A Review on Internet of Things' Operating Systems, Platforms and Applications

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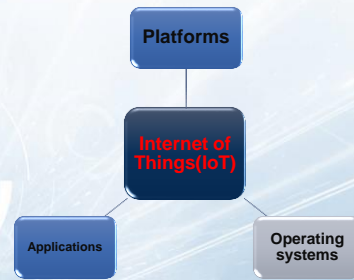## Contents

1. Introduction
2. IoT Architecture
3. IoT Operating Systems
4. IoT Platforms
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Internet of Things(IoT)

"IoT is the network of physical objects or "things" embedded with electronic devices, software technologies, sensors, and network connectivity, which facilitates these objects to collect and exchange data for availing various services"
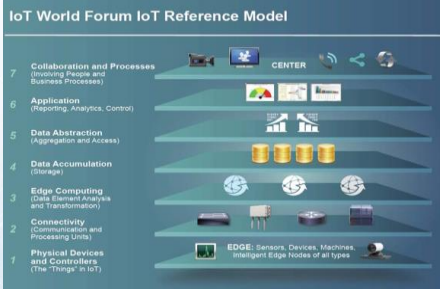

Introduction

- Platforms
- Internet of Things(IoT)
- Applications
- Operating systems

IoT Architecture

IoT World Forum IoT Reference Model

7. Collaboration and Processes (Involving People and Business Processes)
6. Application (Reporting, Analytics, Control)
5. Data Abstraction (Aggregation and Access)
4. Data Accumulation (Storage)
3. Edge Computing (Data Element Analysis and Transformation)
2. Connectivity (Communication and Processing Units)
1. Physical Devices and Controllers (The "Things" in IoT)

EDGE: Sensors, Devices, Machines, Intelligent Edge Nodes of all types

Figure 1. IoT ITU Reference Model[1]

Operating systems

TABLE 1
IoT Operating Systems [2, 3,4]

Operating System	Min RAM	Min ROM	Multi-Threading	Support language
FreeRTOS	< 10 KB	< 12 KB	Full support	C
Contiki	< 2 KB	< 30 KB	Partial support	C
RIOT	~ 1.5 KB	~ 5 KB	Full support	C, C++
Tiny OS	< 1 KB	< 4 KB	Partial support	C
nutiX	32KB	-	Full support	C
Open WSN	-	-	Partial support	C
Nut/OS	-	20 KB	Full support	C
Linux	~1MB	~1MB	Full support	C, C++
Android	-	-	Full support	Java
LiteOS	4 KB	-	Full support	C

Platforms

TABLE 2.
Platforms for Internet of Things [5,6,7]

Platform	Scalability	Availability 24 * 7	Security and privacy provisioning	Support for millions of devices
Axeda Oracle java Embedded	Yes	Yes	Yes	Yes
IBM Blue Mix	Yes	Yes	Yes	Yes
Nimbits	Yes	Yes	No	No
Thing Worx	Yes	Yes	Yes	Yes
Microsoft Azure	Yes	Yes	Yes	Yes
Thing Speak	Yes	Yes	No	No
Sensor cloud--	Yes	Yes	Yes	--
Digital Service Cloud	Yes	Yes	Yes	Yes
Yaler	Yes	Yes	No	No
Xively	Yes	Yes	Yes	Yes
Amazon web service	Yes	Yes	Yes	Yes
Google Cloud Compute	Yes	Yes	Yes	Yes
Zetta	No	Yes	No	No

Applications

TABLE 3
IoT Applications [7,8,9,10]

Application Domain	Technology / Technique	Strengths/ Benefits	Weaknesses
Smart Aerospace and aviation	RFID tags	Safety and operational reliability of aircrafts can be significantly improved	Suspected unapproved parts
Smart Transportation	DSRC, RFID, accelerometer, smart phone, GPS		Ease of security attack
Smart Tele-communications	GSM, NFC, low power Bluetooth, WLAN, multi-hop networks, GPS and sensor networks together with SIM-card	High Security	/
Smart Medical and healthcare	• Basic data of patient will be stored in server for comparison. •RFID, Internet, mobile network, camera, microphones and other equipment.	• Provides options for both Internet and mobile network. • Convenient to users.	High computation cost for patient parameter comparison Time consuming and threshold dependable.
Smart City	RFID,NFC and Sensor network	•Control over light, water and other resources in a city •Traffic light control	Network failure due to security attack
Smart House	Smart phone Sensors (Heat, Light), NFC, Bluetooth	•Household appliance controlling, •Distance learning, •Energy saving	/
Smart Agriculture	WLAN, Sensors and RFID	•Real time detection of animals, •Delivering crops directly to consumers •Managing quality	/

Security Challenges

1- Active attacks(i.e Denial of Service (DoS) attacks)

2- Passive attacks(i.e Eavesdropping)

3- Physically securing sensors

Solutions ?

1- End-to-End Security Mechanisms
2- End-to-End Data Encryption
3- Access and Authorization Control
4- Activity Auditing
5- Hardened Cloud Infrastructure
6-Equal Protection across Multiple protocols
7- Usecurity and privacy education

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Thank you.

Questions ?