A Survey of Mobile Crowdsensing Techniques: A Critical Component for The Internet of Things

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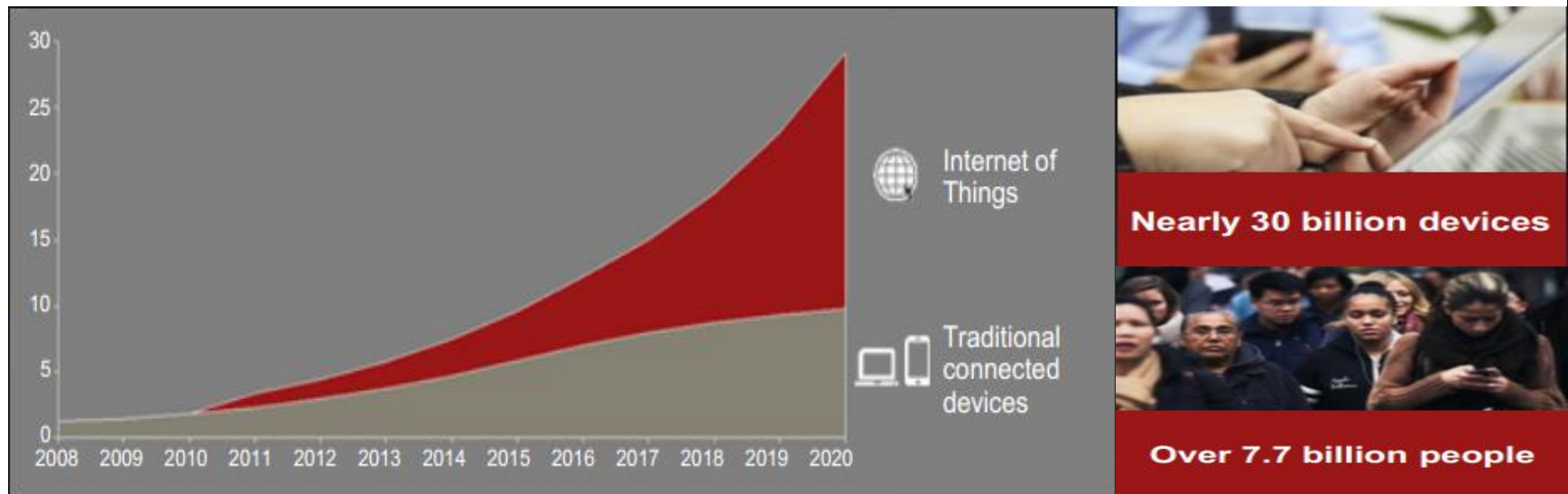
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Outline

- Introduction
- Background
- Existing Mobile Crowdsening (MCS) Strategies
- Challenges and Future Research Direction
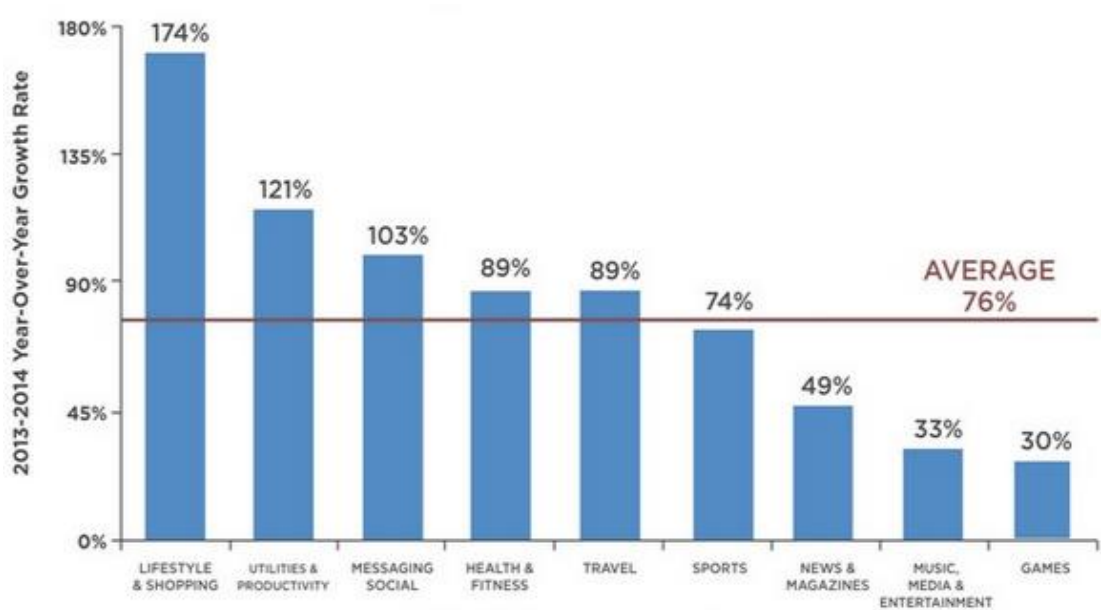- Conclusions

Introduction

- The Trend of IoT's growth

By 2020, the number of IoT devices is twice as that of traditional connected devices

The Trend of Crowdsensing

Based on the statistics in 2014, the number of mobile users grows 76% year-over-year, and it becomes increasingly popular.

Objectives

- To learn the problems existing in MCS and how the proposed methods help develop solutions in the past

- To learn the strength and limitations of different MCS techniques for smartly managing resource to achieve low cost and high QoS and how we can use those techniques to solve similar problems

- To provide guidance on the future research directions of mobile crowdsensing for IoT
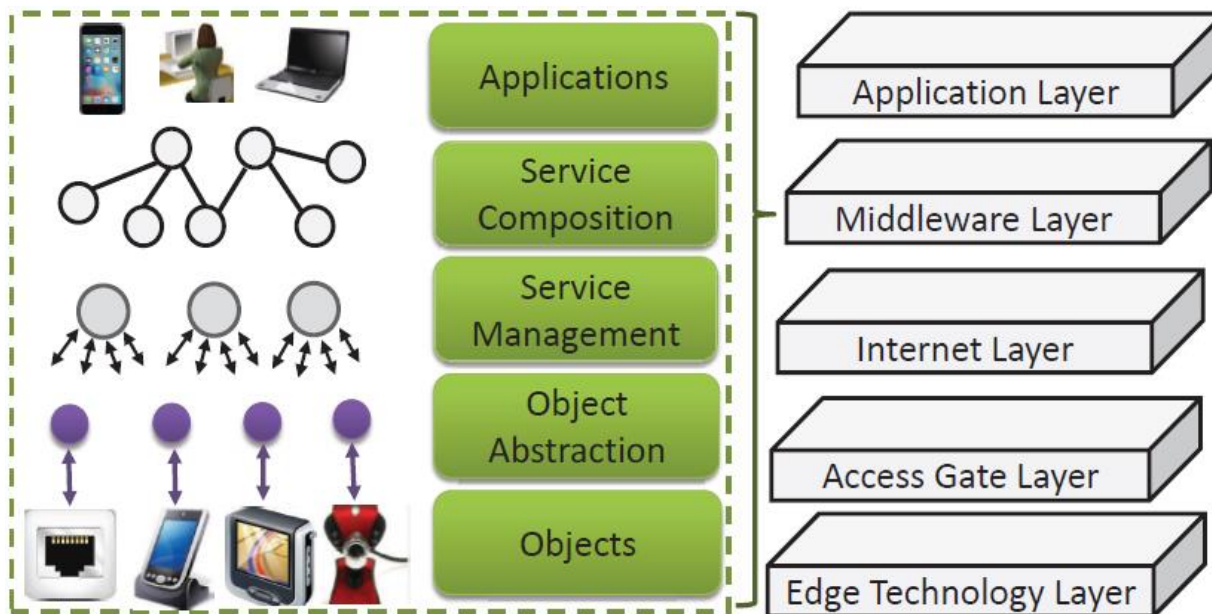
Background

- What is the Internet of Things (IoT)?

IoT: The Internet of Things allows people and things to be connected Anytime, Anyplace with Anything and Anyone, ideally using Any path/network and Any service.
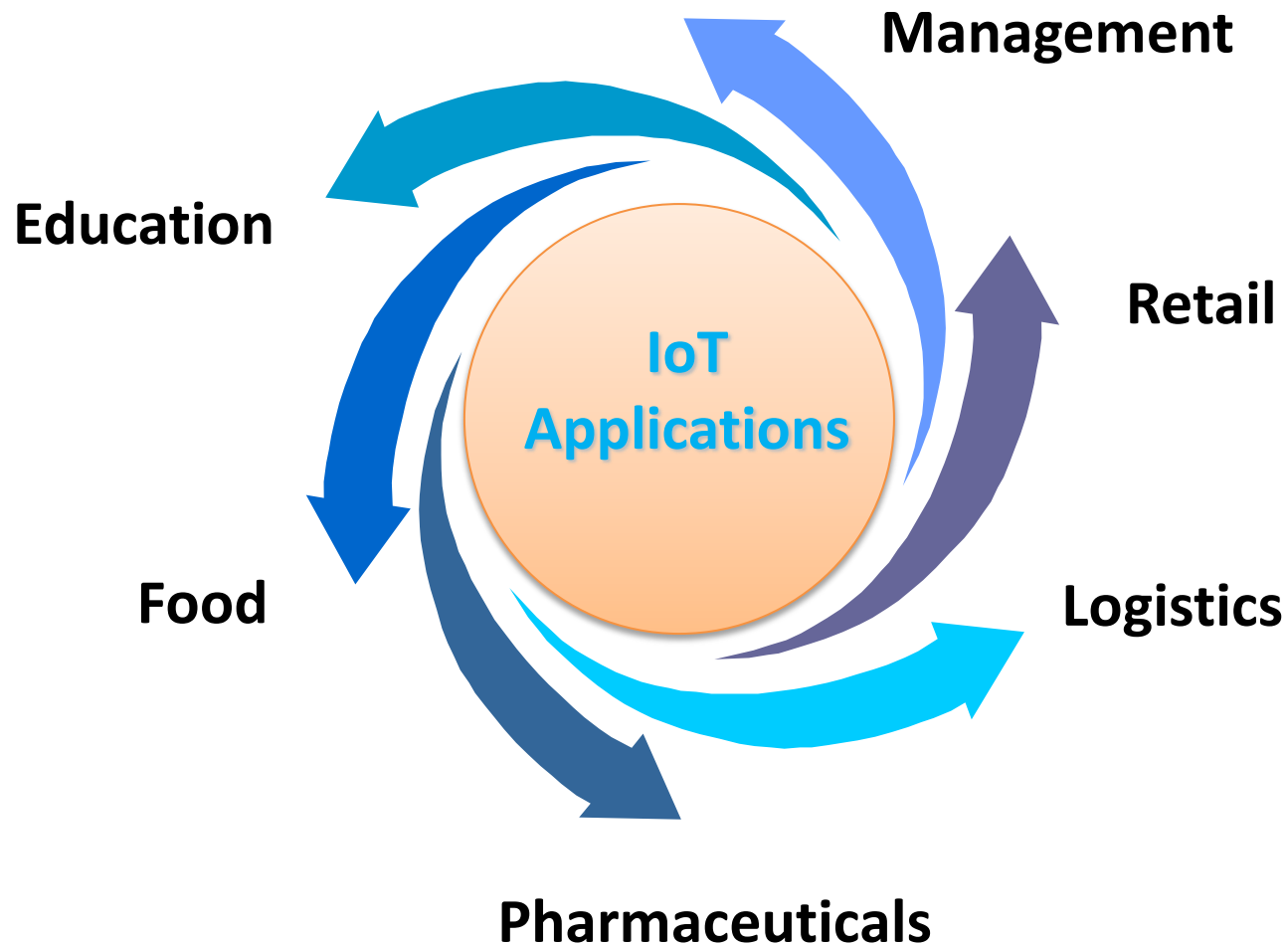
Architecture of IoT

- Architecture of IoT and its five layer middleware

Architecture of IoT (right) and the architecture of its five layer middleware (left).
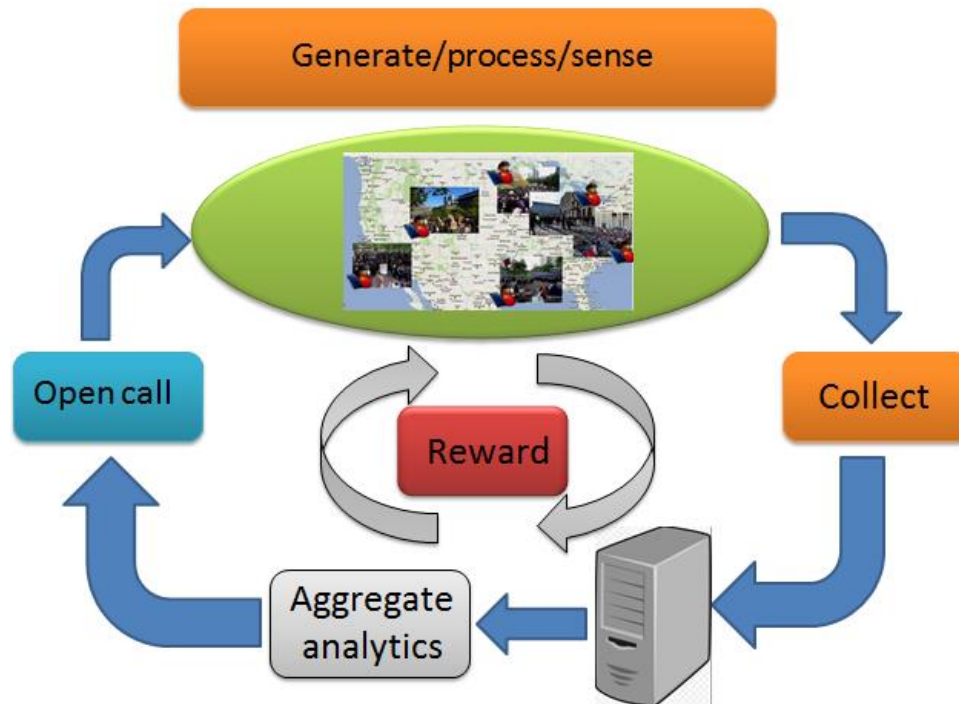
Applications of IoT

Management

Retail

Education

IoT Applications

Logistics

Food

Pharmaceuticals

What is Mobile Crowdsensing?

Mobile Crowdsensing: Individuals with sensing and computing devices collectively share data and extract information to measure and map phenomena of common interest.

Mobile Crowdsensing Framework

Mobile Crowdsensing framework: Individuals collect data; aggregate analytics; open call; generate/process/sense
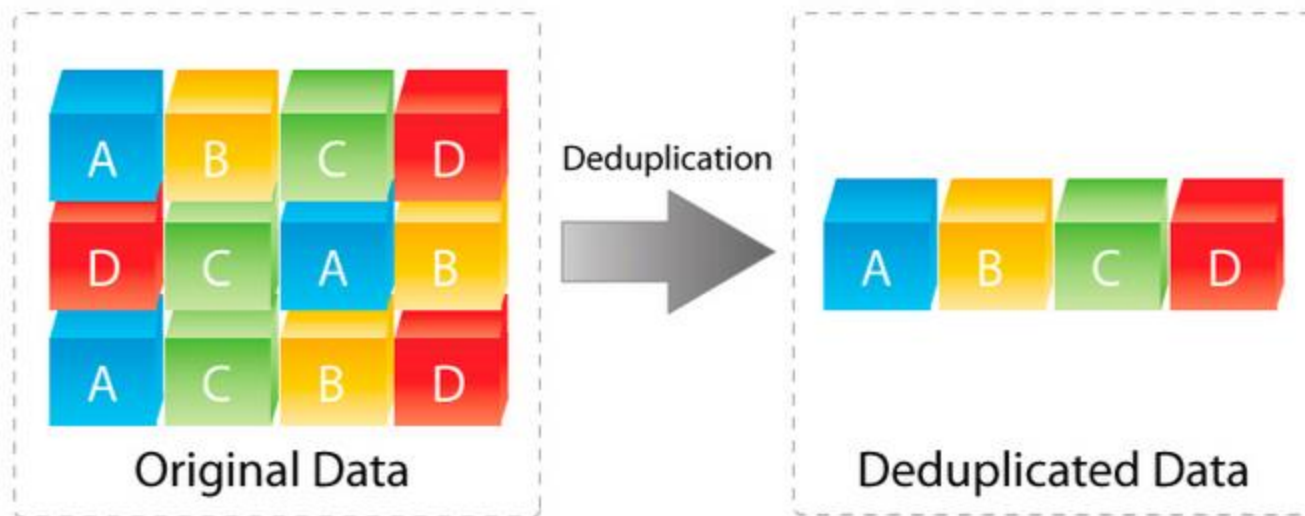
Mobile Crowdsensing Strategies

- Three basic mobile crowdsensing strategies
  - All the data is collected by the user manually by controlling the sensing devices, such as smartphone with specific application. This approach is attention-consuming and inefficient.
  - Data collection is partially controlled by the user and by sampling, which is performed periodically. Sometimes, the data can be collected opportunistically, i.e., when the user opens some applications.
  - Context-aware data sensing is triggered by predefined context, such as a particular location or time slot. This method releases the users from focusing on the crowdsensing tasks and makes it practical.
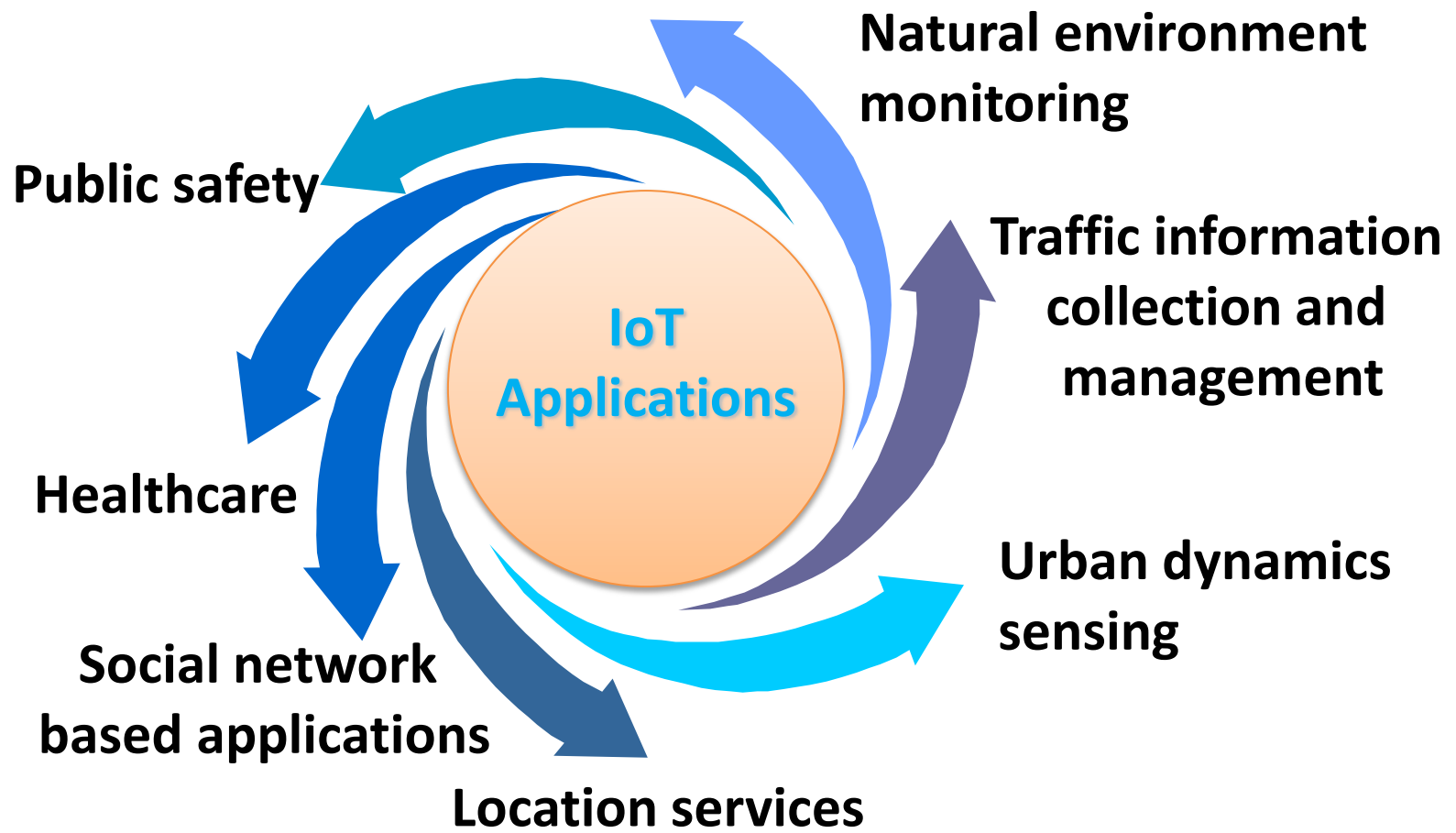
Mobile Crowdsensing Procedure (cont.)

- Three basic mobile crowdsensing procedures
  - Data collection
  - Data storage
    - Data deduplication is widely used in this procedure.

  - Data upload
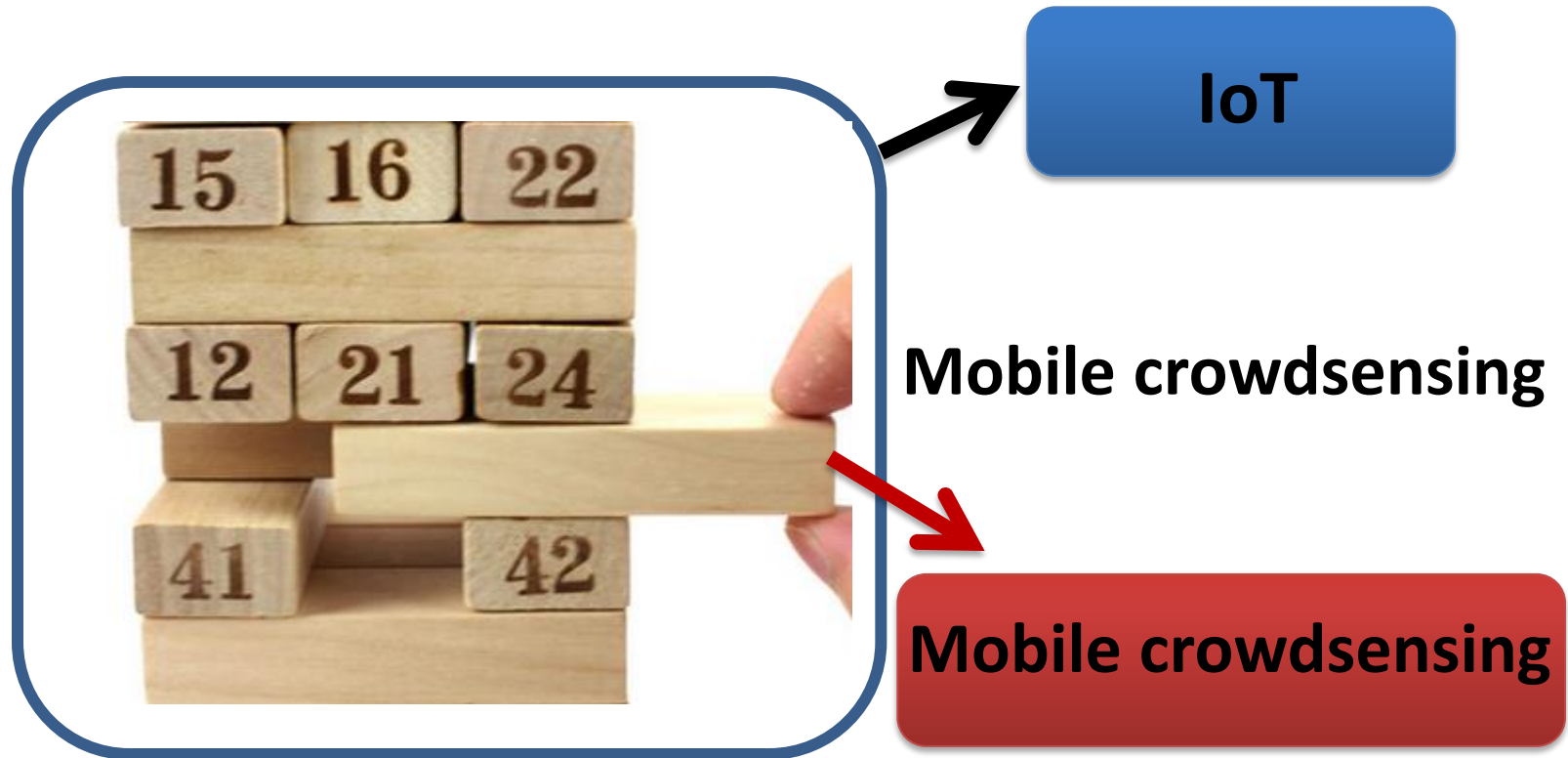
Applications of Mobile Crowdsensing

Natural environment monitoring

Public safety

Traffic information collection and management

IoT Applications

Healthcare

Urban dynamics sensing

Social network based applications

Location services

Mobile Crowdsensing and IoT

IoT

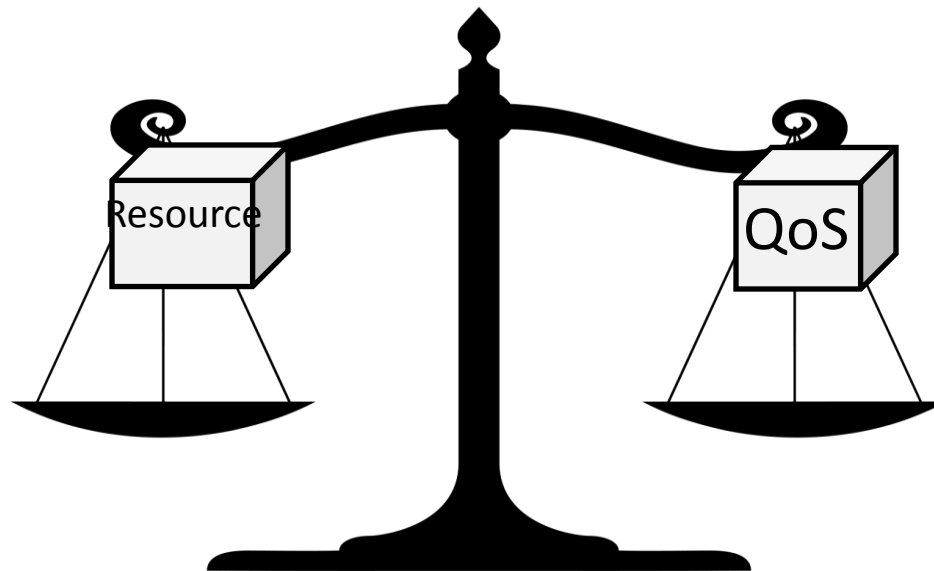**Mobile crowdsensing**

Mobile crowdsensing

Mobile Crowdsensing is a critical component of IoT

Existing Mobile Crowdsensing Strategies

- Various kinds of strategies
  - Deduplication based strategies
    - Pros: Using metadata for reducing data redundancy
    - Cons: Additional information of data is required
  - Compression based strategies
    - Pros: Low bandwidth and storage requirement
    - Cons: Existing data accuracy loss
  - Machine learning based strategies
    - Pros: Fully automatic information classification
    - Cons: Requiring large training data set
  - Context-aware based strategies
    - Pros: Monitor and visualize service of a virtual world
    - Cons: High bandwidth requirement
  - Peer-to-peer based strategies
    - Pros: Independent to centralized infrastructure
    - Cons: Low reliability
  - Opportunistic based sensing
    - Pros: Energy-efficient
    - Cons: Poor real-time performance

Resource Usage and QoS

- Resource limitation
  - Sensing devices (e.g., sensors and mobile phones) usually have limited resources, and the resource limitations arise as a challenge for crowdsensing.
  - Achieve the trade-off between resource usage and quality of service
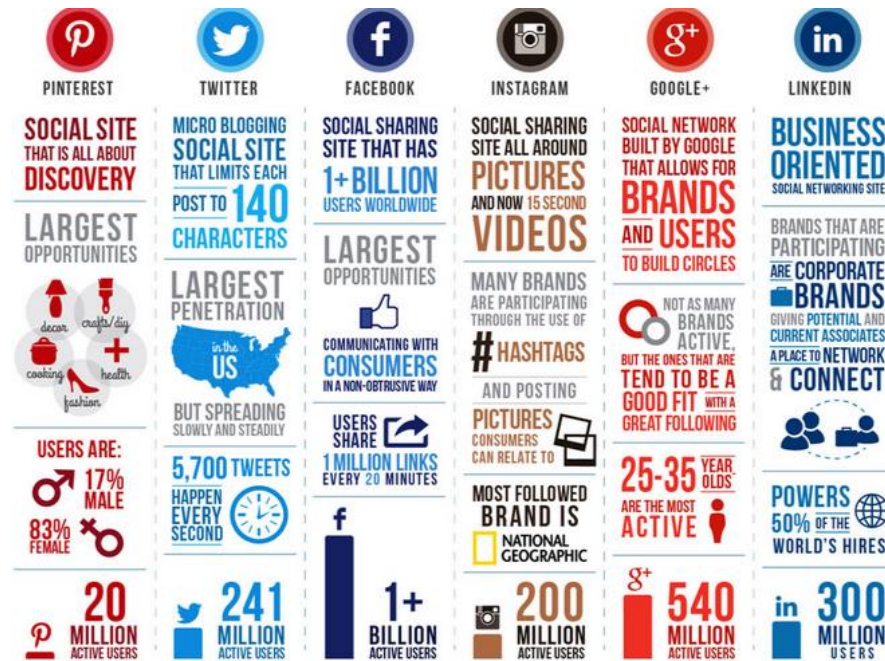
Challenges in Mobile Crowdsensing for IoT

- Automated configuration of sensors

  – In IoT, a large number of sensing devices are expected to be connected together over the Internet. Therefore, the connection and configuration of sensing devices to applications become a key challenge.

- Privacy, security, and data integrity

  – The sensing devices potentially collect sensitive data of individuals, thus privacy arises as a key problem.

Future Research Directions

- Optimization of multiple factors (e.g., localization, prediction and energy budget)
  - The trade-off between higher location accuracy and lower energy consumption for the mobile crowdsensing devices is critical to successfully implement various algorithms

- Privacy protection
  - Privacy protection is a principal issue that has not yet been well addressed, especially in the crowdsensing area.

Future Research Directions (cont.)

- Social Internet of Things (SIoT)
  - Social networks have the advantage of efficiently discovering and distributing services

IoT and social media

Conclusions

- Our contributions
  - Review the different kinds of existing mobile crowdsensing techniques with analysis and comparison
  - Discuss the challenges in mobile crowdsensing for IoT
  - Provide the future research directions for mobile crowdsensing in IoT

- Future work
  - Given an in-depth study of challenges and techniques, solutions for addressing problems in mobile crowdsensing for IoT

Thank you!
Questions & Comments?

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