



Rapid IoT prototyping with mbed and Firebase: WiFi devices

Asst.Prof.Dr.Supachai Vorapojpisut
Thammasat University

<https://github.com/vsupacha/tensailab-embc/tree/master/mbedFirebase>

IoT development



	Node	Area	Security	Objective
Service	$N > 1000$	No limit	Must be	Business
Organization	$N > 100$	Buildings	Should be	Specific target
Study	$10 < N < 100$	Zone	Not required	Data
Hobby	$N < 10$	Home	Not required	I can do

IoT security

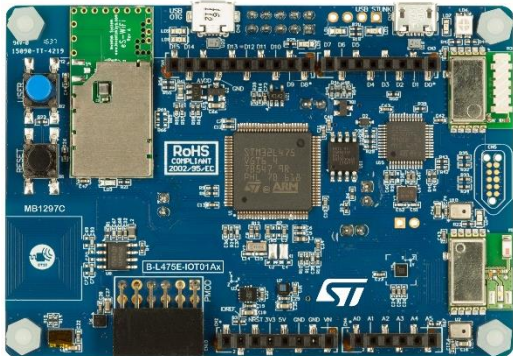


Insufficient privacy protection

Lack of device management

Insecure default settings

Insecure network services



Insecure data transfer and storage

WiFi AP – LAN – DNS – servers



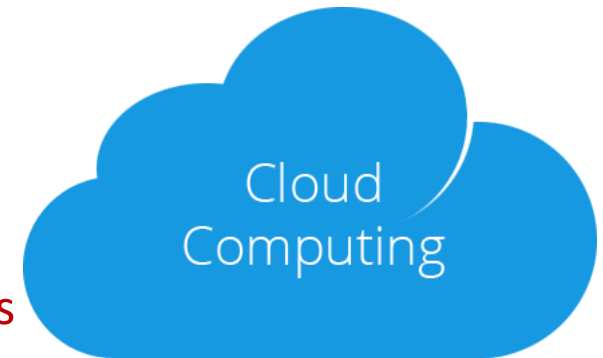
Use of insecure or outdated components

Lack of physical hardening

Lack of secure update mechanism

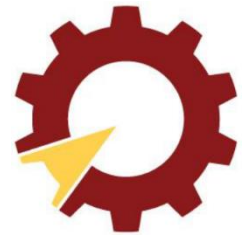
Weak, guessable, or hardcoded passwords

Insecure ecosystem interfaces



[https://www.owasp.org/index.php/OWASP Internet of Things Project](https://www.owasp.org/index.php/OWASP_Internet_of_Things_Project)

IoT platforms



Lack of physical hardening

Insufficient privacy protection

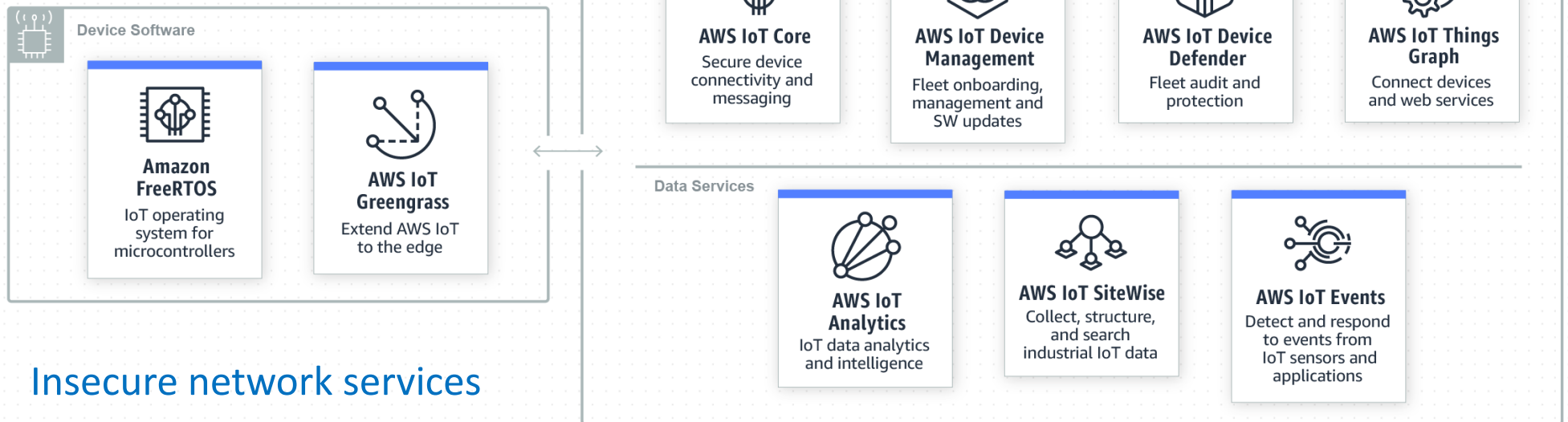
Insecure default settings

Weak, guessable, or hardcoded passwords

Insecure ecosystem interfaces

Lack of secure update mechanism

Lack of device management



Insecure network services

Insecure data transfer and storage

Use of insecure or outdated components

Views of IoT implementation



Physical



- I/O interfaces: **digital, analog, timing, comm.**
- Temporal behaviors: **period, response time**
- Data operations: **aggregate, filter, detect**
- Power management: **sleep, clock freq.**

C-I-A

Cyber

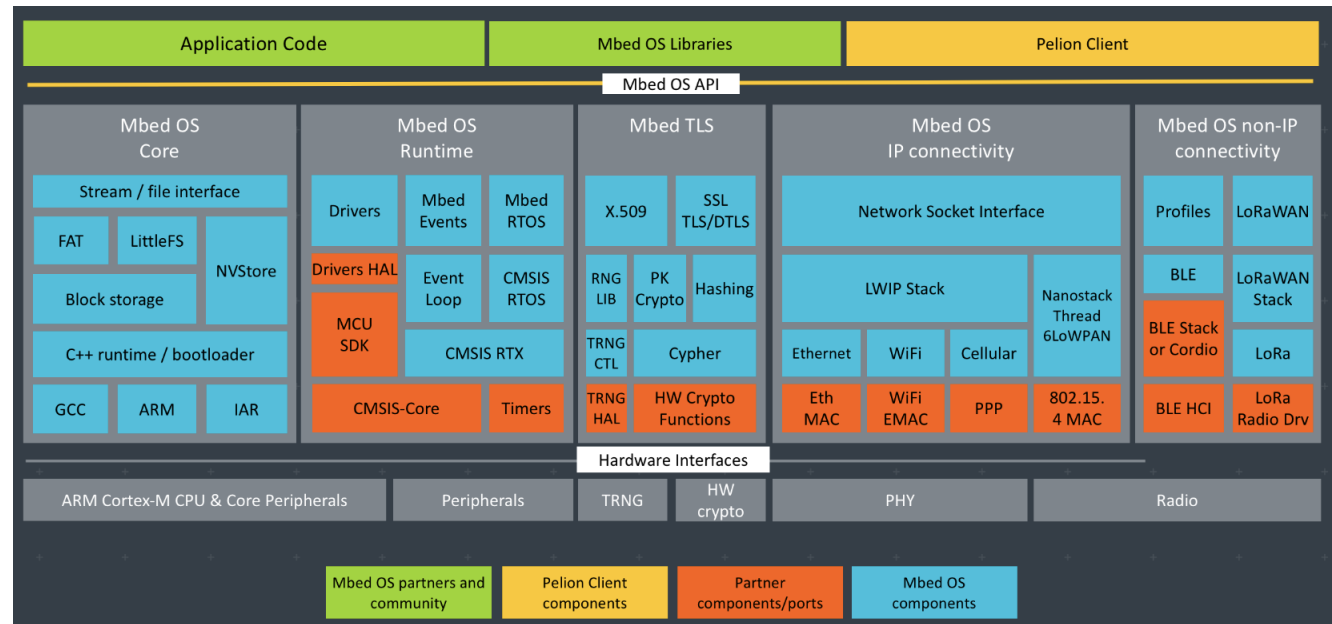
- Interfaces: **web API**
- Device & user operations: **register, AAA**
- Storage: **CRUD**
- Data operations: **summarize, detect anomalies, classify, machine learning**

mbed os

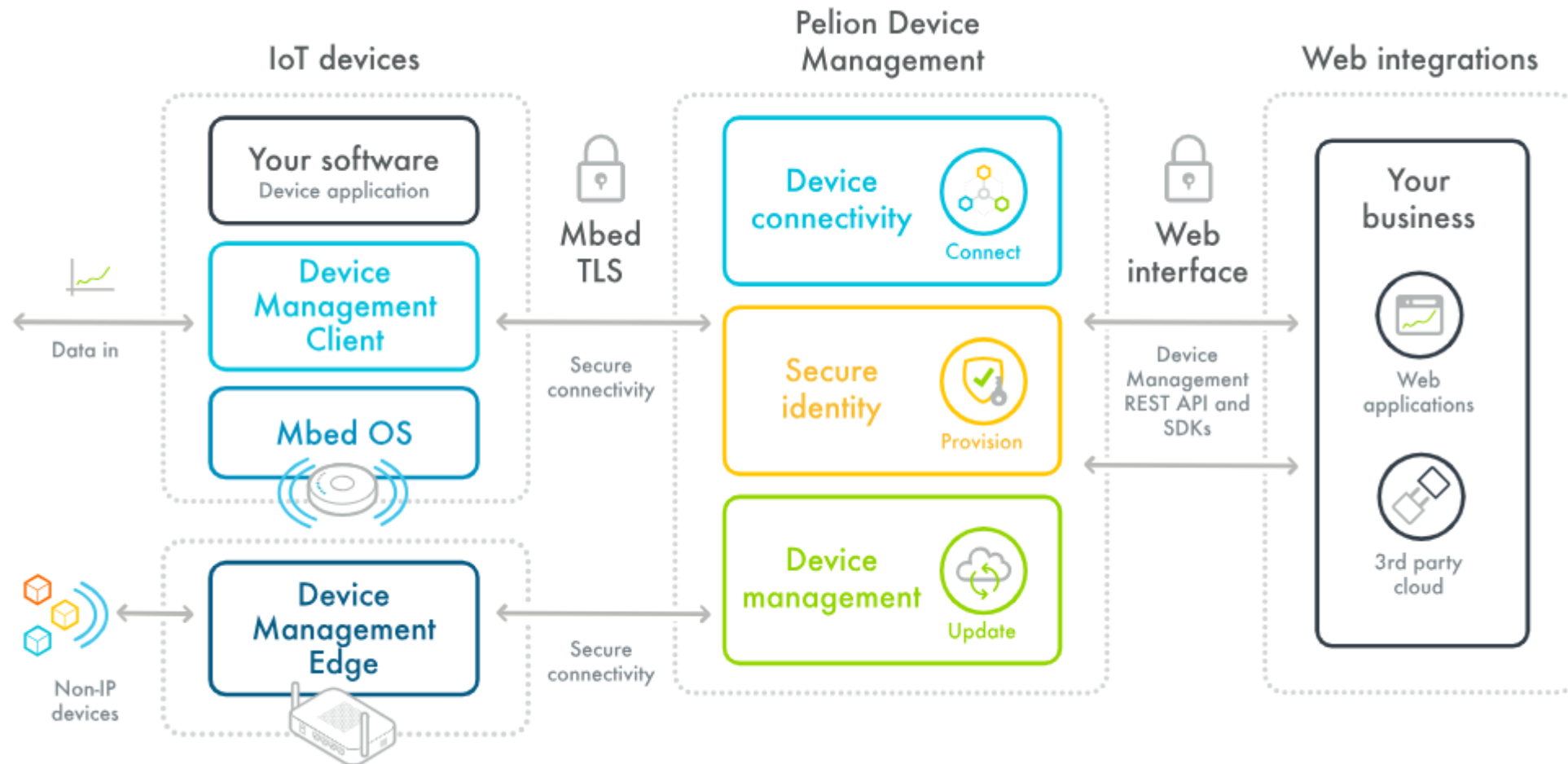


<https://os.mbed.com/platforms/ST-Discovery-L475E-IOT01A/>

<https://os.mbed.com/>



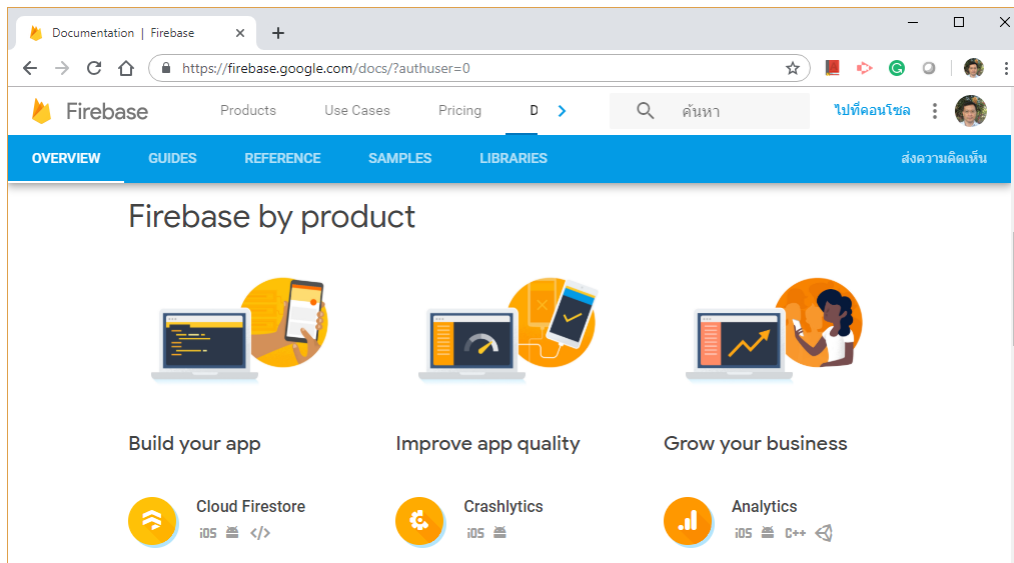
mbed IoT platform



Google Firebase



<https://firebase.google.com/docs/?authuser=0>



Cloud Firestore

iOS Android </> NODE JAVA Python GO

Cloud Functions for Firebase

iOS Android </> C++ Kotlin

Cloud Storage

iOS Android </> C++ Kotlin

Firebase Authentication

iOS Android </> C++ Kotlin NODE JAVA

Development flow



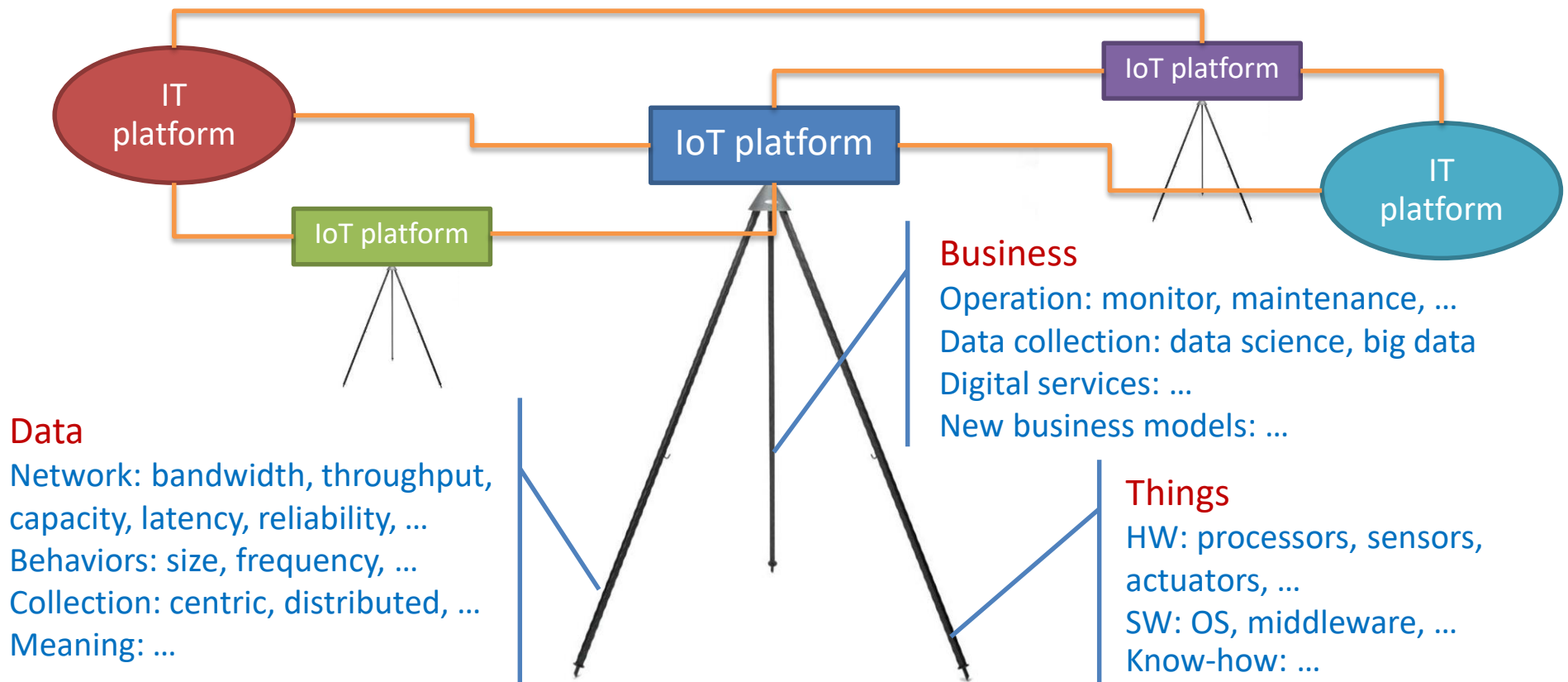
Things

1. Register at os.mbed.com
 - Add HW platform
2. Create new project
 - Add driver/middleware
3. Write code
 1. Add root CA certificate
 2. Create network interface
 3. Add handler code
 4. Start HTTPS request
 5. Parse JSON response

Service

1. Register at firebase.google.com
 - Create web project
 - Create auth token
2. Prepare node.js & firebase CLI
3. Write firebase rules
4. Write trigger code
 - HTTP trigger
 - Database trigger

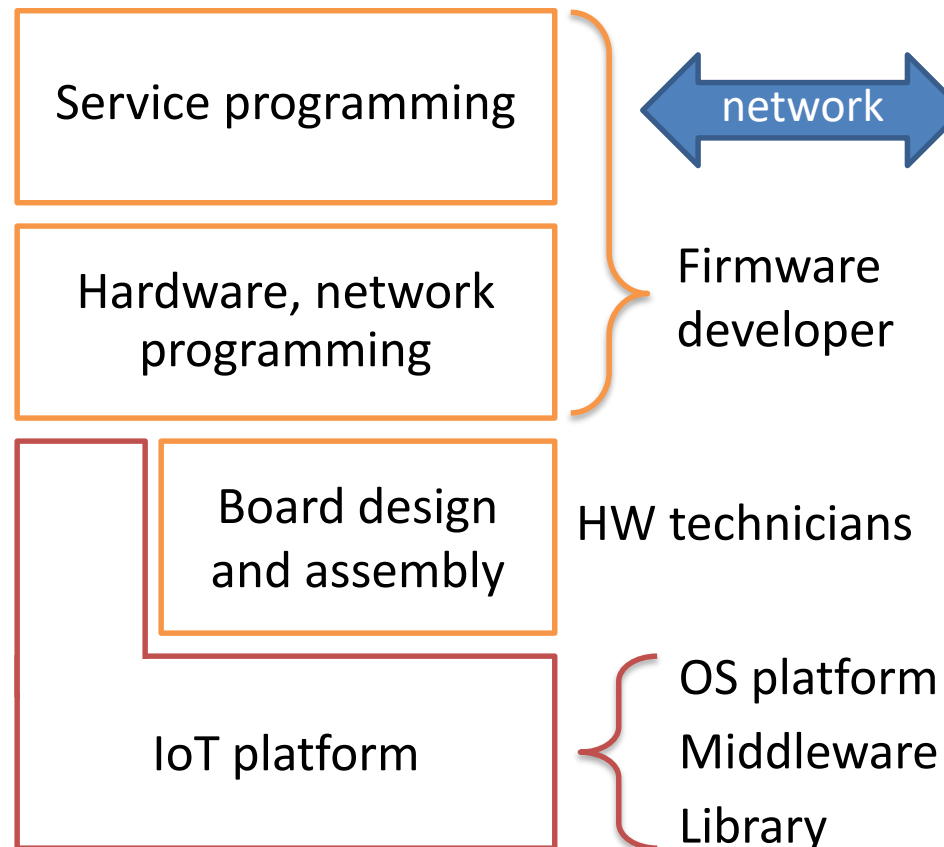
Internet of Things



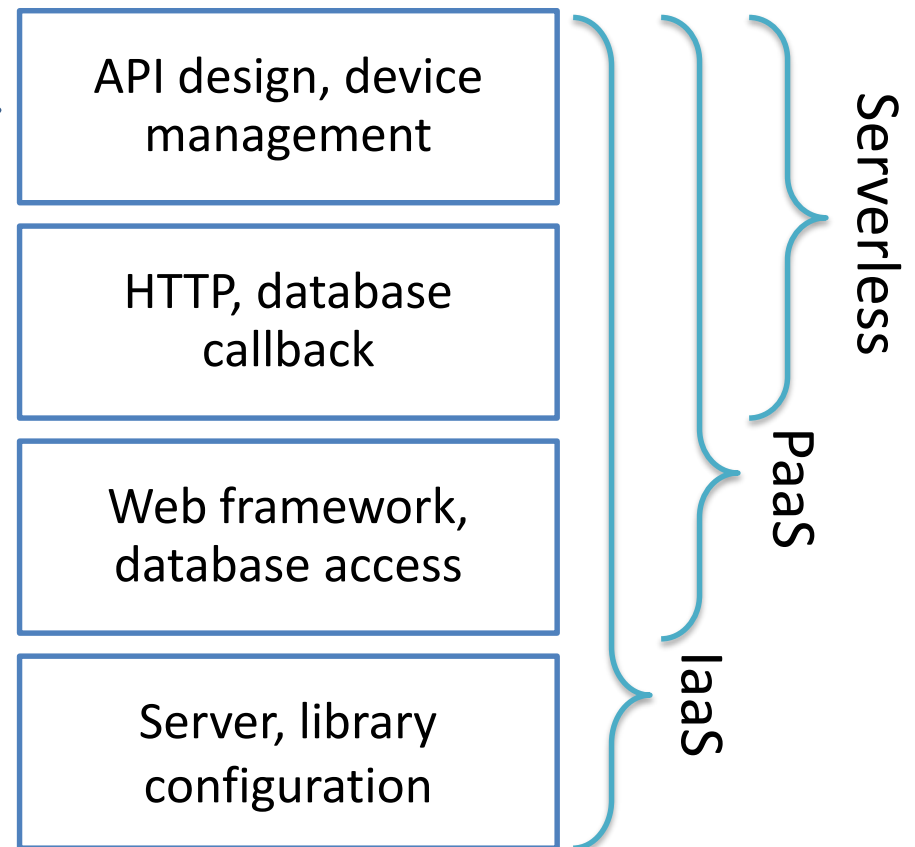
IoT development → deployment



Device development



Service development



IoT platform: A, G, M, ... ?



IoT building blocks

- Device management
- Cloud backend: IaaS, PaaS, ...
- Application enabler
- Advanced analytics
- Security features

Vendor capabilities

- Total developing entities & solutions
- Usage metric
- Public/on-premise support
- Certification process
- Target segments

Device management features

- Coverage of devices
- Device monitoring
- Command & control
- OTA firmware update
- Edge computing supports

Pricing model

- By device numbers
- By users
- By data usage / message
- By solutions
- Pricing period

IoT real-world deployment



CAPital EXpenditures

- Software development
xxxk\$ – xxM\$
- Hardware development
xxk\$ – xxxk\$
- Device deployment
xxk\$ – xxxk\$

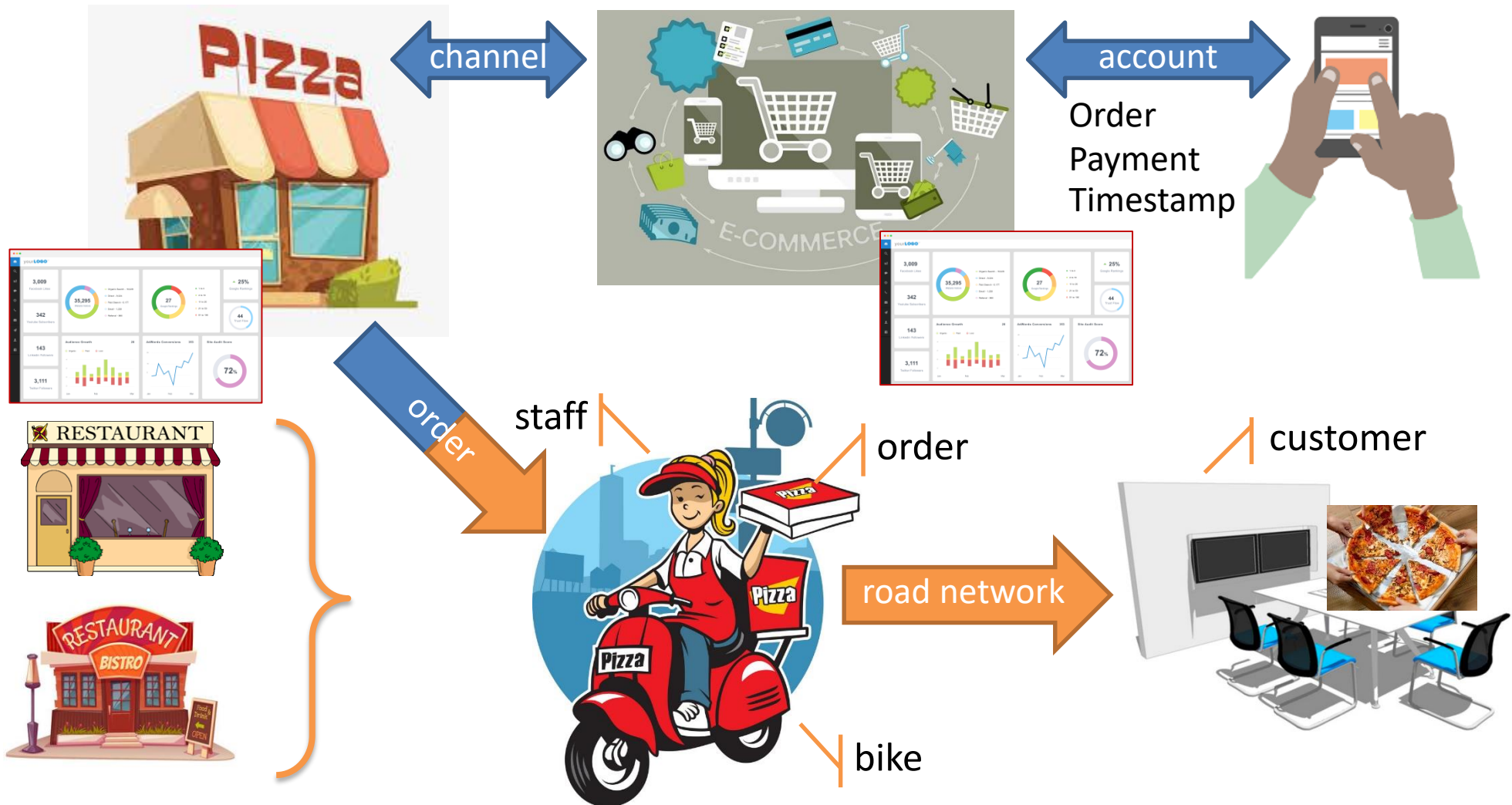
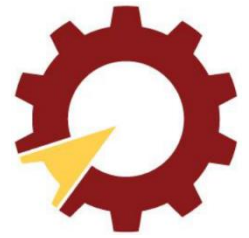
Per device, Per customer

OPerating EXpenses

- Cloud computing
 - Instance time
 - Transaction & bandwidth
 - Database access
 - Storage
 - Additional services
- Employee expenses
 - Developers
 - O&M staffs

Business insights → performance + opportunity → expected RoI

IoT scalability





Trade-off: responsiveness + cost



Channel cost, device number,
message size, message rate



Wireless technology	Device number	Message size	Message rate
WiFi 			
LPWAN 			

How big names teach IoT



MIT Sloan

1. Demystifying the Internet of Things
2. Leading IoT: Levels of Mastery
3. Leadership Capabilities
4. An Overview of IoT Technologies
5. Aligning IoT and Strategy
6. Creating an IoT Roadmap for the Future

Stanford Continuing Studies

1. Introduction to IoT landscape and applications
2. IoT User Experience (UX)
3. IoT & Big Data
4. The Business of IoT
5. The Technology of IoT
6. IoT Security
7. IoT Standards & Regulations



**IOT IS ABOUT BUSINESS,
MAKING IT IS JUST A STEP**