Kansas City-IEEE Smart Cities Initiative

(Technology Projects)

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University of Missouri - Kansas City

"IEEE Selects Municipalities Kansas City, Missouri, United States of America, and Casablanca, Morocco to Engage in IEEE Smart Cities Initiative" on 10/21/2015

http://smartcities.ieee.org/home/ieee-selects-municipalities-kansas-city-missouri-united-states-of-america-and-casablanca-morocco-to-engage-in-ieee-smart-cities-initiative.html

The theme of KCMO proposal "City as Lab":

- *Foster citizen co-creation through a "city as lab" approach (education, entrepreneurship, public safety, and mobility)*
- *The 'Living Lab' innovation partnering with the Cisco's Smart+Connected Communities initiative and Google fiber (Vendor-driven → Community-driven).*

Proposal led by:

Kari Keefe (Think Big Foundation), Aaron Deacon (KC Digital Drive), Dave Nall (IEEE Kansas City Section), Tony Luppino (law school, UMKC), Deep Medhi, Baek-Young Choi, Sejun Song (SCE, UMKC), and Kate Garman (City of Kansas City)

WiFi-Honk, WiFi-Amber, and More …

WiFi-based direct communication technology research for IoT

WiFi-Honk: WiFi beacon stuffed car-to-other direct communication smartphone application for Vulnerable Road Users (VRU) safety.

- *"WiFi-Honk! Smartphone App Gets Pedestrians out of the Way"*, IEEE Spectrum, July 2014,
- The Best Video Award at ACM Mobisys 2014

WiFi-Amber: Effective object tracking and event detection system through opportunistic crowd sensing which exploits cloud, smartphones and small IoT tag.

- Key technical features: privacy and security, energy efficiency, scalability, accuracy, and sensing effectiveness

Further applications: healthcare/industry IoT, people with special needs, pet tracking, law enforcement, smart tourism, etc.

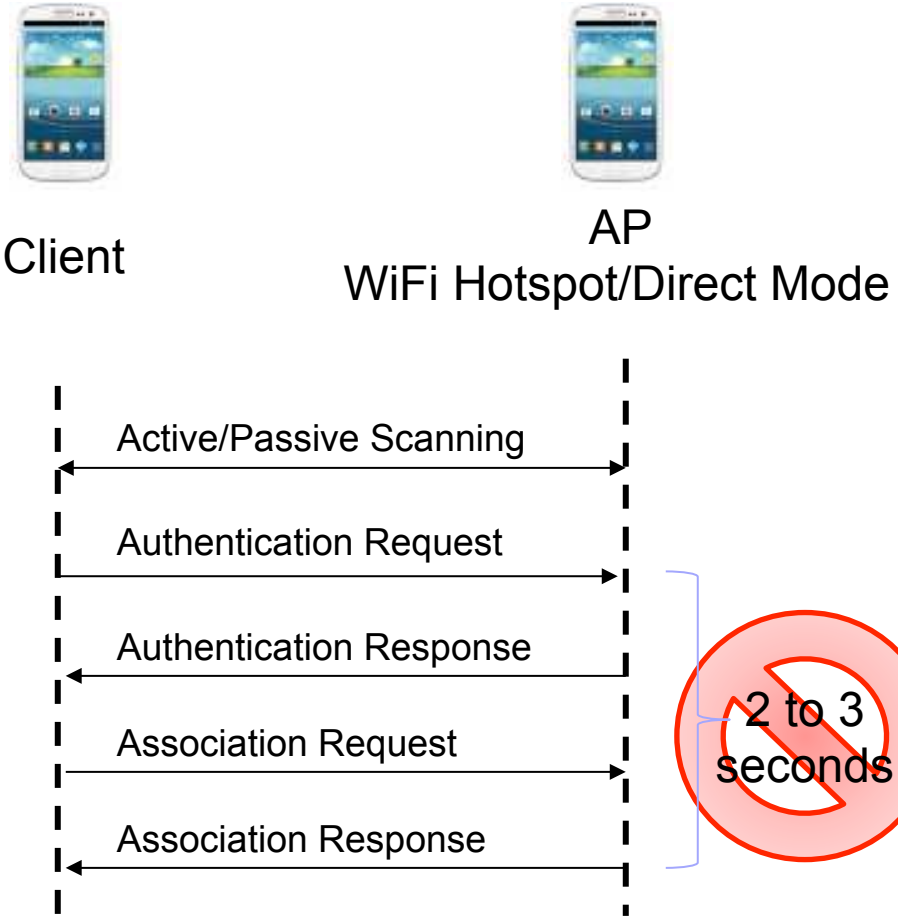
Led by Drs. Baek-Young Choi and Sejun Song in collaboration with Air Force Research Labs (AFRL)

Can WiFi be a Vehicular Communication Protocol?

Protocol	Range	Mobility	Deployment
DSRC	< 1 Km	> 60 Mph	Not available yet Expensive Hard to retrofit
WiFi	< 100 m	< 5 Mph	Ubiquitous Long association time
Cellular	< 10 Km	> 60 Mph	Ubiquitous Long association time

- V2V (Vehicle to Vehicle) and V2I (Vehicle to Infrastructure) with dedicated short-range communications (DSRC) has been actively investigated to enhance the traffic safety.
- However, the vulnerable road users (VRUs) safety is left unprotected due to the lack of the practical communication methods.

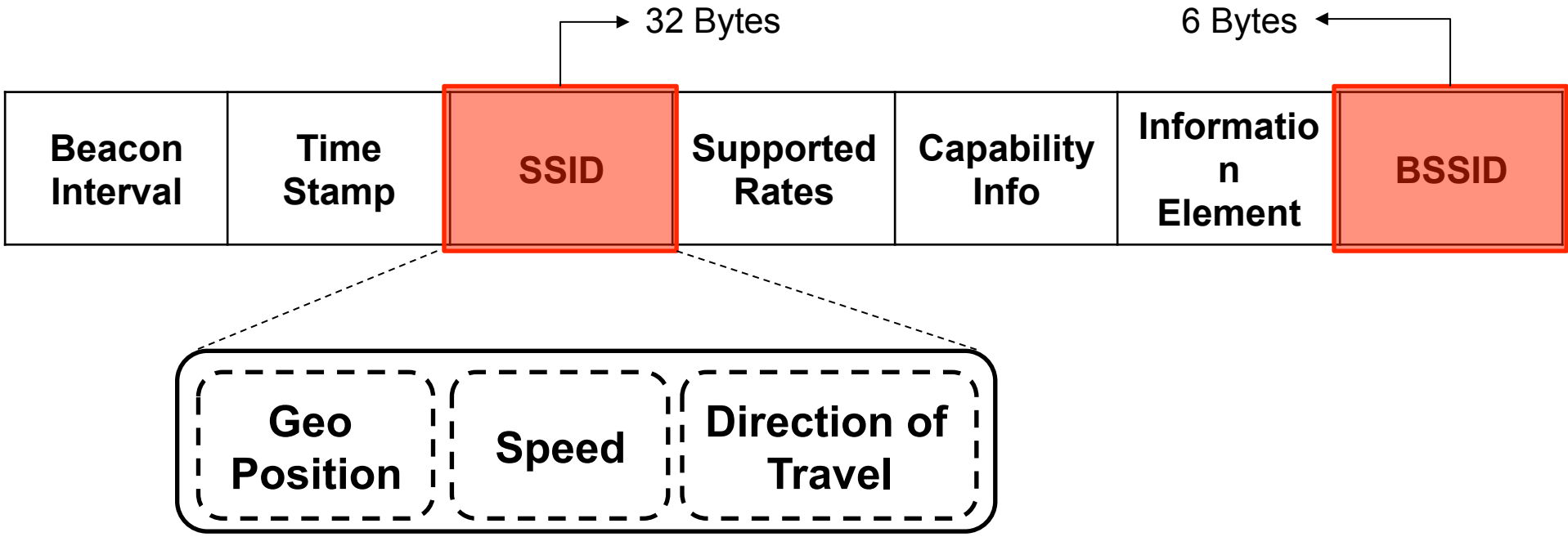
WiFi is Everywhere, But…



WiFi-Honk!

- Cost effective and practical safety means for both VRUs and vehicle drivers
- Uses ad hoc mode of smartphones (WiFi Direct/ Hotspot) for communication
- No additional hardware for DSRC or modification to smartphones required
- Mobility constrains of WiFi are removed by using WiFi Beacon Stuffing

WiFi Beacon Stuffing



- Beacons are broadcasted every 100 ms in WiFi Hotspot/Direct mode (configurable)
- Passively scanned in WiFi Hotspot/Direct discovery mode

WiFi-Honk

https://www.youtube.com/watch?v=wjagsXS4fq0&feature=youtu.be

WiFi-Amber:
Effective Opportunistic Crowd Sensing IoT System for Restoring Missing Objects

Smart ci tizen's
qual ce!

Eitan Blasingame
Missing: Feb 28, 2008
DOB: Oct 22, 2006
Age Now: 7
Sex: Male

Erika Brown
Missing: May 16, 2006
DOB: Jun 20, 1991
Age Now: 22
Sex: Female

HELP BRING ME HOME

Recognize **May 25th** as
National Missing Children's Day
in your community.

Visit Take25.org
for more information.

Melissa Braden
Missing: Mar 16, 2006
DOB: Apr 6, 2005
Age Now: 8
Sex: Female

Colt Clark
Missing: Apr 20, 2006
DOB: May 24, 1996
Age Now: 17
Sex: Male

In the US alone, there are approximately **800,000** children younger than 18 who have been reported missing

It Takes a Whole Village to Protect a Child

The first 3 hours are critical!

Spread the News!

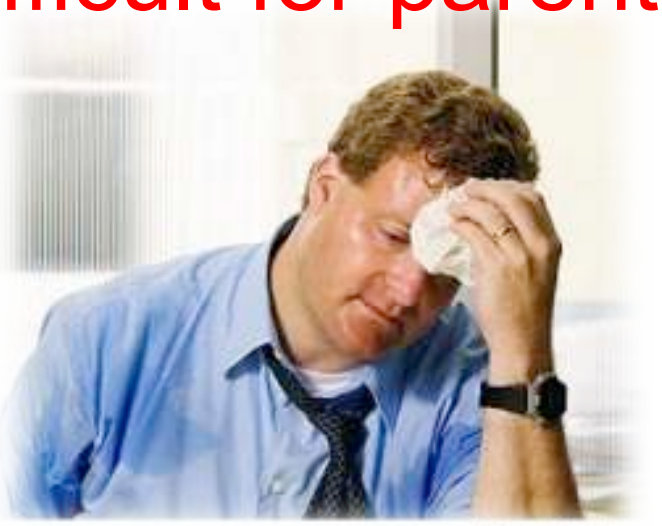
Search Together!

Issuing an AMBER Alert

- Law enforcement must confirm that an abduction has taken place
- The child is at risk of serious injury or death
- There is sufficient descriptive information of child, captor or captor's vehicle to issue an Alert
- …

Not to desensitize the community with too many alerts

Difficult for parents



Secret Weapons in our Smart Cities

Billions of smartphone users

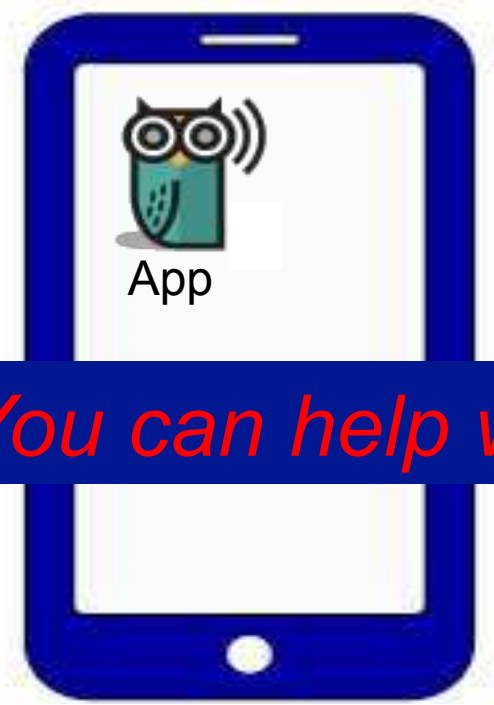
Billions of WiFis

However, …

Are we willing to give up our important phone calls, meetings, and batteries (and identity) in response to ALL the general missing child alerts?

Wi-Fi Amber

- Using an affordable tiny tag (for child) and smartphones (for search)
- Automatic turn-on, sensing, and reporting application
- Ensuring privacy of a child as well as volunteers

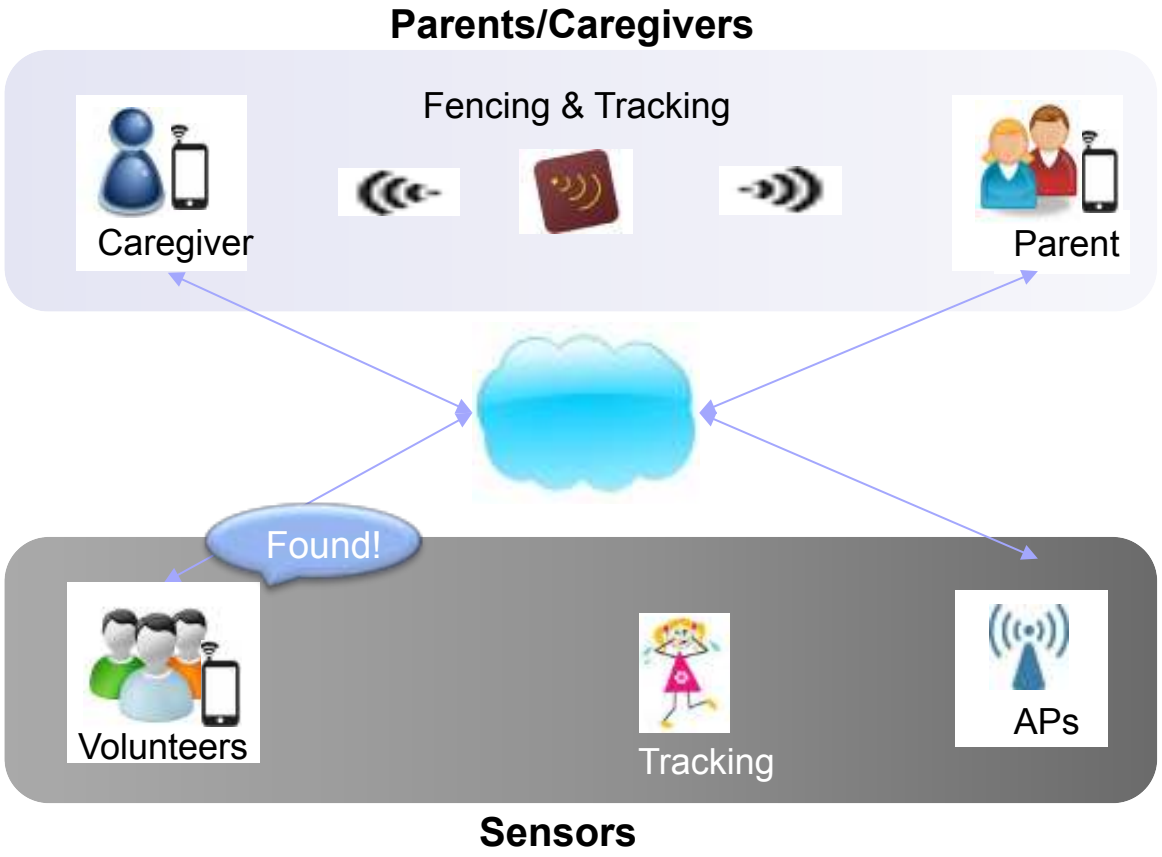


Wi-Fi Tags

You can help without your consciousness!

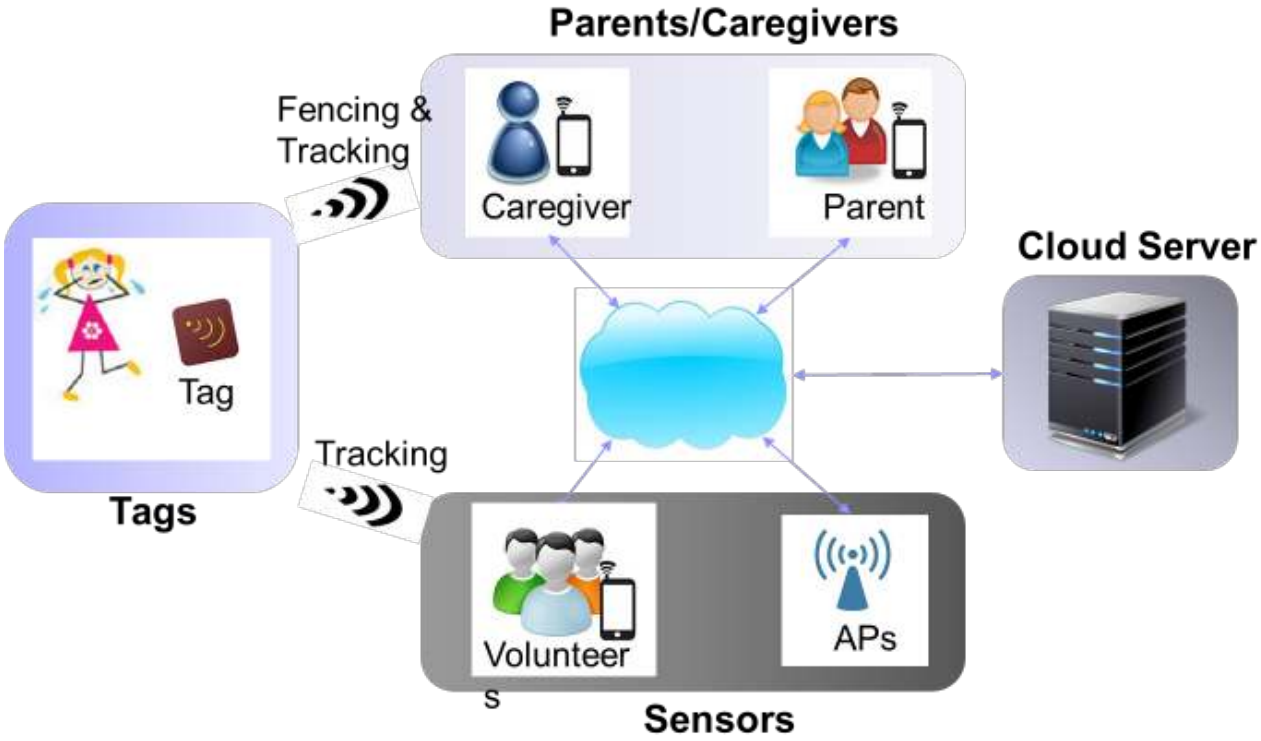
Our Contributions

- **Wi-Fi based Crowd Sensing architecture based on Cloud Assisted IoT system**
- **Dynamic Smartphone Apps (seamless to users, energy efficient)**
- **Privacy & Security for Child, Parent and Volunteers**

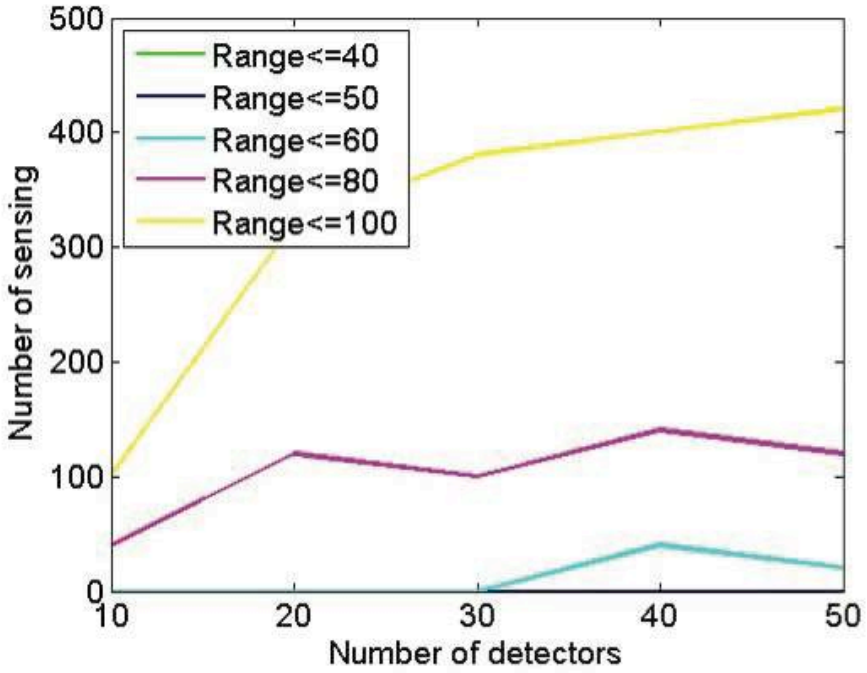


Researched Technical Issues

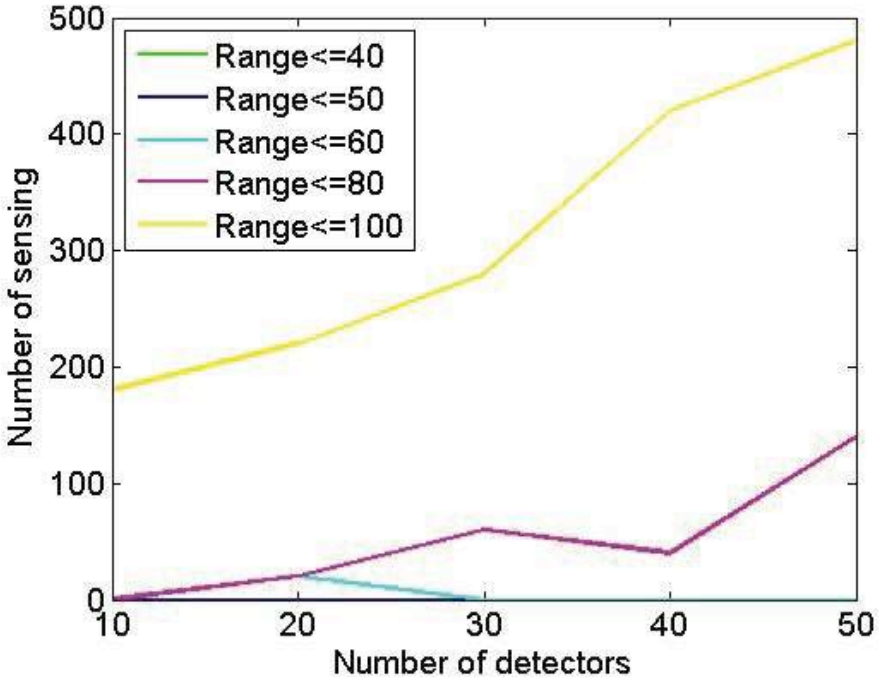
- **Sensing effectiveness**
- **Energy efficiency**
- **Privacy**
- **Security**



Sensing Effectiveness: WiFi



The same speed

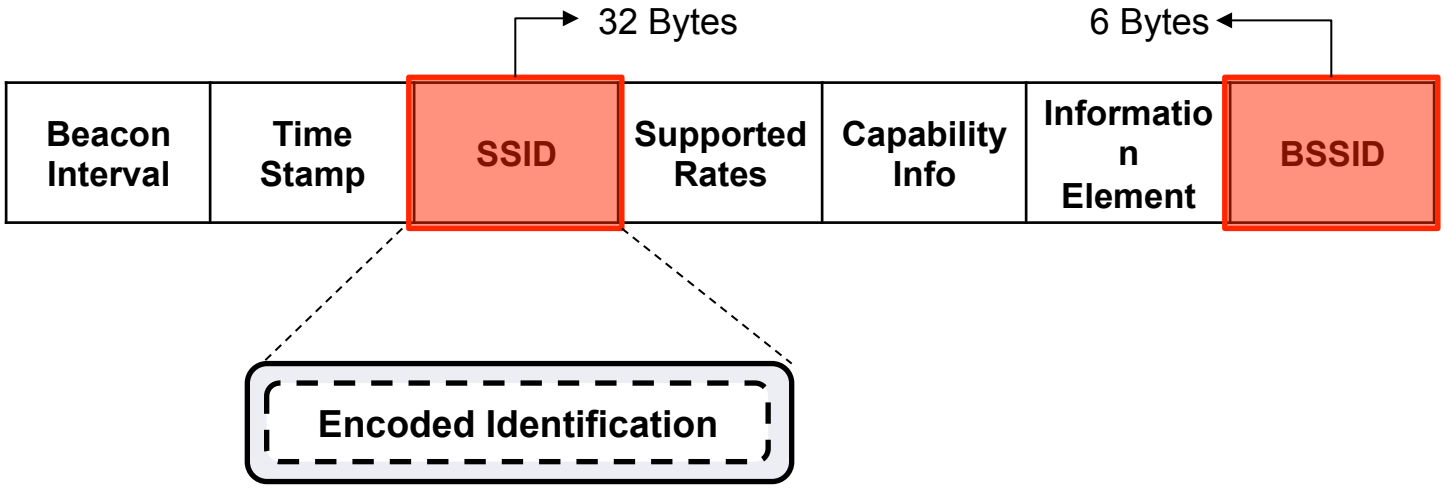


Faster target speed

Sensing Range is Important especially with mobility

WiFi Beacon Stuffing

- WiFi authentication bypassing technique
  - ref. Our previous work, ‘WiFi-Honk’ for connected vehicles

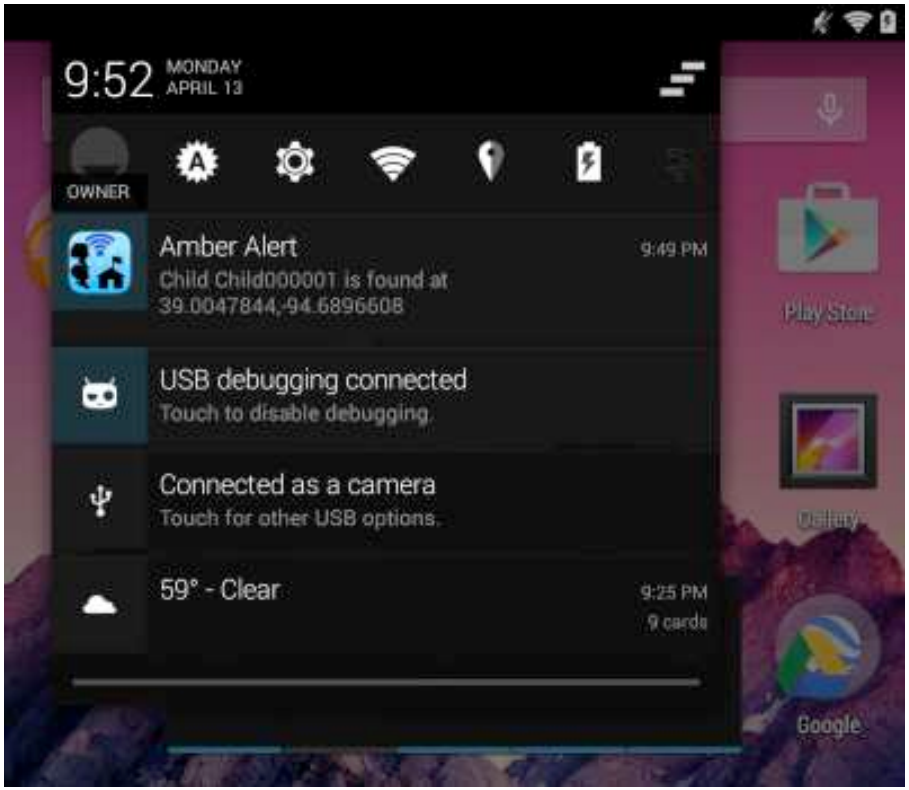


Tag Prototype

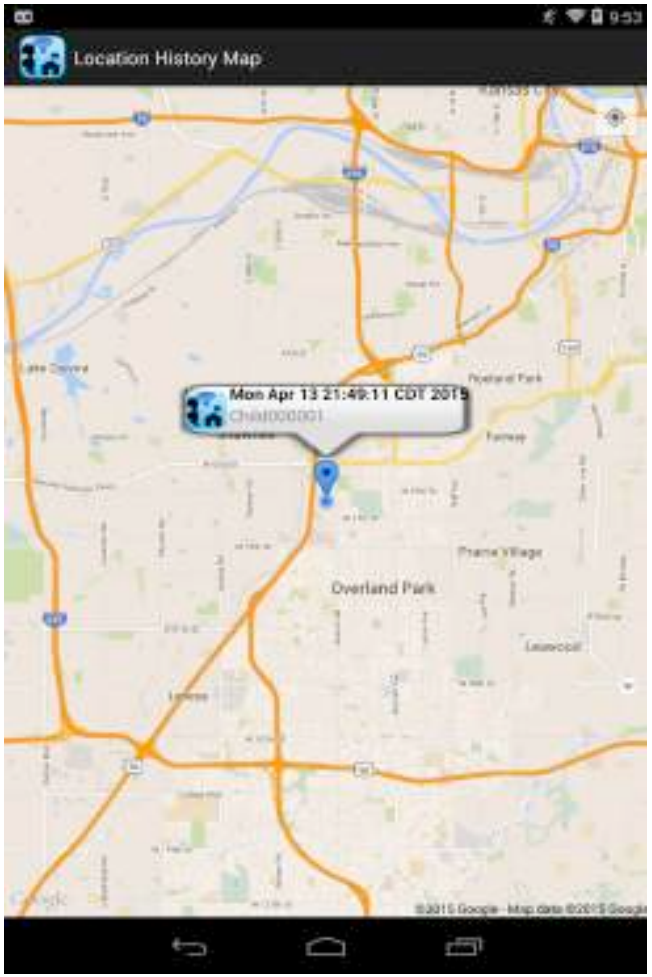
Raspberry Pi 2 based Tag

$5 real size Tag

Found Notification



Child Found Notification



Check the Child Location

Usages

- Families with Children, Educational institutions, Amusement Parks, Malls, Big Stores

Further Usages

- People with special needs
  - ex. Alzheimer, Autism, etc.
- Road Safety
- Pet Tracking
- Internet of Things (IoT): ex. in healthcare and industry

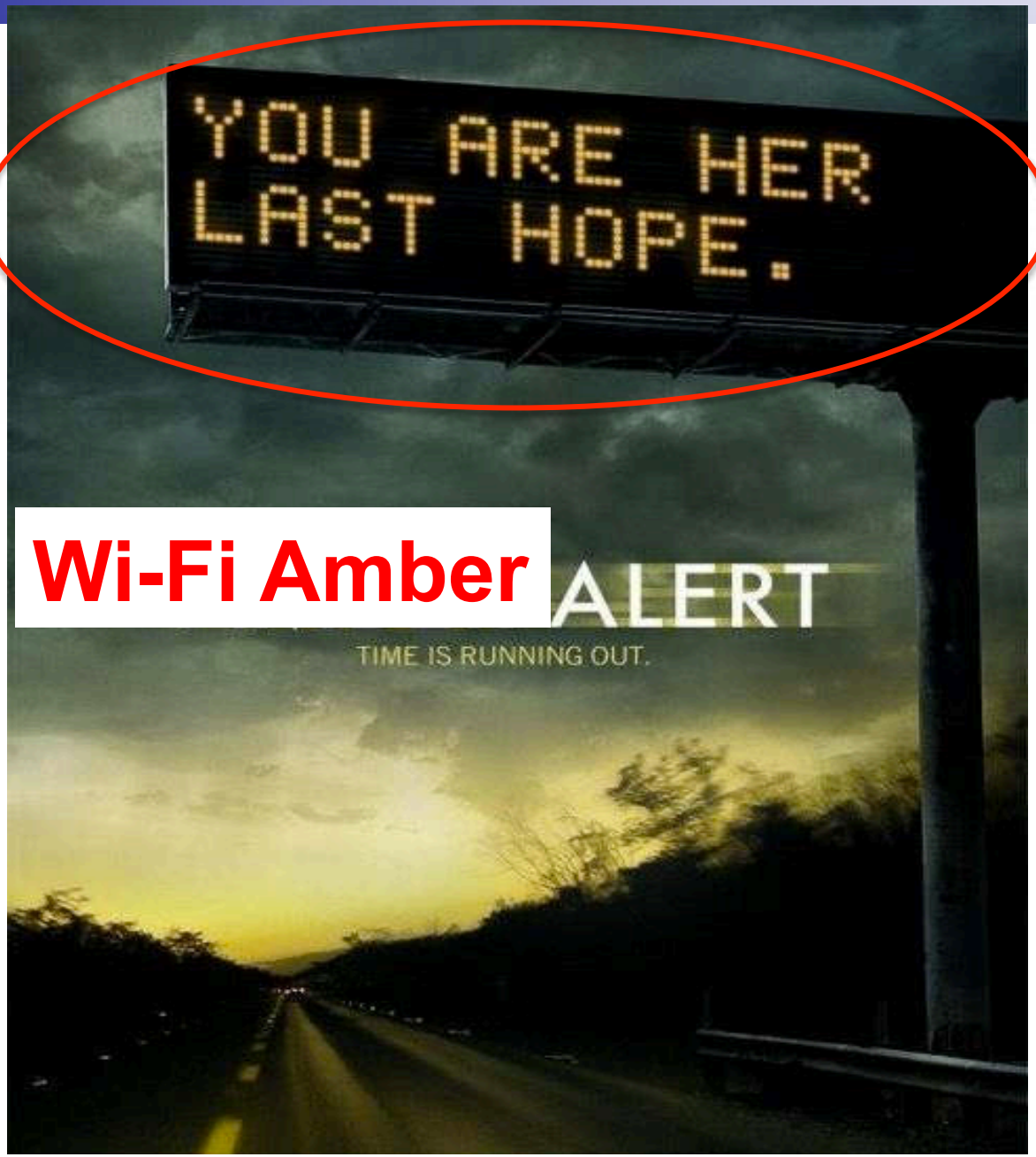
Take-Away

Wi-Fi Amber:

Fast and effective child monitoring IoT system

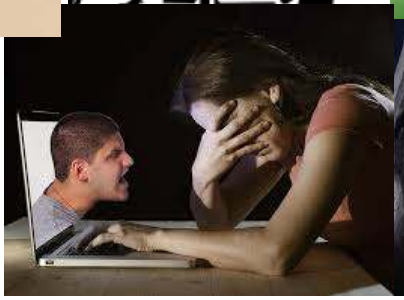
- Smartphone based opportunistic crowd sensing
  - ✓ Sensing effectiveness
  - ✓ Energy efficiency
  - ✓ Security and Privacy
- Easy application to healthcare and industry

It Takes a Whole Community to Protect Children
Let's Protect Them Together


YOU ARE HER
LAST HOPE.
Wi-Fi Amber
ALERT
TIME IS RUNNING OUT.

SAPE: Sexual Assault (SA) Protection, Prediction, and Education

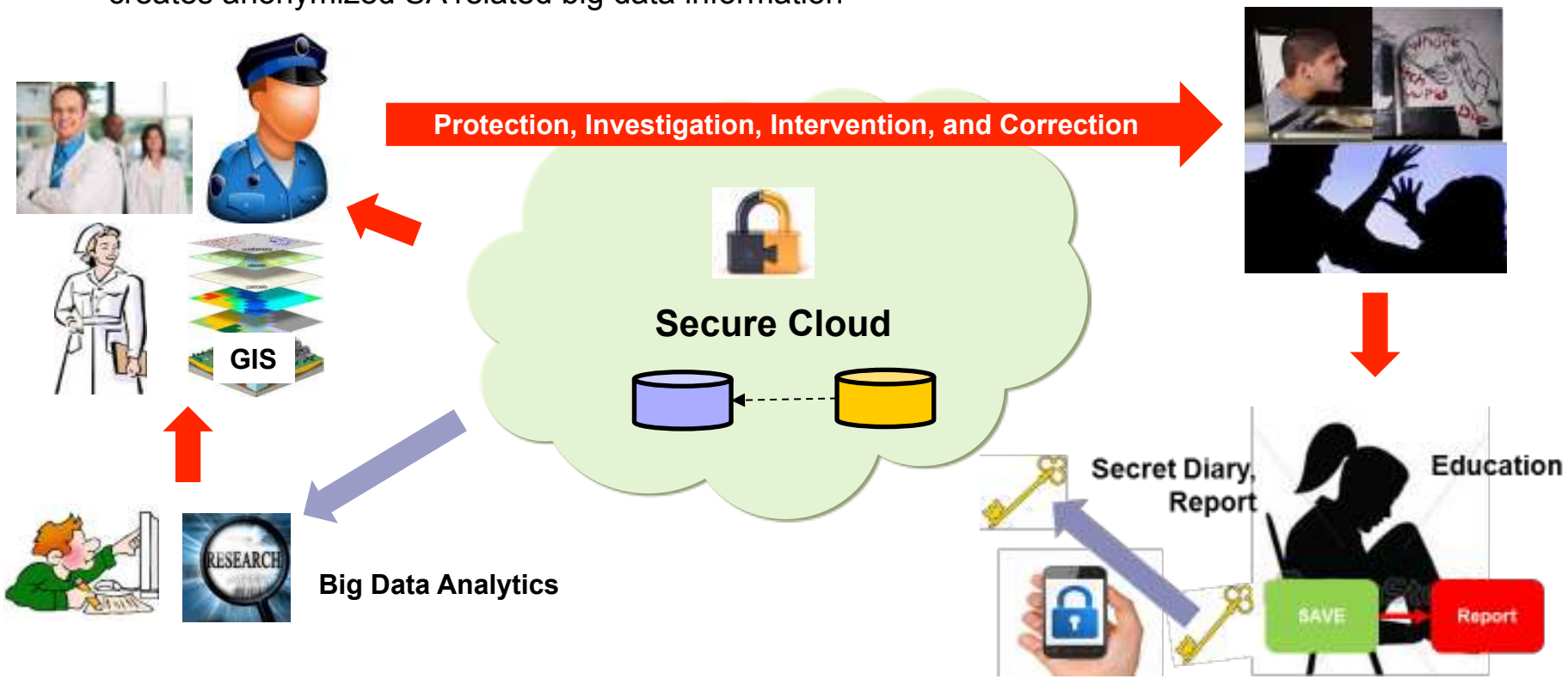
- SA happens a lot in many forms of relationships with different types. However, 98 out of 100 attackers walk out free.
- It is one of the most under-reported crimes, thus lacks related data.
- Many entities try to search/analyze the SA related data from the light to severe cases in various forms to find any meaningful information for placing the efficient and effective protection, prediction, healing, and incentive mechanisms → Need more Data
- SAPE is a pilot project to anonymously create and share data that is potentially related to Sexual Assault (SA).



From https://rainn.org/get-information/statistics/reporting-rates

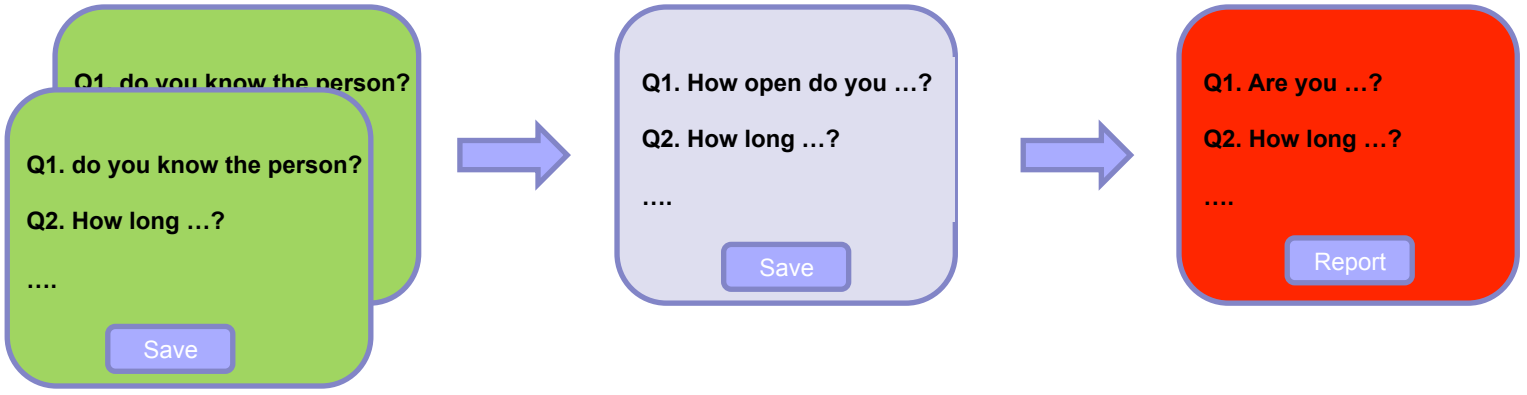
SAPE: Sexual Assault (SA) Protection, Prediction, and Education

- SAPE system consists of a front-end smartphone application, intelligent big data analysis tools, and a secure back-end cloud system.
  - provides easy-to-use diary style interface – including ambiguous cases
  - educates young potential victims using progressive questionnaires designed by subject-matter expert (SME)
  - ensures the privacy of both potential victim and attacker
  - creates anonymized SA related big data information



SAPE Education Example

- Young potential victims are not clear about the sexual assaulting situation
- Progressive questionnaires designed by subject-matter expert (SME)
  - ✓ Start with simple questions and lead more specific questions
  - ✓ During the Q&A process the screen color will be changed to "RED" if the situation is serious enough to report



Several related occasions

MOOL (Massive Open Online Labs)

- MOOL combines a MOOC with various scenarios-based virtual labs, remote/ special laboratory facilities, virtual field trip resources, and IoT.
  - ✓ enables various personalized, realistic, and interactive online learning services
  - ✓ diversifies the learning and teaching experience
  - ✓ extends education for students with visible and invisible disabilities
  - ✓ spurs the growth of the online or distance learning ecosystem
- In smart cities, MOOLs connect via high speed Inter-Clouds.

DarWiN: Data Driven Research-Wise Network Infrastructure Upgrade

"A $500,000 NSF grant award to upgrade the backbone of the UMKC computer network to a high-speed 100-gigabit network. The upgrade includes inter-campus communication, connectivity between core research buildings, and dedicated connections for research to external regional entities.", 10/15/2015, UMKC Today

Provides an enhanced platform for solving a variety of single-, inter-, and multi-disciplinary science and engineering research and education problems:

- ✓ end-to-end campus network performance management,
- ✓ large data movement service research,
- ✓ chemical fingerprinting and sequencing research,
- ✓ computational physics and electronic structure research,
- ✓ human balance and ambulation research.

Further infrastructure research applications:

- ✓ Network Architecture based on Virtualized Networks for Smart Cities
- ✓ NSF Public Safety Big Data Spoke
- ✓ Smart Campus and Research Core (Cisco IoT and Google fiber campus)

Led by Drs. Sejun Song, Deep Medhi, Baek-Young Choi, and Mary Lou Fritts

Thanks! … Qs?


smart
city
data
private
business
technology
public
services
grid
critical
mobile
initiatives
infrastructure
community
benefits
computing
discussion
population
service
also
think
need
great
healthcare
make
water
help
like
starting
systems
energy
analytics
better
take
approach
leaders
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key
use
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apps
growth
sector
transport
technologies
citizens
agree
consumer
education
models
many
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buildings
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safety
projects