

Social and Urban Computing Group

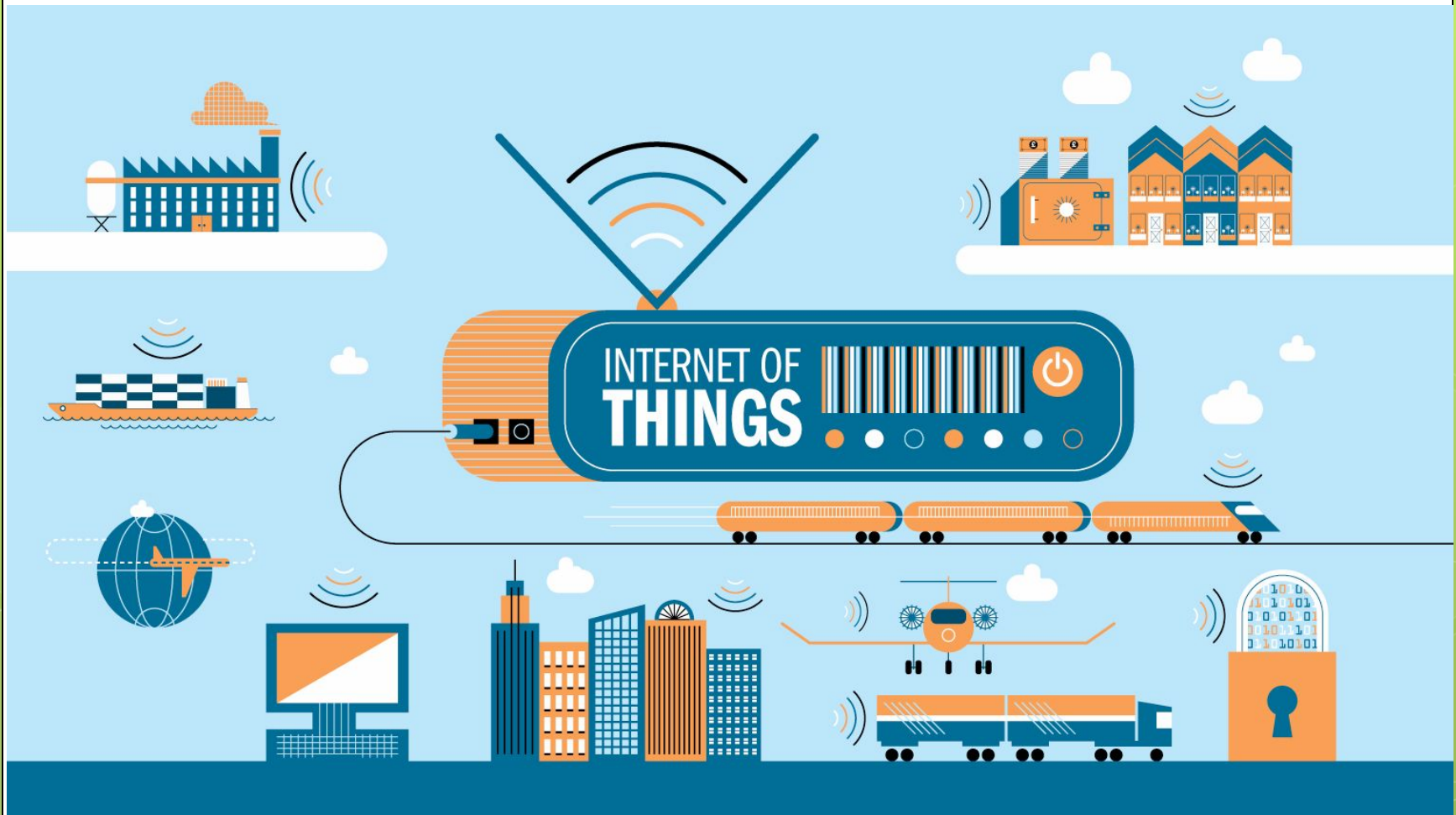
Internet of Things

*Overview, challenges
and solutions*

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



"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."

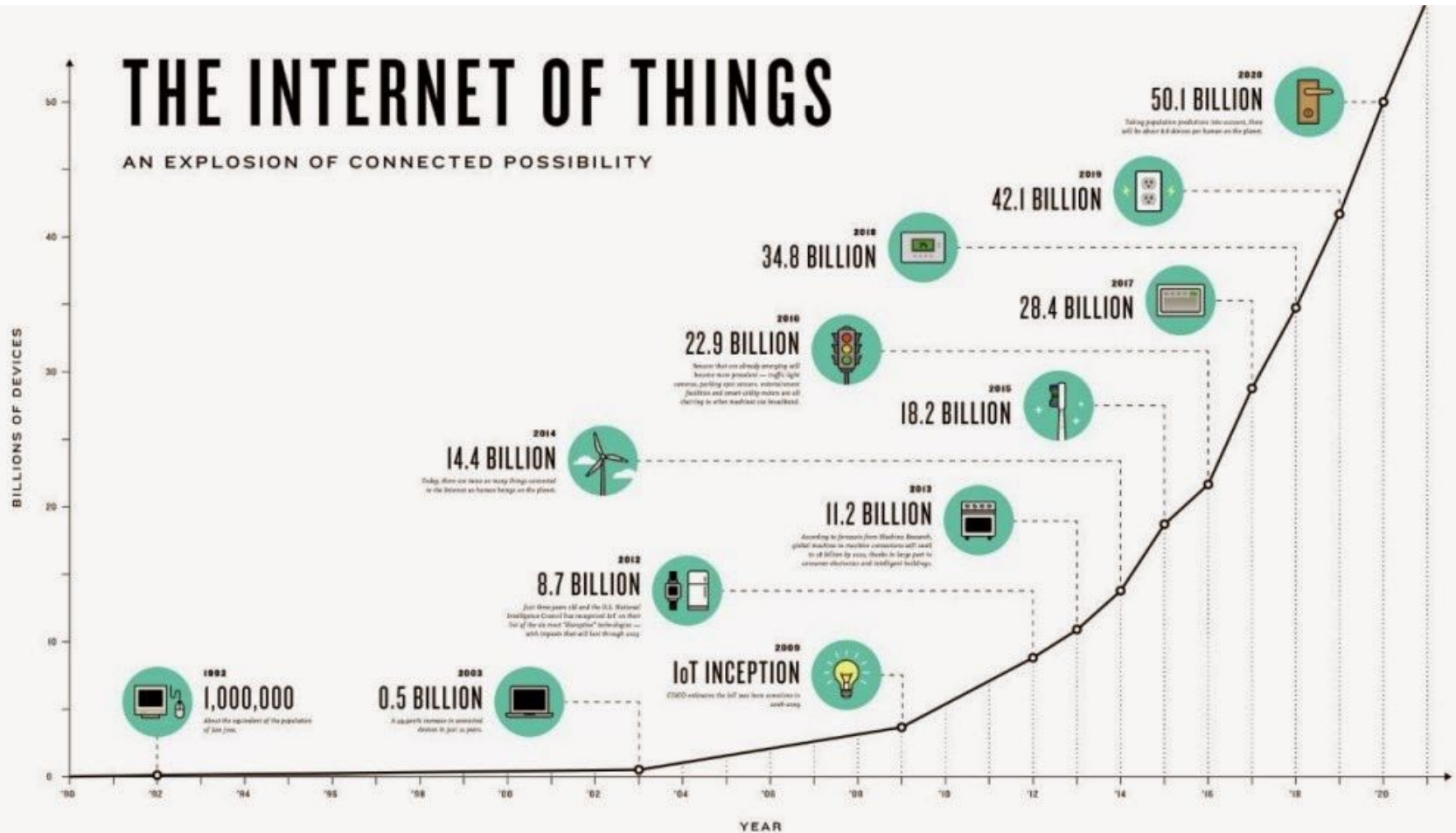
"Internet of Things Global Standards Initiative". ITU.

Smart Devices



THE INTERNET OF THINGS

AN EXPLOSION OF CONNECTED POSSIBILITY



2020

4
BILLION

Connected People



\$4
TRILLION

Revenue Opportunity



25+
MILLION

Apps



25+
BILLION

Embedded and
Intelligent Systems



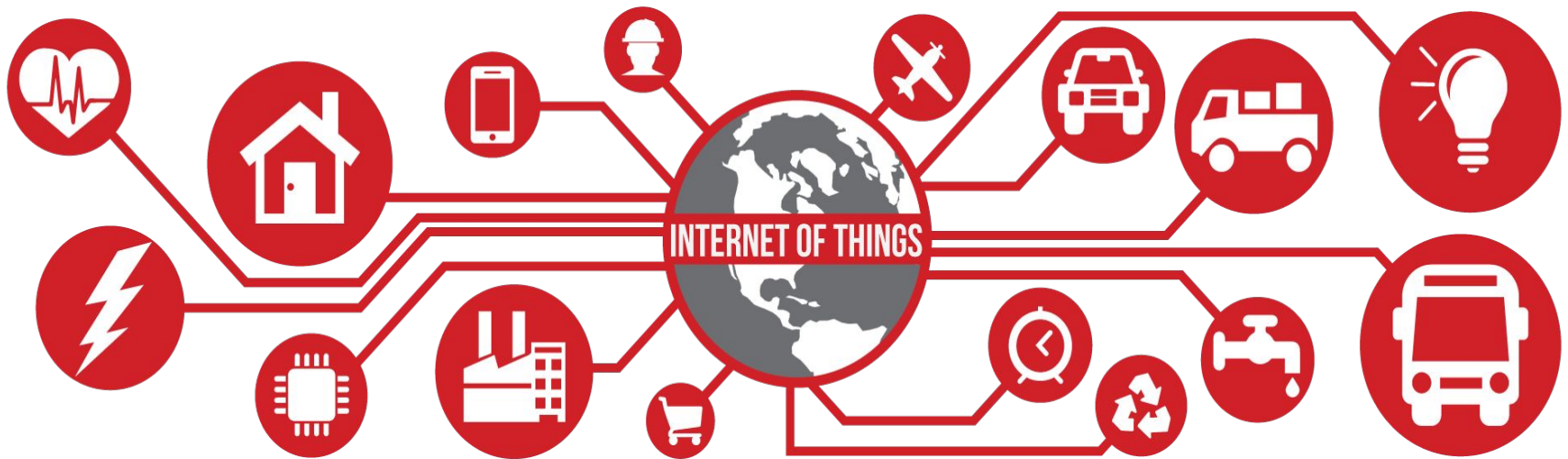
50
TRILLION

GBs of Data




□ 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)

- Add network interface to existing “things”
- Arduino 
 - Standard interface
 - Highly programmable and configurable
- Intel Galileo
- Samsung Artik
- Nanode, Pinguino, Teense, ...
- Raspberry
- ...

- 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

- 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

- 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

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



Data

Leveraging data into more useful information for decision-making



Things

Physical devices and objects connected to the Internet and each other for intelligent decision-making; often called Internet of Things (IoT)



IoE

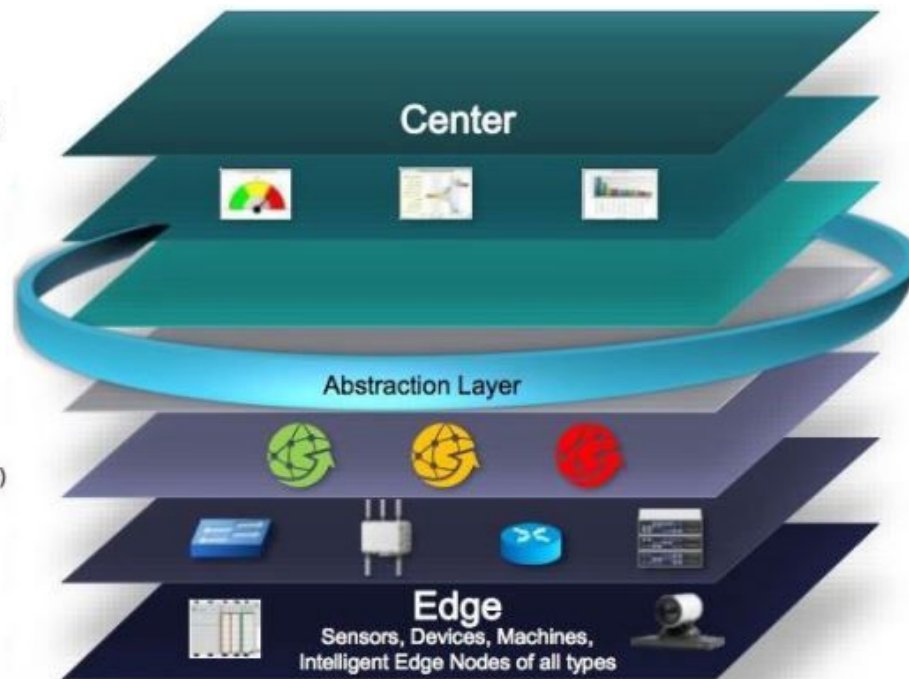
[#FutureOfIT](#)



- 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

Levels

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



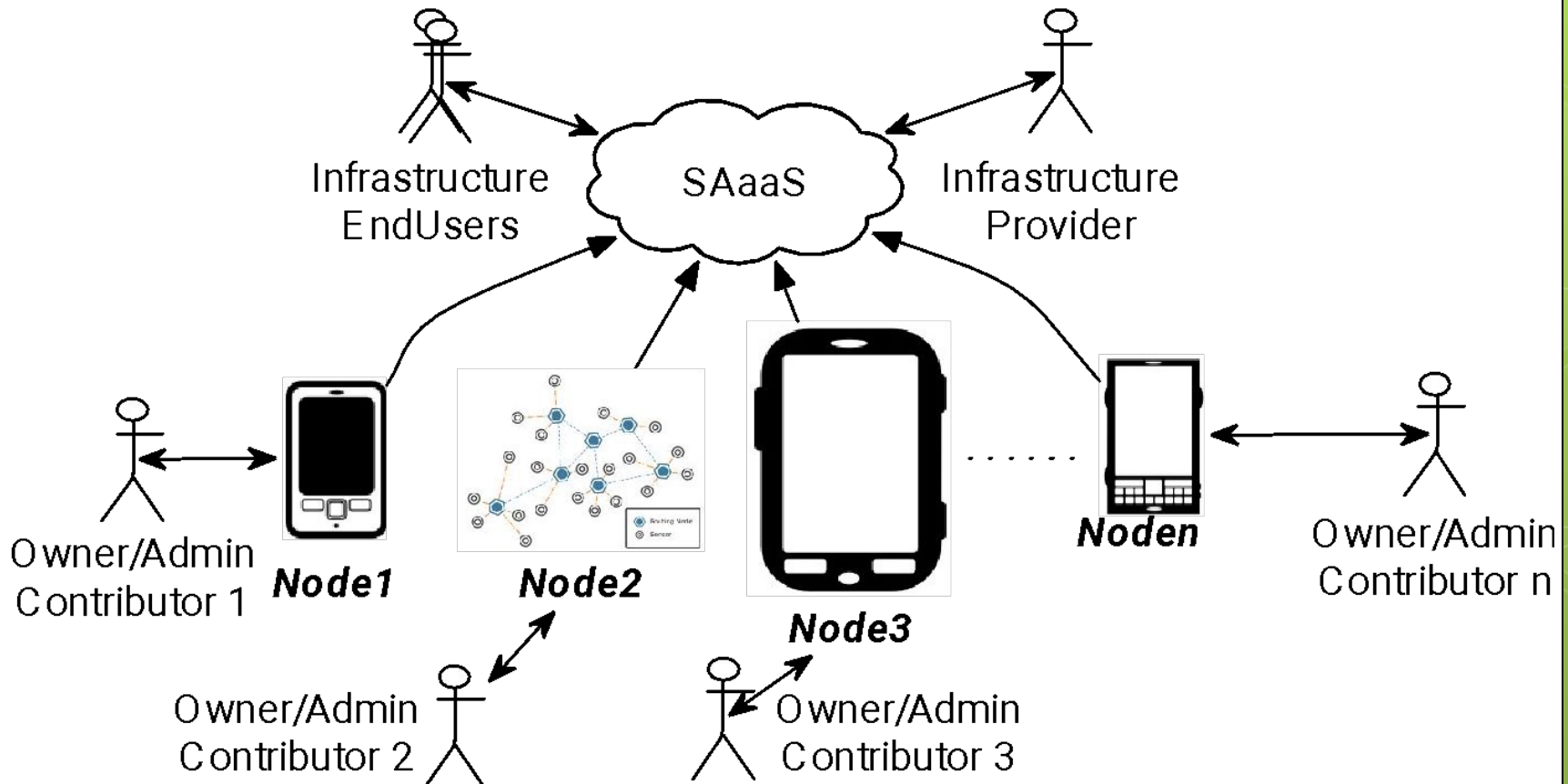
- IoT, Cloud and Smart Cities
 - SensorCloud
 - SDC
 - MCSaaS
 - ...

- 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, ...



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



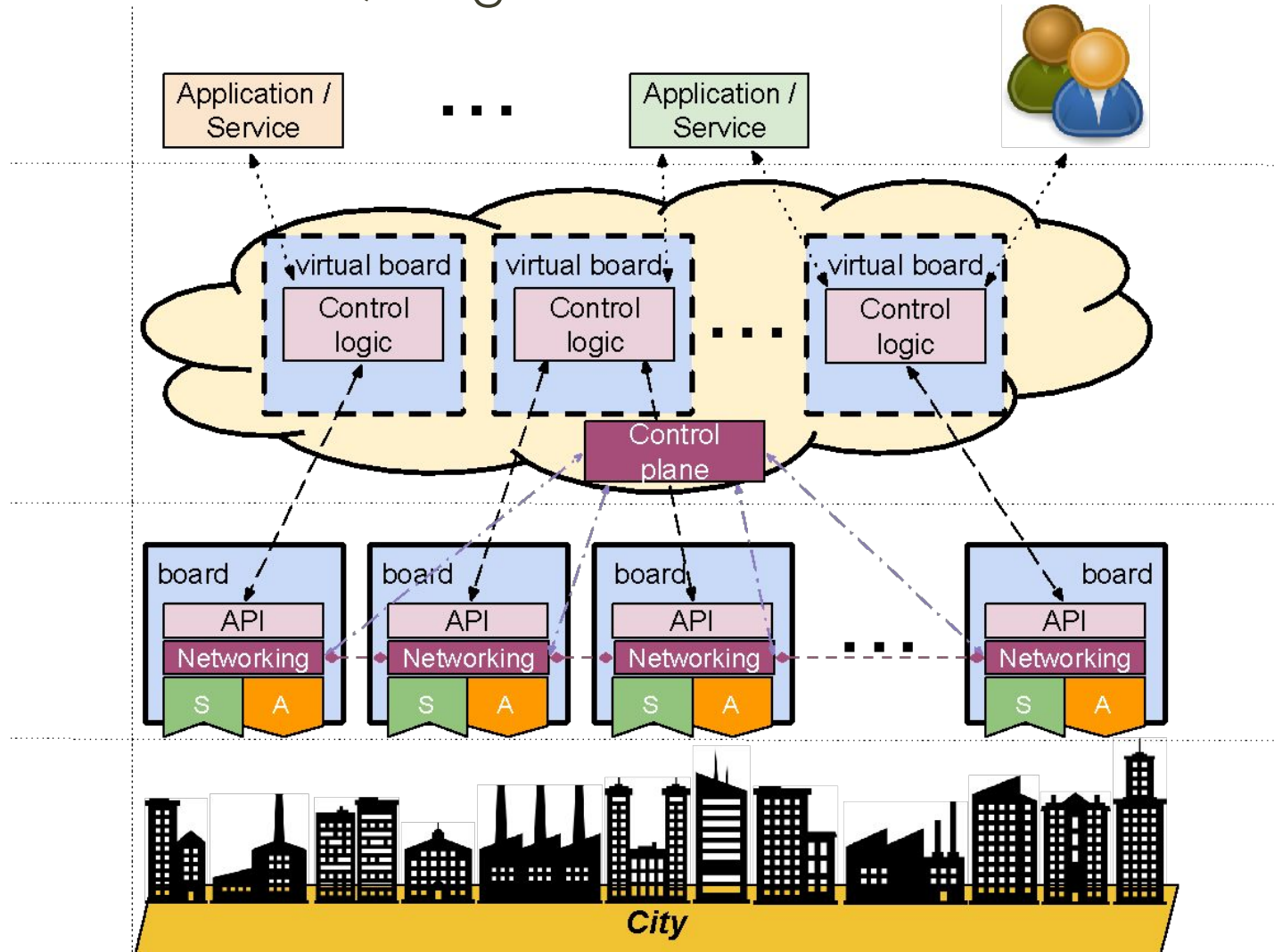


Massachusetts
Institute of
Technology



dog hunter

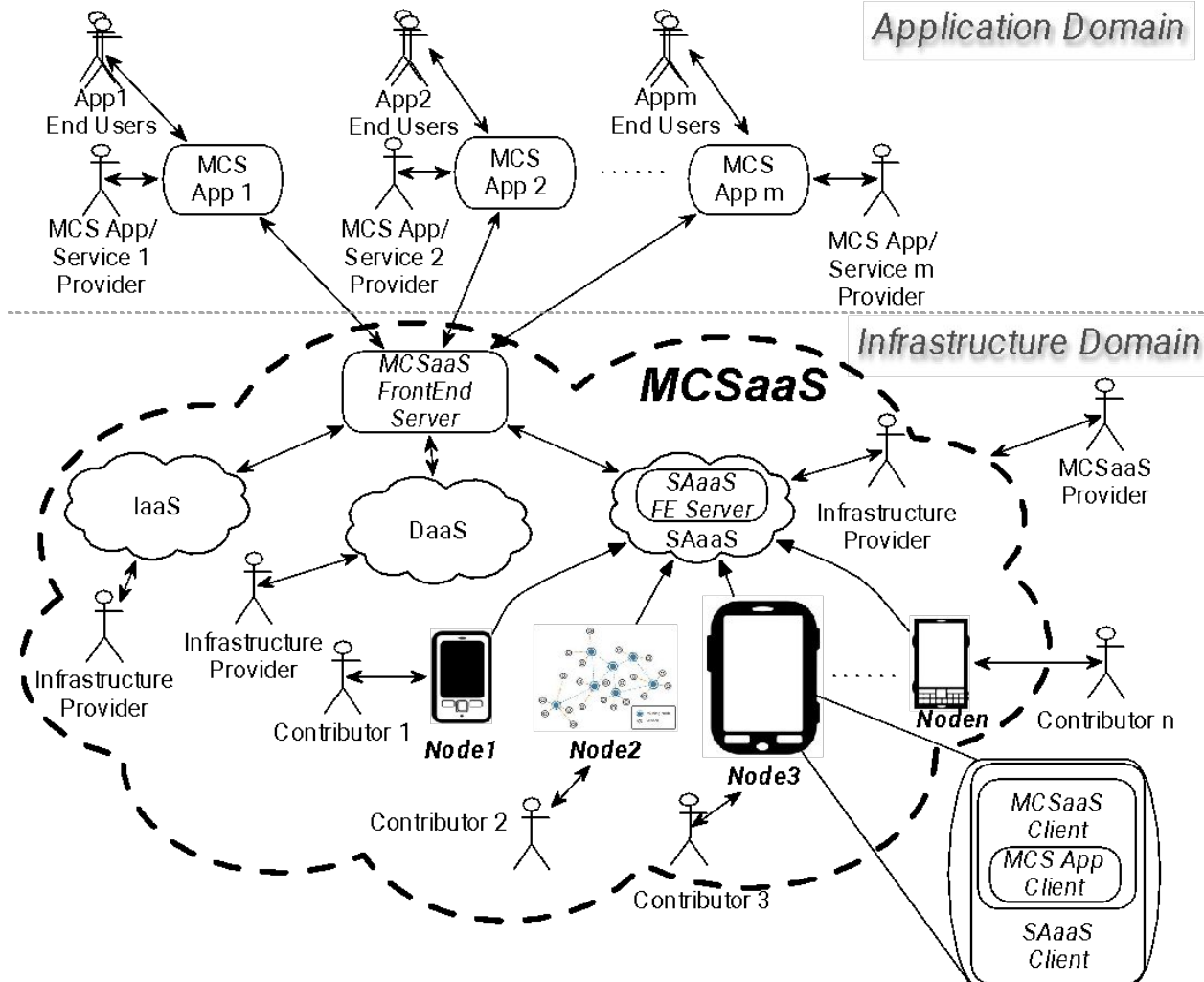
Goal: Smart, Programmable and Customizable Cities





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Goal: Unlock MCS capabilities



QUESTIONS?

