



# Internet of Things (IoT)

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## Pengenalan IoT

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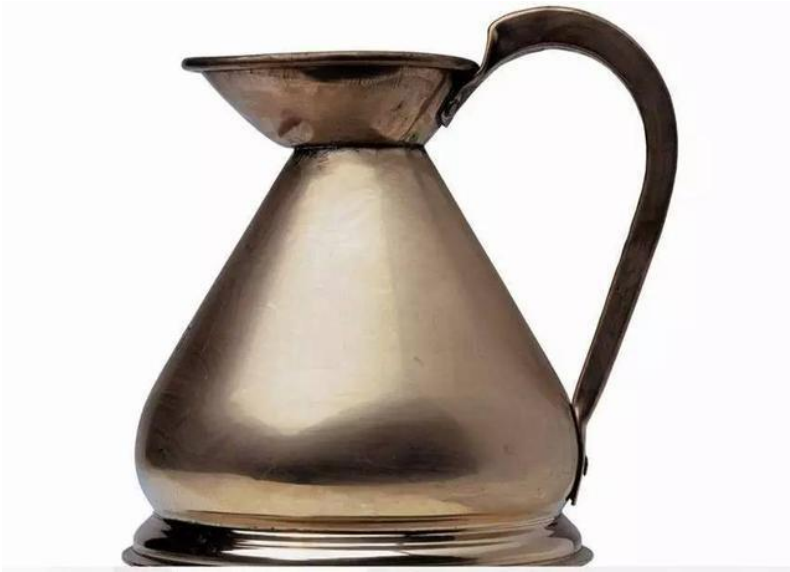
Mochammad Zen Samsono Hadi, ST. MSc. Ph.D.

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# Topik Bahasan

- Mengapa IoT
- Apa itu IoT
- Aplikasi IoT
- Bagaimana untuk memulai
- Hardware
- Software

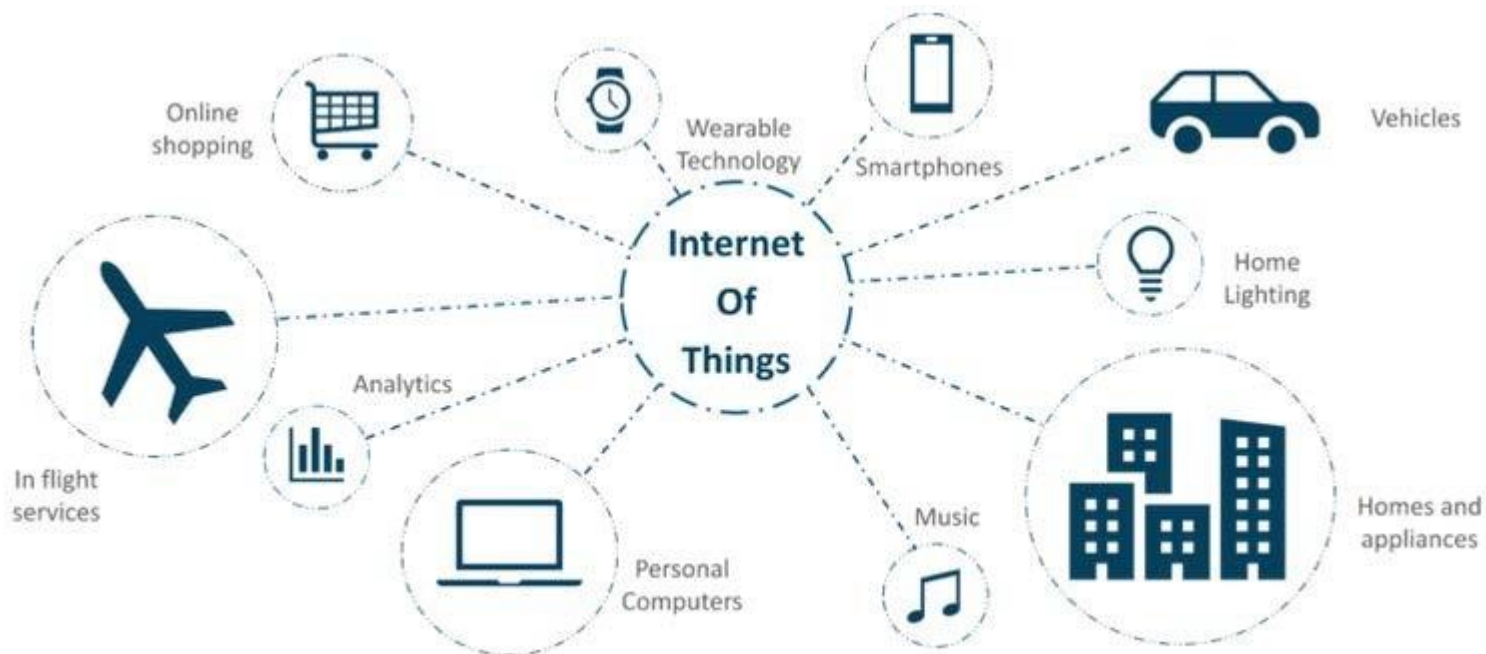
# Asal usul IoT



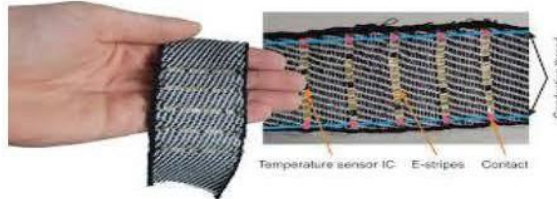
Teko kopi Ruang Trojan pada tahun 1991: Di Ruang Trojan Laboratorium Komputer di Universitas Cambridge, para ilmuwan turun untuk melihat apakah kopi sudah matang, tetapi sering kali kembali dengan tangan kosong. Untuk mengatasi masalah ini, mereka membuat serangkaian program dan memasang kamera portabel di sebelah teko kopi. Kamera diarahkan ke teko kopi. Teknologi pengambilan gambar melalui komputer ini digunakan untuk memeriksa kapan saja kopi sudah matang, menghilangkan kebutuhan untuk naik dan turun tangga.

# Mengapa IoT

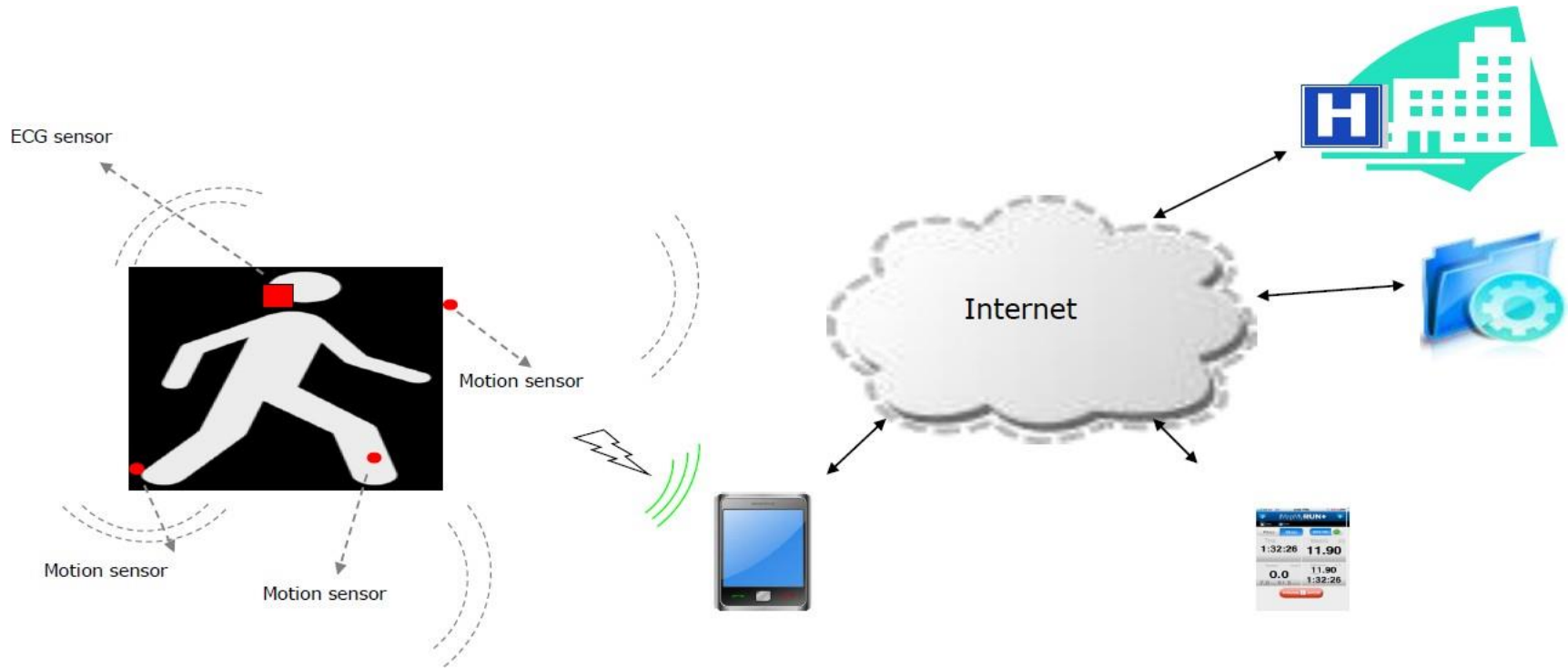
- Ingin menerima lebih banyak data
- Ingin mengontrol banyak hal
- Ingin mengotomatisasi
- Ingin membuat segalanya lebih cepat
- Segalanya menjadi terhubung



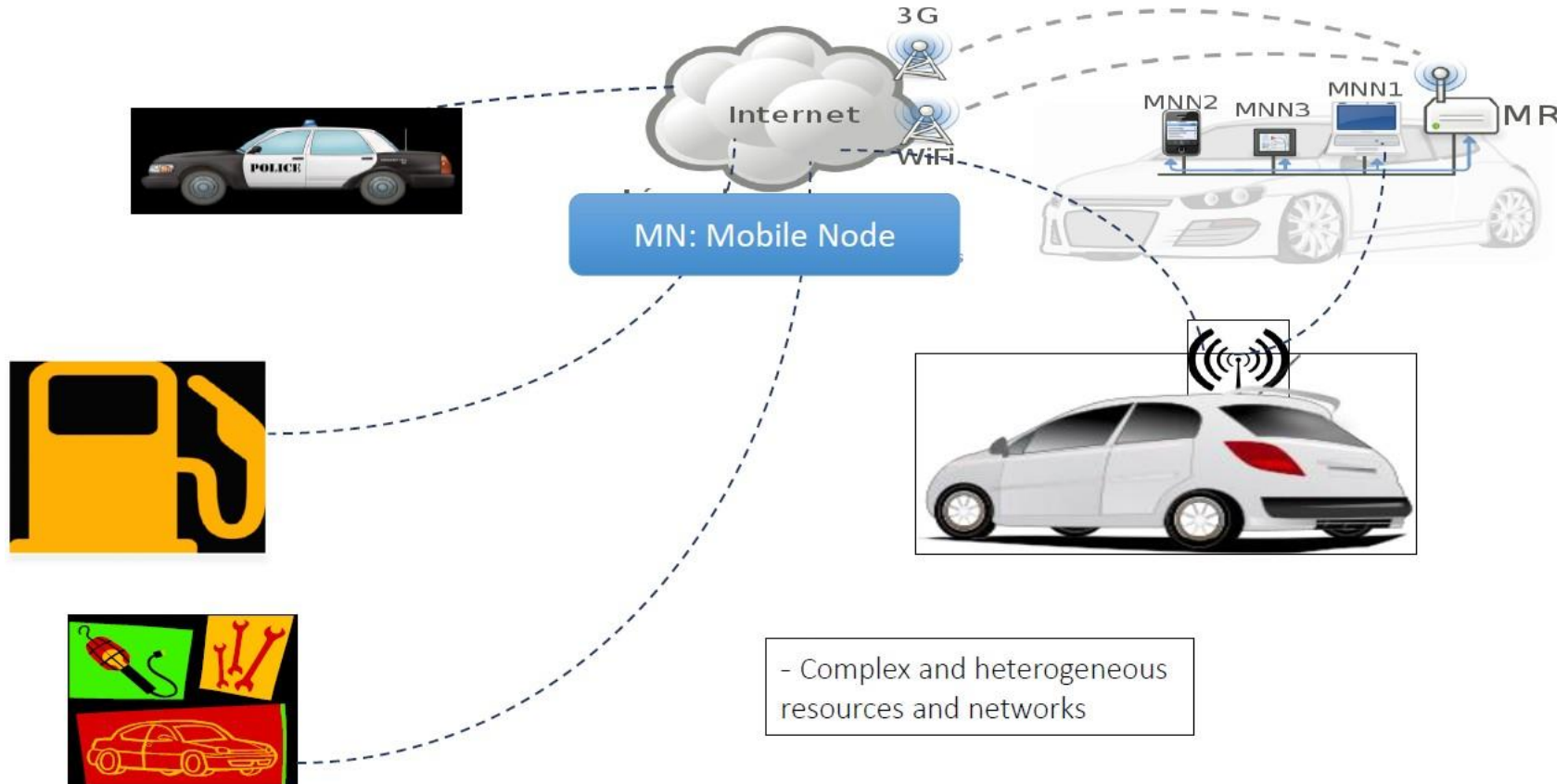
# Mengapa IOT: Perkembangan sensor & perangkat yang terhubung



# Orang terhubung dengan berbagai hal



# Things terhubung ke things



# IoT vs. Teknologi "Serupa"

- USN (Ubiquitous Sensor Networks)
- M2M (Machine-to-Machine)
- IoE (Internet of Everything)
- CoT (Cloud of Things)
- WoT (Web of Things)
- CPS (Cyber Physical Systems)



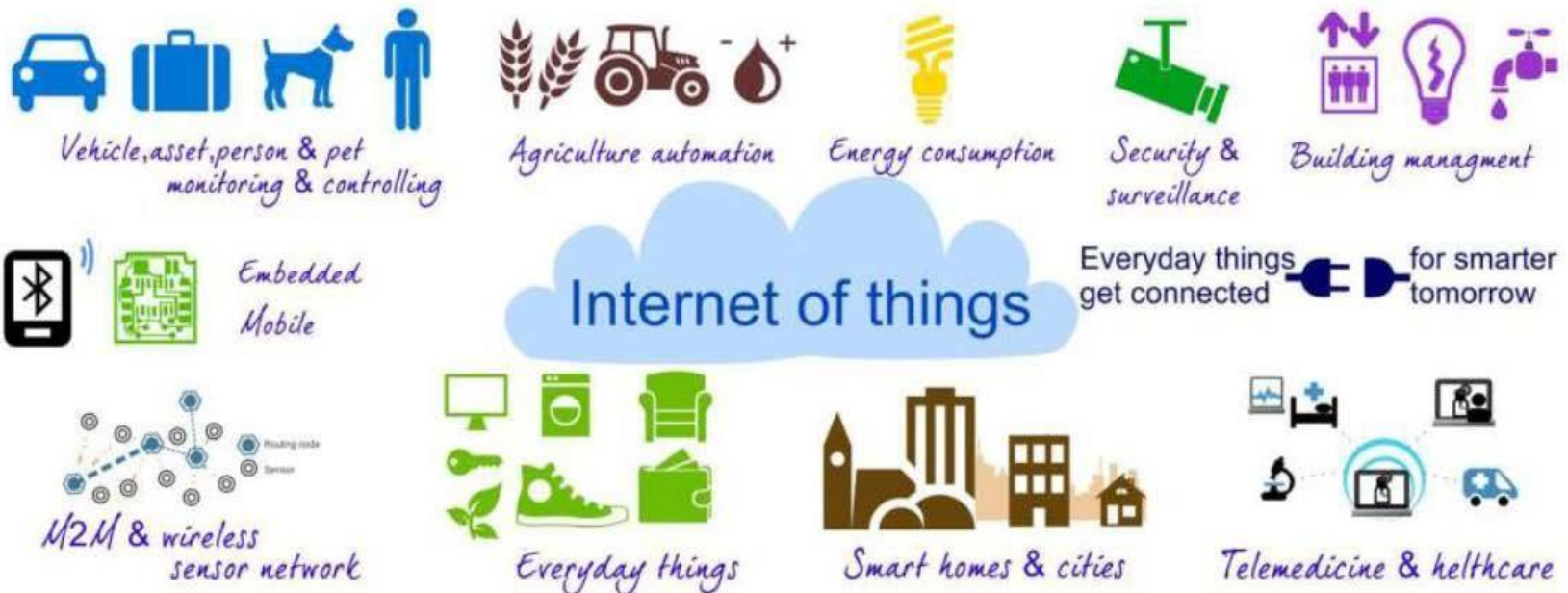
# Apa itu IoT

- Interkoneksi melalui Internet pada perangkat komputasi yang tertanam dalam objek sehari-hari, memungkinkan perangkat tersebut mengirim dan menerima data.

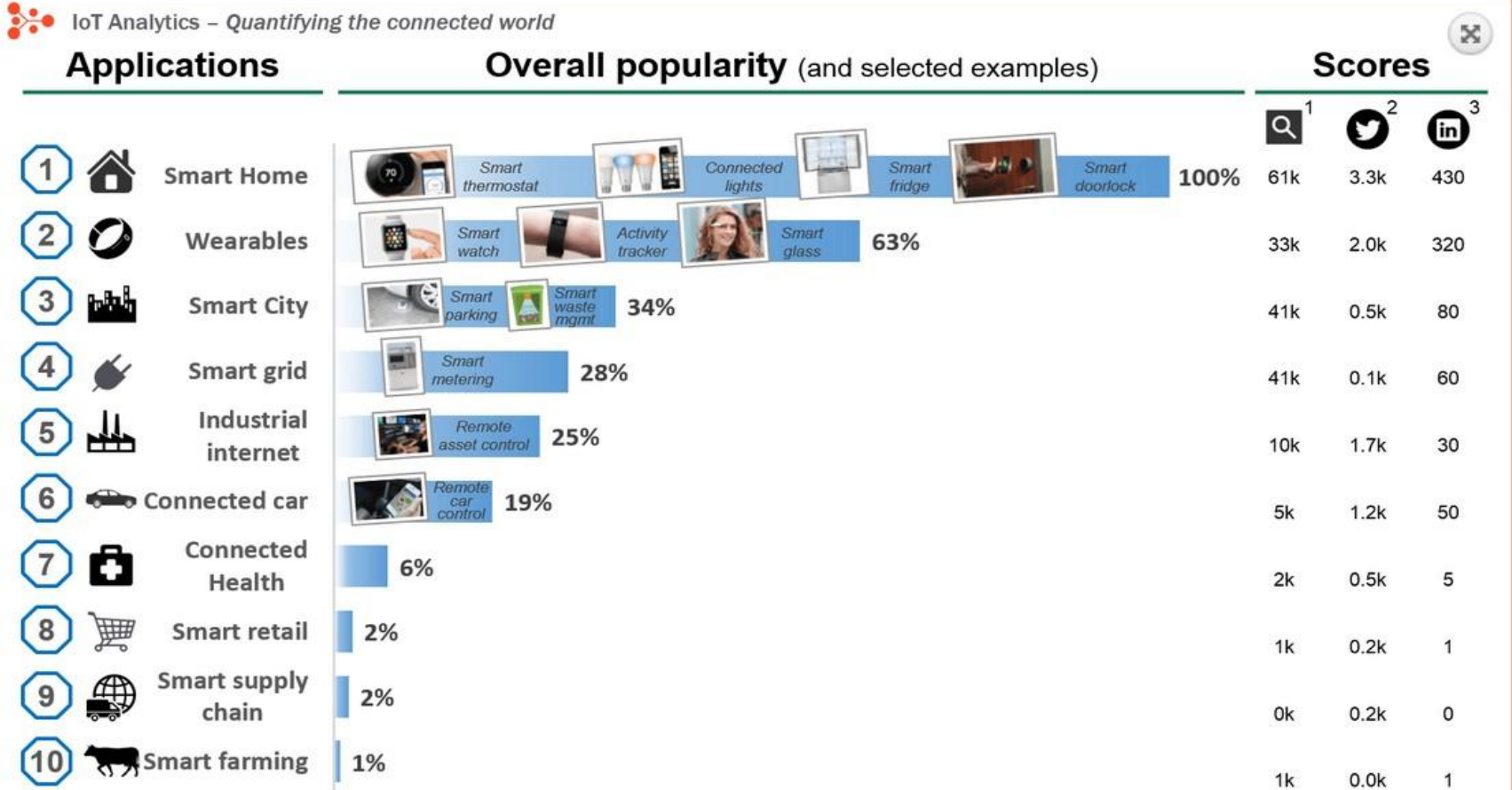


# Apa itu IoT

- IoT adalah sistem perangkat komputasi yang saling terkait, mesin digital dan mekanis, objek, hewan atau manusia yang dilengkapi dengan pengidentifikasi unik (UID) dan kemampuan untuk mentransfer data melalui jaringan tanpa memerlukan interaksi manusia-ke-manusia atau manusia-ke-komputer.



# Rangking Aplikasi IoT



1. Monthly worldwide Google searches for the application 2. Monthly Tweets containing the application name and #IOT 3. Monthly LinkedIn Posts that include the application name. All metrics valid for Q4/2014.

Sources: Google, Twitter, LinkedIn, IoT Analytics

# Aplikasi dan Teknologi IoT

## IoT Technologies

Sensors & Wireless Sensors Networks (WSN)

Radio-Frequency-Identification

Semantics & Interoperability

IoT Cloud Integration

IoT Analytics & BigData

## IoT Applications

Smart Cities & Communities

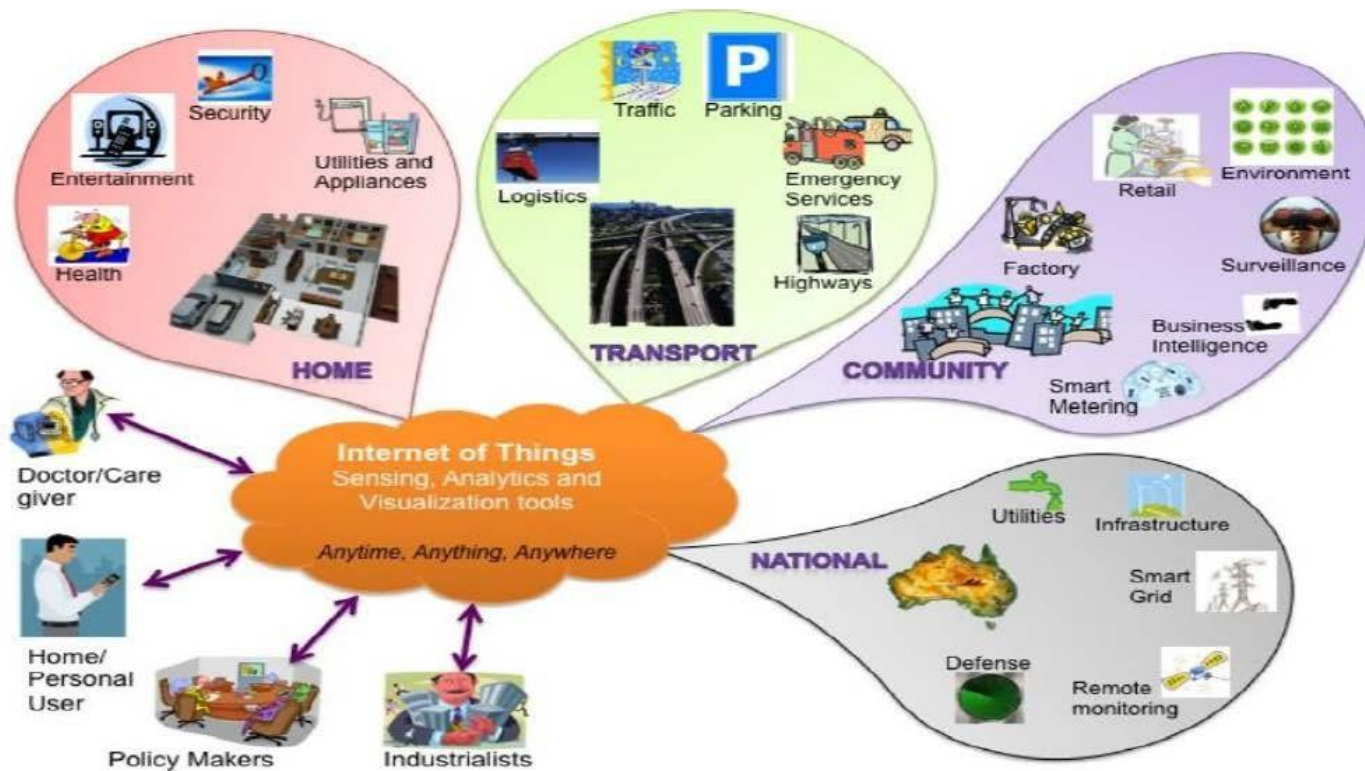
IoT in Healthcare

IoT in Manufacturing & Logistics

IoT in Transport (e.g., Connected Car, Self-Driving Car)

IoT in Smart Buildings (e.g., Facility Management)

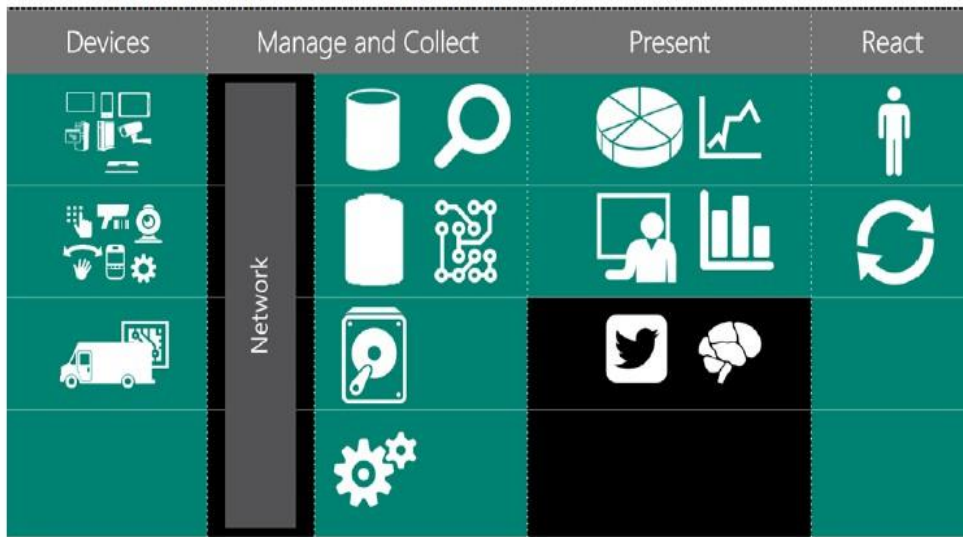
# Area Aplikasi IoT



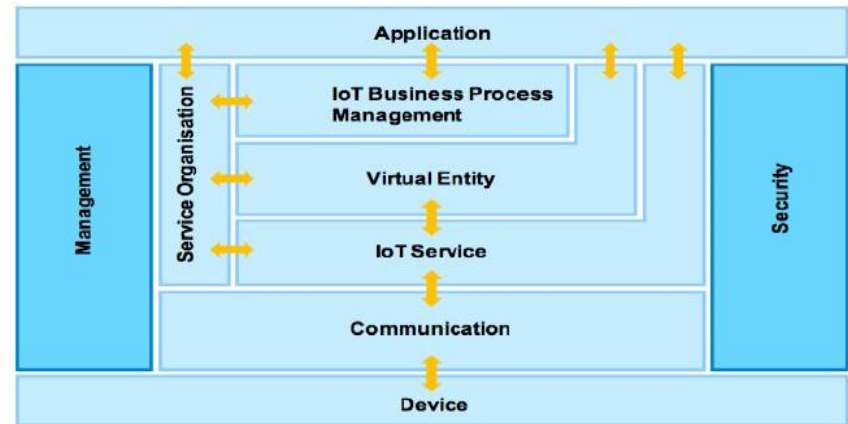
Source: J. Gubbi et al. / Future Generation Computer Systems 29 (2013) 1645–1660

# Komponen IoT yang khas

- Sensors/Actuators
- Communication between servers or server platforms
- Server/Middleware Platforms
- Data Analytics Engines
- Apps (iOS, Android, Web)

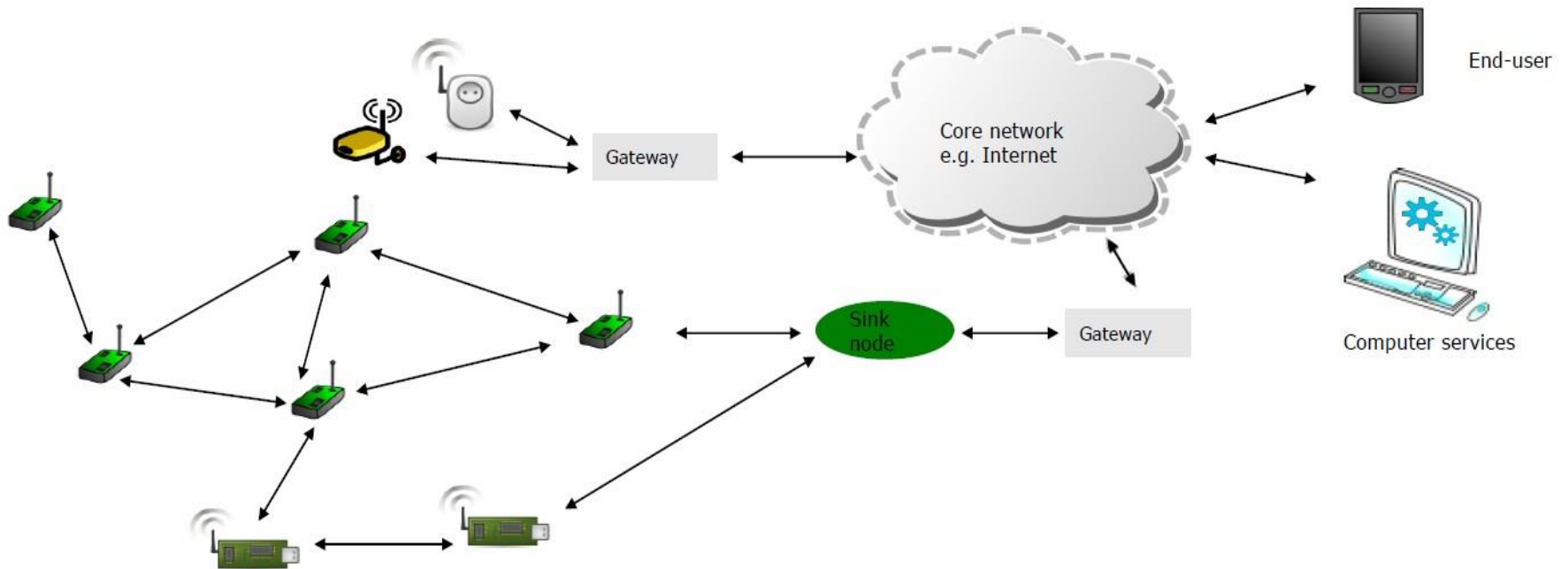


Source: Microsoft Blogs ([blogs.msdn.microsoft.com](https://blogs.msdn.microsoft.com))

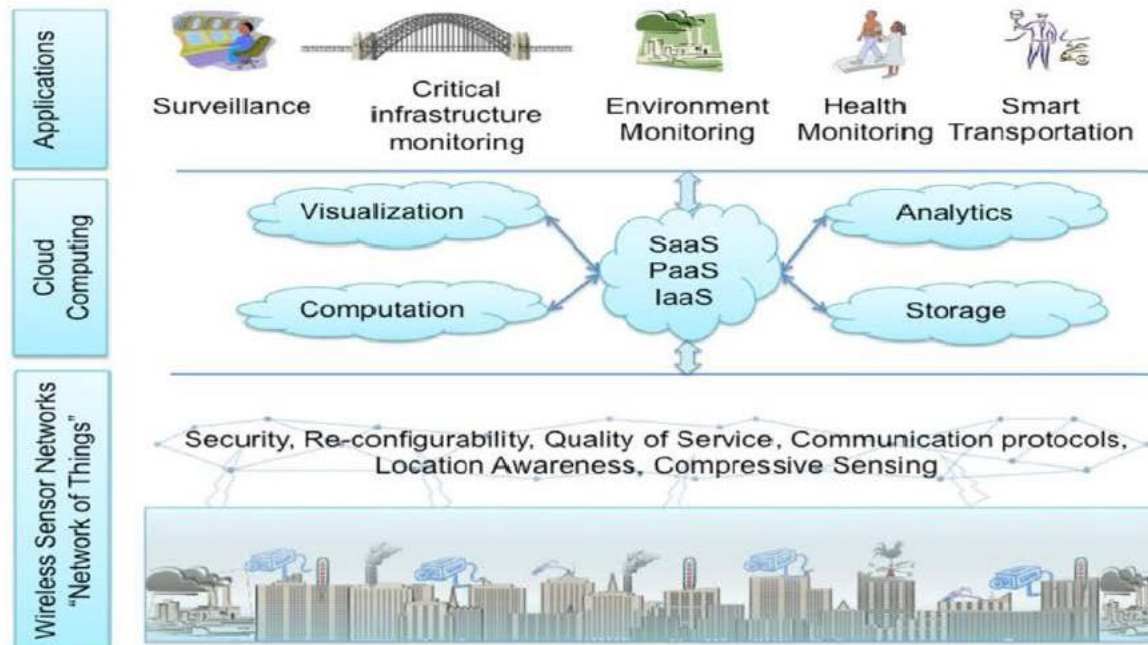


IoT-A Architecture Model ([www.iot-a.eu/](http://www.iot-a.eu/))

# Wireless Sensor Networks (WSN)



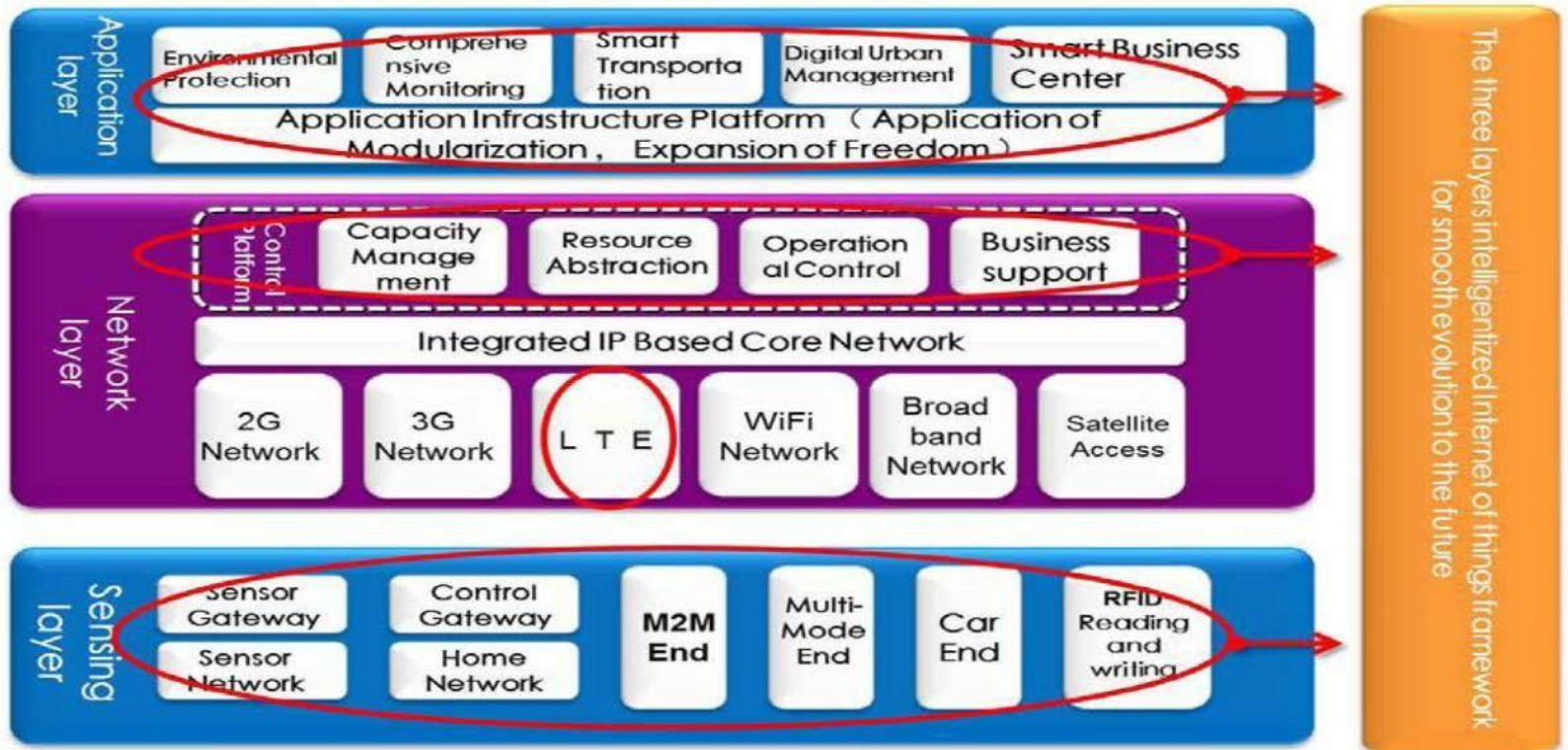
# IoT & Cloud Computing



Source: J. Gubbi et al. / Future Generation Computer Systems 29 (2013) 1645–1660

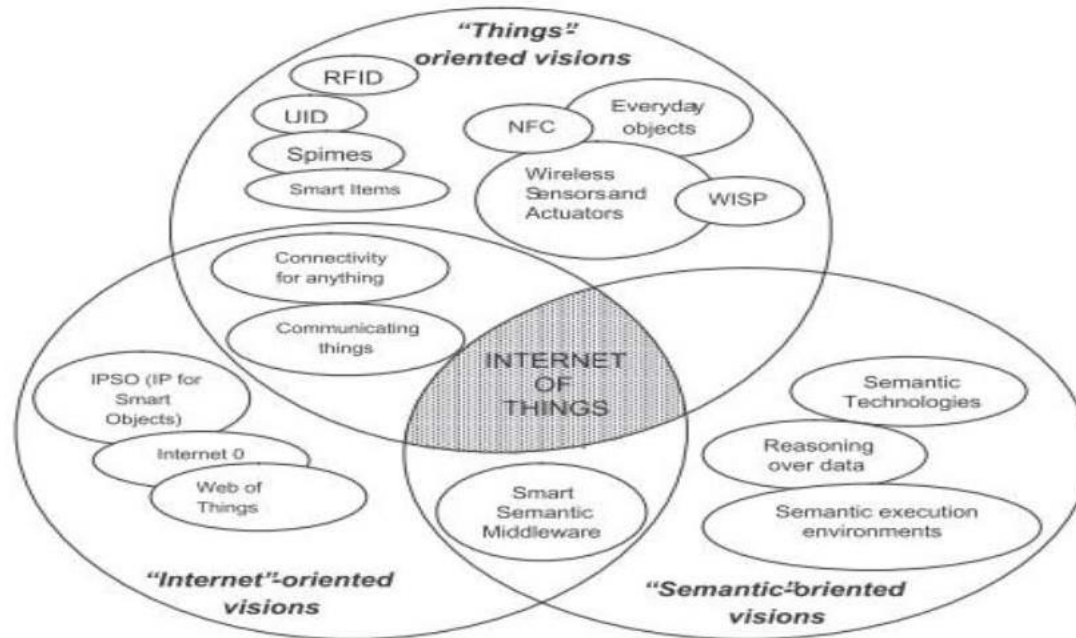


# Elemen Penerapan IoT



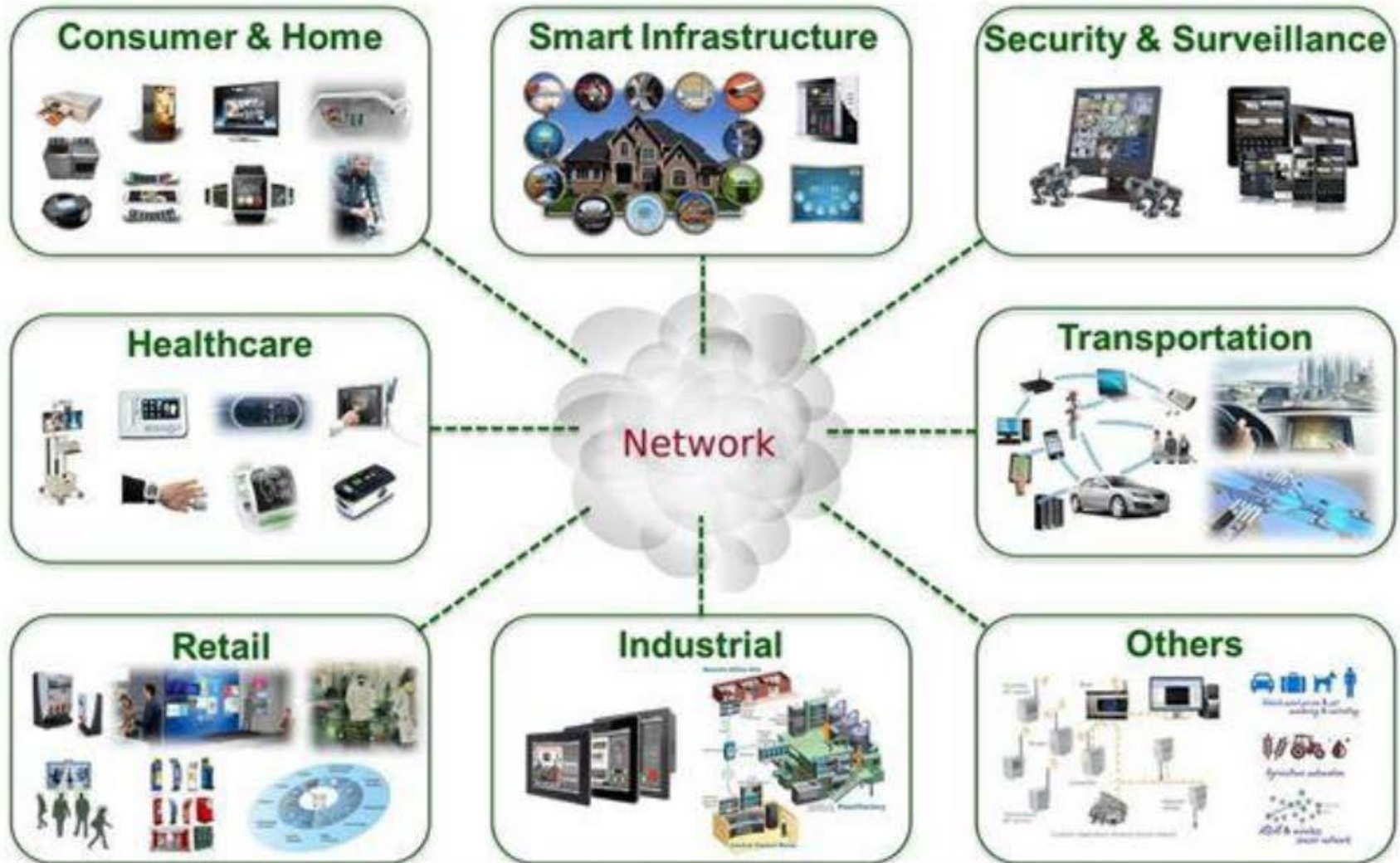
Source: Datang Telecom Technology & Industry Group

# Perspektif & Visi IoT

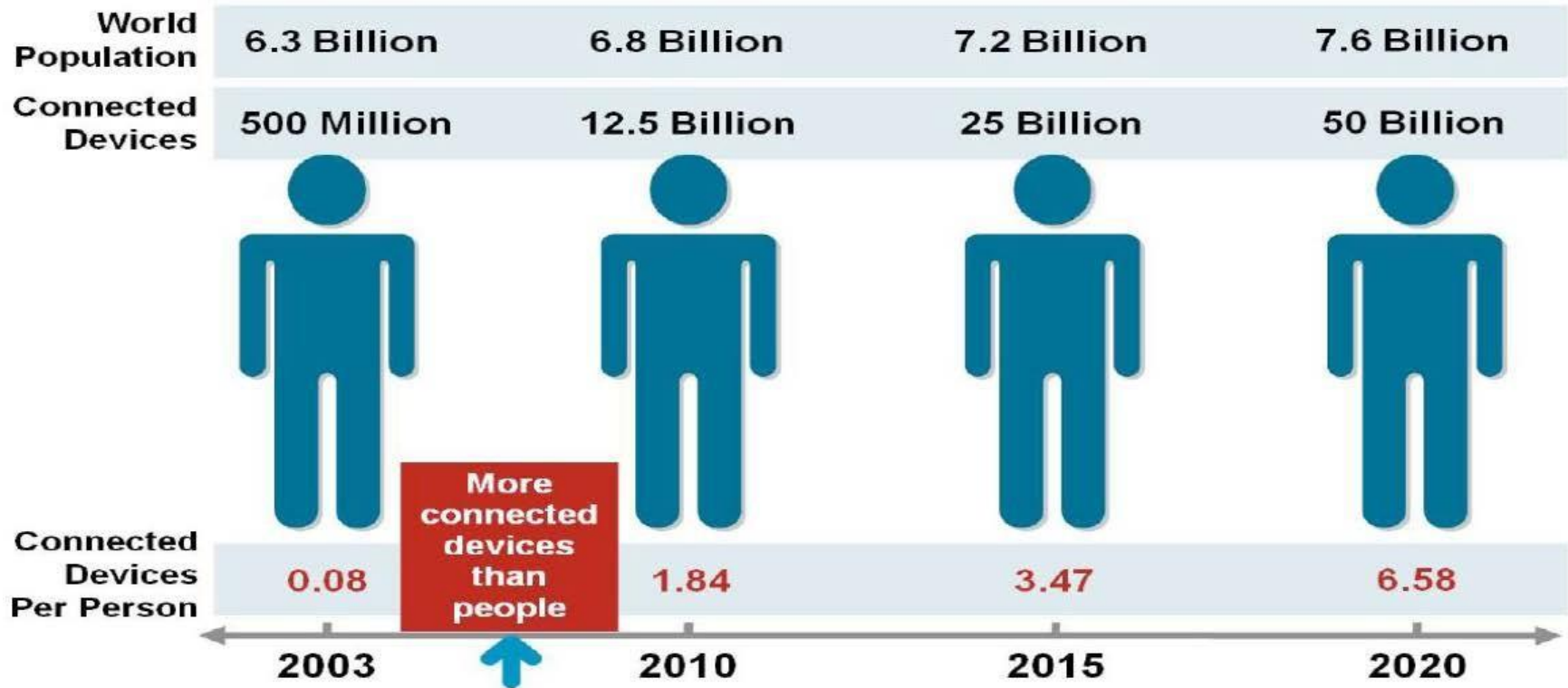


L. Atzori et al. / Computer Networks 54 (2010) 2787–2805

- Semua aktifitas manusia terhubung dengan internet



# Kemunculan dan Kebangkitan IoT



# Perangkat IoT: Sensor

## Sensor

- Provides usable output in response to a specified measurement
- A sensor acquires a physical parameter and converts it into a signal suitable for processing (e.g., optical, electrical, mechanical)

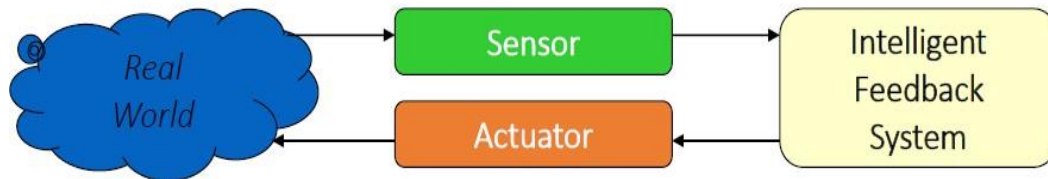
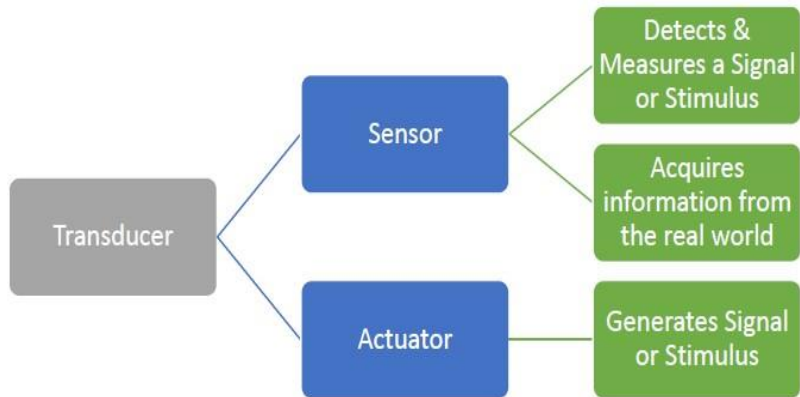
## Deployment and Applications

- Bodies, automobiles, airplanes, cellular telephones, radios, chemical plants, industrial plants, etc.
- Many other applications

# Perangkat IoT: Sensor

Stimulus Type	Signal/Quantity
Acoustic	Wave (amplitude, phase, polarization), Spectrum, Wave Velocity
Biological & Chemical	Fluid Concentrations (Gas or Liquid)
Electric	Charge, Voltage, Current, Electric Field (amplitude, phase, polarization), Conductivity, Permittivity
Magnetic	Magnetic Field (amplitude, phase, polarization), Flux, Permeability
Optical	Refractive Index, Reflectivity, Absorption
Thermal	Temperature, Flux, Specific Heat, Thermal Conductivity
Mechanical	Position, Velocity, Acceleration, Force, Strain, Stress, Pressure, Torque

# Perangkat IoT: Sensor & Aktuator



- Transducer:
  - Converts a primary form of energy into a signal with a different energy form
- Energy form examples:
  - Mechanical
  - Thermal
  - Electromagnetic
  - Optical
  - Chemical
  - etc.

# Contoh Sensor

## Temperature sensors

- Temperature can be measured through pressure, volume, electrical resistance, and strain
- Applications: Buildings, chemical process plants, engines, appliances, computers, etc.



## Accelerometers

- Measures along one axis and is insensitive to orthogonal directions
- Applications: Vibrations, blasts, impacts, shock waves, air bags, washing machines, heart monitors, car alarms, etc.



## Light Sensors

- Composed of photoconductor, such as a photoresistor, photodiode, or phototransistor
- Applications: Cameras, infrared detectors, and ambient lighting applications





# Contoh Sensor

## Ultrasonic sensors

- Used for position measurements
- Sound waves emitted are in the range of 2-13 MHz
- Sound Navigation And Ranging (SONAR)
- Radio Detection And Ranging (RADAR)



## Photogate

- Used in counting applications (e.g., motion period identification)
- Records time at which light is broken
- Includes infrared transmitter and receiver at opposite ends of the sensor



## CO2 Gas Sensor

- Measures gaseous CO2 levels in an environment
- Measures CO2 levels in the range of 0-5000 ppm (parts per million)
- Monitors infrared radiation absorbed by CO2 molecules



# Kriteria Pemilihan Sensor

## Economic

- Cost
- Availability
- Lifetime
- Etc.

## Environmental

- Size
- Power Consumption
- Interference & Sensitivity
- Etc.

## Sensor Characteristics

- Sensitivity
- Range
- Stability
- Error
- Response Time

# Sensor

- Ukur nilai
- Kirim raw data
- Daya rendah



# Pemrosesan dan Penyimpanan Lokal

- Dapatkan data dari sensor
- Proses
- Kirim beberapa data ke Edge/Fog Computing



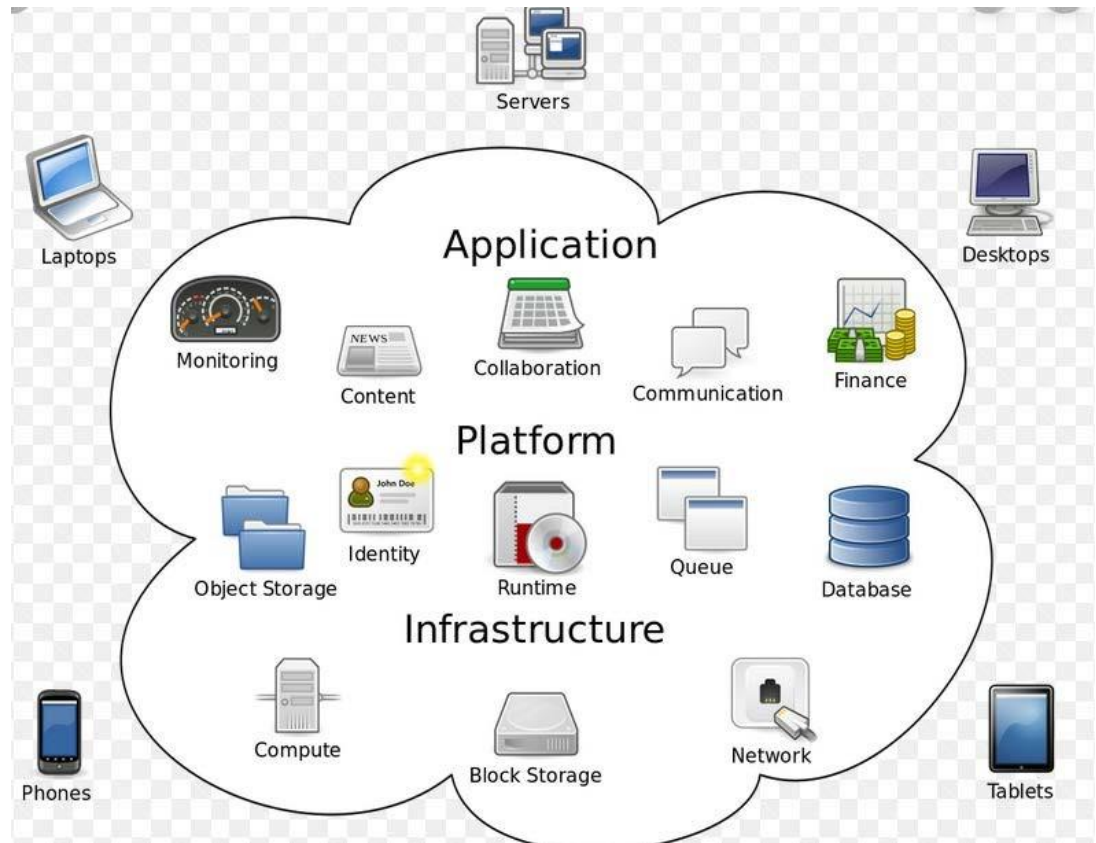
# Network dan Internet

- IoT Gateway
- Mengumpulkan data dari sensor
- Protocols
  - CoAP
  - MQTT
  - HTTP
  - XMPP



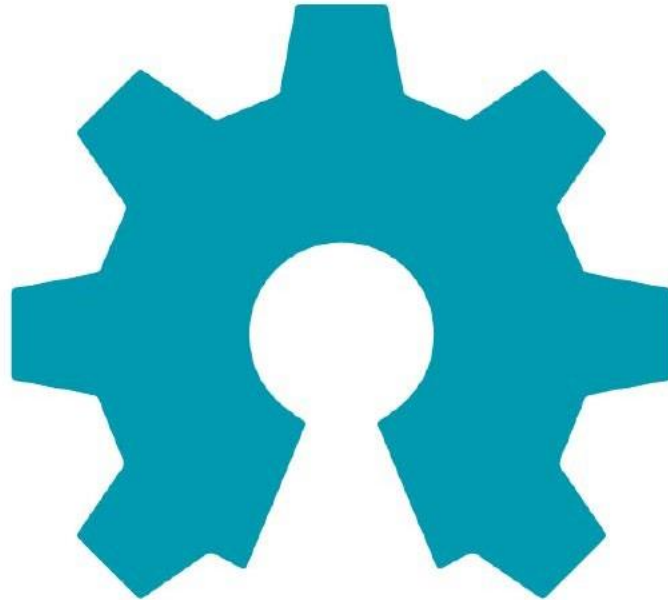
# Cloud Processing dan Storage

- Aggregate Data
- Storage
- Kesimpulan



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# Bagaimana memulainya?



**open source  
hardware**

# Microcontroller

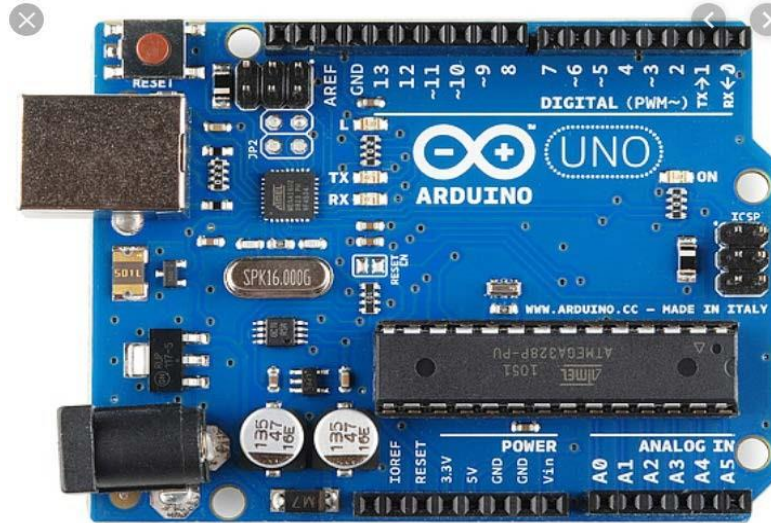
- Perangkat kecil yang dapat diprogram
- Mudah dihubungkan





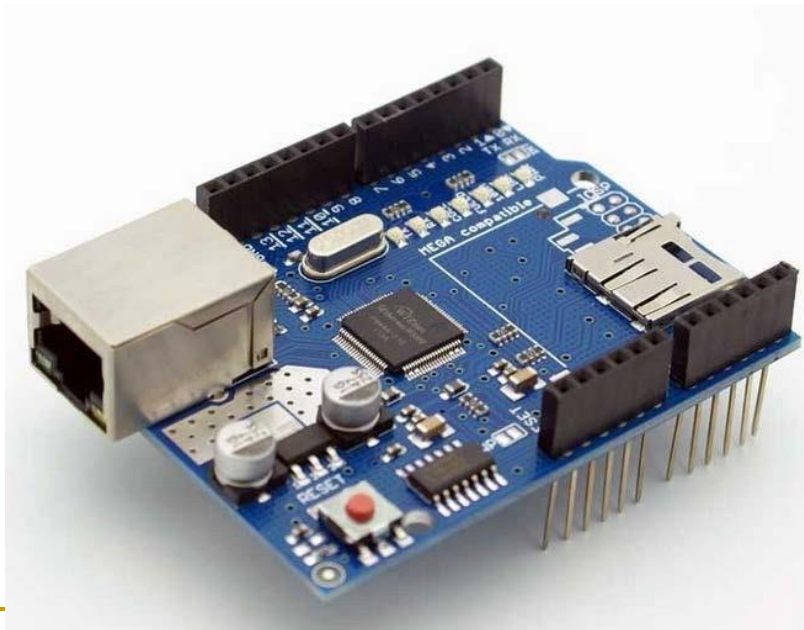
# Arduino

- Perangkat kecil yang dapat diprogram
- Mudah dihubungkan
- Open Source
- Memiliki perangkat lunak yang mudah digunakan



# Arduino Ethernet

- Perangkat kecil yang dapat diprogram
- Mudah dihubungkan
- Open Source
- Memiliki perangkat lunak yang mudah digunakan
- Hanya sekitar 4 koneksi jaringan simultan



# Perangkat IoT: Arduino

## Overview

- Open-source electronics prototyping platform
- Flexible & easy-to-use hardware and software
- Typical Users: Artists, designers, hobbyists
- Applications involving interactive objects or environments

## Benefits

- Microcontroller: Bridge between cyber & physical worlds
- Balances functionality and ease of use
- Low costs (e.g., starting from \$35)
- Arduino C

## Types

- Leonardo
- Due
- Micro
- LilyPad
- Esplora
- Uno



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# Pemrograman Arduino

- C++ based: A handful of new commands
- Programs are called “sketches”.
- Sketches need two functions:
  - void setup( ): Runs first and once
  - void loop( ): Runs over and over, until power is lost or a new sketch is loaded
  - PIN = Global Variables

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# Pemrograman Arduino

- `digitalWrite(pin, value)`: Sends a voltage level to the designated pin
- `pinMode(pin, mode)`: Designates the specified pin for input or output
- `digitalRead(pin)`: Reads the current voltage level from the designated pin
- Analog versions of above: `analogRead`'s range is 0 to 1023
- Serial commands: `print`, `println`, `write`
- [www.arduino.cc](http://www.arduino.cc): Online support forum

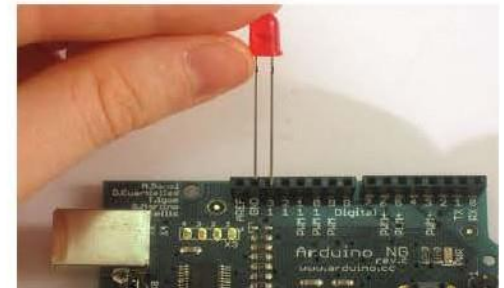
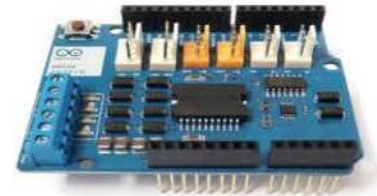
# Sensors & Shields

## Sensors

- Can be both binary or a range
- Measure a range of values, vary their resistance to reflect their detection
- Arduinos sense voltages, not resistances
- Sensors that only vary their resistances: Voltage divider to provide the Arduino a voltage is required

## Shields

- Circuit boards that plug into the top of an Arduino in order to enhance its functionality
- Examples: Ethernet, GPS, Motor, Prototype

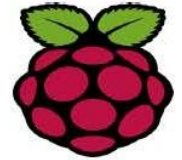


# Raspberry Pi

- Komputer
- Menjalankan Linux
- Pemrograman yang lebih berorientasi pada perangkat lunak
- Full Networking System



# Perangkat: Raspberry Pi



## Raspberry (University of Cambridge)

- Credit card sized PC: Plugs into a TV or monitor
- Extensively used for IoT Education
- Typical Uses: Programming, Electronic Projects, Office, HD Videos Playback
- Cost: Approx. \$35-\$100 (depending on extras)





# Komponenten Raspberry Pi

## Core

Raspberry Pi board

Prepared Operating System SD Card

USB keyboard

Display (with HDMI, DVI, or Composite input)

Power Supply

## Extras

USB mouse

Internet connectivity: LAN cable

Powered USB Hub

Case

## Programming Languages

C

C++

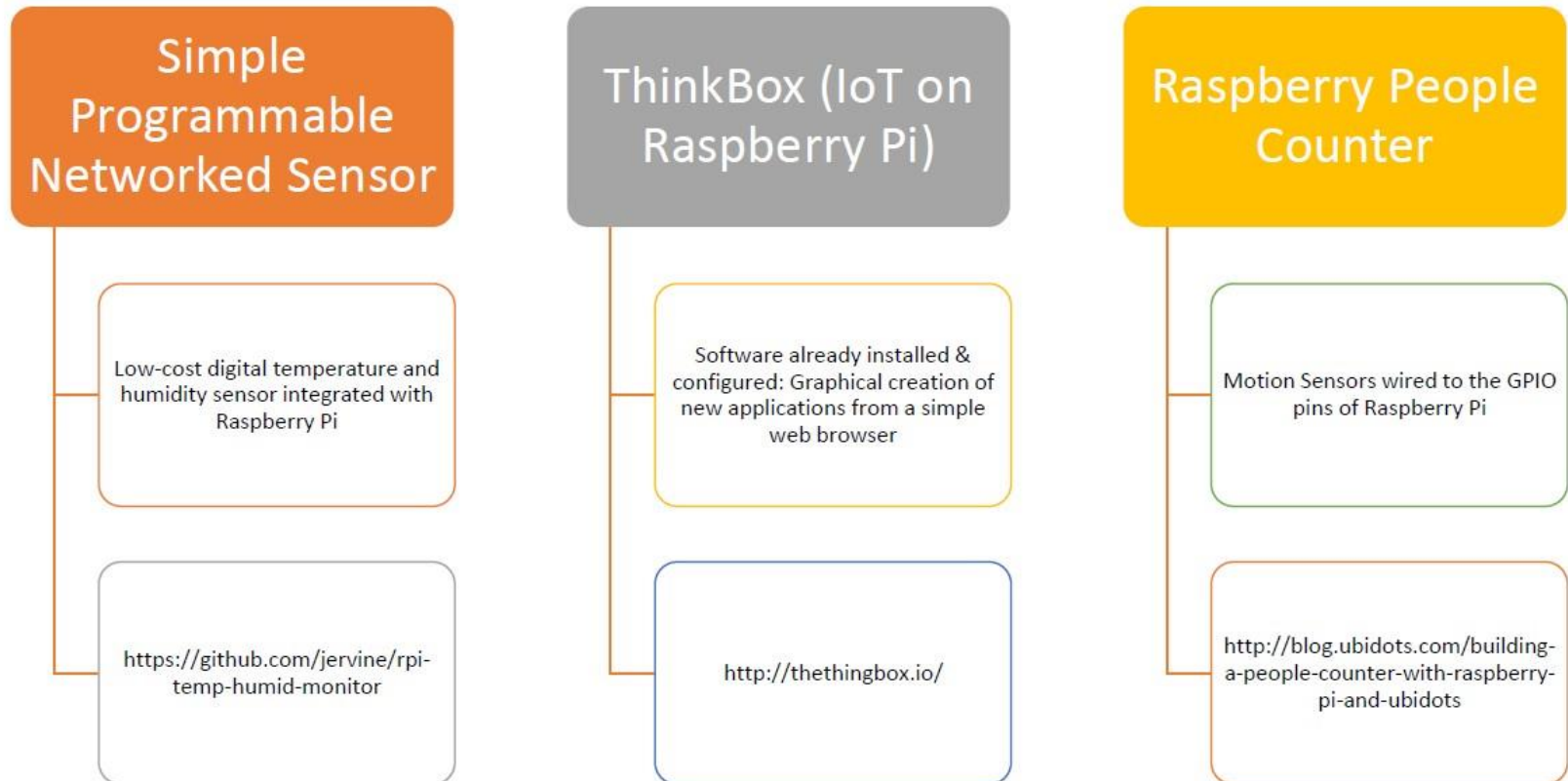
Java

Scratch

Ruby

Any supported on ARM6

# Contoh Proyek IoT: Raspberry Pi



# Raspberry Pi dan Arduino

HARDWARE



SOFTWARE AND NETWORKING SYSTEM



# Pendukung Sensor



**Arduino**  
\$25  
ATmega328

**ChipKIT**  
\$30  
PIC



**LaunchPad**  
\$4  
MSP430

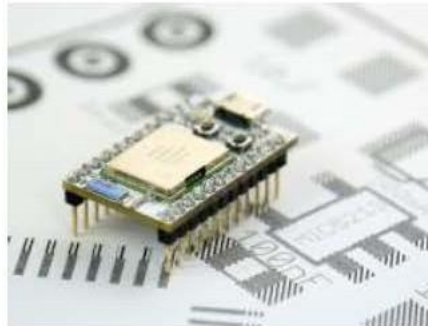
# Board untuk sensor dan pemrosesannya



## STM32

\$30

ARM Cortex M0,  
M3, M4



## Particle

\$35

ARM

WiFi Internet



## Espruino

\$30

ARM

Javascript

# Board untuk pemrosesan dan jaringan



## Raspberry Pi

\$35

900 MHz ARM, GPU  
1 GB RAM

Compute Module

## Intel® Galileo

\$50

400 MHz Quark x86  
256 MB RAM



## Intel® Edison

\$70

1 GHz Dual Core Atom x86  
1 GB RAM  
WiFi  
BLE  
4 GB Flash

# Board untuk pemrosesan dan jaringan



## Beaglebone Black

\$45

1 GHz ARM, GPU

512 MB RAM

4 GB Flash

## UDOO Neo

\$50

i.MX 6 Solo ARM, GPU

ARM M4

512 MB or 1 GB RAM



## Parallella

\$99

1 GHz Dual Core Zynq ARM

16 or 64 Epiphany CPUs



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# Software





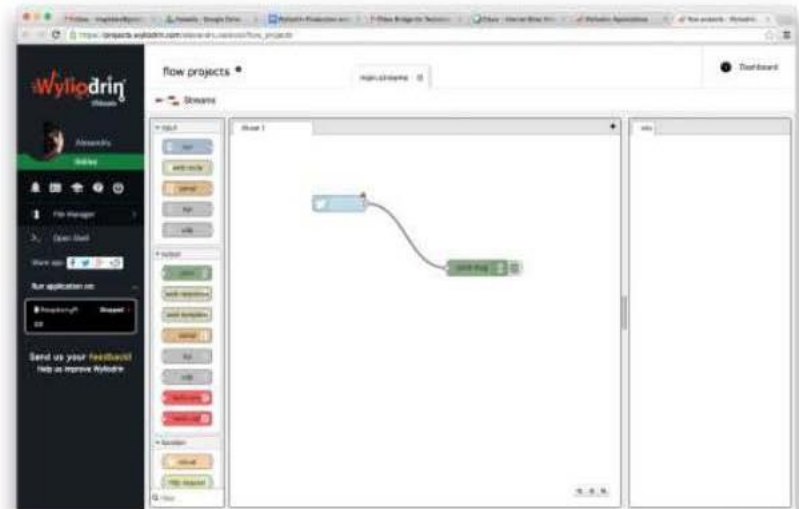
# Prototyping

## ARDUINO



```
Arduino IDE - Blink | Arduino 1.6.3  
Blink  
// Blink  
// Turns on an LED on for one second, then off for one second, repeatedly..  
// This example code is in the public domain.  
//  
// Pin 13 has an LED connected on most Arduino boards.  
// give it a name:  
int led = 13;  
  
// the setup routine runs once when you first reset the board  
// initialize the digital pin as an output.  
void setup() {  
  pinMode(led, OUTPUT);  
}  
  
// the loop routine runs over and over again forever!  
void loop() {  
  digitalWrite(led, HIGH); // turn the LED on (HIGH is the voltage level)  
  delay(1000);             // wait for a second  
  digitalWrite(led, LOW); // turn the LED off by making the voltage LOW  
  delay(1000);             // wait for a second  
}
```

## WYLIODRIN



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## Why use Wylidrin?

With the **Wylidrin solutions** you can get started and prototype simple IoT applications or move to the next level and use our professional solution to **develop, deploy** and **update** applications for industrial **Internet of Things systems**.



Set up your Raspberry Pi in minutes and prototype your first IoT application using Wylidrin STUDIO.



Use a professional IDE to remotely deploy and monitor industrial IoT solutions



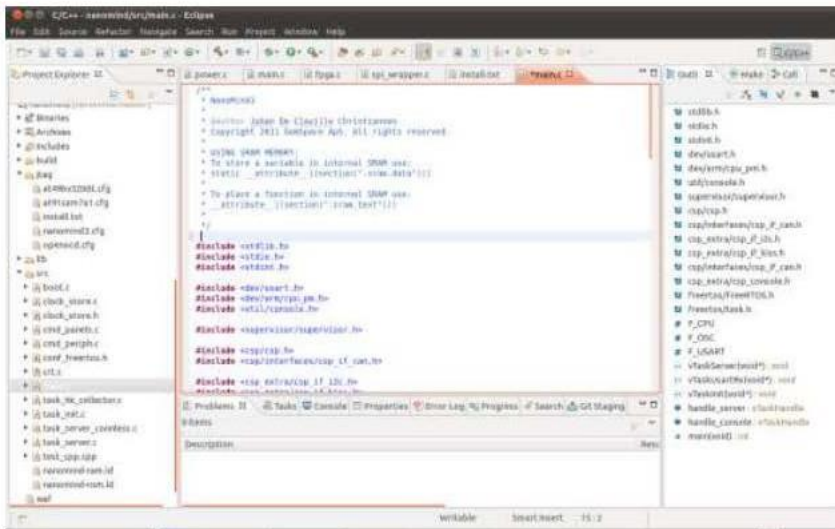
Use Wylidrin Enterprise to improve the scalability of your industrial IoT systems by pushing application updates with one click



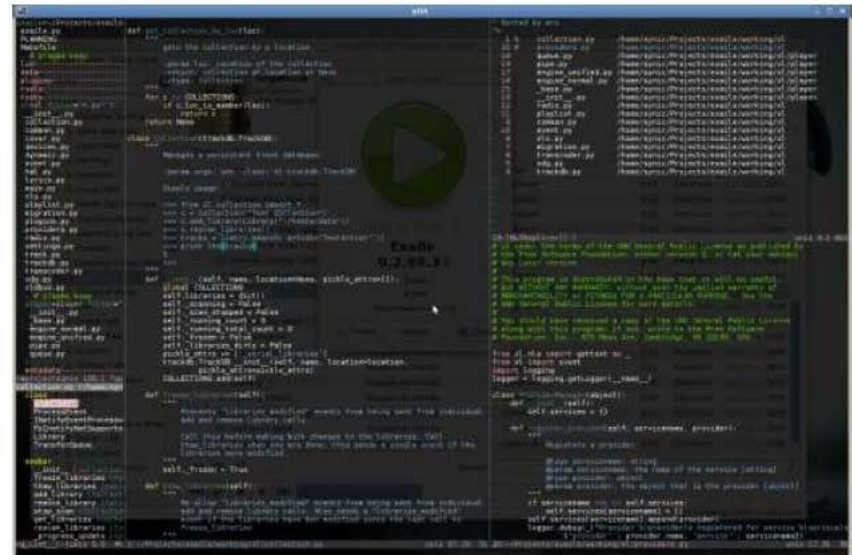
Go through our wide array of video and written tutorials to gain an overview of the Internet of Things.

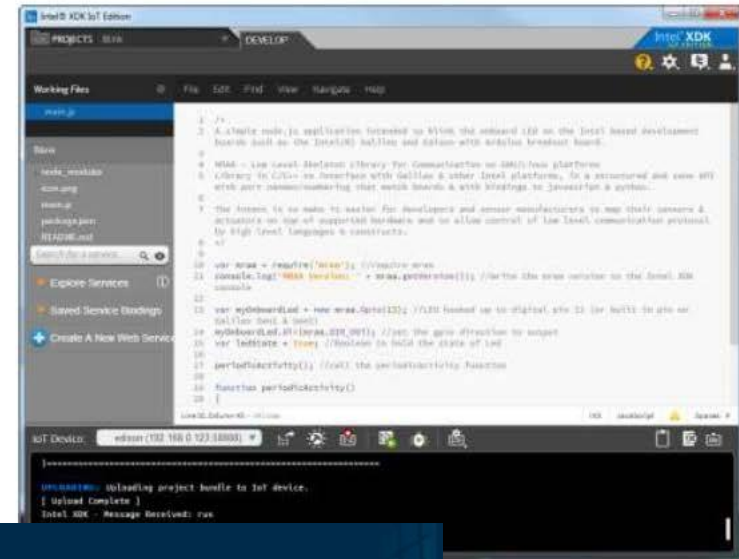
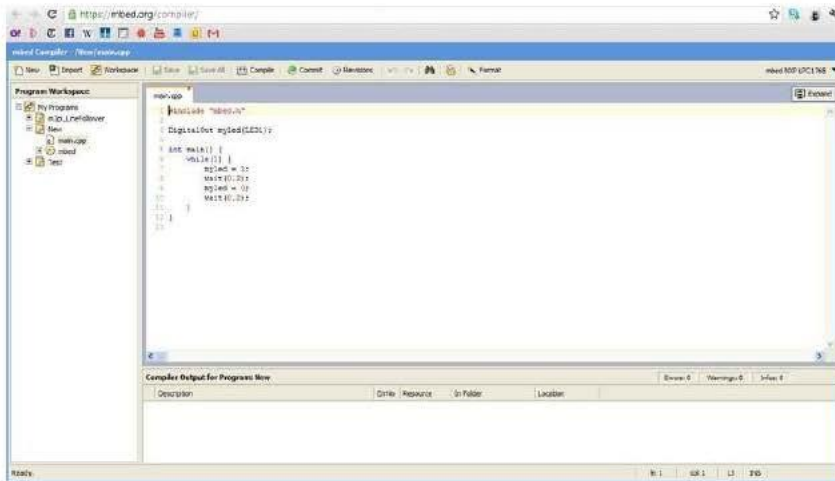
# Professional Programming

## ECLIPSE



## VIM





# IoT Device Development

Mbed makes device development quicker. For IoT and many other embedded use cases, Mbed helps you and your team to take a product from prototype to production rapidly.

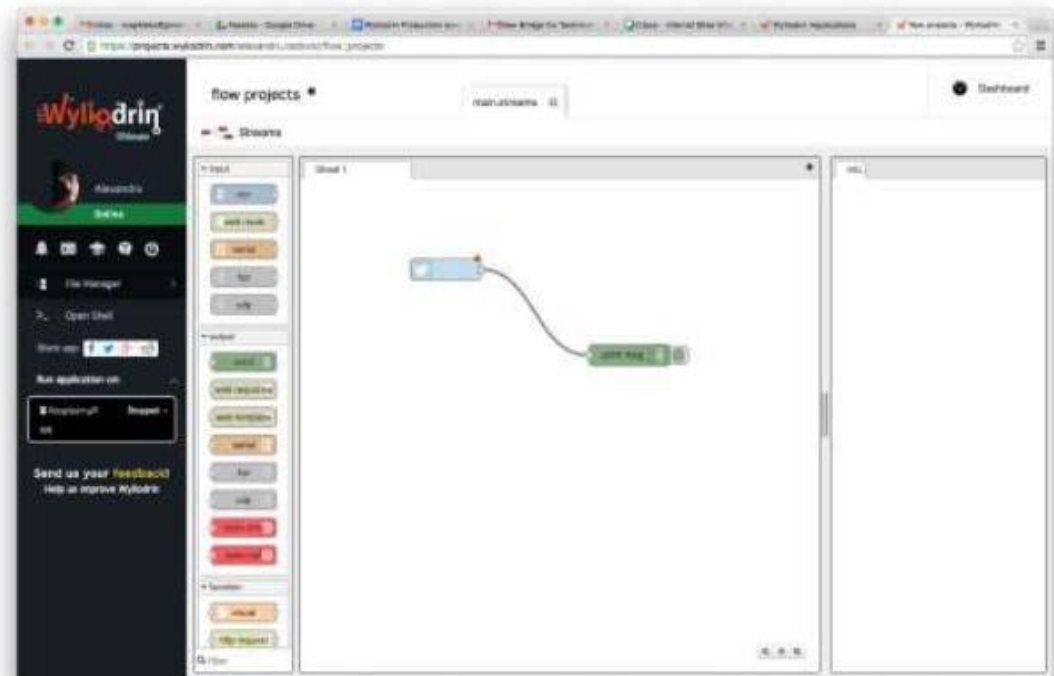
Create an Mbed Account to Get Started

Try Pelion Device Management with Mbed

- The leading open source IoT operating system, with support for NB-IoT, LoRaWAN, BLE, NFC and other communications stacks.

# Solutions Builder

- Wyliodrin
  - Prototyping
  - Devices Management
  - Programming
  - Signal Processing
  - Servers



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# References

- [https://en.wikipedia.org/wiki/Internet\\_of\\_things](https://en.wikipedia.org/wiki/Internet_of_things)
- <https://www.edureka.co/blog/iot-applications/>
- <https://ocw.cs.pub.ro/courses/iot>
- Introduction of IoT - John Soldatos, PhD
- M. Udin Al Rasyid, Materi Kuliah IoT