CS433: Internet of Things
NCS463: Internet of Things

Dr. Ahmed Shalaby

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Publications [Titles(11) :: Papers(3) :: Abstracts(11) **]**

Courses Files(93)

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External links: (41)

News

Great Teams: Embedded System Course: CanSat Project. [2022-07-04]
https://www.youtube.com/watch?v=w7v8W1ENgqMmore

Research Interests

Hardware Security, System on Chip, Network on Chip, VLSI, Embedded System, High Efficiency Video Coding (HEVC)

Selected Publications

- Efficient autoencoder-based human body communication transceiver for WBAN
- Sentry-NoC: a statically-scheduled NoC for secure SoCs
- Automatic arrival time detection for earthquakes based on Modified Laplacian of Gaussian filter

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The Now Habit - عاده الإنجاز
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PROJECTION MAPPING

Internet of Things – What?

- **Internet of Things** (IoT) is an application domain that integrates different technological and social fields.

Despite the diversity of research on IoT, its definition remains fuzzy.

Towards a Definition of the Internet of Things (IoT)

- **Internet of Everything** (IoE) is used by Cisco to refer to people, things, and places that can expose their services to other entities.
- **Industrial IoT (IIoT),** IoT applications favored by big high-tech companies. IIoT can be used to efficiently track and manage the supply chain, perform quality control and assurance, and lower the total energy consumption.

Internet of Things – What?

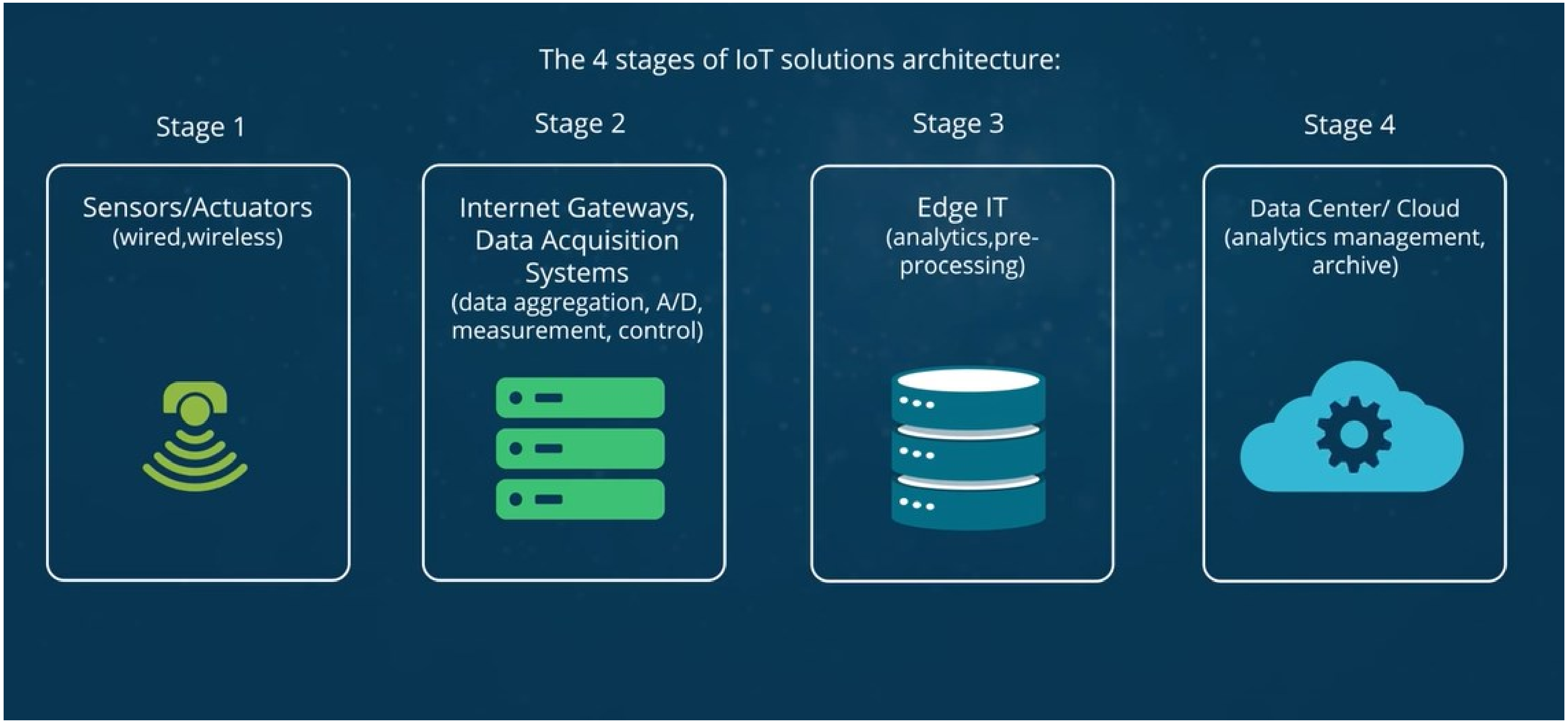
Two important pillars of IoT: “Internet” and “Things”

- “**Internet**” refers to the vast category of applications and protocols built on top of sophisticated and interconnected computer networks, serving billions of users around the world 24/7.

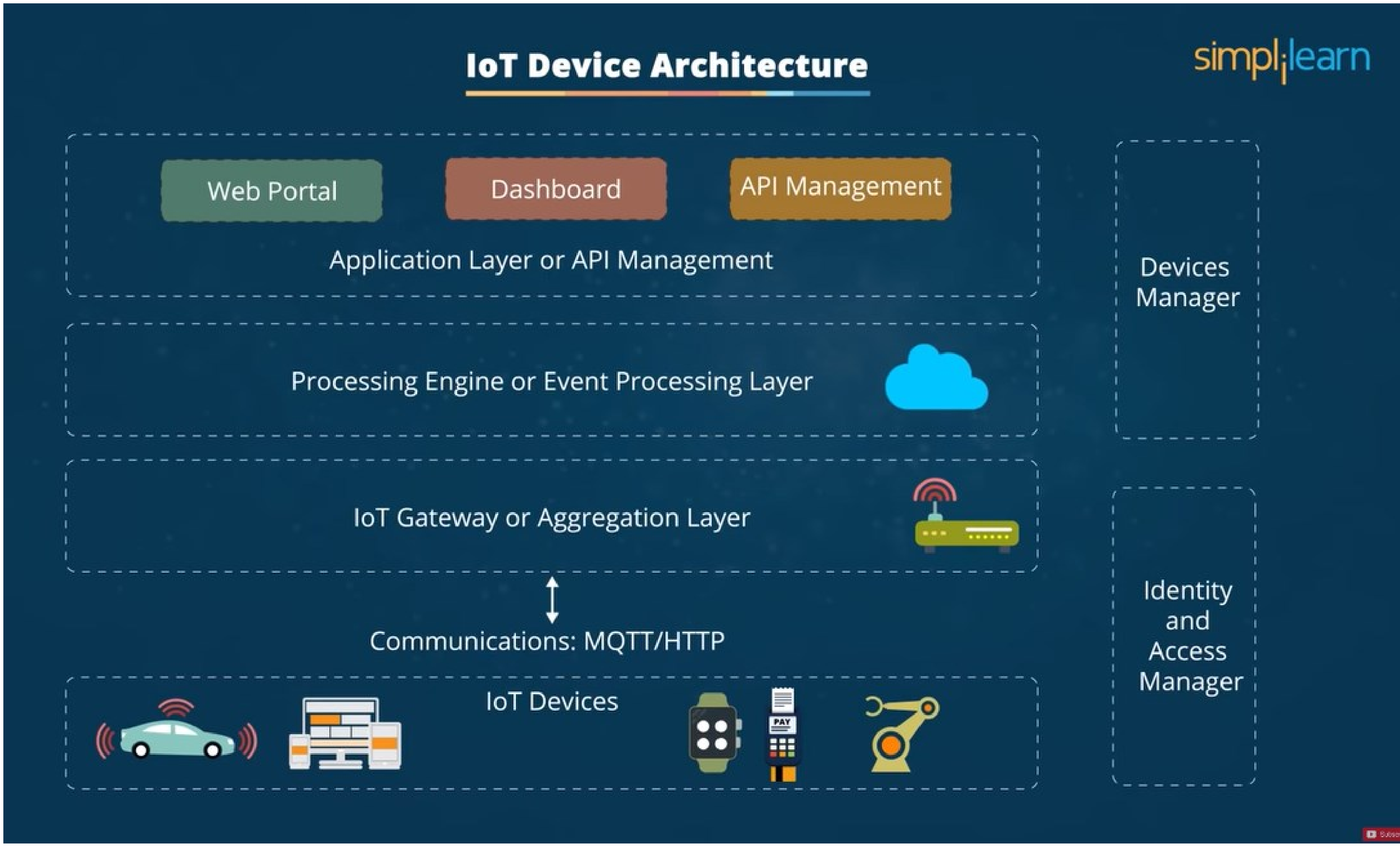
- “**Things**” are a generic set of entities, including smart devices, sensors, human beings, and any other object that is aware of its context and is able to communicate with other entities, making it accessible at any time, anywhere.

“Kevin Ashton” is accredited for using the term “Internet of Things” for the first time during a presentation in **1999** on supply-chain management. [**RFID**]

Internet of Things – What?



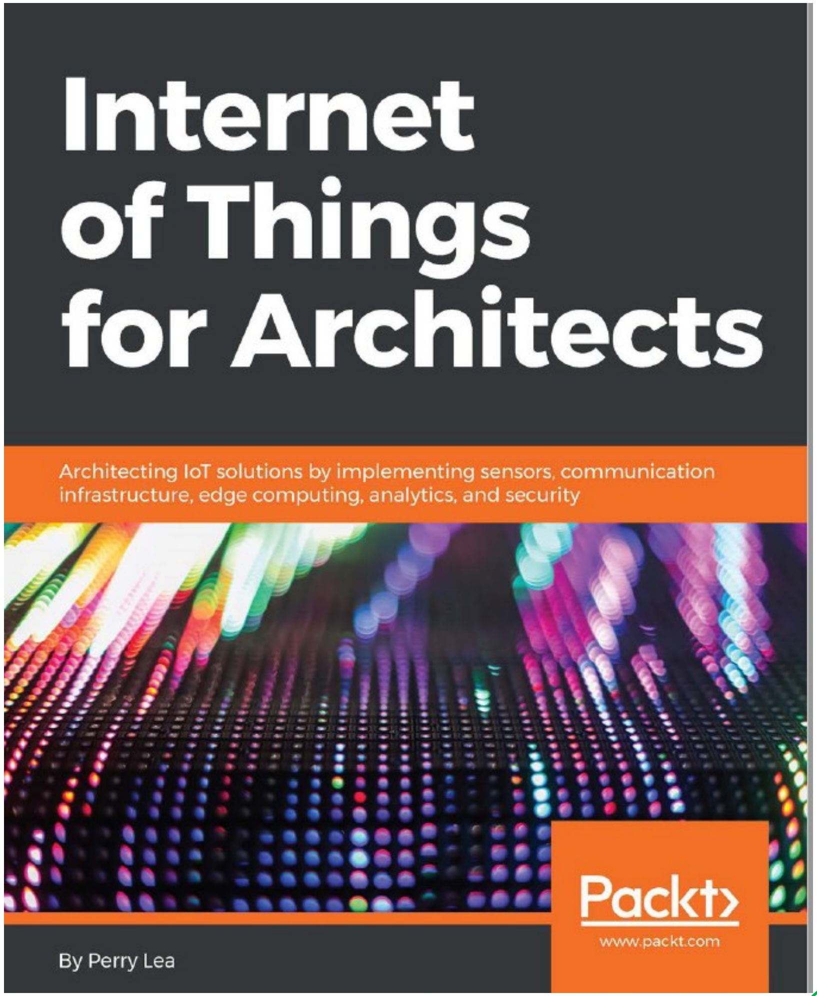
Internet of Things – What?



Internet of Things – How?

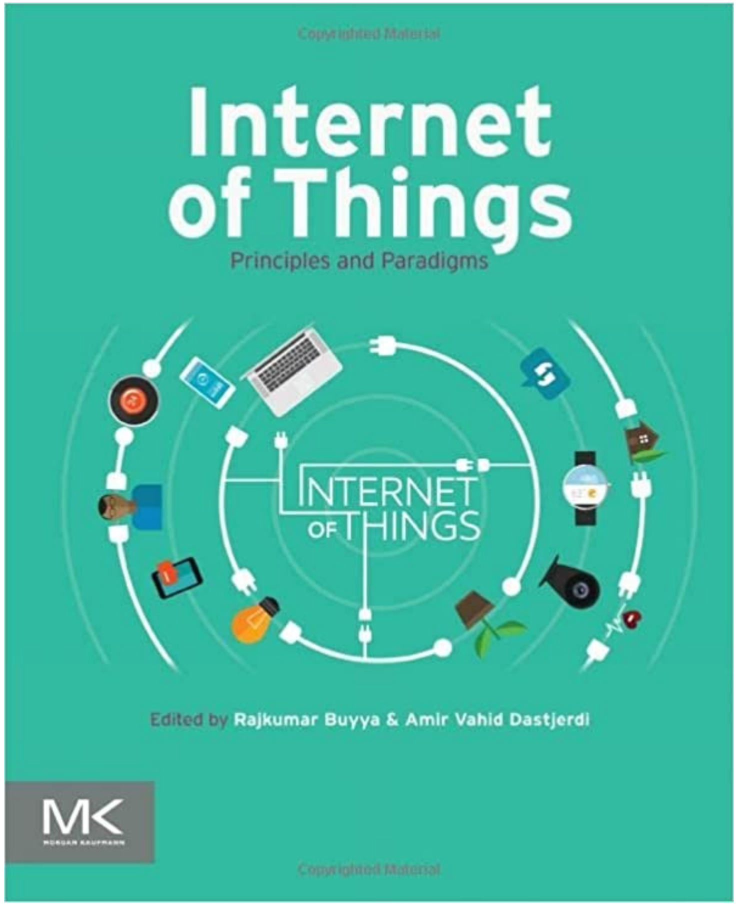
- Chapter 2: IoT Architecture and Core IoT Modules.
- Chapter 3: Sensors, Endpoints, and Power Systems.
- Chapter 4-8: Communications and Information and Networks.
- Chapters 9-10: IoT Edge, Fog, and Cloud Protocols.
- Chapter 11: Data Analytics and Machine Learning.
- Chapter 12: IoT Security.
- Chapter 13: Consortiums and Communities

Lea, Perry. *Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security.* Packt Publishing Ltd, 2018.



Internet of Things – How?

- Part I: IoT ecosystem concepts and architectures
- Part II: IoT enablers and solutions
- Part III: IoT data and knowledge management
- Part IV: IoT reliability, security, and privacy
- Part V: IoT applications



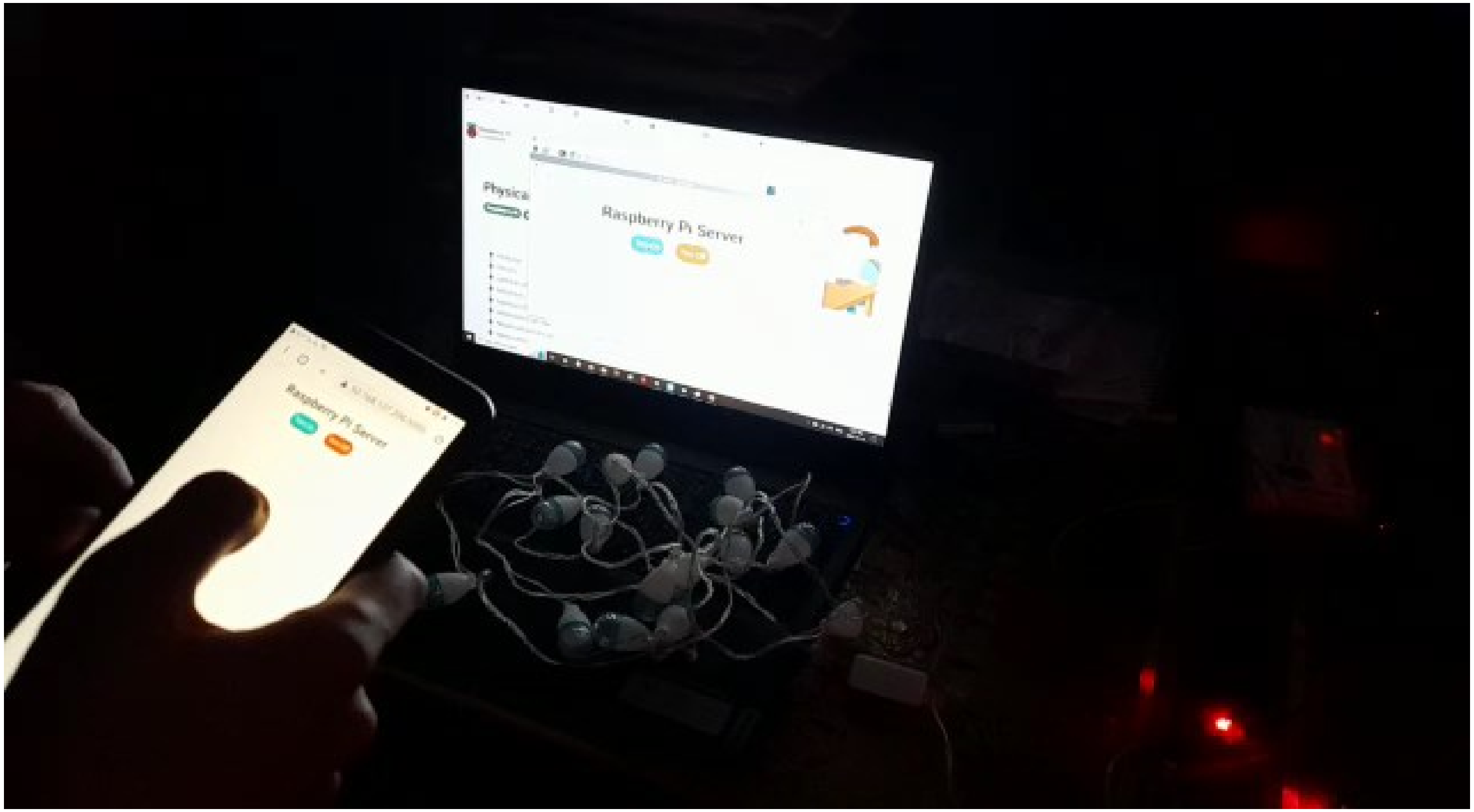
[Internet of Things Principles and Paradigms](#)
By: Rajkumar Buyya, Amir Vahid Dastjerdi

[AWS IoT: Developing and Deploying an Internet of Things](#)

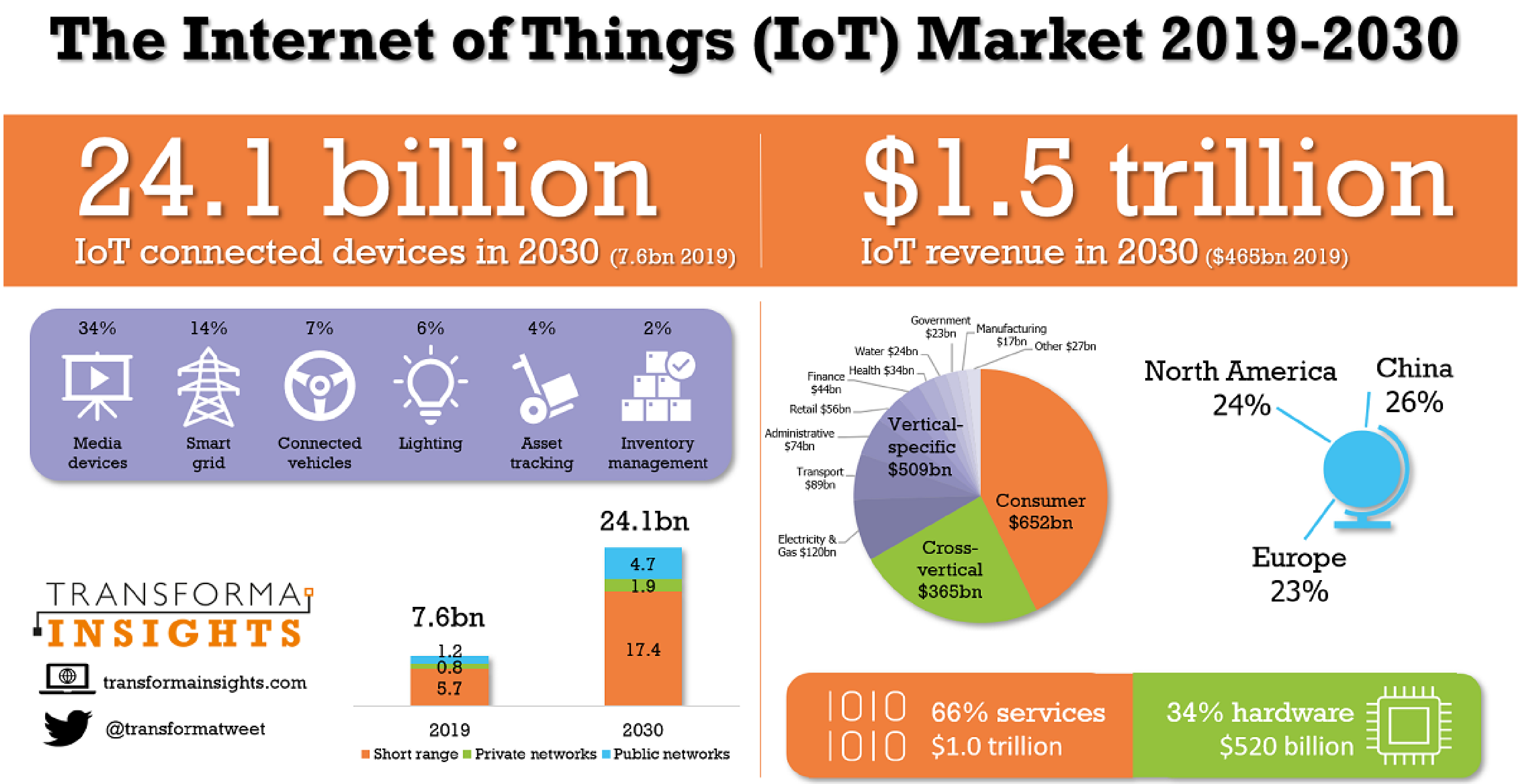
Internet of Things – Why?

[Internet of Things]

IoT by Example

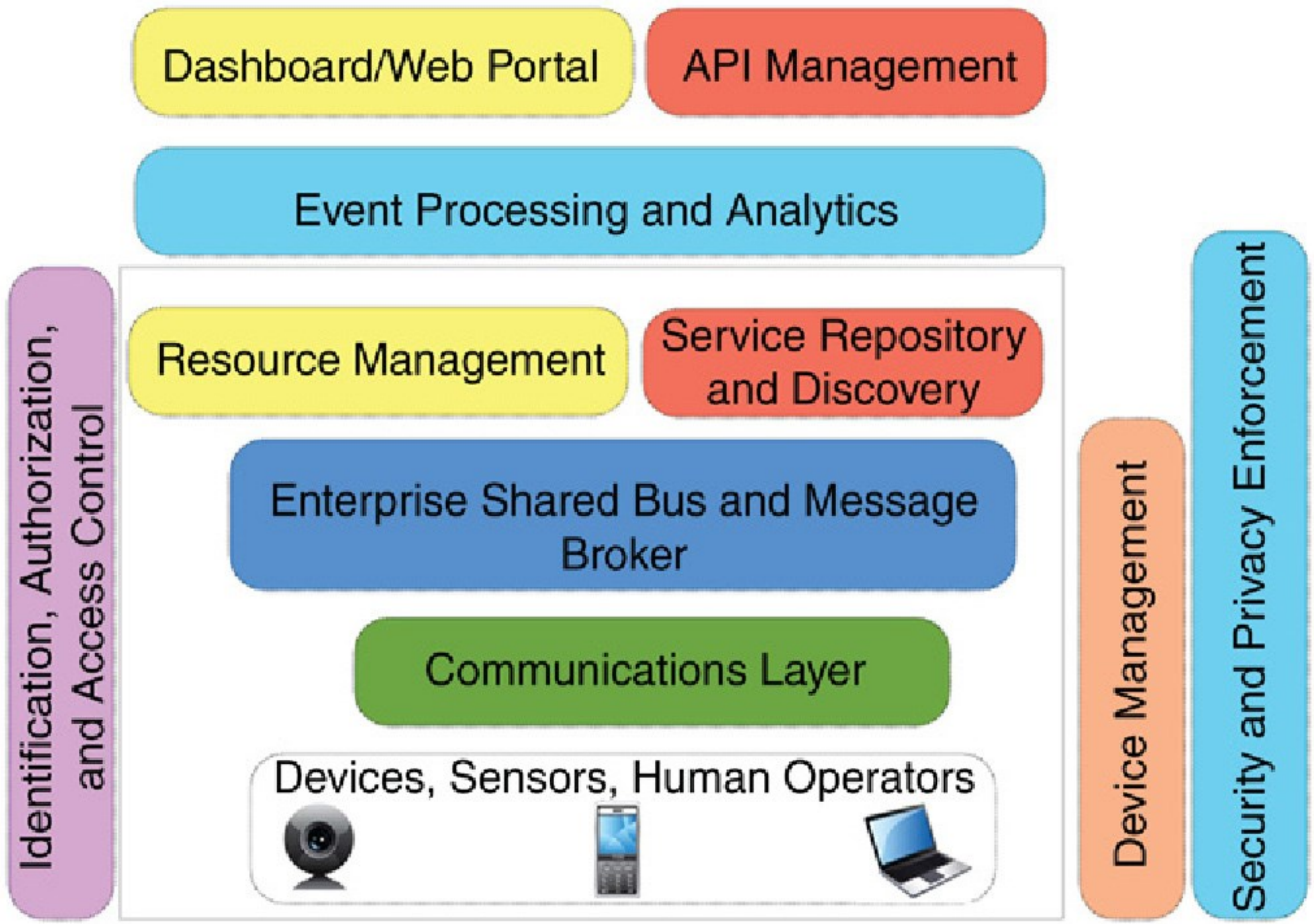


IoT Market Share



https://transformainsights.com/news/iot-market-24-billion-usd15-trillion-revenue-2030

IoT Architectures



IoT Architectures

- IoT state-of-the-art architectures need to have a certain level of adaptability to properly handle dynamic interactions within the whole ecosystem Since mobility and dynamic change of location have become an integral part of IoT systems.

- Service layers include event processing and analytics, resource management and service discovery, as well as message aggregation and Enterprise Service Bus (ESB) services built on top of communication and physical layers.

- Web-based dashboards (or equivalent smartphone applications) for managing and accessing Application Programming Interfaces (APIs). API management is essential for defining and sharing system services.

- Lightweight data-exchange formats like **JSON** can reduce the overhead by replacing large ***XML*** files used to describe services. This helps in using the communication channel and processing the power of devices more efficiently.

IoT Data Management And Analytics

❑ IoT & The Cloud

Due to its on-demand processing and storage capabilities, cloud computing can be used to analyze data generated by IoT objects in batch or stream format. A pay-as-you-go model adopted by all cloud providers has reduced the price of computing, data storage, and data analysis, creating a streamlined process for building IoT applications.

❑ Real-time Analytics In IoT & Fog Computing

The processing and storage capability of these devices can be utilized to extend the advantages of using cloud computing by creating another cloud, known as Edge Cloud, near application consumers, to decrease networking delays, save processing or storage costs, perform data aggregation, and prevent sensitive data from leaving the local network

Table 1.1 Cloud Versus Fog

	Fog	Cloud
Response time	Low	High
Availability	Low	High
Security level	Medium to hard	Easy to medium
Service focus	Edge devices	Network/enterprise core services
Cost for each device	Low	High
Dominant architecture	Distributed	Central/distributed
Main content generator—consumer	Smart devices—humans and devices	Humans—end devices

IoT Data Management And Analytics

- IoT - Cloud & Fog

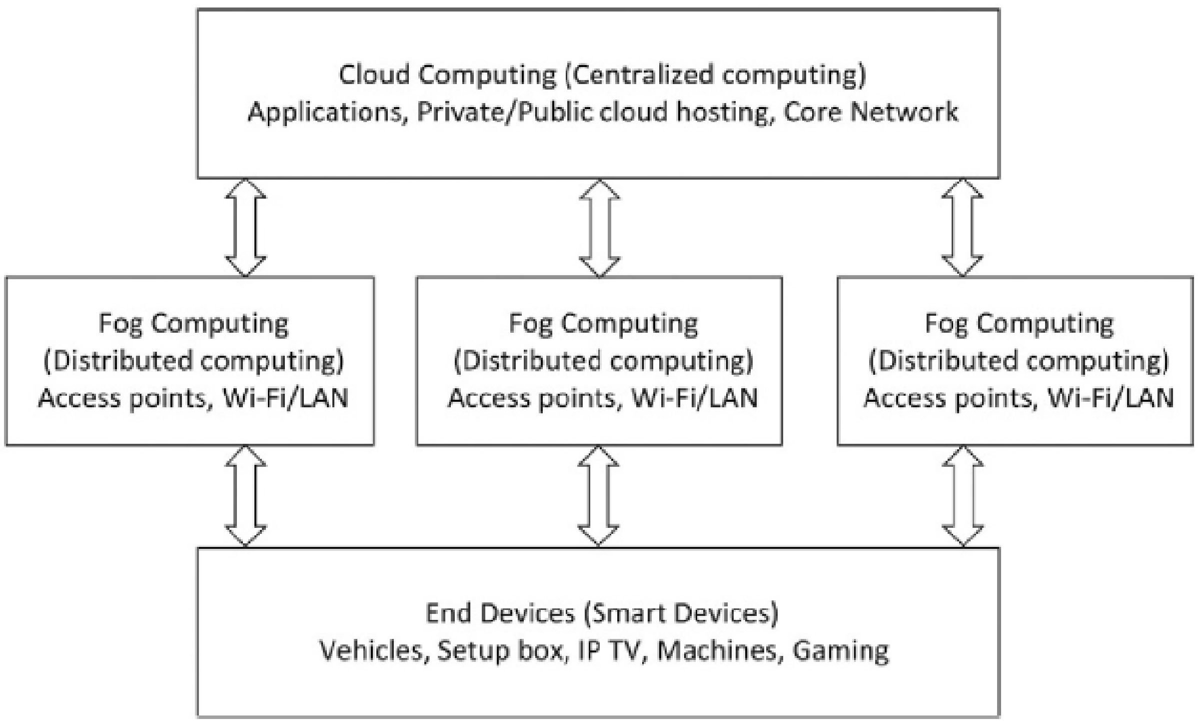
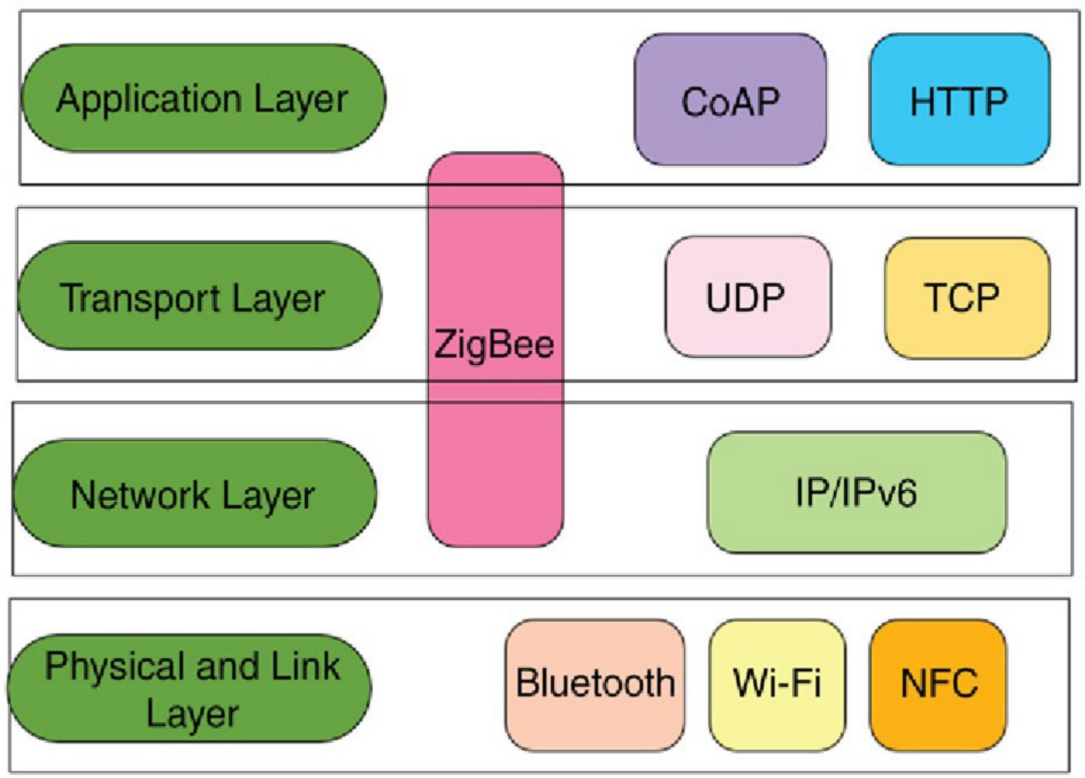


FIGURE 1.5 Typical Fog Computing Architecture

Communication Protocols .



Communication Protocols ..

Table 1.2 IoT Communication Protocols Comparison

Protocol Name	Transport Protocol	Messaging Model	Security	Best-Use Cases	Architecture
AMPQ	TCP	Publish/Subscribe	High-Optional	Enterprise integration	P2P
CoAP	UDP	Request/Response	Medium-Optional	Utility field	Tree
DDS	UDP	Publish/Subscribe and Request/Response	High-Optional	Military	Bus
MQTT	TCP	Publish/Subscribe and Request/Response	Medium-Optional	IoT messaging	Tree
UPnP	—	Publish/Subscribe and Request/Response	None	Consumer	P2P
XMPP	TCP	Publish/Subscribe and Request/Response	High-Compulsory	Remote management	Client server
ZeroMQ	UDP	Publish/Subscribe and Request/Response	High-Optional	CERN	P2P

The publish/subscribe model is a common way of exchanging messages in distributed environments, and, because of its simplicity, it has been adopted by popular M2M communication protocols like **MQTT**. In dynamic scenarios, where nodes join or leave the network frequently and handoffs are required to keep the connections alive, the publish/subscribe model is efficient. This is because of using push-based notifications and maintaining queues for delayed delivery of messages.

IoT Development & its Applications

Table 1.3 List of IoT-Related Projects

Name of Project/Product	Area of Focus
Tiny OS	Operating System
Contiki	Operating System
Mantis	Operating System
Nano-RK	Operating System
LiteOS	Operating System
FreeRTOS	Operating System
RIOT	Operating System
Wit.AI	Natural Language
Node-RED	Visual Programming Toolkit
NetLab	Visual Programming Toolkit
SensorML	Modeling and Encoding
Extended Environments Markup Language (EEML)	Modeling and Encoding
ProSyst	Middleware
MundoCore	Middleware
Gaia	Middleware
Ubiware	Middleware
SensorWare	Middleware
SensorBus	Middleware
OpenIoT	Middleware and development platform
Koneki	M2M Development Toolkit
MIHINI	M2M Development Toolkit

Standardization & Regulatory Limitations

Table 1.4 IoT Standards

Organization Name	Outcome
Internet of Things Global Standards Initiative (IoT-GSI)	JCA-IoT
Open Source Internet of Things (OSIoT)	Open Horizontal Platform
IEEE	802.15.4 standards, developing a reference architecture
Internet Engineering Task Force (IETF)	Constrained RESTful Environments (CoRE), 6LOWPAN, Routing Over Low power and Lossy networks (ROLL), IPv6
The World Wide Web Consortium (W3C)	Semantic Sensor Net Ontology, Web Socket, Web of Things
XMPP Standards Foundation	XMPP
Eclipse Foundation	Paho project, Ponte project, Kura, Mihini/M3DA, Concierge
Organization for the Advancement of Structured Information Standards	MQTT, AMPQ

IoT growth rate will cause difficulties for standardization. Strict regulations about accessing radio frequency levels, creating a sufficient level of interoperability among different devices, authentication, identification, authorization, and communication protocols are all open challenges facing IoT standardization.