



Internet of Things: An Introduction

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What is it or What are they?

The **Internet of Things (IoT)** is the network of physical objects—devices, vehicles, buildings and other items— **embedded with electronics, software, sensors, and network connectivity** that enables these objects to collect and exchange data. -

WikipediaA

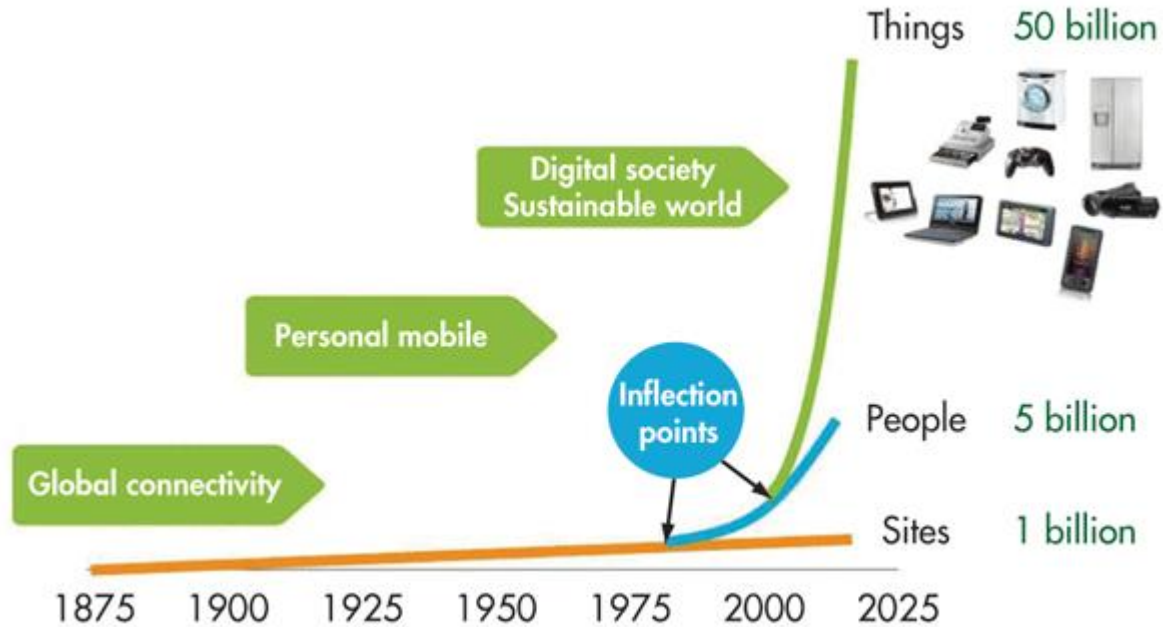
The Internet of Things revolves around increased **machine-to-machine communication**; it's built on cloud computing and **networks of data-gathering sensors** - Wired Magazine

GE's "Industrial Internet" vision: "the convergence of machine and intelligent data... to create brilliant machines."

Gartner's 2015 Hype Cycle for Emerging Technologies



The evolution of connected computing



Examples



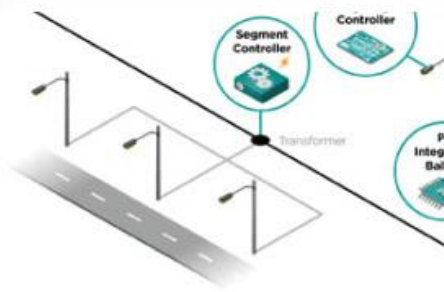
HEAT YOUR HOME EFFICIENTLY



MAKE SURE THE OVEN IS OFF



KEEP YOUR PLANTS ALIVE



LIGHT STREETS MORE EFFECTIVELY



REMEMBER TO TAKE YOUR MEDS



MONITOR AN AGING FAMILY MEMBER



TRACK YOUR ACTIVITY LEVELS



CHECK ON THE BABY



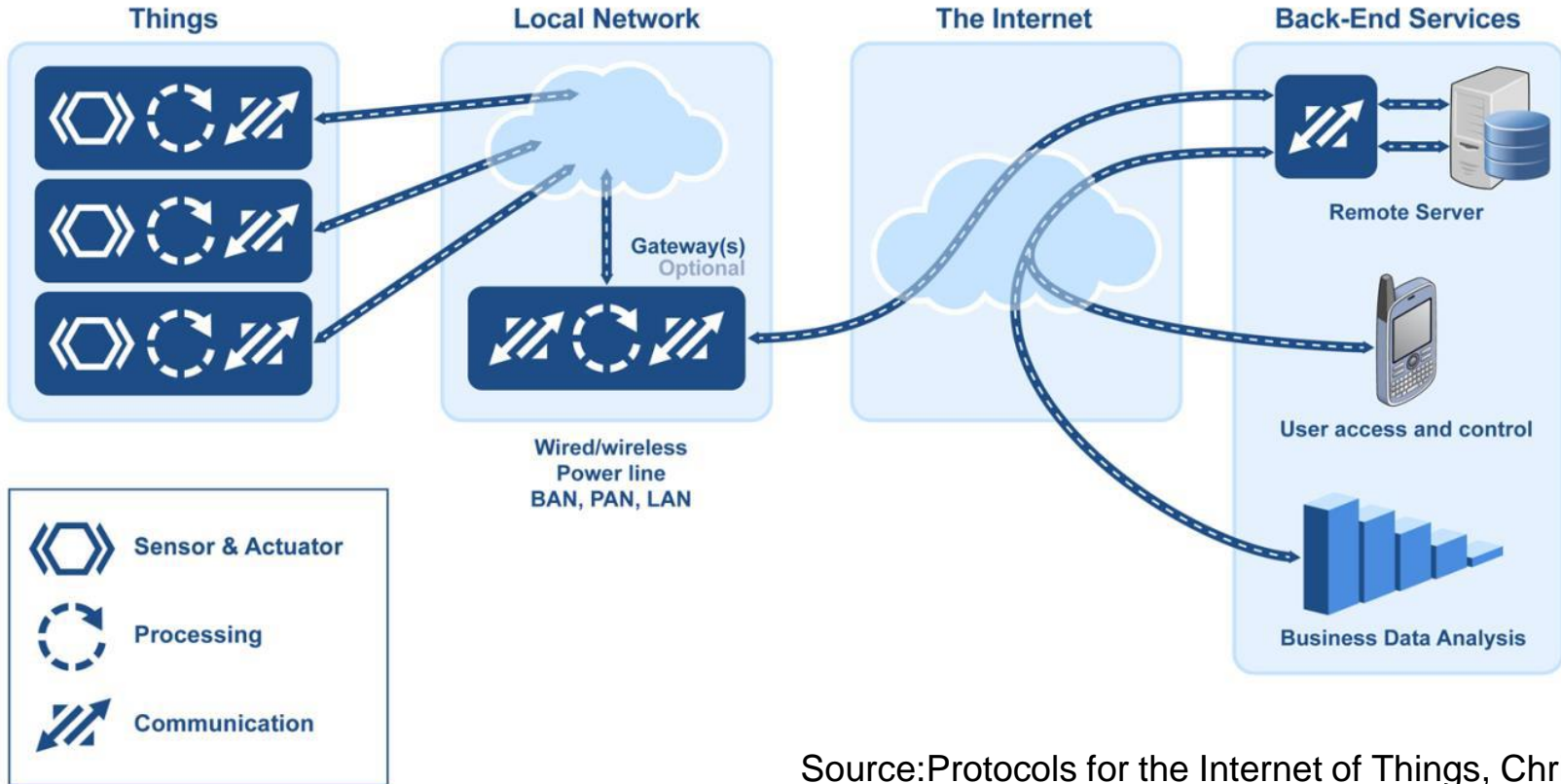
MONITOR POLLUTION LEVELS



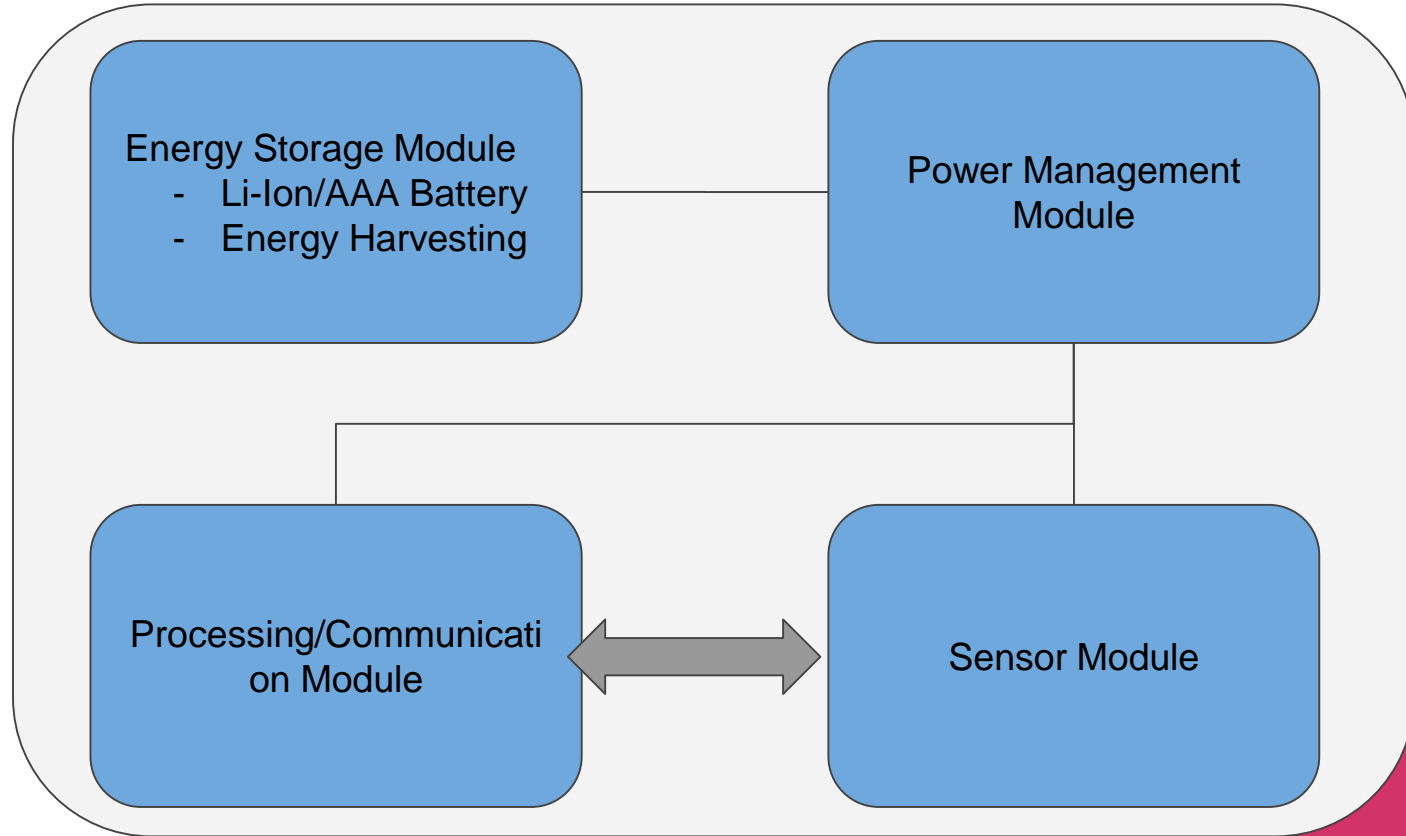
TRACK WATER

IoT End-to-End Context

IoT is Made of Embedded Devices

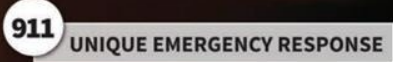
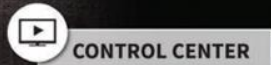
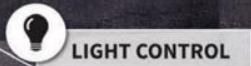
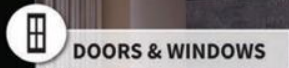
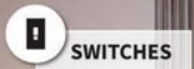


An IoT Device



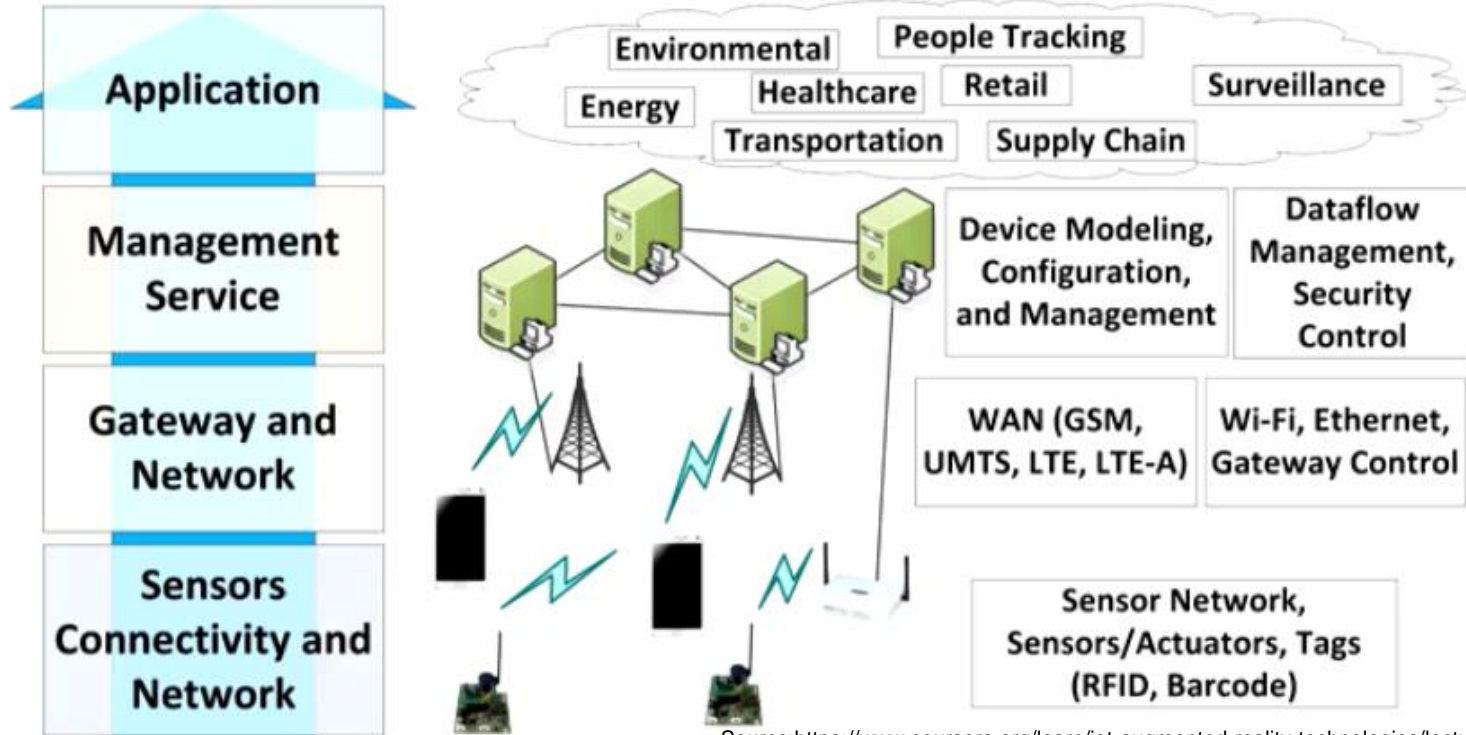
SAGE

by HUGHES
SECURITY & HOME AUTOMATION



IoT Architecture

IoT Architecture Layers



IoT Protocols

Layer 1 & 2

Zigbee

802.15.4 IEEE

Z-Wave

ADT and others

Bluetooth*

Full Up Stacks

WiFi

Cellular

IoT Protocols

Layer 3

6LowPAN

IPv6 over Low power Wireless Personal Area Networks (IETF Standard)

Defines encapsulation and header compression mechanisms that allow IPv6 packets to be sent and received

Targets Low Data rate wireless networks and resource constrained devices

Defined adaptation layer with regular IPv6 domain

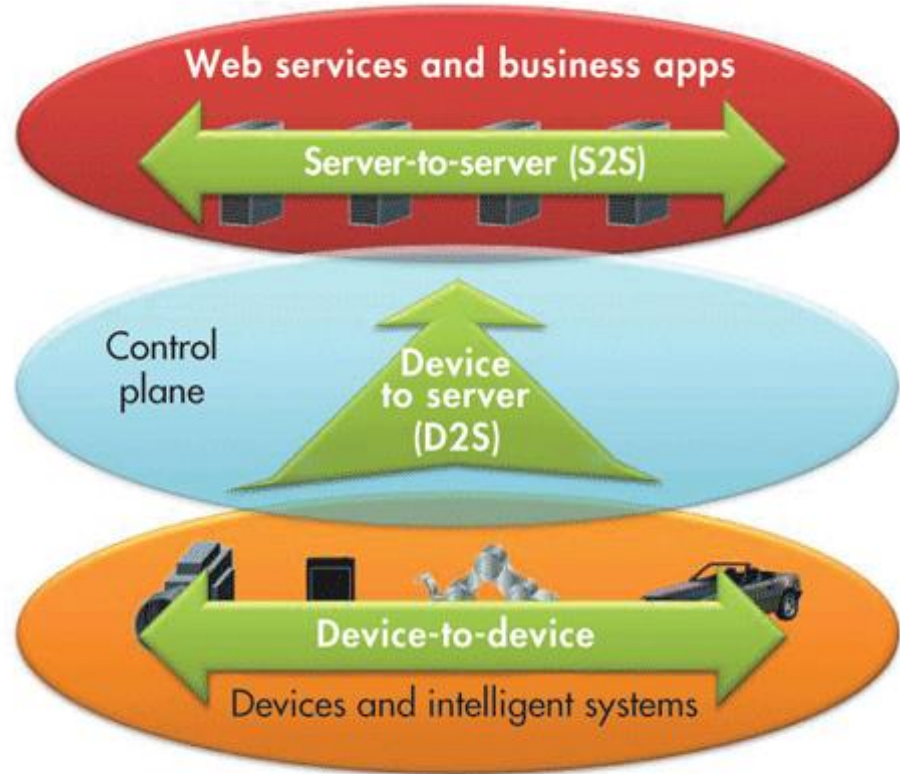
Protocol Overview

D2D - Device to Device

D2S - Device to Server

MQTT - Message Queue
Telemetry Transport

XMPP - Extensible Mess
and Presence Protoc



Protocol Overview

D2S - Device to Server

MQTT - Message Queue Telemetry Transport

XMPP - Extensible Messaging and Presence Protocol

D2D

DDS - Data Distribution Service

Thread -

S2S - Server to Server

Protocols

MQTT - Message Queue Telemetry Transport

For collecting device data and communicating it to servers - D2S

Hub-Spoke

Example: monitoring the transmission lines

XMPP - Extensible Messaging and Presence Protocol

For connecting devices to people (D2S)

addressing scheme (name@domain.com) helps connect the needles in the
huge Internet haystack



Protocols

DDS - Data Distribution Service targets devices that directly use device data

Efficiently delivers millions of messages per second to many simultaneous receivers

Bus topology

Example: connecting sensors and actuators in an industrial setting

AMQP - Advanced Message Queuing Protocol (AMQP) - S2S

Most appropriate for the control plane or server-based analysis functions

Example: analyzing the power usage back at the data center

Impact On Hughes

Lot of *chatter* in inroute traffic

Small messages, but lots of them

Will keep inroute *active*

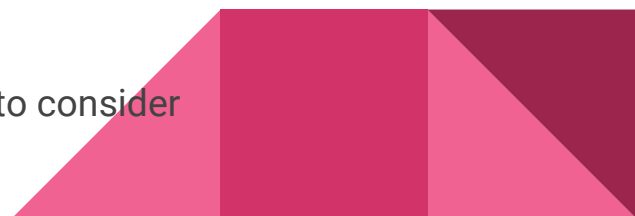
M2M traffic *may not be spoofed !*

Save on resources !

Handle lot more UDP traffic

Based on the device functionality, reliability will be one big area to consider

First Feature to handle IoTs





"Learning is Knowledge - Sharing
is Wisdom"

Consider Sharing @ Lunch & Learn Sessions

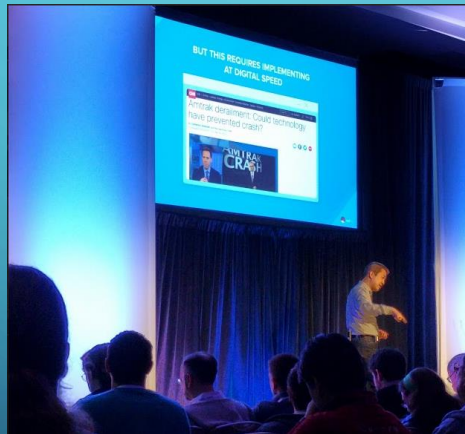


IOT AND LINUX

CAN MY LIGHTBULB RUN LINUX?

IOT AND LINUX

- Embedded Linux Conference 2016
 - IoT currently fractured across many layers
 - Linux Foundation trying to help standardize
 - Lots of competition and urgency (from corporations) to become *the* standard



Bryan Che, Red Hat

IOT AND LINUX

CAN MY LIGHTBULB RUN LINUX?

- Possibly. But should it?
- A few questions:
 - What should my IoT device run?
 - How will it communicate with other IoT devices?
 - How can I make my device developer-friendly?
 - How do I handle all the IoT data being generated?
- No easy answers. Everything still rapidly evolving.
- Most solutions - from edge devices to thing OSes, are built on some form of Linux



IOT AND LINUX

WHAT SHOULD MY DEVICE RUN?



Google's solution
(based on Android)



Linux Foundation – corporation
sponsored embedded Linux development
tools



Linux Foundation + Wind River =
super lightweight RTOS



Linux Foundation + TSG (Intel, Samsung,
etc.) = "OS of Everything"

IOT AND LINUX

HOW WILL MY DEVICE(S) COMMUNICATE?



Lightweight
publish/subscribe messaging

Google's solution (tightly
integrates with Brillo)



Cloud-scalable
messaging protocol
"central nervous
system"

IOT AND LINUX

HOW WILL MY DEVICE(S) COMMUNICATE?

Linux Foundation –
(funded by OIC)
standardization layer

IoTivity



IOT AND LINUX

- OS/Protocol is based on needs
- Rapidly evolving
- Lots of solutions work – pick one
- Edge devices might need to support variety of different protocols

