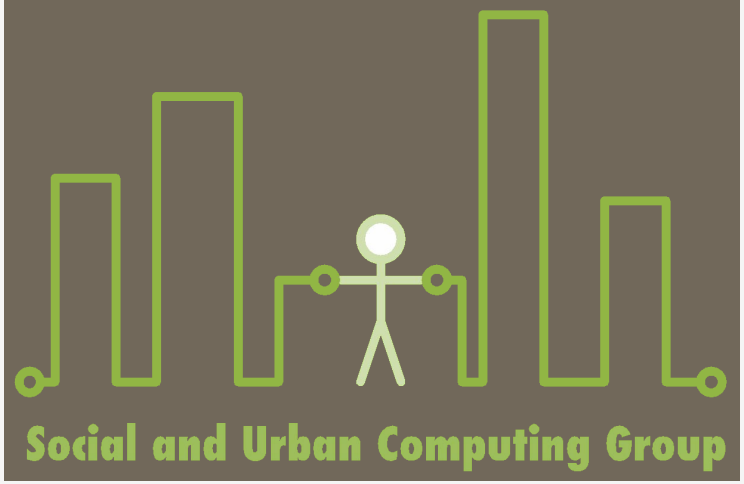

Internet of Things

Overview, challenges and solutions

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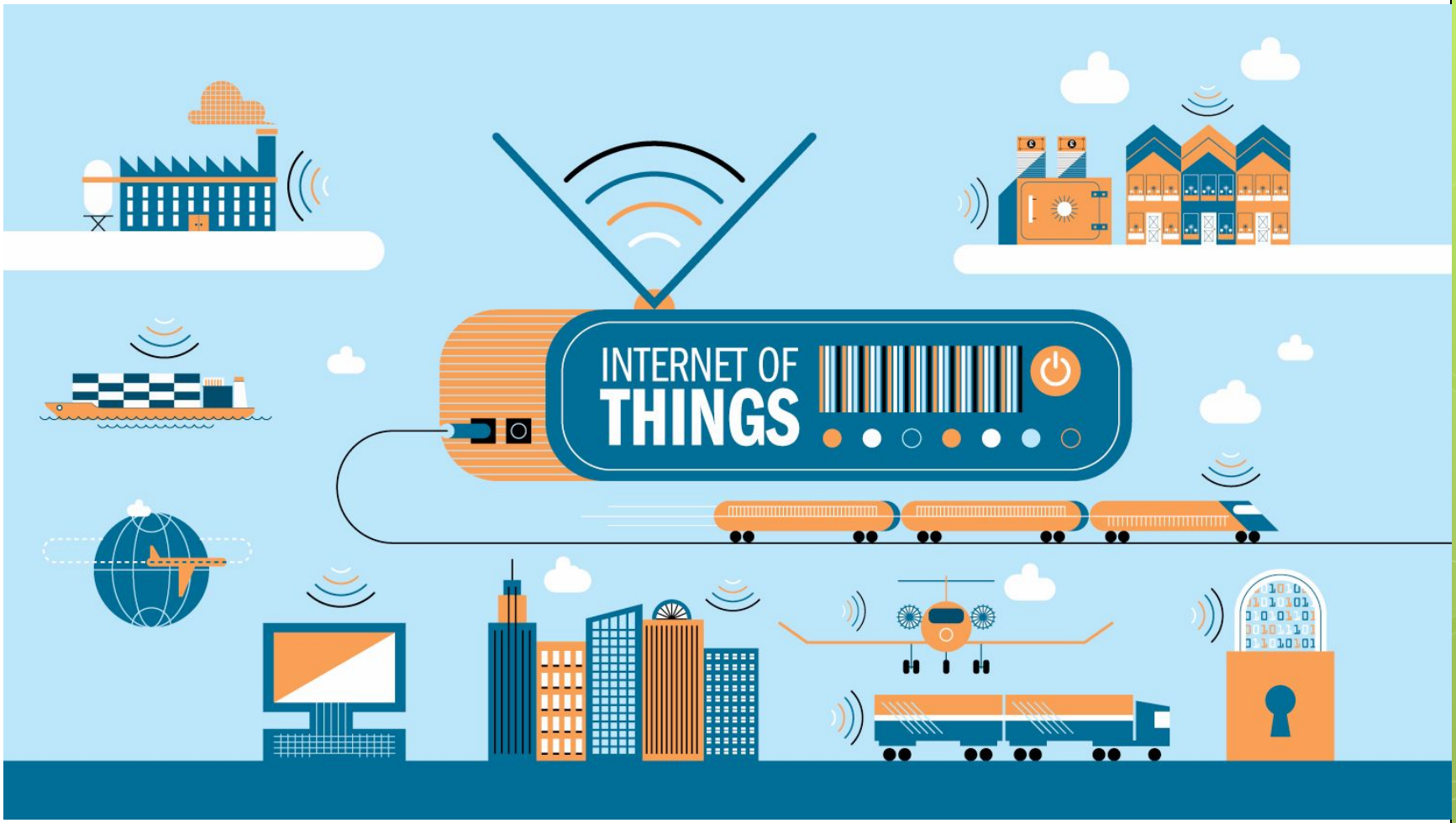
Agenda

- IoT
- Smart Devices
- Trends
- Issues and Challenges
- IoE, Fog Computing, CoT, SDT

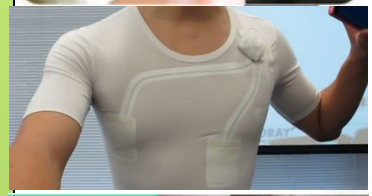
IoT

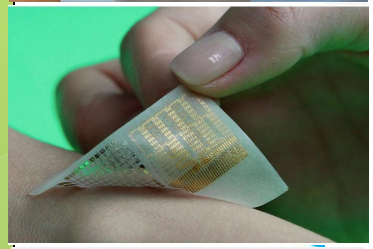


"IoT is the network of physical objects - devices, vehicles, buildings and other items embedded with electronics, software, sensors, and network connectivity - enabling these objects to collect and exchange data."

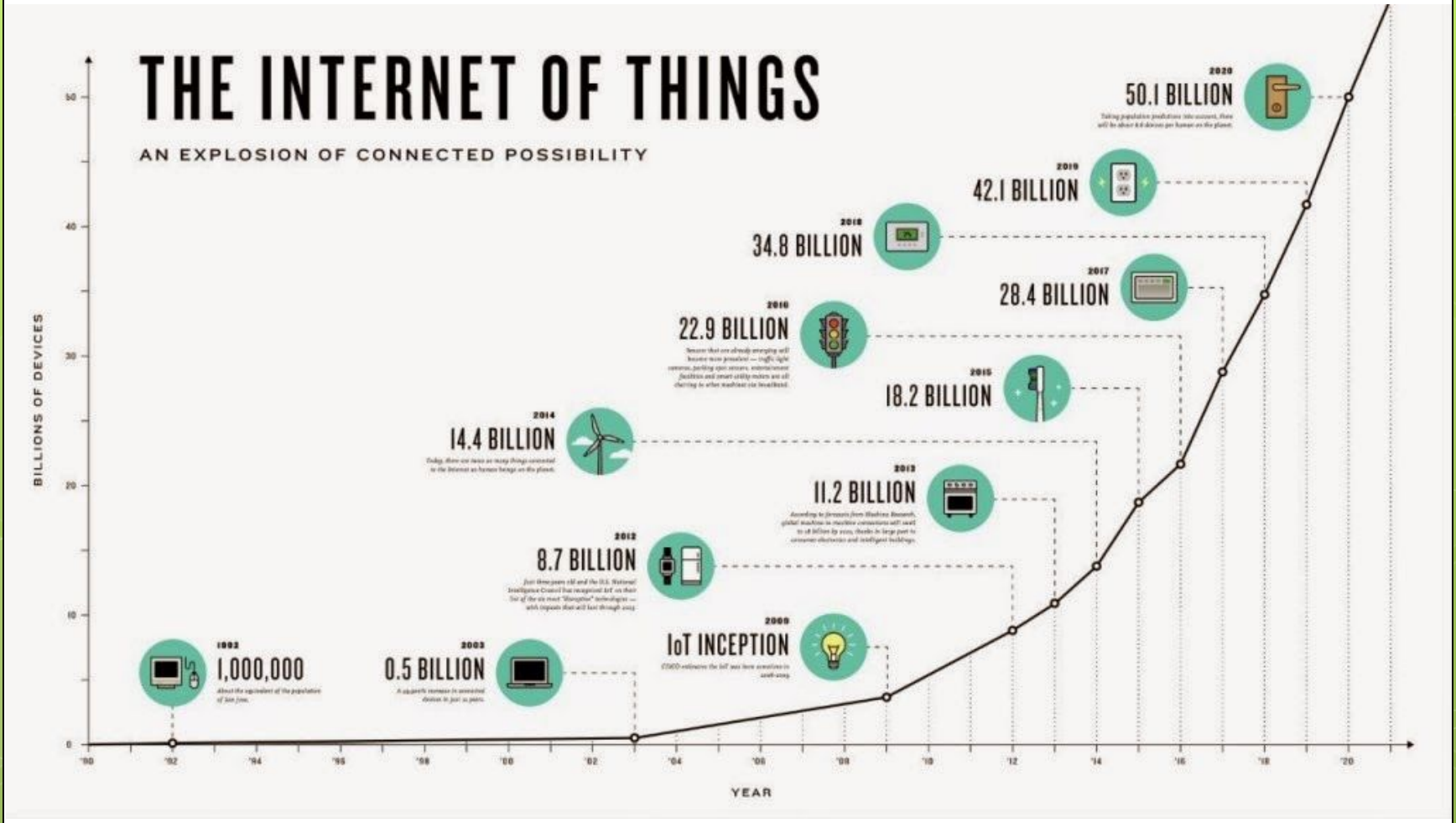
"Internet of Things Global Standards Initiative". *ITU*.

Smart Devices

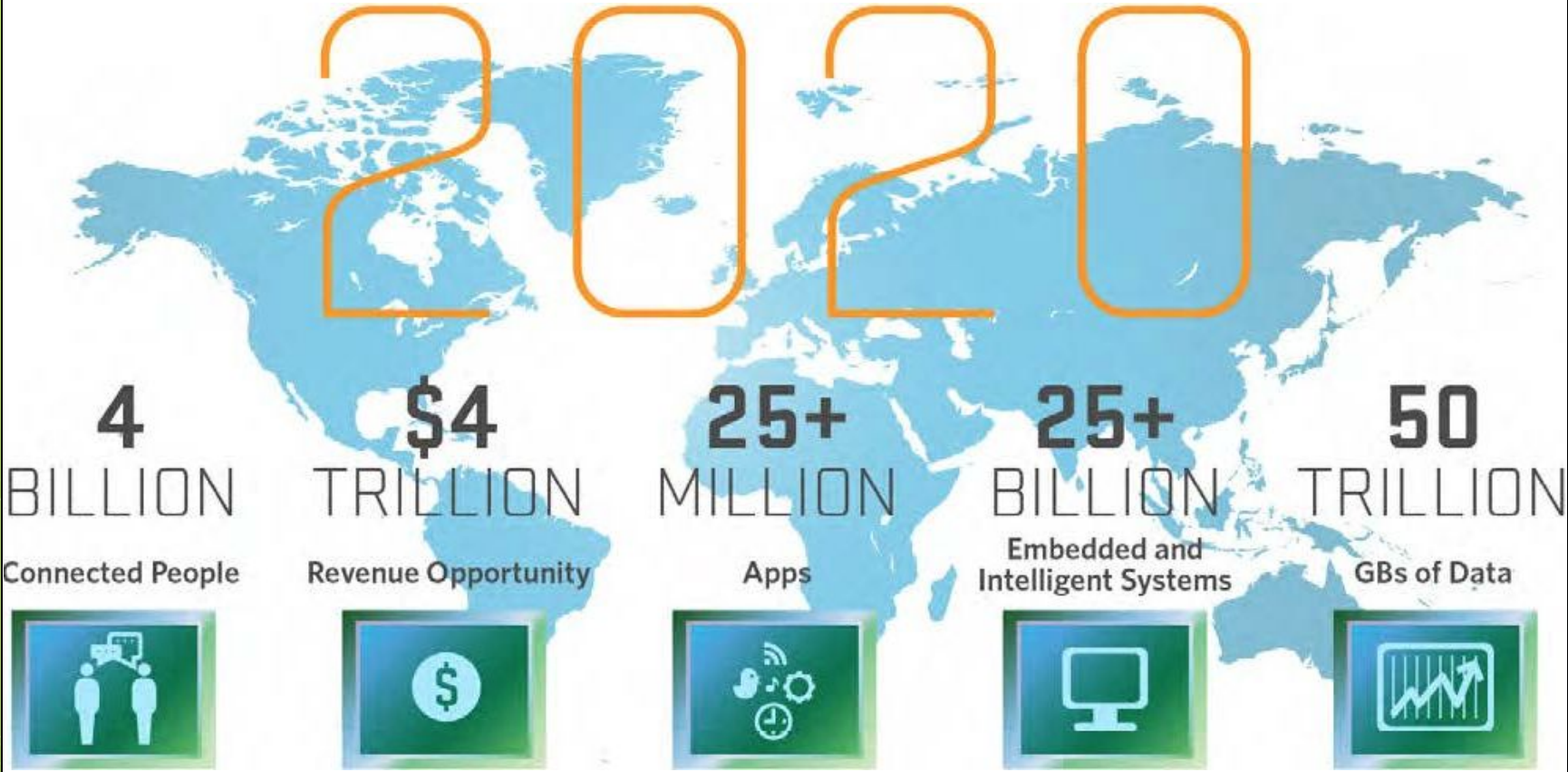




Trends

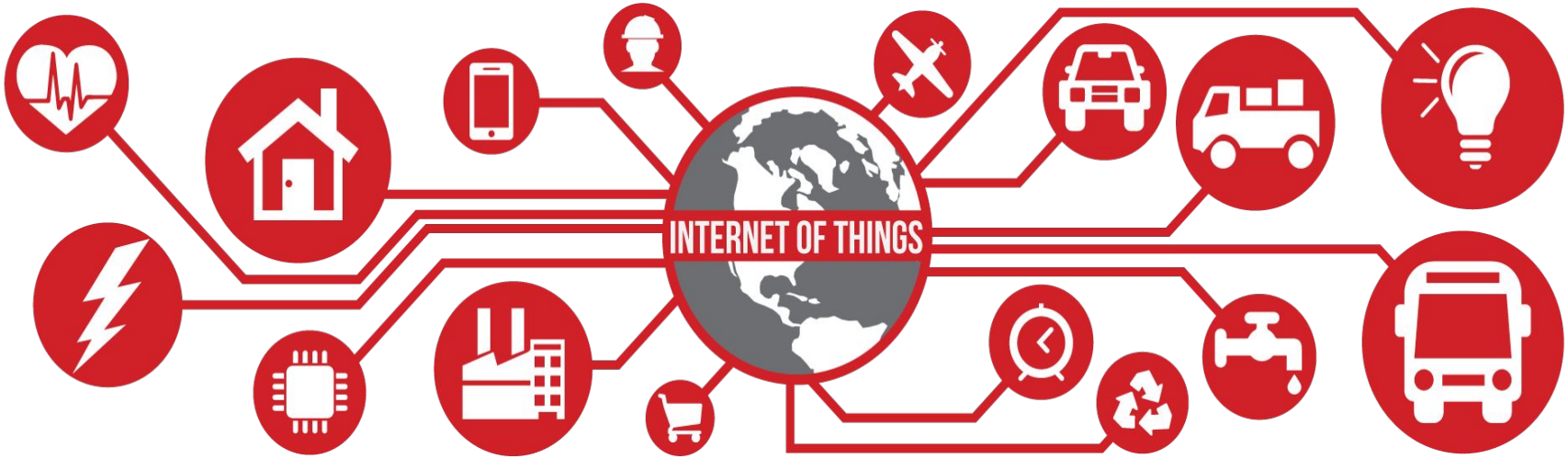

THE INTERNET OF THINGS
AN EXPLOSION OF CONNECTED POSSIBILITY
BILLIONS OF DEVICES
YEAR
1992
1,000,000
2003
0.5 BILLION
2009
IoT INCEPTION
2012
8.7 BILLION
2013
11.2 BILLION
2014
14.4 BILLION
2015
18.2 BILLION
2016
22.9 BILLION
2017
28.4 BILLION
2018
34.8 BILLION
2019
42.1 BILLION
2020
50.1 BILLION

Trends


2020
4
BILLION
Connected People
$4
TRILLION
Revenue Opportunity
25+
MILLION
Apps
25+
BILLION
Embedded and Intelligent Systems
50
TRILLION
GBs of Data

Issues and Challenges

- Issues
  - Not smart/ Internet enabled devices (e.g. sensors and actuators),
  - Not smart objects and things



- *Challenges*
  - IoT-zation, turn to smart
  - Interconnections, Network
  - Identify and categorize things
  - Management (things and data)

IoT-zation

- Add network interface to existing “things”
- Arduino 

  - Standard interface
  - Highly programmable and configurable
- Intel Galileo
- Samsung Artik
- Nanode, Pinguino, Teense, …
- Raspberry
- …

Networking

- Heterogeneous nodes-things
  - Communication protocols and mechanisms
  - Unmanned Machine-to-Machine interaction (M2M)
    - CoAP: a light HTTP protocol
    - MQTT: a PubSub system
    - AllJoyn: “discovery” of resources and services
  - Distributed -> No Control
  - Best effort -> No Guarantees

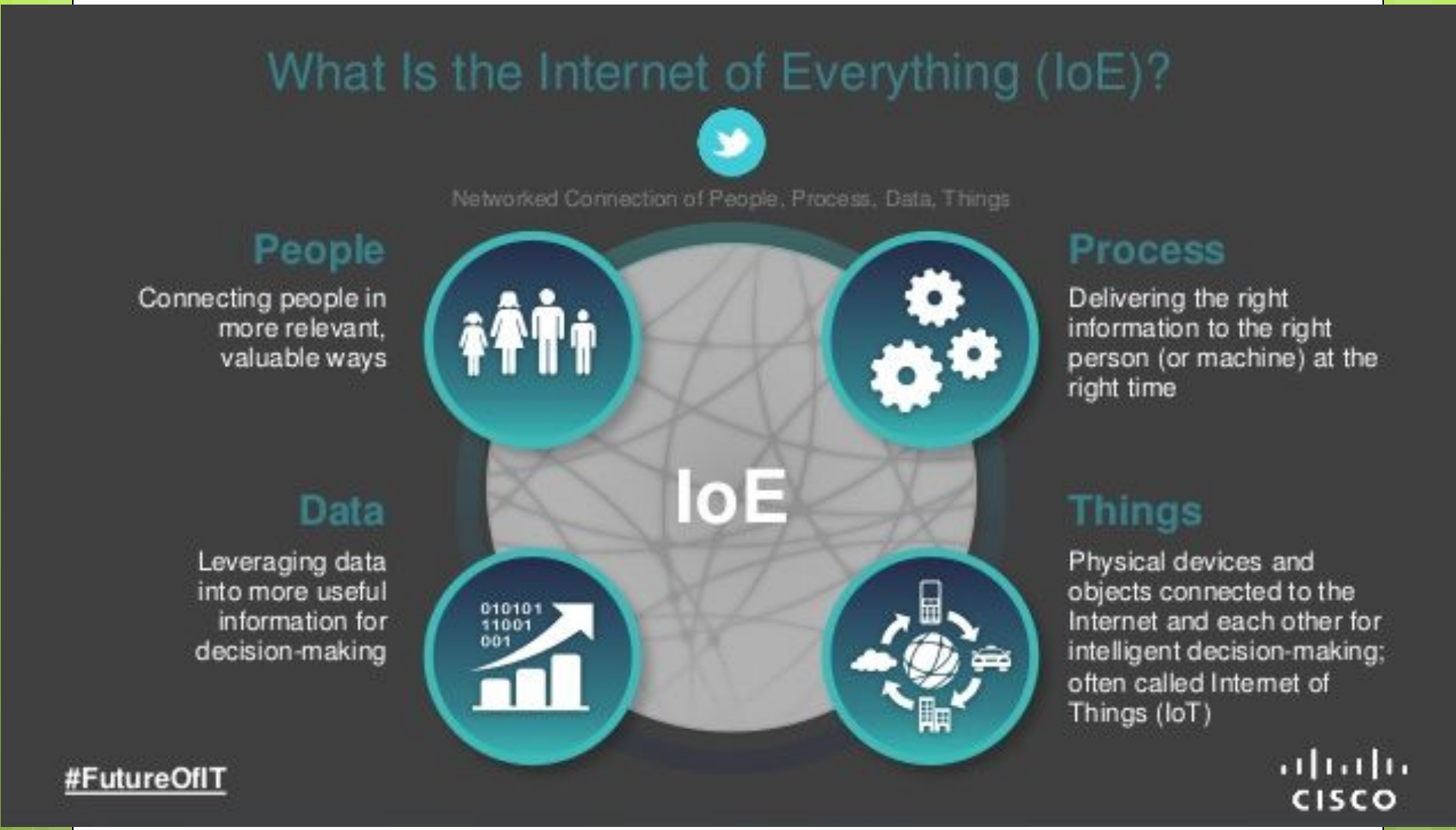
Identify Things

- What is a thing?
- Need of a common knowledge base, semantics, ontologies
  - Sensor and actuator types and metrics
    - OGC Sensor Web Enablement (SWE), Sensor Model Language (SML), (W3C) Semantic Sensor Network (SSN)
  - Semantic Web
    - XML, Resource Description Framework RDL, OWL,
  - Dynamic semantics
- Web of Things

Management

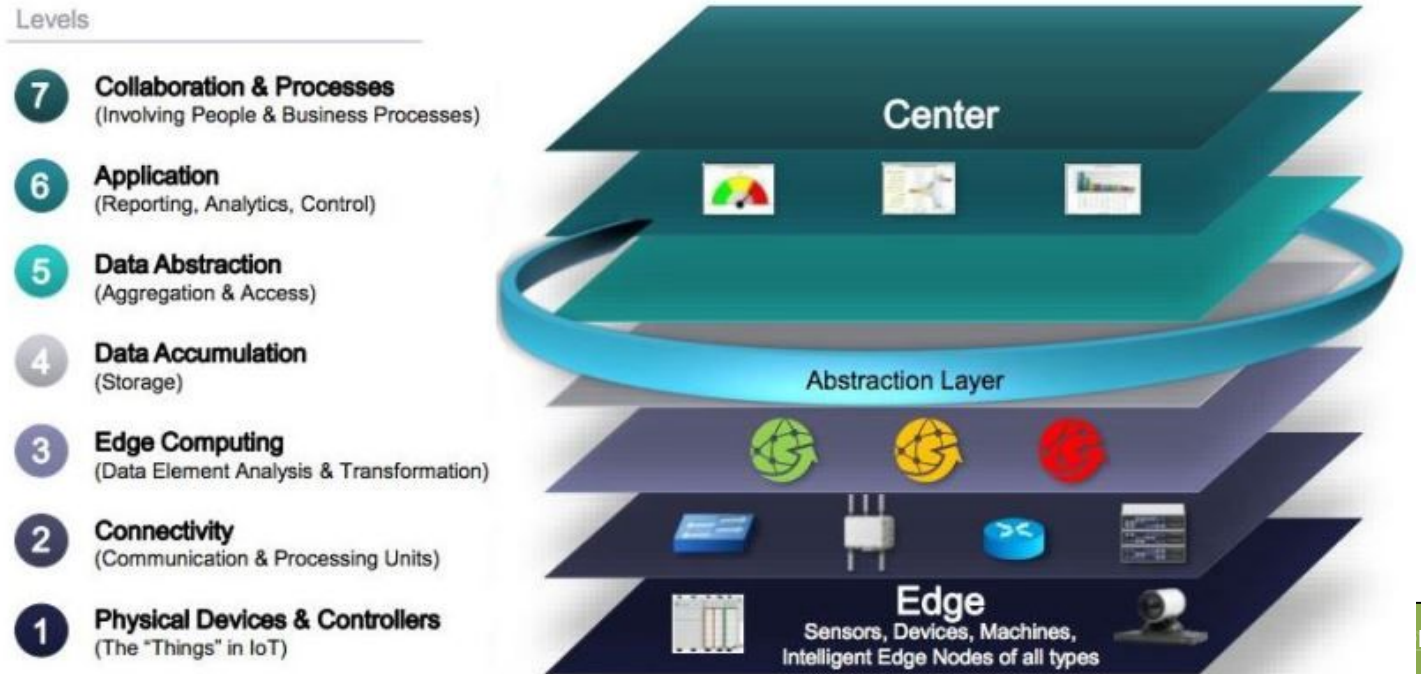
- Wide-scale – billions of things
  - Huge amount of data (Zettabytes 2^70-10^21)
- Solutions
  - Distributed, Autonomic, self-organizing
  - IoT-Cloud convergence: ubiquitous
    - Technological -> Cloud support IoT - SaaS
    - Methodological -> adopt the Cloud-service oriented paradigm to the provisioning of things Cloud of things, Things as a Service - IaaS
  - Software defined and virtualized ecosystems
    - SD things, SD cities, SDIoT

IoE


What Is the Internet of Everything (IoE)?
Networked Connection of People, Process, Data, Things
People
Connecting people in more relevant, valuable ways
Process
Delivering the right information to the right person (or machine) at the right time
IoE
Data
Leveraging data into more useful information for decision-making
010101
11001
001
Things
Physical devices and objects connected to the Internet and each other for intelligent decision-making; often called Internet of Things (IoT)
#FutureOfIT
CISCO

Fog Computing

- Aims at extending Cloud to the edge of an enterprise's network
- Facilitates the end devices-Cloud compute, storage and networking interactions
- Consists of a control plane and a data plane
- Emphasizes proximity to end-users and client objectives, dense geographical distribution and local resource pooling, quality of service (QoS) and edge analytics/stream mining

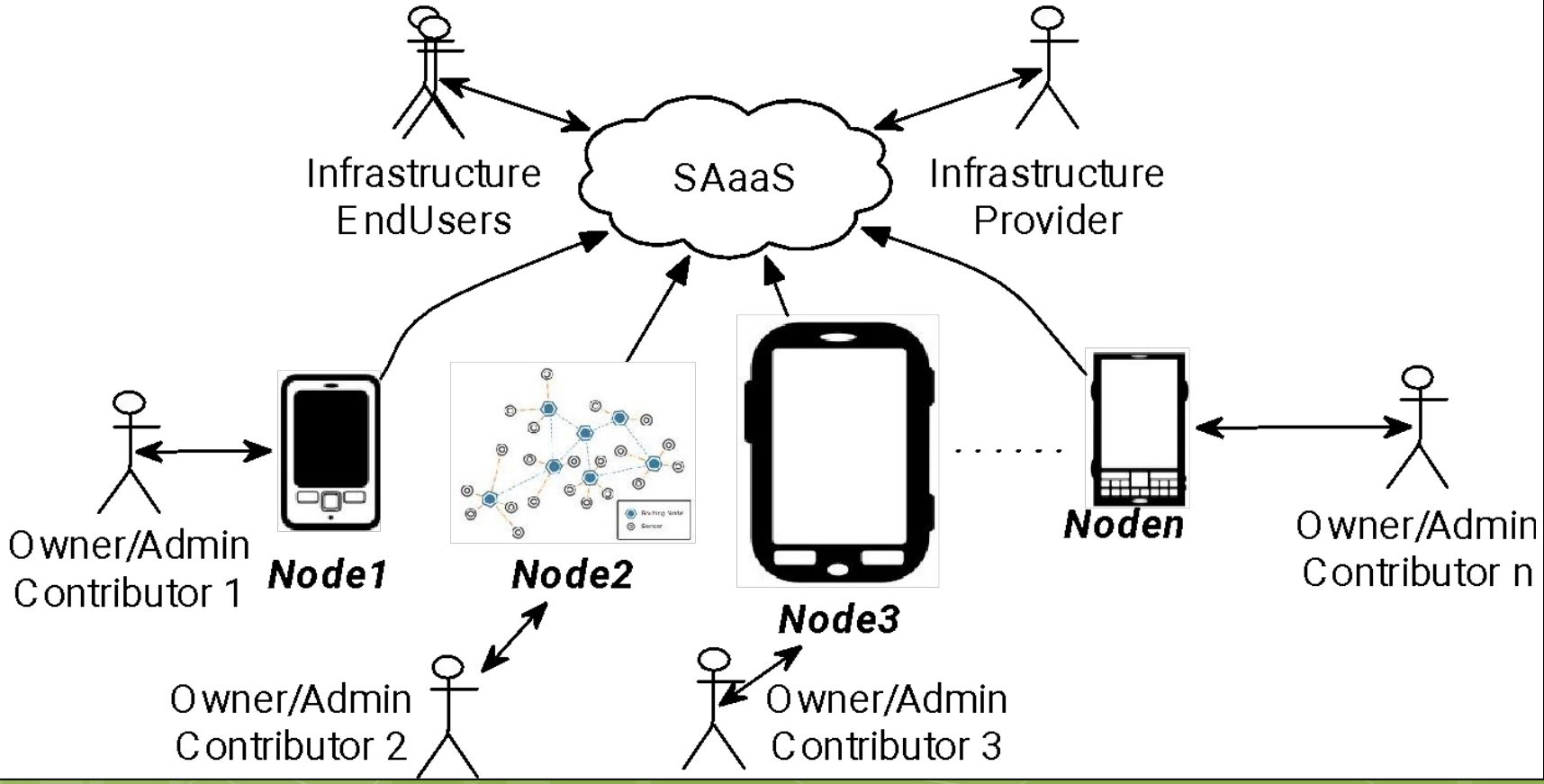


Ideas and Projects

- IoT, Cloud and Smart Cities
  - SensorCloud
  - SDC
  - MCSaaS
  - …
- Requirements:
  - 2-6 students/project
  - Java and/or Python
- International partnership, visit opportunities
  - Politecnico di Milano, Massachusetts Institute of Technology, National Technical University Athens, University of Messina, …
  - Cisco, Dog Hunter, RosTelecom, …

SensorCloud

- Goal: Implementing a Cloud of sensors
  - Device-centric
  - Involving actuators

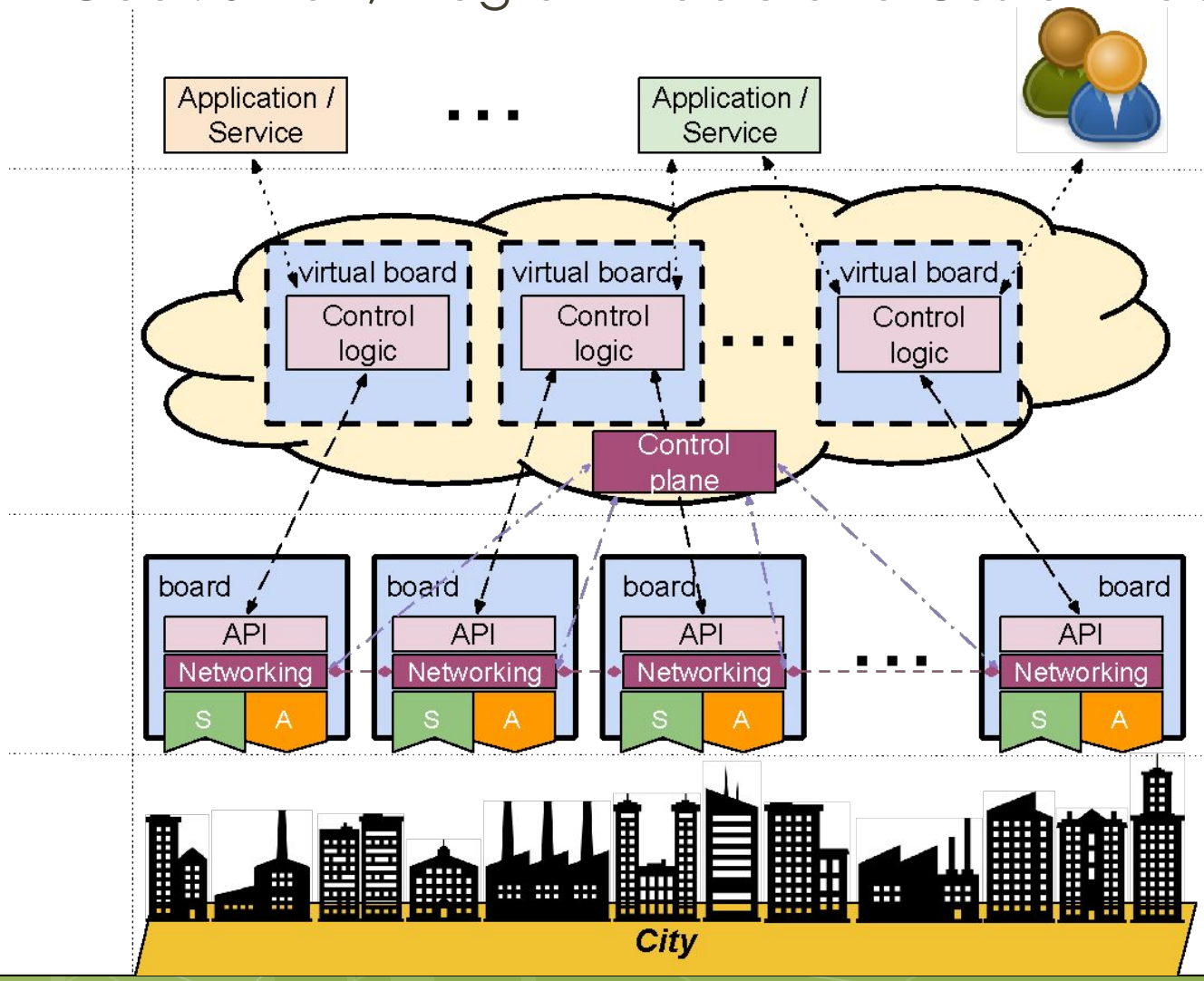


Software Defined Cities

Massachusetts Institute of Technology

dog hunter

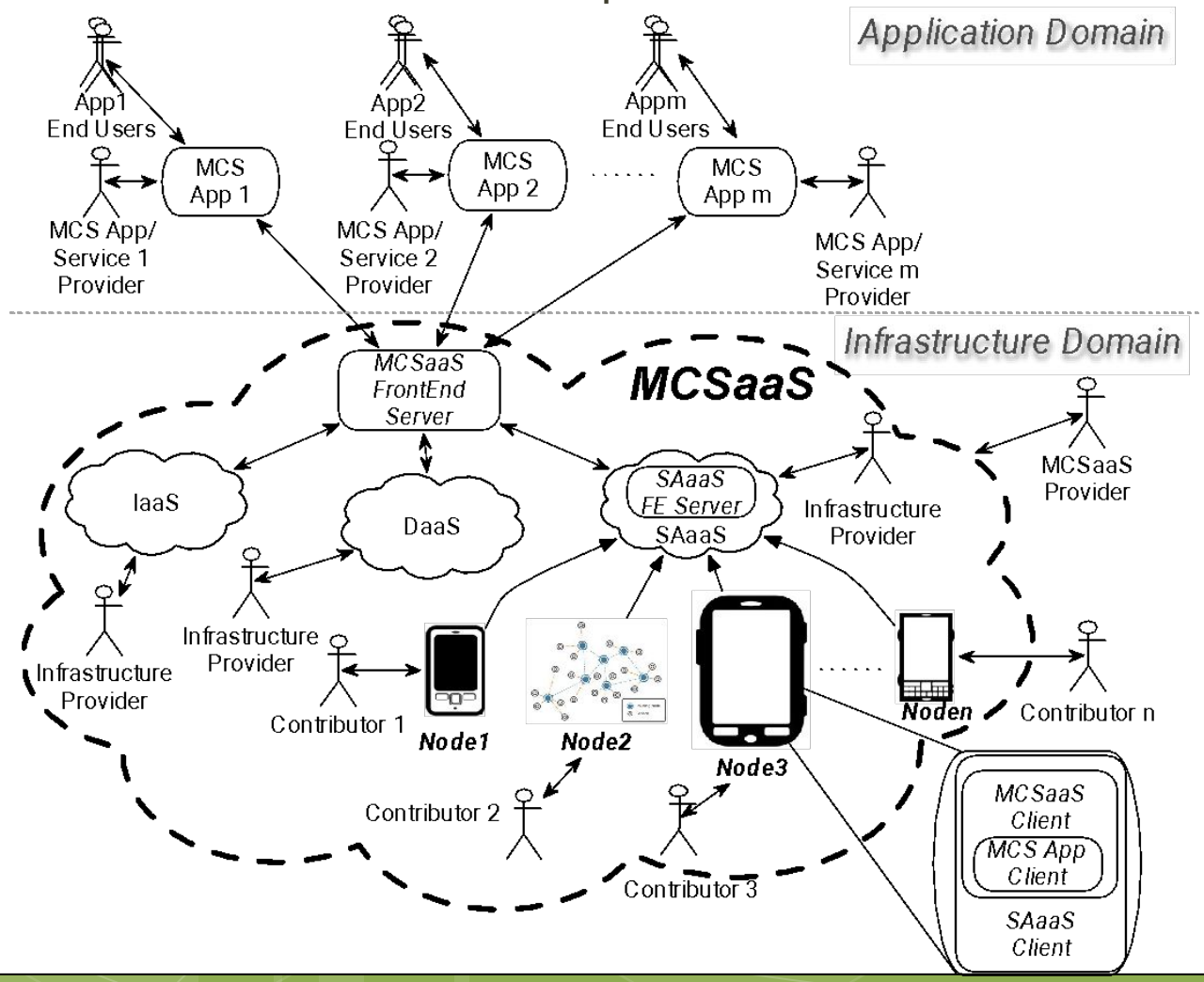
- Goal: Smart, Programmable and Customizable Cities



Mobile CrowdSensing aaS

Massachusetts Institute of Technology

- Goal: Unlock MCS capabilities



Thanks!

QUESTIONS?