i-WATCH

iWatch: BIG Data Management and Analytics for Intelligent Surveillance

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IMSC Integrated Media Systems Center

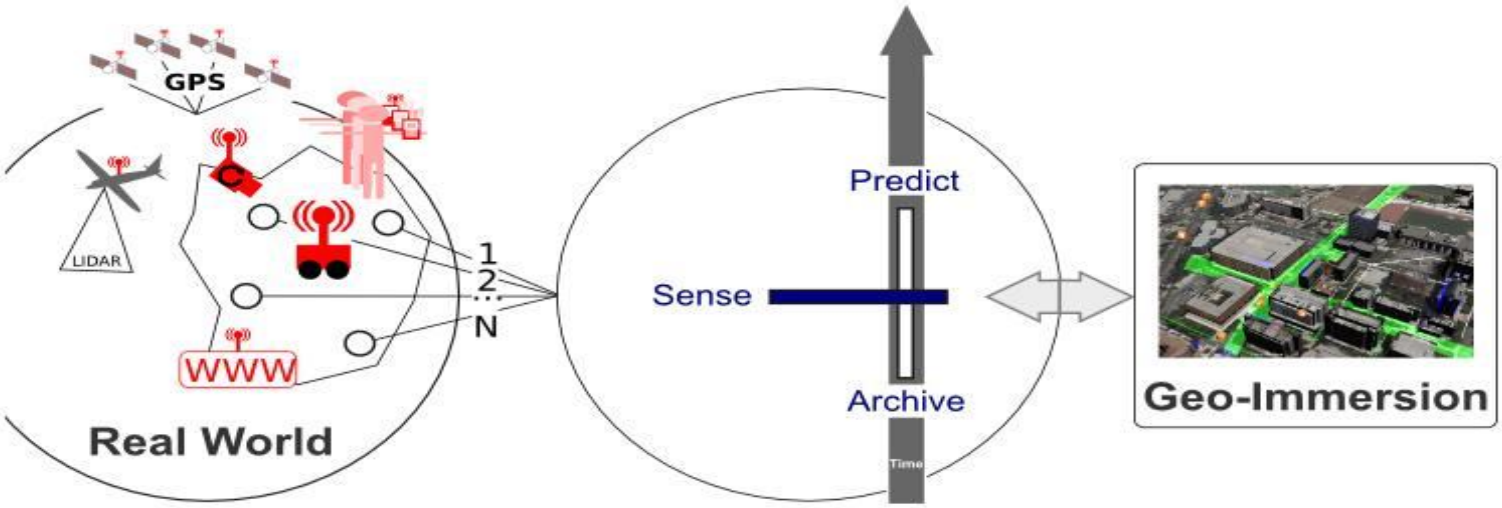
Outline

- An Overview of the iWatch Project
- Vertical Cuts: Application-Specific Prototypes
  - iWatch for Safety and Security (i4S)
  - iWatch for Health (i4H)
  - iWatch for Energy (i4E)

Project Objectives

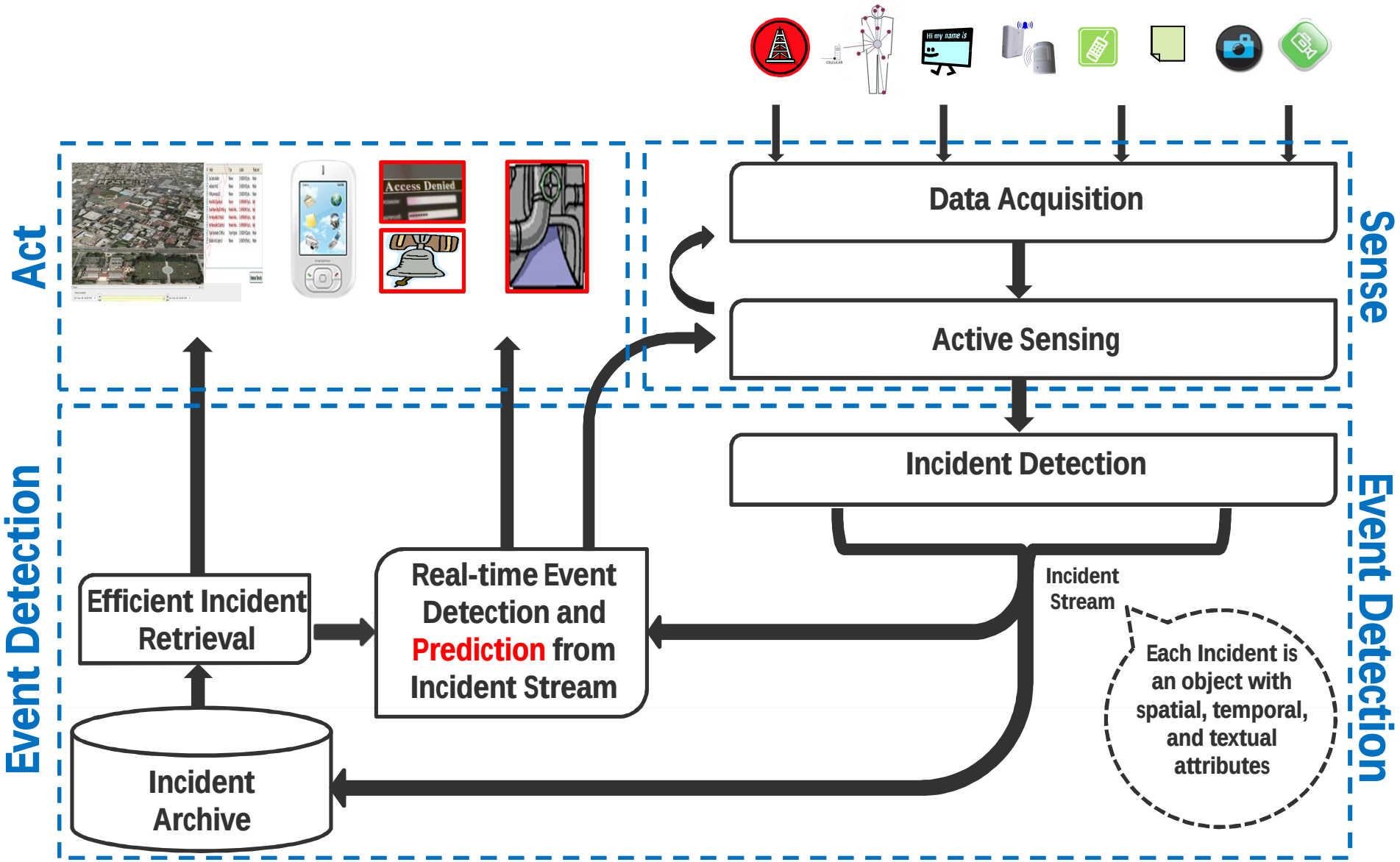
- A Multi-purpose System for Intelligent *Geoimmersive Surveillance*
- An End-to-End System!
- A Research Showcase
- A Technology Showcase

GeoImmersive Surveillance

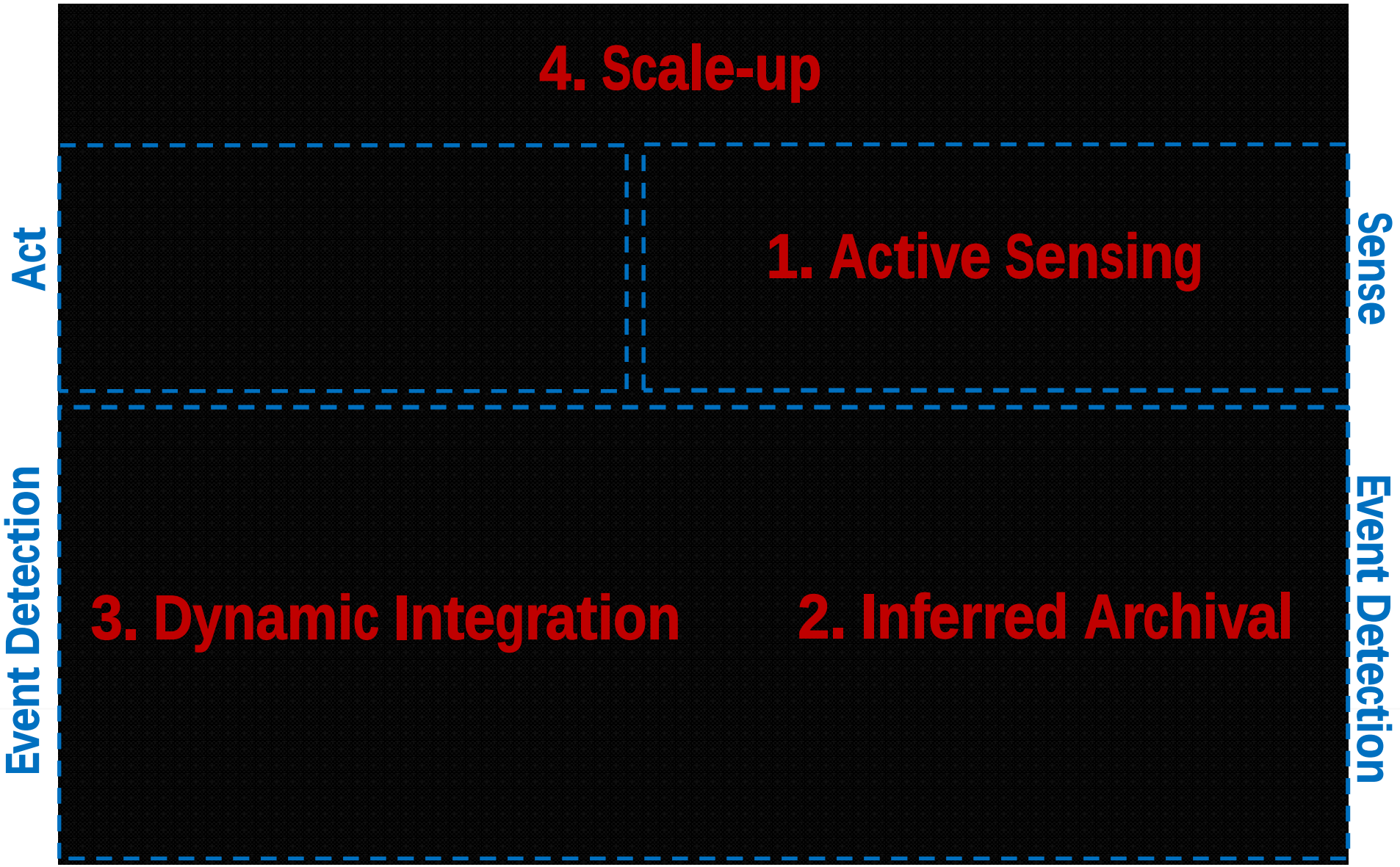


- **Sense**
  - *Multi-modal* sensing
  - *Deep* sensing
  - *Active* sensing
- **Detect Events**
  - *Forensic analysis*
  - *Real-time monitoring*
  - *Prediction* of potential expected (and unexpected!) events
- **Act**
  - *Visualization*
  - *Recommendation*
  - *Actuation*

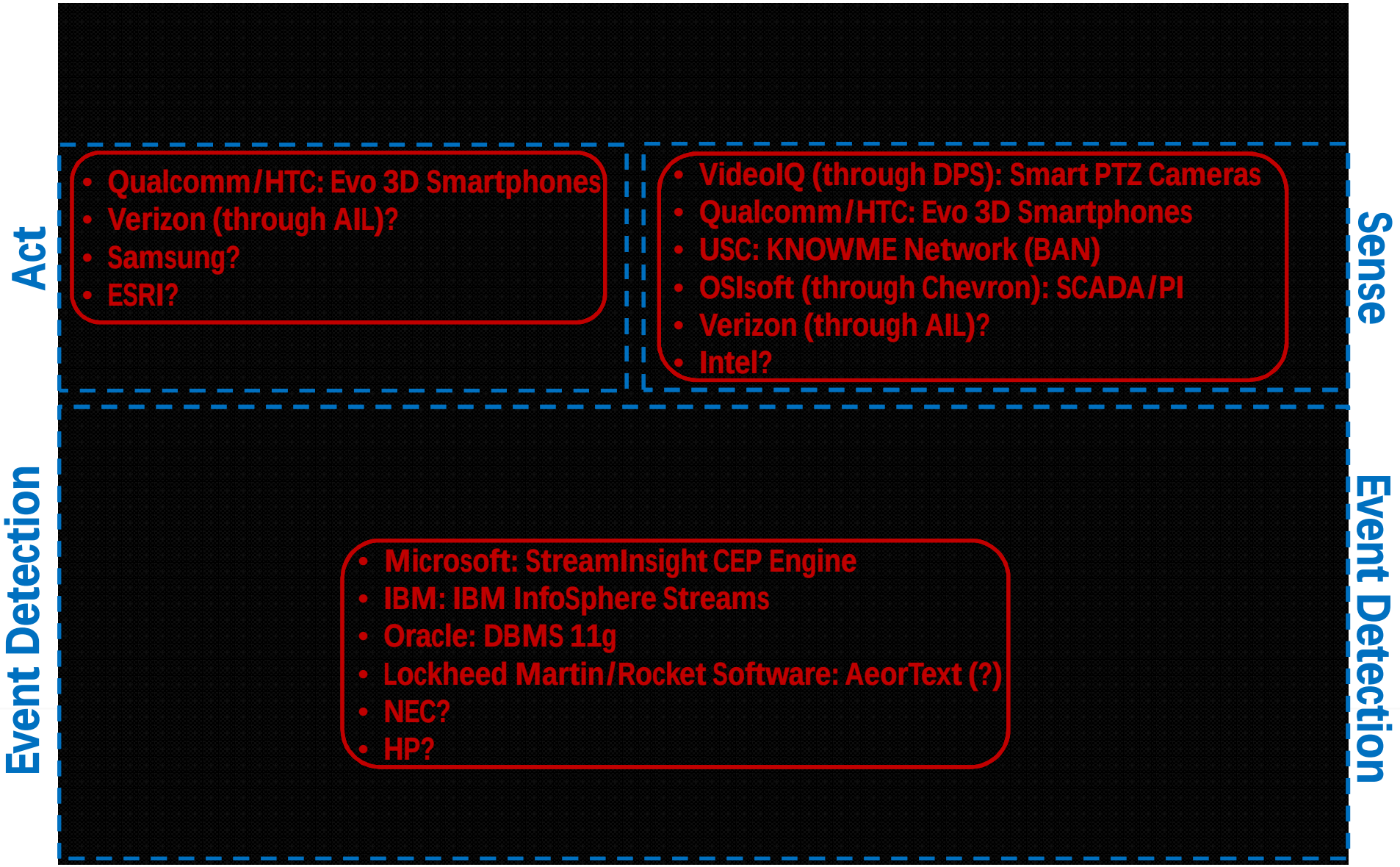
iWatch System Architecture



Research Showcase



Technology Showcase



Project Timeline

January 2011

Applications	Sponsors	Technologies	Funding	Team
Safety and Security	IMSC	Oracle 11g	~20K	IMSC Researchers (4) IMSC Students (2)

Project Timeline (cont'd)

January 2012

Applications	Sponsors	Technologies	Funding	Team
Safety and Security Public Health Energy	IMSC NIJ NGC CREATE (DHS) USC (DPS) CIA? NGA? CTSI? NIH? LA County? Oracle? CiSoft (Chevron)	Oracle 11g IBM Microsoft Qualcomm	1.2M+	USC Public Safety USC Doctors (3) CHLA Doctors (1) Reservoir Engineers Sponsors' PMs IMSC Researchers (4) IMSC Postdocs (4) IMSC Students (15) Industry Partners USC AMI

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  - iWatch for Health (i4H)
  - iWatch for Energy (i4E)

iWatch for Safety and Security (i4S)

- **Purpose:** Forensic and Real-time Criminal Activity Detection from Multi-Source Multi-Modal Data
- **Sponsors:** NIJ, NGC, CREATE, DPS
- **Team:**
  - Law Enforcement and Security/Intelligence Experts: Mark Greene (NIJ), Ed Tse (NGC), Carol Hayes (DPS)
  - Risk Analysis: Isaac Maya (CREATE)
  - Incident Detection from Video: Ram Nevatia (Tracking), Gerard Medioni (Face detection)
  - Geo-keyword Incident Indexing: Cyrus Shahabi
  - Spatiotemporal Event Detection: Farnoush Banaei-Kashani
  - Mobile Video Search: Seon Ho Kim







Approach

- Motivation:

  Multi-modal integration enables more effective surveillance systems for criminal activity detection

- Challenge:

  Data overload in detecting events in large environments over long time intervals

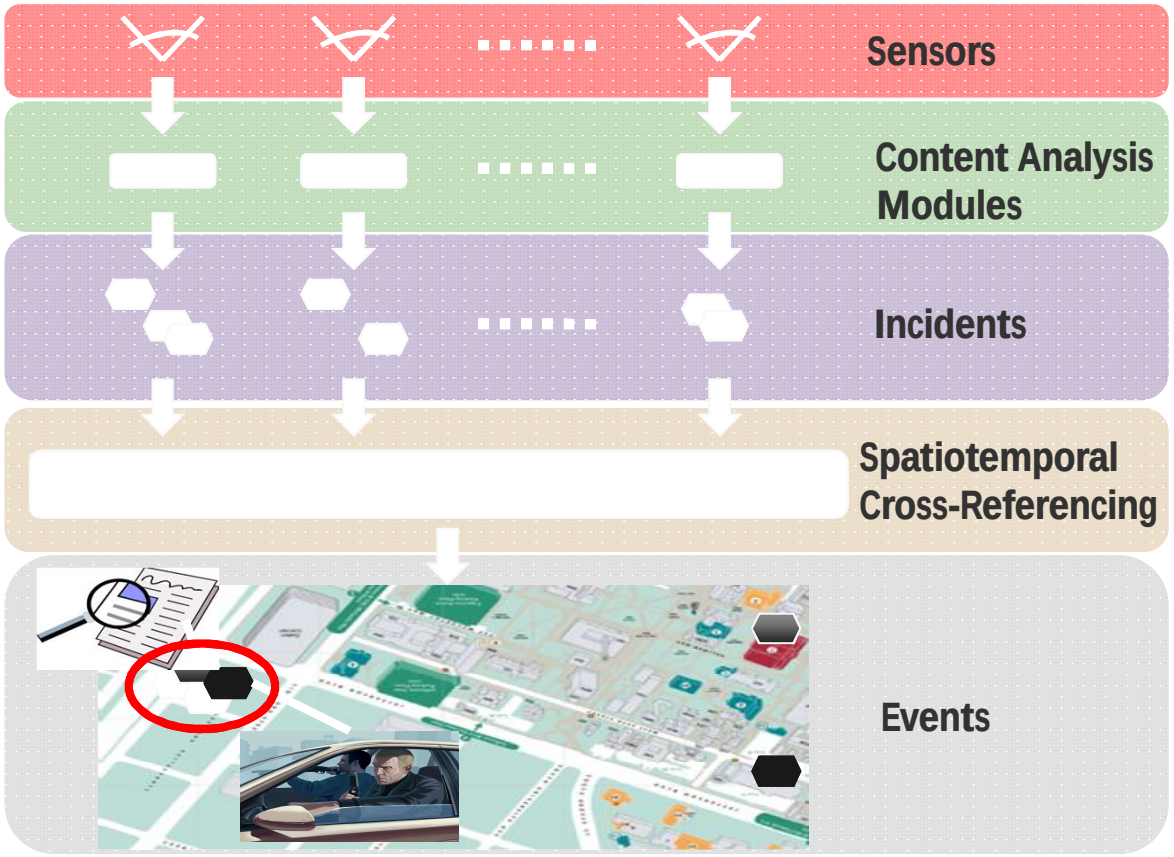
- Proposed Approach:

  Utilize state-of-the-art content analysis techniques to extract *incidents* from input data streams, while integrating the incidents in the **spatiotemporal domain** (rather than content domain) to detect *events*

Approach (cont'd)

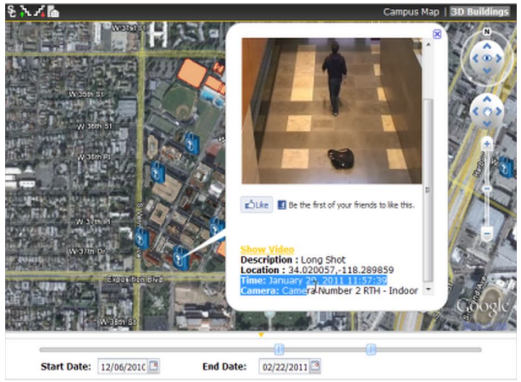
- Advantage:

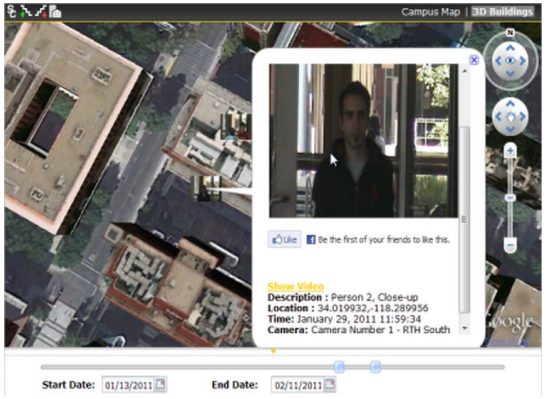
  Allows for event detection in large spatial and temporal scales

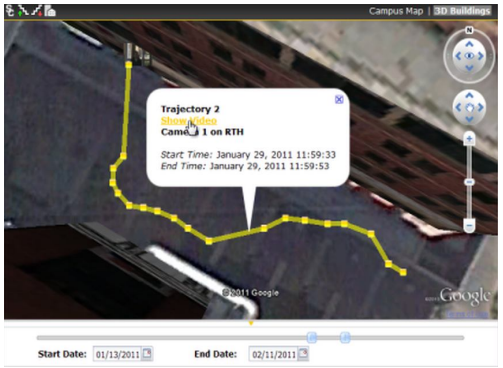


Last Year's Demonstration

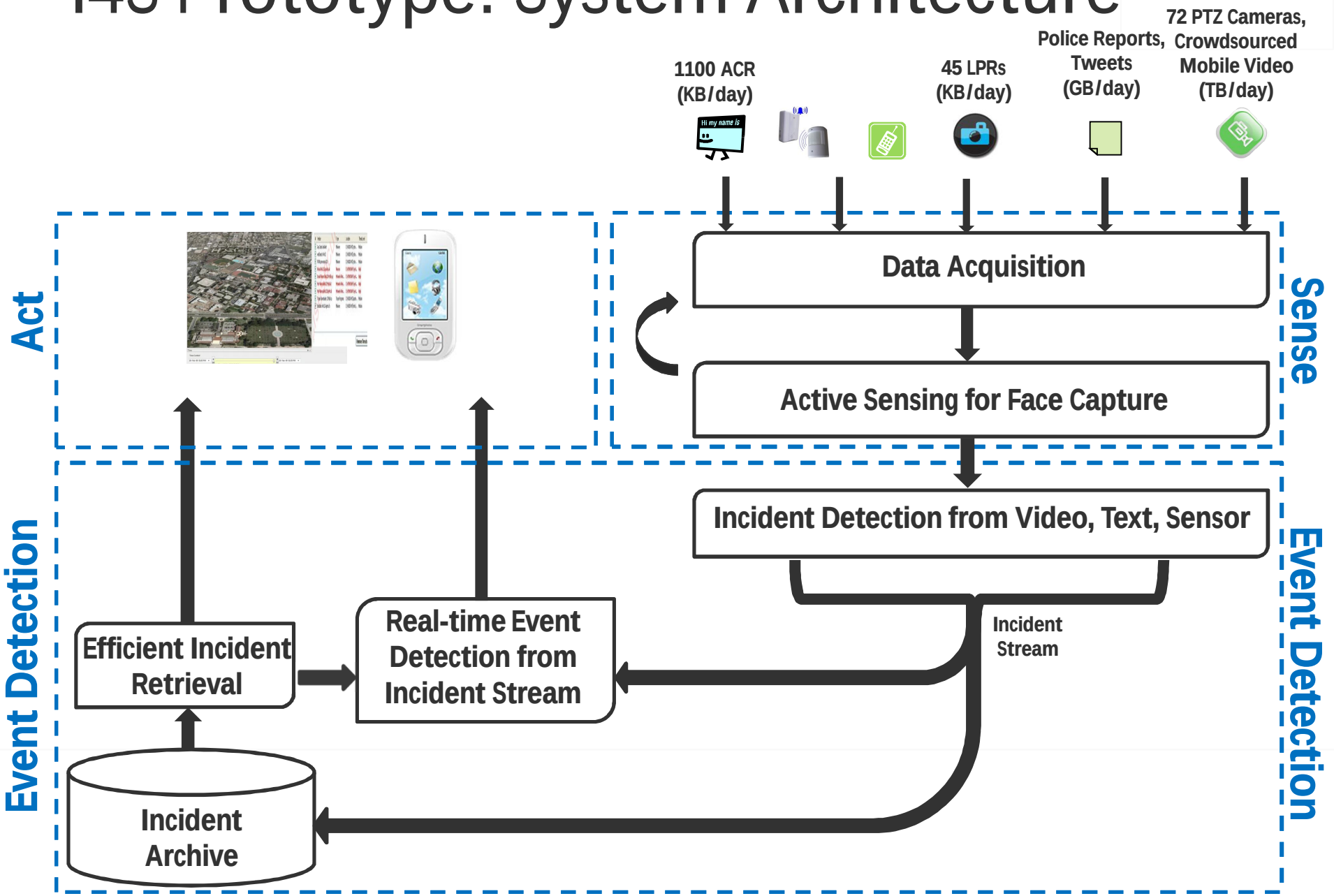
- Mode: Forensic Analysis
- Input: Video feed from 25 PTZ cameras



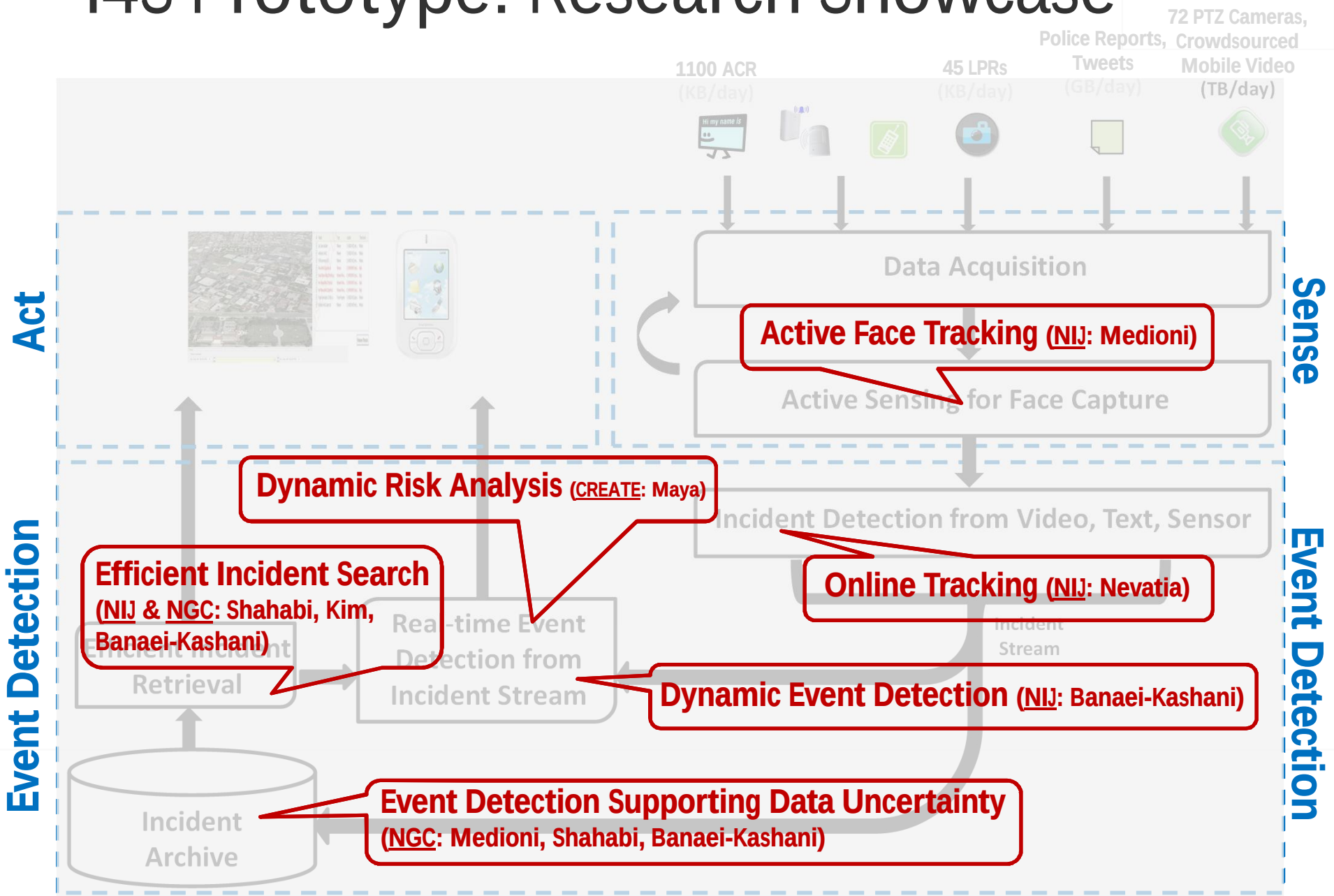




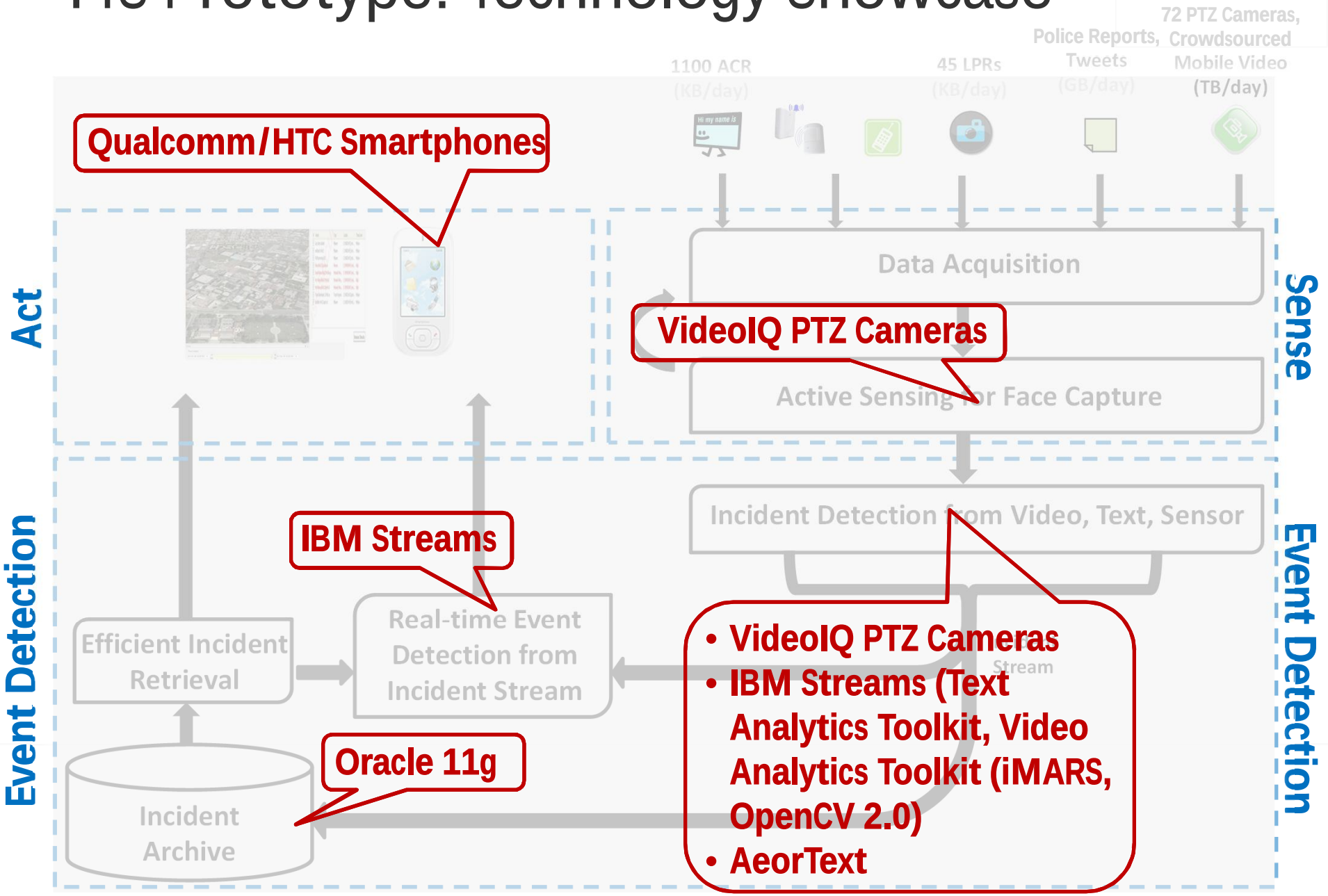
i4S Prototype: System Architecture



i4S Prototype: Research Showcase



i4S Prototype: Technology Showcase



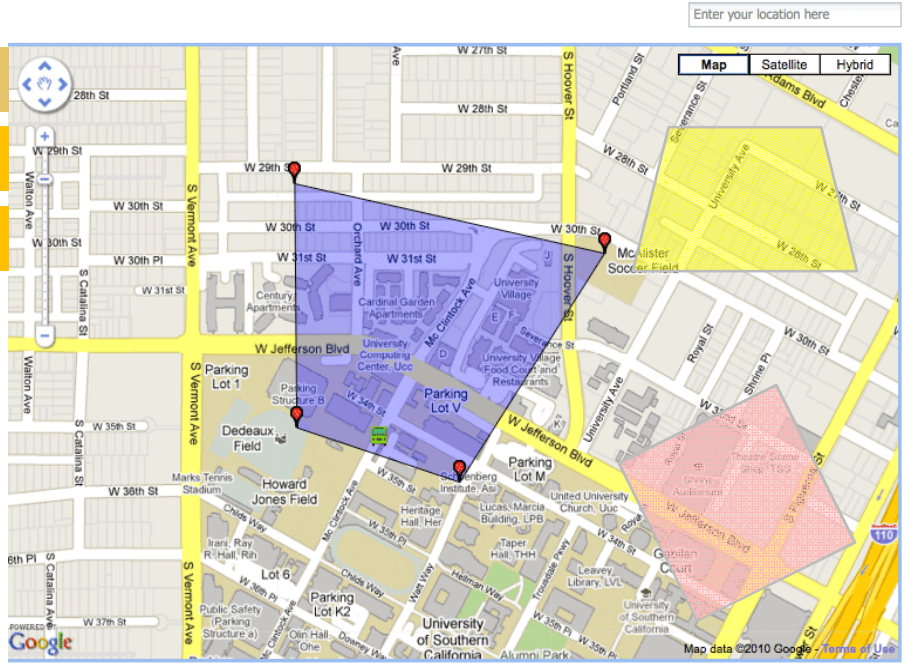
Sample Demonstration

Server-side User Interface

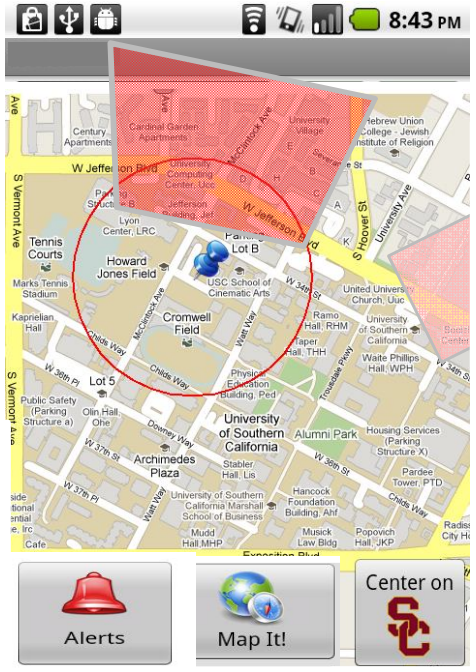
Create

Update

Monitor



Mobile Client



Search for “Geofence Demo” on Youtube

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iWatch for Health (i4H)

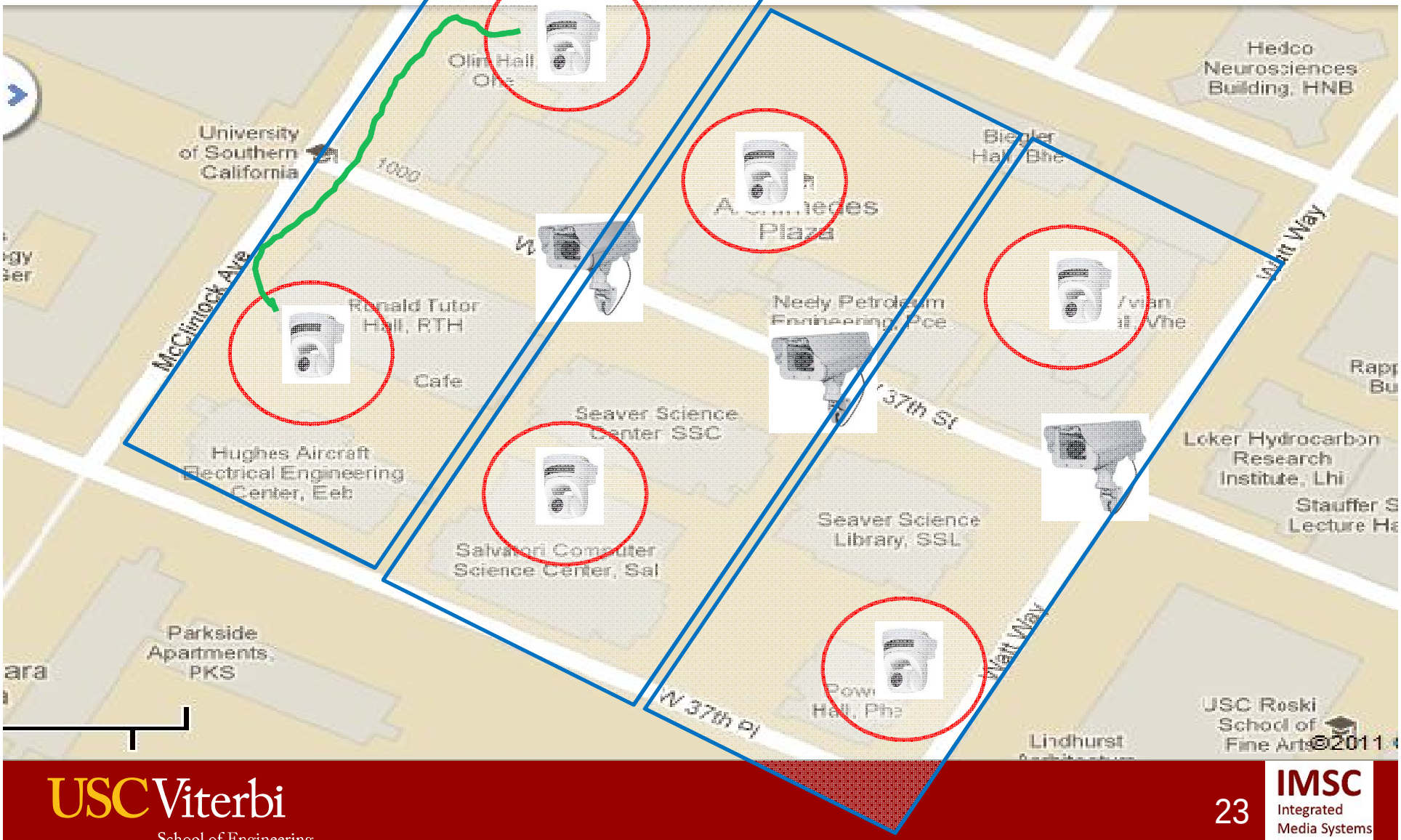
- Special-Purpose Prototypes
  - Prototype I: Contact Investigation
  - Prototype II: Understanding Geography of Diabetes
  - Prototype III: Point-of-Care Mobility Monitoring

i4H-Prototype I: Contact Investigation

- **Purpose:** Retrospective and Real-time Contact Investigation
- **Sponsor:** NIH?
- **Team:**
  - Contact Investigation: Dr. Brenda Jones (TB), Dr. Pia Pannaraj (Flu)
  - Tracking and Face Detection: Gerard Medioni
  - Spatiotemporal Contact Analysis: Farnoush Banaei-Kashani, Cyrus Shahabi




Step I: Data Collection



Step II: Reachability Analysis

Input

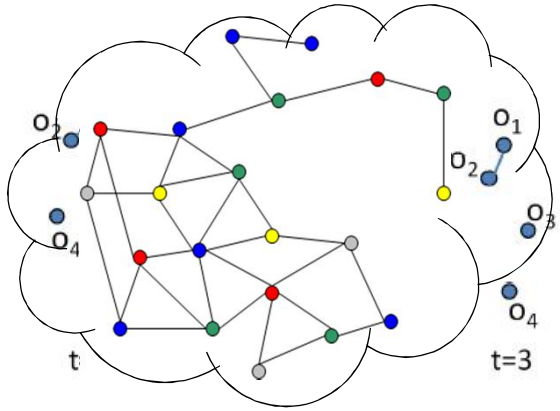
A graph G which is:

- Large scale (Huge number of edges and vertices)
- Temporal (Edges are added and deleted over time)
- Geospatial (Nodes are moving in space)

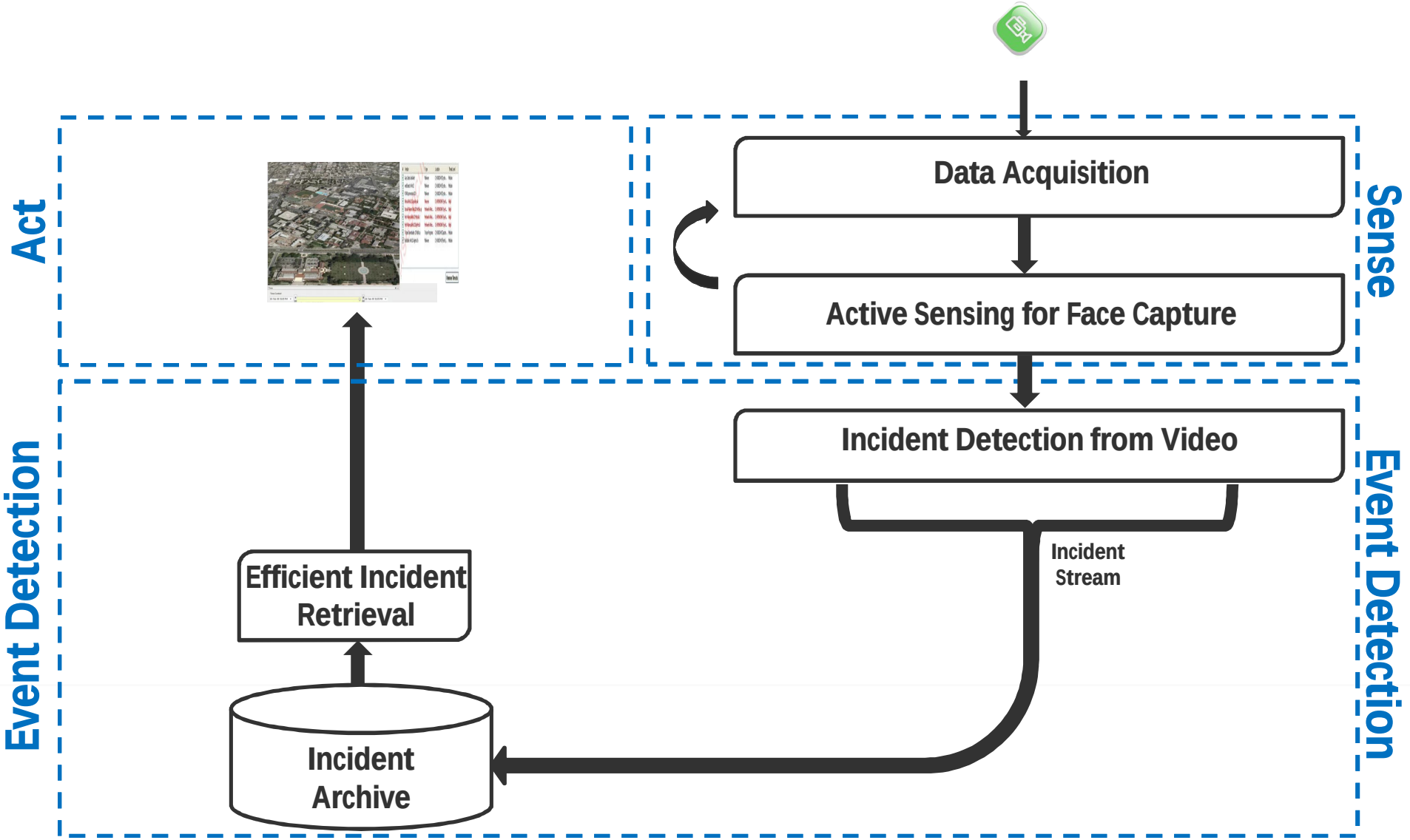
Queries

Within a time interval [a,b], find:

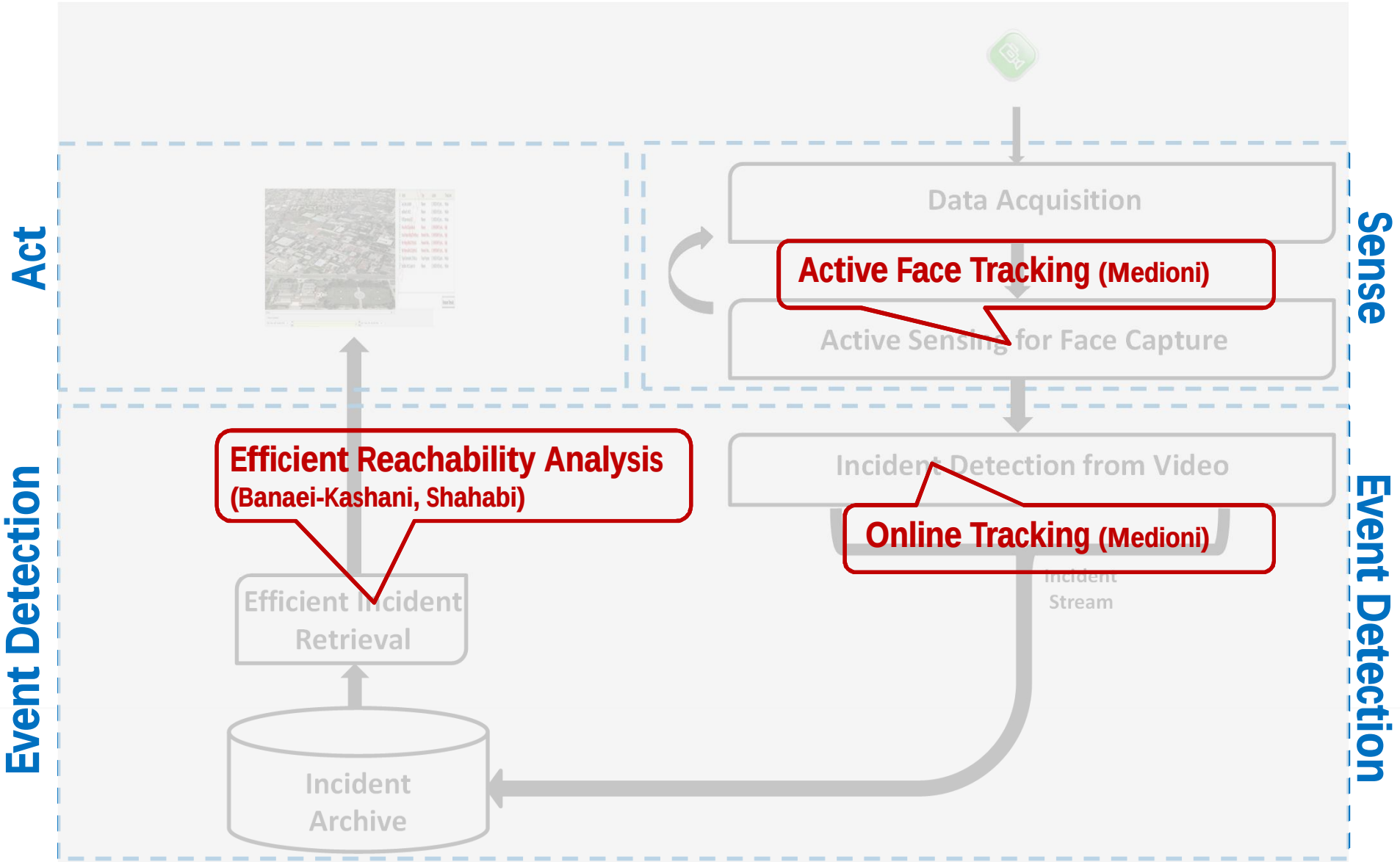
- Whether u is reachable from v?
- The individuals reachable from v?
- The individuals that can reach v?



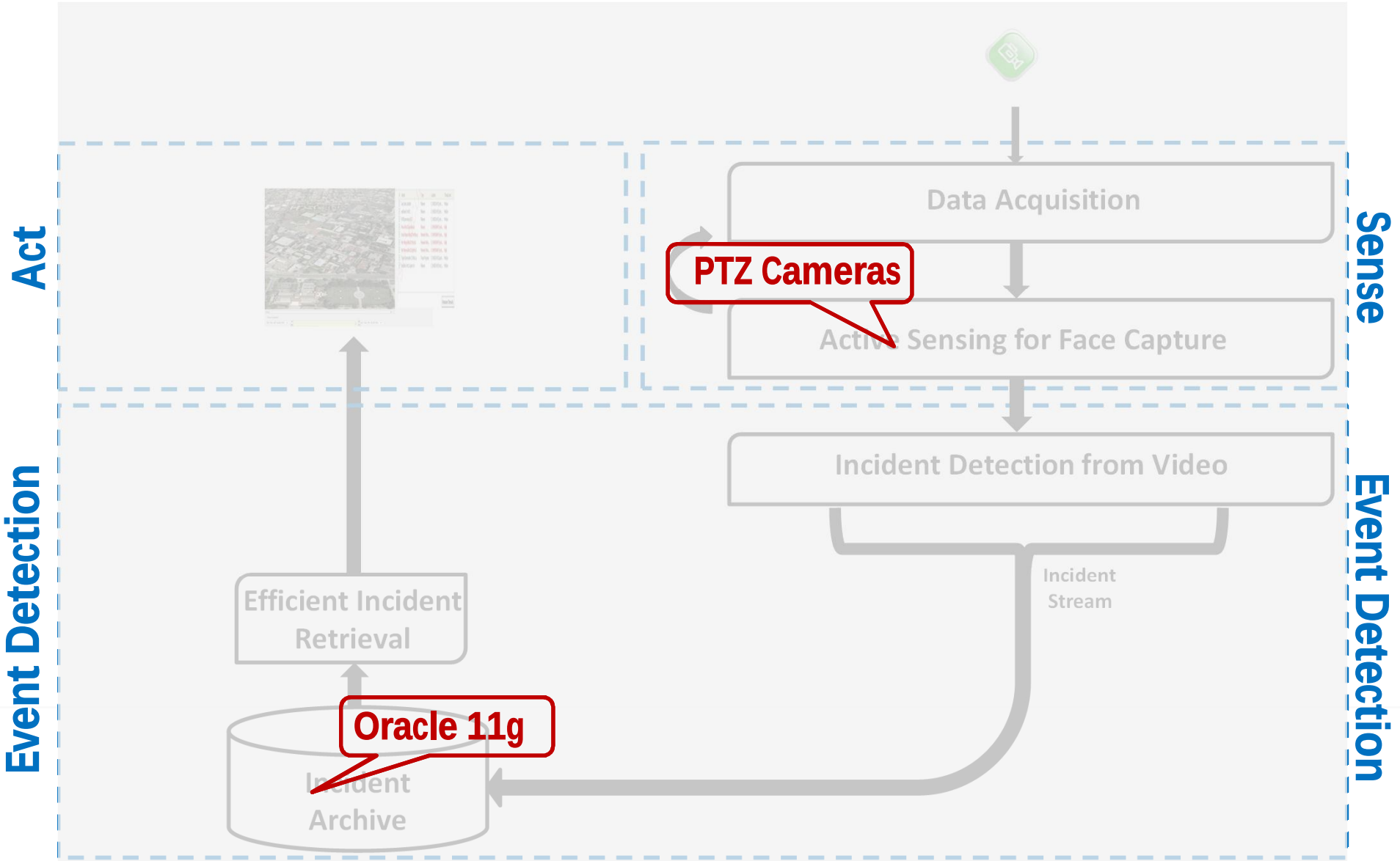
i4H-Prototype I: System Architecture



i4H-Prototype I: Research Showcase

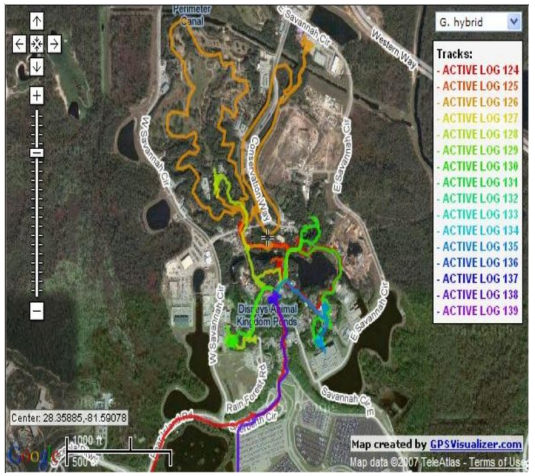


i4H-Prototype I: Technology Showcase



i4H-Prototype II: Understanding Geography of Diabetes

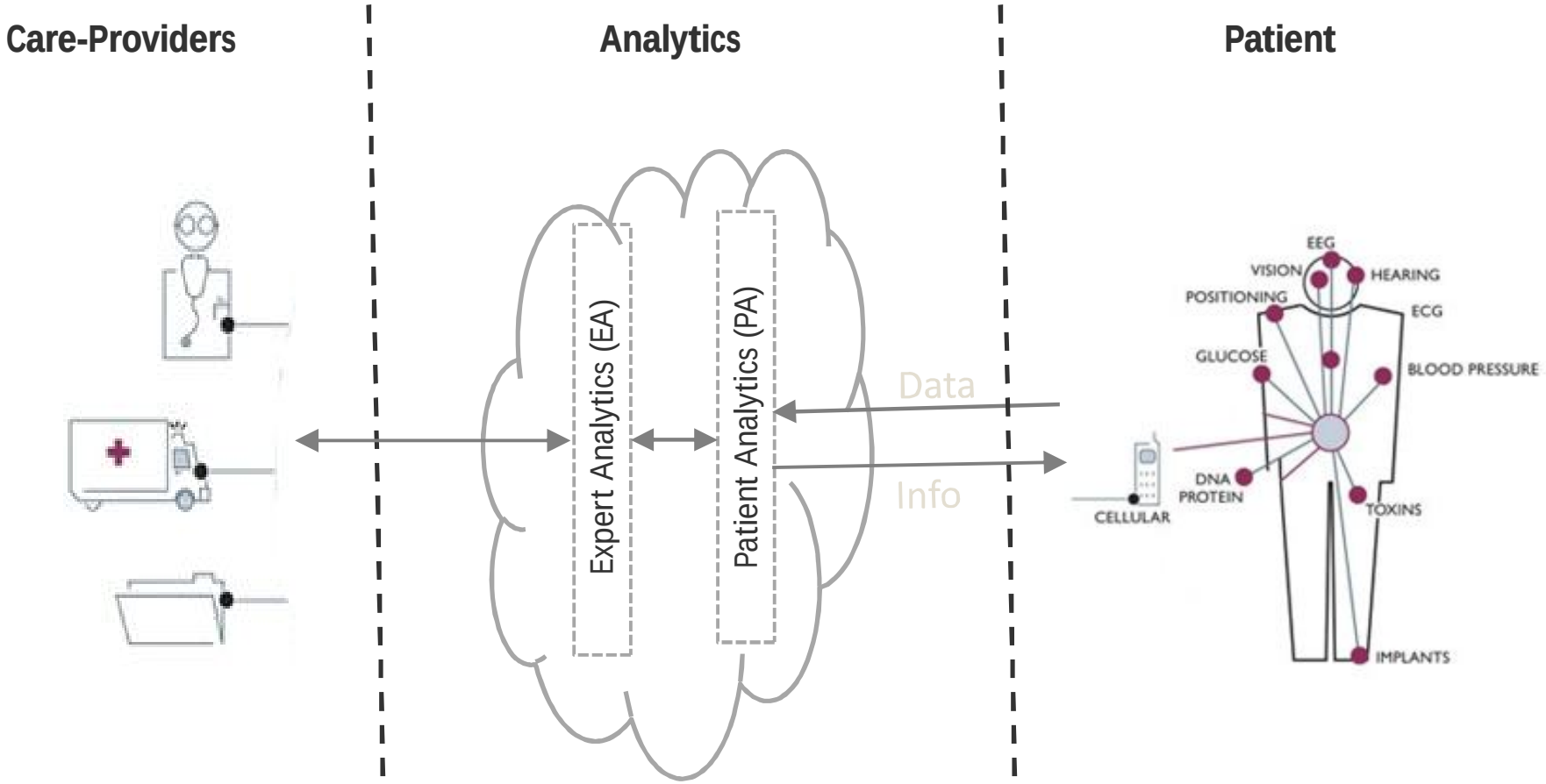
- **Purpose:** Spatial Analysis and Mining of Diabetes Patient Data to Understand Spatial Causative pathways, Processes, and Patterns
- **Sponsor:** Verizon?, Oracle?
- **Team:**
  - Diabetes: Dr. Andy Lee
  - Use-case and Market Analysis: Nathalie Gosset (AMI)
  - Body Area Sensor Network: Murali Annavaram
  - Spatial Data Analysis and Mining: Farnoush Banaei-Kashani, Cyrus Shahabi







Vision

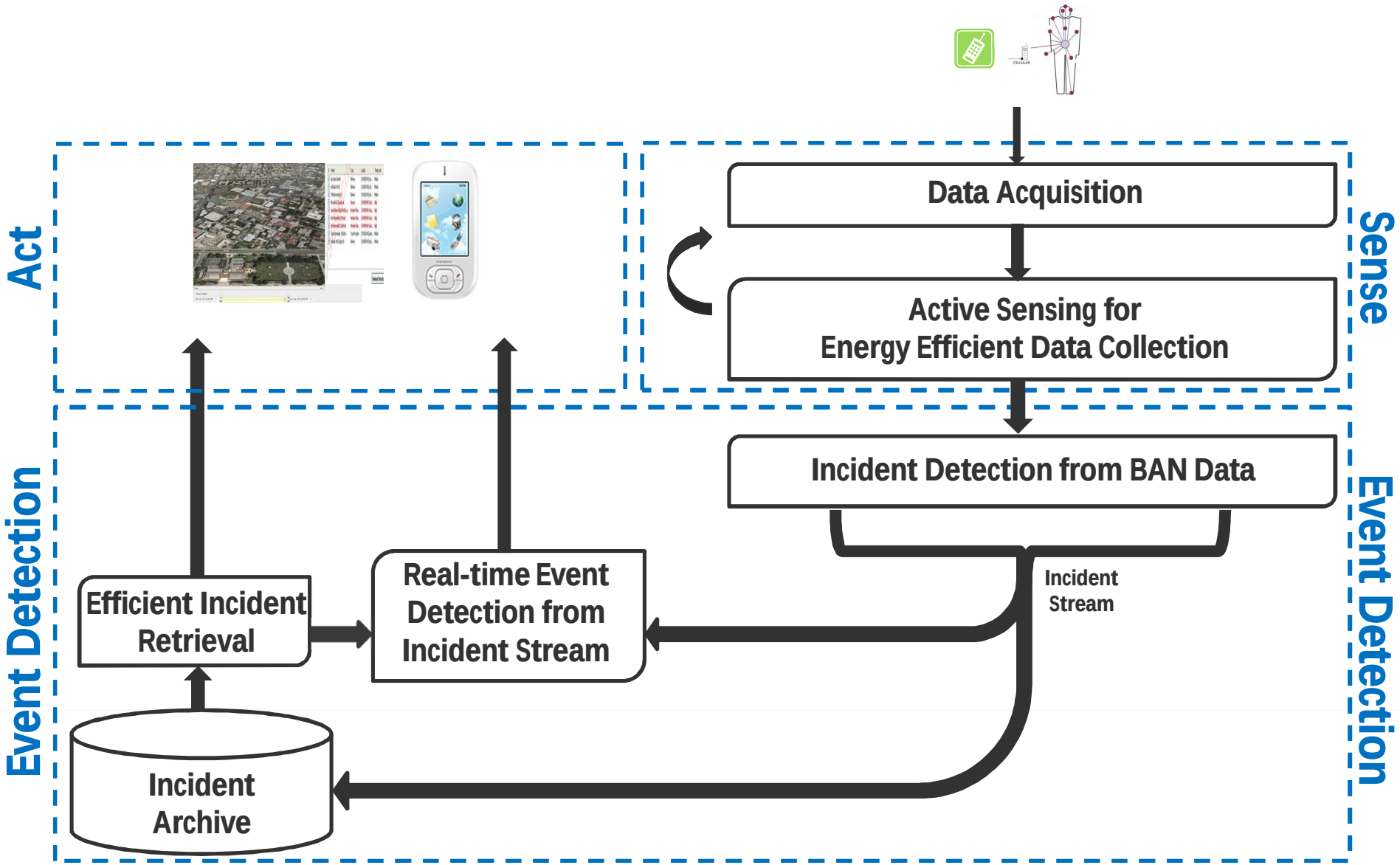

Care-Providers
Analytics
Patient
Expert Analytics (EA)
Patient Analytics (PA)
Data
Info
EEG
VISION
HEARING
POSITIONING
ECG
GLUCOSE
BLOOD PRESSURE
DNA
PROTEIN
CELLULAR
TOXINS
IMPLANTS

Analytics

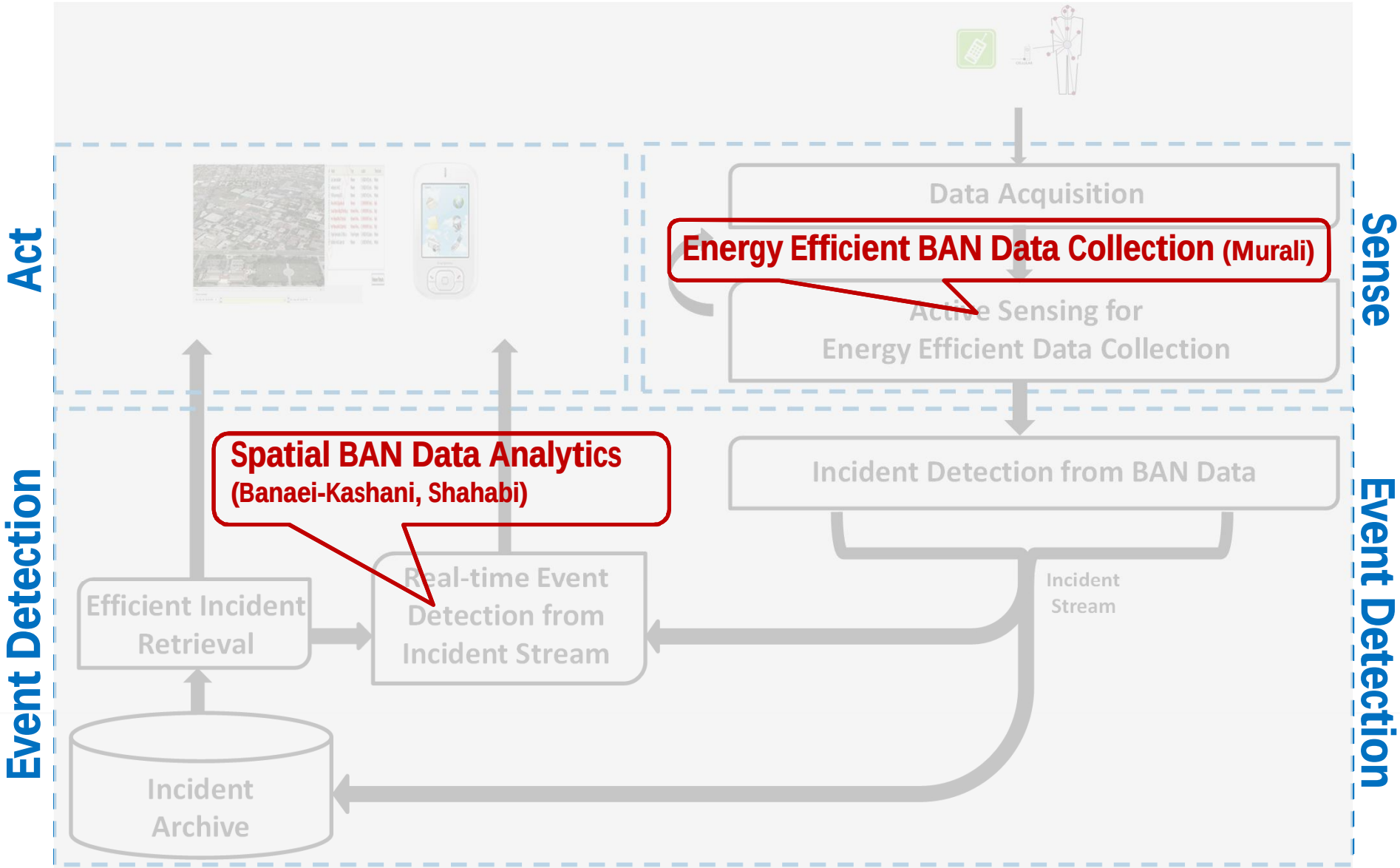
- Categories:
  - Patient Analytics vs. Expert Analytics
  - Trajectory Analytics vs. Spatial Analytics
  - Individual Analytics vs. Collective Analytics

- Exemplary Analytics:
  - Spatial outlier detection to distinguish “good signatures”
  - Spatial co-location rules to identify causative processes

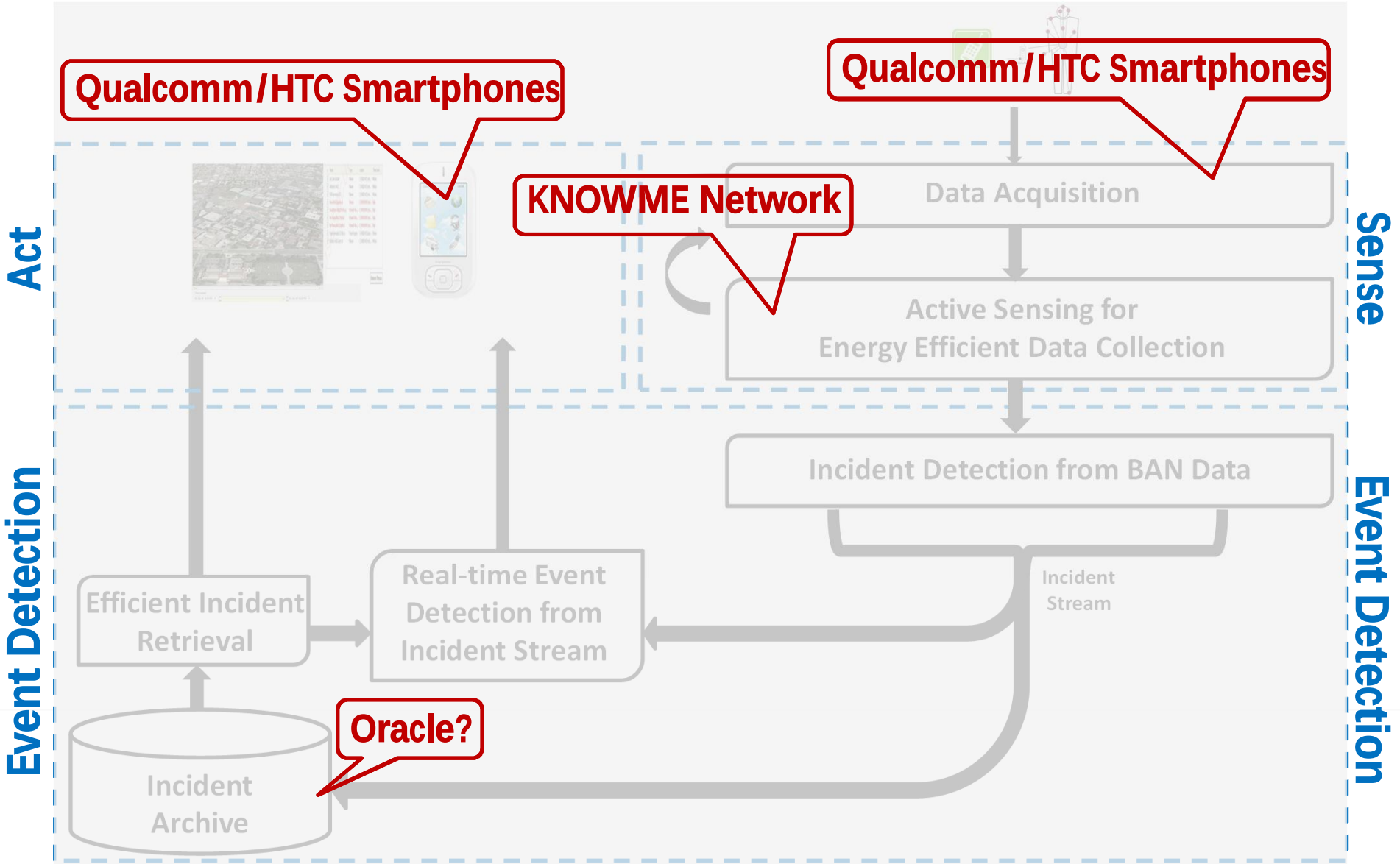
i4H-Prototype II: System Architecture



i4H-Prototype II: Research Showcase



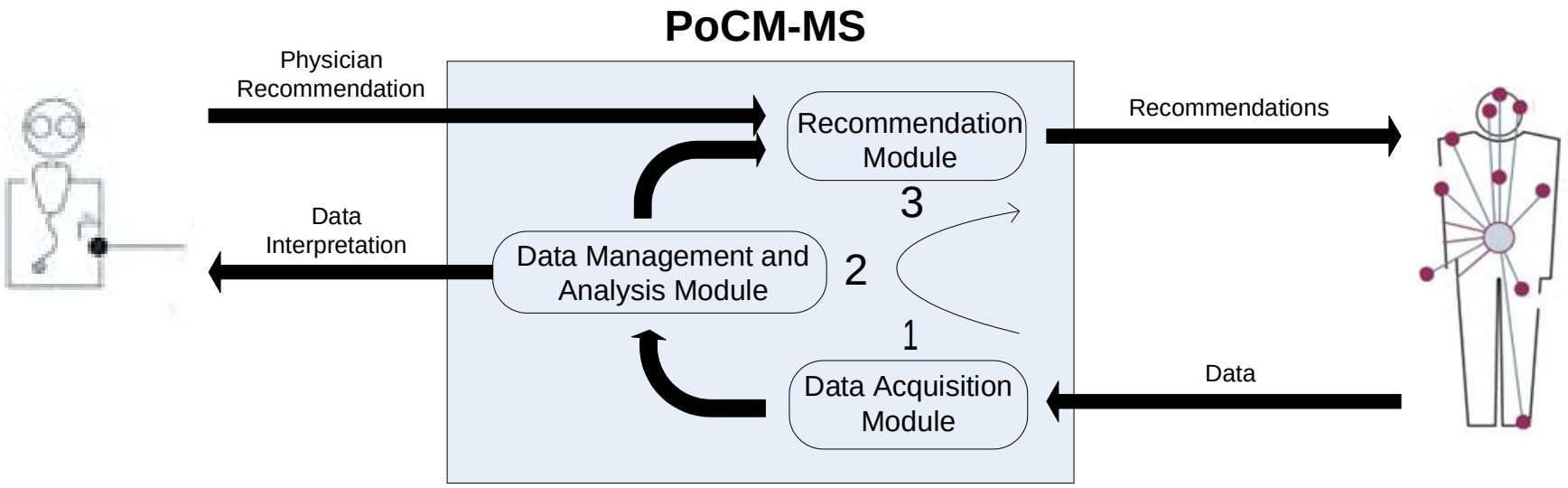
i4H-Prototype II: Technology Showcase



i4H-Prototype III: Point-of-Care Mobility Monitoring

- **Purpose:** Real-time Mobility Monitoring for 1) Rehabilitation of Stroke-induced Mobility Limitations, and 2) Optimization of Pharmacologic Interventions for Parkinson's Disease
- **Sponsor:** CTSI?, Oracle?
- **Team:**
  - Rehabilitation: Dr. Carolee Winstein et al.
  - Use-case and Market Analysis: Cesar Blanco (AMI)
  - Video Data Analysis: Gerard Medioni
  - Sensor Data Analytics: Farnoush Banaei-Kashani, Cyrus Shahabi

Vision


PoCM-MS
Physician Recommendation
Recommendation Module
Recommendations
3
Data Interpretation
Data Management and Analysis Module
2
1
Data Acquisition Module
Data

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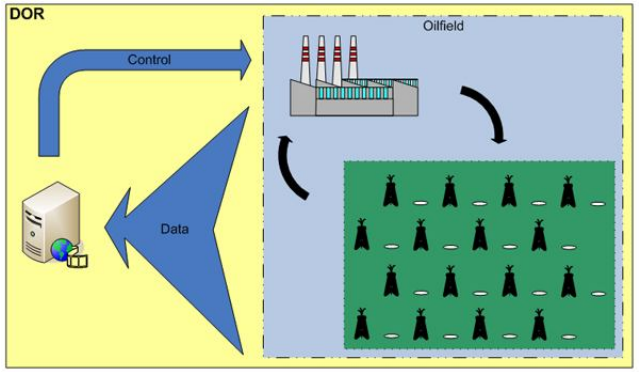
  - iWatch for Energy (i4E)

iWatch for Energy (i4E)

- **Purpose:** On-the-Fly Decision-Making based on Real-Time Stream Data to Enahnced Oil Recovery
- **Sponsor:** Chevron/CiSoft?
- **Team:**
  - Stream Data Analytics: Farnoush Banaei-Kashani, Cyrus Shahabi



Vision

1. **With GPS data from all moving objects** in the field (vehicles, field workers, and perhaps robots that are monitoring and operating the field, etc.)
   - A Safety Application: Fire Announcement
   - Work order optimization application
   - A Security application: GeoFence

2. **With sensor data from all wells** in the field (e.g., production/injection rate detectors, bottom hole pressure and temperature readers, smoke and hazard detectors, vibration detectors)
   - Waterflood monitoring and optimization (WMO) application
   - A Safety and incident detection application: Fire Detection

3. **With sensor data from the equipment** in the field (RFID readers, vibration detectors, status sensors)
   - Inventory application
   - A Facility management application as well as safety application: Failure Detection

Q & A