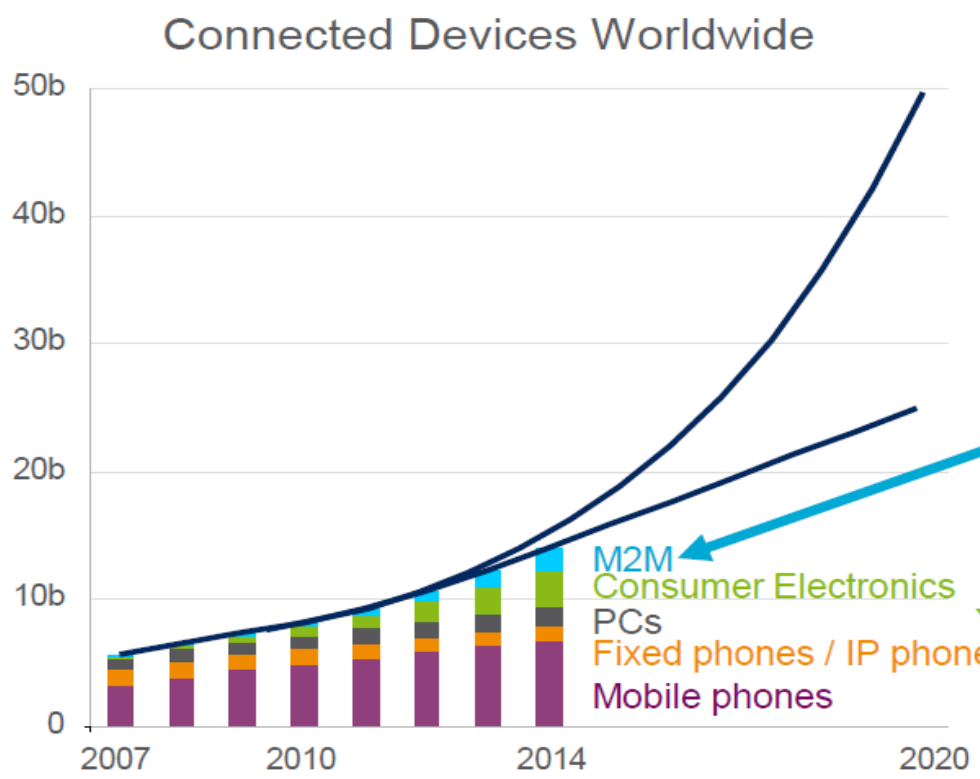
# Outline

1. Overview of M2M Devices, Networks, and Applications
2. M2M Ecosystem
3. M2M Challenges
4. M2M App Store
5. M2M Service and Management Trends
6. M2M Common Service Layer Standards
7. Summary

# M2M Devices - things with 2-way communication and limited human I/O

| M2M Vertical           | Example Devices  |
|------------------------|--|
| Transportation         | Telematics on-board unit, digital signage                                  |
| Security/Public Safety | Surveillance camera, building/home access control device, unmanned vehicle |
| Smart Energy           | Meter, energy management device, recloser                                  |
| Payment/Tracking       | Vending machine, point of sale, RFID reader                                |
| Health                 | Vital sign monitor, tele-medicine device                                   |
| Smart Home             | Refrig., washer, light control, robot                                      |
| Consumer Electronics   | TV, set-top box, game machine, digital frame                               |

# Numbers of Connected Devices



**Addressing Industries**

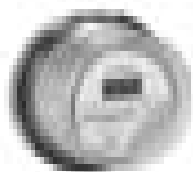
- Traffic systems, Automotive
- Transport and logistics
- Utilities – smart grid
- Security – connected buildings
- Home appliances
- Medical automation, Remote healthcare
- ATM, Point of sale, Vending
- Critical infrastructures
- Monitoring and control

**More devices per person**

- eBook readers, Music players, DVD players, Gaming devices, Cameras, Home appliances, In-vehicle entertainment etc.

**New telecom cycle: 10x devices, 10x industries**

# M2M Device, Network, Application (DNA)



## A “Device”

Thing that has capabilities, attributes, and 2-way communication protocol.

Receives commands to perform capabilities (e.g., switch on/off, start collect data, send data) & generates events when the values of attributes change or response s to commands.

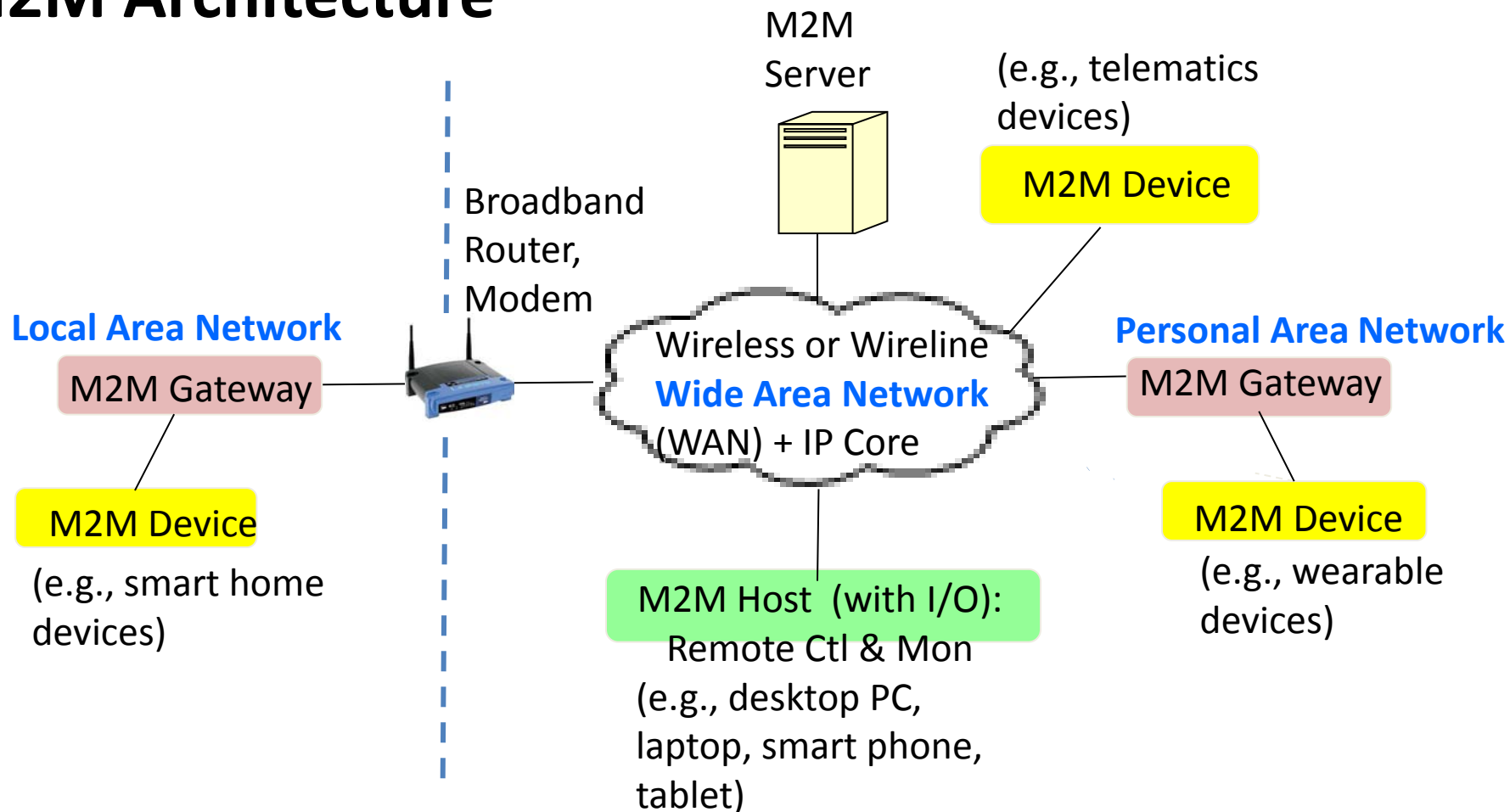
## A “Network”

wireless, wired, or mixed net:  
wide, gateway, & personal area

## An “Application”

Software that issues commands, handles events, makes sense of the collected data, & interworks with other software.

# M2M Architecture



**\* App/Software can be on M2M Server, Gateway, Device, and Host.**

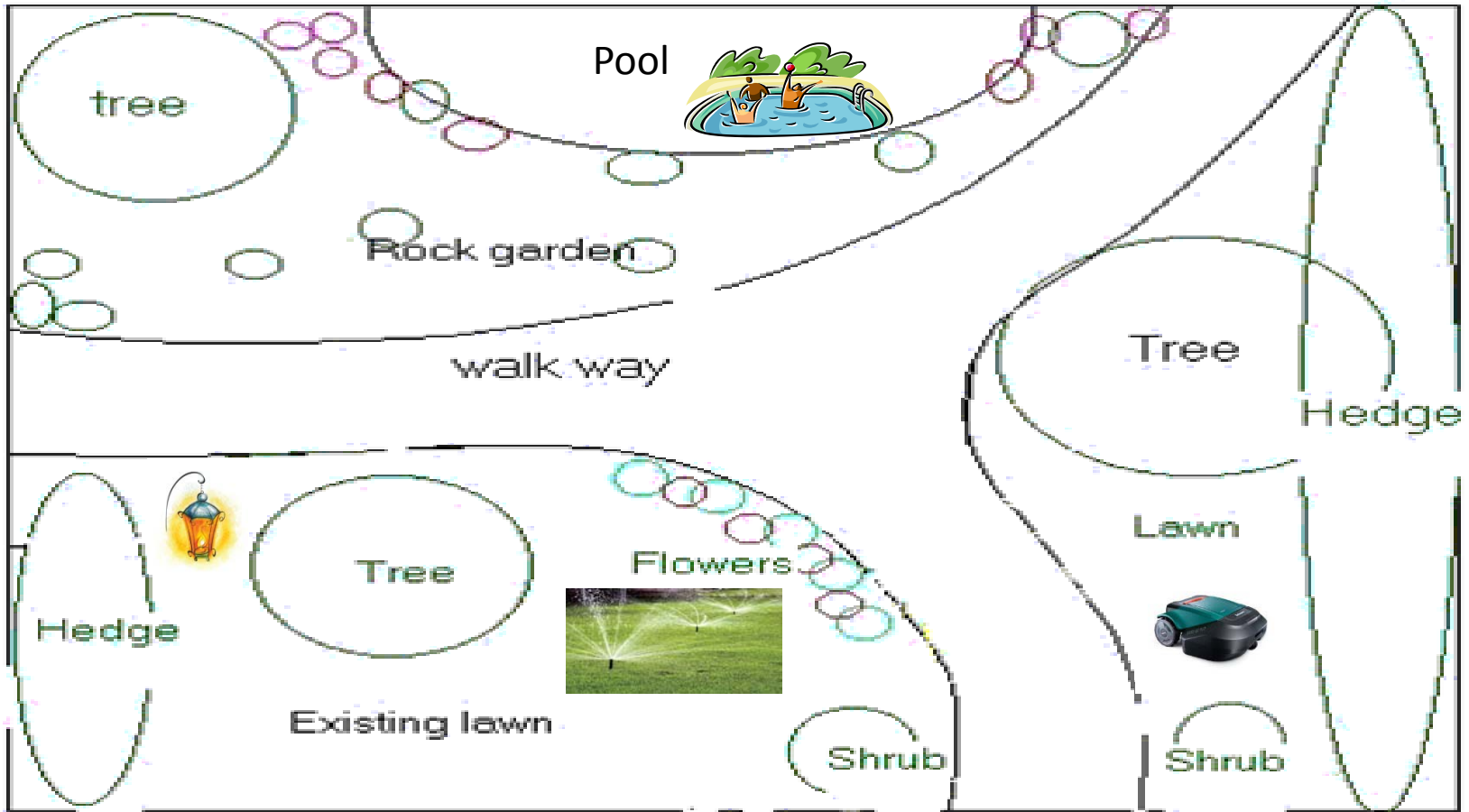
# Example Networks

|          | Wide Area Network  | Local Area Network                            | Personal Area Network      |
|----------|--|---|----------------------------|
| Wireless | 2.5G, 3G, 4G, Satellite                                  | WiFi, Z-Wave, Zigbee, Insteon, IrDA, DSRC     | Bluetooth, ANT+, NFC, RFID |
| Wireline | Fiber, Cable, DSL, PLCC, Broadband over Power Line (BPL) | G.Hn, KNX, HPNA, MoCA, UPA, Ethernet, CAN bus |                            |





# Outdoor M2M Device Examples



# Sample Wearable Devices



# Sample Telematics Devices



Before-Market OBU

After-Market OBU

Google Driverless OBU  
(Intra-Car Communication)



## VIDEO CAMERA

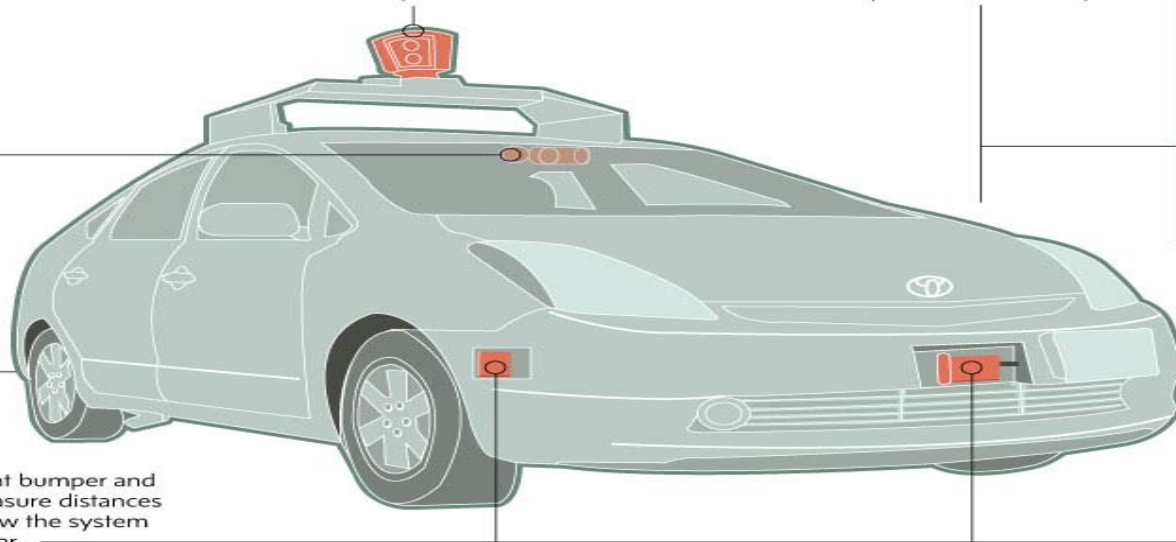
Mounted near the rear-view mirror, the camera detects traffic lights and any moving objects.

## LIDAR

A rotating sensor on the roof scans the area in a radius of 60 metres for creation of a dynamic, three-dimensional map of the environment.

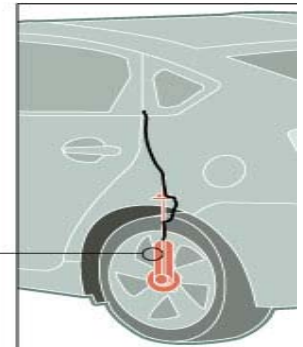
## POSITION ESTIMATOR

A sensor mounted on the left rear wheel measures lateral movements and determines the car's position on the map.



## DISTANCE SENSORS

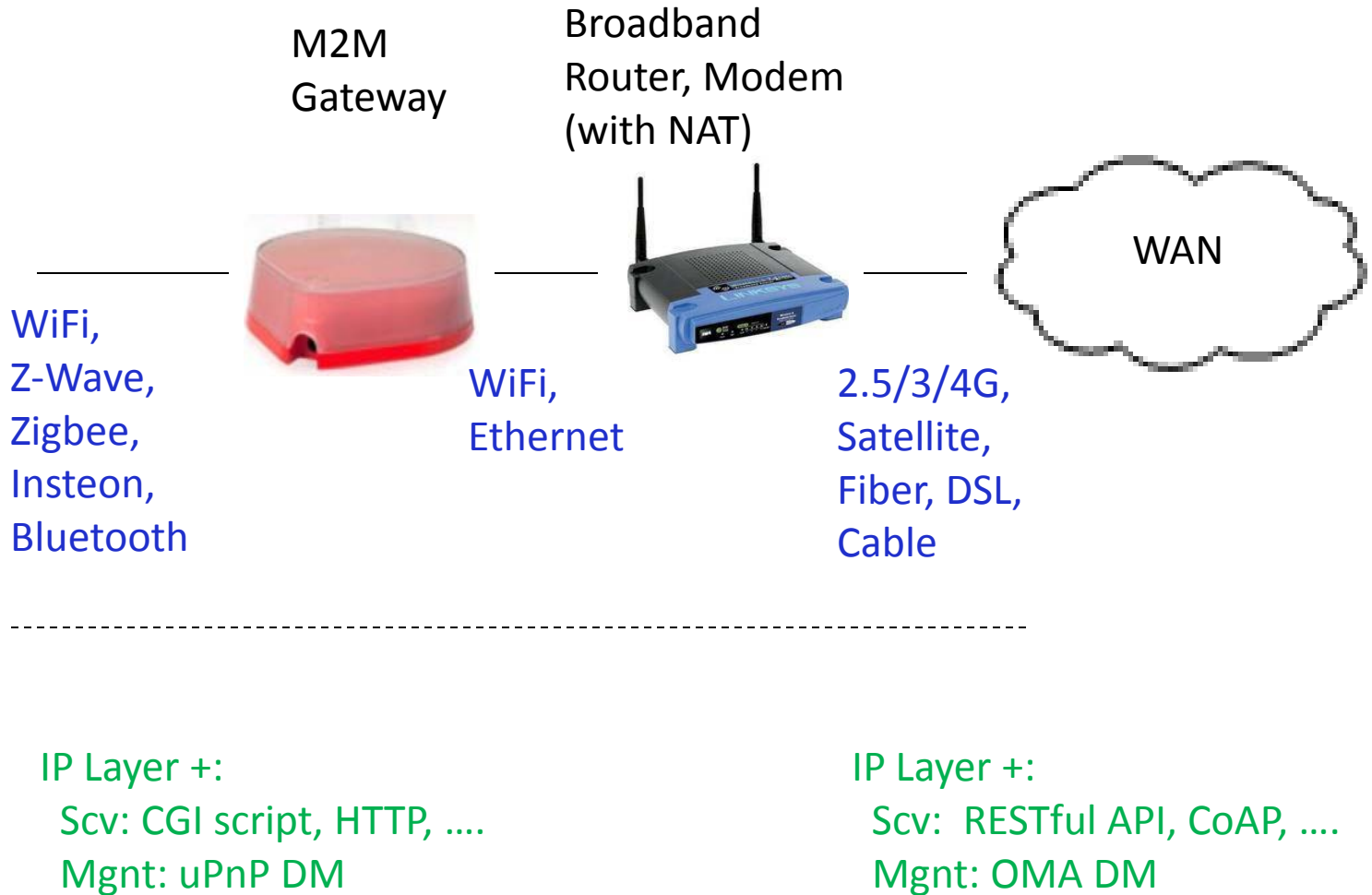
Four radars, three in the front bumper and one in the rear bumper, measure distances to various obstacles and allow the system to reduce the speed of the car.



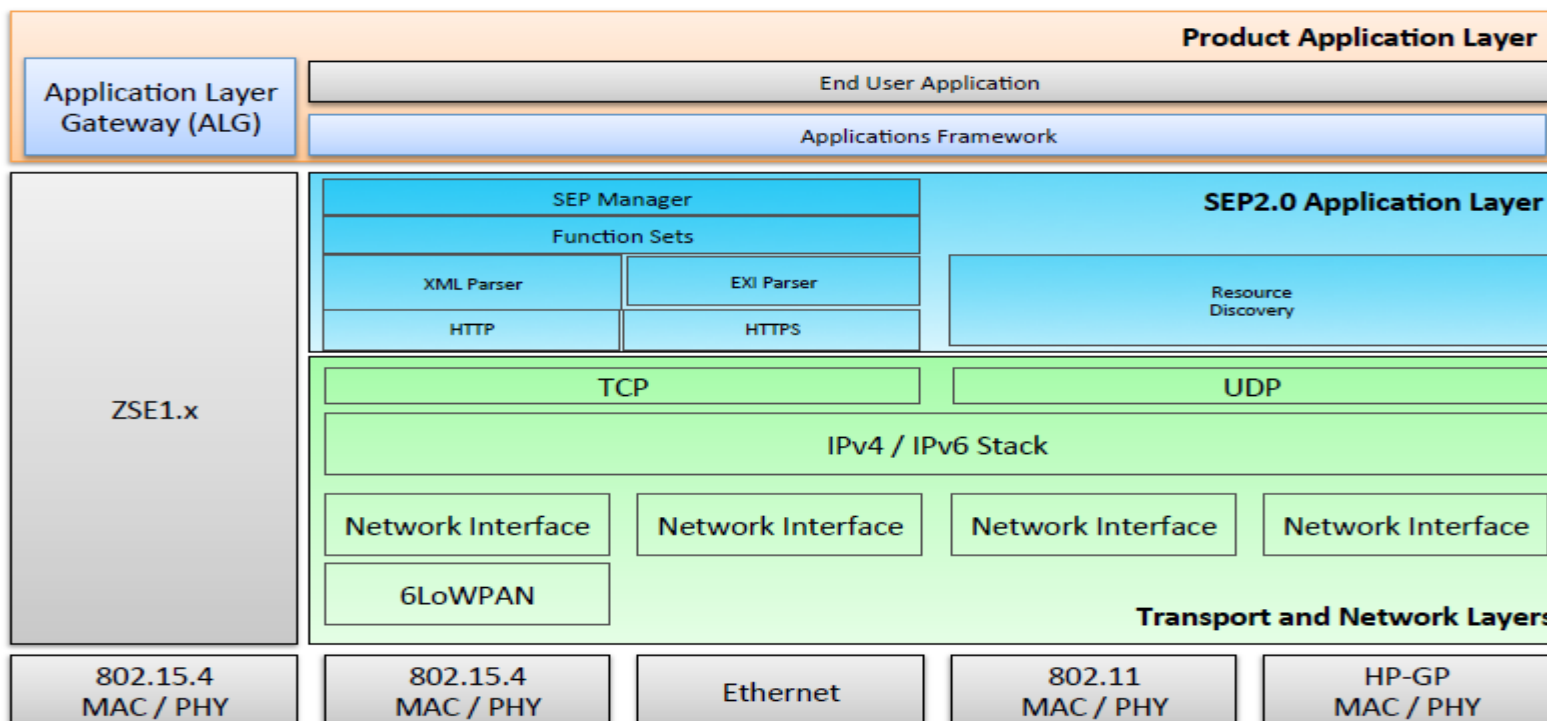
# M2M Gateway Capabilities

1. Connect M2M devices without WAN interface to a Wide Area Network for services or management
2. Convert and adapt protocols among communicating M2M devices (for independently developed protocols or evolving protocols)
3. Expose and consume Web or M2M services in a cloud
4. Automate integrated functions of multiple M2M devices in a gateway area
5. Manage homogeneous or heterogeneous M2M devices in a gateway area

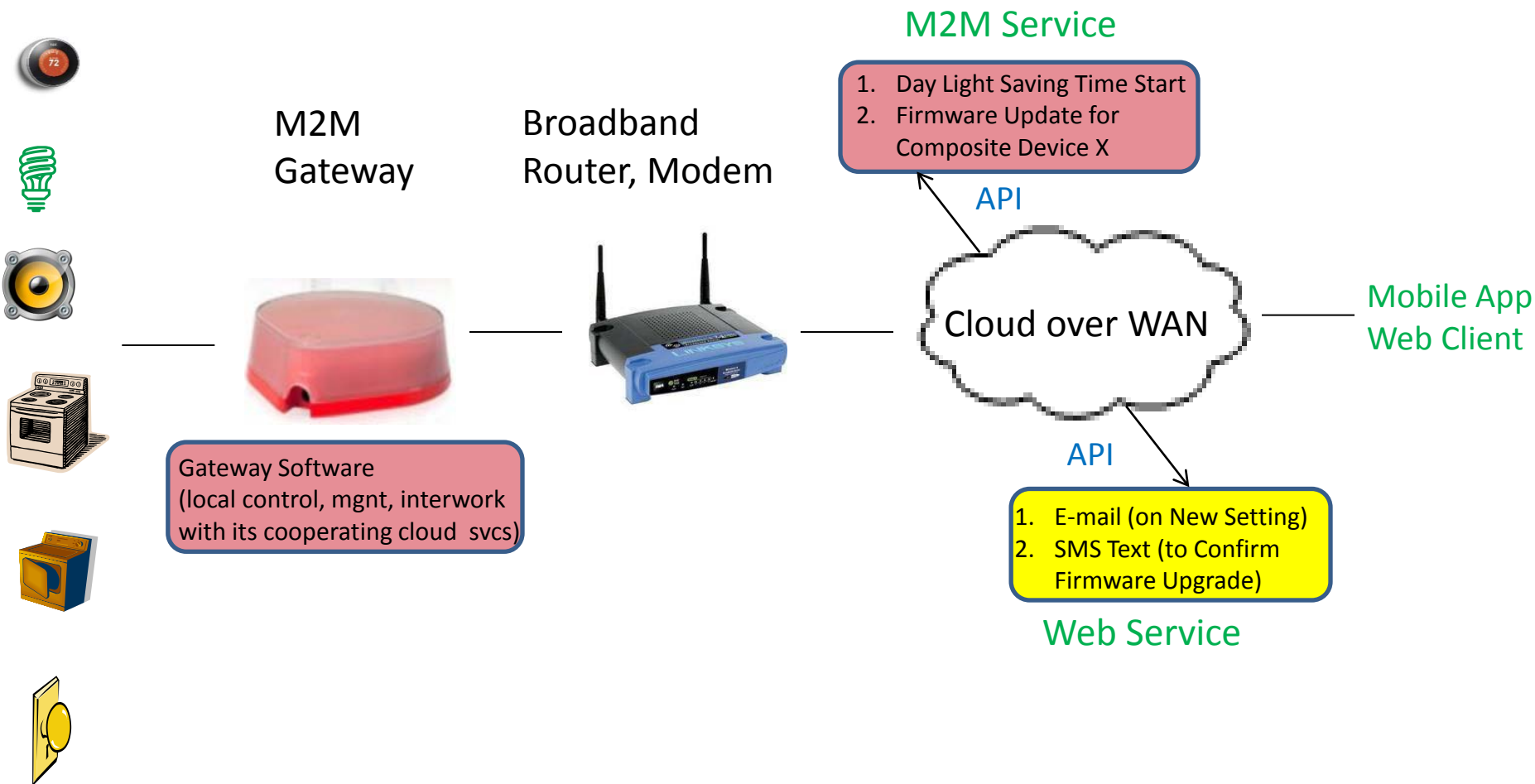
# M2M Gateway for Independently Developed Protocols



# M2M Gateway for Protocol Evolution: Smart Energy Profile SEP 1.0 to SEP 2.0



# M2M Gateway Supporting Web or M2M Services



# HVAC Control with Multi-Level Autonomy Modes & Autonomous Mode Issue

“Auto Turn-Off” Using Motion Detector

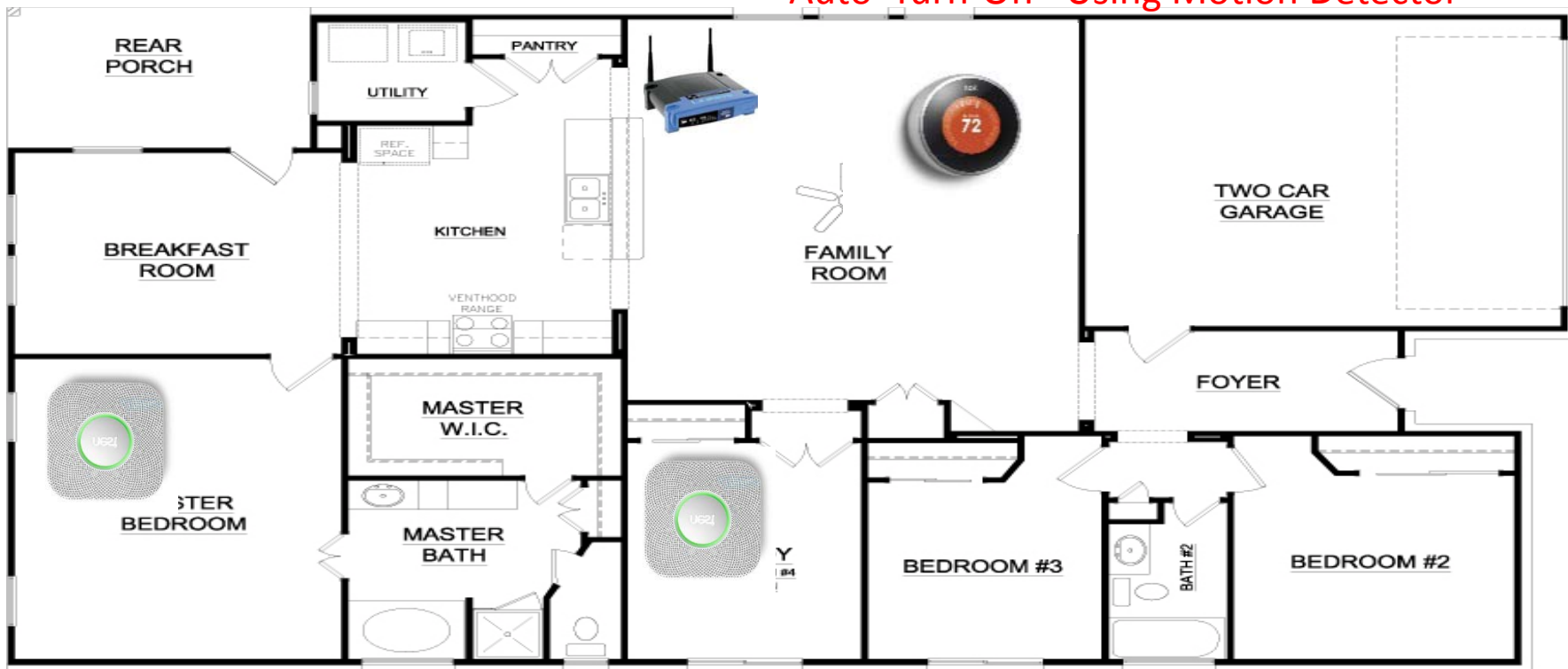


Remote Control, Configuration  
by User via App



# HVAC Composite M2M Device – Multiple Devices from Single Device Vendor

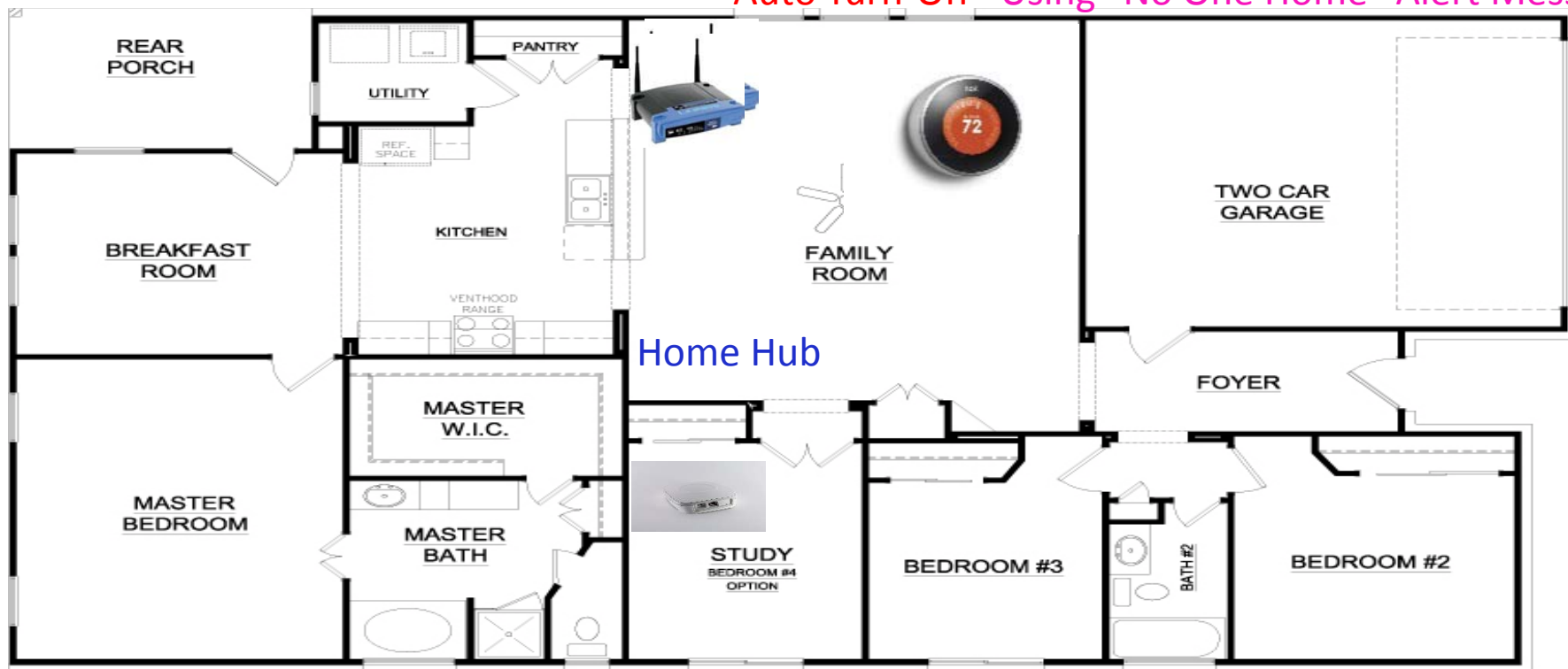
“Auto Turn-Off” Using Motion Detector



Smoke/CO Detector with Motion Detector

# HVAC Composite M2M Device – Devices from A Gateway Vendor and Device Vendors

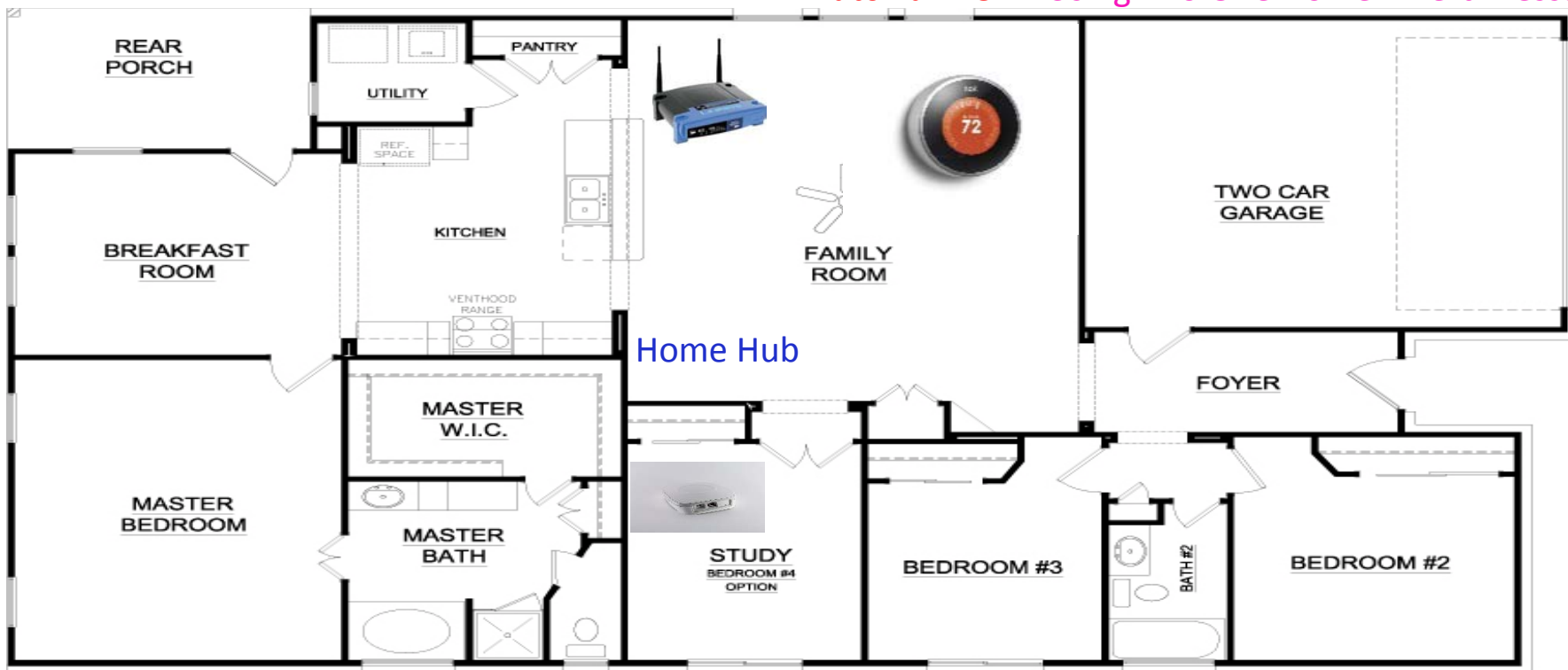
“Auto Turn-Off” Using “No One Home” Alert Message



Presence Sensors

# Configure A HVAC Composite Device with Aid from A Voice Recognition Device

“Auto Turn-Off” Using “No One Home” Alert Message



Clive, Watson



Siri, Cortana



“OK Google”

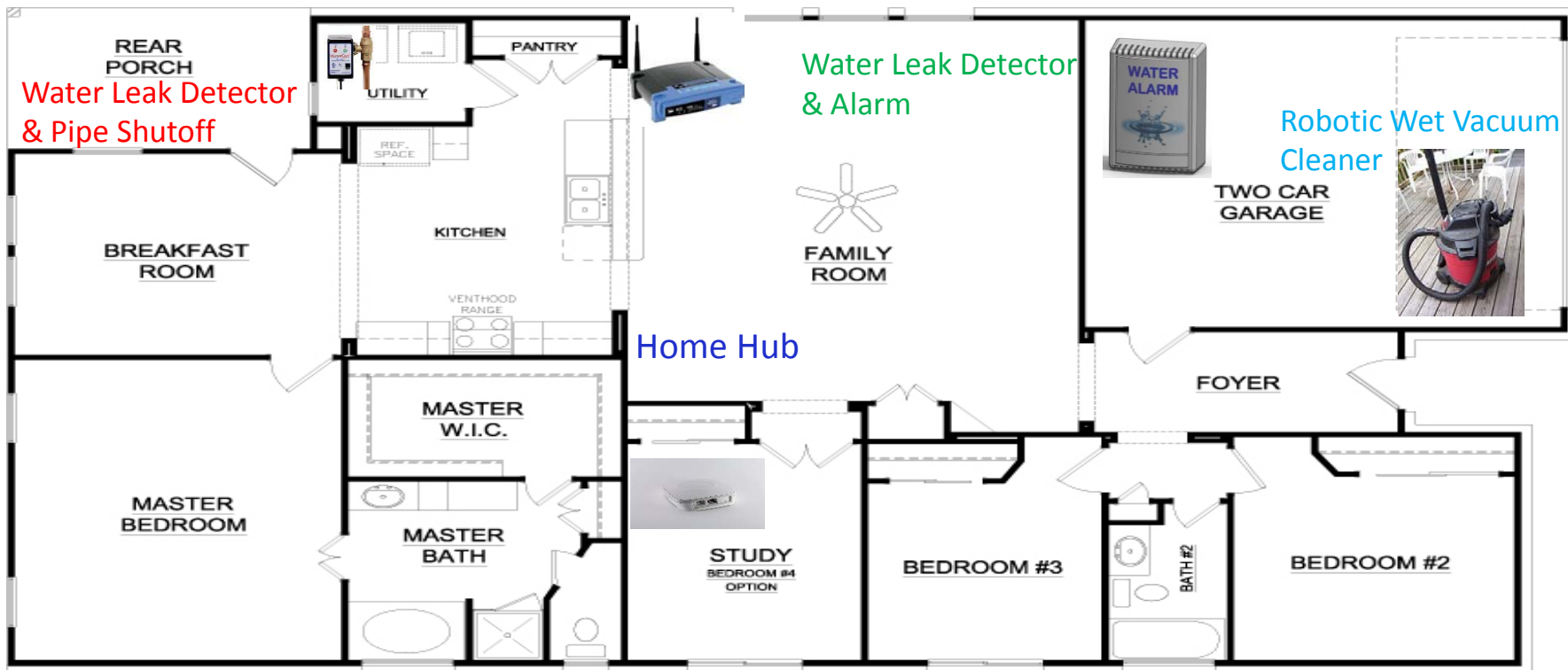


“Hello Ivey”



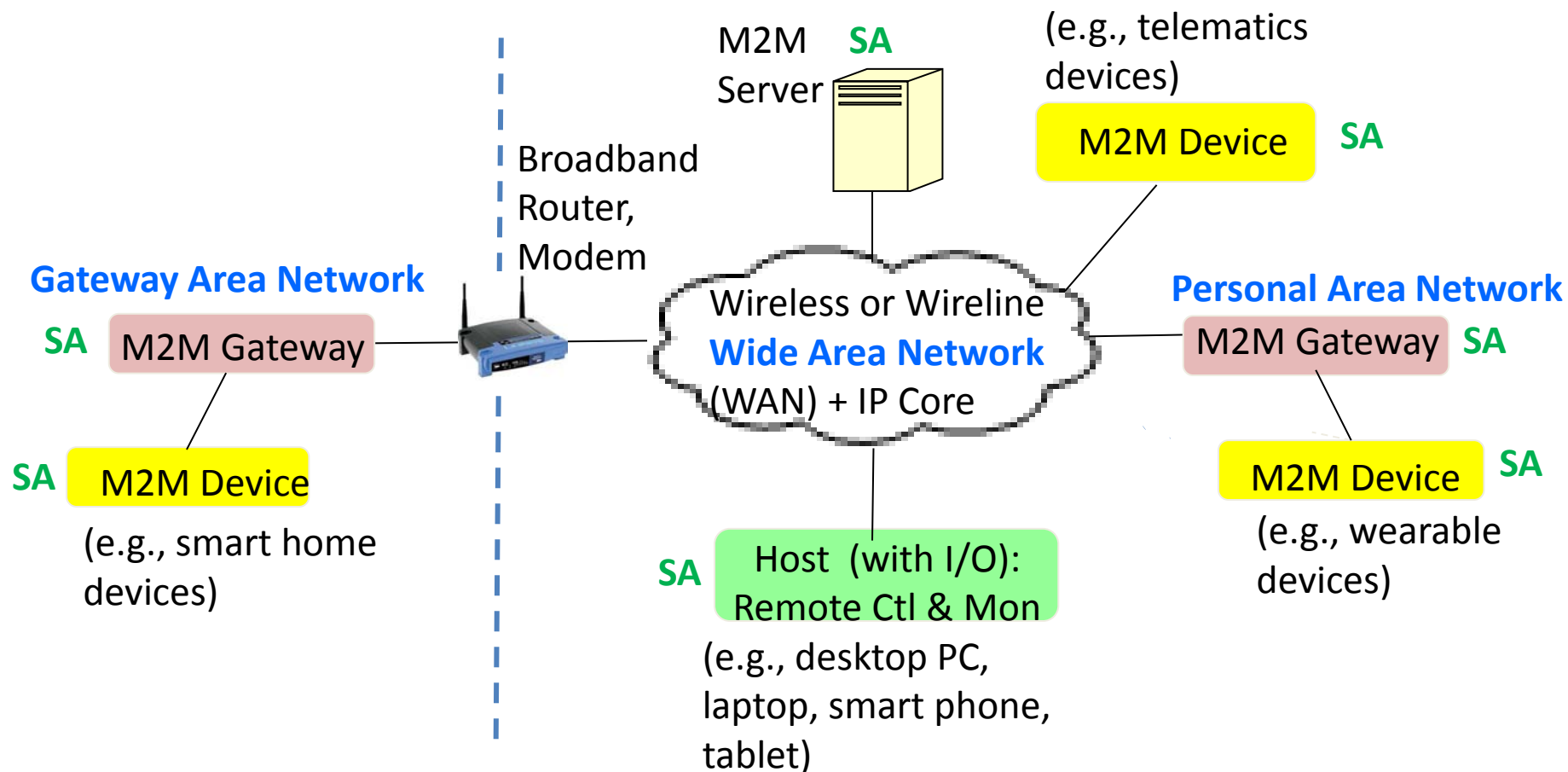
“Add One Person”

# Water Leak Control Composite Device with Multi-Level Autonomy Modes



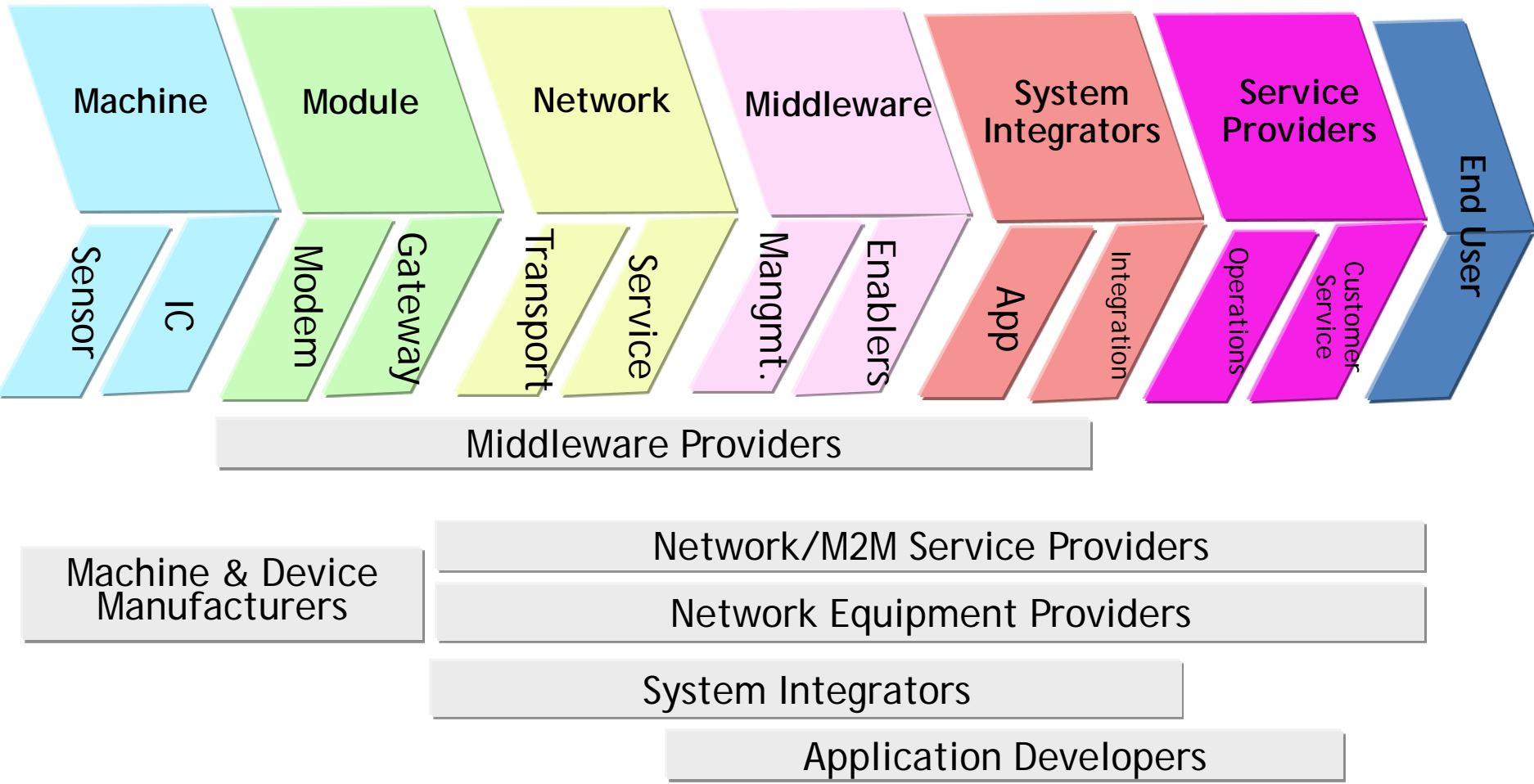
Receive Alarm, Control  
Robotic Wet Vacuum Cleaner

# Where Software Application (SA\*) Can Be Located



**\* App/Software can be on M2M Server, Gateway, Device, and Host.**

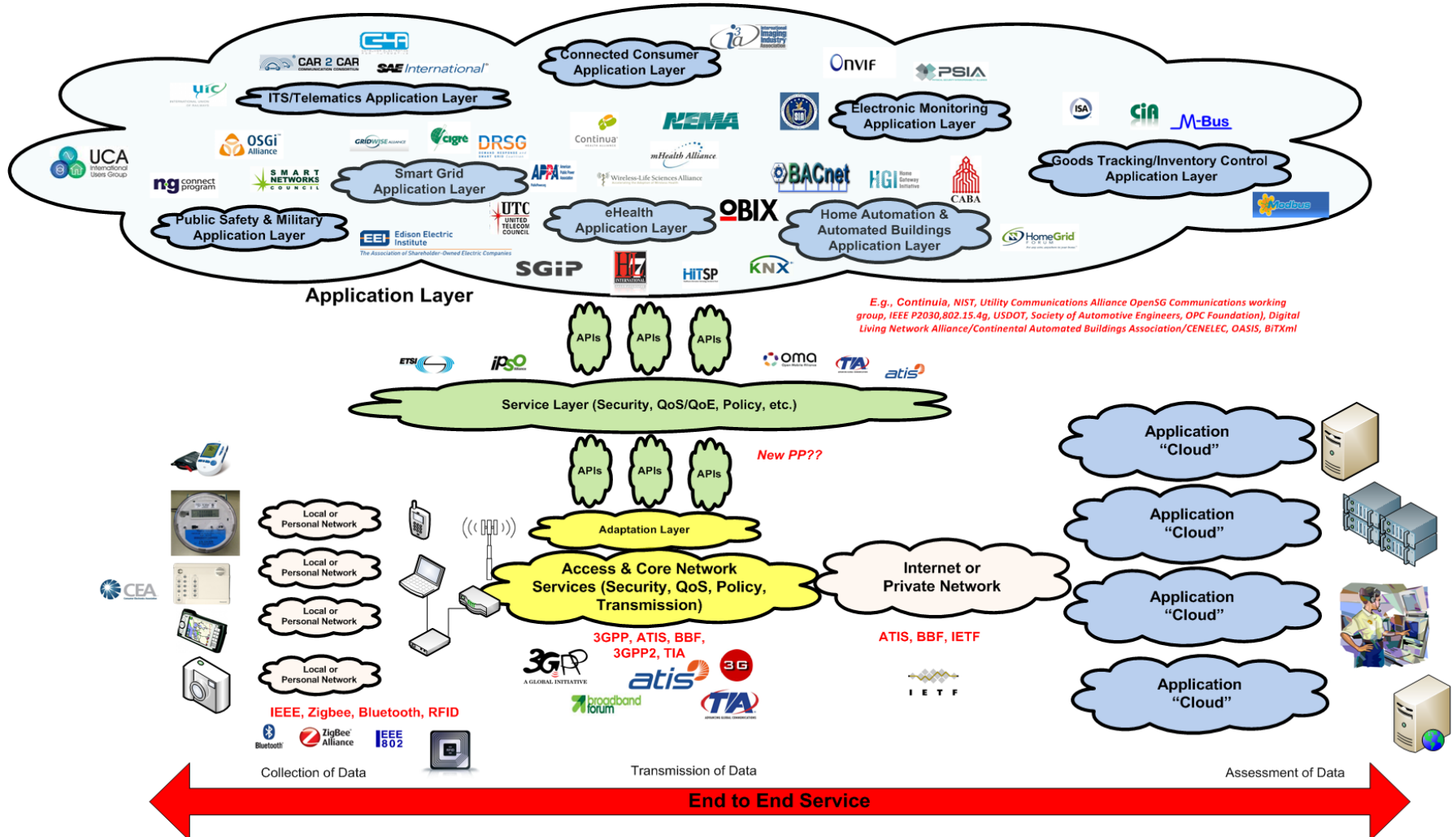
# M2M Ecosystem – Value Chain



# M2M Business and Technical Challenges

1. M2M services take a long time and involve multiple stakeholders to develop and deploy.
2. The business models for M2M services vary and are still changing.
3. A large variety and number of types of M2M Devices come to market quickly.
4. M2M Devices have a long life span, which requires extensible and robust system design to support evolution and enhancements.
5. Some desirable autonomous services require composition of multiple types of M2M Devices from one or more vendors.
6. There are multiple DNA related standards in each vertical market and across markets.
7. Initial provisioning methods for M2M Devices and M2M Gateways vary, and some require networking knowledge.
8. A M2M Device is often “locked in” with a specific application and cannot be used by other applications.
9. There are no standard object/resource models even for the same type of M2M Devices; hard to multi-source a M2M Device type for an existing service.
10. A M2M service may need to manage a large number or group of devices in sunny and rainy day conditions.
11. M2M Devices may require low power operation, auto charging, smart start/stop, and energy harvesting.

# Many M2M Related Standards

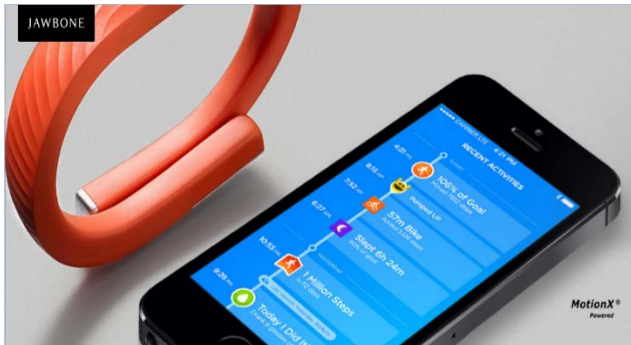


Source: ATIS

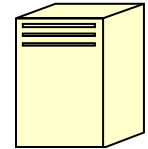


# Non Unified Object/Resource Models

## Example: Activity Monitoring Wristband



SA-Wellness Management



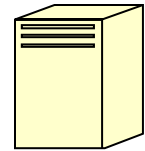
# Service and Manage Large Number of Groups and Devices



Power restored for 2K meters



M2M Gateway



Commercial Mobile Alert System (CMAS),  
Multimedia Broadcast Multicast Service (MBMS)

Signal Phase Timing (SPAT);  
Firmware Upgrade (V2C, V2V)

# Application Store Types for M2M Device Apps

| Application Store Owner   | M2M Device Apps in Application Store   |
|---|--|
| Smart Phone OS Vendor (e.g., Google Android, Apple iOS, Windows Mobile/8, QNX, Tizen, Firefox OS) | Apps for Configuring and Controlling M2M Devices and Gateways  |
| M2M System-on-a-Chip (SOC) Vendor (e.g., MediaTek)  | Device Apps Using the API for SOC  |
| M2M Device Vendor (e.g., Jawbone)   | Device Centric Connected Apps  |
| M2M Gateway Vendor (e.g., SmartThings)  | Gateway Based Composite Device Apps  |
| Web Service Connect Platform Vendor (e.g., IFTTT)   | Web Based Connected Device Apps  |
| M2M Service Provider (e.g., Wireless Operators, Telematics Service Provider)                      | Non-Subscribed Supplemental Apps (e.g., App for the infotainment , remote home control, usage based insurance, or car-to-car connection feature of a telematics service) |

# IFTTT (IF This Then That) Platform

Integration of Virtual (Web App) and Physical (M2M Device) World

| If (Trigger)             | Then (Action)            |
|--------------------------|--------------------------|
| Web App                  | Web App                  |
| Web App                  | M2M Device with REST API |
| M2M Device with REST API | Web App                  |
| M2M Device with REST API | M2M Device with REST API |

# Telematics Service and Management for Intl. Market



200 Countries  
600 Carriers

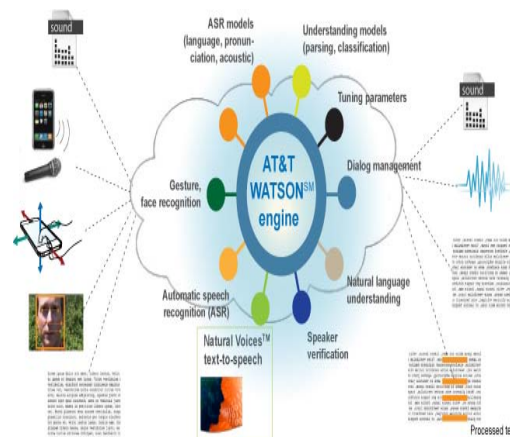


Single Global SIM

Management  
(Provisioning  
Device)



Natural  
Languages



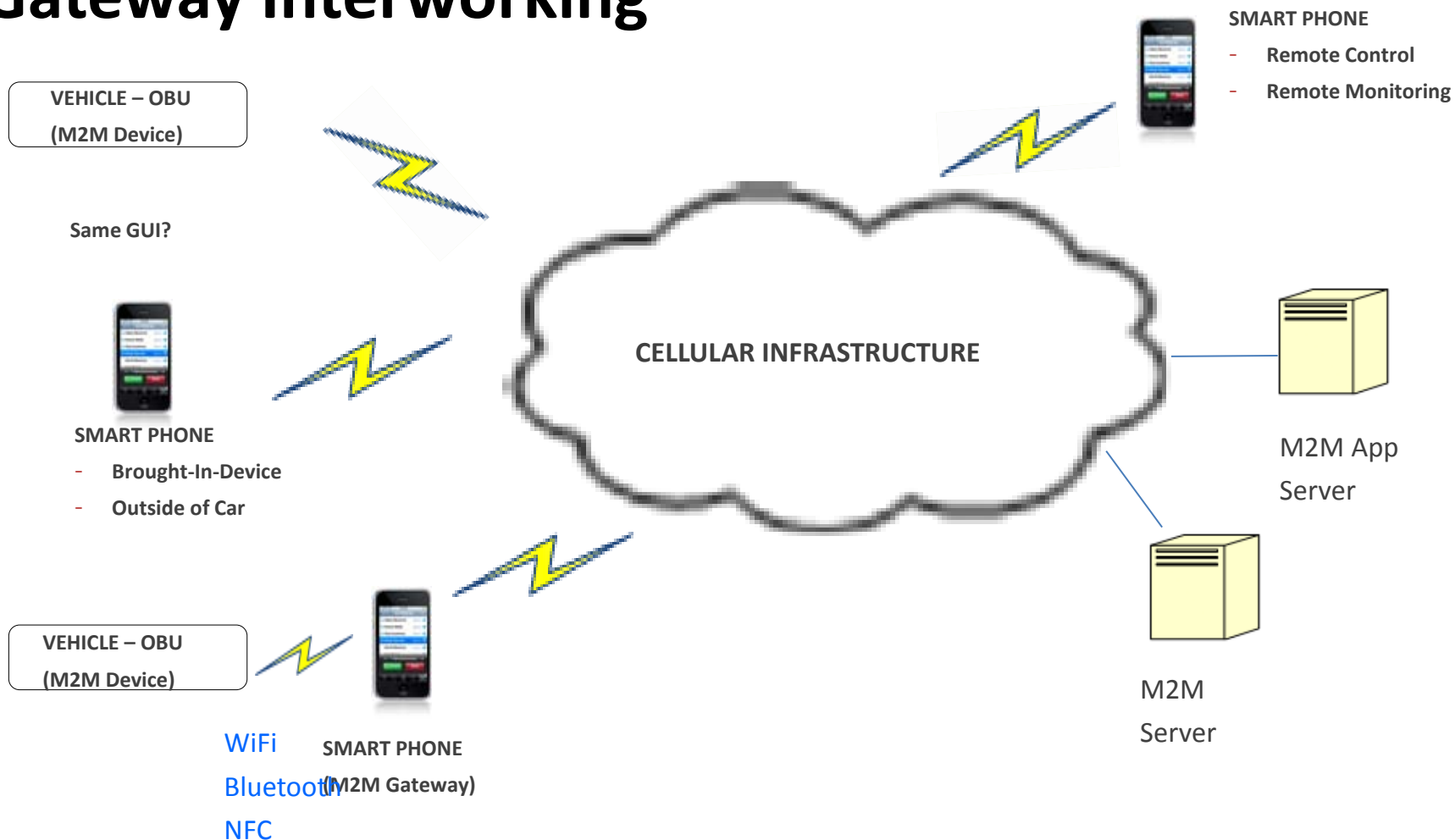
Service  
(Voice Control  
App)

Watson Speech Engine

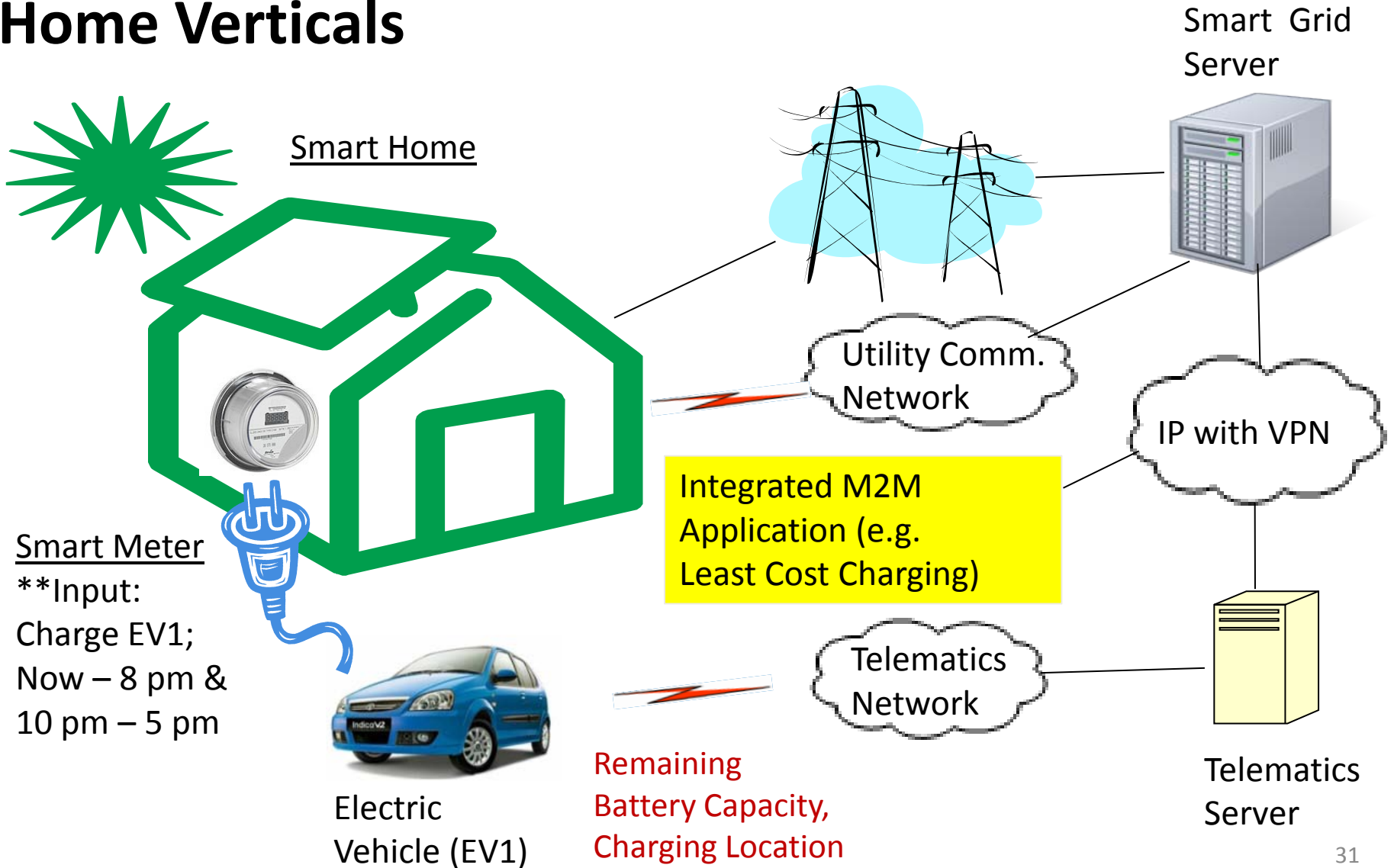


GM Chevy Impala 2014

# Telematic Service and Management via Device - Gateway Interworking



# Telematics Integration with Smart Grid and Smart Home Verticals



# Overview of ETSI M2M Architecture

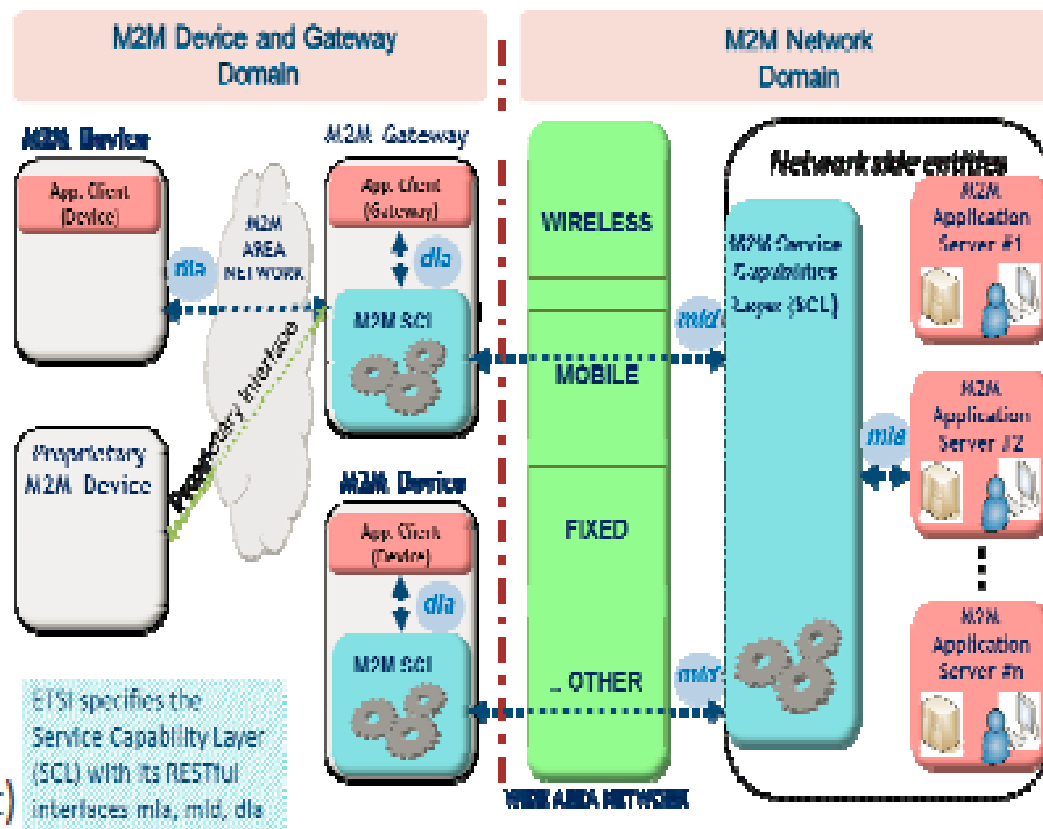
- Defines a “Service Capability Layer” (SCL) on top of connectivity layers

- SCL in network server, gateways and devices.
- SCL does *registration, access rights, security&authentication, data-transfer (containers), subscribe / notify, groups ...*

- API for applications is based on REST principles allowing

- Scalability (stateless, idempotent)
- Unreliable connections
- Binding to e.g. HTTP, CoAP

- Re-uses TR-069 (from BBF) and OMA DM (from OMA) for device management





# OneM2M Standard for Common Service Layer

- Organizations
    - ICT/Telecom SDOs: ETSI (Europe), ATIS, TIA (North America), CCSA (China), ARIB, TTC (Japan), TTA (Korea)
    - Others standards and specifications setting organizations (e.g., OMA)
    - Industry groups
    - Associations
    - Specific technology organizations
  - Individual Companies
    - Service Providers (e.g., M2M SPs, Telecom SPs, Service Layer SPs)
    - M2M service users (e.g., Utilities)
    - Vendors (e.g., M2M Application Providers)
  - Regional/Country Governmental Entities
- Also incorporating input from member companies participating in non-OneM2M standard bodies (e.g. BBF, NIST)

\* ETSI: European Telecommunications Standards Institute  
ATIS: Alliance for Telecommunications Industry Solutions  
OMA: Open Mobile Alliance

# OneM2M Standard for Common Service Layer

- A. Common set of service layer capabilities
- B. Access independent view of end-to-end services
- C. Open/standard interfaces, APIs, and protocols
- D. Security, privacy, and charging
- E. Reachability and discovery of applications
- F. Identification and naming of devices and applications
- G. Device management
- H. Abstraction and semantic capability enablement
- I. Interoperability