

Adaptive Software Systems

GS/EECS 6432

Engineering IoT Systems

Marin Litoiu

Department of Electrical Engineering and Computer Science
York University

mlitoiu@yorku.ca

<http://www.ceraslabs.com>

IoT is happening..

“We expect to see 20 billion internet-connected things by 2020. These “things” are ...dedicated-function objects, such as vending machines, jet engines, connected cars and a myriad of other examples.”

Gartner, 2017

“The deployment of connected devices is still in its early stages, but Canada’s technology sector is well positioned to become a global leader in IoT - projected to deliver up to \$11.1 trillion globally in economic value by 2025.”

Robert Watson, President and CEO, Information Technology Association of Canada

SELECTED IOT APPLICATIONS

Smart Grid

Smart Buildings

Green Computing

Smart shopping
and elderly web
tasking

Digital
Ecosystems

Wearable
Computers

Smart Ocean

Tidal Energy

Smart water

UAVs

Connected Cars

Smart Transport

Energy

Computing

Environment

Vehicles



IoT Foundations

Smart Internet of Things (IoT)

Physical and engineered systems whose operations are controlled by a computing core

Tight and seamless coordination between computational & physical resources

Exceed today's systems in scale, adaptability, autonomy.

IBM Initiative

Smarter Systems for a Smarter Planet



The world is getting smarter

More instrumented, interconnected, intelligent



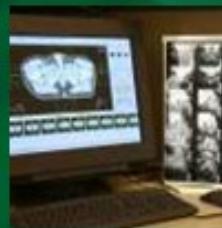
Smart traffic
systems



Intelligent
oil field
technologies



Smart food
systems



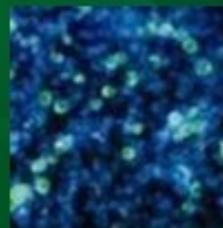
Smart
healthcare



Smart energy
grids



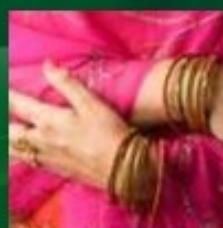
Smart
retail



Smart water
management



Smart supply
chains



Smart
countries



Smart
weather

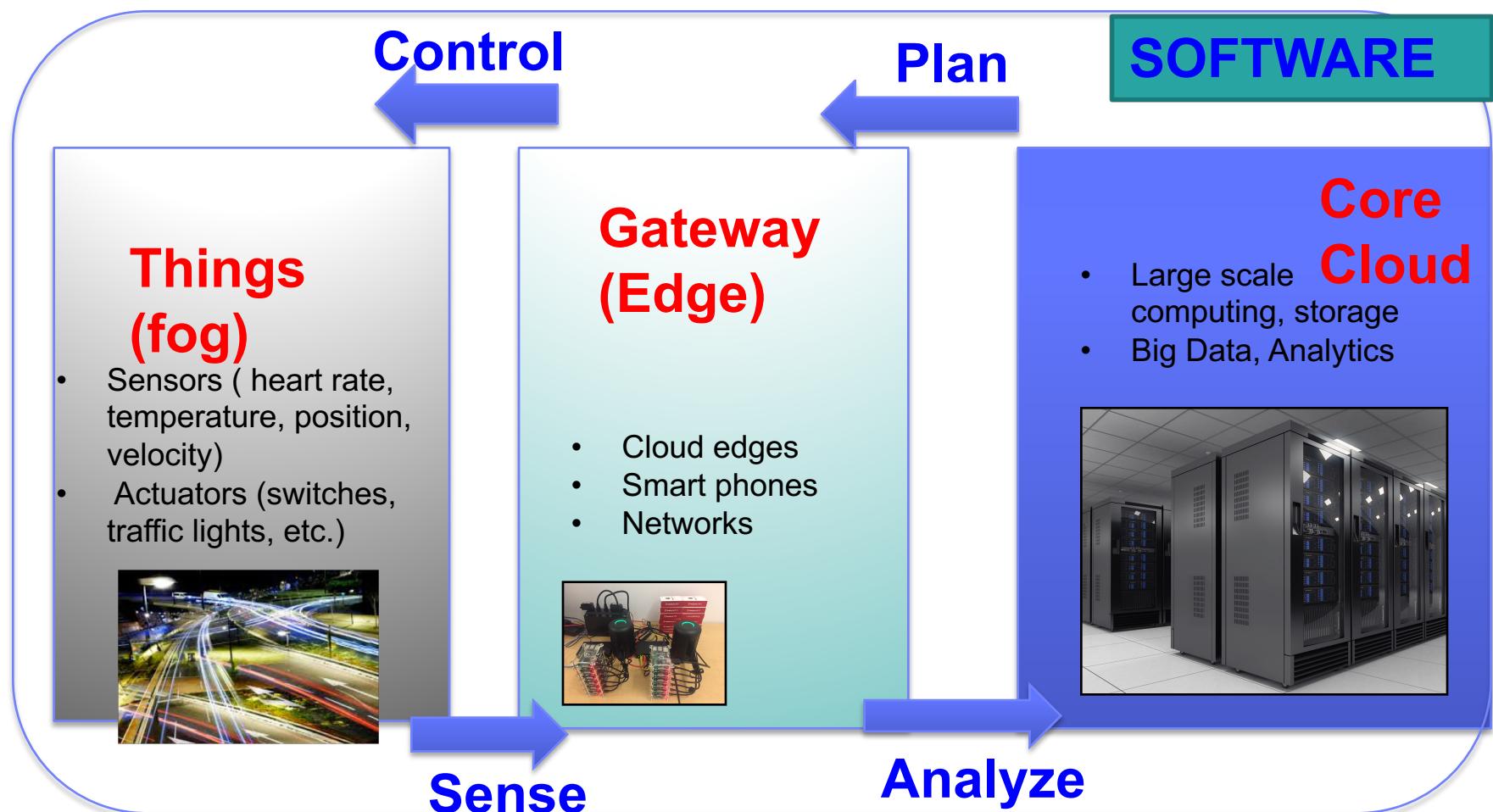


Smart
regions



Smart
cities

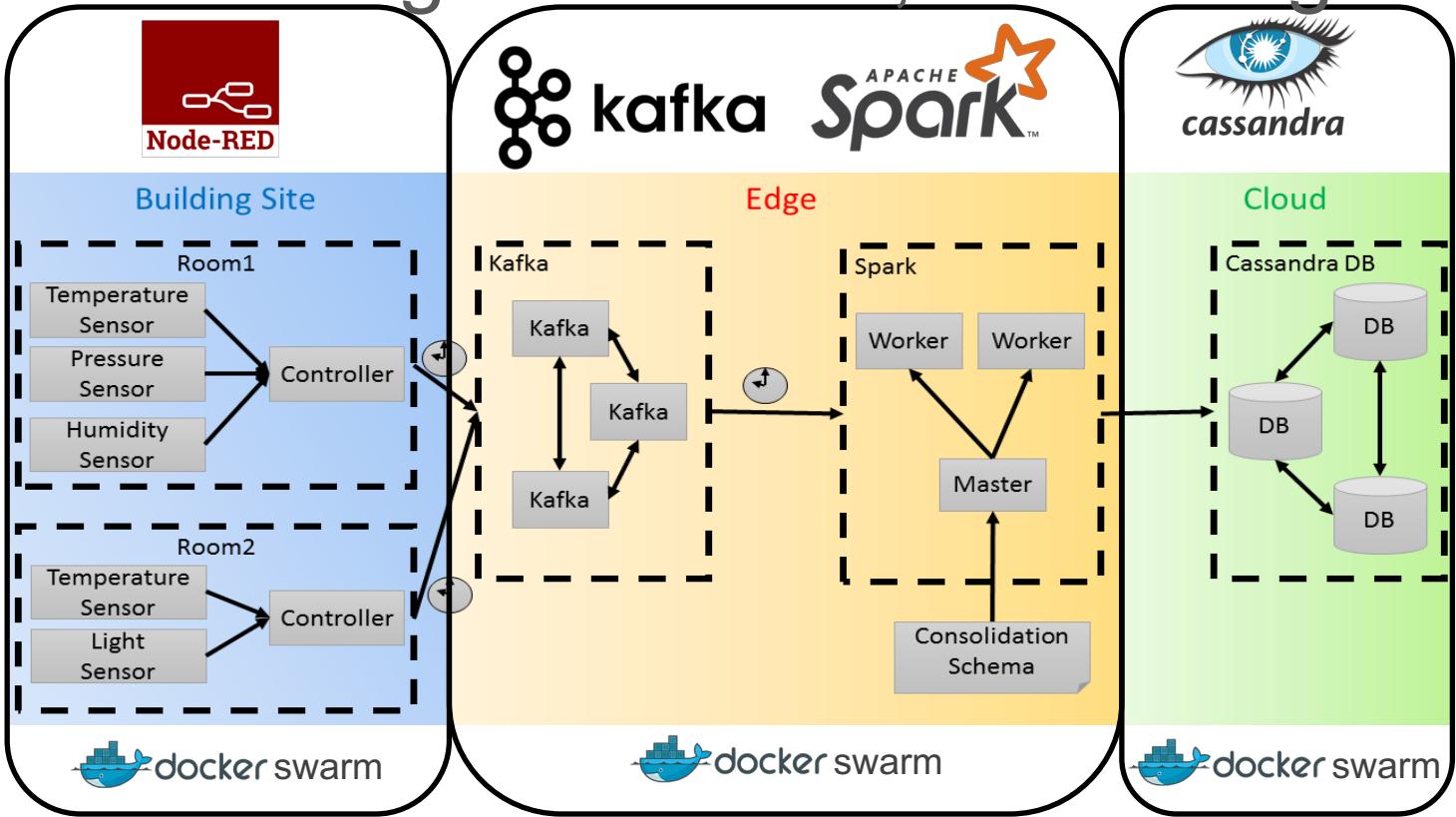
IoT: An Adaptable Software Intensive System



➤ MacManus: Why Software is More Important Than Sensors in the Internet of Things,

© Marin Litoiu
ReadWriteWeb (2010)

Smart Buildings: Protocols, Technologies



MQTT
Wifi
Bluetooth
5G
Zigbee



HTTP



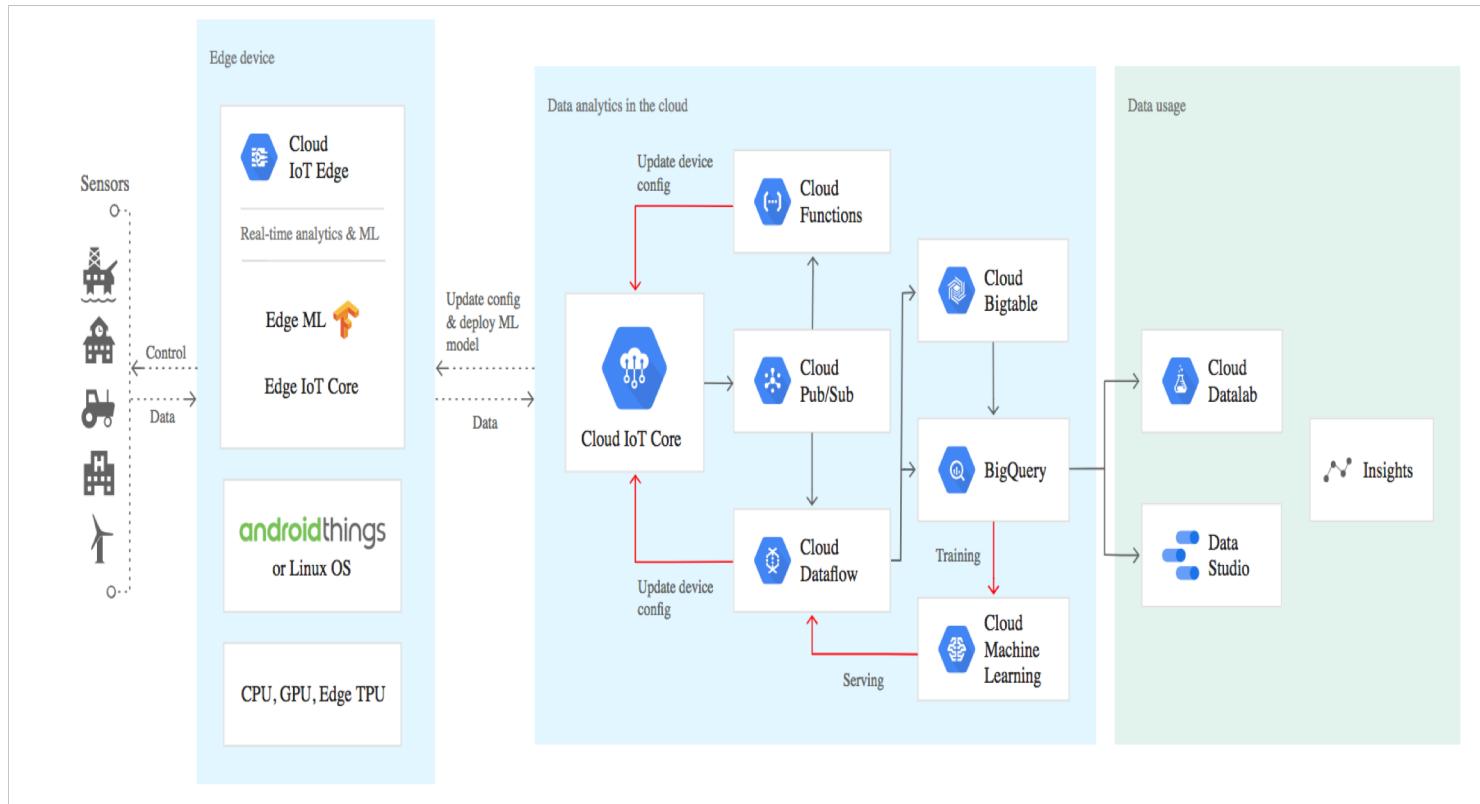
Smart Buildings: Twins

- Each physical thing can have a “digital twin”
 - A model (analytical, simulation, etc..)

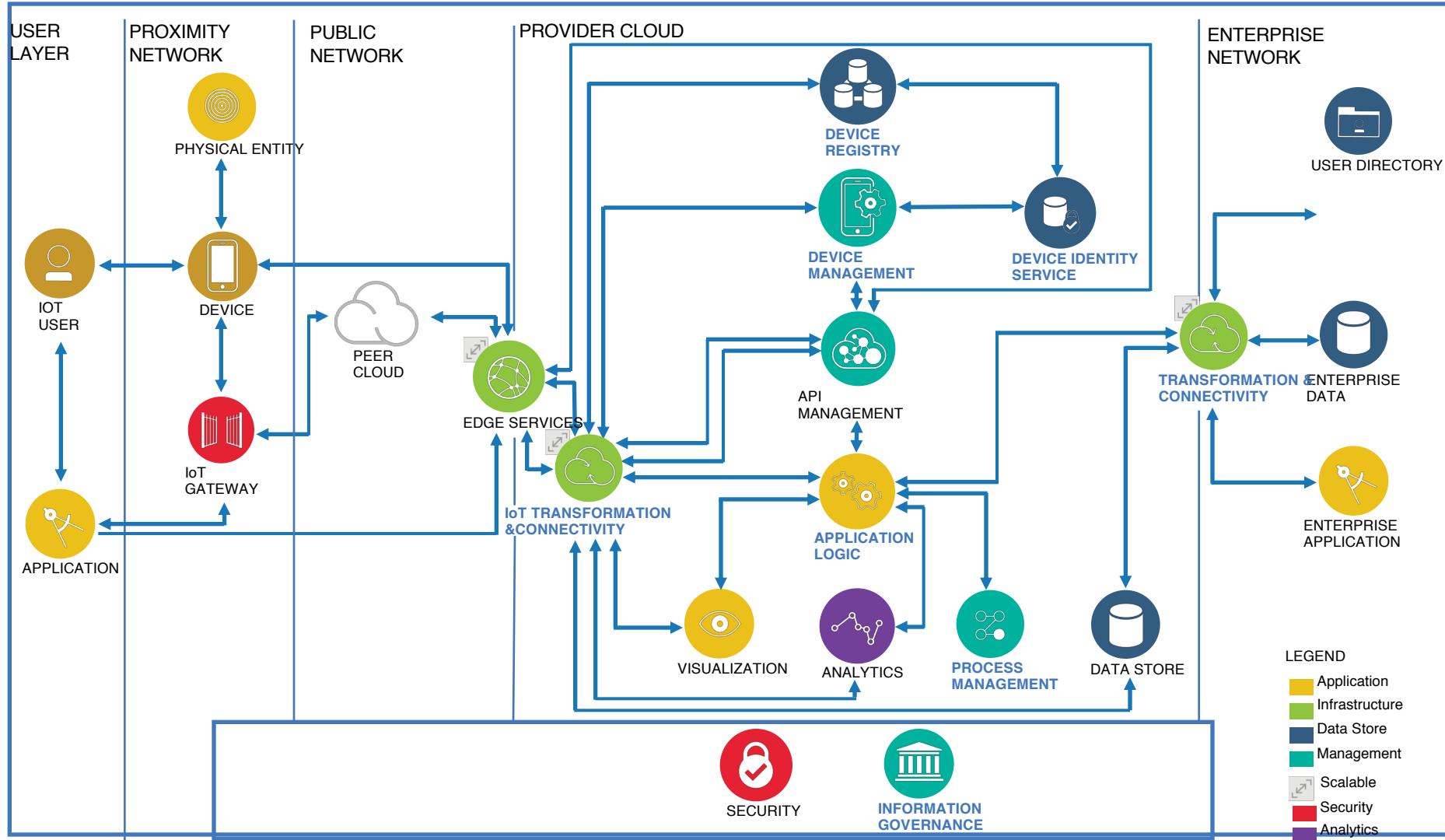


Google IoT Infrastructure

- Google: <https://cloud.google.com/solutions/iot/>



IBM IoT Infrastructure



IBM IoT Platform

- **Overview of IBM Cloud solutions**
- <https://console.bluemix.net/docs/services/IoT/index.html#gettingstartedtemplate>
-
- **IBM Architecture Blueprint**
- <https://www.ibm.com/cloud/garage/files/iot-high-level.pdf>

Short tutorial with TI C2650

- **How to connect TI c2650 to IBM cloud**
- **Advanced Tutorial: IoT with Watson assistant**
 - <https://developer.ibm.com/recipes/tutorials/talk-to-your-sensor-using-the-watson-iot-platform-and-conversation-services/>

IoT Software Big Challenges

- **Scalability**
 - Can we support trillions of sensors (TSensors)?
- **Software engineering for ultra large scale systems**
 - How do we design, test software for this dynamic world?
 - How can we make the software more reliable and self-managing?
- **Security and privacy**
 - How do we protect against attacks, leaks?
- **Societal implications and acceptance**