Rethinking Wireless Network Management Through Sensor-Driven Contextual Analysis
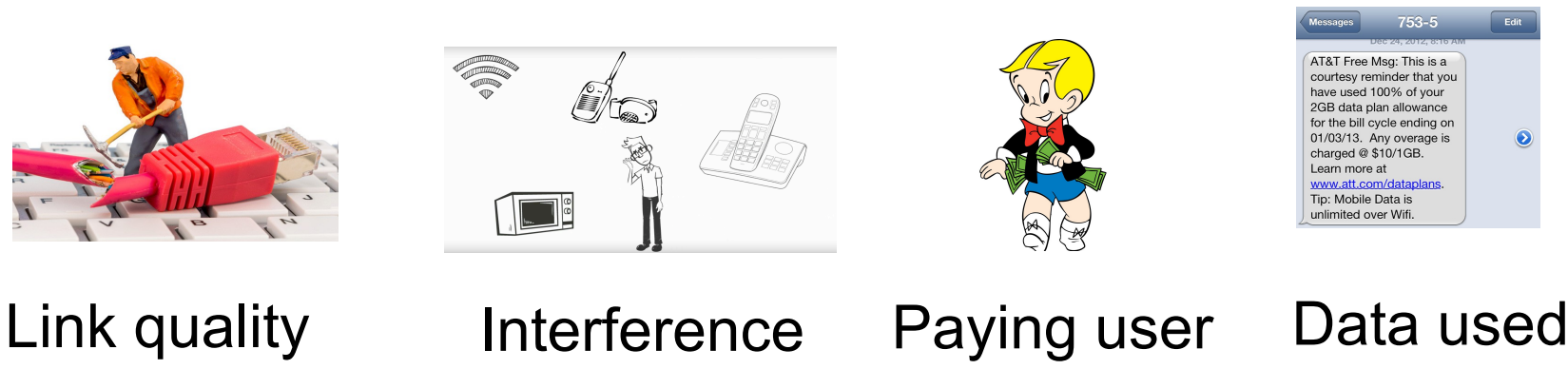
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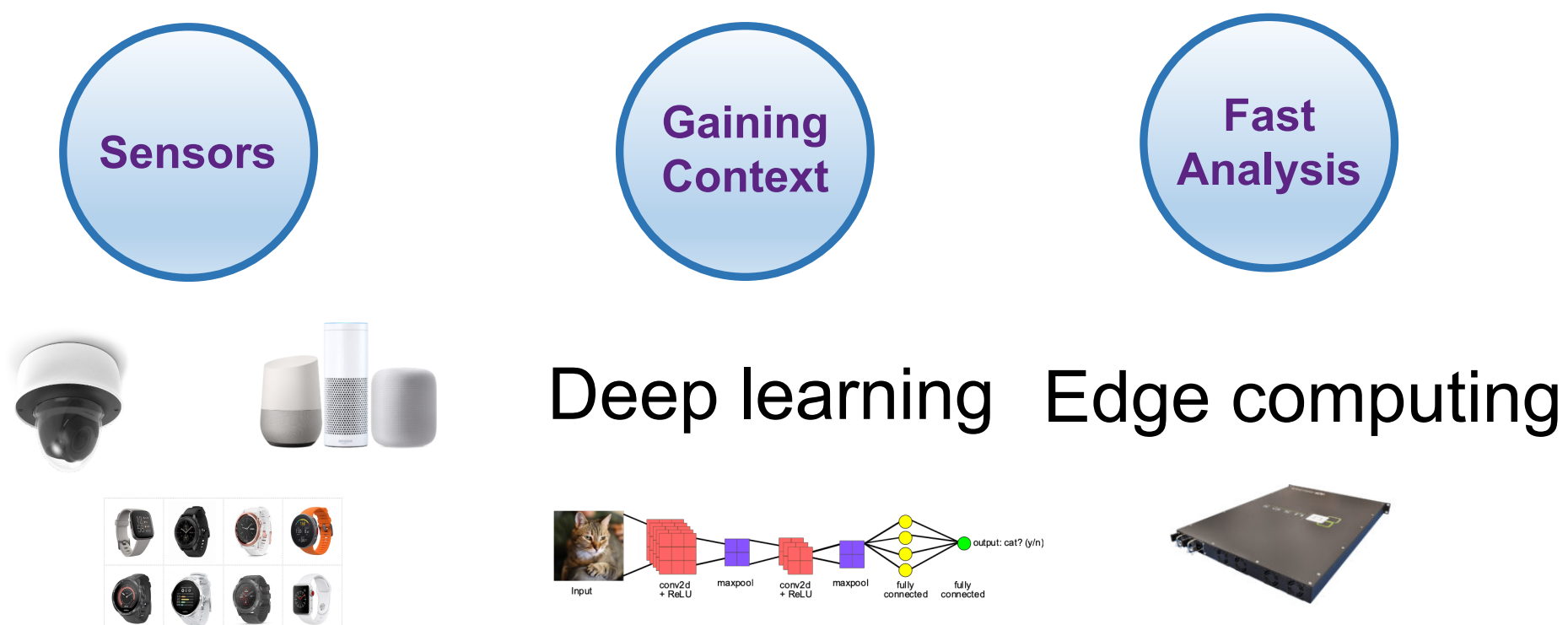[1]University of Colorado Boulder   [2]Cisco Meraki

Problem and Goal

- Today, networks managed on in-band information and other easily-obtained management information

Link quality   Interference   Paying user   Data used

- We propose a **new way** to manage networks

- Goal: to use user's **context** for network management

On phone   Dancing   On laptop   Wearing hat   Happy

- Why now? Fundamental advances in three thrusts:

Sensors   Gaining Context   Fast Analysis

Deep learning   Edge computing

Our Proposal: SenseNet

- User's context data from sensors to manage network

More Flexible Wireless Utilization   Out Of Band Integration For Social Good   Enabling New Revenue Streams

- Schedule traffic **efficiently** and **intelligently**

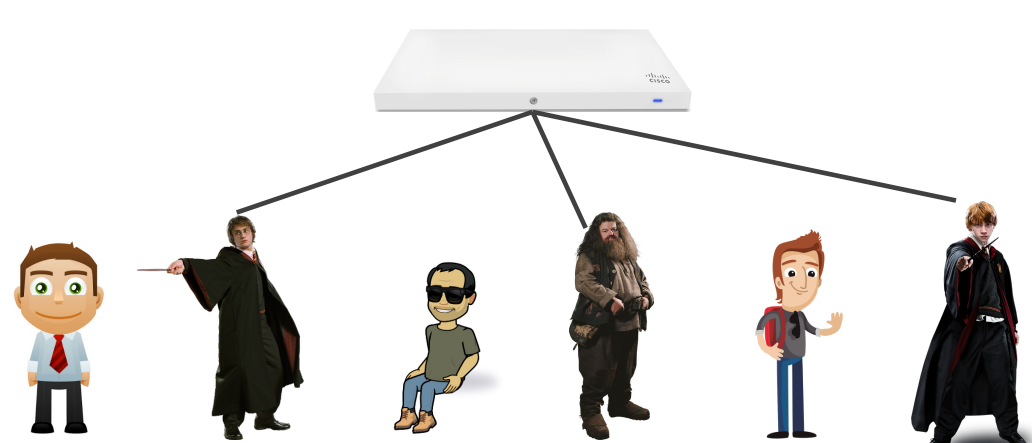Equal bandwidth for all the users on network
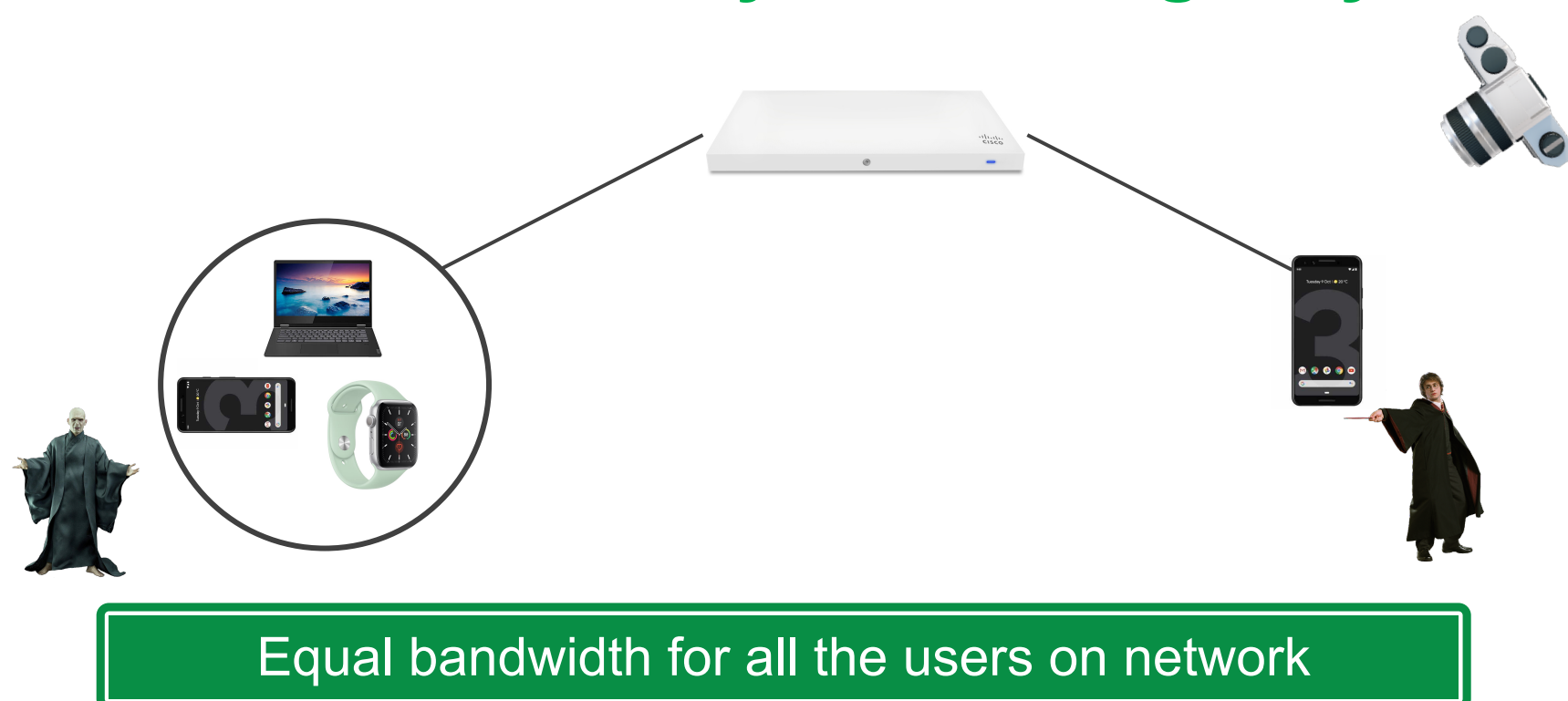
- New mechanisms to **increase public safety**
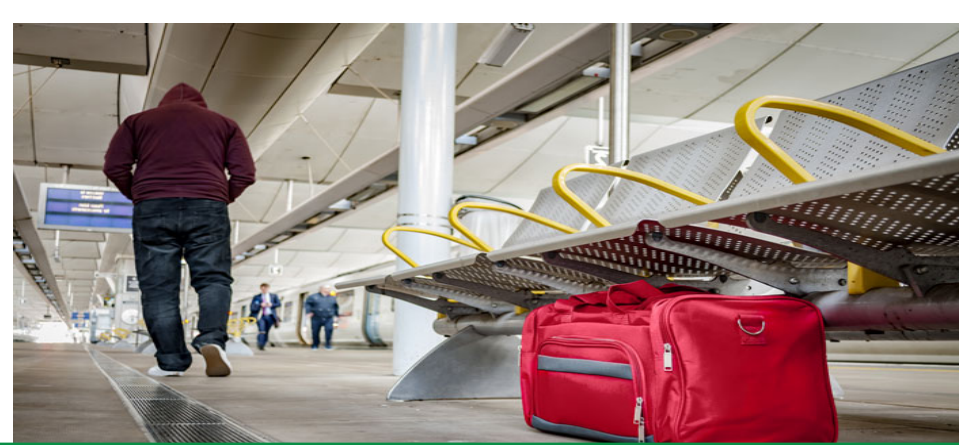
Monitor traffic of wireless devices in unattended bags

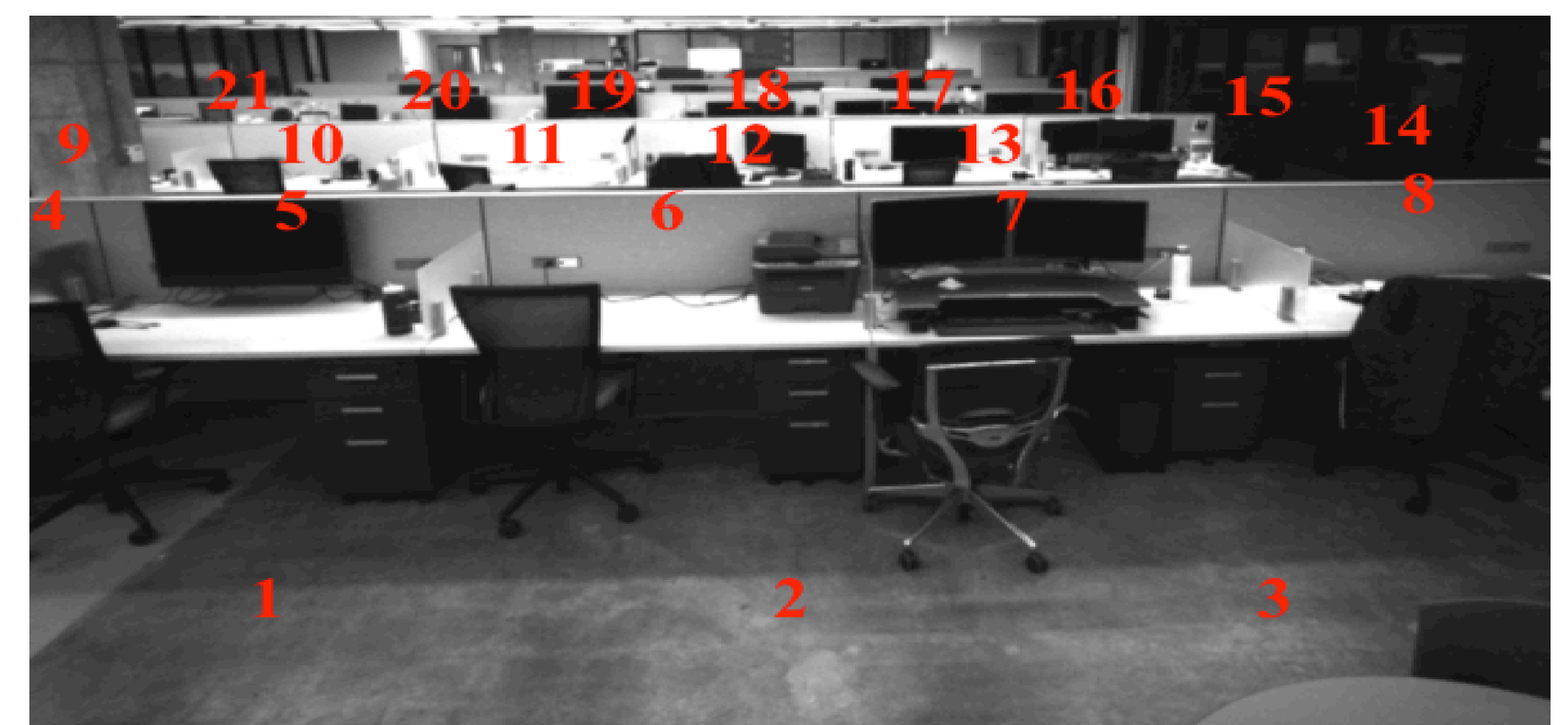- Wireless providers can create new **revenue streams**

Better bandwidth to Harry Potter fans

Evaluation

- Equipment setup:

Intel D435i   Google Wi-Fi AP   Pixel 3

- Collection points:

- User pairing: pair users in sensor & wireless domain
  - Fundamental primitive required for SenseNet
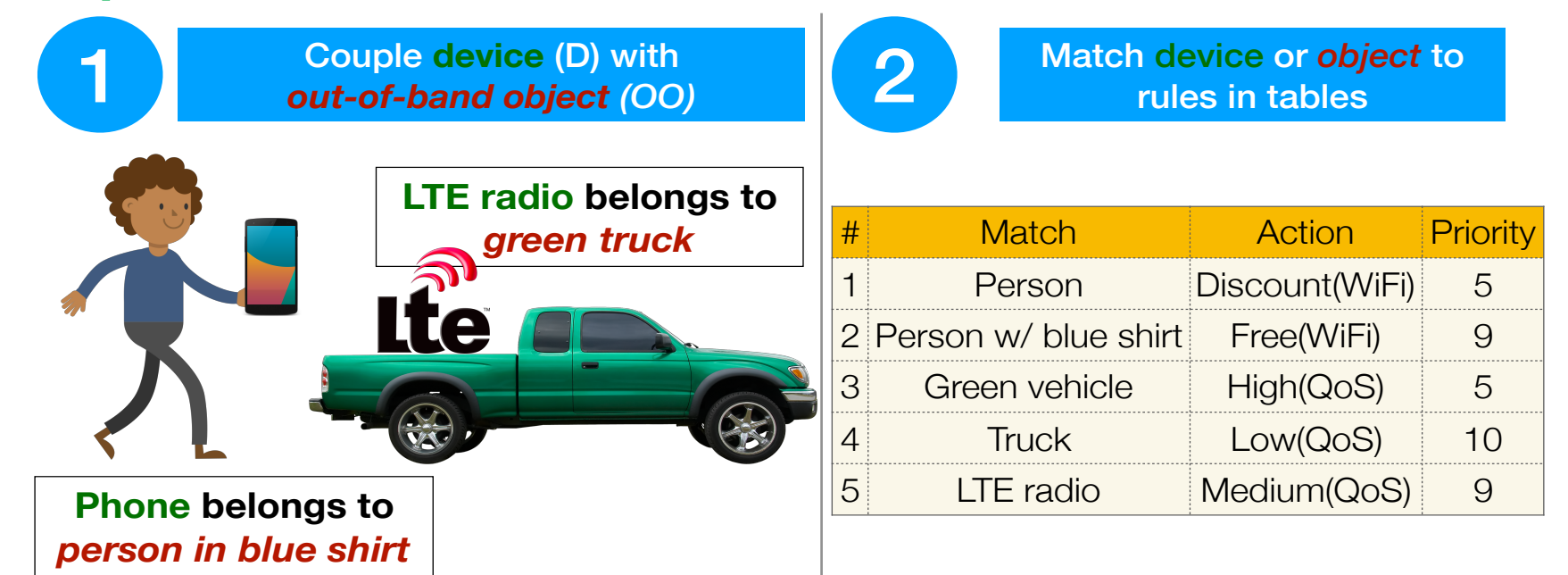 - We use Hungarian method for assignment

Total Pairings	Matched Pairings	Accuracy
21	19	90.47%

- Improved localization and geofencing results in paper

Challenges and Future Work

- **Programmable Framework**
  - Use **OpenFlow-**like rules and tables to instantiate rules on context

1. Couple **device (D)** with **out-of-band object (OO)**

LTE radio belongs to *green truck*

Phone belongs to *person in blue shirt*

2. Match **device** or **object** to rules in tables

#	Match	Action	Priority
1	Person	Discount(WiFi)	5
2	Person w/ blue shirt	Free(WiFi)	9
3	Green vehicle	High(QoS)	5
4	Truck	Low(QoS)	10
5	LTE radio	Medium(QoS)	9

- **Security and Privacy**
  - Most sensing systems deployed in public, which may **limit concerns**
  - Prior work can be utilized: intelligent brokers; smart sensors

- **Expanding Scope of Sensors**
  - Integrating **other sensors** along with video sensors

- **Heterogeneous Deployments**
  - Heterogeneous deployments of sensors and edge
  - Compiler can determine where and how to run functionality

Summary

- We propose a new way to manage wireless networks using user or device context derived from sensors
- We demonstrate example use cases which show promise for SenseNet
- We also outline challenges needing to be overcome to make SenseNet practical