Introduction

Internet of Things

CS5055 – 2025I
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SRC: BUYYA&VAHID, U.MELBOURNE

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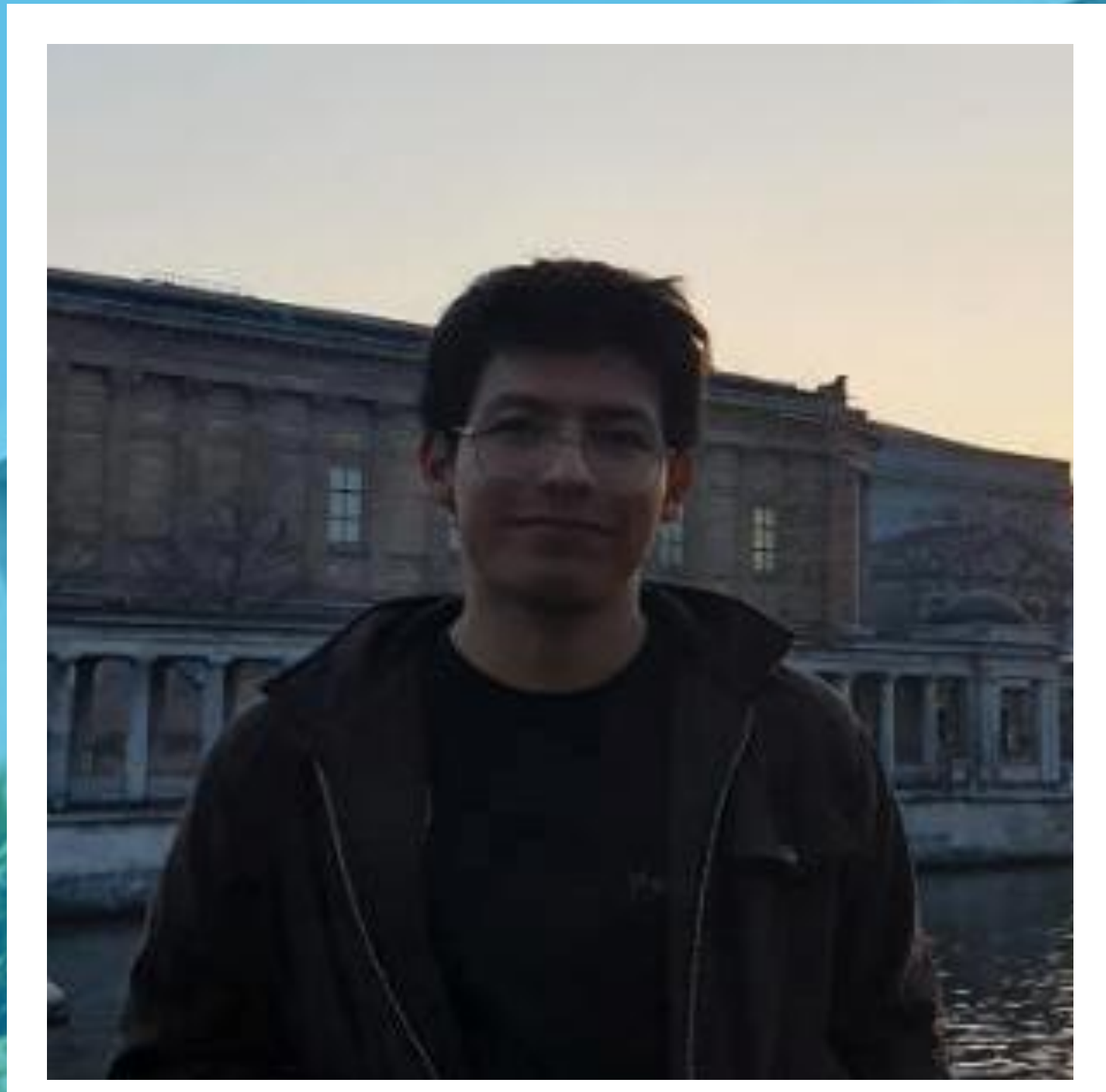
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He has a master's degree in Nanophysics from the Freie Universität Berlin (Germany) and the École Polytechnique (France). He has completed internships in different institutions and companies (INICTEL-UNI, STMicroelectronics and EPFL) where he has obtained extensive experience in semiconductor physics, optics and device design. His current research interests focus on photonics, design optimization and nanophysics.

Executive Summary

- **Motivation:** IoT emerges as a solution to define smart devices as "things".
- **Problem:** We need to define a scope of IoT study and the main design goals and platforms.

- **Overview:**

 - CS5055 course logistics.

 - Internet of Things (IoT) introduction.

 - Review of IoT fundamentals and computing systems.

- **Conclusion:** IoT emerges as an integral platform to propose next-gen designs for providing services using networking and "things".

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IoT design perspective

Embedded systems for IoT

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CS5055 Internet of Things

- **Introduces** fundamental **concepts of IoT paradigm for design and implementation.**

- **Objectives:**

 - Show the principles of interconnected IoT systems.

 - Explain the interaction between computing and sensing for IoT.

 - Implement an IoT application system as a solution.

- **Content:**

 Distributed in two modules:

 - First module, from Week 1 to Week 8

 - Second module, from Week 9 to Week 16

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Evaluation

- For more details, please refer to the course Syllabi in Canvas or:

	THEORY	LABORATORY
EVALUATION *only if the student pass both theory and laborary parts of the course	Evaluación Continua C1 (5%) Examen Parcial E1 (15 %) Examen Final E2 (15%)	Laboratorio 1 L1 (10%) Laboratorio 1 L2 (10%) Laboratorio 1 L3 (10%) Laboratorio 1 L4 (10%) Proyecto P1 (5%) Proyecto P2 (20%)
	35%	65%
	100%	

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Important Rules

- UTEC rules:
- https://z9r4docs.utec.edu.pe/sites/default/files/2025-03/Reglamento%20Acad%C3%A9mico_0.pdf

Do not:

- **Publish your solution repos or share with other students before evaluation in canvas.**

- **Use partial or entire solutions and code implementations** from: a) online repositories, c) or other students (including those who have already taken the course).

  - **In doubt, ask instructor**

Do:

- Discuss ideas and problems with other students

- Ask your instructor

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Logistics

- **All course communication via Piazza.** Use email for emergencies.
  - Do not send direct messages, use the server channel. Do not be afraid to ask ☺

  - **Arch** forum: do not send code, solutions, or illegal items.

  - Piazza

  - Laboratory professor: Gabriel Arias

    - Jueves: 20:00 – 22:00

    - Viernes: 20:00 – 22:00

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Logistics

- **Use email for emergencies.**

- **Case: one or more members of your team go AWOL**
    - Each report must have the list of people which where working on the project/lab and their contributions, e.g.

Universidad
Escuela

Título del Reporte
Curso

Integrantes del Grupo
- Integrante 1: revisión bibliográfica/búsqueda de normas/
- Integrante 2: implementación de nodo sensor/revisión bibliográfica
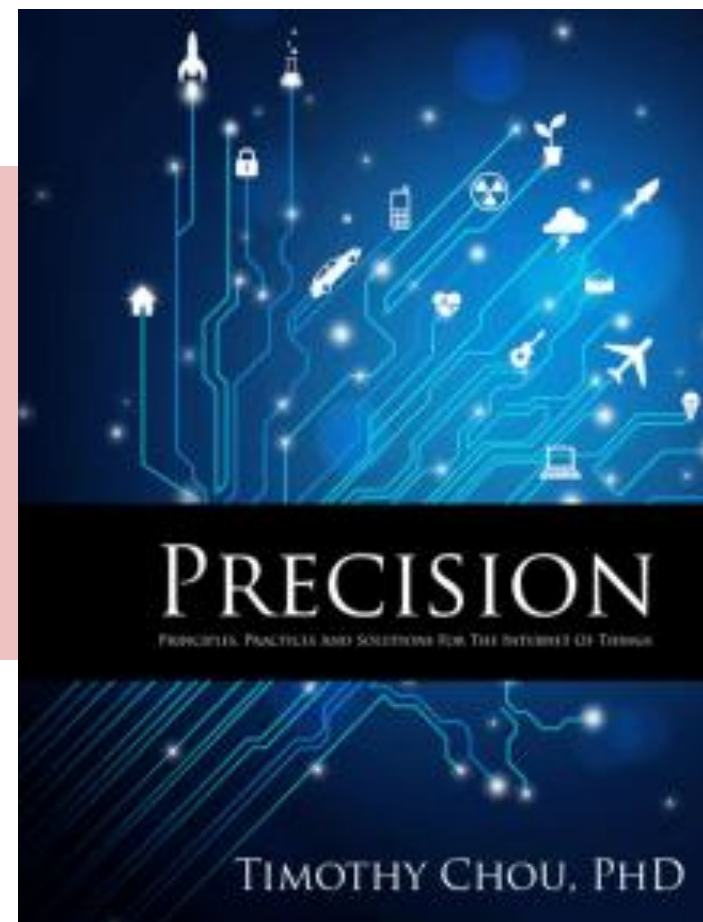- Integrante 3: implementación de nodo sensor/revisión bibliográfica/frontend

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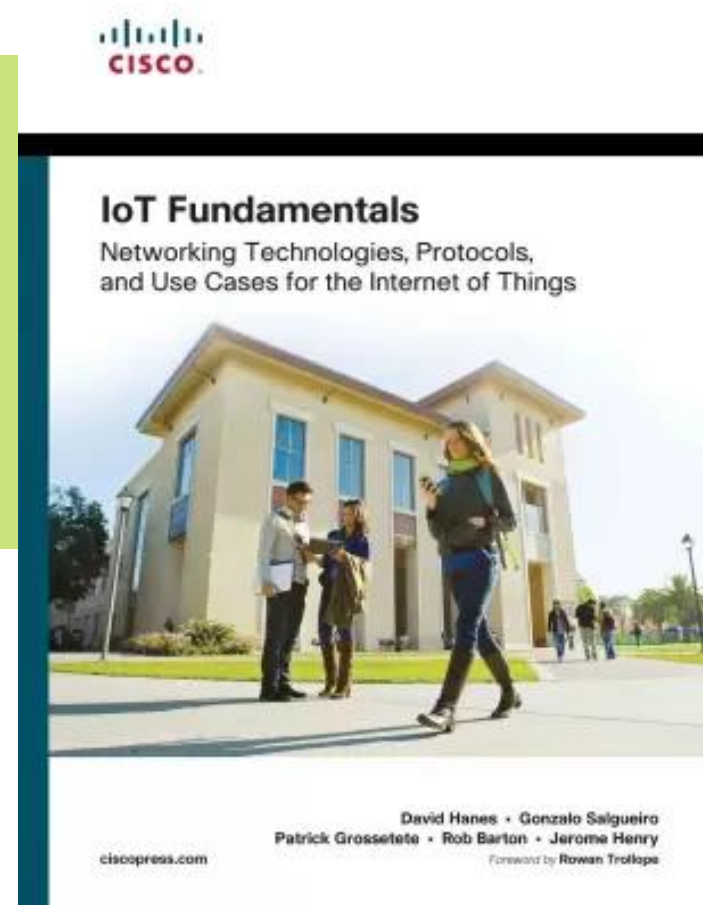UNIVERSIDAD DE INGENIERÍA Y TECNOLOGÍA

1 Enjoy the IoT trip ☺

Books

- The **books** for our IoT course are:

Chou T. (2020). Precision: Principles, Practices and Solutions for the Internet of Things. Lulu Press.

Hanes, D., Salgueiro, G., Grossetete, P., Henry, J. y Barton, R. (2017). IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things. Cisco Press.

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What is expected from IoT?

https://www.youtube.com/watch?v=mklV-DnKgwg

#Arm #IoT #InternetofThings
IoT on Arm: It's Time to Build

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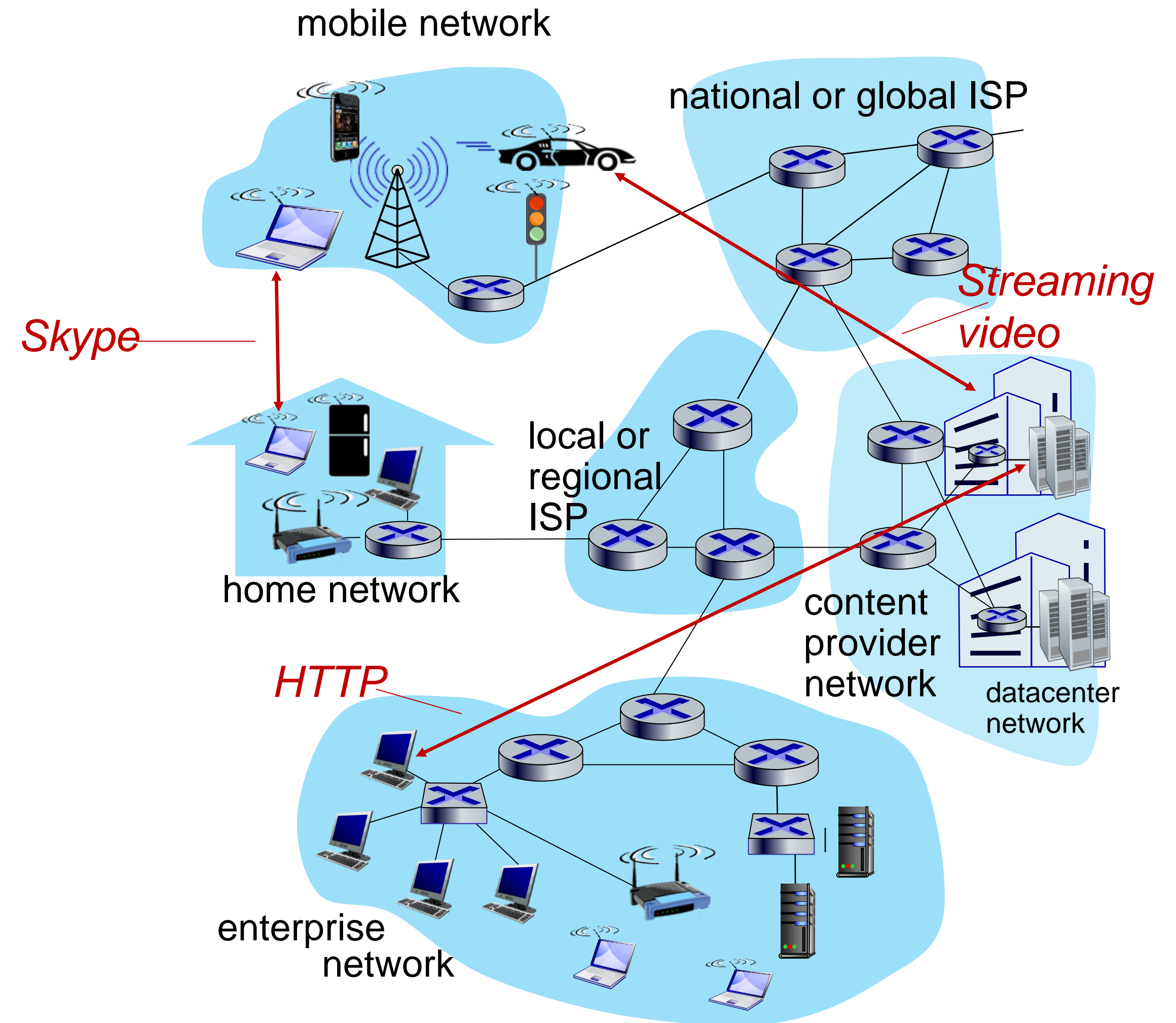Introduction

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"Fun" Internet-connected devices

Amazon Echo

Internet refrigerator

IP picture frame

Pacemaker & Monitor

Tweet-a-watt: monitor energy use

bikes

Security Camera

Slingbox: remote control cable TV

Web-enabled toaster + weather forecaster

cars

AR devices

scooters

Internet phones

Gaming devices

sensorized, bed mattress

Fitbit

Others?

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Recall: the Internet: a "services" view

- ***Infrastructure*** that provides services to applications:
  - Web, teleconferencing, email, games, e-commerce, social media, inter-connected appliances, …

- provides ***programming interface*** to distributed applications:
  - "hooks" allowing sending/receiving apps to "connect" to, use Internet transport service

mobile network

national or global ISP

Skype

Streaming video

local or regional ISP

home network

content provider network

HTTP

datacenter network

enterprise network

What about "Things"?

- **Set of entities:** smart devices, sensors, human beings, and any other objects aware of its context and is able to communicate with other entities

  1. Accessible at any time, anywhere.

  2. Integration of mobile devices, edge devices like routers and smart hubs, and humans in the loop as controllers.

- **Need to support** a diverse set of devices and communication protocols.

- **Example:** 1) from tiny sensors, to 2) also powerful back-end servers that are utilized for data analysis

Internet of Things (IoT)

IoT: Internet + Things

- Kevin Ashton is accredited for using the term "Internet of Things", 1999 - on supply-chain management conference.

- **Connectivity** (also 'smartness') is a fundamental aspect for IoT:

  - **Initially:** Radio-Frequency Identification (RFID) used to be the dominant technology wireless sensor networks (WSN)

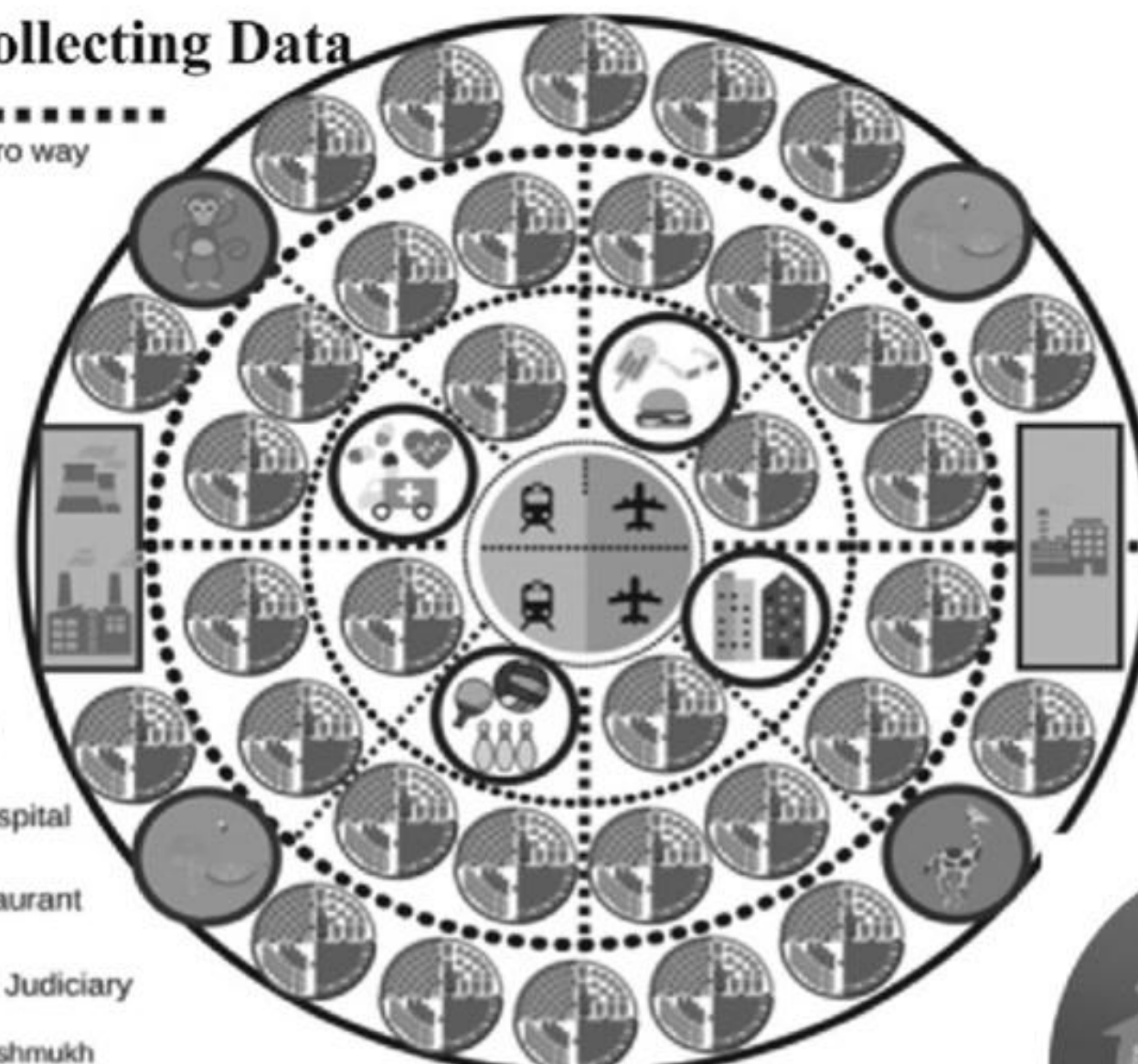 - **Now:** Bluetooth-enabled devices augmented the mainstream adoption of the IoT trend.

IoT

- Sensing

- "Smartness"
  - Big data
  - Analytics

Sensing and Collecting Data

- - - - - - - - - - - - - - -
Road + Super speed metro way

- A Single Block
- Water Body
- Green Cover
- Factory
- Railway Station
- Airport
- Recreation Center
- Multi Speciality Hospital
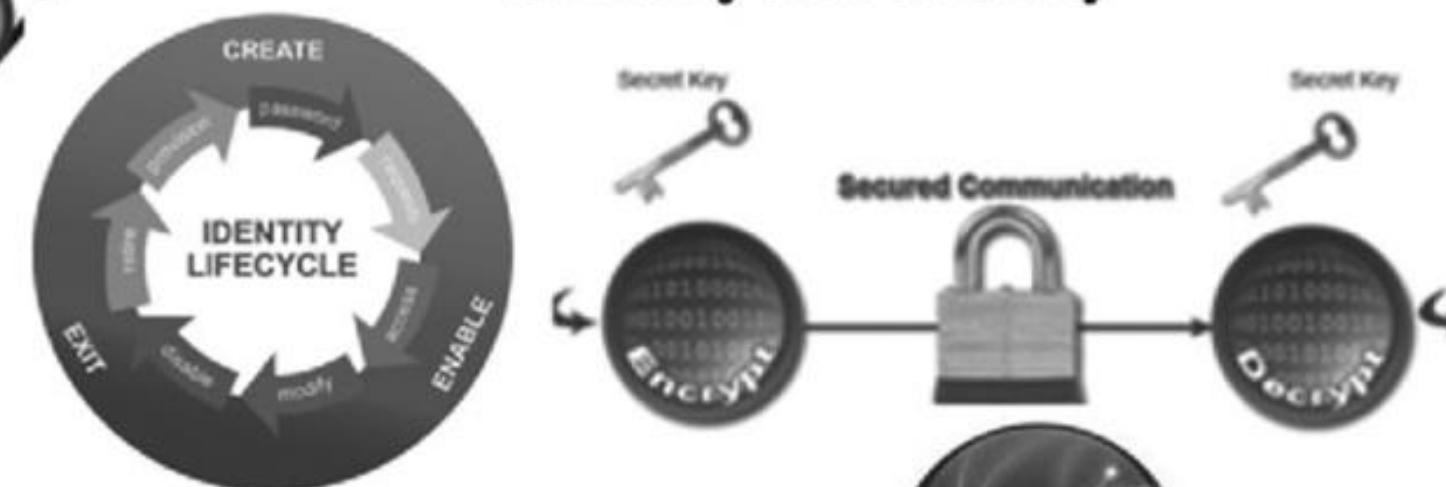- Multiplex and Restaurant
- Administration and Judiciary

Designed by Jayati Deshmukh

Predict and Optimise the Decision

Visualise and Model

Extract and Filter

Keeping Humans in the Loop

Security and Privacy

CREATE
IDENTITY LIFECYCLE
EXIT ENABLE

Secret Key   Secret Key
Secured Communication
Encrypt   Decrypt

SDN

Connecting Objects and Humans

| WPAN | W-Mesh | WLAN | WWAN |

Data Analytics and Decision Making

Stream 1
Stream 2
STORM   BIG DATA

Cloud Services

- Human factor (regulate, improve)
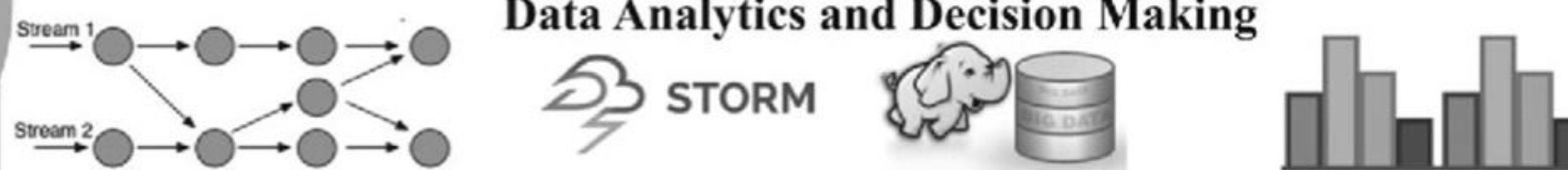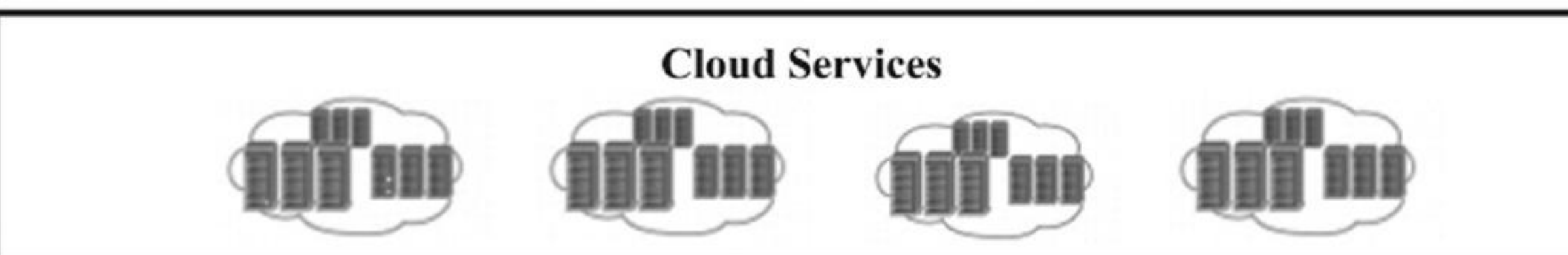
- Protection

- Connectivity (protocols, etc,)

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IoT Architecture (as a service)

- **Service Oriented Architecture (SOA):**
    1. **Sensing layer** is integrated with available hardware objects to sense the status of things
    2. Network layer is the infrastructure to support over wireless or wired connections among things
    3. Service layer is to create and manage services required by users or applications
    4. Interfaces layer consists of the interaction methods with users or applications

Reference IoT implementation

- Executable program that complies with the I/O behavior of the standard.
  - May be written in a variety of language.
- Standards for communication, sensing, privacy, etc.
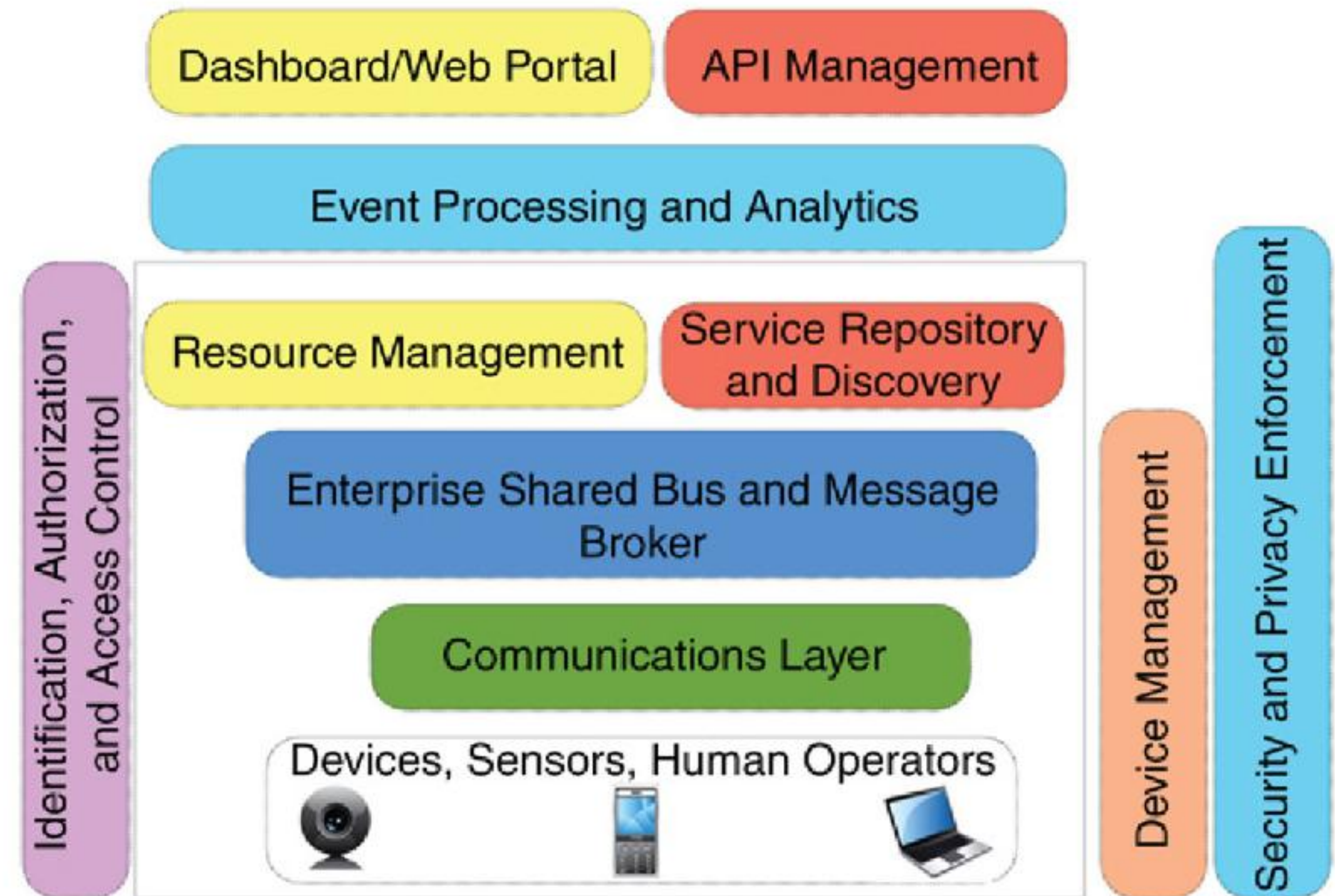
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Platform design

- **Required hardware to execute the IoT service.**

- **Turn system requirements and software models into detailed requirements.**

  - Use profiling and analysis tools to measure existing executable specifications.

- **Explore the design space manually or automatically.**

- **Develop hardware abstraction layers and other software.**

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- **Platform-based (hardware) design**
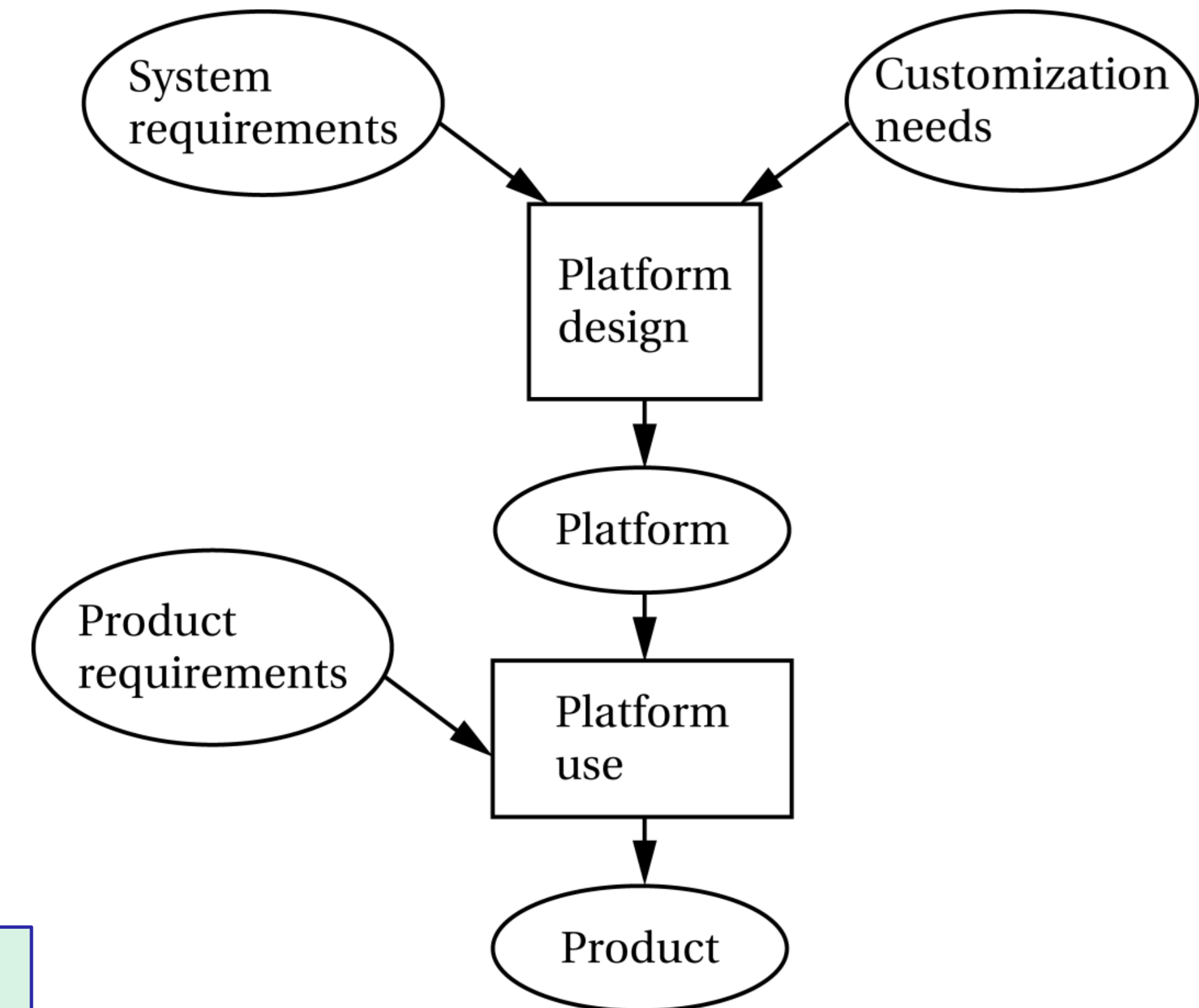
  - Platform includes hardware, supporting software.

  - Two stage process:

    1. Design the platform.

    2. Use the platform.

- Platform can be reused to host many different systems.

Smart sensing is the first requirement.

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Summary

- **We introduce our course:** evaluation and objectives.
- **We review the IoT design perspective:**
  - Infraestructure and architectural
- We highlighted the **relevance of the hardware platform for deployment of the IoT system.**