IoT-Empowered Robotics

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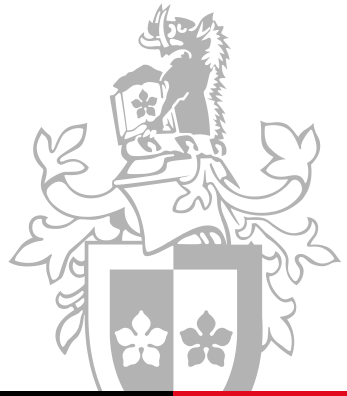

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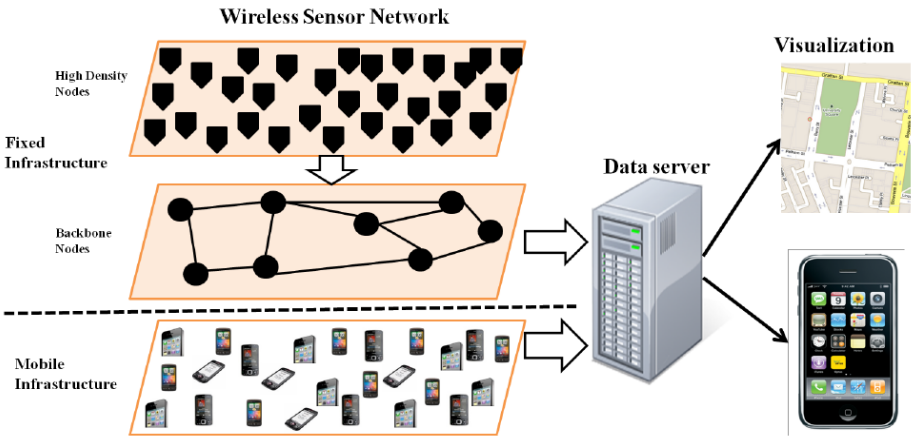
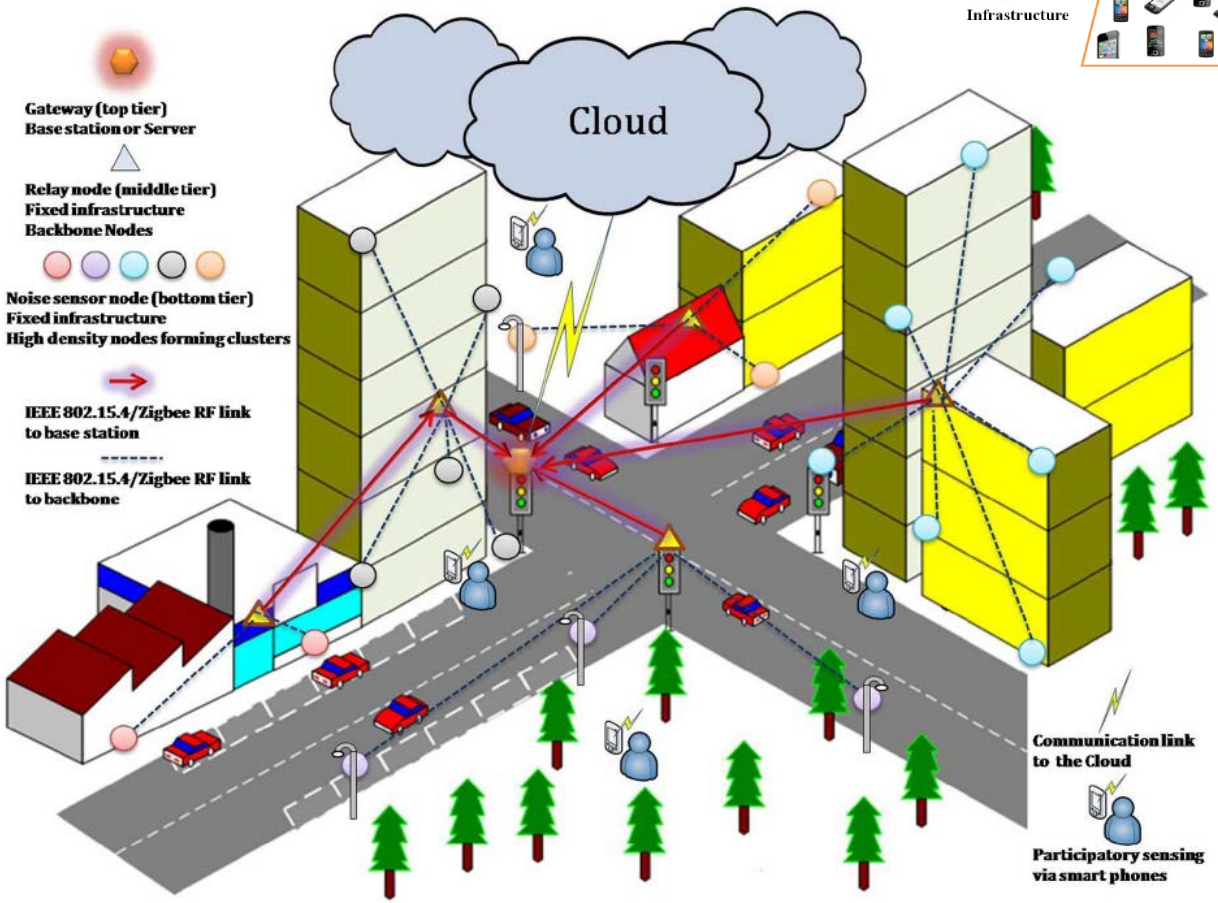
Noise Mapping Project

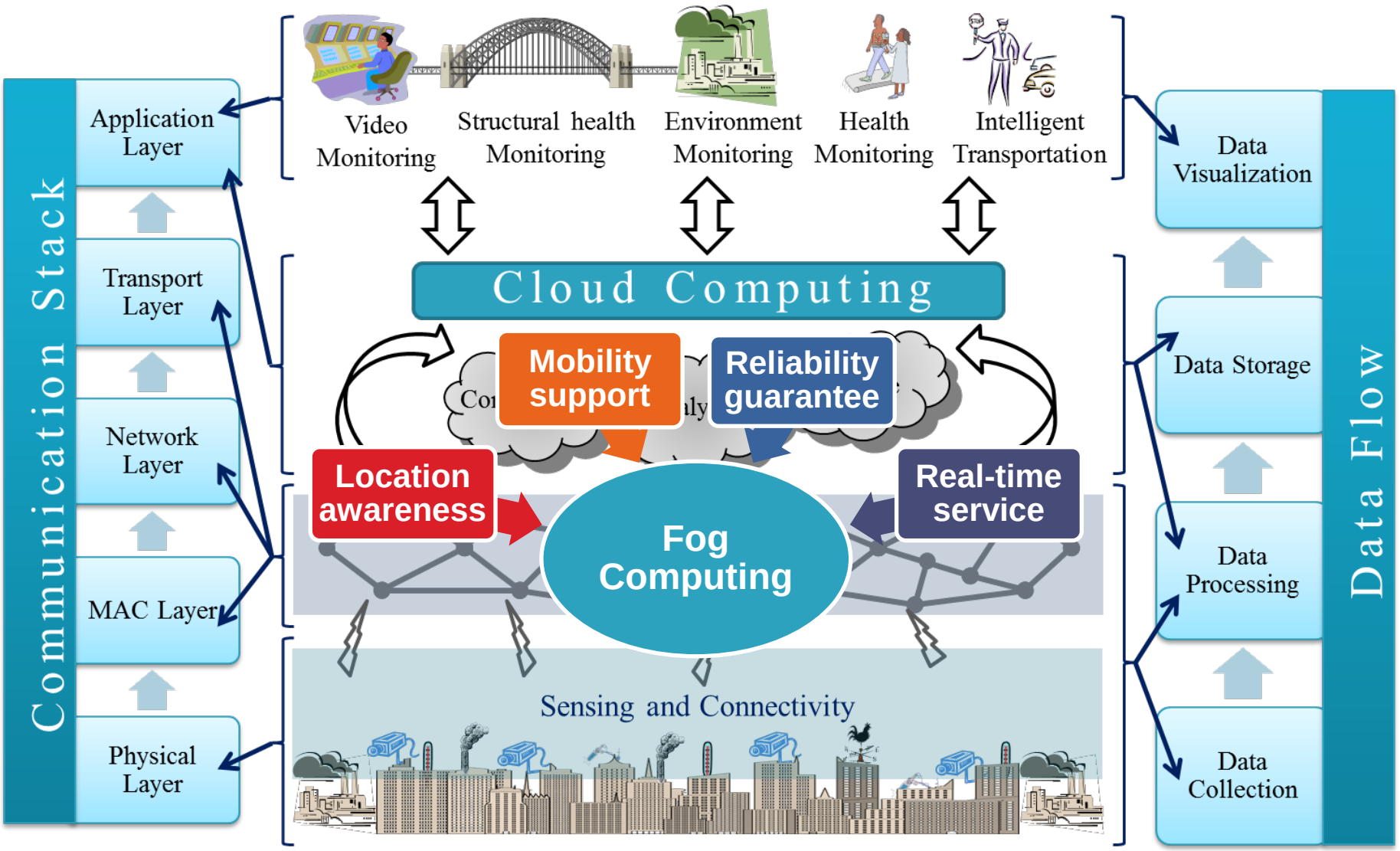
ISSNIP @ Unimelb
City of Melbourne





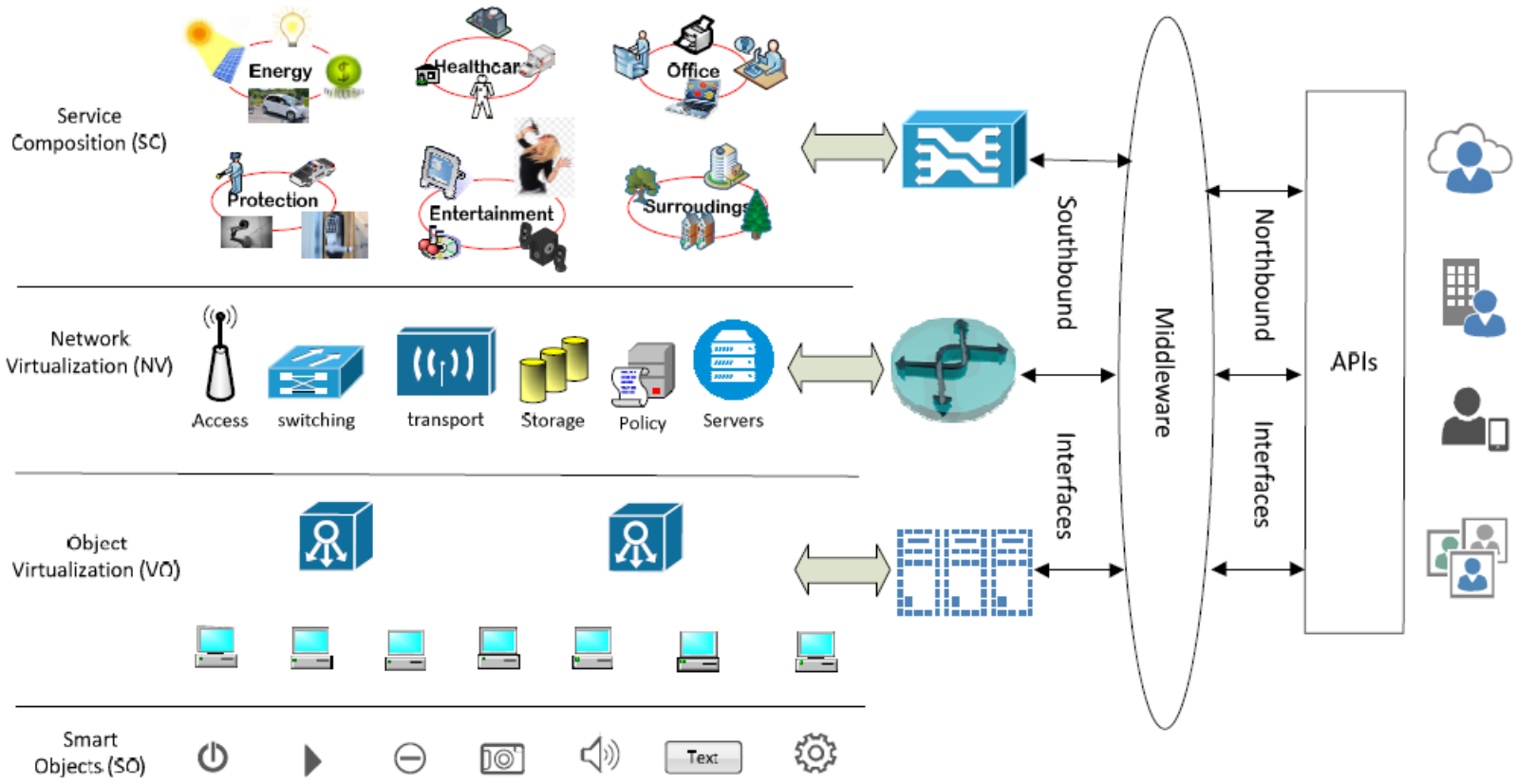
- **Conventional**
  - Sound Level Meters: Hand held devices, limited duration and measurements
- **Wireless Sensor Network Platform**
  - Nodes: Sensors (microphone), Motes (communications, local processing), Sink nodes (data aggregation, routing), Central server(s)/cloud
- **Implementation**
  - Hybrid: Fixed/static WSN infrastructure, Crowdsourcing via mobile phones

IoT Infrastructure for Smart City



Jiong Jin, Jayavardhana Gubbi, Slaven Marusic and Marimuthu Palaniswami, "An Information Framework of Creating a Smart City through Internet of Things," *IEEE Internet of Things Journal*, vol. 1, no. 2, pp. 112-121, April 2014.

Fog Computing by Virtualization



Secure Service Virtualization

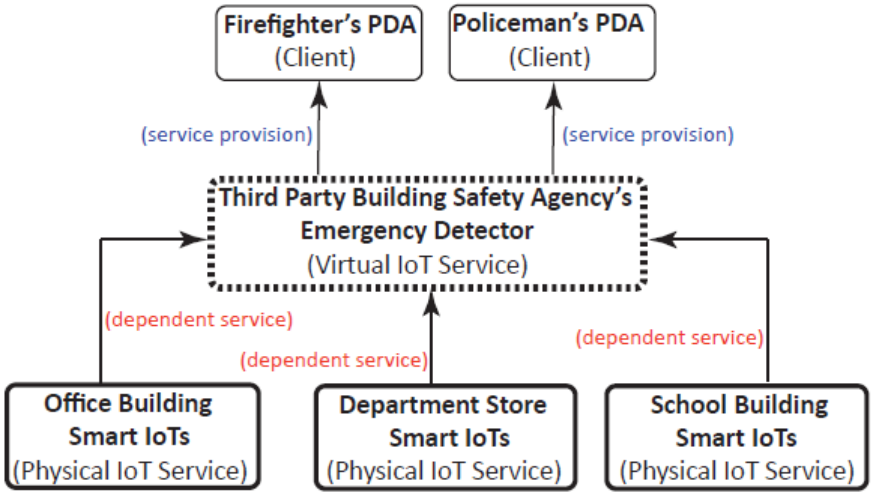


Fig. 1: A single-level IoT virtualization for smart building safety management

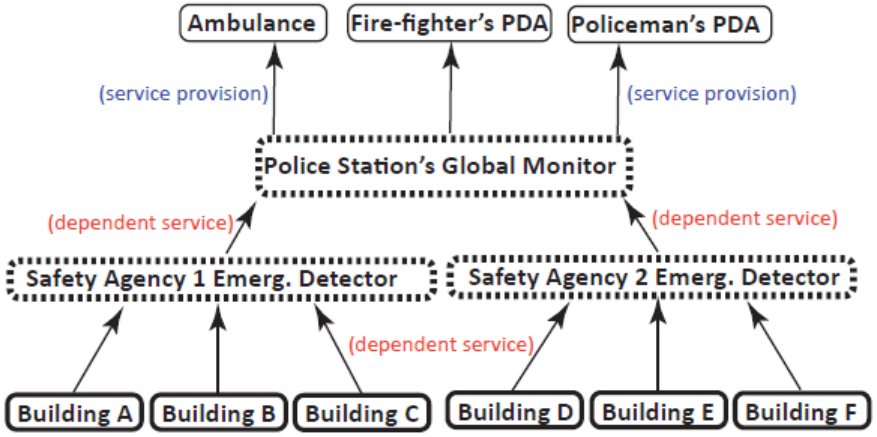


Fig. 2: Multi-level IoT virtualization

Hajoon Ko, Jiong Jin, and Sye Loong Keoh, "Secure Service Virtualization in IoT by Dynamic Service Dependency Verification," *IEEE Internet of Things Journal*, accepted on 20 March 2016, to appear.

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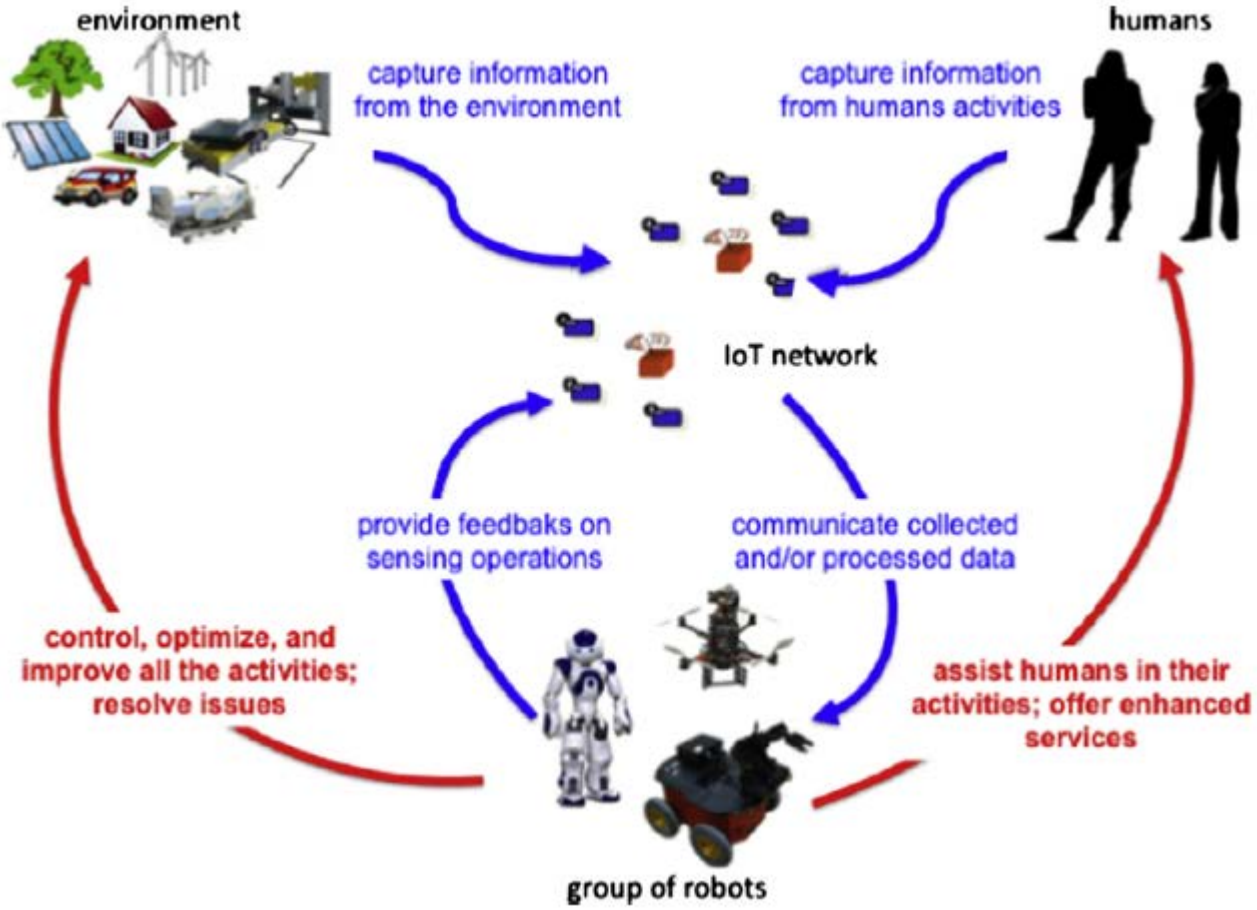
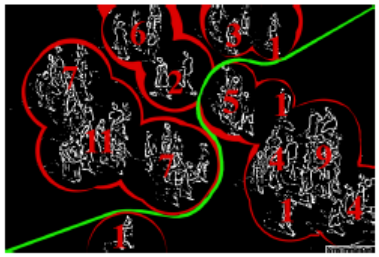
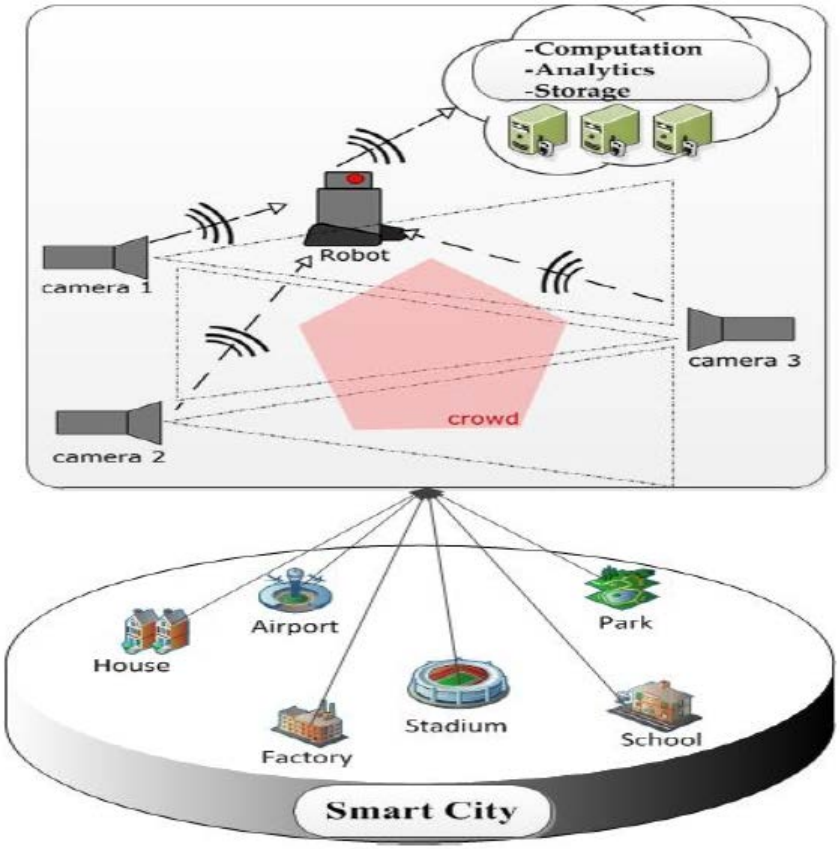
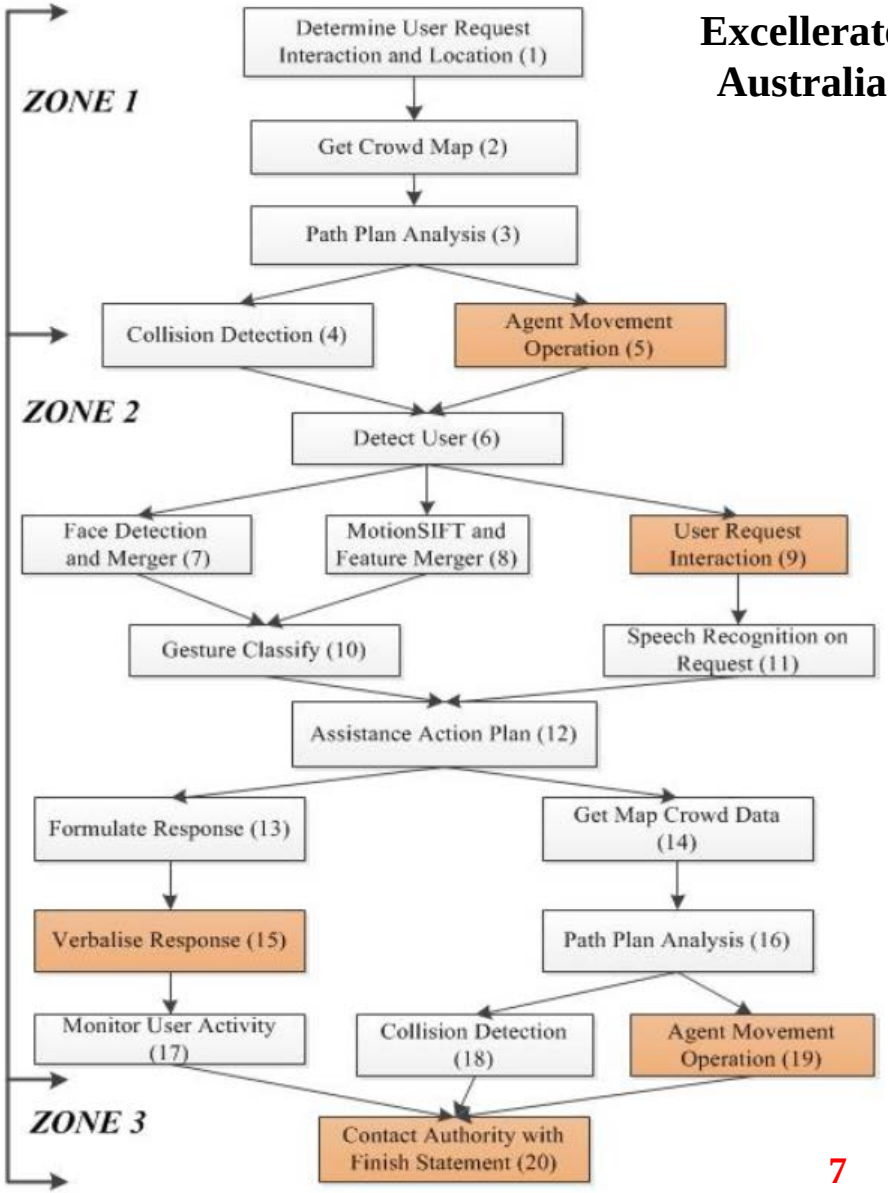


Source: L. A. Grieco *et al*. "IoT-aided Robotics Applications: Technological Implications, Target Domains and Open Issues," *Computer Communications*, vol. 54, pp. 32-47, 2014.

Robotic Crowd Control System Project







Excellerate Australia

Cloud Robotics

Cloud Computing + Networked Robotics = Cloud Robotics

Source: B. Kehoe *et al*. "A Survey of Research on Cloud Robotics and Automation," *IEEE Transactions on Automation Science and Engineering*, vol. 12, no. 2, pp. 398-409, April 2015.

Cloud Robotics

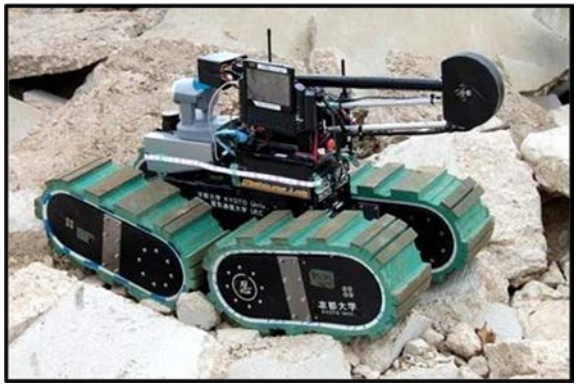
Challenge 1: how to develop an interface between robot(s) and cloud computing infrastructure for faster task execution but less energy consumption

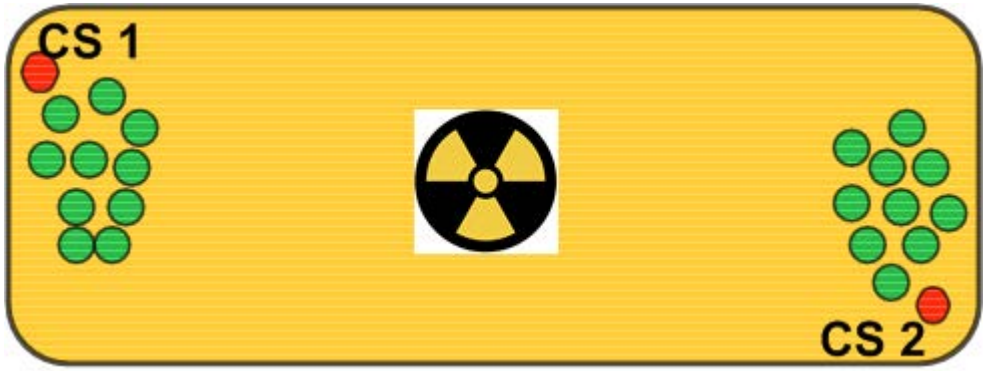
Challenge 2: how to achieve on-demand mobility and meantime make offloading decisions based on the trade-off between computation and communication

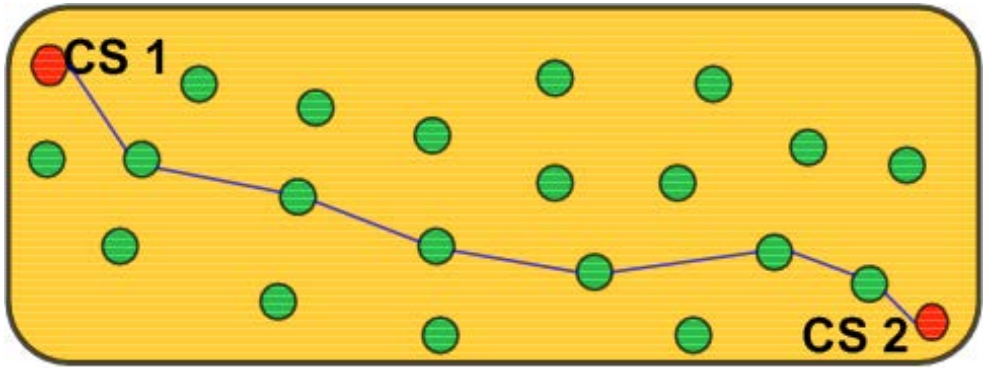
- *Big data:* to enable the access to vast data repositories and remote data libraries in the cloud
- *Knowledge sharing:* to facilitate robotic skill-learning through shared knowledge via the cloud
- *Offloading:* to offload heavy computational tasks (e.g., simultaneous localization and mapping, image and video processing) to the cloud

Mobile Robotic Networks

- *Environment monitoring:* sense the parameters and detect any change
- *Target tracking:* track particular dynamic target in the field
- *Area coverage:* cover the disaster area for better response







Mobile Robotic Networks

Challenge 1: how to design effective interactive rules and distributed control strategies to capture collective behaviors of robots

Challenge 2: how to guarantee the network connectivity and quality-of-service provisioning

- *Rendezvous:* to achieve agreement on the location
- *Flocking:* to realize velocity matching
- *Formation control:* to deploy robots on locations that keep specific distance between each other
- *Network design and optimization mechanism:* to regulate multiple traffic types and provide quality-of-service support of versatile applications within the network

Many thanks for your attentions

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