2016 Public Safety Broadband Stakeholder Meeting

Day 3

#PSCR2016

SNAPSHOT: In-Building Coverage Measurements
Practical Techniques for Public Safety

Bob Johnk, Joe Parks, Chris Dennis, Jason Kahn, Alison Kahn, Sanjeev Sharma

PSCR

First we studied impacts to indoor coverage in various network deployment scenarios (macro, small-cell, DAS)

Then we asked ourselves…

How can we help Public Safety?

PSCR

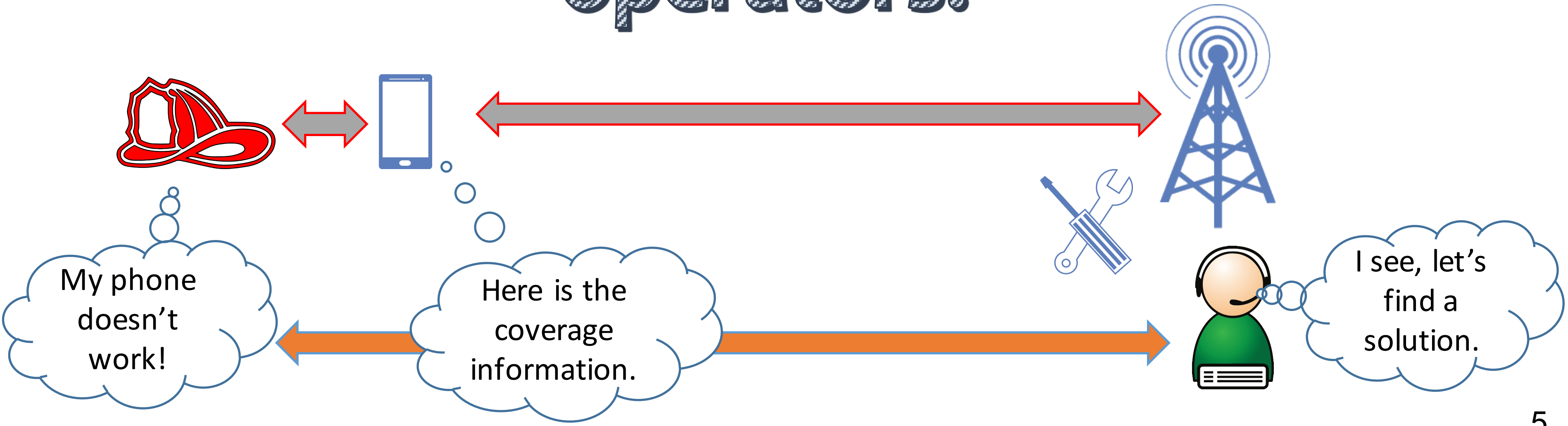
Communicating coverage issues is difficult

The User <u>experiences</u> the Network.

The Operator <u>measures</u> the Network.

So we narrowed our focus…

How can we help Public Safety discuss coverage issues with operators?



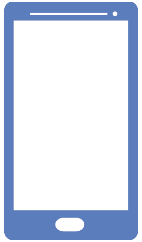
Our Hypothesis

With a simple scoring system, a device's radio may be used to reliably measure and relate coverage conditions to the NPSBN operator.

PSCR

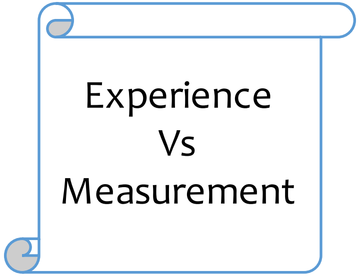
Our Approach

1. Data Access



2. Reference System

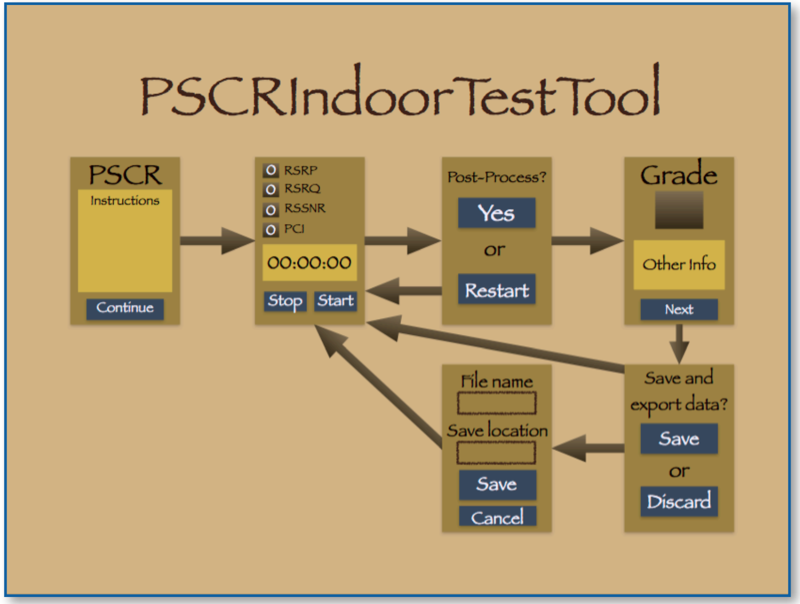
3. Scoring Method



4. Test Hypothesis

1. Can we develop a conceptual app and access the vital measurement data in the device?
2. Can we confirm the measurements are trustworthy?
3. Can we develop a simple yet accurate scoring methodology?
4. Can we report reliable coverage information to an operator?

1. Accessing the Data



Some of the Challenges we faced:

- Operating System (OS) Reference Signal Received Power (RSRP) reporting nuances
  - 1dB increments
  - Data smoothing/averaging increases the reporting interval
- Device to Device variance
  - antenna design, receiver architectures, and signal processing

We needed an app to access the data, this was a fun challenge.

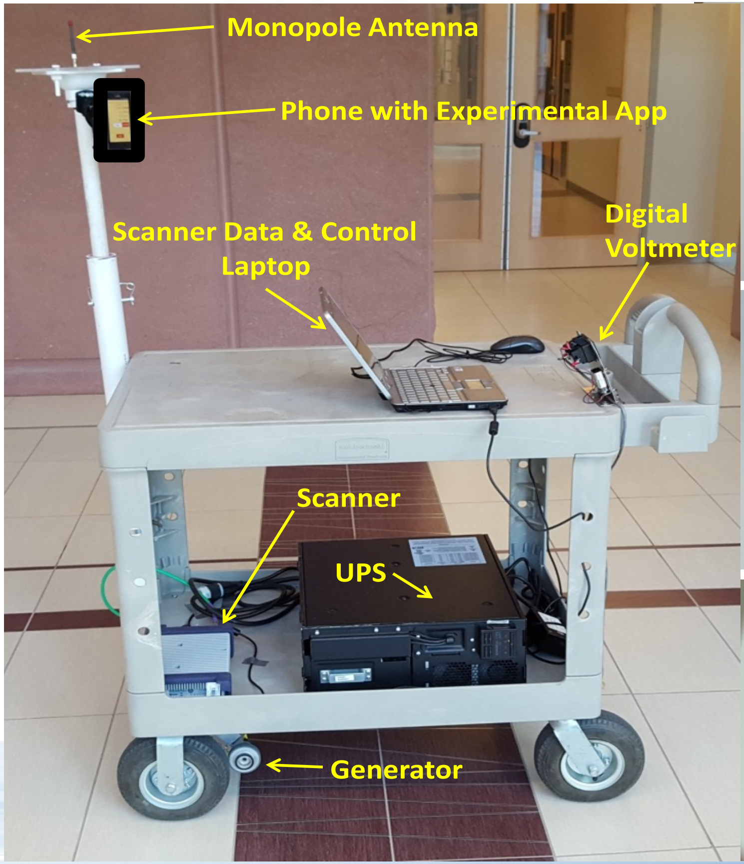
2. Reference Measurement System

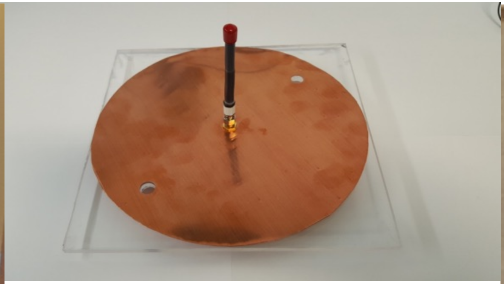
Our System Consisted of:

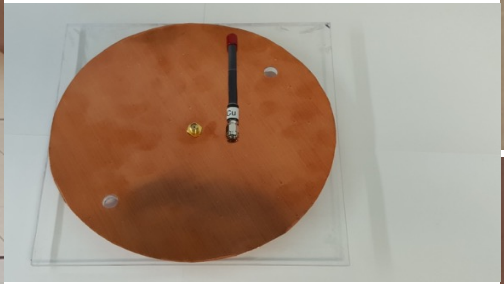
- Precision LTE channel analyzer
- Calculable monopole antenna
- High-quality interconnecting cables with losses characterized
- Dielectric cart to minimize reflections
- Measurement capability to ensure constant cart speed
- Dielectric mount that permits stable & variable positioning of phone
- UPS power supply

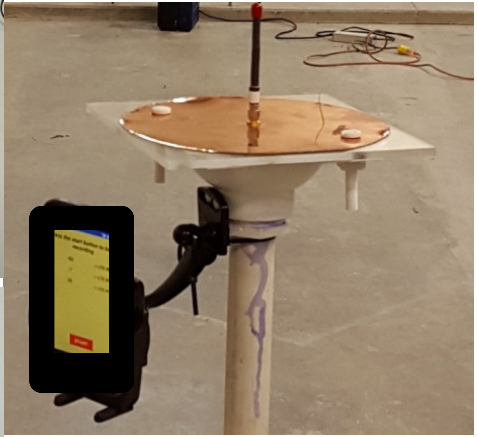
We needed a way to verify our device measurements were "trustworthy".

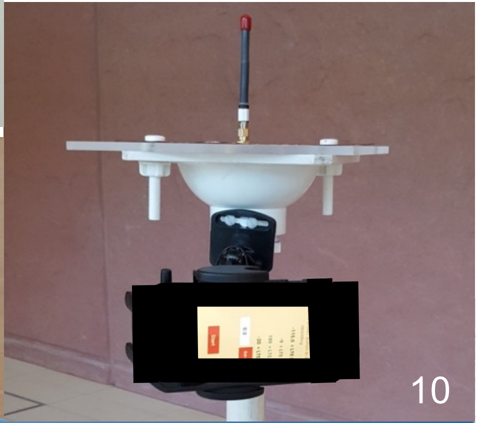
Reference Cart Details



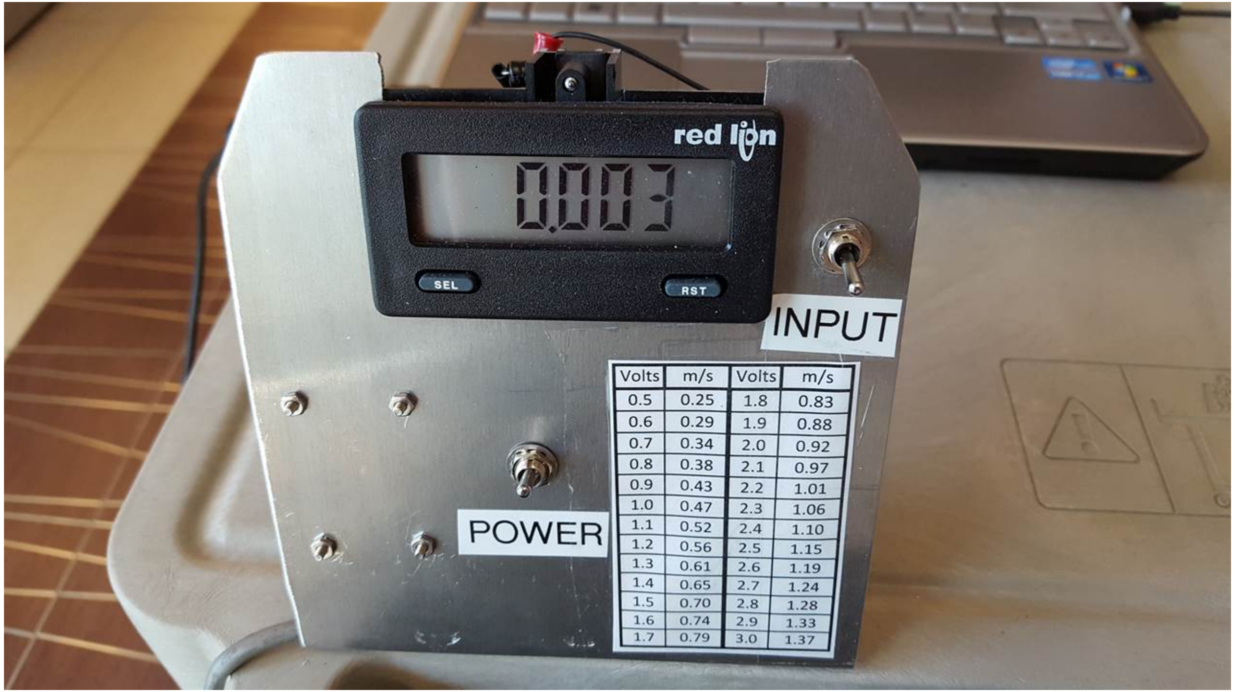








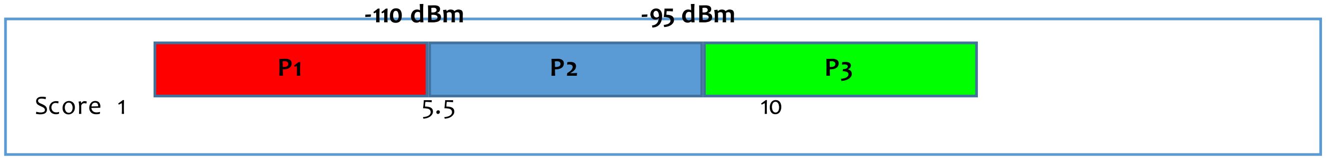
Cart in Action & Maintaining Constant Speed



3. A simple scoring system

Conceptual Requirements:

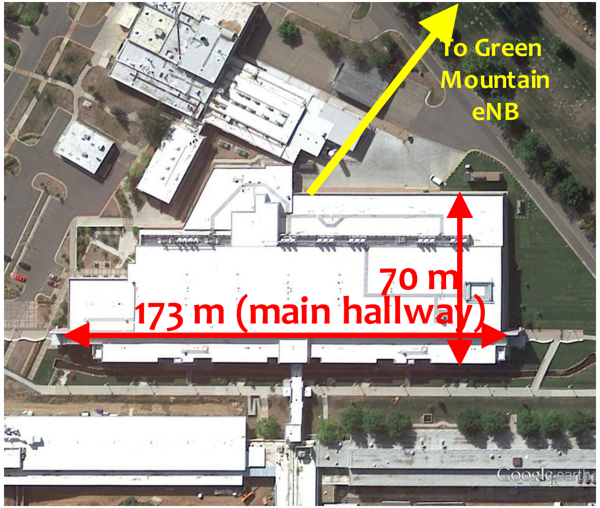
- We started with RSRP—meaningful & less complexity
- Device should record measurements over a coverage zone (i.e. by room, by floor, by area)
- Measurement should be sensitive enough to detect small variances
- Measurements should be binned, normalized and weighted on a scale of 1-10



- Note: We are still validating the efficacy of this method of scoring.

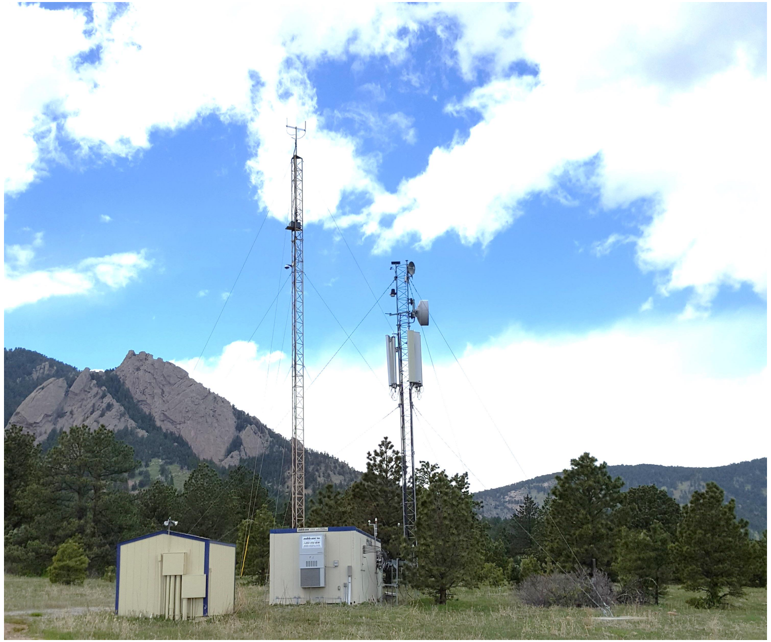
We needed scoring method that could close the gap between experience and measurement.

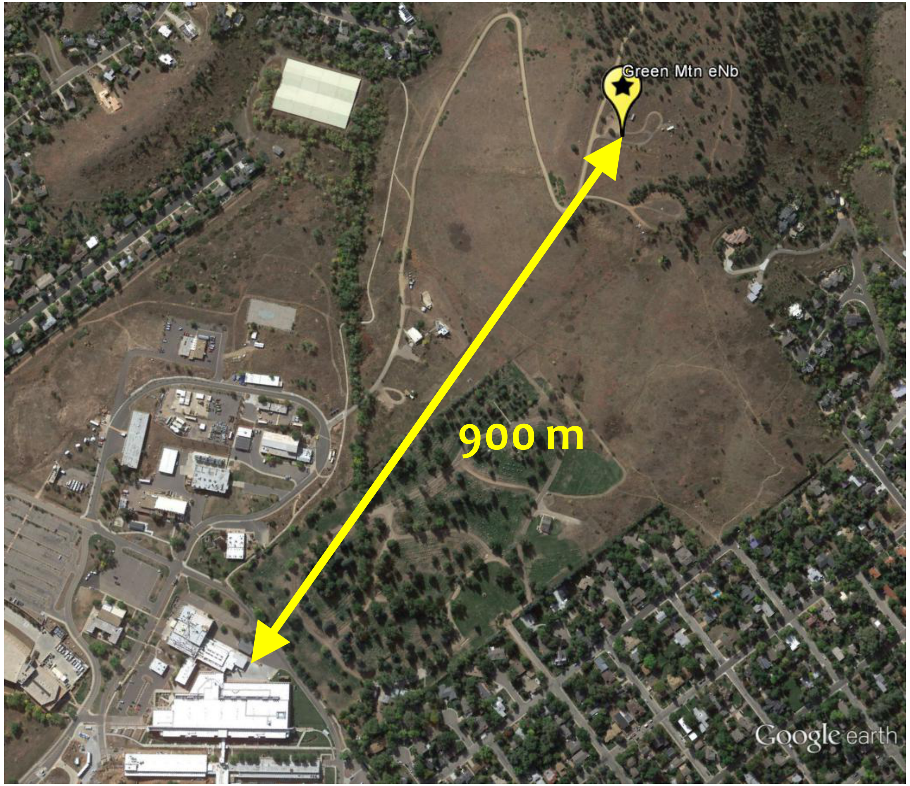
4. Test Hypothesis in well known location



- NIST PML Lab Building
  - Indoor/Outdoor coverage measurements
  - Near PSCR's Green Mountain Evolved Node B (eNB)
  - Modern construction (circa 2012)
  - Concrete and low-E glass
  - 283,000 square feet
- Large area & wide signal variations—strong to very weak
- Stable measurement environment & lots of measurement possibilities

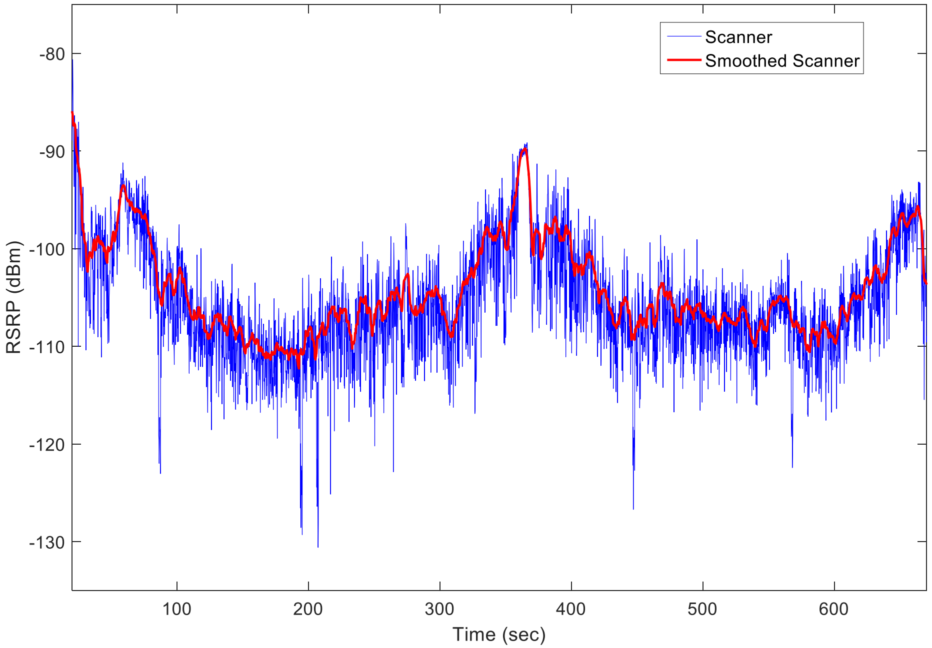
Green Mountain eNB to PML Path

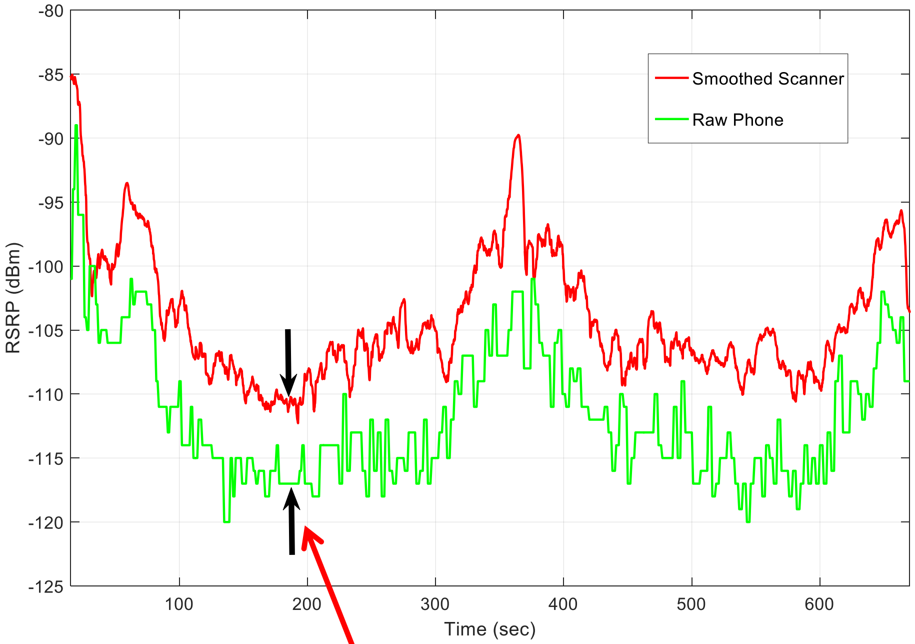




PML Main Hallway

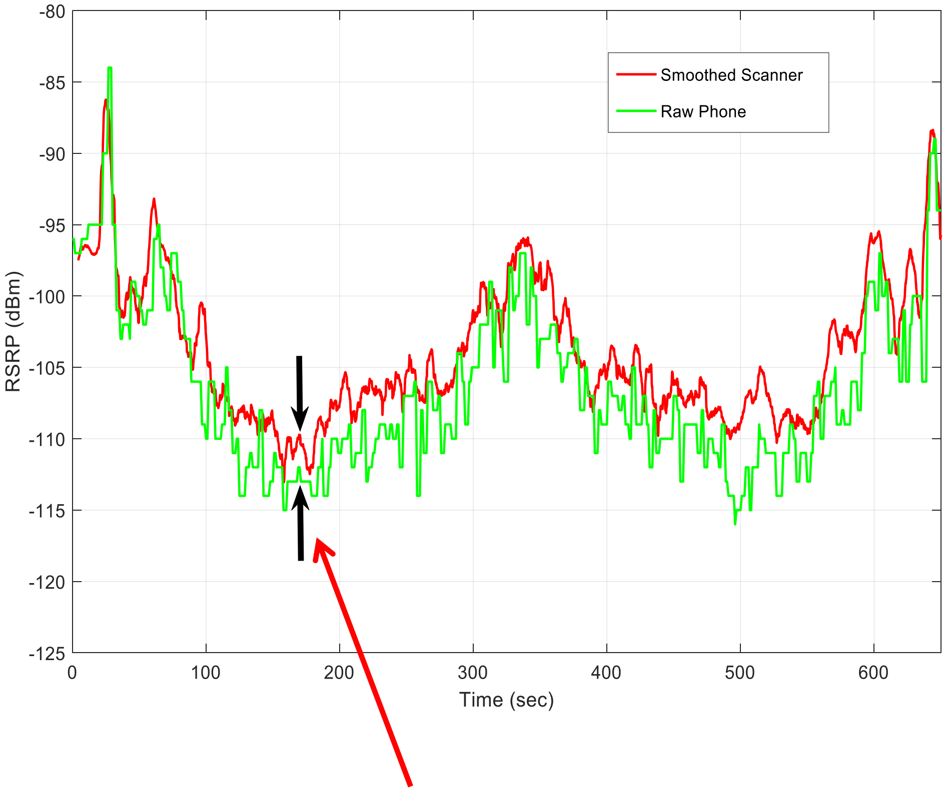
Initial Results – Phone and Reference





Note the offset – Needs investigation

Results for Another Device…

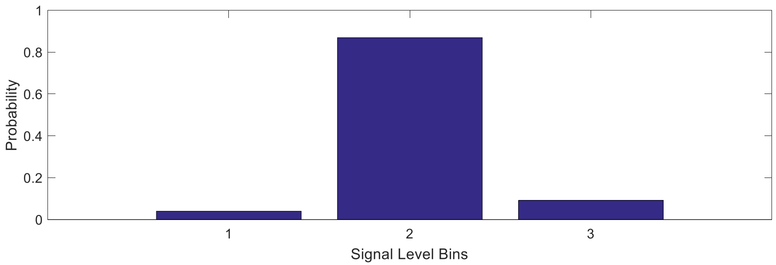


Note the decreased offset – Also needs investigation

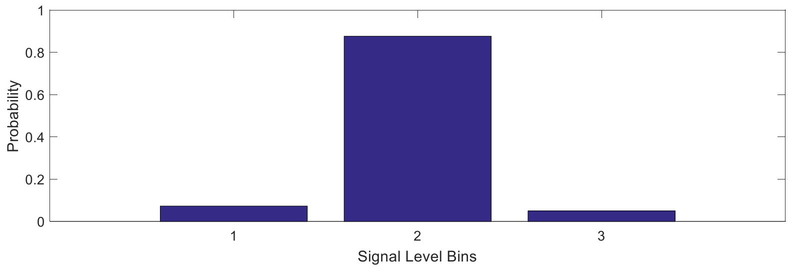
Impact of Offsets on Binning

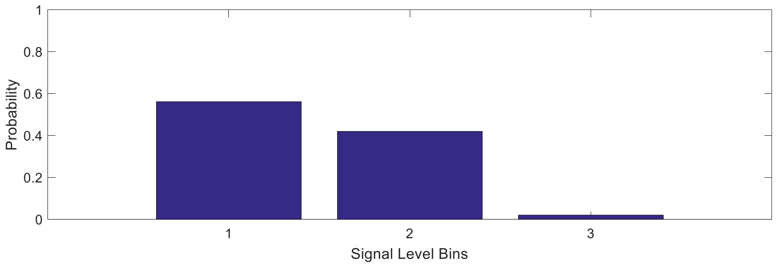
Measurements Day 1

Measurements Day 2



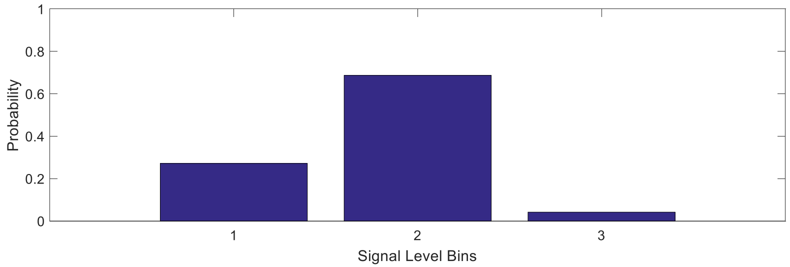
Scanner



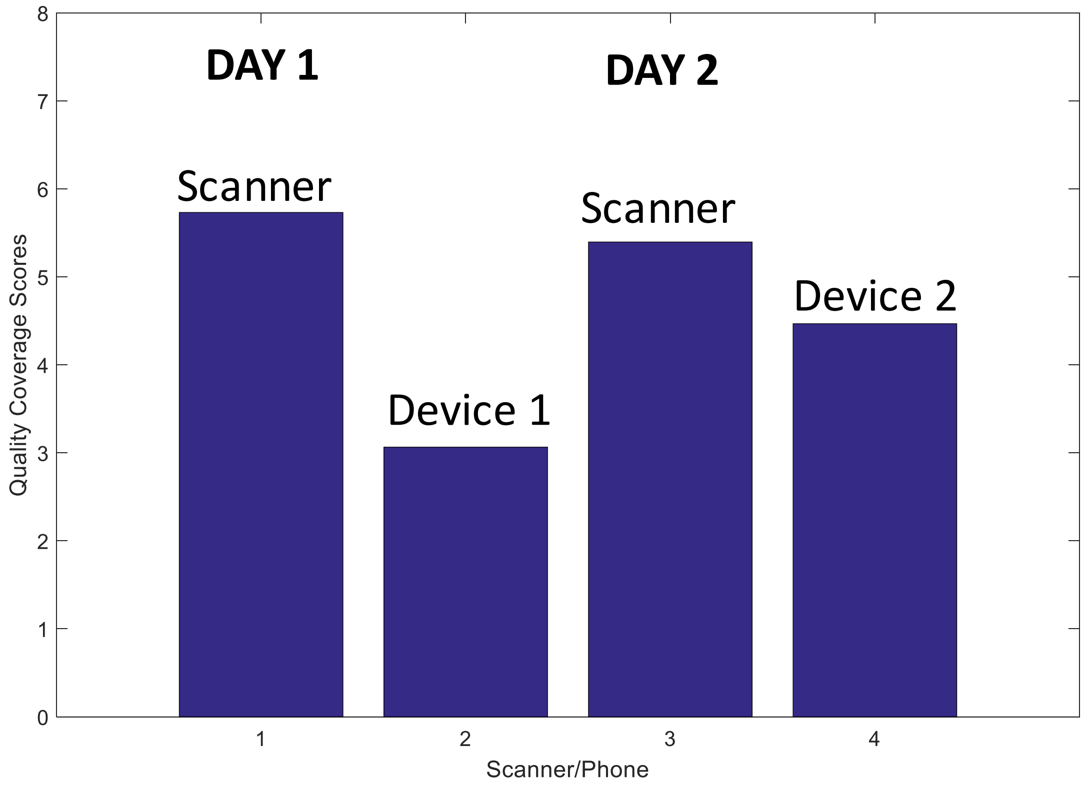


Device 1

Device 2



Scoring-Impact of Device Characteristics



Comments on Work So Far…

- For the indoor environment of the PML, we can harmonize scoring with phones & a reference measurement system using a constant correction factor—results are very preliminary but look promising
- We also saw that our scoring system can detect small changes—e. g. influence of monopole antenna, orientation of device, holding the device
- Looks promising in tests conducted so far, but we have a lot of work to do—more testing environments!
- We will need to specify test procedures to Public Safety if this pans out
- Interesting work with some surprises…

Acknowledgements

- We thank the Department of Homeland Security Office for Interoperability and Compatibility (DHS-OIC) for their funding and generous support of this project
- Our Team--Joe Parks, Chris Dennis, Jason Kahn, Alison Kahn, Sanjeev Sharma
- Dereck Orr, Tracy McElvaney, & Andy Thiessen—for their vision
- Lab Ops Team of PSCR-Ellen Ryan, Lisa Soucy, & Roger Blalock—for their excellent support & facilitating this effort
- Steve Voran for some great insights and conversations on scoring measured results

User Interface Roadmapping for Public Safety

Mobilizing the Future from Interface to Experience

Mary Theofanos (NIST)

PSCR

User Interfaces are critical to PSCR success

To make the right decisions First Responders require the:

1. Right information
2. At the Right time
3. Delivered in the Right way

The human interface is as "fundamental as any hardware, processor configuration, operating system or programming environment" (Anonymous).

Consequences of a poor user interface

A holistic approach is required

The Public Safety Community is not monolithic

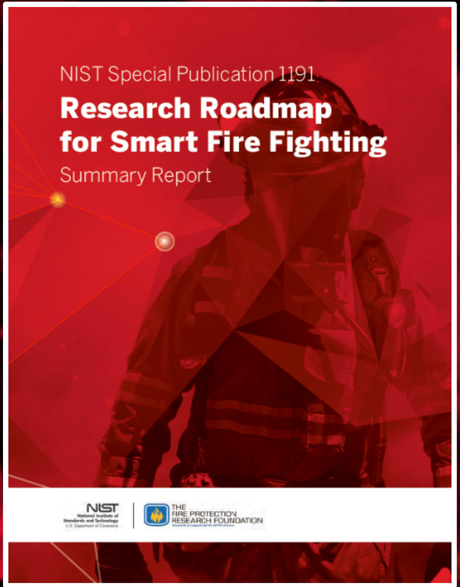
The panel represents a diverse and broad cross section of perspectives:

1. Ray Bizal represents the front line, the user community
2. Brad Fain represents the promise of new technologies contributing to the solutions, the research academic community
3. Lexie Spiro represents the existing technology spectrum, the vendor community
4. Brian Stanton represents testing and evaluation, the standards community

RESEARCH FOUNDATION

RESEARCH FOR THE NFPA MISSION

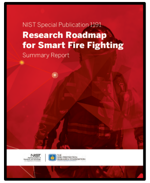
User Interface / User Experience of Smart Fire Fighting



"Mobilizing the Future from Interface to Experience"

PSCR Stakeholder Meeting

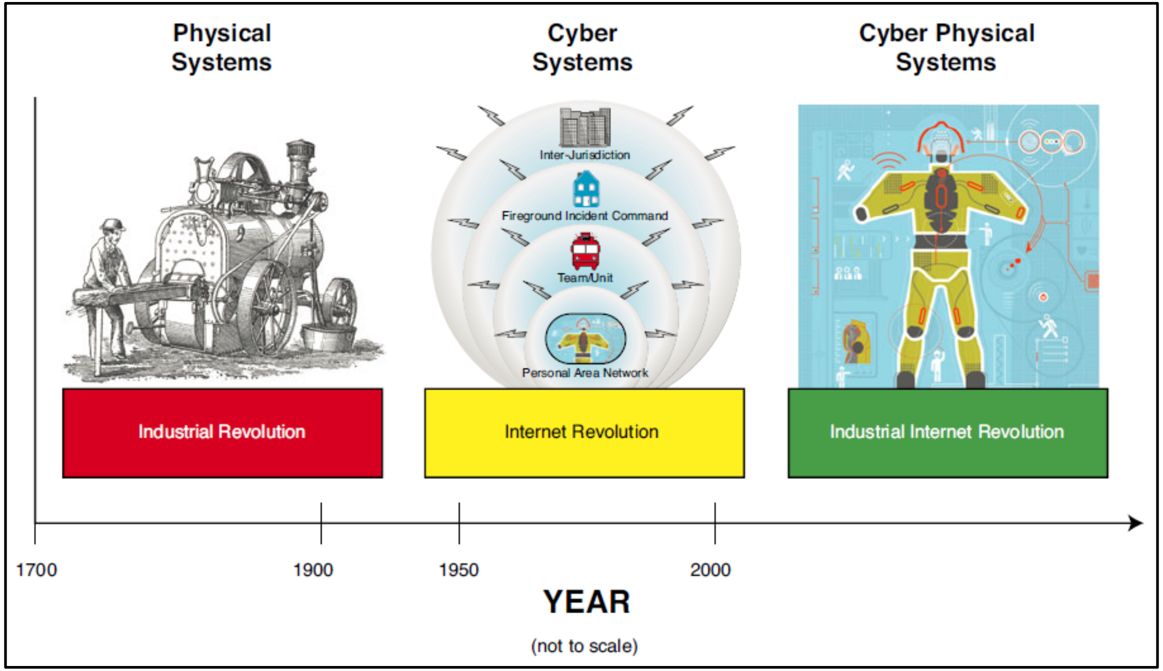
7-9 June 2016 | Ray Bizal, NFPA San Diego, California



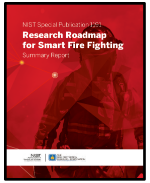
Understanding the Basics

CPS: Cyber Physical Systems

Historical Perspective



Understanding the Basics



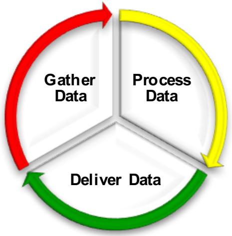
Key Concepts

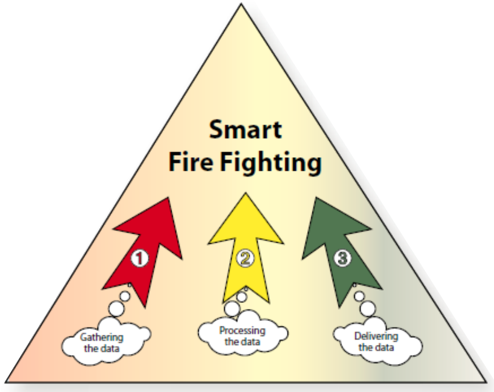
SMART : Specific, Measurable, Attainable, Relevant and Timely

CPS : *Cyber Physical Systems*

- World of Cyber Physical Systems composed of three basic areas:

~~1) Gathering of Data (Communication)~~
~~2) Processing of Data (Computation)~~
~~3) Use of Data (Targeted Decision Making)~~



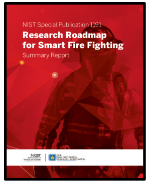


Focus Here: "CPS- Smart"

- Not to be confused with other efforts to introduce scientific approaches

RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION

Understanding the Basics



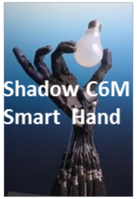
Emerging Technologies & Fire Fighting

Augmented reality

Augmented reality

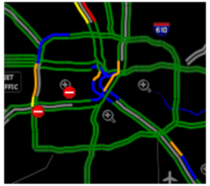
Smartphone Apps

Smart Clothing



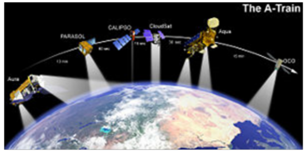
Robotics

Autonomous vehicles



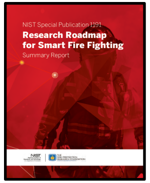
Real-time data from distributed sources

Fully interoperable equipment



Satellite information

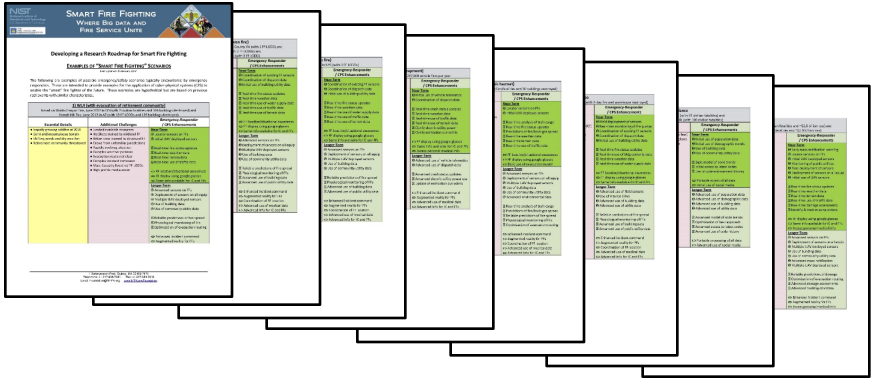
UAV (Drones)



CPS Smart Fire Fighting Scenarios

Ten Basic Fire Fighting Scenarios for CPS Applications

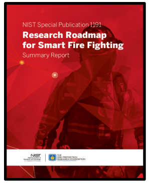
1) WUI
2) Residential Fire
3) Hi-Rise Fire
4) Vehicle Extrication
5) Train Derailment (HazMat)
6) Hi-Challenge Warehouse
7) Illegal Nightclub
8) Tornado
9) EMS (Mass Casualty Event)
10) Elevator Rescue



- Hypothetical challenging scenarios
- Intent to inspire and promote insight
- Loosely based on real events

RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION

CPS and the Internet of Everything

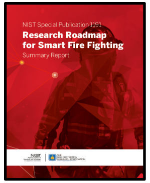


SMART PHYSIOLOGICAL MONITORING

Fitbit Force: Fitness tracker

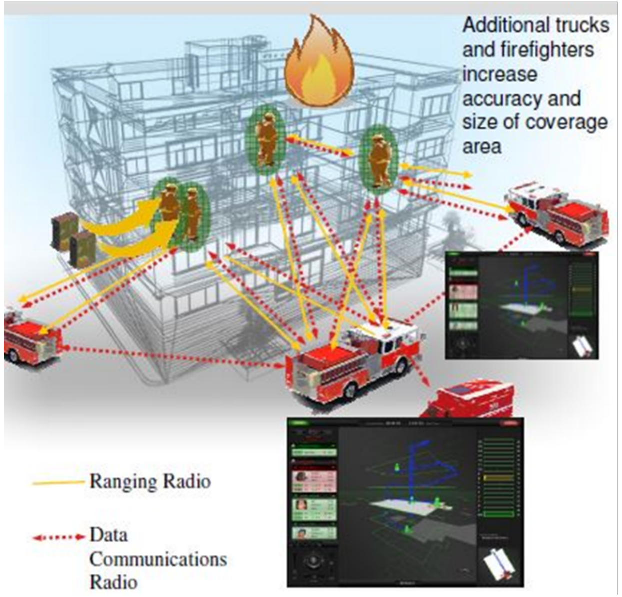
PHASER:
Physiological Health Assessment System for Emergency Responders

- DHS initiative
- Focus: Reducing cardiovascular risk
- Big Question: How to implement the technology?



CPS and the Internet of Everything

Smart Location/Tracking

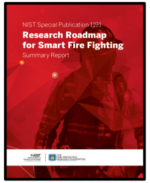


GLANSER:
A Scalable Emergency Responder Locator System

- DHS initiative, with partners
- Key challenge: accuracy within buildings

Estimote: Connect your environment with iBeacons

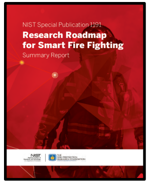
CPS and the Internet of Everything



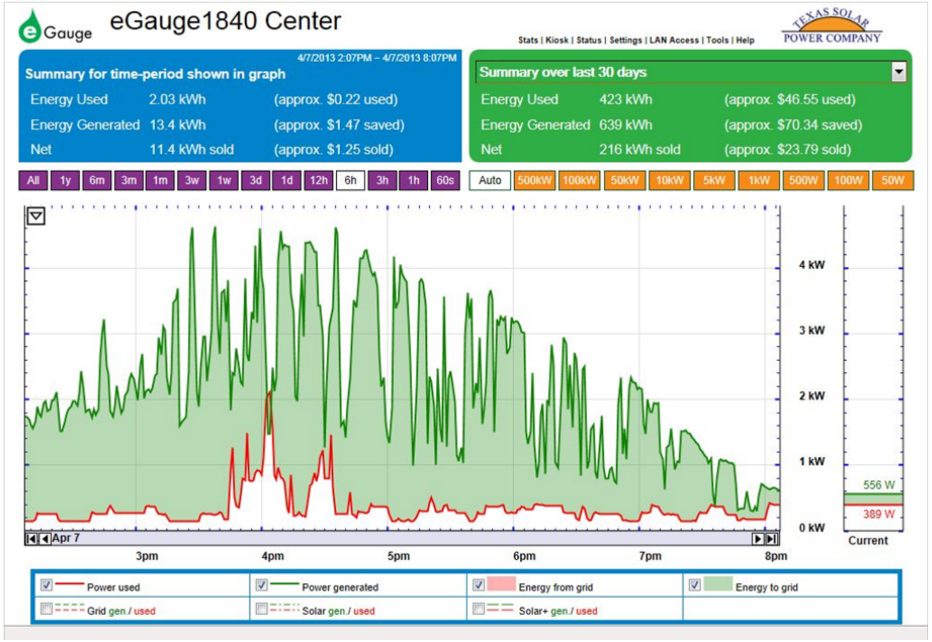
Smart Buildings

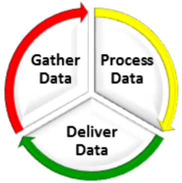
Integration of Building Systems
and Intelligent Buildings of the Future

CPS and the Internet of Everything

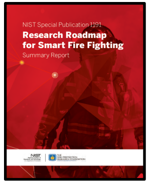


SMART ELECTRIC POWER SUPPLY





CPS and the Internet of Everything

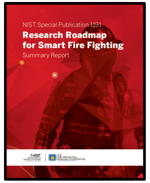


WHAT DATA IS OF INTEREST TO THE FIRE SERVICE?

EVERYTHING!

FOR EMERGENCY RESPONDERS, ALL DATA HAS VALUE. VIRTUALLY NOTHING IS EXCLUDED!

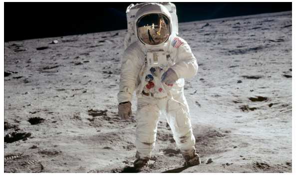
Data: The New Commodity



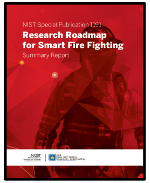
Data is the New Oil?

dunnhumby
essential customer genius

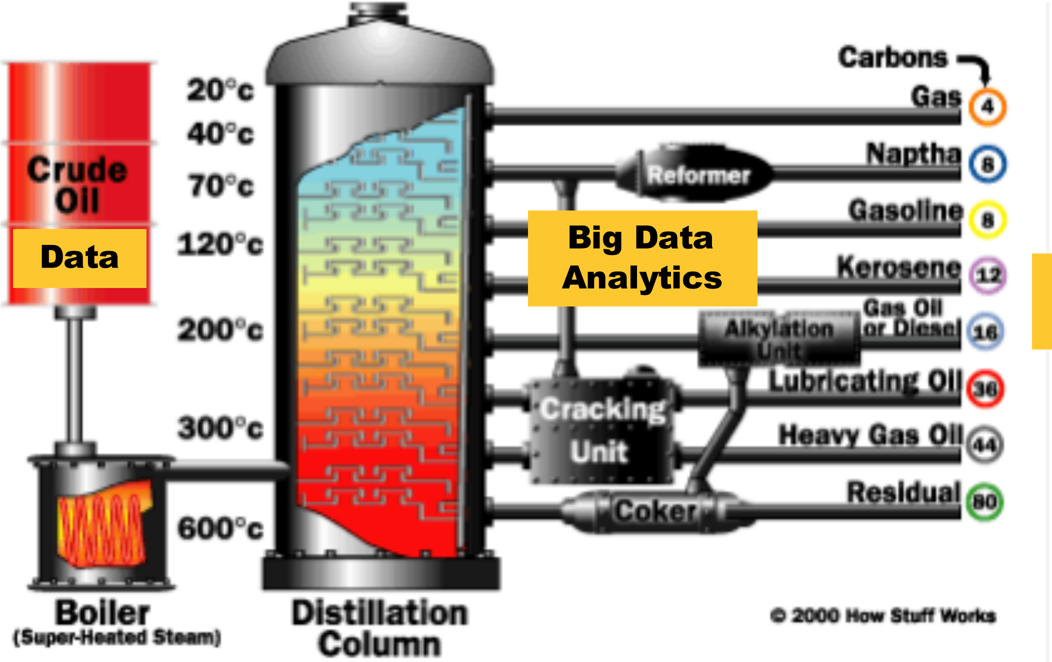
"Data Is The New Oil.
Data Is Just Like Crude.
It's Valuable, But If Unrefined
It Cannot Really Be Used."



Data: The New Commodity



How is Crude Oil Refined?



Data

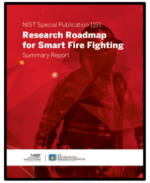
Big Data Analytics

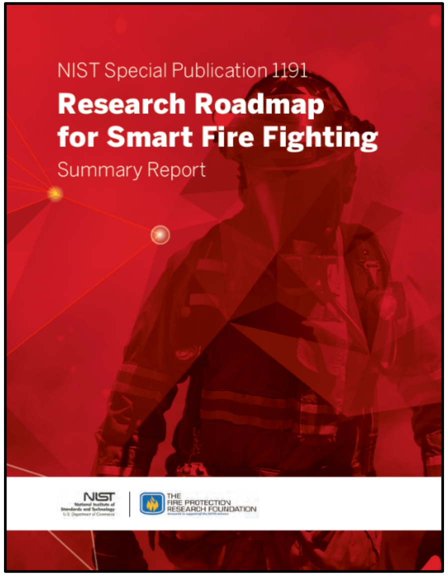
Insights & Solutions

Data Pre-Processing

Data Integration

The Research Roadmap for Smart FF



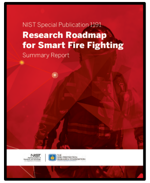


Project Report available on the Foundation website

www.nfpa.org/SmartFireFighting

NFPA RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION

The Research Roadmap for Smart FF

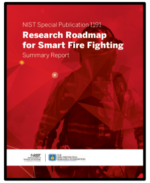


Project Scope:

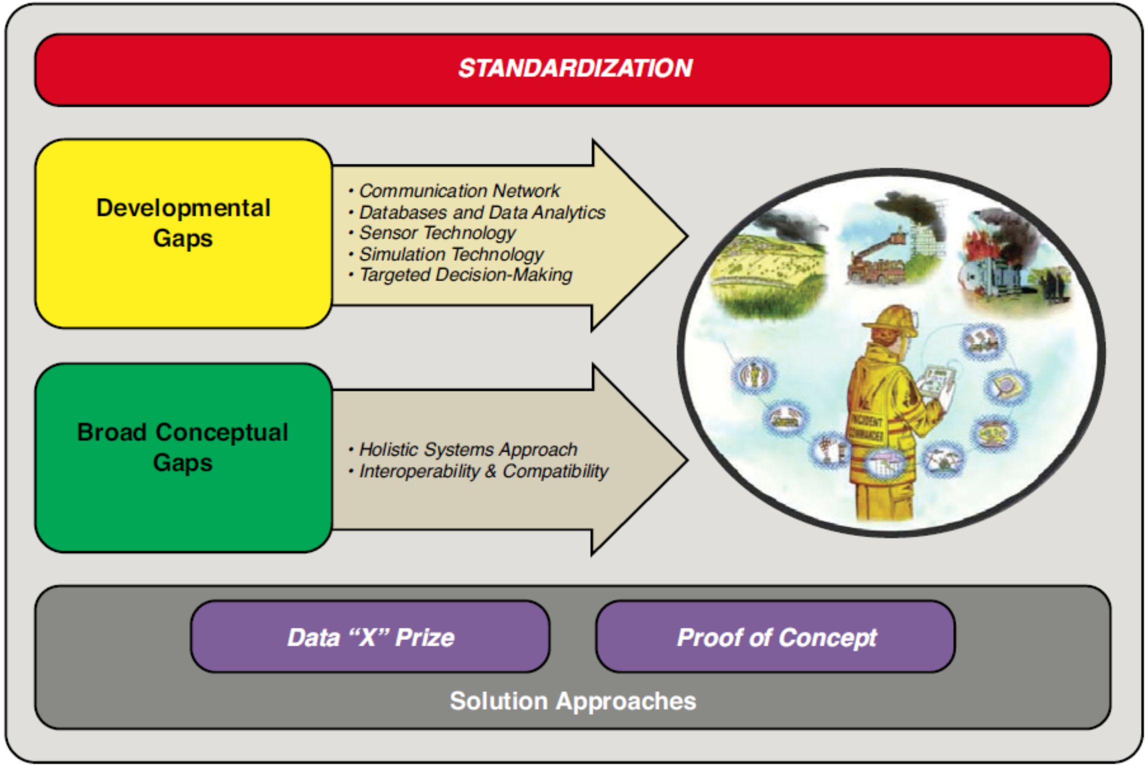
- All Activities Handled by the Fire Service
- All Fire Service Tasks
  - i.e., Consistent with NFPA Pro-Qual Standards
- All Types of Events
  - Structural, Wildland, Special Ops, etc.
- All Stages of Events
  - Pre-Event, During Event, Post-Event, etc.

Project funded by
National Institute of Standards and Technology
NIST

The Research Roadmap for Smart FF

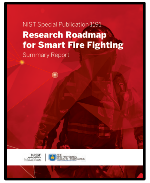


[Research Priorities for CPS Smart Fire Fighting]



RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION

Next Steps and Future Directions

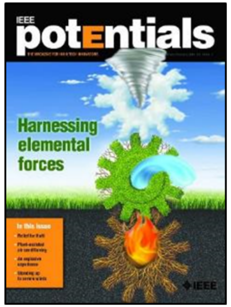


Examples of targeted outreach relating to CPS-Smart Fire Fighting

(demonstrating the broad diversity of the involved constituents)

NFPA Membership

NFPA Membership

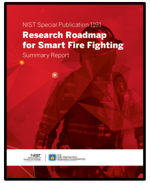


IEEE Membership

SFPE Membership

(forthcoming)

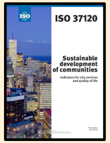
RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION



Next Steps and Future Directions

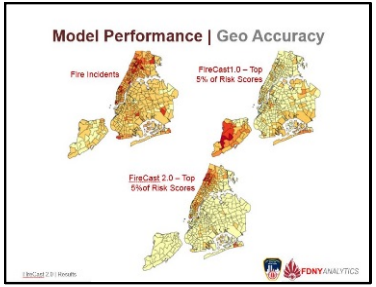
Examples of Standardization Activities and Outreach

- *Example of Related NFPA Standards Activity: NFPA 950/951*
  - NFPA 950: *Standard for Data Development & Exchange for the Fire Service*
  - NFPA 951: *Guide to Building and Utilizing Digital Information*
- *Example of Other Related Standards Activity: ISO 37120*
  - ISO 37120: Sustainable Development of Communities
  - Chapter 10: *Fire and Emergency Response*



Other Examples:

- **Smart Home Summit** (Palo Alto, CA; Oct 2015)
- **Smart Enforcement Workshop** (Tempe, AZ; Nov, 2015)



NFPA Journal Article, Nov/Dec 2014

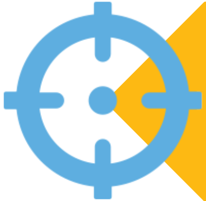
RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION

2016 PSCR June Stakeholder Meeting

June 9, 2016

Dr. Brad Fain, Georgia Tech
brad.fain@gtri.gatech.edu
404 407 7261

The Approach: User-centered design



Define the problem
- Stakeholders
- Missions
- Functions
- Tasks

Design to the need
- How and when to display data, and to whom
- What comprises actionable info
- What needs to be monitored
- Determine sensor/device constellation

Strategic integration
- Leverage existing systems and gear
- Leverage Commercial Off-the-Shelf (COTS) first, then custom designs
- Integrate into existing workflows
- Forward looking implementation
- Account for availability of infrastructure

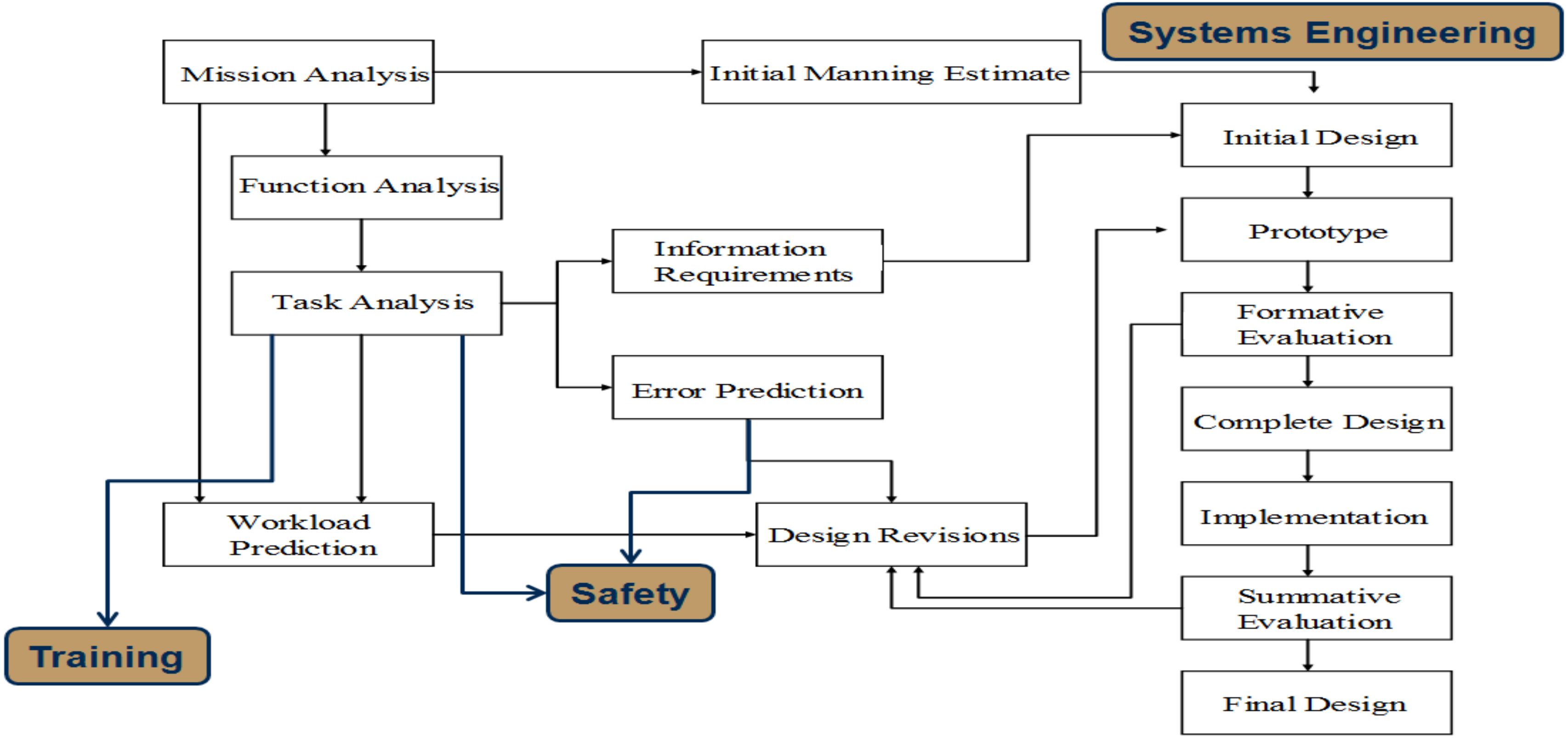
Domains of HSI

- Human Systems Integration (HIS) is a *systems engineering process* that requires full consideration of the human components of a system from the onset of an development activity

DoD Instruction 5000.2 requires an acquisition program manager to initiate a HIS program in order to:

- optimize total system performance,
- minimize total ownership costs, and
- ensure that the system is built to accommodate the characteristics of the user population that will operate, maintain, and support the system

Human Factors Engineering



State of Integrated Soldier Electronic Systems

- Command and control systems at the top level are robust
- Integration at the vehicle level is catching up
- The nascent Soldier Electronic Systems – a hodgepodge of disconnected technologies, available to some but not others
- Future forces are characterized by a simultaneous reduction in human personnel and increase in individual/squad capabilities
- The availability of viable networks in remote areas will increase the proliferation of connected systems

Command & Vehicle Level

- Information Sharing Environment (ISE)
- Traffic Management Centers
- Distributed Joint Command and Control

Design is fully self-supporting, with its own power, environmental control, and SATCOM — augmented with autonomous rapid response and en route capabilities

Notional Technology Roadmap

- Number of near-term deployable technologies deliver maximum value if implemented within a well-integrated fashion
- Proper integration today will yield more logical progression towards training/adoption of next-gen tech

2015

- Soldier sensing modalities
- Electronic Warfare (EW) Sensing
- Electro-Optical (EO)/Infrared (IR) Sensing
- Soldier Personal Area Networks (PAN)
- Blue Force Tracking
- Soldier networking schemes
- Securing soldier networks
- Early decision support
- Situational Awareness (SA) including aug. reality/Virtual Reality (VR)
- Integration of unmanned squad members
- **Bottom line**: By 2020 deployed forces can fully leverage common 2015 technology

5 yrs

- Next Gen power, communications, & processing
- Field proven algorithms and data distillation techniques
- Combat use of enhanced SA and decision support tools
- Limited deployments of exoskeletons and increased participation of unmanned team members
- **Bottom Line**: All soldiers electronically augmented

10 yrs

+20 yrs

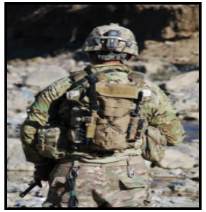
LATER

- 'Ironman' like capabilities start to become feasible
- Electronics and armor fully integrated
- **Bottom Line**: 'Futuristic' technologies begin to be realized

Related Projects: Soldier-worn sensing

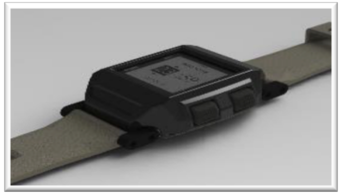
Integrated Blast Effects Sensor Suite

- Capture soldier-centric blast and other traumatic event data for mounted/dismounted scenarios
- Construct a platform & sensor agnostic architecture, capable of being integrated onto various body armor or vehicles
- Build survivable systems with mechanisms for transporting data from theater to Conterminous United States (CONUS) databases
- Deployed 1000 soldier and 50 vehicles

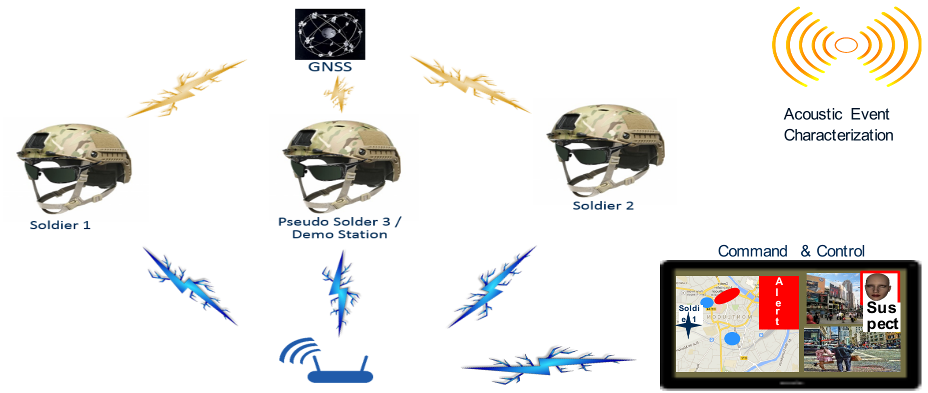


Integrated Soldier Sensor System

- Instrument US Army soldiers with helmet, body, and physiological status sensor systems to capture traumatic events and monitor soldier health
- Develop a fieldable system leveraging tactical wireless solutions for personal area networks and inter-soldier networks
- Minimize burden to soldiers through smart integration with existing protective equipment



Related Projects: Enhanced Human SA IRAD

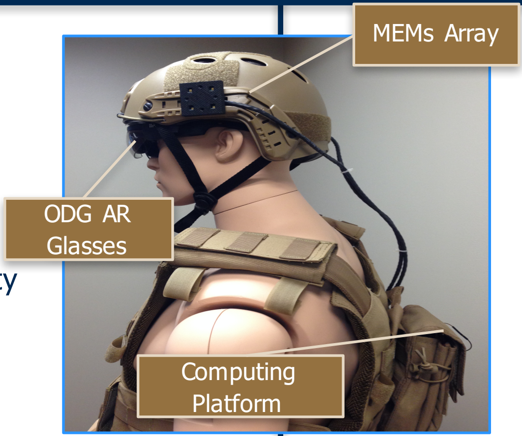


Objective

- Develop and demonstrate a collaborative, wearable computing solution for increasing soldier situational awareness
- Full solution will include multiple capabilities:
  - Facial recognition
  - Acoustic event characterization/geolocation
  - Blue Force Tracking
  - Augmented Reality user displays
  - Collaborative sensing and correlation
  - Chem-Bio sensing

Technical Approach

- Micro-Electrical Mechanical Systems (MEMs) microphone sensor Testing and Evaluation (T&E)
- Acoustic algorithm development
- Android mobile platform development
- Osterhout Design Group (ODG) Augmented Reality glasses
- Integrated soldier worn system
- Integrated networking of sensing units



Payoffs

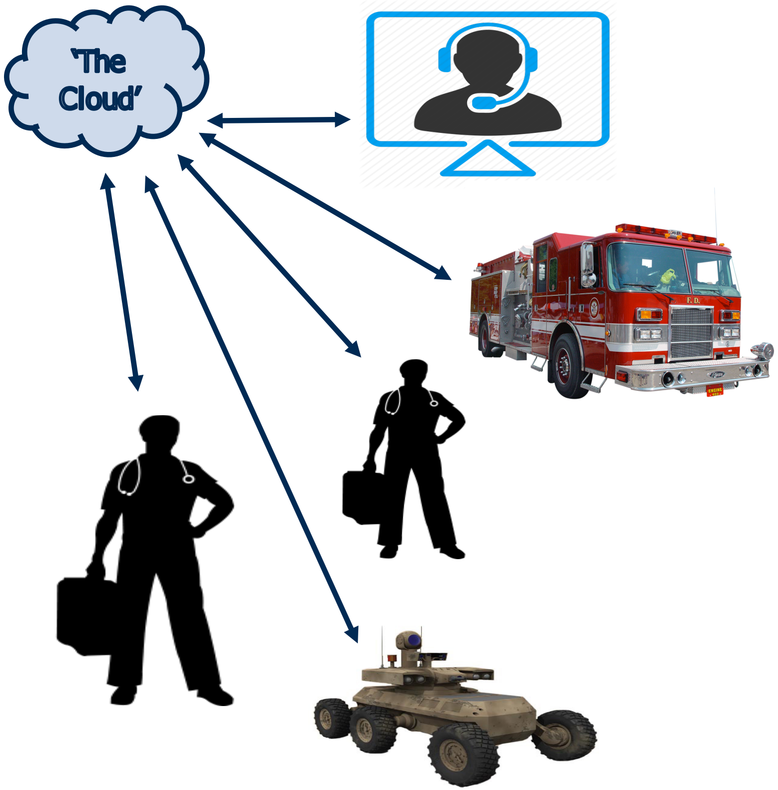
- Distributed squad event correlation
- Multi-modal sensing squad common operating picture
- Extensible soldier system
- Scalable, low-cost microphone solution
- Expandable acoustic baseline algorithm
- Chem-Bio sensing proof of concept

Walkthrough of a notional architecture

Individual Team Member

- Open architecture "Body Area Network (BAN)" of various small, low-power sensors to monitor individual status (location, activity, physiological status, etc)
- BAN operates independent of available infrastructure.
- Each sensor node may process data into summary chunks of information rather than raw streaming data
- BAN data aggregated at a personal comm hub node (which also contains multiple sensors)
- Personal comm hub displays individual data, maps, messages, etc. as well as maintains mobile connectivity to higher echelon services
- Personal comm hub can be used to cache specific information about the user or about the mission to support activities in denied environments

Walkthrough of a notional architecture



Team Coordination

- Mobile broadband allows for access to cloud based services for various data consumers
- Peer to peer connections or ad-hoc networks established for team members in proximity
- Bandwidth usage tuned to required response time for the specific mission/application
- Initial sensor fusion for tactical operations performed at this level
- Custom user interfaces and data visualizations for preventing information overload and providing quick understanding of actionable data
- Custom utilities built to automate and enhance workflows and 'crew management'

Walkthrough of a notional architecture

Data Analytics, Planning, and Visualization

- Big data repository and analytics
- Complex algorithm execution at this level
- Direct link to command center situational awareness
- Characterize performance and identify drivers of trends/outcomes
- Historical tracking allows for identification of opportunities for improvement and most efficient utilization of resources
- Data used for planning, training, and logistics
- Real time response monitoring, modeling, and prediction

Lessons Learned

- Successful implementation begins with understanding the user and the mission
- A successful architecture exists independent of the specific sensor nodes/devices within it, and is easily upgraded. Tailoring the architecture to a particular user is where sensor selection and display integration occurs.
- Availability of data and data flows must match environmental and operational constraints/requirements
- Equipment must integrate with existing gear and not interfere with operations
- Weight is **always** a factor
- Equipment must be “rugged” and designed for austere environments and situations
- The implementation must be unobtrusive and useful

MOTOROLA SOLUTIONS

User Experience Design

Design for mission critical intelligence

Lexie Spiro
Director, User Experience Design
Motorola Solutions Inc.

CTO INNOVATION DESIGN

ANALOG

DIGITAL

INFORMATION ENABLED

MISSION CRITICAL COMMUNICATIONS

MISSION CRITICAL INTELLIGENCE

The 2 things police officers hate the most are…

1. **Change**
2. **The way things are**

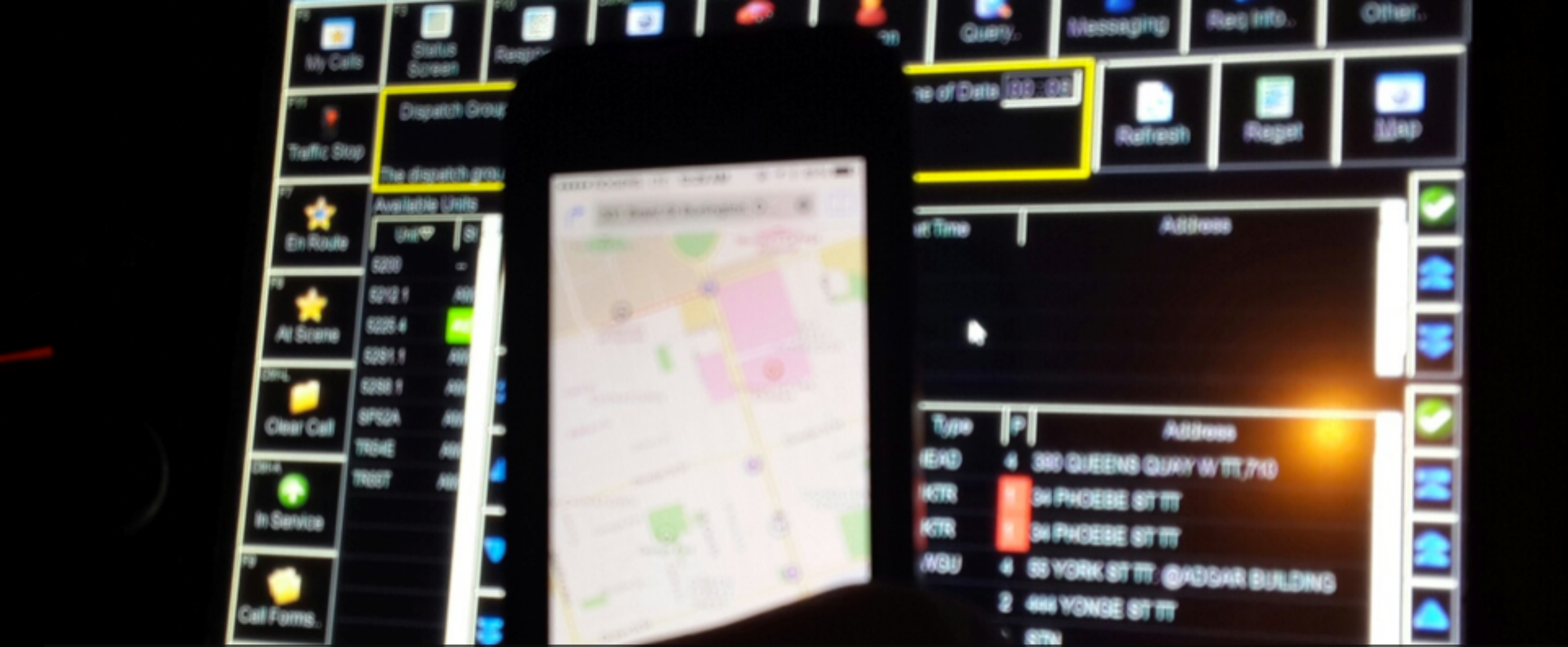
Create **great products and solutions** by translating research insights into impact through a **user centered design** process.

Video - Motorola Solutions Approach to Design and Research

UX & Design Research is a tool we use to learn about our customers' business processes, workflows, challenges & needs

It involves being in the field with users on ride-alongs, training sessions and site tours to conduct observational research

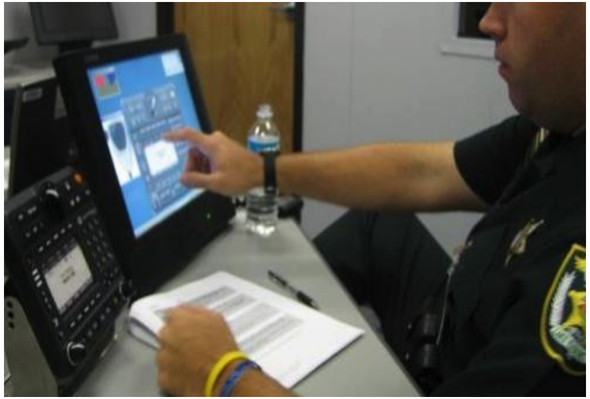
Sometimes it is about immersing ourselves in the user's world



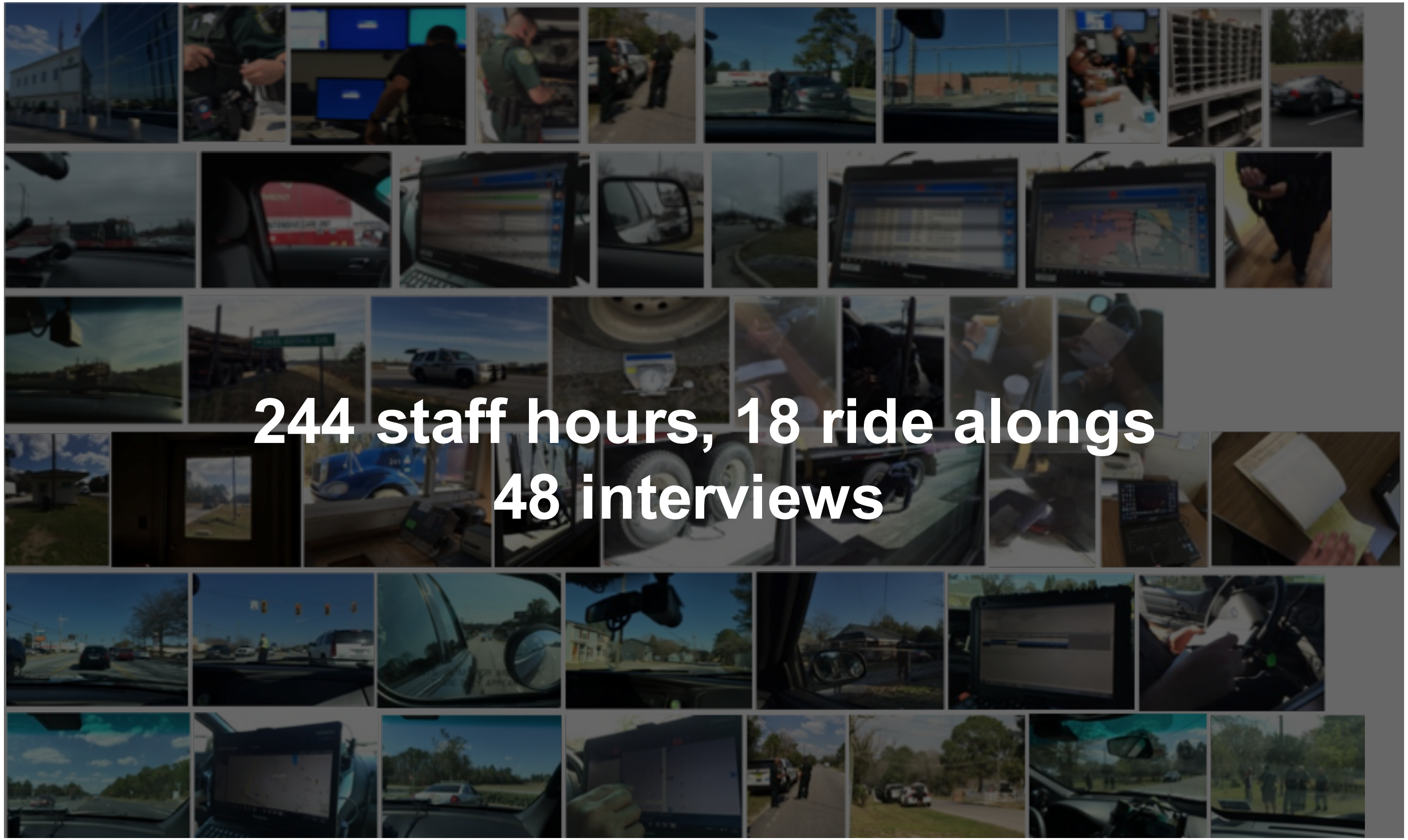
It is about ensuring that we are focused on customer challenges rather than on our portfolio

We watch how users interact with technology, understanding what works and what doesn’t work and WHY

Design, prototype, test, design, prototype, test…



So far in 2016...



What do we look for?

How information flows from proactive policing to the incident to the records, investigations, crime analysis, DAs and courts...

How does the officer communicate and access information based on context? (in vehicle vs. out of vehicle; mission critical vs. routine)

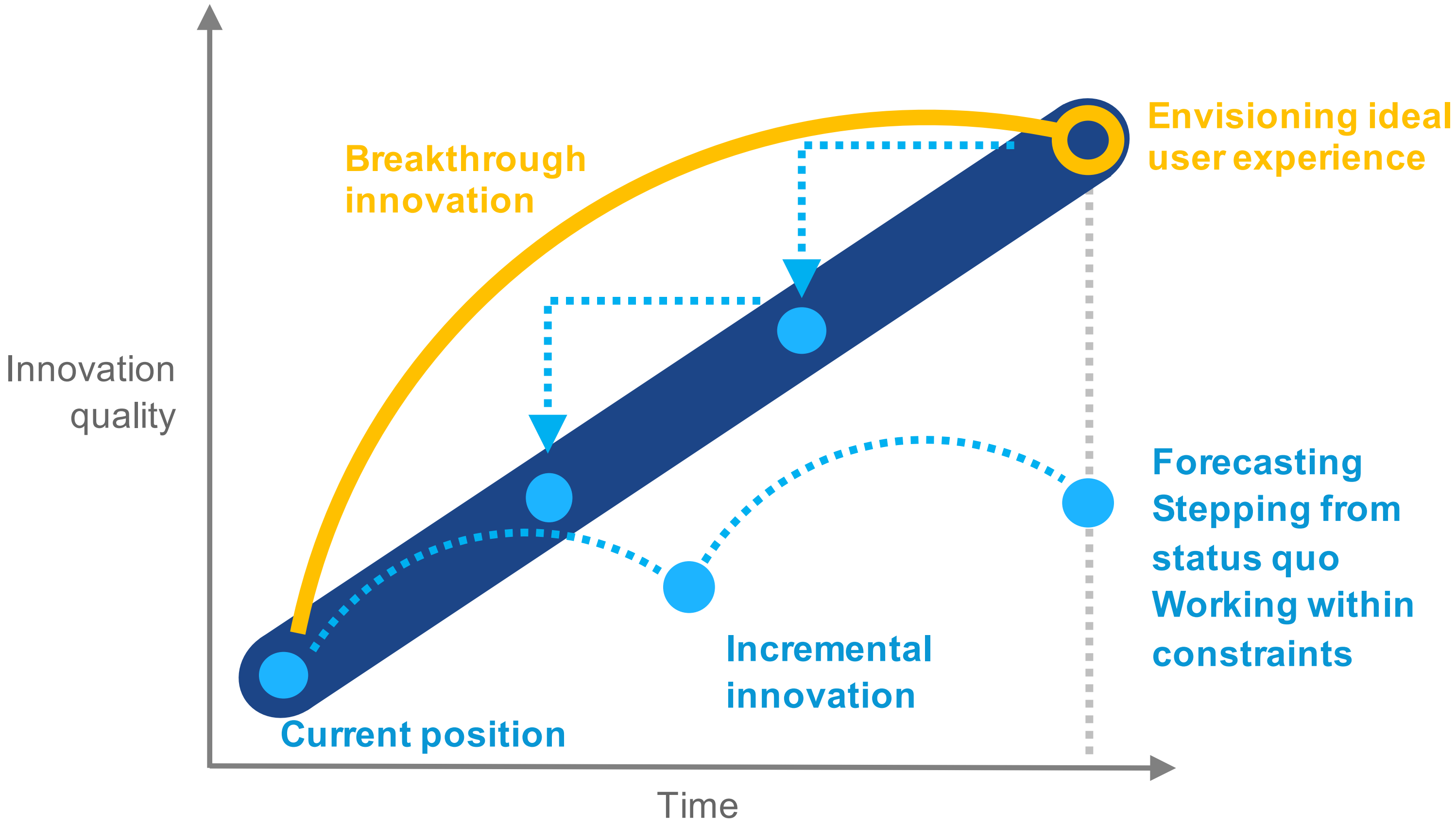
How can we enhance situational awareness without adding distraction and improve collaboration without adding more apps and devices?

How can we streamline the workflow and improve productivity, so that the officer can spend more time patrolling?

How do we do all this while ensuring officer safety?

Then what?

Backcasting



UX Design Strategy

Purpose built

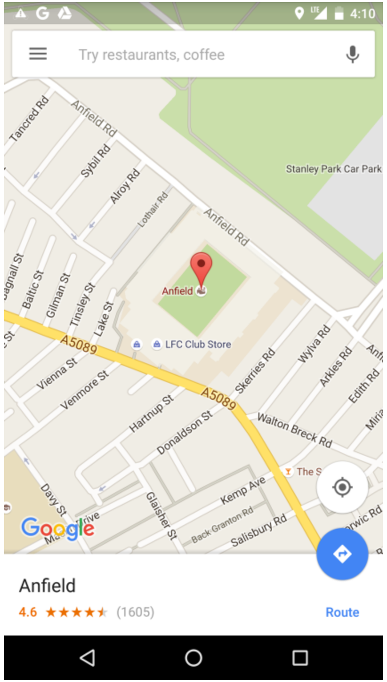
User centric

Adaptive

Purpose built solutions leverage research insights to deliver an experience that is tailored specifically to the individual user's needs.

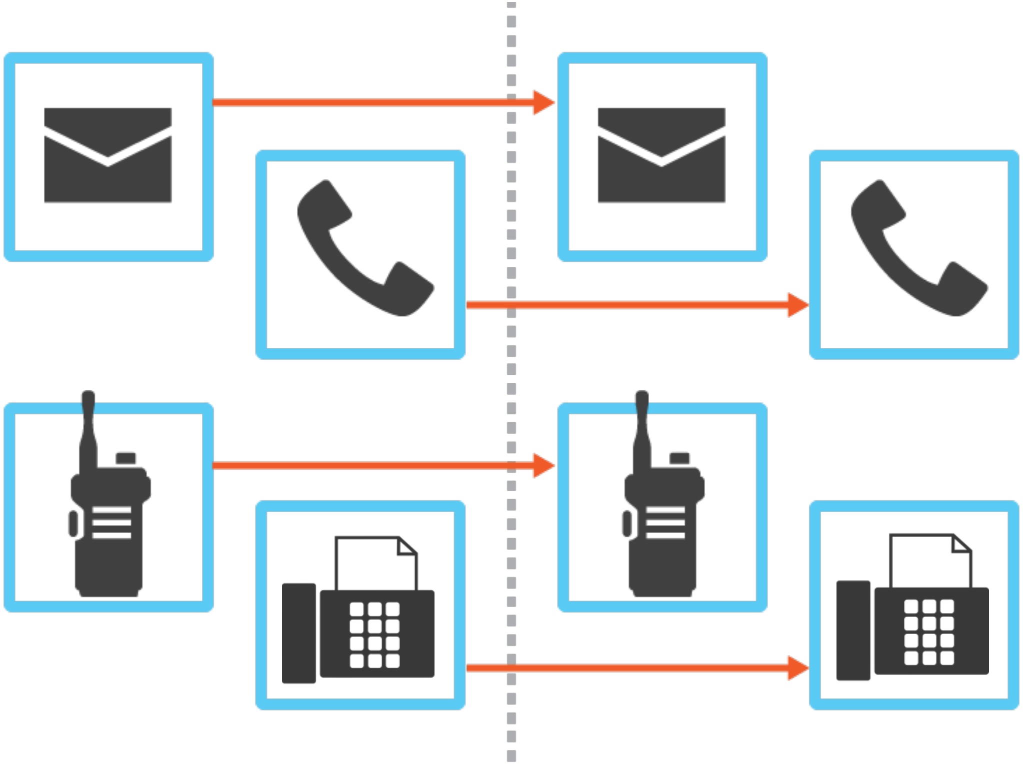

MOTOROLA
MOTOROLA

Purpose Built Apps

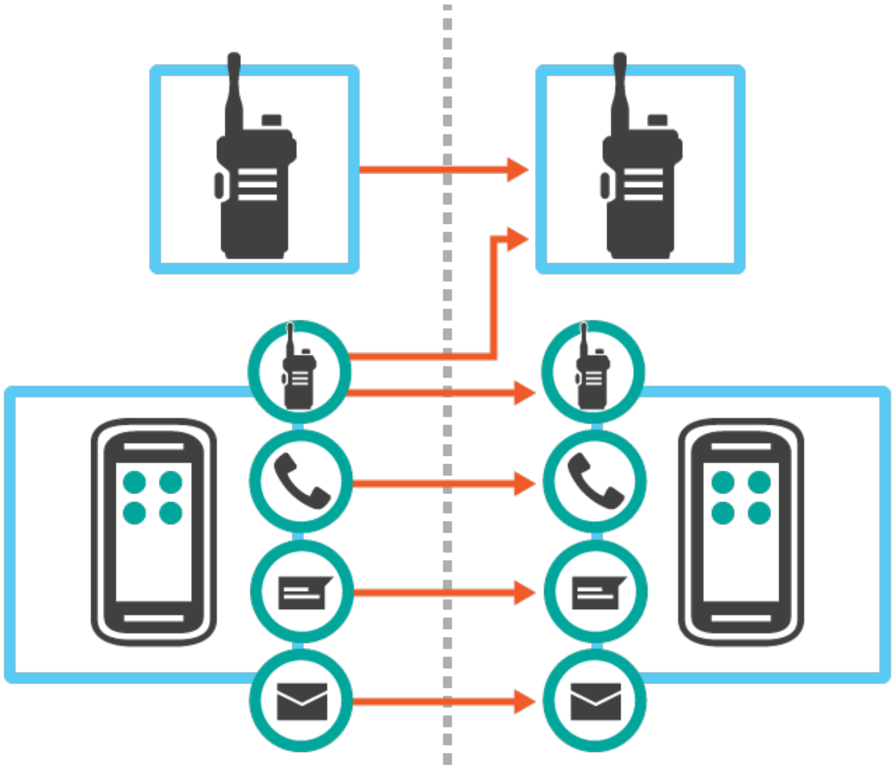


User centric solutions break down technology silos, placing the user at the center of focus, to enable them to communicate seamlessly and in new ways.

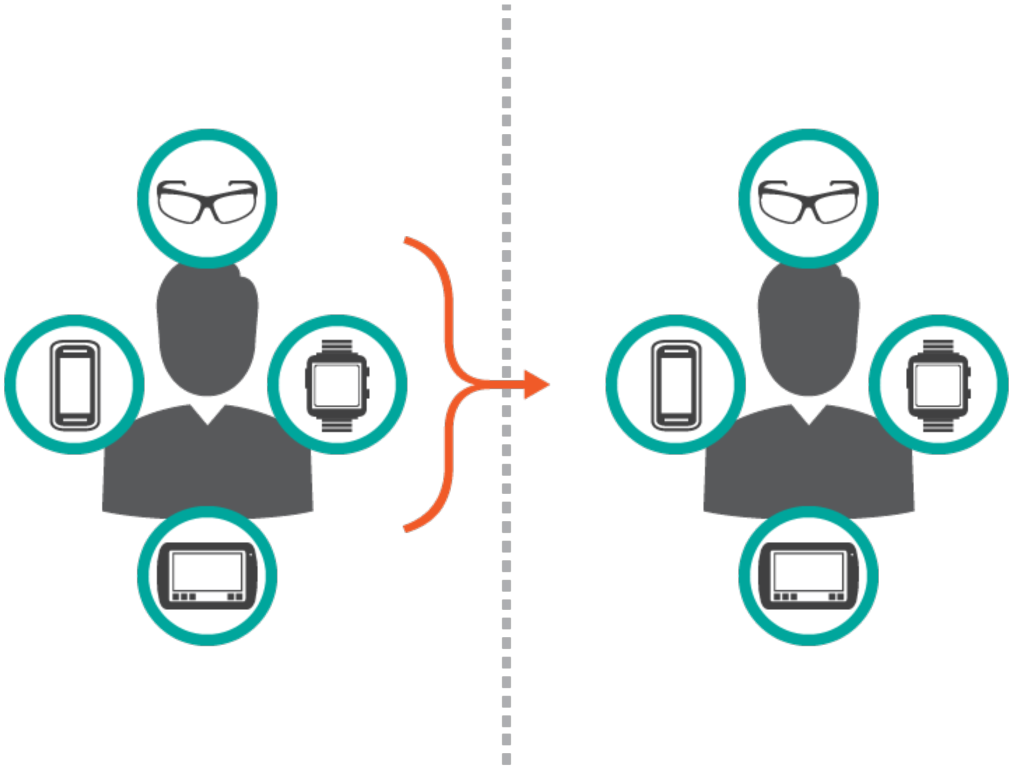
In the past...



Today…



Future...



Adaptive solutions streamline content, presenting only what is necessary given customer, role, and contextual needs.


POLICE

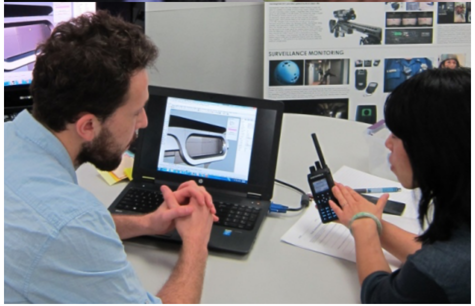

SHERIFF


PFA

Our users should rely on us to deliver the right user experience in any scenario- from the precinct to inside the car to out of the car and into the incident.

We design applications and devices ranging from data-intensive, deep workflows to eyes up & hands free interactions.

We do this by studying their needs, developing insights, designing purpose built, user-centric, adaptive solutions, and testing these solutions with end users.



It never ends…

INFORMATION TECHNOLOGY LABORATORY

User Centered Design

- Brian Stanton
- Yee-Yin Choong
- Kristen Greene

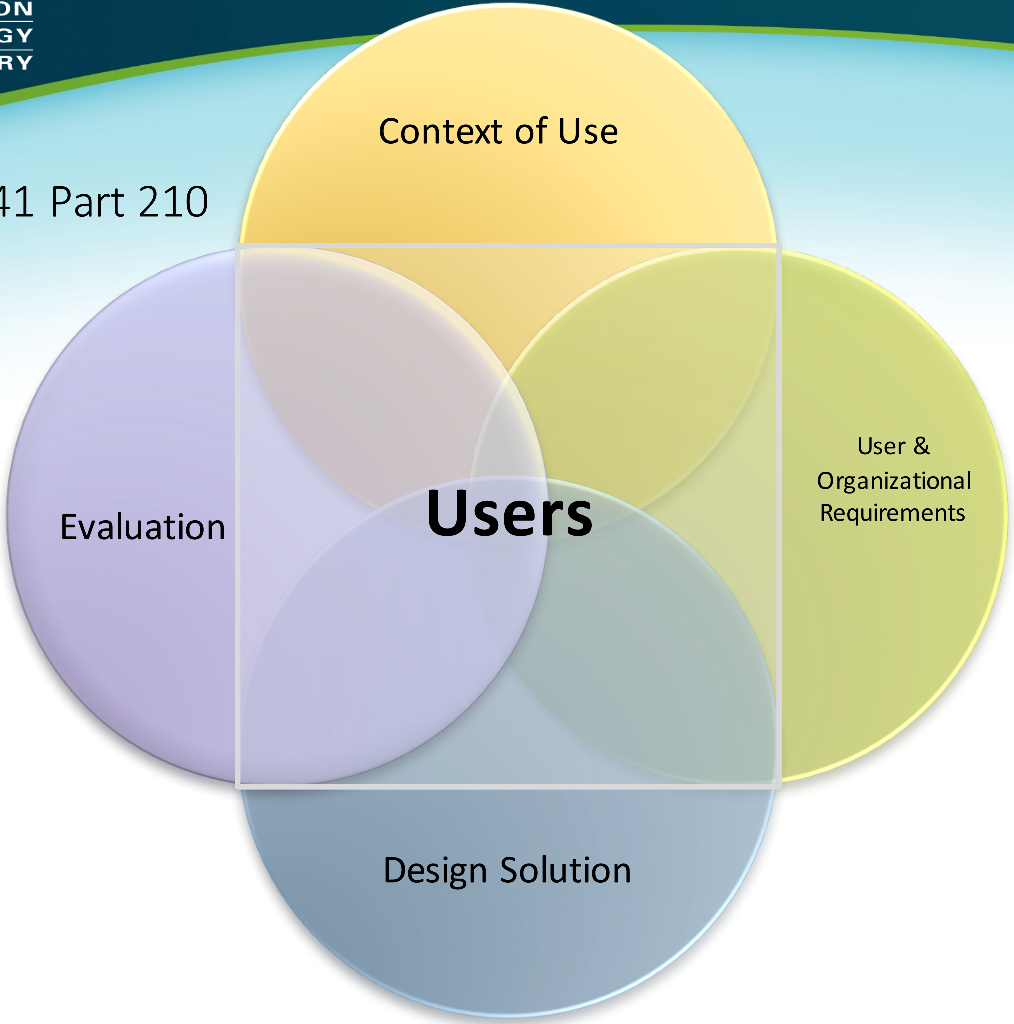
Improving performance

- Make sure the system supports the users' tasks and goals
- Measure Effectiveness, Efficiency, and User Satisfaction
  - Effectiveness – quality
  - Efficiency – Timing
  - User Satisfaction – fulfillment, no frustration, enjoyment, contentment

User Centered Design

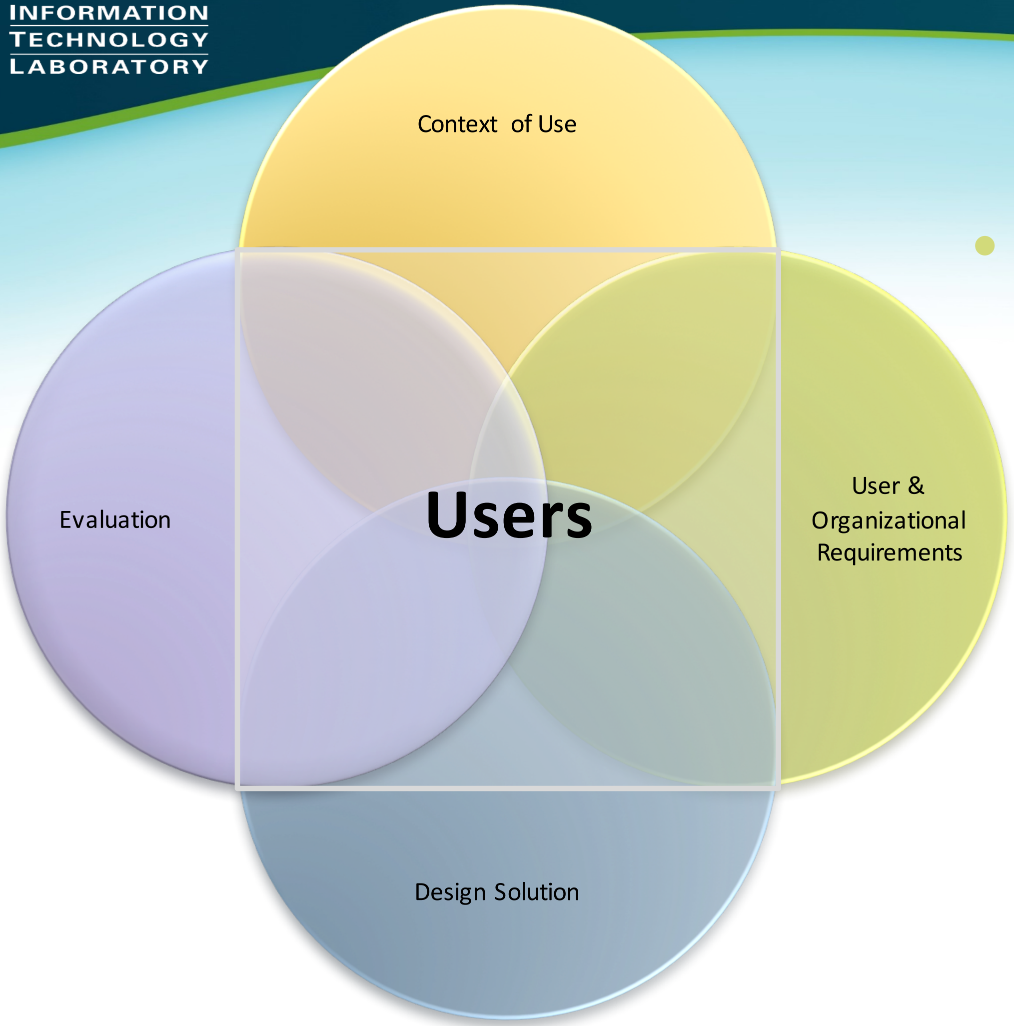
- ISO 9241 Part 210 Ergonomics of human-system interaction part 210:Human-centred design for interactive systems.

ISO 9241 Part 210



Common Industry Format (CIF) Standards

- ISO/IEC 25063 Context of Use Description
- ISO/IEC 25064 User Needs Report
- ISO/IEC 25065 User Requirements Specification
- User Interaction Specification
- User Interface Specification
- ISO/IEC 25066 Evaluation Report
- Field Data Report
- ISO/IEC 25062 (summative test report)



- ISO/IEC 25063 Context of Use Description
  - System Goals
  - Stakeholders
  - Users characteristics
  - Tasks
  - Environments

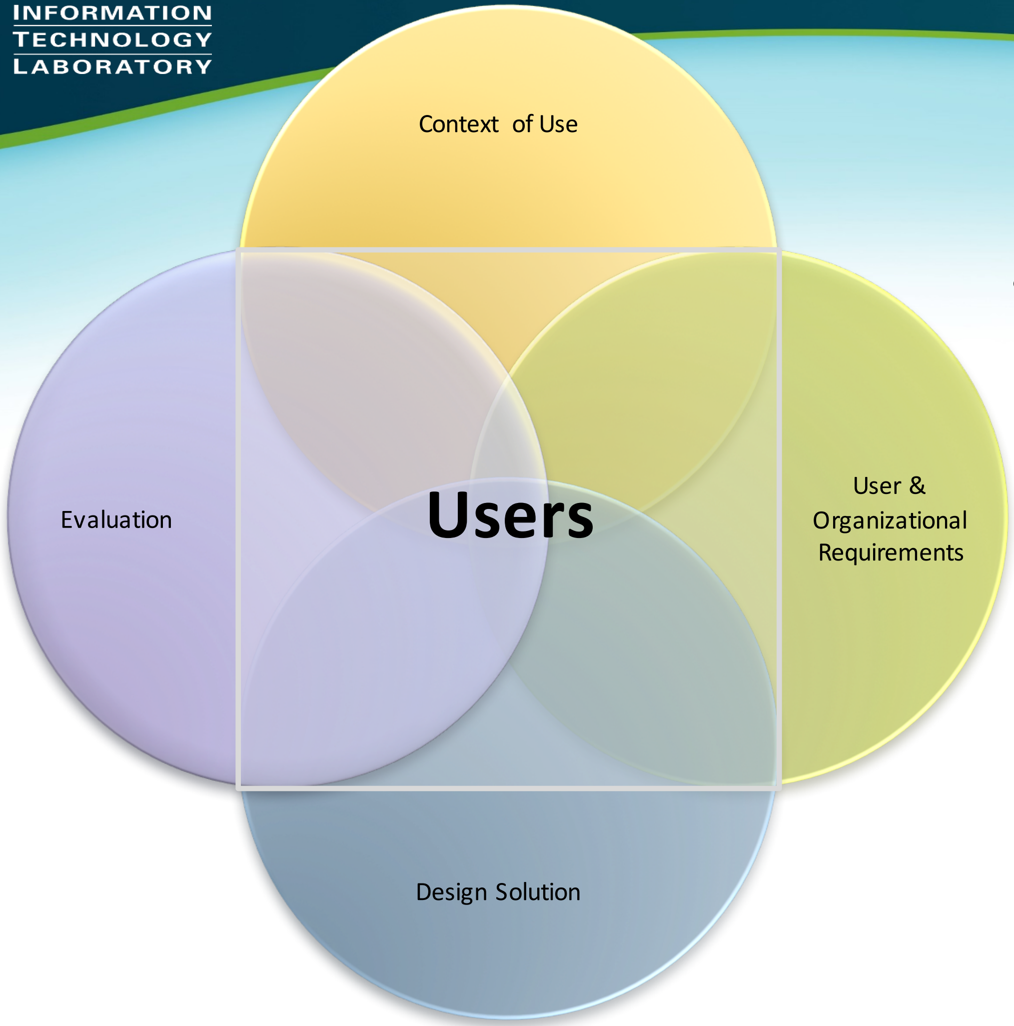
Context of Use – FBI Hostage Rescue Team

Context of Use – Houston Police

Context of Use – Houston Police

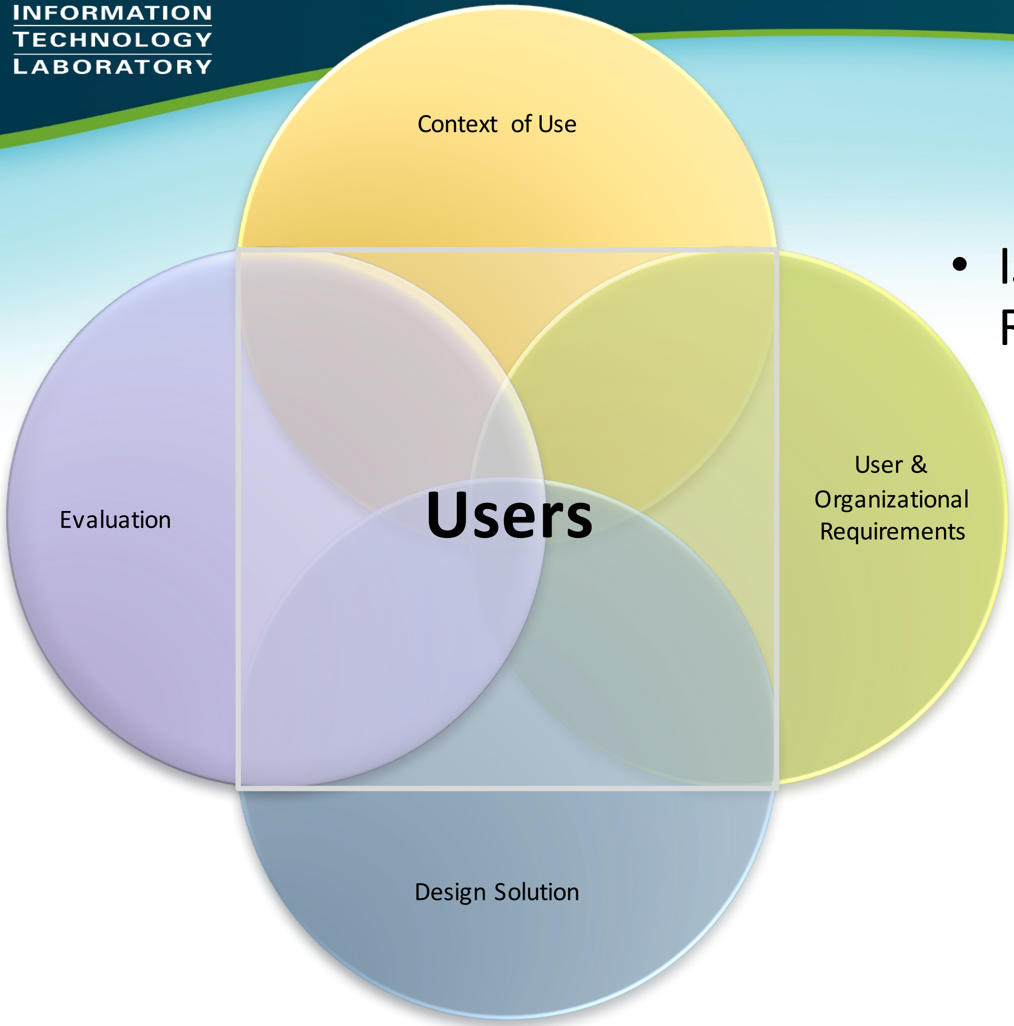
Context of Use – Houston Police

Context of Use – Houston Police

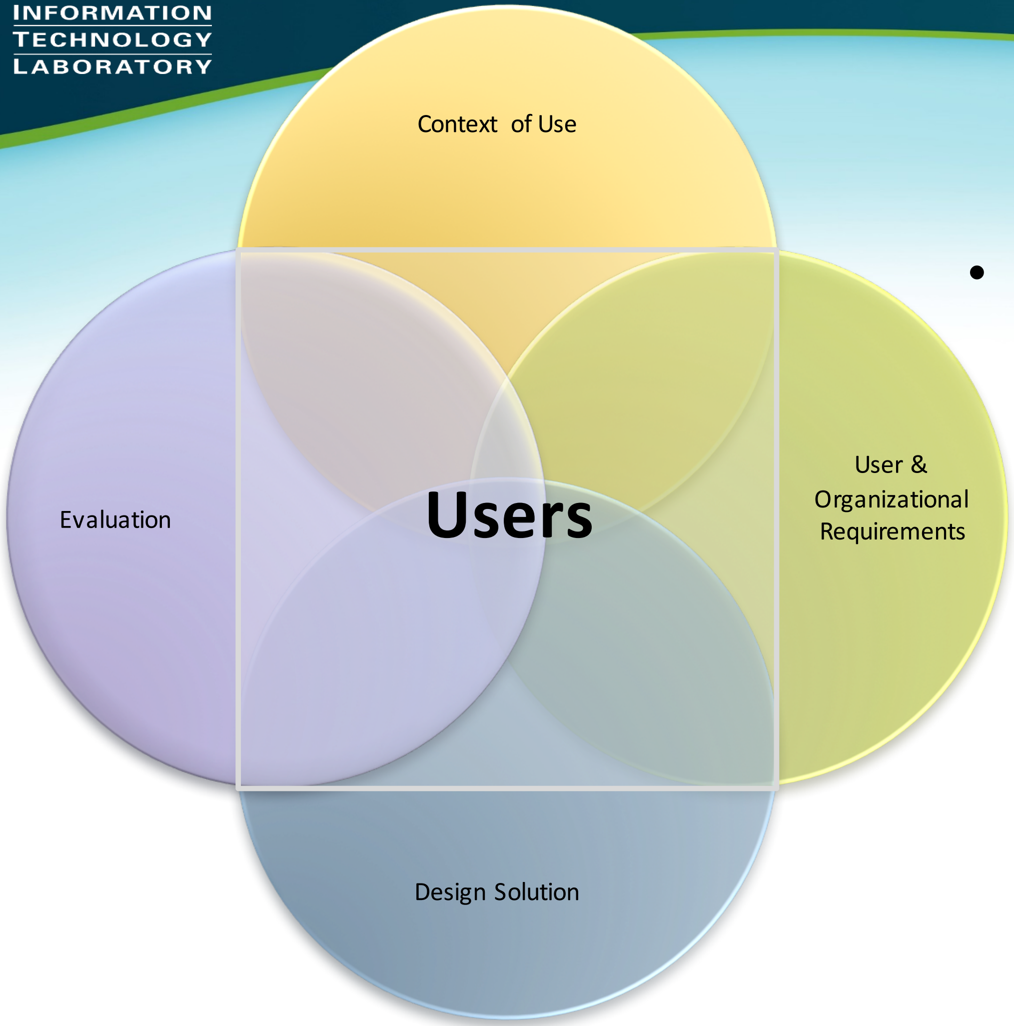


- ISO/IEC 25064 User Needs Report
  - Identified
  - Stated
  - Derived
  - Implied

User Needs



- ISO/IEC 25065 User Requirements Specification
  - Context of Use
  - User Needs
  - Relevant UI knowledge, standards, & guidelines
  - Effectiveness, efficiency, satisfaction criteria
  - Organizational



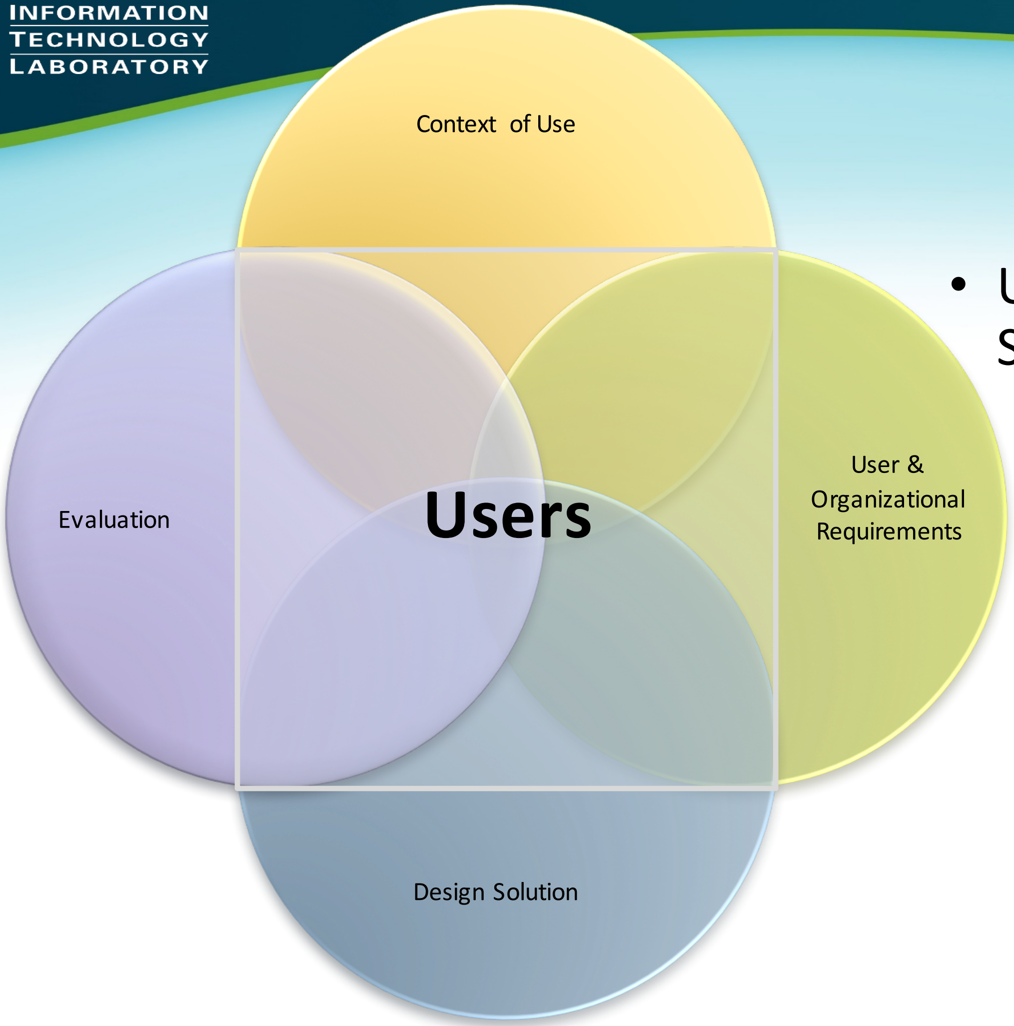
- User Interaction Specification
  - Workflow
  - Subtasks
  - Dialogue Model
  - Task specific usability objectives
  - Information architecture

User Interaction Specification

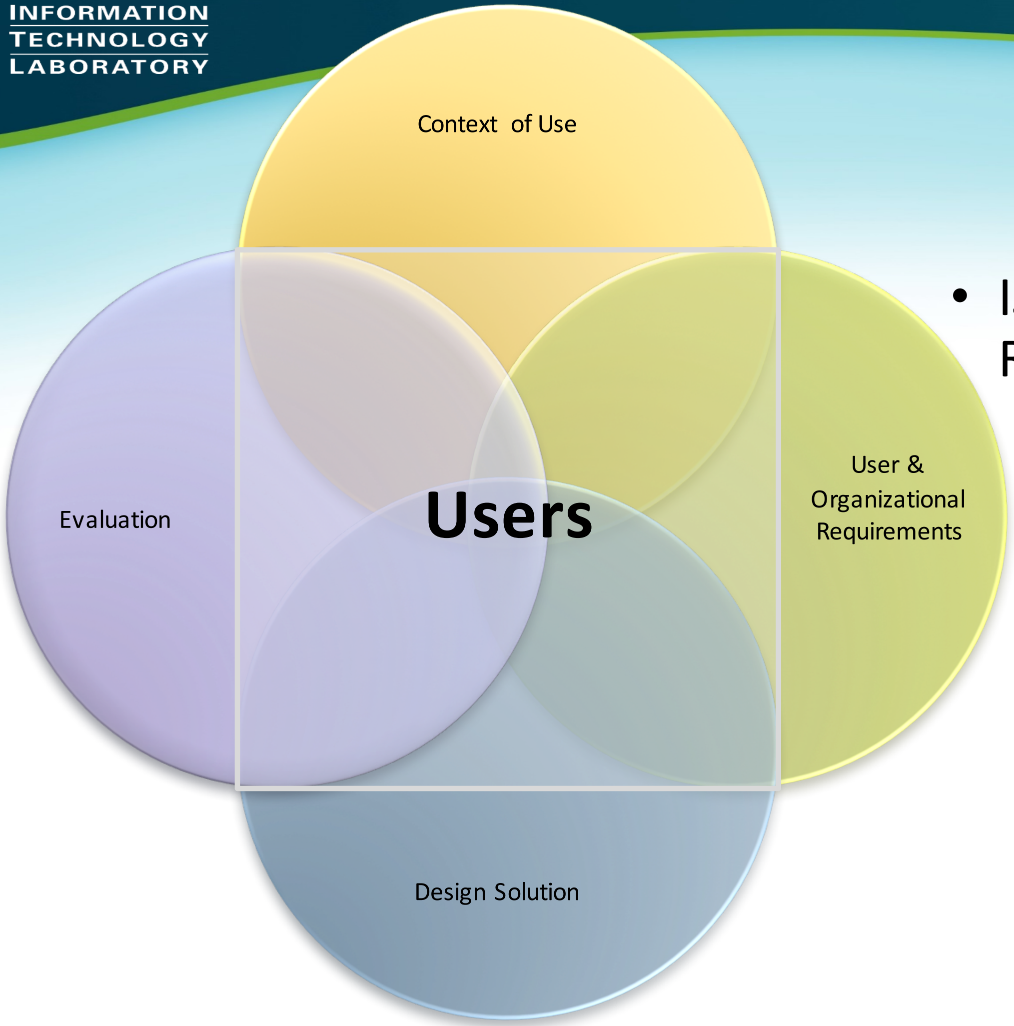
UC- QCP.01	Launch QCP
Actors	HRT member
Precondition	None
Postcondition	QCP application successfully launched
Includes	UC-Connection.01
Extends From	
Super Use Case	
Trigger	User decides to start QCP application
Description	
Process Description	
Primary Process Scenario	**Launch QCP Application**
Step 1	User decides to launch QCP application

Step 2	QCP application presents to the user:
	• A new transaction with its TCN (transaction number):
	  • Completion status of each of the areas: personal data, fingerprints, and photos
	  • Options to access the followings:
	    • UC – Personal Data.01
	    • UC – Fingerprints.01
	    • UC – Photos.01
	• Options to
	  • UC – Connection.01
	  • UC – Transactions.01
	  • UC – File Management.01

Exceptions, Error Situations:	• Error: QCP fails to start ○ QCP logs error(s)
Alternate Scenario Exceptions:	
Open Issues/Notes	

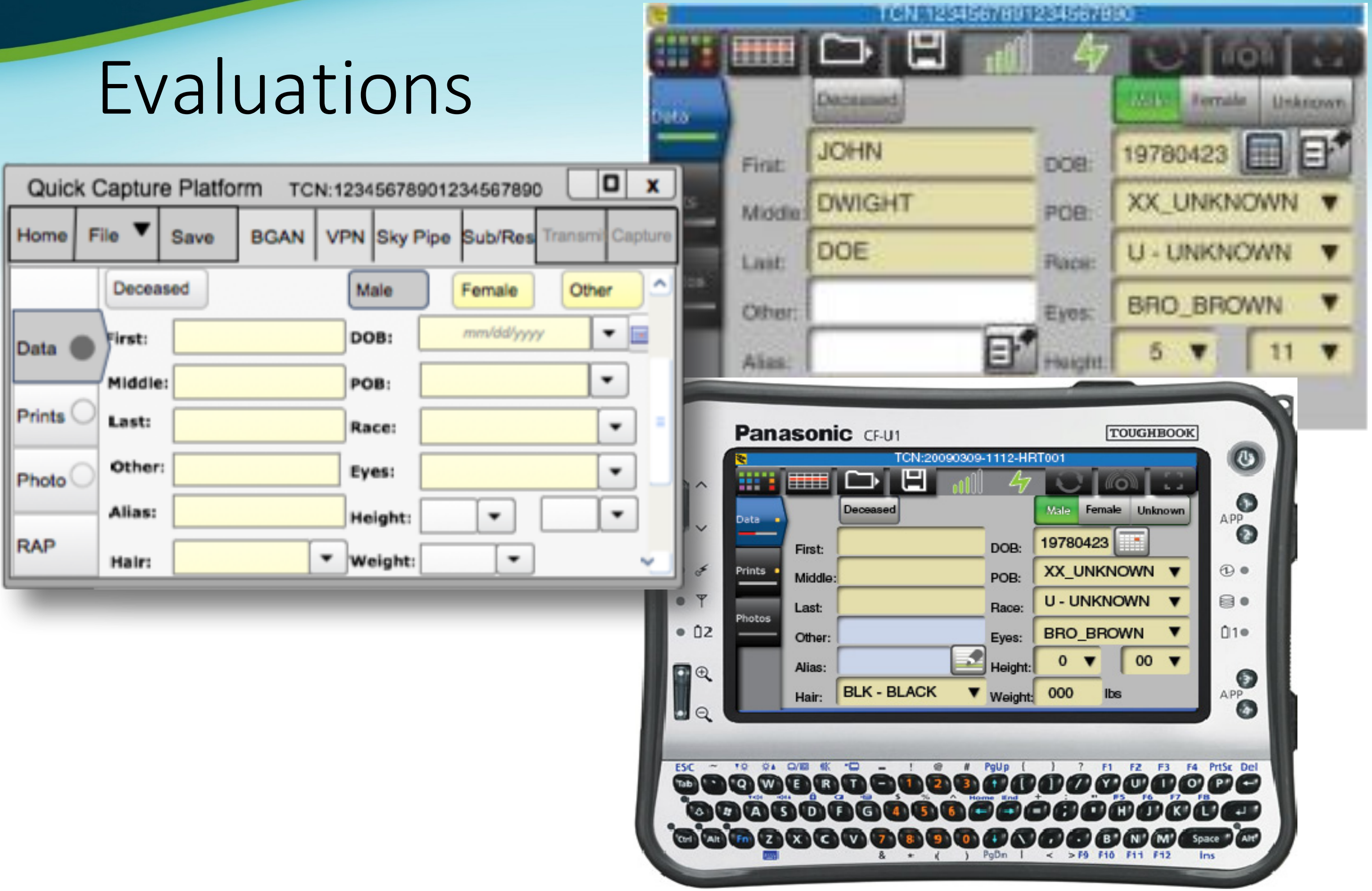


- User Interface Specification
  - Task & system objects
  - User Interface elements
  - Views
  - Properties, behaviors, & relationships
  - Dialogue techniques

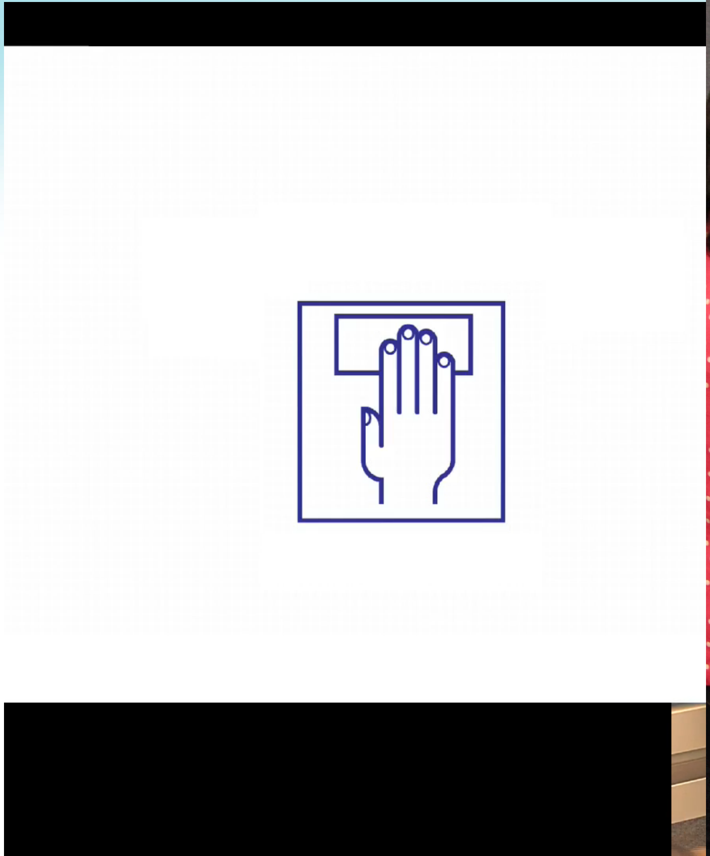


- ISO/IEC 25066 Evaluation Report
  - Usability problems
  - Recommendations
  - Conformity with user requirements

Evaluations

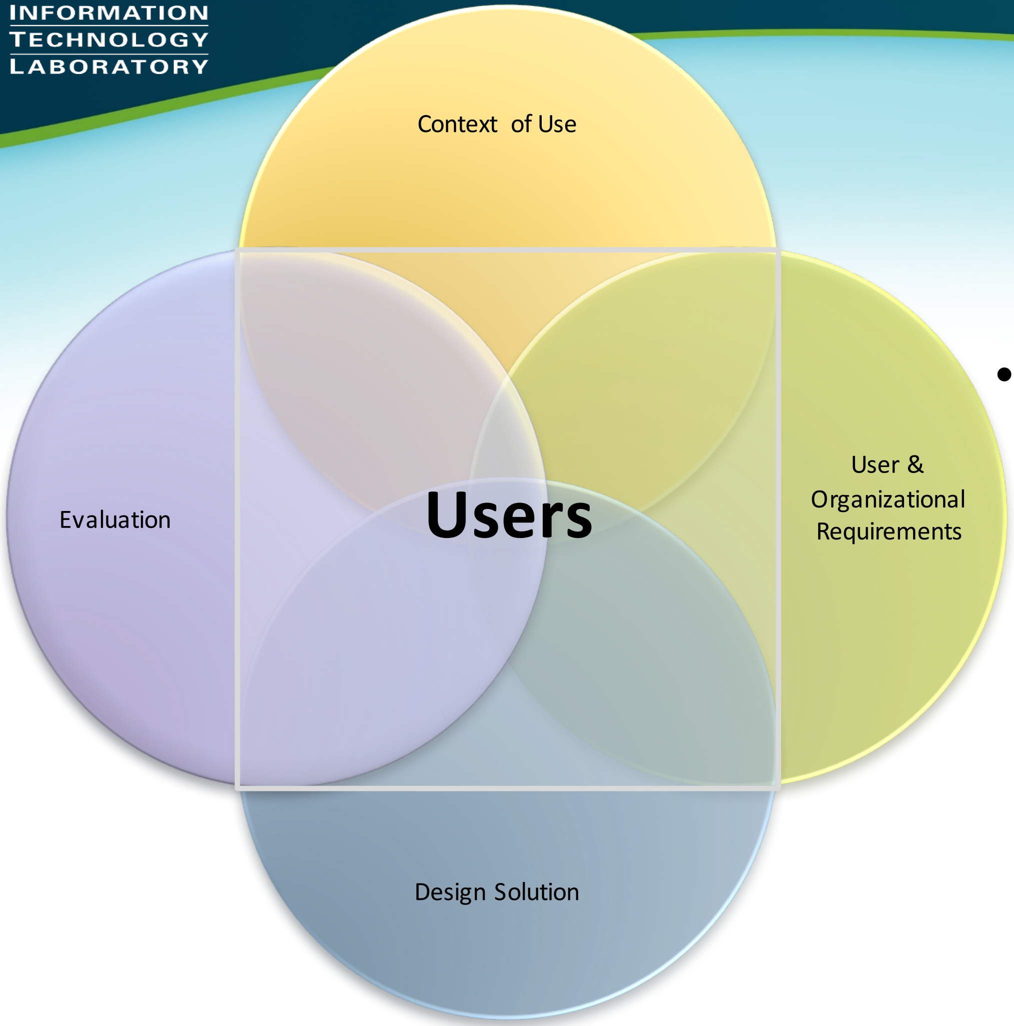


Evaluations

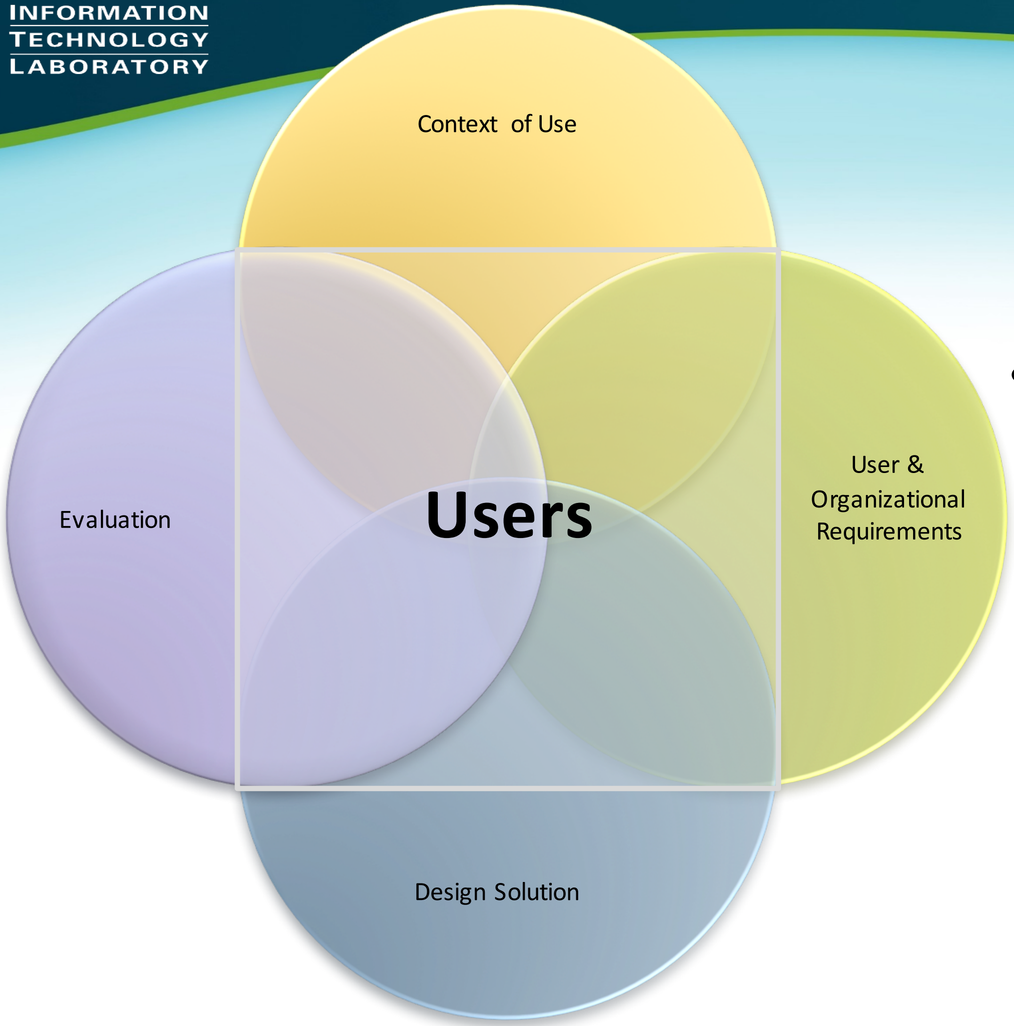


Evaluations - example

- Effectiveness
  - Task completion rate: 97.5%
  - Errors: 6.95
- Efficiency
  - Task completion time: 45.8 (sec)
- Satisfaction
  - Comfort: 4.3 (1 – uncomfortable; 5 – very comfortable)
  - Confidence: 4.2 (1 – no confident; 5 – very confident)



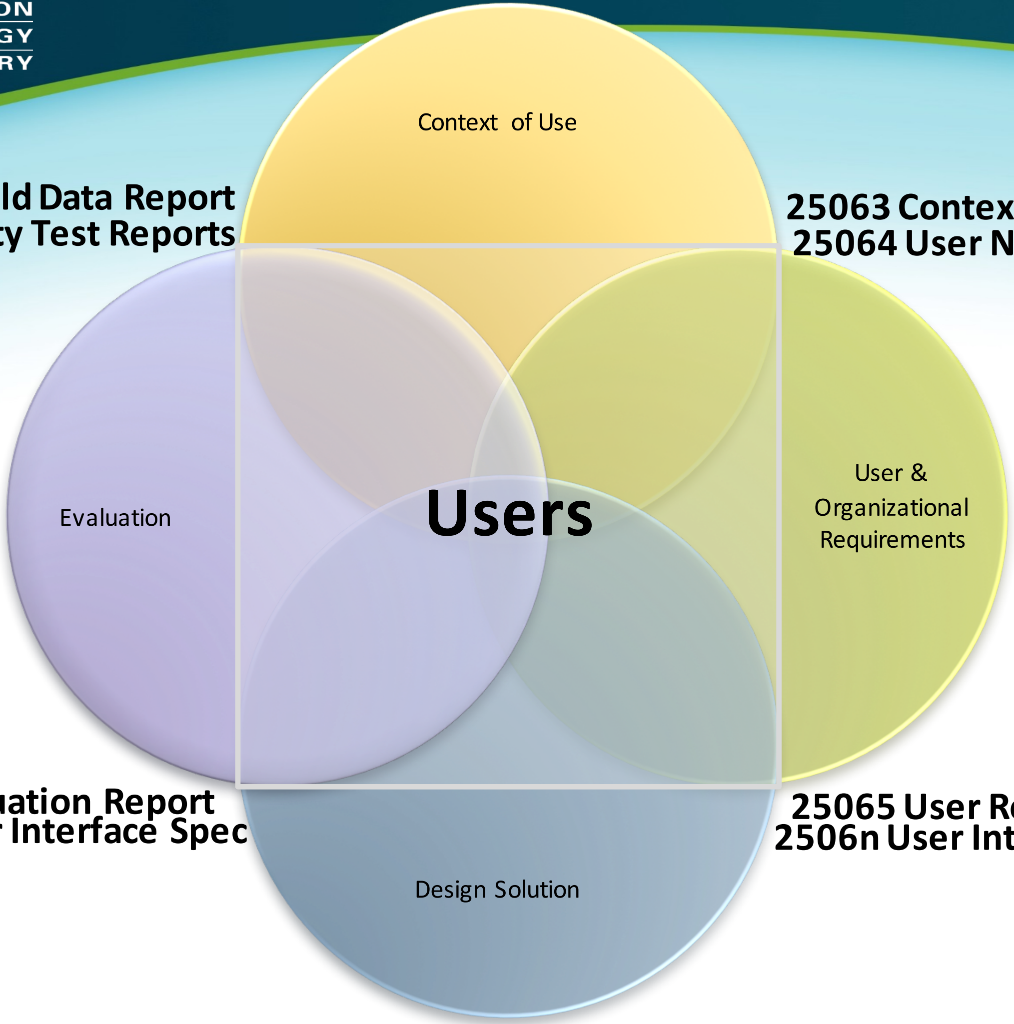
- ISO/IEC 25062
  - Formal summative evaluation
  - Baseline
  - Comparison among products



- Field data report
  - Actual usage
  - Emergent user requirements

25060 Field Data Report
25062 CIF Usability Test Reports

25063 Context of Use Description
25064 User Needs Report



25066 Evaluation Report
2506m User Interface Spec

25065 User Requirements Spec
2506n User Interaction Spec

PSCR UI Roadmapping

UI Stakeholder Working Group
<u>Total membership: 54</u>

- Initial Kickoff Call: May 11, 2016
- To date: Trends and Drivers, Use Cases
- Next call: June 15, bi-weekly for one hour

SNAPSHOT: Public Safety's Immersive Test Environment

Dereck Orr, *NIST CTL Division Chief & PSCR Program Manager*

Public Safety's Immersive Test Environment

Possible uses of Augmented & Virtual Reality

PSCR June Stakeholder Conference 2016

Dereck Orr

Thank you for attending!

PSCR's current testing and evaluation mission

Testing for real-world operating conditions can be extremely challenging

and

Challenges in and out of the lab:

In real-world conditions:
- Certain testing may be
  - impractical
  - expensive
  - logistically burdensome
- Conditions are relatively **uncontrollable**
- Results are often **non-repeatable**

In the lab:
- Testing provides for
  - controlled environment
  - repeatable conditions
- Often does not reflect real-world operating conditions

Overall disconnect between tests conducted in simulated vs. real-world conditions

In real-world conditions:

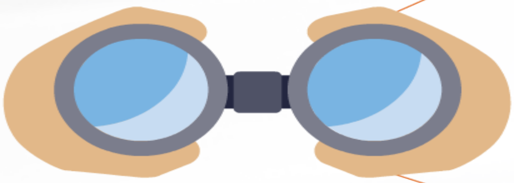
- Certain testing may be
  - impractical
  - expensive
  - logistically burdensome
- Conditions are relatively **uncontrollable**
- Results are often **non-repeatable**

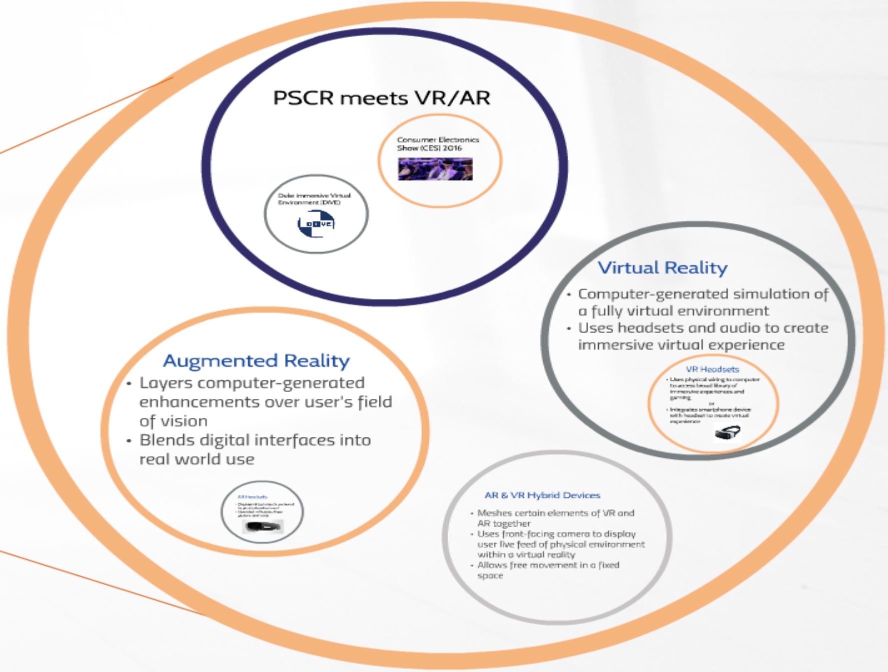
In the lab:

- Testing provides for
    - controlled environment
    - repeatable conditions
- Often does not reflect real-world operating conditions

Overall disconnect between tests conducted in simulated vs. real-world conditions

Virtual Reality (VR)/ Augmented Reality (AR): Technology Overview





PSCR meets VR/AR

Consumer Electronics Show (CES) 2016

Duke immersive Virtual Environment (DiVE)

DiVE

Virtu

• Comput

Consumer Electronics Show (CES) 2016

Duke immersive Virtual Environment (DiVE)

Augmented Reality

- Layers computer-generated enhancements over user's field of vision
- Blends digital interfaces into real world use

AR Headsets

- Displays virtual objects anchored to physical environment
- Operated with gaze, finger gesture, and voice

AR Headsets

- Displays virtual objects anchored to physical environment
- Operated with gaze, finger gesture, and voice

Virtual Reality

- Computer-generated simulation of a fully virtual environment
- Uses headsets and audio to create immersive virtual experience

VR Headsets

- Uses physical wiring to computer to access broad library of immersive experiences and gaming

or

- Integrates smartphone device with headset to create virtual experience

VR Headsets

- Uses physical wiring to computer to access broad library of immersive experiences and gaming

or

- Integrates smartphone device with headset to create virtual experience

AR & VR Hybrid Devices

- Meshes certain elements of VR and AR together
- Uses front-facing camera to display user live feed of physical environment within a virtual reality
- Allows free movement in a fixed space

Can Public Safety leverage the emerging technologies of VR and AR to address testing and evaluation issues (and more)?

What are the possibilities?

VR/AR Real World Application: Happening Now!

VR has grown to include film, gaming, and education

NYT VR film app

'VR Education's' Apollo landing app

Sony PlayStation 4 VR

Consumers will spend $5.1b on VR hardware, software, and accessories in 2016

www.fortune.com

"Everyone wanted a piece of Virtual Reality at this years CES"

www.cnet.com

171 million people will be using VR headsets by 2018

www.virtualrealityreporter.com

Can Public Safety leverage the emerging technologies of VR and AR to address testing and evaluation issues (and more)?

What are the possibilities?

Sony and NASA team up for *Mighty Morphenaut* project, using VR to operate robots in space

www.roadtovr.com

include film, gaming,
and education

NYT VR film app

'VR Education's' Apollo landing app

Sony PlayStation 4 VR

171 million people will be using VR headsets by 2018

www.virtualrealityreporter.com

Cons
on V
anc

VR has grown to include film, gaming, and education

NYT VR film app

'VR Education's' Apollo landing app

Sony PlayStation 4 VR

171 million people will be

appening Now

Consumers will spend $5.1b on VR hardware, software, and accessories in 2016

www.fortune.com

Now:

$5.1b

ware,

016

rtune.com

"Everyone wanted a piece of Virtual Reality at this years CES"

www.cnet.com

ge the

f VR

Sony and NASA team up for *Mighty Morphenaut* project.

016
rtune.com

"Everyone wanted a piece of Virtual Reality at this years CES"

www.cnet.com

ge the
f VR
g and
ore)?

s?

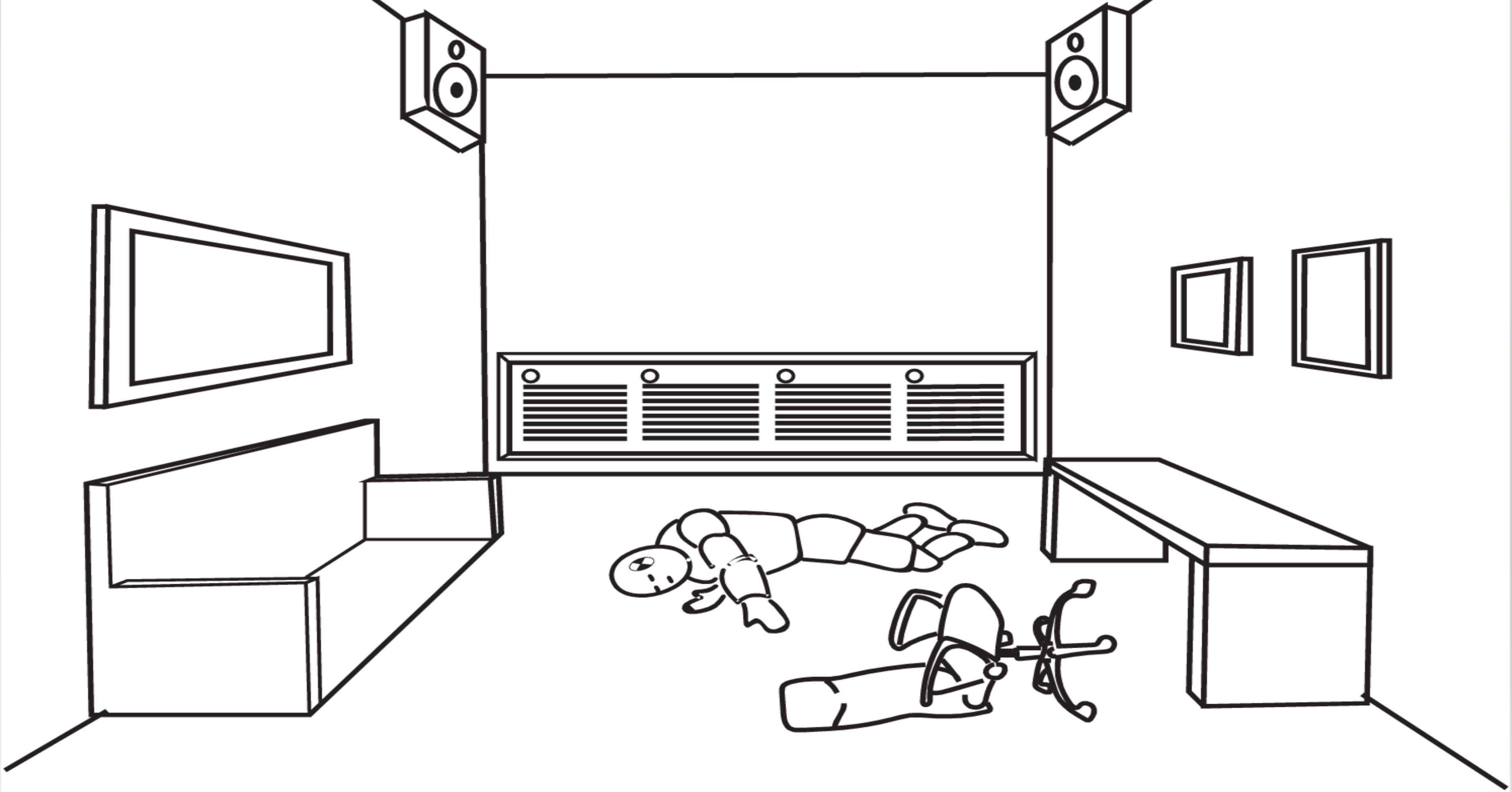
Sony and NASA team up for *Mighty Morphenaut* project, using VR to operate robots in space

www.roadtovr.com

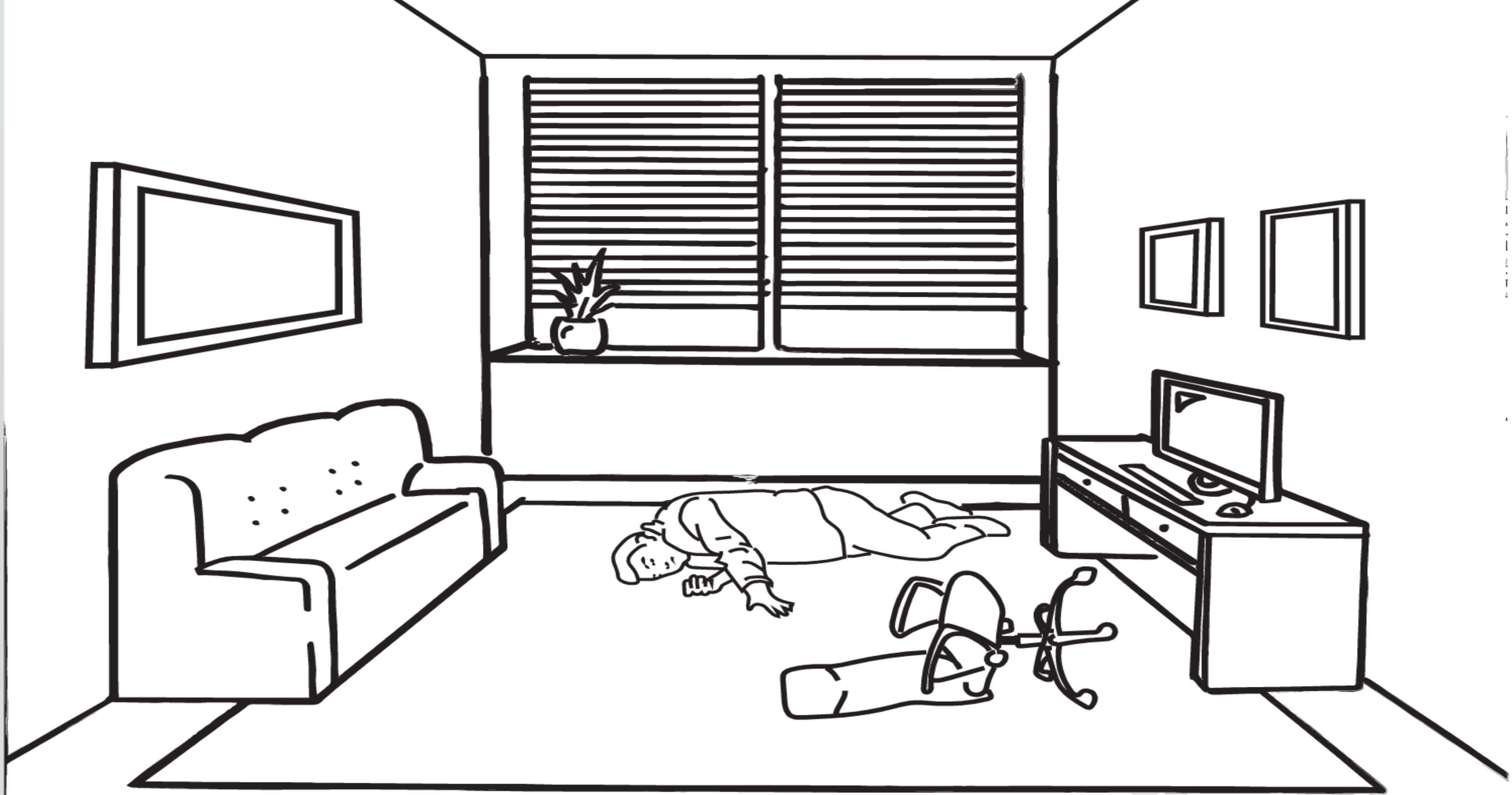
Public Safety's Immersive Test Environment
Possible uses of Augmented & Virtual Reality
PSCR June Stakeholder Conference 2016
Dereck Orr
PSCR
VR/AR Real World Application: Happening Now!
VR has grown to include film, gaming, and education
Consumers will spend $5.1b on VR hardware, software, and accessories in 2016
"Everyone wanted a piece of Virtual Reality at this years CES"
171 million people will be using VR headsets by 2018
Sony and NASA team up for Mighty Morphenaut project, using VR to operate robots in space
PSCR's current testing and evaluation mission
PSCR
Challenges in and out of the lab
Virtual Reality (VR)/ Augmented Reality (AR): Technology Overview

CR will investigate the use of a virt

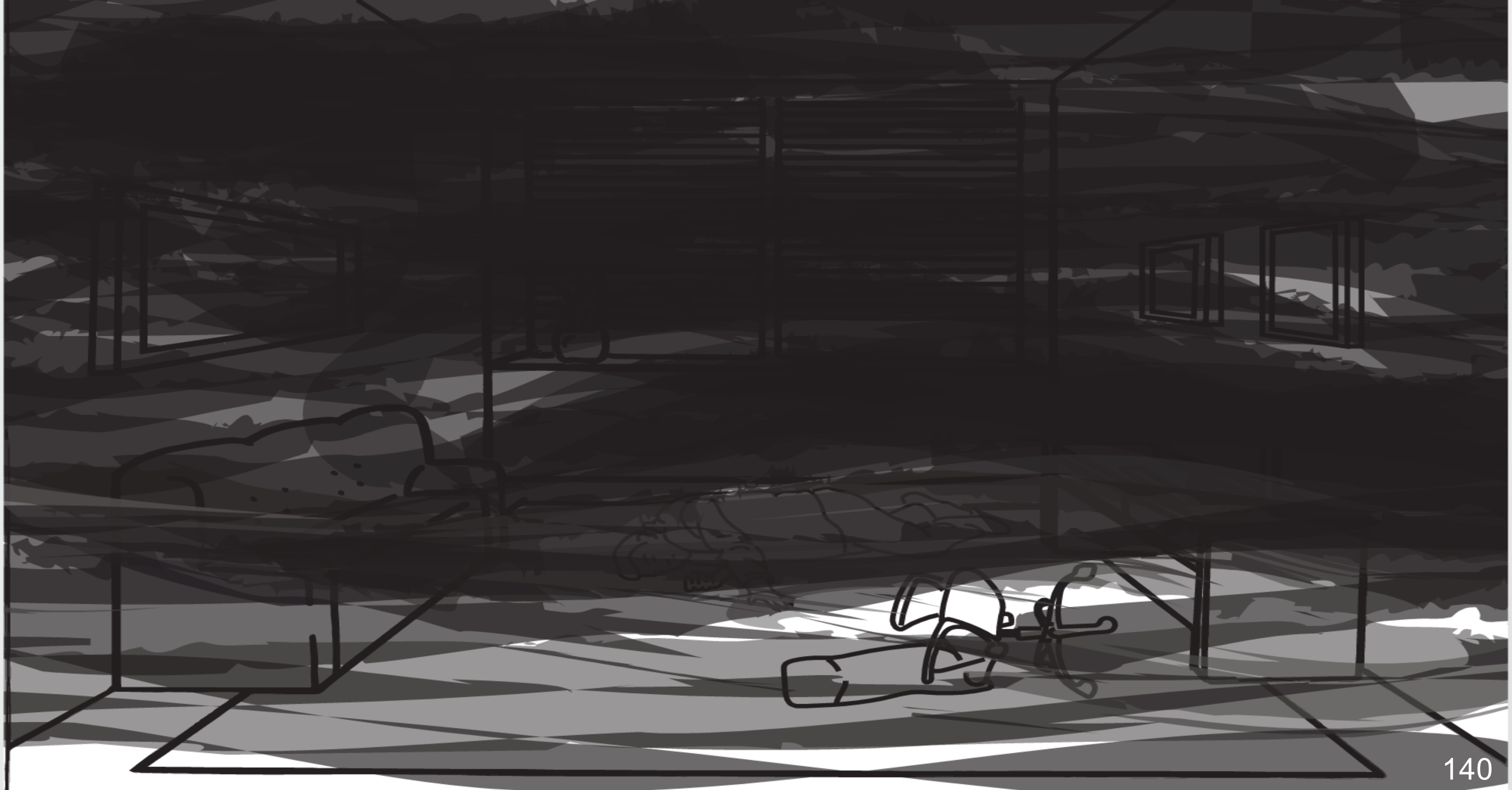
PSCR will investigate the use of a virtually augmented public safety test bed to test and measure emerging technologies and interfaces



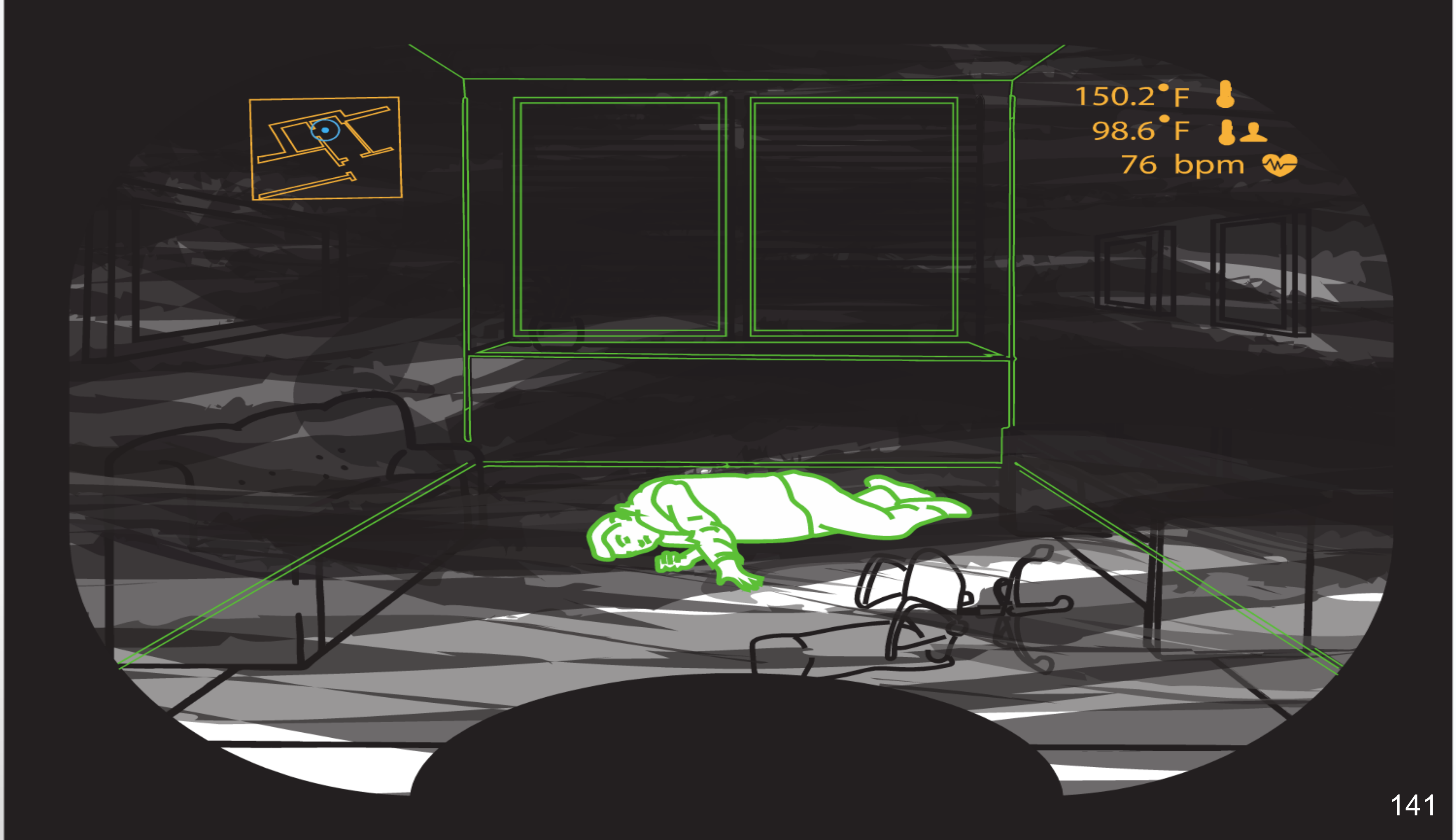
Physical test structure



Test infrastructure through AR/VR



Physical infrastructure in operating conditions


150.2°F
98.6°F
76 bpm

- Public Safety virtual test bed may include interaction with physical and virtual objects (furniture, lighting, equipment, etc.)
- Different opportunities offered by Virtual vs. Augmented Reality

Augmented Reality for Public Safety Testing

- Ability to handle and evaluate physical devices in augmented environment
- Limited to physical environment of user, may have to construct customized environs per use case

Virtual Reality for Public Safety Testing

- Ability to access limitless pool of virtual environments with infinite variability
- May be limited ability to handle physical devices for evaluation within fully virtual environment

Augmented Reality for Public Safety Testing

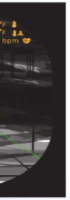
- Ability to handle and evaluate physical devices in augmented environment
- Limited to physical environment of user, may have to construct customized environs per use case

Virtual Reality for Public Safety Testing

- Ability to access limitless pool of virtual environments with infinite variability
- May be limited ability to handle physical devices for evaluation within fully virtual environment

Capability to test and measure the effectiveness of emerging technologies on public safety operations:

- User interface/ user experience
- Analytics
- Audio quality
- Biometric sensors & devices
- Location-based Services accuracy

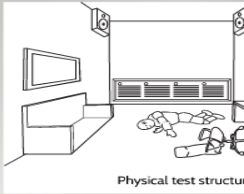


Open source library of user environments and interfaces

- Library/database of software environments accessed using VR/AR hardware devices
- Users can select from database of environments based on desired use case/testing scenario

PSCR could sponsor physical spaces where AR environments can be configured....

...the possibilities are endless!



$ Potential Benefits of Investment

- Low-cost value multiplier
- Demonstrate operational and communications based challenges facing public safety
- Effectively & efficiently evaluate solutions
- Accelerated prototyping (benefits 'solver community'
- Leveraged for multiple uses including training & education

Moving Forward & Next Steps

- Ideation challenge for achieving public safety focused virtual infrastructure (software, hardware, & physical spaces)
- PSCR User Interface R&D Roadmap: Ongoing working group effort
- PSCR to consider hosting VR/AR technology roundtable to further inform PSCR efforts

International Public Safety LTE Deployment Panel

Lessons Learned from Around the World

Panelists

- Moderator: Andrew Thiessen, *PSCR Standards Lead* Jeff Bratcher, *FirstNet CTO*
- Richard Hewlett, *Deputy Director, Emergency Services Mobile Communications Programme (ESMCP), UK Home Office*
- Jeong-ki Kim, *Director, Ministry of Public Safety and Security (MPSS) of Korea*
- Joe Fournier, *Portfolio Manager - Wireless Technologies, Centre for Security Science (CSS), Government of Canada*
- Jeff Bratcher, *FirstNet CTO*

Emergency Services Mobile Communications Programme

Richard Hewlett, *Deputy Director, Emergency Services Mobile Communications Programme (ESMCP), UK Home Office*

PSCR

Home Office

Emergency Services Mobile Communications Programme

PSCR Public Safety Broadband Stakeholder Meeting
9 June 2016

HM Government

National Police Chiefs' Council

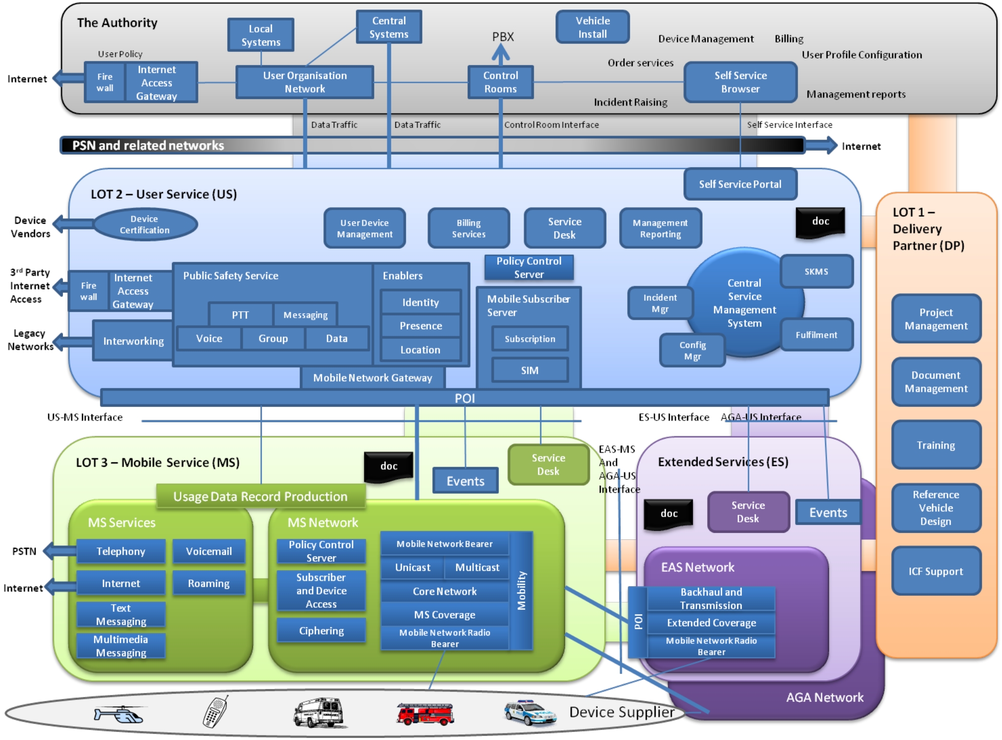
CFOA Chief Fire Officers Association

ASSOCIATION OF AMBULANCE CHIEF EXECUTIVES

ESMCP Scope

- National Voice and Broadband Data Service
  - Public LTE network with enhancements
  - 97% geographical coverage across Great Britain
  - Use of c18,000 base stations
  - Air to Ground network
  - Upgrades for resilience
- Mission Critical Communications Service
  - PTT Group and Point to Point Communications
  - Person Down Capability (Emergency Button)
  - Public Safety Messaging (P2P and Group)
  - Video streaming (P2P and Group)
  - Initially pre-standards then moving to 3GPP standards

System Architecture



HM Government

NPCC National Police Chiefs' Council

CFOA Chief Fire Officers Association

ASSOCIATION OF AMBULANCE CHIEF EXECUTIVES

Commercial Approach

- Funding approach – Invest to Save
  - Her Majesty's (HM) Treasury allocated budget for Founding Sponsor Bodies
  - Core Service a mixture of Capital Expenditures (CAPEX) and Operating Expense (OPEX)
  - Payback year 2023/24
  - Project management, devices, control room systems procured locally
- Procurement disaggregated into separate lots
- Re-compete contracts more regularly to exploit market forces and take advantage of technological evolution

ESN Users

- **Founding Sponsor Bodies**
  - 44 Police forces
  - 50 Fire and Rescue Services
  - 13 Ambulance Trusts
- **Other User Organisations**
  - National Crime Agency, British Transport Police, Civil Nuclear Constabulary, MoD Police, etc.
  - Central government departments and Local governments
  - Transport agencies and utility companies
- **Control rooms**: c230
- **Vehicles**: c50,000
- **Aircraft**: c115
- **Users**: c300,000

HM Government

NPCC National Police Chiefs' Council

CFOA Chief Fire Officers Association

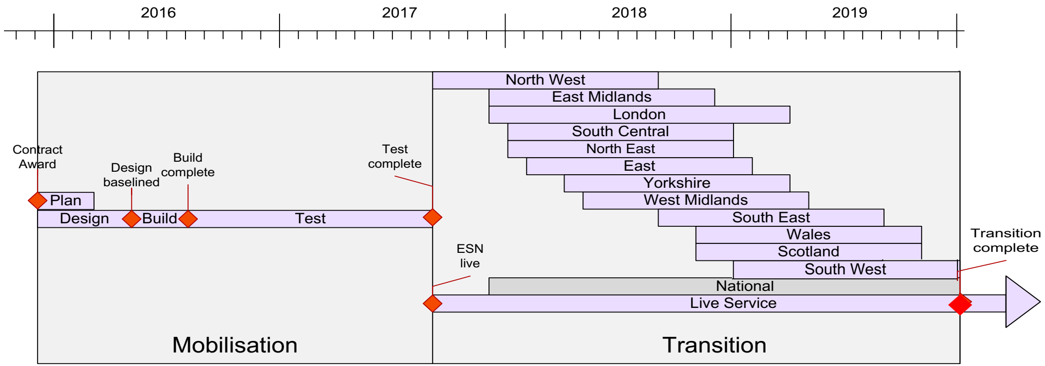
ASSOCIATION OF AMBULANCE CHIEF EXECUTIVES

Procurement

- **Main projects:**
  - Lot 1: Delivery Partner (KBR)
  - Lot 2: User Services (Motorola)
  - Lot 3: Mobile Services (EE)
- **Related projects:**
  - Extended Area Services
  - Air to Ground Services
  - London Underground Services
  - Procurement Framework for devices (Handheld, vehicle & airborne devices)
  - Control room upgrades
  - WAN connections
- **Dependent projects:**
  - Network Rail (Telecoms)
  - Crossrail
  - Mobile Infrastructure Programme
  - Government estates

Timescales

- Mobilisation – 21 months to design, build, test and assure
- Transition – 27 months to migrate users to ESN



- Transition will be completed in 12 Regional Transition Groups and one National Transition Group

HM Government
NPCC National Police Chiefs' Council
CFOA Chief Fire Officers Association
Association of Ambulance Chief Executives

PSCR

Korea SafeNet

Jeong-ki Kim, *Director, Ministry of Public Safety and Security (MPSS) of Korea*

The Status of Korea SafeNet

June 09, 2016

By Jeong-ki Kim

The Ministry of Public Safety and Security, KOREA

국민안전처

Video file of Korea Safenet demonstration
(June 3, 2016)

Agenda

I. Overview

- Concept of Korea SafeNet
- Structure of Korea SafeNet
- Comparison : Usual vs Emergency Pilot status
- Milestones

II. Pilot Project Status

- SafeNet Pilot Deployment
- SafeNet Pilot Network Configuration
- Public Private Cooperation

III. Future Plan

- SafeNet Deployment Scenario
- SafeNet Future Evolution Scenario

IV. Summary

I. Overview

Concept of Korea SafeNet

Nationwide unified network will be utilized activities such as usual duties and prevention services as well as Integrated command, control and assistance among all agencies in disaster.

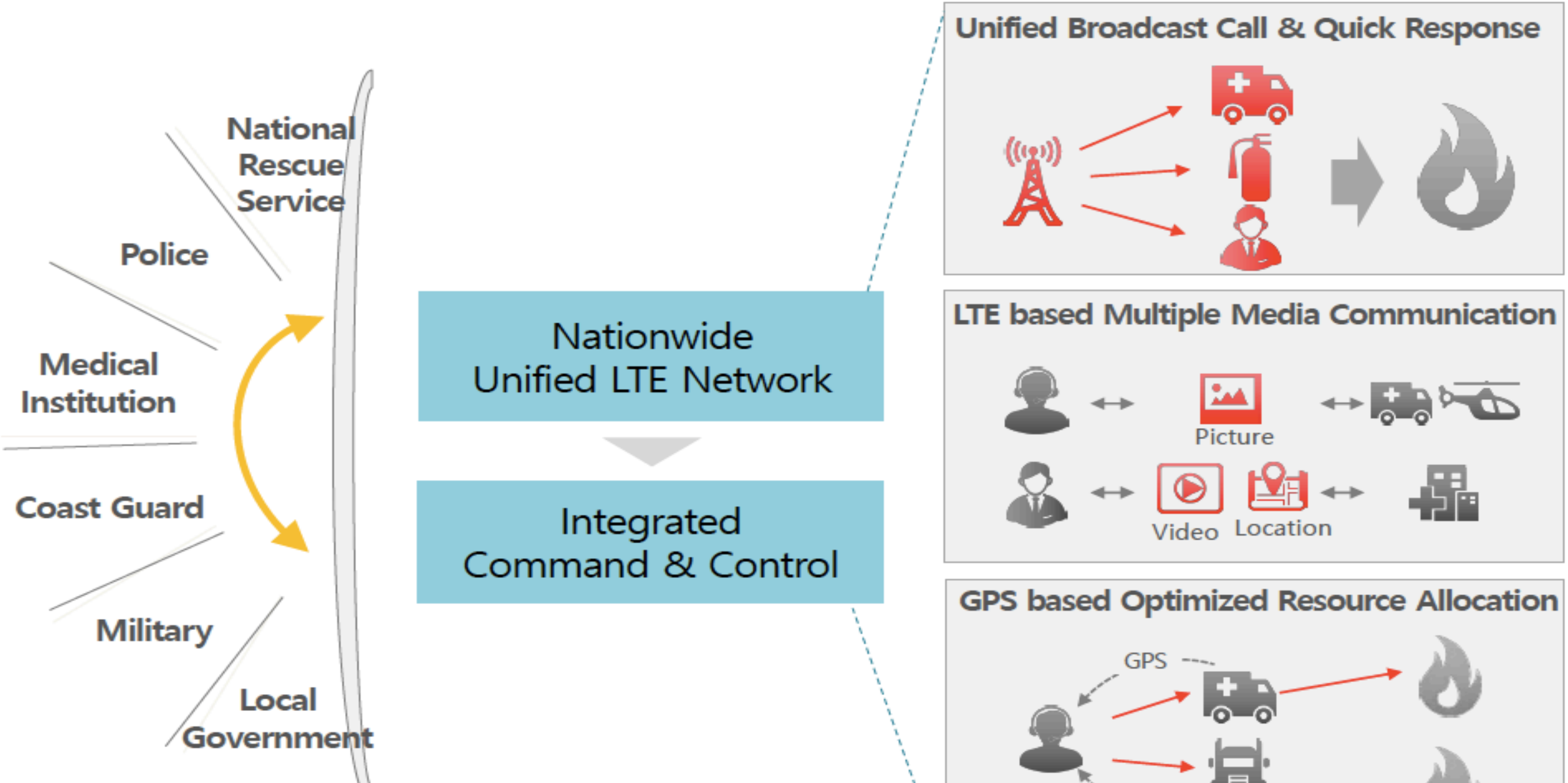
▣ Nationwide Unified Network

- ✓ Usage for 333 agencies
- ✓ in 8 departments

▣ Target of PS-LTE Standard Rel.13

- ✓ 37 Functional Items such as :
  - direct mode,
  - stand alone base station etc.,

Structure of Korea SafeNet



※ 8 departments
National Rescue, Police, Coast Guard,
Military, Local Gov., Medical, Electric, Gas

Comparison : Usual vs Emergency

Usual

- **Fire/Rescue** Facilities information, Routing
- **Police** Security screening, CCTV
- **Coast Guard** Ship information inquiry
- **Integrated Defense** Joint military service
- **Safety management** Inspection record, registration
- **Medical** Remote diagnosis, patient record
- **Electric/Gas** Remote monitoring

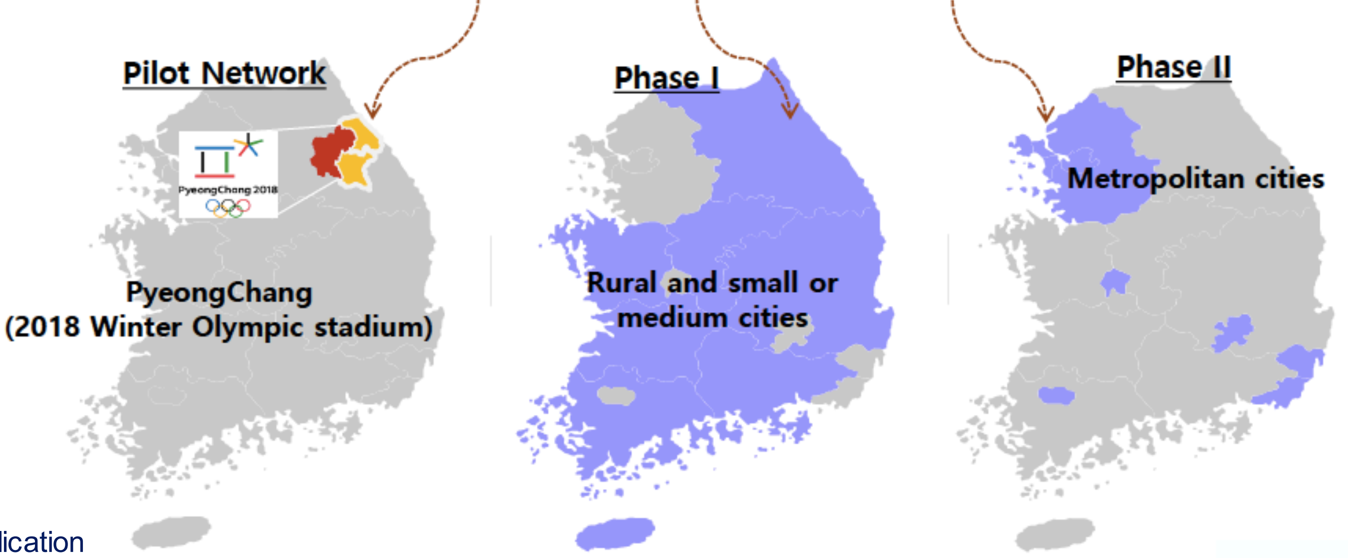
Emergency

- **Rapid situation assessment**
  Video of site, GPS information,
  Simultaneous propagation of situation
- **Simultaneous command**
  Management of communication group
- **Integrated control**
  Group call, emergency call
- **Cooperation between agencies**
  Video conference, resource request

Milestone

- Pilot : Verifying and testing the effectiveness of PS-LTE technologies
- Phase I&II : Rel. 13 Implementation, *SW Application, Interoperability

~Nov. 2014	~OCT. 2015	~Jun. 2016	~ Dec. 2017
PS-LTE Technology & 700MHz	ISP & RFP	Pilot Network	National wide Network



*Semantic Web (SW) Application

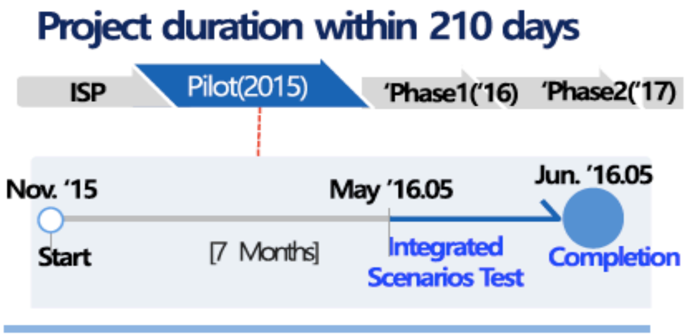
II. Pilot Project Status

SafeNet Pilot Deployment

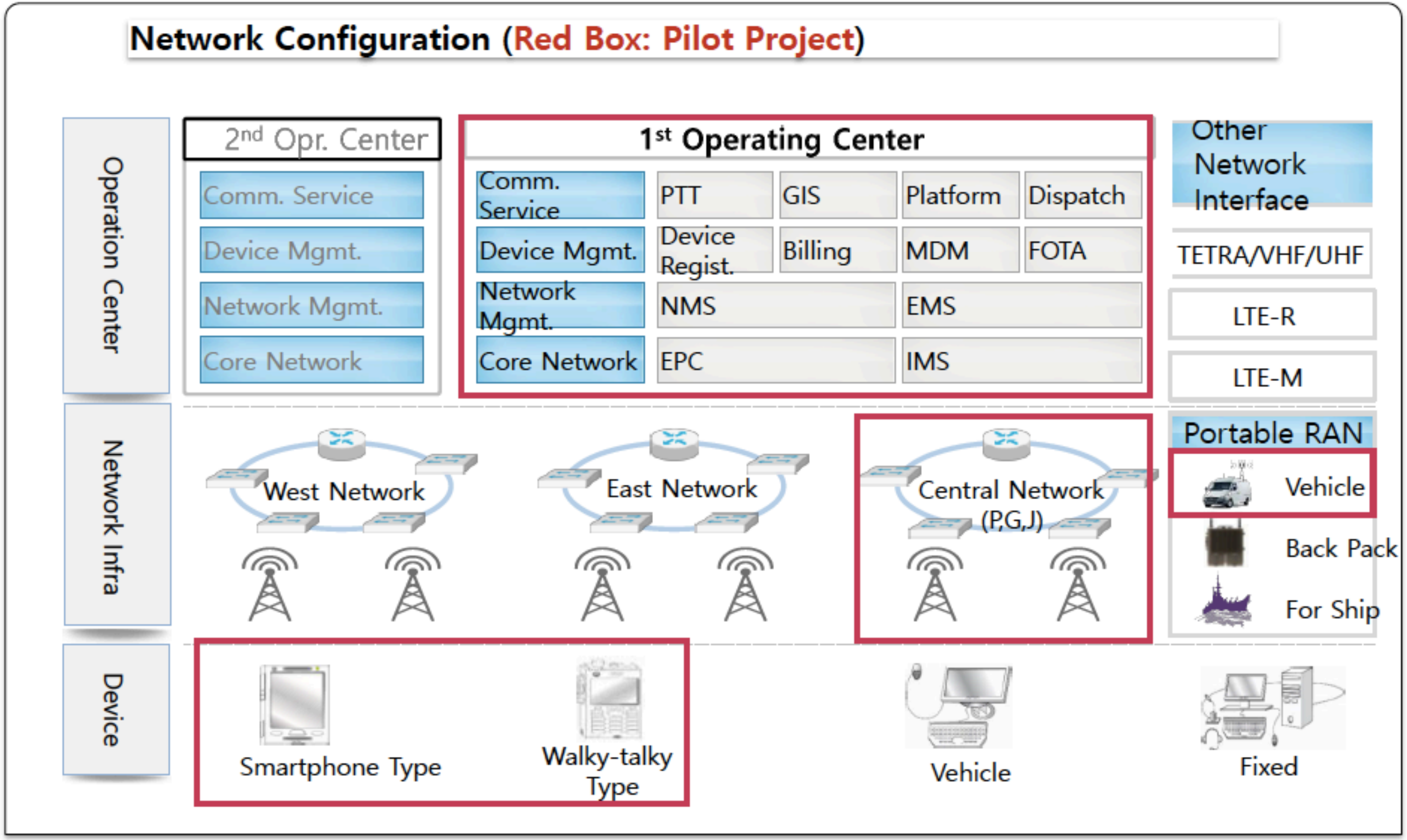
- **Period: Nov.2015 - Jun. 2016**
  - **2 Sub-Projects In parallel : (1)PyeongChang Area+Operating Center, (2)GangNeung & JungSun Area**
- **Budget :** 43.6Bil.KRW (37Mil.US$)
- **Working Scope**

Operation Center(1), Fixed Base Station(205), Mobile Base Station(1), Wireless Phone(2496)

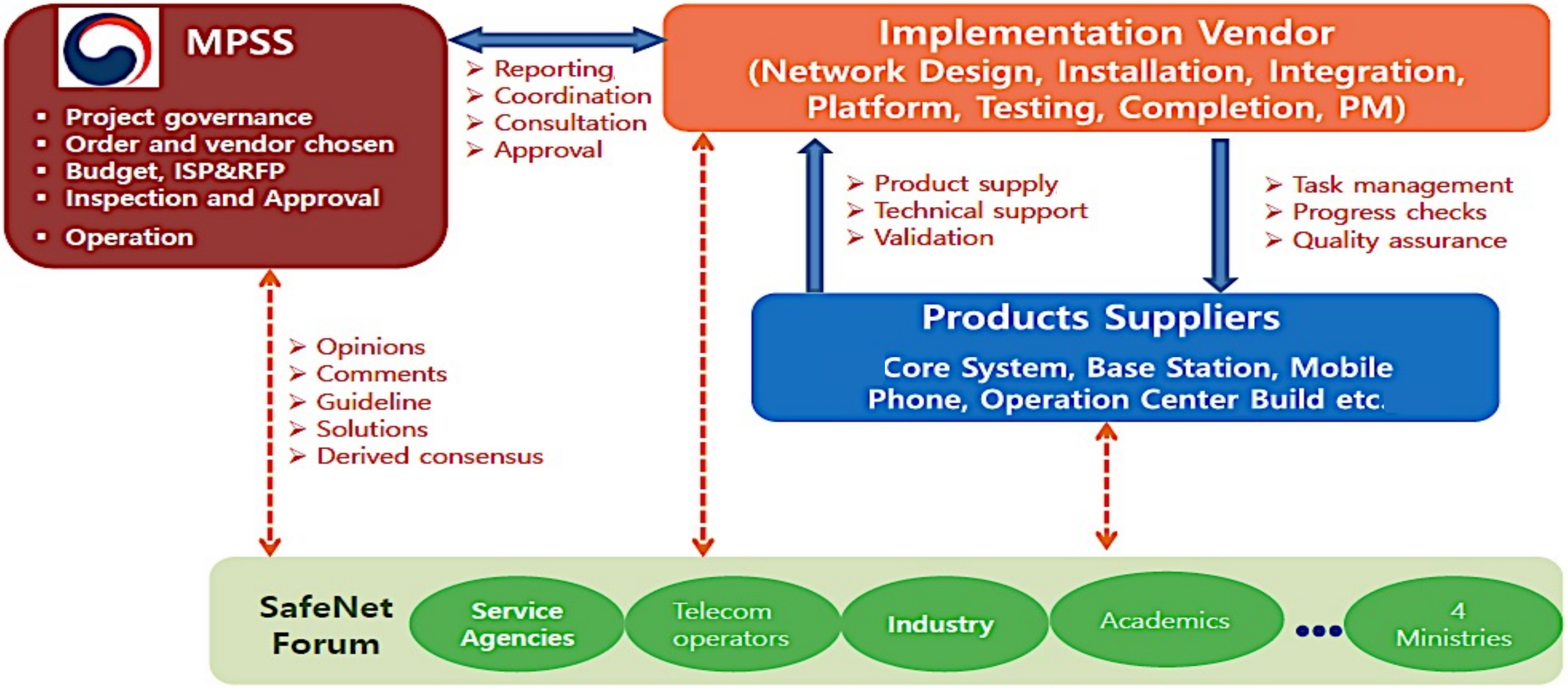
- Trial Network Deployment
- Trial Operation and Maintenance
- Interoperability Test and Security Verification
- Performance (Out/In-Door Coverage, 37 Features)
- Interworking Solution for Commercial Network, Tetra and UHF/VHF
- Interference Test with LTE-R(Railway)/LTE-M(Maritime)



SafeNet Pilot Network Configuration



Public Private Cooperation



Fairness and transparency opinions & guide of policies
Technical Consulting & comments of experts, industries, agencies and academics
Discussing issues and solutions suggested

*Ministry of Public Safety Security (MPSS)

III. Future Plan

SafeNet Deployment Scenario

Pilot ('15 ~'16)	Phase 1 ('16 ~'17)	Phase 2('17)
Gangwon Province (PyeongChang, GangNeung, JungSun) (Deploy 205BS, 2,500MS)	9 Provinces (Deploy 7,300BS, 100K MS)	Seoul, GyeongGi & 6 Metropolitan Cities (Deploy 4,200BS, 100K MS)
- Local Government, Police, Fire Station, Coast Guard	- Local Government, Police, Fire Station, Coast Guard (176 Organizations)	- Local Government, Police, Fire Station, Coast Guard (330 Organizations)
- LTE-R(Railway) Interworking Test	- LTE-M(Maritime) Co-deployment	- LTE-R/LTE-M Interworking
- Smart Phone, Walkie-Talkie	- Smart Phone, Walkie-Talkie, Vehicle, Fixed	- Smart Phone, Walkie-Talkie, Vehicle, Fixed

SafeNet Future Evolution Scenario

Short term (~'17)	Mid term (~'20)	Long term (~'24)
Public Safety Network Completion	Expansion (Military, Organization)	Expansion (Mobile Government)
- Terrestrial Coverage - Coastal ~ 20km	- LTE-R/LTE-M Interworking - Coastal ~ 100km	- Expansion to Aeronautic Area
- LBS Device Remote Control	- IoT u-Health, Drone/UAV	- m-Workspace, Robotics, Wearable devices

IV. Summary

Key Factors for Successful SafeNet

Economic and efficient network deployment

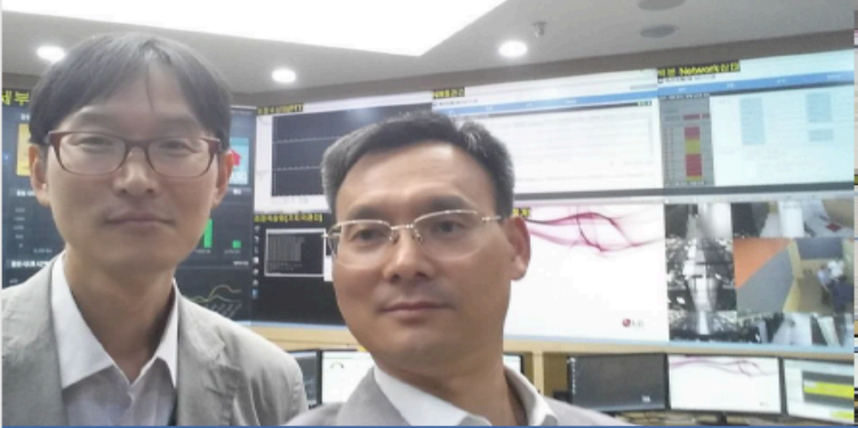
- It has a characteristic that satisfies with liability, disaster responsiveness, interoperability and security as well as disaster response, disaster monitoring, forecasting for maximum utilization

Timely deployment (the world's first commercially available)

- To integrate the disaster management SoP, interoperability, security, and services that the world's first PS-LTE based on nationwide unified LTE network for 333 agencies in Korea.
- Timely establishment of national building projects through close communication and cooperation with stakeholders

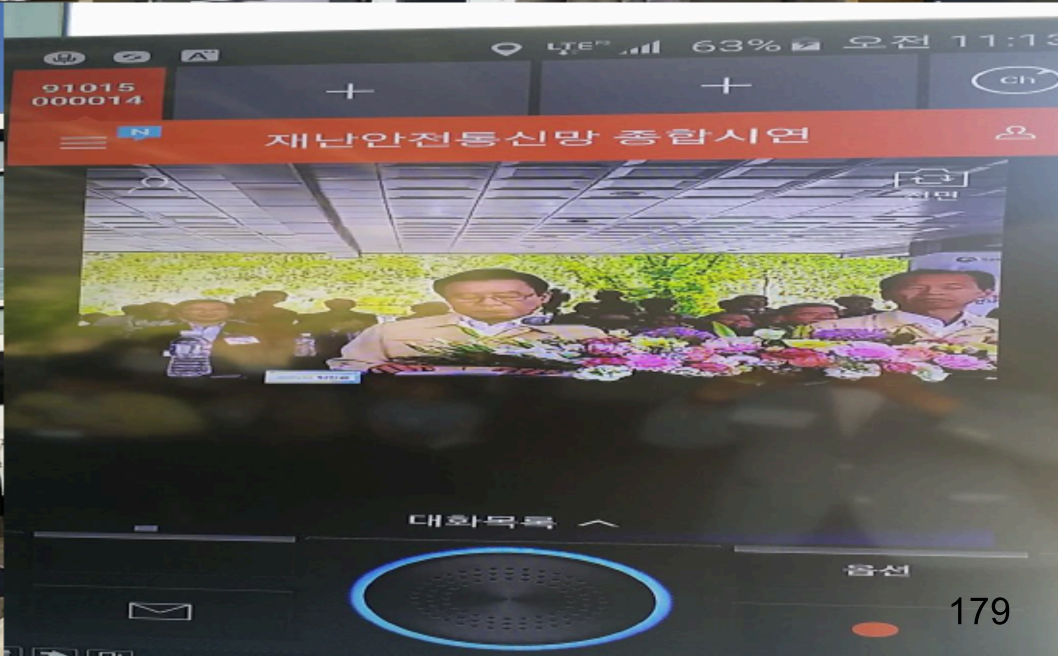
Global leader in creating new markets

- PS-LTE standardization and disaster leading ICT convergence networks (IoT, Big Data, positioning) services market creation.
- One of key factors to expand Global Public Safety in IT markets before and after Pyeong-Chang 2018 Winter Olympic




NMS대시보드(시스템세부현황)


대한민국정부
98호6229


63%
91015
000014
재난안전통신망 종합시연
대화목록
옵션

PSCR

Canada – The 700MHz Public Safety Broadband Initiative

Joe Fournier, *Portfolio Manager - Wireless Technologies, Centre for Security Science (CSS), Government of Canada*

Defence Research and Development Canada
Recherche et développement pour la défense Canada

Canadian Safety and Security Program

700 MHz Public Safety Broadband - Canada

Joe Fournier

2016
Public Safety Broadband Stakeholder Meeting
June 7-9, 2016
PSCR

DRDC | RDDC

Canada

How Did We Get Here?

- Nov 2010: Industry Canada launches "Consultation on a Policy and Technical Framework for the 700 MHz Band and Aspects Related to Commercial Mobile Spectrum"
  - General consensus in the replies from the Canadian public safety community that at least 20 MHz of spectrum is required for broadband wireless services.
- Mar 2012: Minister of Industry announces setting aside 10 MHz of spectrum in the 700 MHz band, with a possible additional 10 MHz to follow
- Aug 2012: Industry Canada launches "Consultation on a Policy, Technical and Licensing Framework for Use of the Public Safety Broadband Spectrum in the D Block the PSBB Block."
  - Public Safety Canada coordinates a joint response by Federal, Provincial, Territorial Authorities, Federation of Canadian Municipalities and the Tri-Services Chiefs Associations on behalf of the First Responder and Emergency Management Communities.
- April 21, 2015: Government of Canada identified an additional 10 MHz for public safety broadband - total of 20 MHz

Key Recent Developments

- Oct 2015: Federal election in Canada
- May 6, 2016: Federal, provincial and territorial (FPT) ministers responsible for emergency management met in Toronto to discuss national priorities.

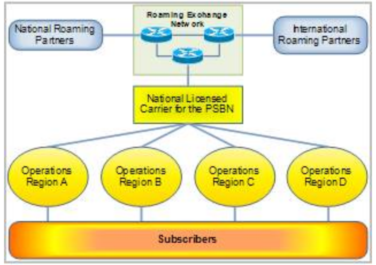
> *"Ministers discussed the status of the joint FPT work to advance a Public Safety Broadband Network. Ministers agreed on the creation of a public-private advisory group to inform the way forward on this important, yet complex initiative."*

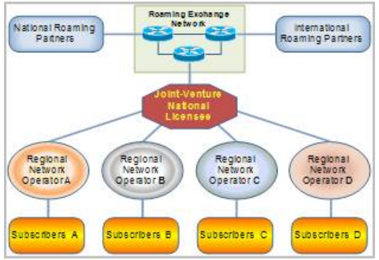
- Already generating increased activity on the Public Safety Broadband Network (PSBN), great opportunity to move forward…. federal stakeholders meeting May 27

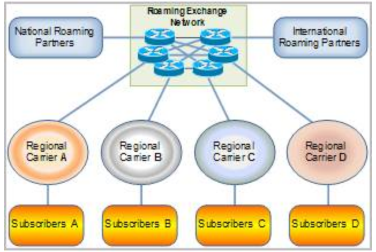
Moving Ahead!

- What is the service delivery / business model of a future the PSBN?
  - Public safety owned/dedicated? Commercial? Public safety but shared w/ commercial?
- What is the governance model?
  - Single carrier network? Multiple regional? Federated network?
  - Who in the public safety community uses the network?
  - What are the tiers of users?
- What are the spectrum licensing conditions?
- What are the user needs? operational, interoperability, and security requirements?
- Interoperability with FirstNet?
- We continue to work on all of this but as of now…

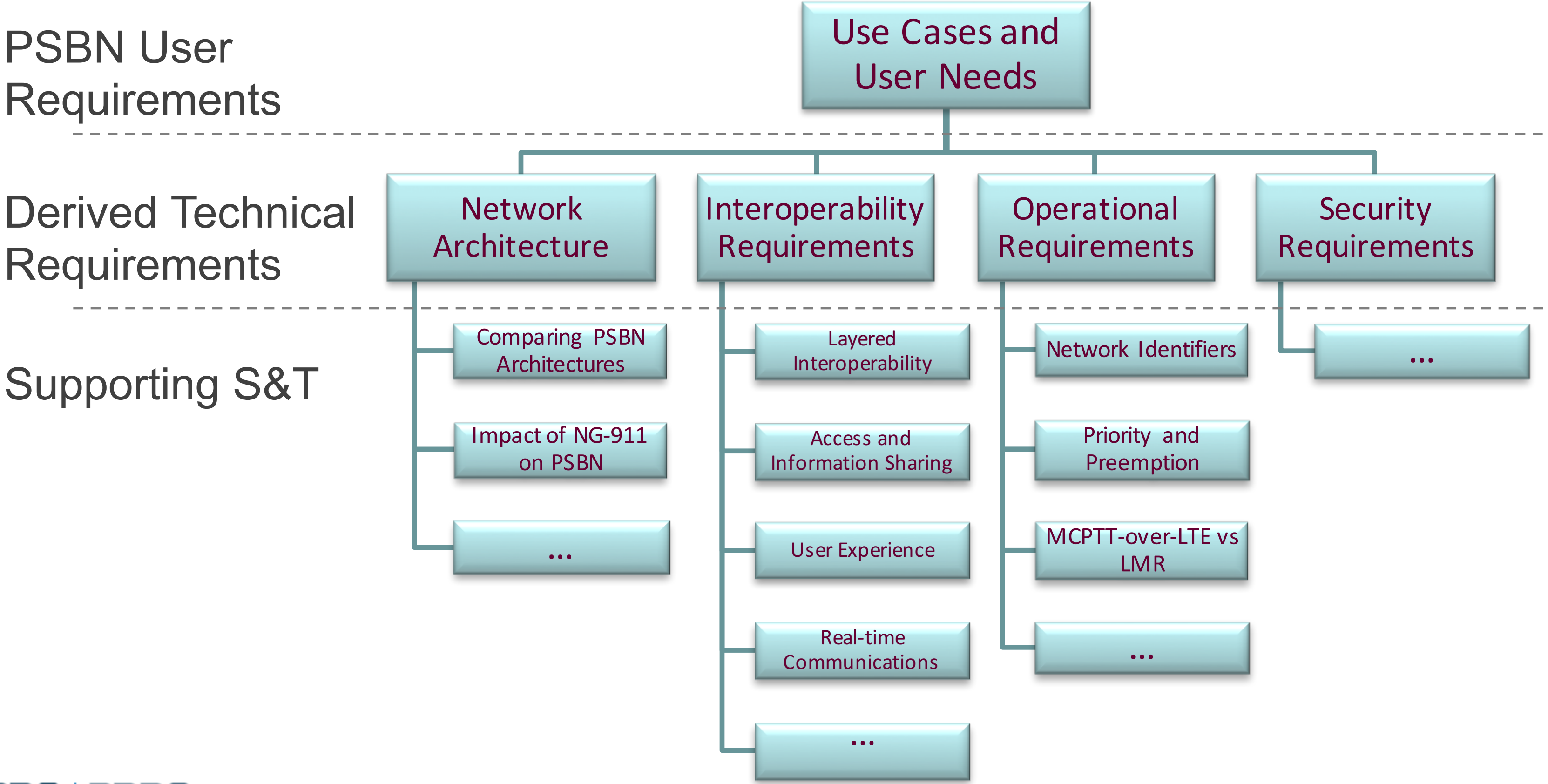
…we are still in the process of defining our "FirstNet"!



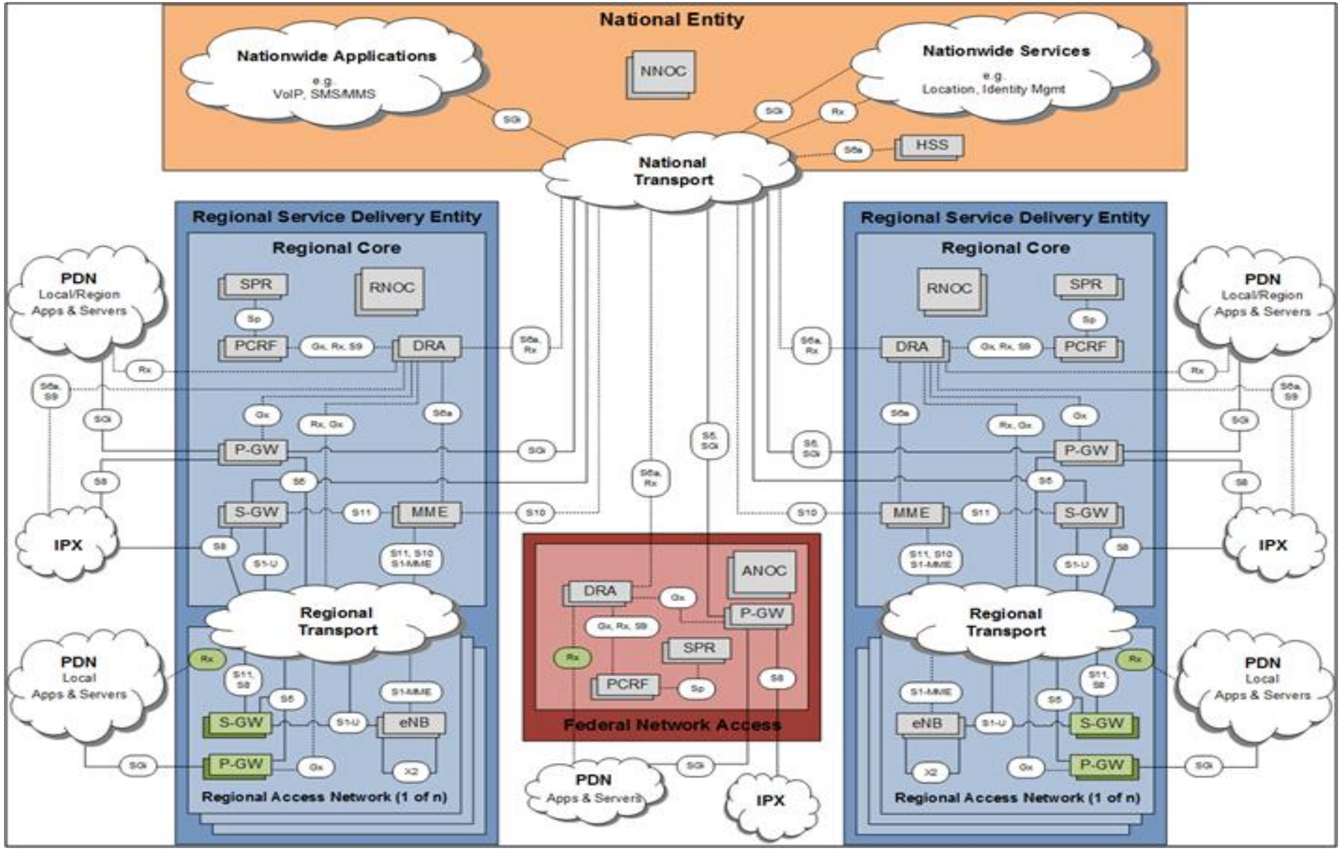




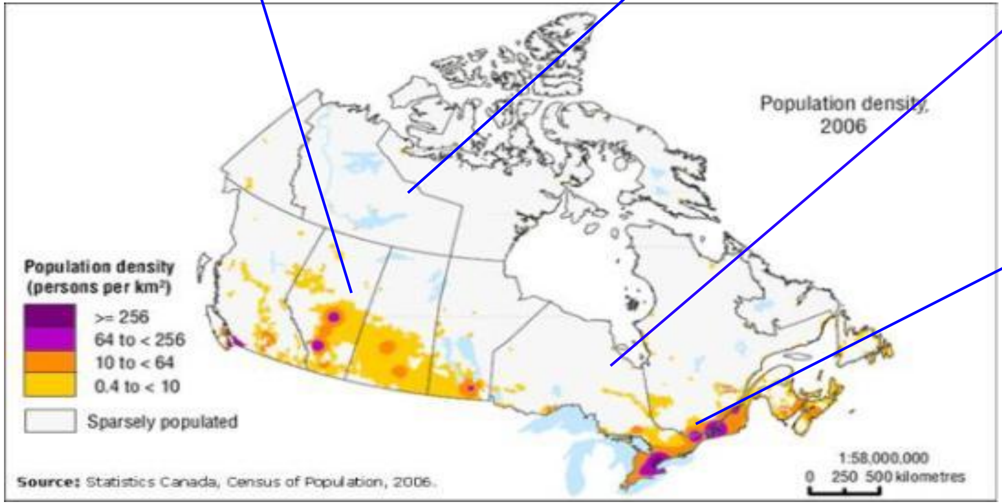
Structured Approach Will Pave Way to Success!



PSBN Network Architecture – Possible Model



A Big Part of the PSBN is Deployable LTE Systems!

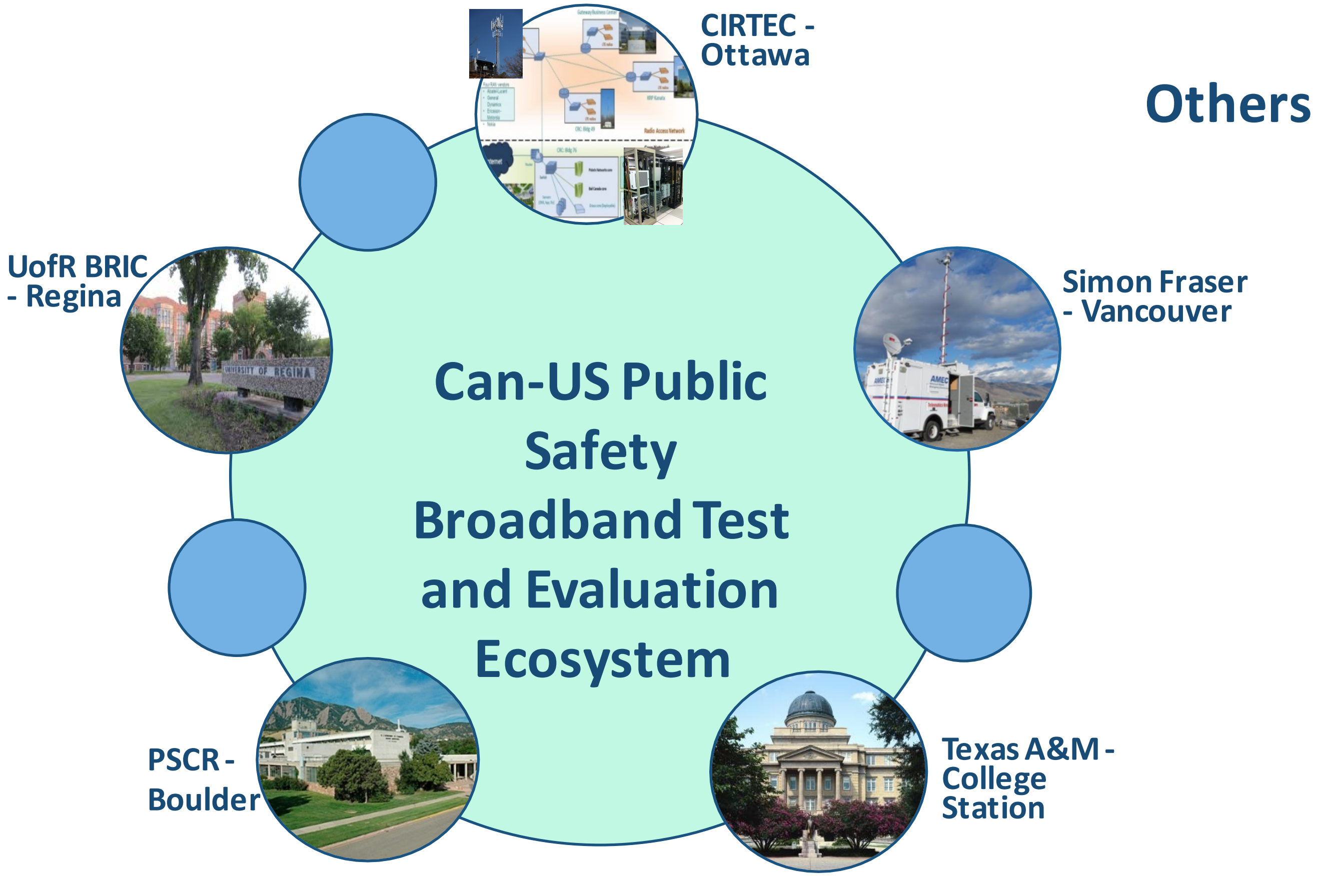


Identified by both U.S and Canada as a critical capability (joint Canada-U.S -chaired NPSTC-CSS Deployable System Work Group (DSWG)

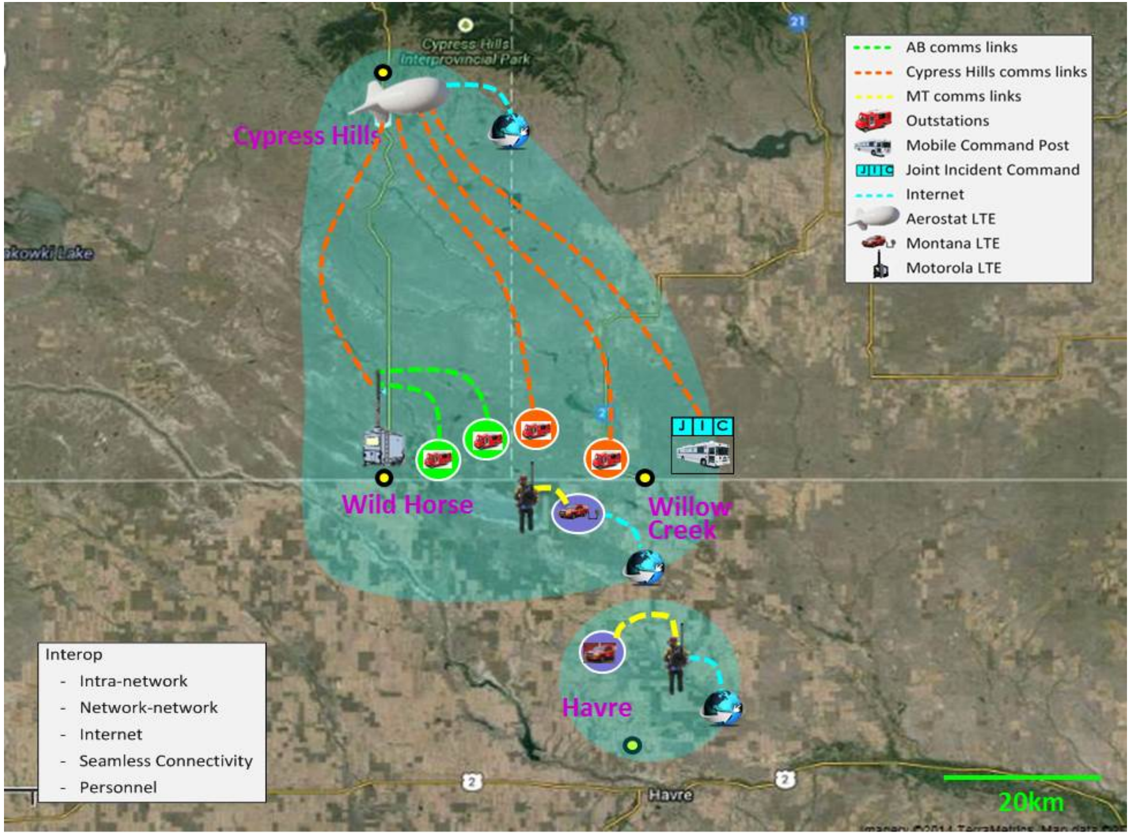
Deployables – Many Delivery Platforms

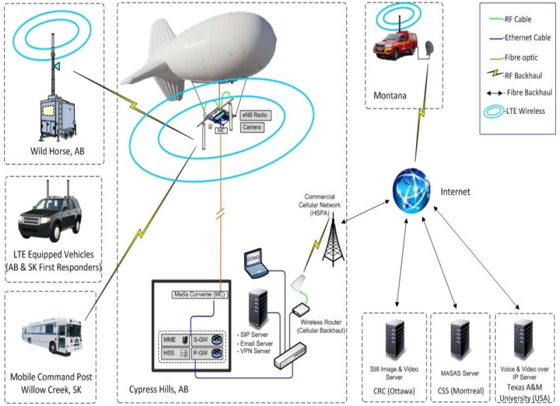
Deployable LTE systems are expected to fit into a wide variety of platforms that would best suit the needs of each incident.

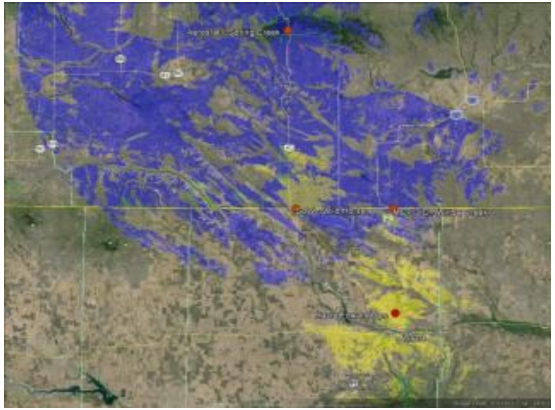
Canada-US Test and Evaluation Ecosystem



Canada-US Enhanced Resilience Experiment III – 700 MHz Deployable LTE







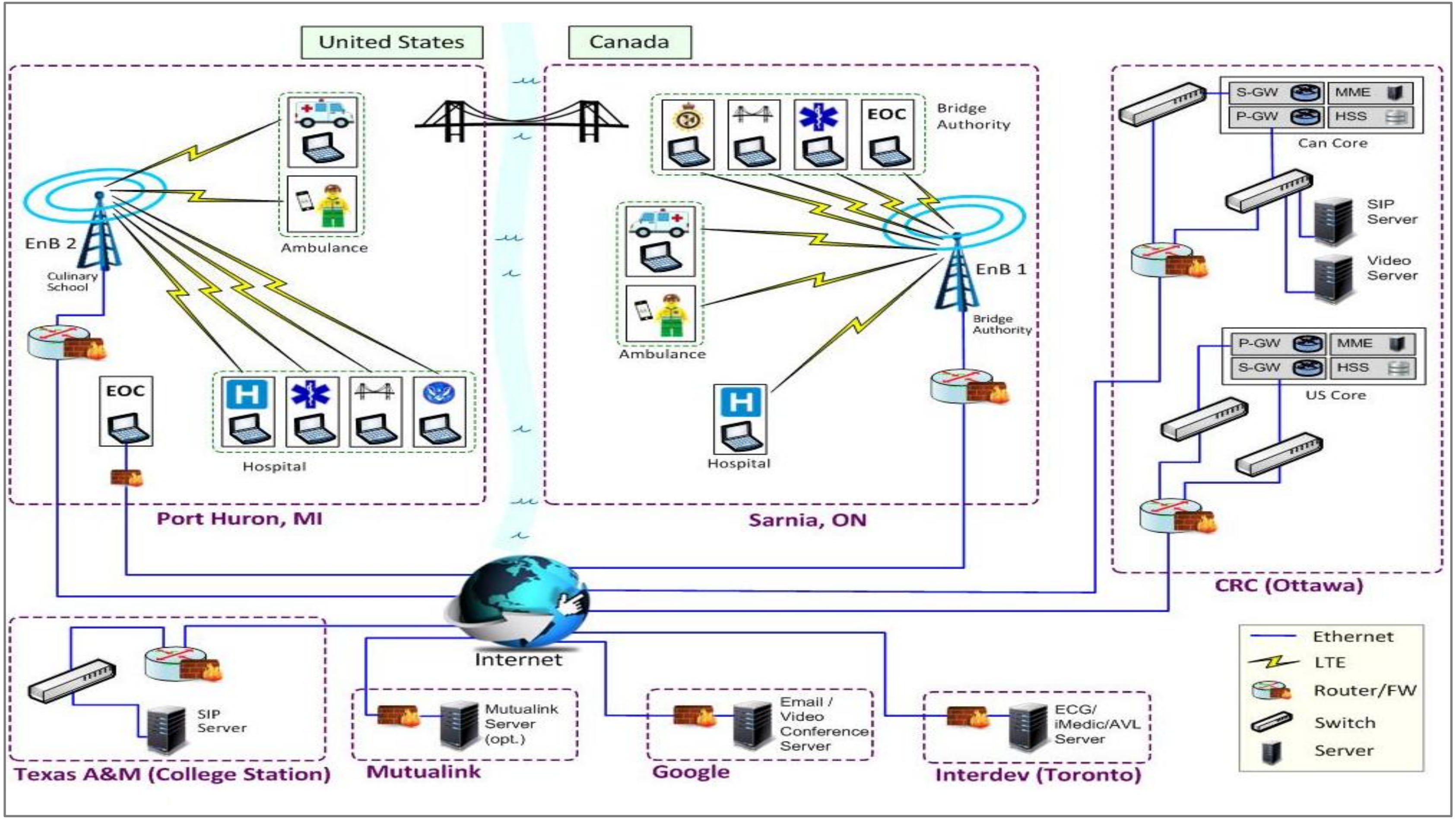
CAUSE IV – Vignette 1

Interoperability of Paramedic Services

Objectives:

- Establish and field test **cross-border 700MHz public safety broadband wireless network capability**
- Examine voice and data communications (e.g., transmission of electrocardiogram tracing, live video, patient records, situational awareness/COP, vehicle tracking)
- Emulation of FirstNet and the Canadian PSBN

CAUSE IV – System Configuration



CAUSE - Bringing New Technology and Users Together

Exciting Times!

- Canada has been working on PSBN for many years but…
- Moving faster and doing more than ever
- Working together within Canada and with our friends to South and internationally!

Joseph.Fournier@forces.gc.ca

PSCR

FirstNet Update

Jeff Bratcher – CTO

FirstNet®

www.firstnet.gov

FirstNet Update

Jeff Bratcher - CTO

PSCR 2016 PSBB Stakeholder Meeting

International Public Safety LTE Deployment Panel

June 09, 2016

What is FirstNet?

- **Mission**
  - Based on 9/11 Commission Report recommendations, FirstNet will ensure the building, deployment, and operation of the nationwide public safety broadband network
- **Organization**
  - FirstNet is an independent authority authorized by Congress
- **Funding and Assets**
  - FirstNet will spend up to $7B to deploy a nationwide public safety mobile broadband network
  - FirstNet brings 20 MHz of Band 14 spectrum to enable a Public-Private Partnership
  - FirstNet is authorized to charge fees, including user fees, core fees and infrastructure fees
- **Governance**
  - 15 member Board, CEO, President and senior management team
  - Consultation with the 50 states, 5 territories, and Washington, D. C.
  - Advised by Public Safety Advisory Committee (PSAC), a 42-member committee consisting of public safety associations, advisory groups, state/local government associations

The FirstNet Network

- **Provide nationwide coverage, including rural and remote areas**
- **Address key public safety needs**
  - Interoperability
  - Priority
  - Reliability and Security
- **Drive innovative solutions/applications for public safety**

The FirstNet Opportunity

In the United States, the number of mobile-connected devices will grow at a compound annual growth rate of 22% from 2014 to 2019. (Cisco Systems)

In the United States, mobile data traffic will grow 7-fold from 2014 to 2019, a compound annual growth rate of 47%. (Cisco Systems)

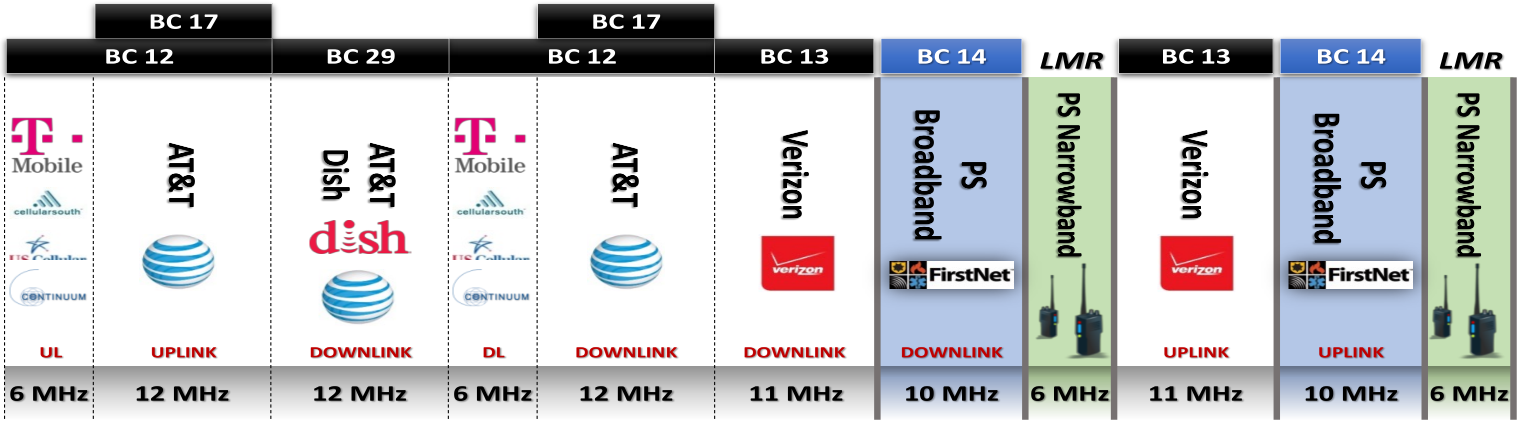
- The FirstNet opportunity provides a unique method to enter the U.S. wireless market or enhance an existing network
- The FirstNet financial model requires less up-front cash investments than the traditional spectrum auction process and also provides cash to support network deployment and operations.

FirstNet Spectrum – Band 14

FirstNet®

20 MHz of Spectrum @ 700MHz

- 3GPP standardized as LTE "Band 14"
- 10 MHz Downlink + 10 MHz Uplink
- Entire 20 MHz swath plus guard bands licensed nationwide to FirstNet
- Allows higher power portable/mobile devices – benefit to rural areas
- 3GPP Standards already in place for up to 1.25W devices



Request For Proposals (RFP) based upon the Statement of Objectives

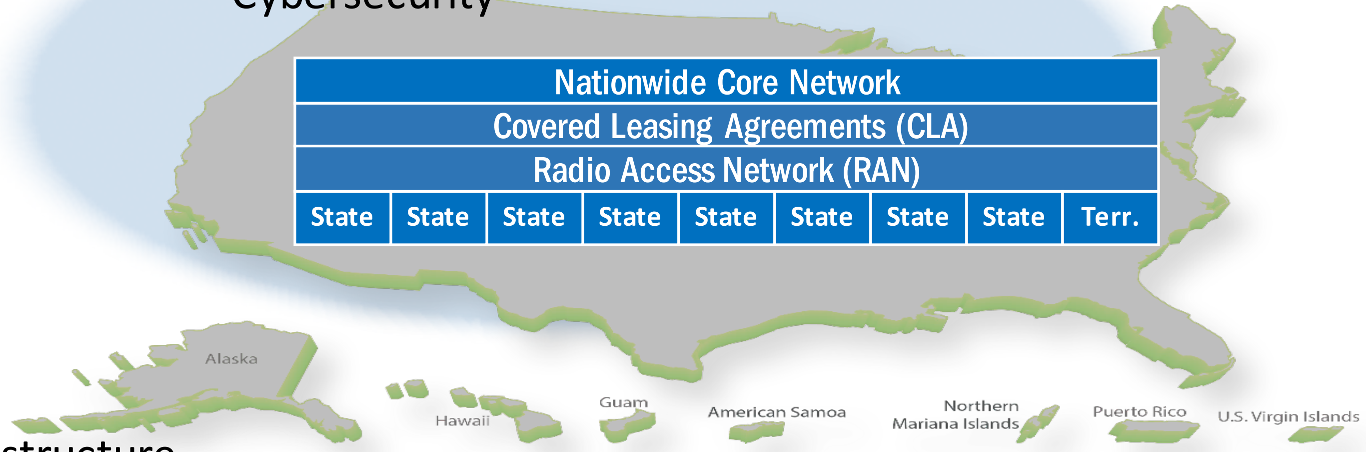
FirstNet®

- Build, Deploy, Operate & Maint. the NPSBN
- Financial Sustainability
- First Responder User Adoption
- Device Ecosystem
- Applications Ecosystem
- Accelerated Speed to Market
- User Service Availability
- Service Capacity
- Cyber Security
- Priority Services
- Integration Of Opt-out State RANs
- Integration of Existing Commercial/ Federal/ Tribal/State/ Local Infrastructure To Support NPSBN Services
- Life-cycle Innovation
- Program and Business Management
- Customer Care and Marketing
- Facilitation of FirstNet's Compliance With The Act & Other Laws

RFP Partnership Benefits

Partner responsible for deployment of

- Network Core
- Radio Access Network (RAN) for States/Terr. that do not exercise opt-out
- Devices and application ecosystems
- Cybersecurity



Key Partnership Benefits:

- Speed to Market
- Economies of Scale
- Leverage partner infrastructure

Public–Private Partnership Enables Success

A Unique Public–Private Partnership Will Achieve FirstNet's Mission

FirstNet Provides

- 20 MHz of low-band spectrum
- Billions in cash
- Relationship with public safety stakeholders
- 25-year contract ordering term (IDIQ)

Partner Provides

- Assets, capabilities, and synergies to meet FirstNet's statement of objectives:
  - Deploy, operate, and maintain the NPSBN
  - Public safety adoption and use of the NPSBN
  - Applications and device ecosystems
- Payments to FirstNet to ensure sustainability and network reinvestment

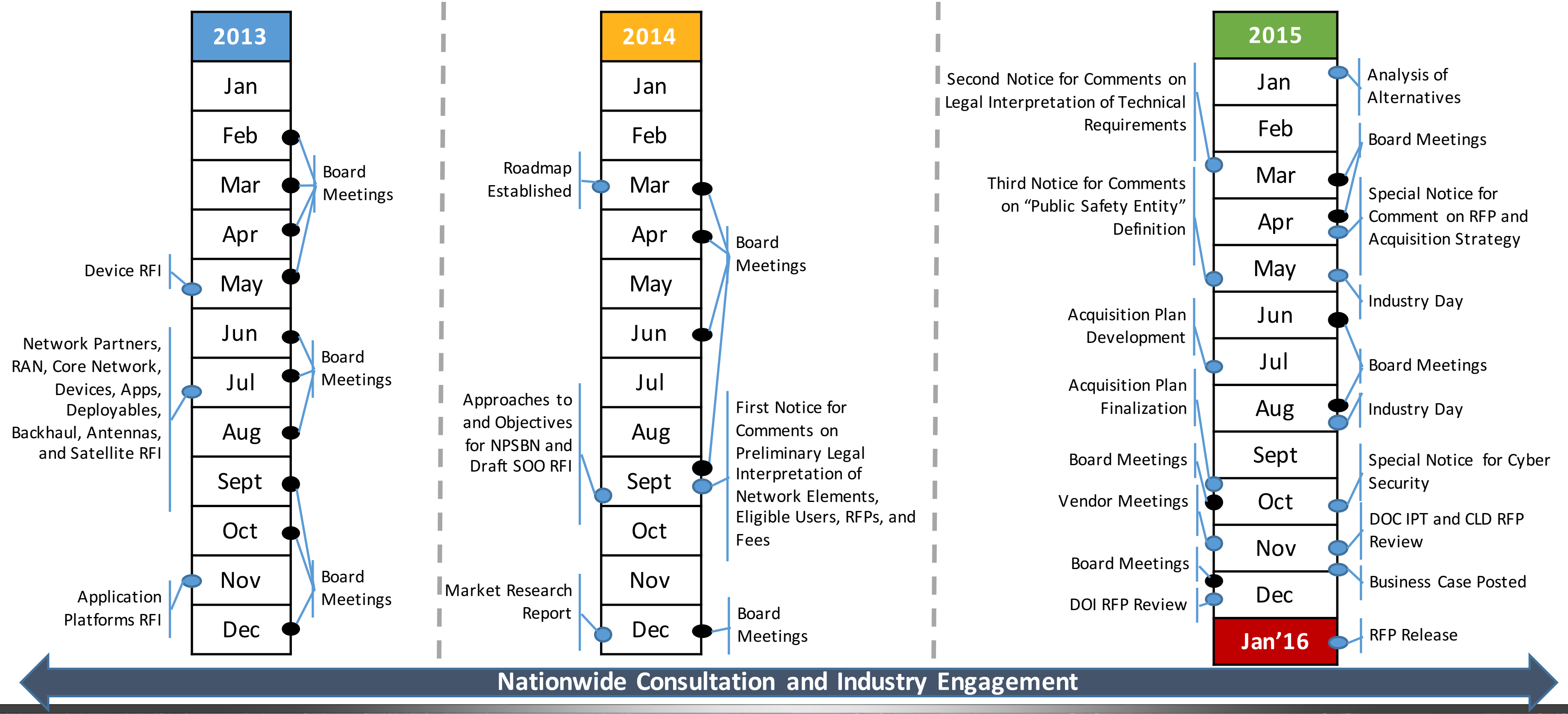
FirstNet Receives

- Nationwide public safety mission achieved with priority, preemption, and a resilient network
- Improved public safety communications capabilities that increase mission performance
- Annual payments to ensure sustainability

Partner Receives

- Cash payments based on buildout milestones
- Rights to monetize Band 14 excess capacity with significant revenue potential for 25 years
- Market of millions of public safety users
- Domestic/global pull-through benefits

RFP Development and Stakeholder Review Timeline



FirstNet RFP – 2016 Timeline

RFP Q&A Metrics

TOTAL # OF QUESTIONS:

447

(inclusive of Pre-Proposal Conference)

TOTAL # OF SUBMITTERS:

26

Evaluation Factors and Sub-Factors

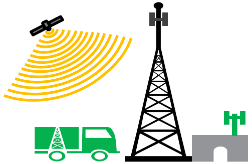
FirstNet®

Business Management Factor

- Leadership and Program Management
- Public Safety Customer Acquisition
- Customer Care and Lifecycle Sustainment
- Financial Standing
- Delivery Mechanism for State Plans

Value Proposition Factor

- Meets FirstNet sustainability objective
- Use of FirstNet's $6.5B
- Demonstrated synergies & added value
- Unbalanced/unreasonable value determination

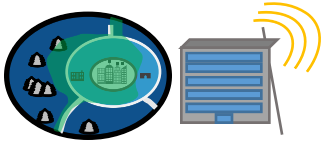


Coverage & Capacity Factor

- Band 14/Non-Band 14* Coverage and Capacity
- Radio Access Networks
- IOC/FOC Milestones for Coverage and Capacity
- Ability to demonstrate rural partnerships

Past Performance Factor

- Successful project completion history (e.g., similar scope, within schedule, within budget, quality deliverables)
- Quality of cooperation and responsiveness
- Performance measure implementation and improvement



Products & Architecture Factor

- Service (public safety features)
- Applications
- Device Ecosystem
- Architecture and Infrastructure
- Operations
- Security

Risk Factor

- Proposal Risk
- Performance Risk

* Where applicable

RFP Questions

- If there are any questions regarding the FirstNet Request for Proposals (RFP) please contact the Contract Officer:

Greg Ruderman

greg_ruderman@ibc.doc.gov

703-964-3590

PSCR

Public Safety Analytics Roadmapping

Paving the Road to the Summit

Speakers

Noah Fritz — City of Tempe – Strategic Planning, Analysis & Research Center; President, International Association of Crime Analysts

Marc Leh — Corner Alliance, Consultant

Tom Sorley — NPSTC; City of Houston, Deputy CIO / Deputy Director, IT Public Safety

John Garofolo — NIST/ITL, Senior Advisor for Information Access Programs

Neil Fishman — IBM, Director, Analytics Group

Analytics – The Charter

Middle Class Tax Relief & Job Creation Act of 2012 §6303

"Establish a research plan, and direct research, that addresses the wireless communications needs of public safety entities beyond what can be provided by the current generation of broadband technology"

NIST R&D

NIST R&D

- MCV
- LMR-LTE
- LBS
- Analytics
- UI

Crosscutting Technologies

User Experience

PSCR

Goals of this Panel Discussion

- Relevance of analytics to public safety
- Results from the PSCR Analytics Roadmap & next steps
- Current NPSTC initiatives in analytics and IoT
- Outcomes from the Video Analytics in Public Safety workshop
- Industry perspective

MoneyBall of Crime Analysis: Creating Better Performance Measures for Policing

❖

2016 Public Safety Broadband Stakeholder Meeting
June 9, 2016 – San Diego, CA

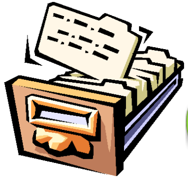
Noah J. Fritz, PhD
SPARC Supv - TPD
President of the IACA

iaca
International Association of CRIME ANALYSTS

The International Association of Crime Analysts
Serving the Crime Analysis Community Since 1990

C/A Capacity Building Grant

What are the three (3) traditional measures of police effectiveness or efficiency?



Catalog of Police Metrics

THE FBI FEDERAL BUREAU OF INVESTIGATION

REPORT THREATS • A-Z INDEX • SITE MAP

Search Site SEARCH

CONTACT US | ABOUT US | MOST WANTED | NEWS | STATS & SERVICES | SCAMS & SAFETY | JOBS | FUN & GAMES

Uniform Crime Reports

Select Language | Get FBI Updates

Home • About Us • CJIS • UCR • Crime in the U.S. • 2013 • Crime in the U.S. 2013

U.S. DEPARTMENT OF JUSTICE • FEDERAL BUREAU OF INVESTIGATION • CRIMINAL JUSTICE INFORMATION SERVICES DIVISION

CRIME in the United States 2013

Criminal Justice Information Services Division | Feedback | Contact Us | Data Quality Guidelines | UCR Home

About Crime in the U.S. (CIUS) By offense, by region, by state, by local agency

About the Uniform Crime Reporting (UCR) Program
A history of the UCR Program

Offenses Known to Law Enforcement

- Violent Crime
- Property Crime
- Clearances

(offenses "closed" by arrest or exceptional means.)

- Go to Offense Tables

Expanded Offense Data

- Homicides
- Trends
- Rates
- Weapons

Persons Arr

Includes data
age, gender,
arrestees for
offenses inclu

- Go to Arre

Caution Against Ranking

Additional Data Collections

Hate Crime Statistics

Data regarding crimes motivated by bias against race, gender and gender identity, religion, disability, sexual orientation, or ethnicity, including those committed by or directed toward juveniles

Law Enforceme Assaulted

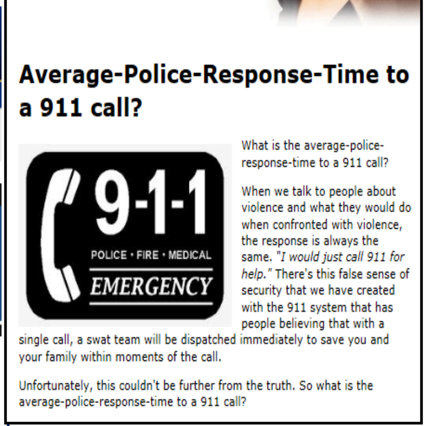
Data regarding felonic
as well as assaults on

Frequently Asked Questions

How many crimes came to the attention of law enforcement in my city in 2013?

How many police officers are employed in my city?

Are more people murdered by a stranger or by someone they know?

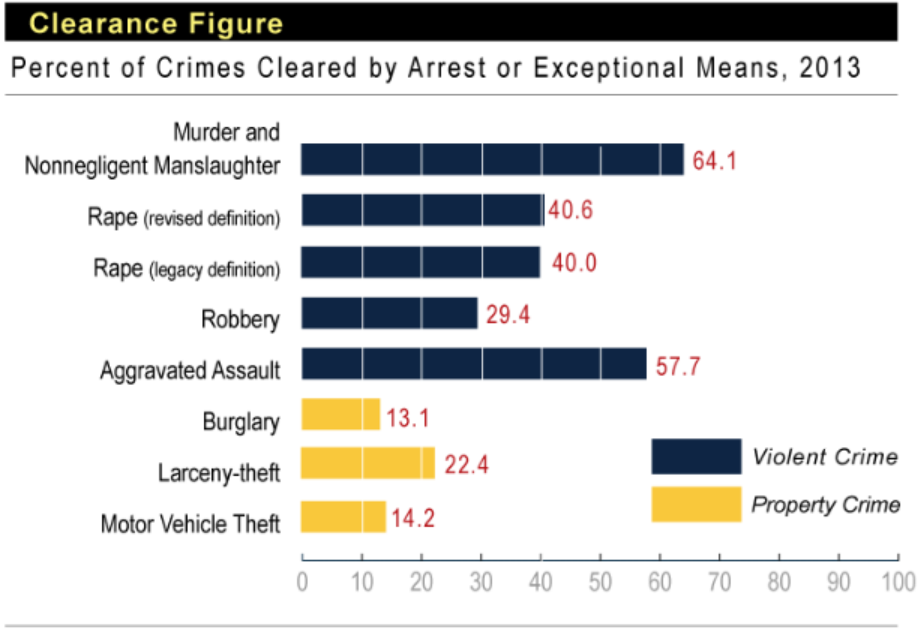


Average-Police-Response-Time to a 911 call?

What is the average-police-response-time to a 911 call?

When we talk to people about violence and what they would do when confronted with violence, the response is always the same. *"I would just call 911 for help."* There's this false sense of security that we have created with the 911 system that has people believing that with a single call, a swat team will be dispatched immediately to save you and your family within moments of the call.

Unfortunately, this couldn't be further from the truth. So what is the average-police-response-time to a 911 call?



Offenses Known to Law Enforcement

How many crimes came to the attention of law enforcement in my city in 2013?

Table 8
ARIZONA
Offenses Known to Law Enforcement
by City, 2013

City	Population	Violent crime	Murder and nonnegligent manslaughter	Rape (revised definition)[1]	Rape (legacy definition)[2]	Robbery	assault	crime	Burglary	theft	theft	Arson	Crime	Rate
Bisbee	5,463	74	1		1	-	72	217	8	202	7	-	291	5,327
Chandler	248,718	575	2		52	162	359	5,900	993	4,628	279	77	6,475	2,603
Fredonia	1,318	3	-		-	-	3	12	4	8	-	1	15	1,138
Gilbert	225,232	193	1	14		47	131	3,472	647	2,672	153	22	3,665	1,627
Glendale	234,006	905	13		49	335	508	13,626	2,410	10,166	1,050	60	14,531	6,210
Mesa	456,155	1,807	22		203	478	1,104	12,916	2,357	9,607	952	124	14,723	3,228
Paradise Valley	13,286	13	-		1	-	12	215	63	146	6	1	228	1,716
Peoria	161,641	254	4		16	59	175	3,830	717	2,906	207	7	4,084	2,527
Phoenix	1,502,139	9,492	118		635	3,233	5,506	60,085	16,747	36,983	6,355	269	69,577	4,632
Scottsdale	225,523	337	4		37	101	195	5,766	1,093	4,465	208	15	6,103	2,706
Tempe	168,501	831	3		62	224	542	7,876	1,276	6,113	487	44	8,707	5,167

[1] The figures shown in this column for the offense of rape were reported using the revised Uniform Crime Reporting (UCR) definition of rape. See Data Declaration for further explanation.

[2] The figures shown in this column for the offense of rape were reported using the legacy UCR definition of rape. See Data Declaration for further explanation.

[3] Because of changes in the state/local agency's reporting practices, figures are not comparable to previous years' data.

- Per Population – Census Data (per 100,000 residents)
- Per Daytime Population – Census data (40% increase in Tempe during the day)
- Per square mile? / Per Household? / Per Parcel?
- Per???

2013 CRIME CLOCK STATISTICS

A Violent Crime occurred every	**27.1 seconds**
One Murder every	37.0 minutes
One Rape every	6.6 minutes
One Robbery every	1.5 minutes
One Aggravated Assault every	43.5 seconds
A Property Crime occurred every	**3.7 seconds**
One Burglary every	16.4 seconds
One Larceny-theft every	5.3 seconds
One Motor Vehicle Theft every	45.1 seconds

The crime clock should be viewed with care. Being the most aggregate representation of UCR data, it is designed to convey the annual reported crime experience by showing the relative frequency of occurrence of the Offenses. This mode of display should not be taken to imply a regularity in the commission of the Offenses; rather, it represents the annual ration of crime to affixed time intervals.

U.S. COMMENT

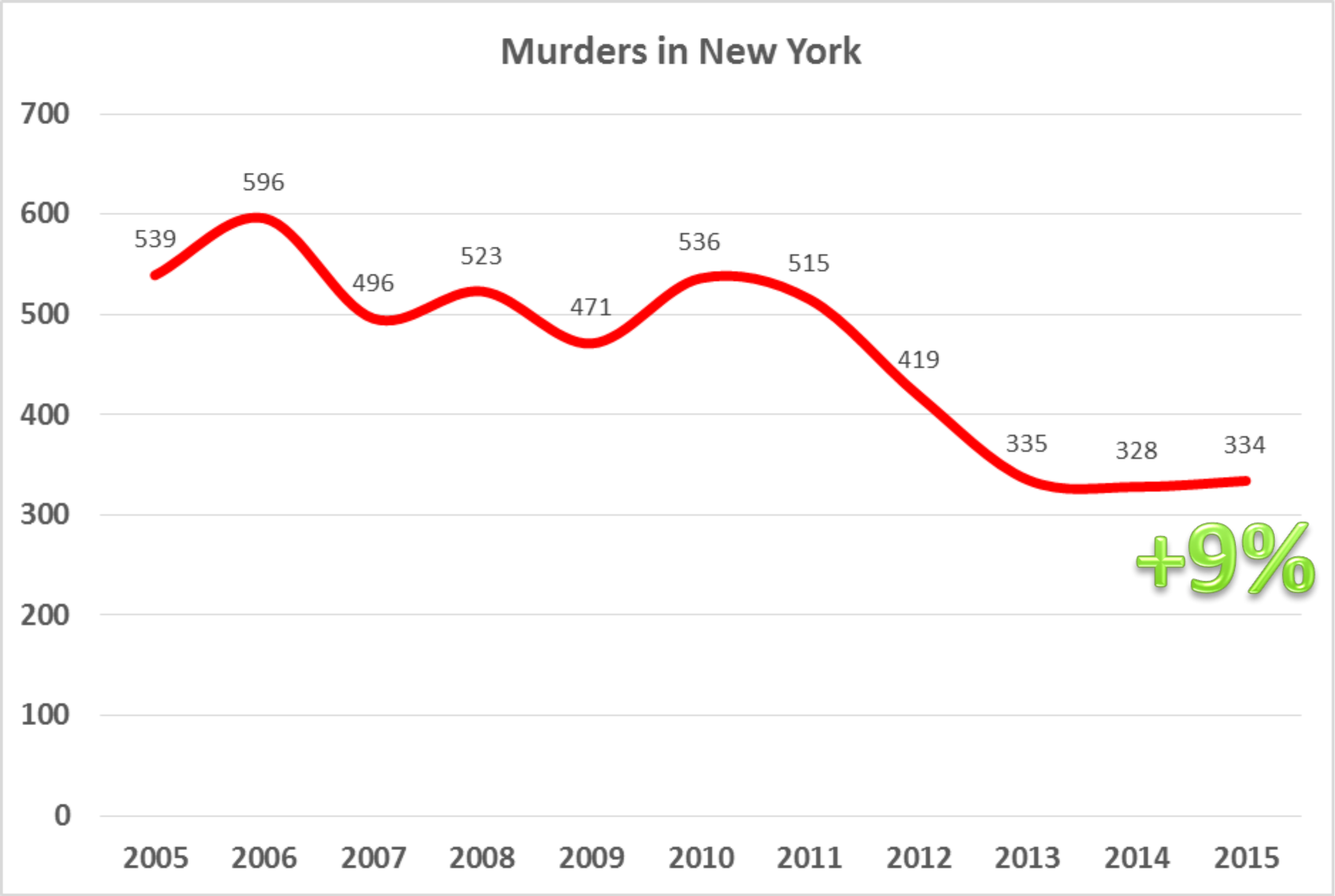
Murder Rates Rising Sharply in Many U.S. Cities

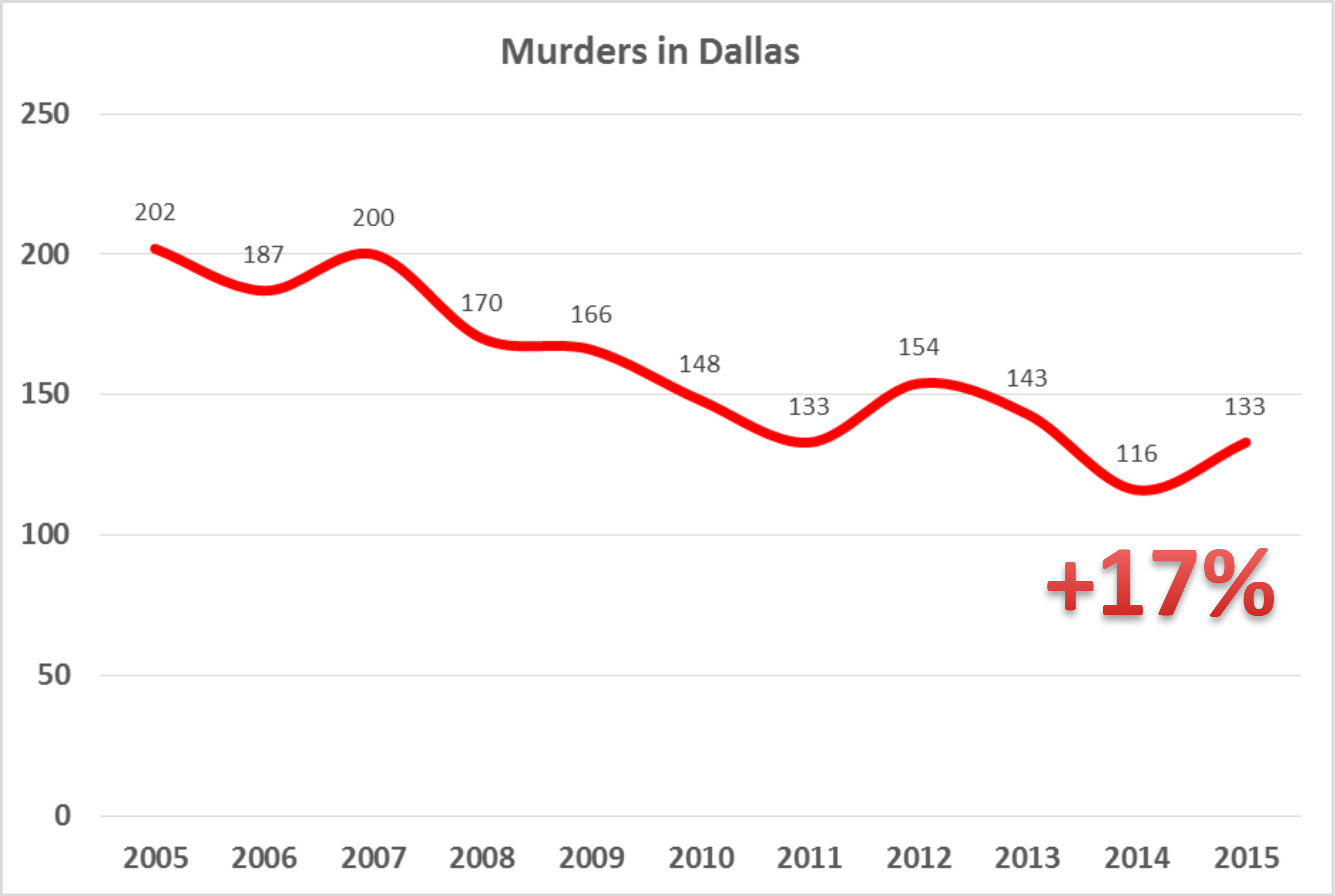
By MONICA DAVEY and MITCH SMITH AUG. 31, 2015

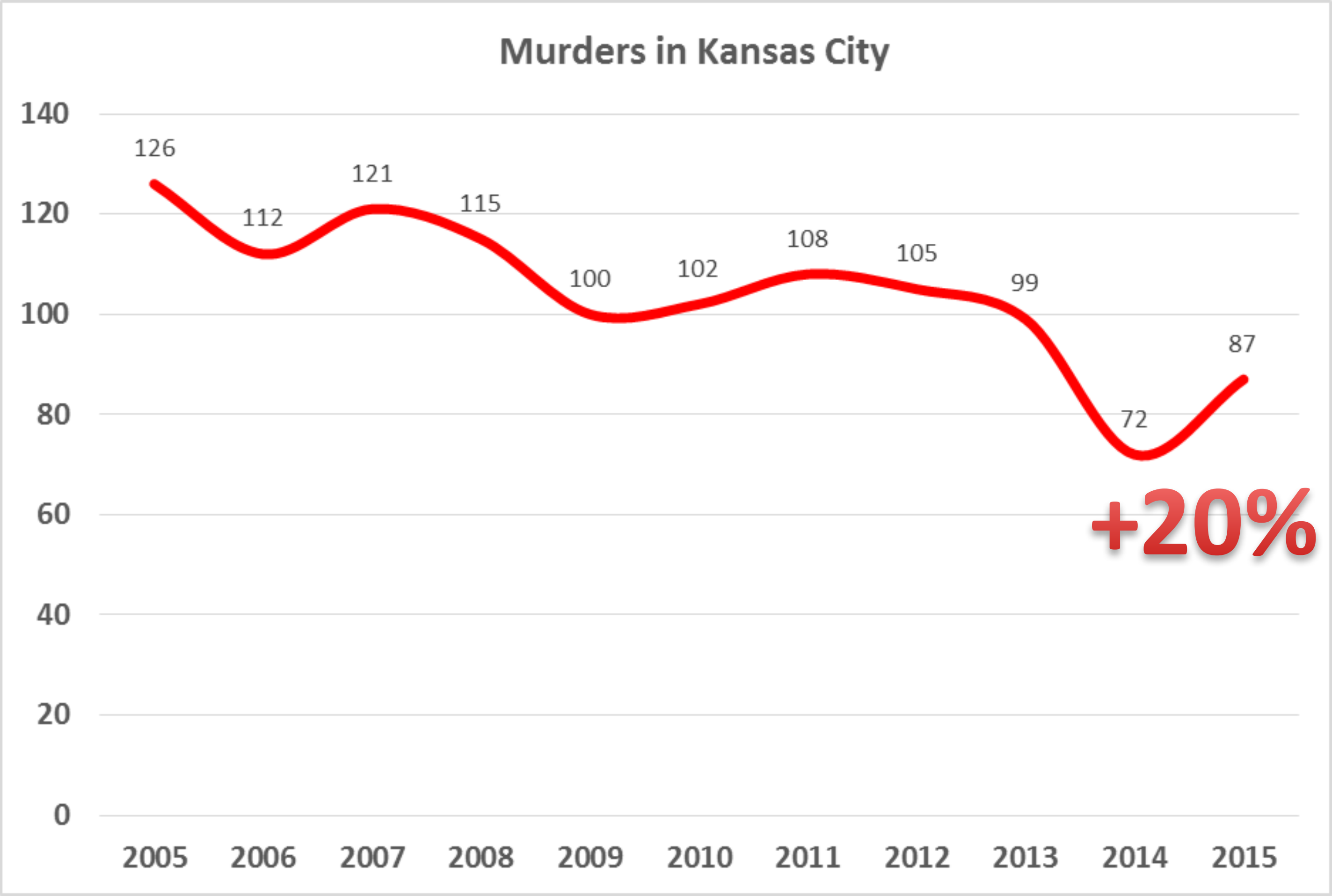
Rising Murder Rates in Big Cities

A sampling of cities where the number of murders so far this year is outpacing the same period last year.

	2014	2015	PERCENT CHANGE
Milwaukee	59	104	76 %
St. Louis	85	136	60
Baltimore	138	215	56
Washington	73	105	44
New Orleans	98	120	22
Chicago	244	294	20
Kansas City, Mo.	45	54	20
Dallas	71	83	17
New York	190	208	9
Philadelphia	165	171	4


Murders in New York
700
600
500
400
300
200
100
0
539
596
496
523
471
536
515
419
335
328
334
+9%
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015


Murders in Dallas
250
200
150
100
50
0
202
187
200
170
166
148
133
154
143
116
133
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
+17%



Murders in Kansas City
140
120
100
80
60
40
20
0
126
112
121
115
100
102
108
105
99
72
87
+20%
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015

Better Metrics

Rahm Emanuel
Mayor

Chicago
Police Department

Garry F. McCarthy
Superintendent

CompStat

Week 34

City Wide

Report Covering the Week of 17-Aug-2015 Through 23-Aug-2015

	Last 7 Days			Last 28 Days			Year to Date			2 Yr	3 Yr	4 Yr
	2015	2014	% Chg	2015	2014	% Chg	2015	2014	% Chg	% Chg	% Chg	% Chg
CRIME COMPLAINTS												
TOTAL	**1276**	**1259**	**1%**	**4798**	**4994**	**-4%**						
THEFT	326	353	-8%	1075	1391	-23%	7798	9474	-18%	-18%	-23%	-22%
MTR VEHICLE THEFT	241	185	30%	917	787	17%	6421	6313	2%	-25%	-40%	-51%
TOTAL	1276	1259	1%	4798	4994	-4%	33240	36210	-8%	-21%	-33%	-40%
SHOOTING INCIDENT	68	51	33%	261	199	31%	1535	1300	18%	22%	-4%	5%

Crime and Incident Statistics in Danvers, MA

The tables below and on the following pages provide crime and other incident data in 2010 as related to other years. The notes provide a few words or explanations of crime and may point to other sections of this report where more detailed analysis is available.

Incident Type	10 Year Average	Usual Range	2012	2013	Change from Average	Notes
Property Crime						
Residential Burglary	45.7	31-60	41	39	-15%	Continuing a downward trend since 2010
Commercial Burglary	27.4	19-36	16	17	-38%	Six were attempted but entry was not gained
Theft from Vehicle	233	171-295	131	178	-24%	Forty-five percent of vehicles were unlocked
Theft from Building	86.1	69-103	72	61	-29%	Several reported at nursing homes & hotels
Theft from Person	21.5	14-29	14	15	-30%	Mostly purses/wallets stolen
Theft from Residence	53.4	46-61	47	23	-57%	Largest statistical decrease of all call types
Theft of Bicycle	17.8	12-23	11	4	-78%	Fewest in last ten years
Theft of Services	18.8	14-24	14	13	-31%	Mostly dining & ditching the bill
Shoplifting	300.5	264-337	314	322	+7%	Up slightly from average; see pg. 14
Auto Theft	35.6	20-51	22	21	-41%	Continuing downward trend seen recently
Arson	2.1	0-4	1	0	-100%	None reported in 2013

MONEYBALL

An official trailer has been released for 'Moneyball', the true story of how Oakland A's general manager Billy Beane (Brad Pitt) assembled a competitive team using computer-generated analysis.

The concept of assembling a winning baseball team based on empirical evidence might not seem so revolutionary today, but it certainly was when the Oakland Athletics did it back in 2002 – a story that will be dramatized in this fall's unorthodox underdog sports tale, ***Moneyball***.

An official trailer has been released for ***Moneyball***, which hints at an intelligent and thoughtful examination of how A's general manager Billy Beane (Brad Pitt) used computer-generated analysis to assemble a winning baseball team.

"The Art of Winning an Unfair Game"

Sabermetrics

Sabermetrics is the specialized analysis of baseball through objective evidence, especially baseball statistics that measure in-game activity. The term is derived from the acronym SABR, which stands for the Society for American Baseball Research. It was coined by Bill James, who is one of its pioneers and is often considered its most prominent advocate and public face.

By re-evaluating the strategies that produce wins on the field, the 2002 Athletics, with approximately $41 million in salary, were competitive with larger market teams such as the New York Yankees, who spent over $125 million in payroll that same season. Because of the team's smaller revenues, Oakland was forced to find players undervalued by the market, and their system for finding value in undervalued players has proven itself thus far.

Today, every MLB Team uses sabermetrics for recruiting and retaining players!

"If You're Not Keeping Score, It's Just Practice."

Ronald D. Snee (2006)

Why measure performance?

Performance measurement can contribute to effective services.

1. What gets measured gets done
2. If you don't measure results, you can't tell success from failure
3. If you can't see success, you can't reward it
4. If you can't reward success, you're probably rewarding failure
5. If you can't see success, you can't learn from it
6. If you can't recognise failure, you can't correct it
7. If you can demonstrate results, you can win public support

Source: Extract from Osborne & Gaebler, Reinventing Government, 1992

What do we do in Policing?

Patrol – Respond to Calls for Service

- Answer CFS
- Take Police Reports
- Arrest Offenders
- Perform On-View Arrests
- Subject Stop identified an offender/warrant
- Subject Stop -> Arrest
- Collect Intel -> Assist Investigations
- Collect Intel -> Led to an Arrest
- Save Lives
- Prevent serious injury
- Administer First Aid
- Conduct Foot Pursuits
- Write Citations
- Look into Complaints against officers

Investigate Crimes

- Active Cases
- ECC
- Interviews / Contacts
- Investigative Leads
- Arrests
- Cases Filed
- Convictions

Traffic Safety

- CFS
- Accident Report Taken
- Accident Investigation
- 961 taken
- 962 taken
- 963 taken
- Citations written
- Warrants from Traffic Stop
- DUI Arrest

C.A.Metrics
the application of statistical analysis to police records especially in order to evaluate *"On-the-Field"* performance .

ON THE FIELD POLICE PERFORMANCE

- Respond to Citizen Calls for Service
- Actively Patrol Neighborhoods
  - OnView–officer generated CFS
- Write or document criminal events
  - Crime Reports
- Enforce Traffic violations
- Crowd Control
- Write tickets or give warnings
- Investigate Crime
- Arrest Perpetrators
- Process Prisoners
- Testify in Court

C.A.Metrics

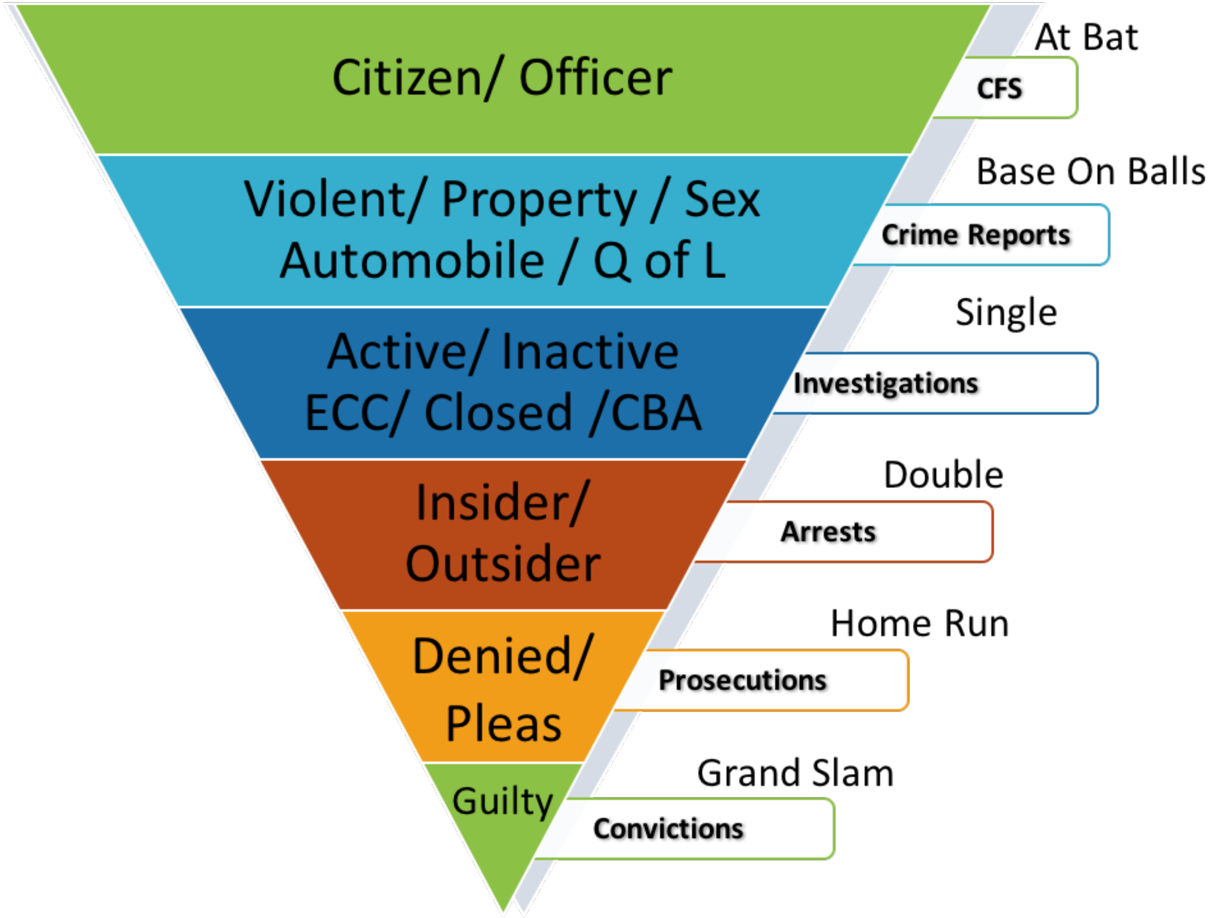
- CFS (# and Minutes)
  - Time on Call / Avg time on Call / per officer or area
- Officer Assists or Back-up
- Directed Patrols
- Follow Up or Additional Case Information (ACI)
- Proactive Community Contacts
- Tickets Written / Cite and Releases
- On view Arrests (Misd. / Felony / DUI)
- Warrants Served / Warnings
- POP Projects
- Street Checks / FICards / Gang Cards
- Reports Written (# and time)
- Solvability Factors
  - Investigative Leads
- Intelligence Tips
- Investigative Arrests/Summons
- Good Arrests → lead to conviction/plea
- Go to Courts/Prosecutions / Prosecution Rate
- Convictions
- Cold Cases versus Cold-Hot Cases
- Crime Series Bulletins – Lead to arrest
- VORC (Value Over Replacement Cop)

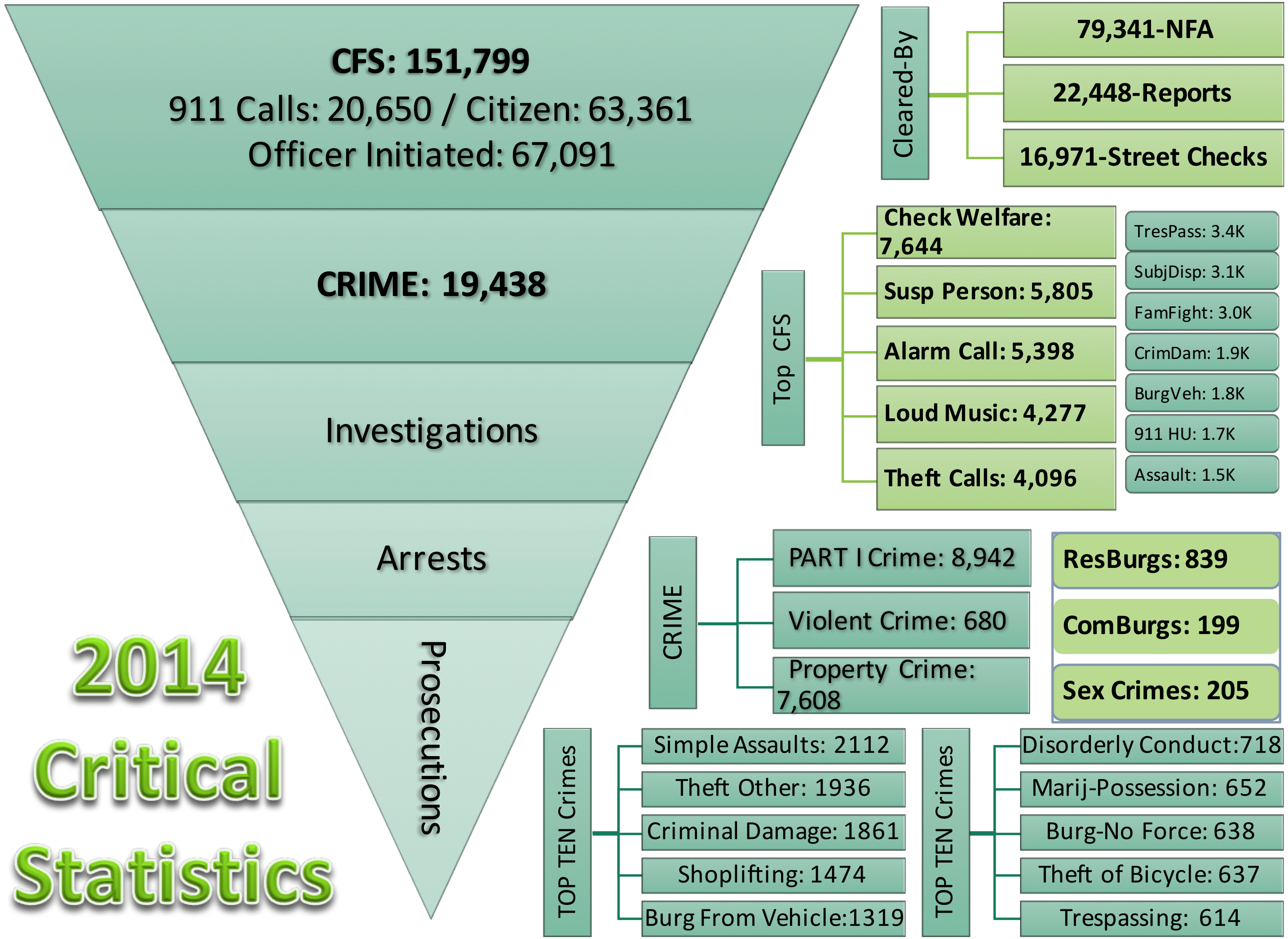
Comstat or Compstat?
Comparative Analysis

Police Batting Averages
Think outside the Box

- CFS (At bat)
- Reported Crime (Base-on-Balls or Walk)
- Investigations (Single)
- Arrests (Double)
- Prosecutions (Home Run)
- Convictions (Grand Slam)

Rates: CFS per Bar
Per Occupancy
Per Apt. Unit
Per Officer
Per Beat


Citizen/ Officer
Violent/ Property / Sex
Automobile / Q of L
Active/ Inactive
ECC/ Closed /CBA
Insider/
Outsider
Denied/
Pleas
Guilty
At Bat
CFS
Base On Balls
Crime Reports
Single
Investigations
Double
Arrests
Home Run
Prosecutions
Grand Slam
Convictions



CFS: 151,799
911 Calls: 20,650 / Citizen: 63,361
Officer Initiated: 67,091
CRIME: 19,438
Investigations
Arrests
Prosecutions
2014
Critical
Statistics
Cleared-By
79,341-NFA
22,448-Reports
16,971-Street Checks
Top CFS
Check Welfare: 7,644
Susp Person: 5,805
Alarm Call: 5,398
Loud Music: 4,277
Theft Calls: 4,096
TresPass: 3.4K
SubjDisp: 3.1K
FamFight: 3.0K
CrimDam: 1.9K
BurgVeh: 1.8K
911 HU: 1.7K
Assault: 1.5K
CRIME
PART I Crime: 8,942
Violent Crime: 680
Property Crime: 7,608
ResBurgs: 839
ComBurgs: 199
Sex Crimes: 205
TOP TEN Crimes
Simple Assaults: 2112
Theft Other: 1936
Criminal Damage: 1861
Shoplifting: 1474
Burg From Vehicle:1319
TOP TEN Crimes
Disorderly Conduct:718
Marij-Possession: 652
Burg-No Force: 638
Theft of Bicycle: 637
Trespassing: 614

2014

CFS
- 151,799 (84,702 Citizens' Requests for Service – 55.8% / 44.2% Officer Initiated)

CRIME
- 19,438 (12.8% of Calls Result in an 05 Disposition Report Taken). 17,975 Criminal Reports in RMS

INVEST
- As of June 1st, closed 17.5% of cases in 2014 (N=3151), with 226 cases still open and 132 unfounded. 71.4% were Early Case Closures.

ARREST
- 14,683 Arrests . 38% are from Tempe, 62% from outside. 2% ouside Valley.

PROSECUTIONS
- ?

http://www.bjs.gov/index.cfm?ty=datool&surl=/arrests/index.cfm#

Food For Thought

For Discussion…over beer?

- How can we determine if we're having an effect on the prevalence of illegal drugs in our communities?
- How can we determine the amount of unreported violence in our county?
- How do we tell who our most productive officers are? How do we define "productivity?"
- How do we determine the demographics of the city's driving population for purposes of racial profiling analysis?

What might these things tell us?

21st Century Analytics

- Ratio of self-initiated calls for service to citizen-initiated calls?
- Number of crimes in a series before initial identification of a series?
- Percentage of crimes in a series that occur after the initial identification of the series?

✓ Ratio of calls for service to crime in each neighborhood?

Crimes per CFS

- The higher the value, say 1.0 would be the case where every call for service generated a crime report
- CFS per Crime Report something like a 5 to 1 ratio
  - So it takes about 5 CFS to generate a crime report, the larger the number of the calls an area submits in relation to crime in the area means something – but what?
- Know the Benchmark!
  - Batting 400 mean in Baseball?

60% of the time players fail at their #1 Offensive Objective!

Theory or Perspective – why measure performance

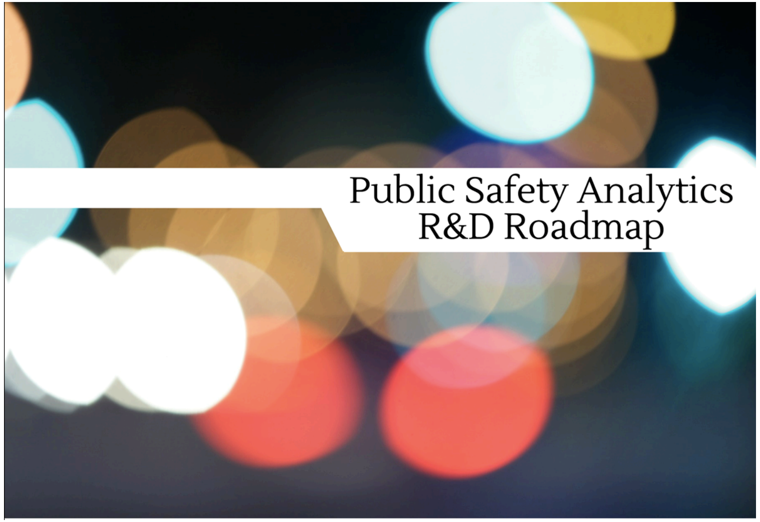
- ✓ More crimes than CFS implies a TRUST issue or a INTIMIDATION issue where the police has to go looking for crime. (50 to 25 = 2.0 crime for every CFS or a 1 to 2 ratio)
- ✓ Where there are more CFS than crime you might have a FEAR of crime issue or a neighborhood that is overly concerned about kids or gangs when in fact it cannot be accounted for. (50 to 100 = 0.5 or a 2-1 ratio)
- ✓ Determine the typical or average number of crimes per CFS and use that a standard reference point or benchmark.
- ✓ Look for neighborhoods that are +/- 1 SD above or below the mean
- ✓ Well above = TRUST-INTIMIDATION
- ✓ Well below = Unsubstantiated FEAR

ACTIONABLE DECISIONS – Do something!

Analytics Roadmap Overview

Marc Leh, Corner Alliance

Accessing the Analytics Roadmap



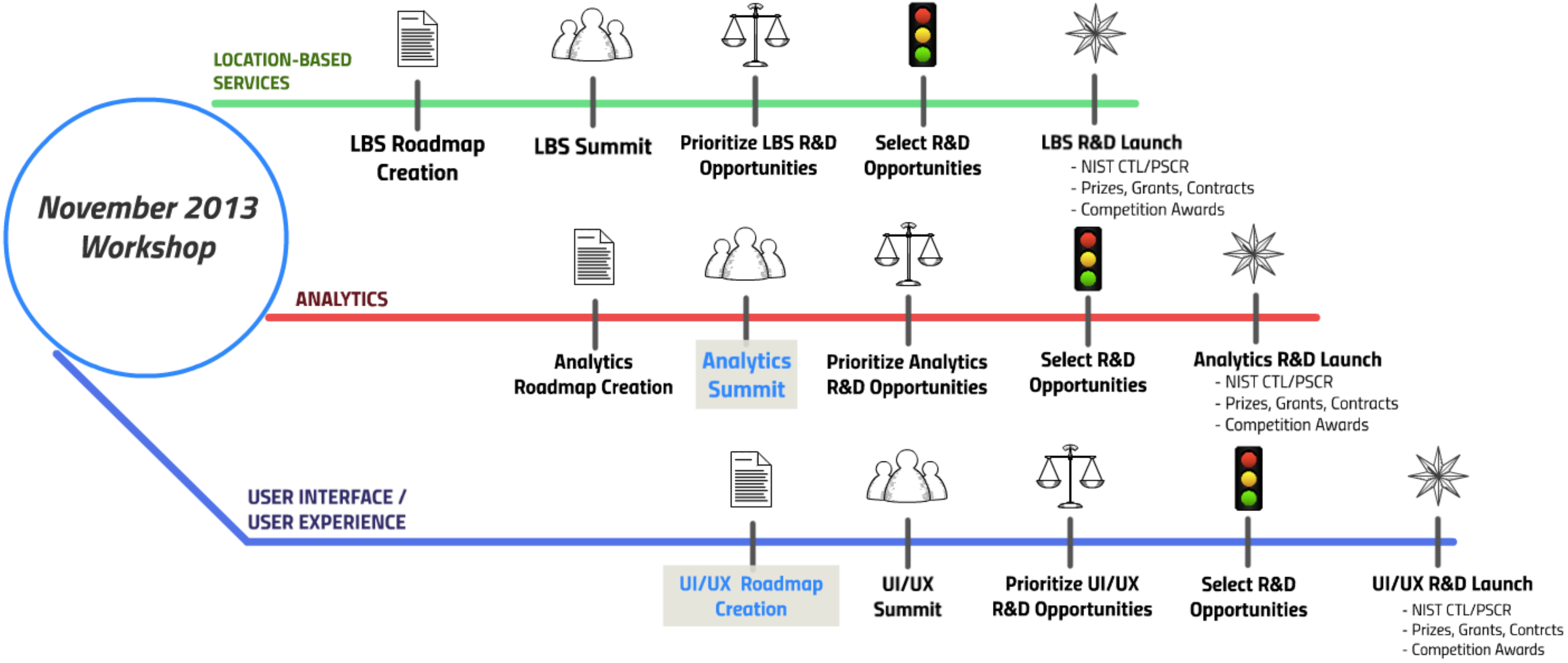
PSCR's *Public Safety Analytics Roadmap* is available:

http://dx.doi.org/10.6028/NIST.TN.1917

PSCR

JUNE 2016

// WHERE WE ARE TODAY

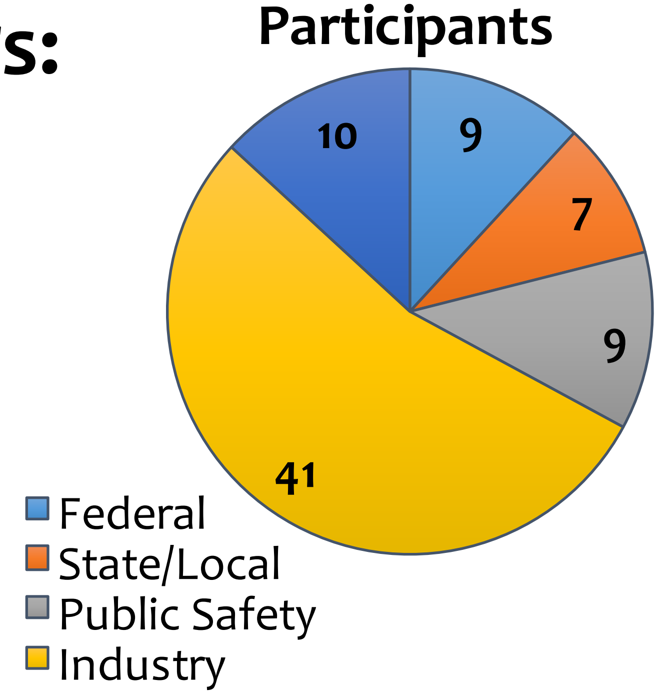


Analytics Roadmap Working Group

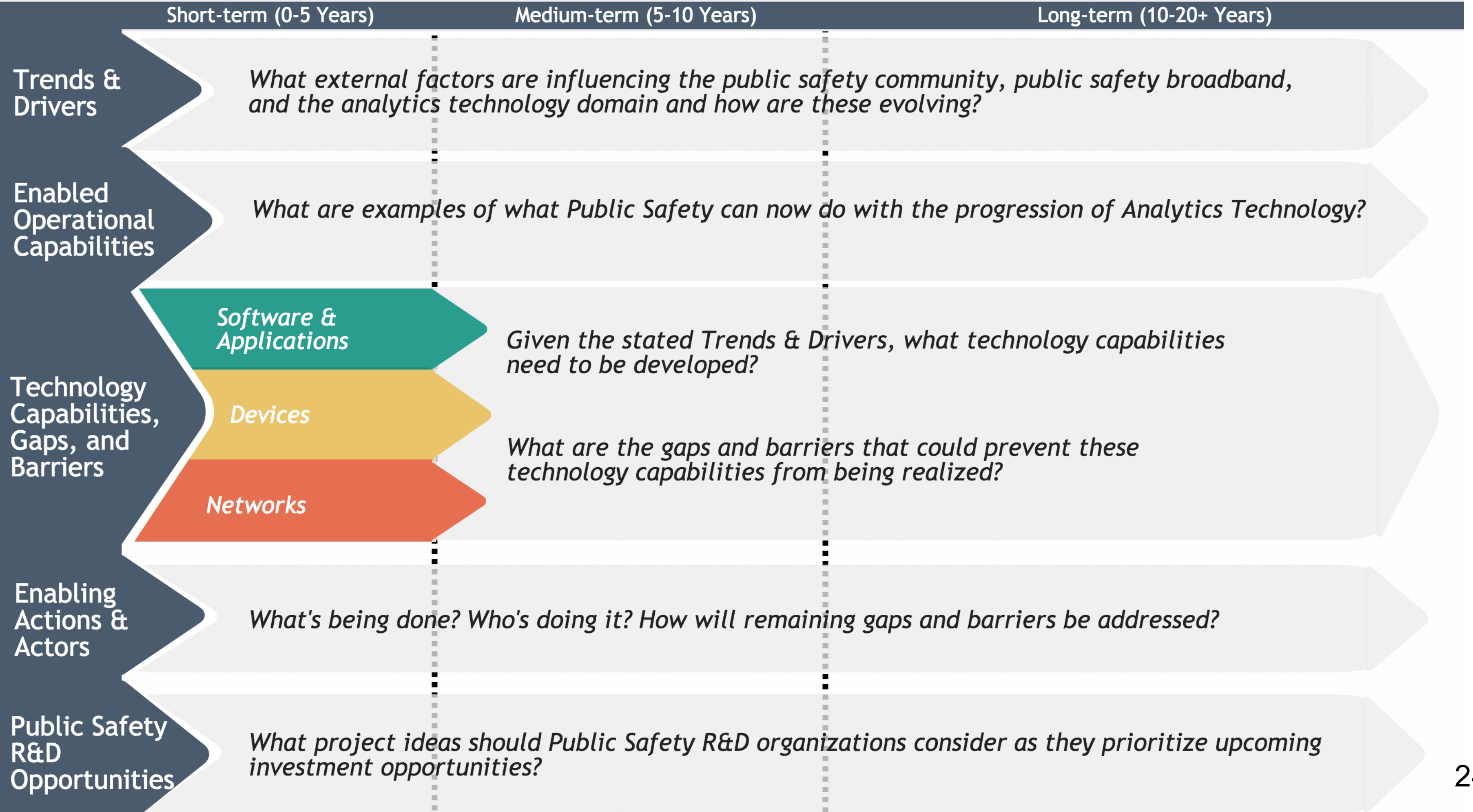
Working Group Meetings:
May - December 2015

76 Participants

Final Report Published:
April 2016

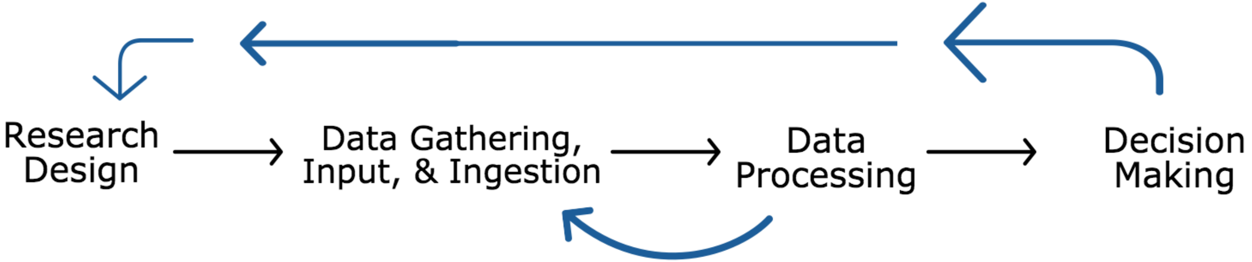


Analytics R&D Roadmap Framework



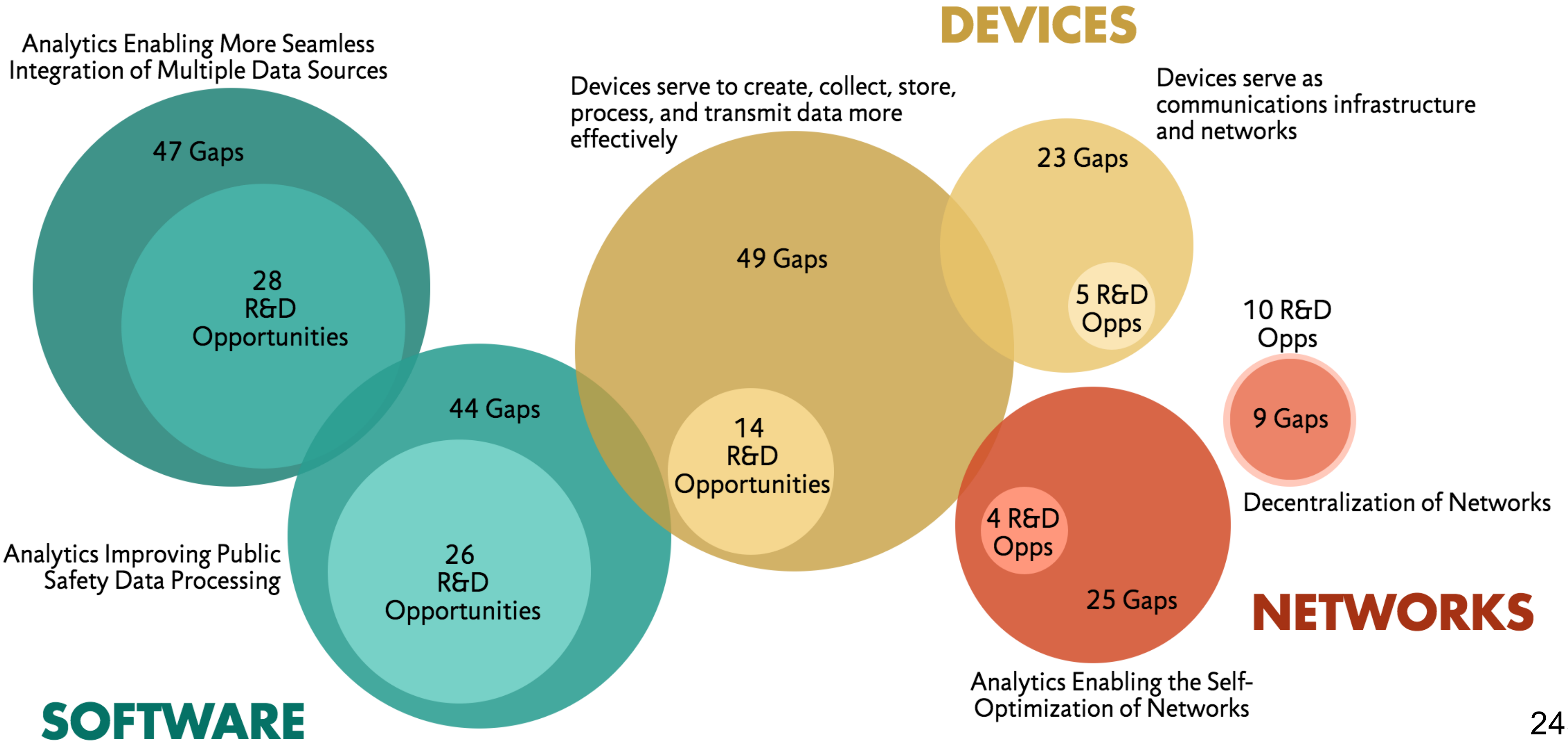
Roadmap Scope

- **Analytics:** *the scientific process of transforming data into insight for making better decisions*
- Remain focused on how user interface enhances public safety:
  - **Response**
  - **Communications**
  - **Operations**
- Account for Analytics Workflow:



PSCR

Overall Roadmap Metrics



Roadmap Outcomes

Need to define standards for sharing source data and extracted metadata

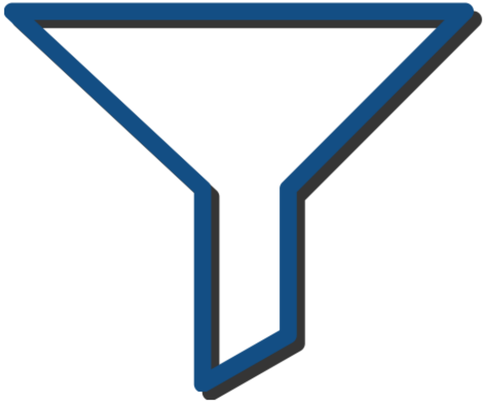
Lack of conversion protocols for various device operating systems

Need improved on-device communications prioritization

Need greater ability to triage and process unstructured data

197 Technology Gaps Total

Need for better load-balancing techniques



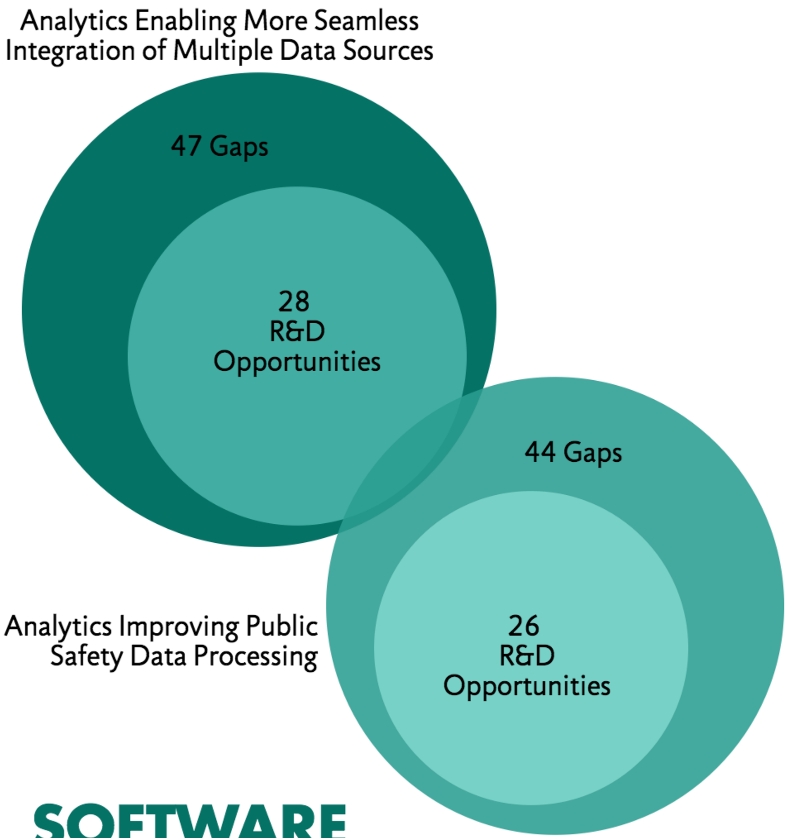
Define common IoT data standards, data quality standards, and processing models

Develop network resiliency and prioritization services to analyze mission-critical data

Compare the processing, bandwidth, and power demands of similar analytic models

86 R&D Opportunities

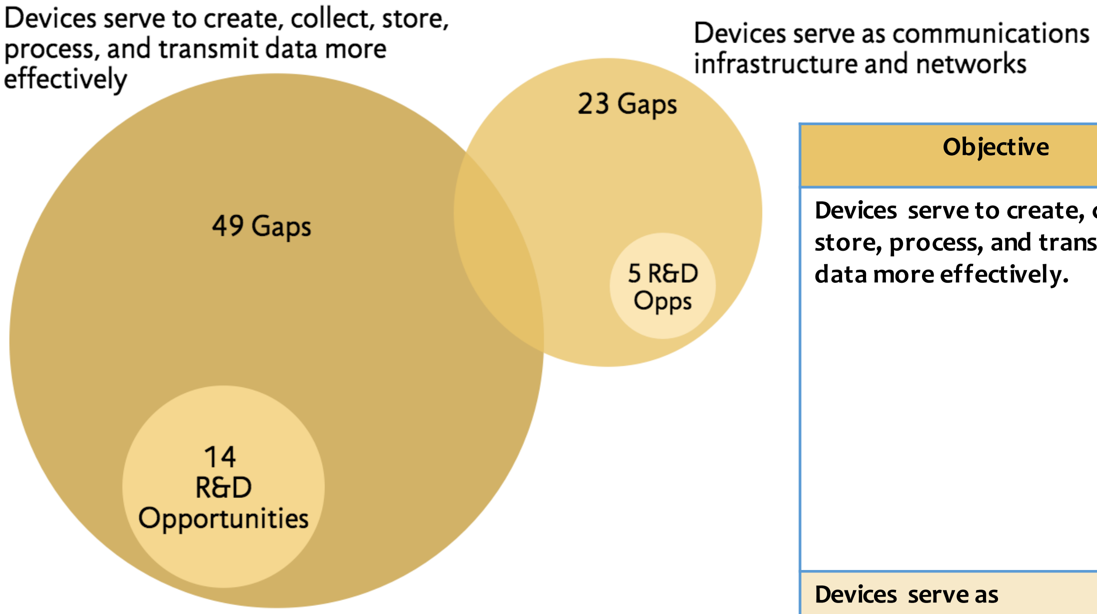
Define requirements for on-device recording and storing of transcripts.



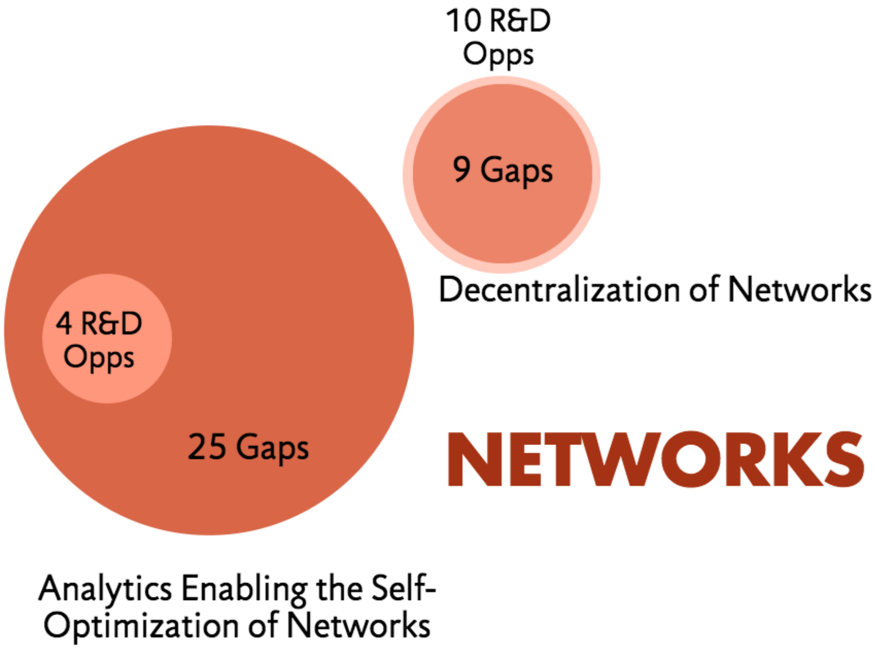
SOFTWARE

Objective	Capability
Analytics Enabling More Seamless Integration of Multiple Data Sources	Increased sophistication of public safety data governance allows for more accurate and efficient integration of disparate data stores.
	Public Safety collects data through increased use of passive applications and analytics at the edge.
Analytics Improving Public Safety Data Processing	Public Safety realizes improvements in software's ability to process large, real-time data streams.
	Public Safety increasingly leverages "state of the art" programming languages, libraries, and techniques to increase computing power, efficiency, and speed.

DEVICES



Objective	Technology Capability
Devices serve to create, collect, store, process, and transmit data more effectively.	First Responder devices will contain more sensors than those in operations today and act as hubs for Personal Area Networks (PANS)
	Localized analytics move closer to the actual collector and consumer of data.
Devices serve as communications infrastructure and networks.	Machine-to-Machine communications architecture becomes more wireless, scalable, and ubiquitous.



NETWORKS

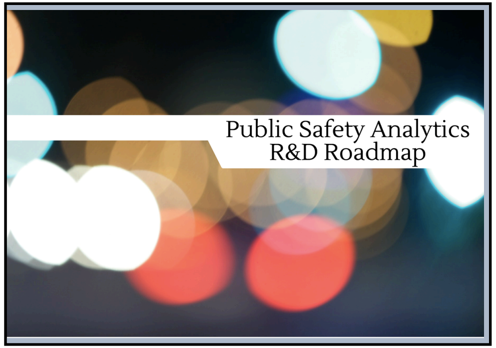
Objective	Technology Capability
Analytics Enabling the Self-Optimization of Networks	Analytics enabling self-monitoring, self-healing, and deterministic analysis of Public Safety Networks
Decentralization of Networks	User Devices serve as their own mini-mesh networks
	Increasing prevalence of deployables and small cell eNodeBs

Analytics Summit (August 3-4, 2016)

Purpose of the Summit is to:

- Socialize the roadmap with a broader audience
- Prioritize gaps and opportunities presented in the roadmap
- Expand on and improve initial roadmap findings to further inform PSCR R&D project planning

Purpose of Analytics Summit



Analytics Problem Statements

Current State Impacts →	Development Enablers →	Future State
Who?	Requirements to collect:	Gap Stakeholders:
What?	Standards to develop:	
How?	Technological Capabilities to build:	Public Safety Operations:
Current Initiatives?	Measurement Capabilities to deploy:	

Technical Barriers	Potential Disruptors

NPSTC

Public Safety Analytics

Public Safety Communications Research (PSCR) Stakeholders Meeting

Tom Sorley, NPSTC Technology Committee Chair

Thursday, June 9, 2016

The member organizations of the National Public Safety Telecommunications Council are grateful to the Department of Homeland Security's Science and Technology Directorate, Office for Interoperability and Compatibility (OIC) and the National Protection and Programs Directorate, Office of Emergency Communications (OEC) Points of view or opinions expressed are those of the originators and do not necessarily represent the official position or policies of the U.S. Department of Homeland Security.

Public Safety Analytics

- NPSTC monitors issues and advocates for the needs of public safety across a wide range of issues, including the impact of analytics on first responder operations.

Public Safety Analytics

- NPSTC Working Groups that are currently examining the impact of analytics:
  - Broadband Emerging Technologies Working Group, Chair Kim Coleman-Madsen
  - Video Technology Advisory Group (VTAG), Chair John Contestabile
  - Cross Border Working Group, Chair Stephen Mallory
  - Unmanned Aircraft Systems and Robotics Working Group, Chair Michael Britt

Public Safety Analytics

- Several issues were identified by NPSTC, which resulted in this topic coming to the forefront:
  - Significant advances by industry in the development of sensor and analytical systems.
  - Evolving interest by public safety on the advantages and efficiencies from use of this technology.
  - Increased awareness of existing Machine-to-Machine (M2M) data exchange platforms.

Public Safety Analytics

- GM and On-Star
  - Automated Crash Sensor Technology
  - Sensor data from vehicle provides critical information for first responders:
    - Frontal, side or rear impact?
    - Was the force severe enough to activate the air bags?
    - Did the vehicle roll over?
    - Is the vehicle now upright, on its side on its roof?
    - What was the force velocity of the impact?

Public Safety Analytics

- GM and On-Star (continued)
  - This information is manually relayed by telephone
  - Automated receipt of this information would speed up the appropriate public safety response.

Public Safety Analytics

- Automated Secure Alarm Protocol (ASAP)
  - Automated exchange of alarm sensor data between the Central Station monitoring agency and the Public Safety Answering Point (PSAP).
  - Data is routed over the National Law Enforcement Telecommunications (NLETS) network.

Public Safety Analytics

- ASAP Program:
  - Verified emergency incidents route automatically to the public safety agencies CAD system.
    - This process speeds up relay of the information.
    - It reduces error in transcription that occur during a phone call.
  - A translation table converts the emergency incident type code to the appropriate type code used by the local agency.

Public Safety Analytics

- ASAP Program – Houston experience:
  - Implemented by the City of Houston on April 28, 2011.
  - Automatic M2M connection between the central station and the Houston Police Department CAD system.
  - The system processes more than 2,000 incidents each week.
  - Recently added ADT to the list of connected companies.
    - Immediately doubled the daily ASAP generated alarm events.
    - Trends of reduction in call volume projected to save 10 FTEs over next two years

Public Safety Analytics

- Video Analytics
  - Significant advances in automation and analytics
    - Motion detection, object identification, crowd analytics
  - Edge processing by devices
    - Reduced network usage because device only transmits data requiring action; vs. transmitting all data for analysis.
  - Provide public safety with an incident alert vs. the need to have an employee watch the camera from activity.
    - Only active incidents are displayed for operator action.

Public Safety Analytics

- Sensors Impacting the PSAP
  - The Next Generation 911 (NG911) IP network will allow transmission of video and data from citizens while also supporting the interconnection of M2M systems.
  - FirstNet (and other networks) will allow transmission of video and data from first responders and their devices.

Public Safety Analytics

- Sensors Impacting the PSAP
  - How do you turn a flood of data into a meaningful message that has a high degree of validity?
    - Problem identification scenarios
    - Automatic grouping based on scenarios
    - Reduces the likelihood of missing important data due to a glut of data

Public Safety Analytics

- Sensors impacting the PSAP:
  - Analytics are needed to manage incoming data from multiple new <u>external</u> sources:
    - Video Systems
      - Security camera video following a fire alarm activation
      - Street level security camera detects a suspicious event
    - Personal Health monitors
      - Google contact lens triggers a low blood glucose alert
      - Wrist band sensor detects a cardiac emergency
    - Sensor systems
      - Detection of natural gas in an apartment complex

Public Safety Analytics

- Sensors Impacting the PSAP:
  - Analytics are needed to manage incoming data from multiple new <u>internal</u> sources:
    - Body worn and in vehicle video systems
      - Incoming live video following activation of the emergency button on a police officer's radio.
    - Health and Safety sensors worn by first responders
      - detection that a police officer has fallen and is not moving
      - low air alarm coming from a firefighters SCBA tank
    - Sensor systems on vehicles and in buildings
      - Automatic crash notification alert received from an ambulance that was transporting a patient to the hospital

Public Safety Analytics

- Analytics and Automated Decision Making:
  - Currently, an employee in a PSAP receives information from a variety of sources, primarily by voice communication.
  - The employee must receive and interpret each piece of information individually and then assess the incident and make a series of decision that will generate a public safety response.
  - Information can flow to multiple individuals in the same PSAP, resulting in a fragmented view of the incident.

Public Safety Analytics

- Analytics and Automated Decision Making:
  - Analytics can help aggregate and assess incoming information.
  - This can result in better decision making (based on the assessment of more input factors)
  - This can result in faster decision making (based on use of computer based analytics)
  - Two recent case studies demonstrated that first responders could arrive up to four minutes faster when using sensor and analytic technology:
    - Gas leak in a commercial building
    - Fight with weapons in a high school

Public Safety Analytics

NPSTC

- Gas leak in a commercial building:

Impact of Technology on Time: Detection to Arrival

PROCESS SEGMENT	Emergency Occurs	Detection	Activate 9-1-1	Call Routed to PSAP	Call Taker Questions/ CAD Entry	Dispatcher Assessment/ Assign Units	Turn Out Time	Travel To Scene/ Arrival	Arrival At Fire	Assess Conditions	Initiate Action
TIME (MIN:SEC)	TIME START	1:00	:10	:10	1:00	:30	:60	6:00	3:00	1:00	TIME STOP
CUMULATIVE LAPSE TIME	0.00	1:00	1:10	1:20	2:20	2:50	3:50	9:50	12:50	13:50	
KEY FUNCTIONS	*A gas leak occurs in a restaurant on the 12th floor of a commercial building	* Citizen smells gas, pauses, investigates and determines there is an emergency	* Citizen locates phone * Dials 9-1-1	*9-1-1 System routes call to PSAP	*Call Taker determines location, type of emergency, and details on the gas leak * Call Taker enters data into CAD	* Dispatcher reviews/confirms which units should respond * Dispatcher alerts units to respond to fire	* Units receive CAD data on MDT * Units review information * Units plan response route	* Units travel to scene * Units arive at address, front door.	* Fire Fighters enter building, determine route 12th floor. * Arrival on 12th floor.	* Fire Fighters assess life safety threat. * Assess conditions * Plan attack	* Fire Fighters work to stop leak
Next Generation First Responder Improvements		*Sensor system detects gas leak	* Sensor alert to PSAP via NG911	* Data call routed directly to PSAP	* Automatic call entry using ASAP protocol	* Enhanced alerting to FF personnel	* Enhanced analytics * Automatic Route suggestions	* Enhanced GIS data to ID building and access	* 3D building plans available prior to arrival	* Interconnected sensors (building and FF) provide rapid situational	
TIME (M:SS)	TIME START	:05	:00	:05	:00	:15	:45	5:30	2:00	:30	
NEW CUMULATIVE LAPSE TIME	0:00	:05	:05	:10	:10	:25	1:10	6:40	8:40	9:10	

>4 Minute Faster Arrival

* Time segments are estimates and actual values vary greatly among public safety agencies
* Chart is designed to show conceptual time savings made possible through the use of sensor technology

Public Safety Analytics

- Fight with weapons in a high school:

Impact of Technology on Time: Detection to Arrival

PROCESS SEGMENT	Emergency Occurs	Detection	Activate 9-1-1	Call Routed to PSAP	Call Taker Questions/ CAD Entry	Dispatcher Assessment/ Assign Units	Turn Out Time	Travel To Address	Arrival At Scene	Assess Conditions	Initiate Action
TIME (MIN:SEC)	TIME START	1:00	:30	:10	1:00	:30	:10	6:00	3:00	:30	TIME STOP
CUMULATIVE LAPSE TIME	0.00	1:00	1:30	1:40	2:40	3:10	3:20	9:20	12:20	12:50	
KEY FUNCTIONS	A fight breaks out in a high school and one of the suspects is holding a large knife.	* A teacher is a nearby classroom is alerted to the fight and runs into the hallway.	* Teacher alerts the school front desk. * Front desk dials 9-1-1	*9-1-1 System routes call to PSAP	*Call Taker determines location, type of emergency, and details. * Front desk has minimal information * Call Taker enters data into CAD	* Dispatcher reviews/confirms which units should respond * Dispatcher alerts units to respond.	* Units receive CAD data on MDT * Units review information * Units plan response	* Units travel to scene * Units arive at address, front door of school	* Officers enter school, determine route to specific wing. * Arrival at scene	* Officers at scene, differentiate suspects from bystanders.	* Officers take action.
Next Generation First Responder Improvements		*video analytics detect fight in progress; identify a probable weapon	* Sensor alert to PSAP via NG911	* Data call routed directly to PSAP	* Automatic call entry using ASAP protocol, reviewed by Call Taker. (Call taker also processes 911 call from school)	* Rapid dispatch to officers, with building plan and image/video file.	* Automatic Route suggestions	* Enhanced GIS data to ID building and access	* 3D building plans available prior to arrival	* video imagery provides complete suspect description	
TIME (M:SS)	TIME START	:05	:00	:05	:15	:15	:10	5:30	2:00	:30	
NEW CUMULATIVE LAPSE TIME	0:00	:05	:05	:10	:25	:40	:50	6:20	8:20	8:50	

4 Minute Faster Arrival

* Time segments are estimates and actual values vary greatly among public safety agencies
* Chart is designed to show conceptual time savings made possible through the use of sensor technology

Public Safety Analytics

- The ability to aggregate and analyze multiple inputs will increase the efficiency of public safety decision making.
  - A smoke detector is activated in room 100 at a community college at midnight. Moments later, a fire alarm pull station is activated in the hallway outside room 100.
  - A camera detects light smoke in the hallway before the smoke reaches the threshold to activate another smoke detector.

Public Safety Analytics

- Ability to aggregate and analyze multiple inputs (continued):
  - A camera detects dozens of occupants running toward an exit.
  - A camera in room 100 detects active fire and calculates the size of the fire.
- M2M sensor and analytics would result in a full response by public safety, before the first 911 call was received.

Public Safety Analytics

- Analytics Issues:
  - How do these devices communicate with public safety agencies (spectrum and network interconnection issues)?
  - How do we create a common format for data exchange so sensor information can be aggregated and analyzed?
  - What steps are necessary to insure high reliability of sensor and analytical data?

Video Analytics in Public Safety (VAPS) Workshop Review

John Garofolo

Senior Advisor, NIST Information Technology Laboratory - Information Access Division

and

Chair, NITRD Federal Video and Image Analytics (VIA) Working Group

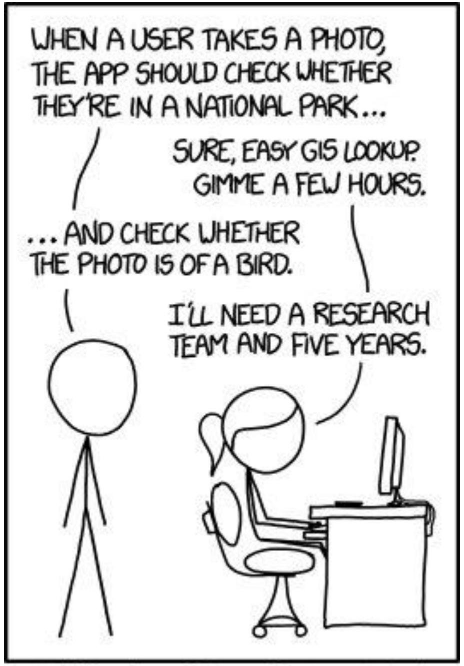
johngarofolo@nist.gov

PSCR Public Safety Analytics Panel

June 9, 2016

VAPS Background

- Groundbreaking workshop held here this past Monday to foster knowledge sharing, strategic thinking, and collaboration across the diversity of stakeholder communities in the emerging area of video analytics in public safety.
- Began as strategic need called out by the Federal NITRD Video and Image Analytics (VIA) Working Group with 30 member agencies, resulted in collaborative effort
  - DHS Science and Technology Directorate - Office for Interoperability and Compatibility (DHS/S&T/OIC) Video Quality in Public Safety (VQiPS) Program
  - White House Office of Science and Technology Policy (OSTP) National Science and Technology Council (NSTC)
  - NIST Communications Technology Laboratory and NIST Information Technology Laboratory
- **Big thanks to PSCR for supporting the VAPS workshop and hosting it as a satellite of the PSCR Broadband Stakeholder Meeting and opportunity to brief it here**



IN CS, IT CAN BE HARD TO EXPLAIN THE DIFFERENCE BETWEEN THE EASY AND THE VIRTUALLY IMPOSSIBLE.

Understanding and leveraging the richness of the visual world **(content)** is hard but important!

What is Computer Vision and Video Analytics?

- ***Computer Vision*** is an area of research devoted to creating an automated understanding of the world we see

- ***Video Analytics (VA)*** are applications of Computer Vision that leverage information and knowledge from video data content
  - **Who** (people detection and identification)
  - **What** (objects, activities, events, behaviors, relationships)
  - **Where** (world map space, 3D space, and 2D frame space)
  - **When** (date, time of year, time of day)

- Three general VA application types:
  - **Retrospective** (What has already happened?)
    - archive management, search, triage, forensic investigation
  - **Present** (Is something happening now?)
    - situation awareness and alerting, encoding, compression
  - **Future** (Will something happen?)
    - prediction based on the past and present

Video Analytics Applications are Immense, Diverse, and Growing!

Helping…

- us **take better pictures**
- **communicate/archive/search** immense **archives and live streams of video data**
- us learn more about **our surroundings and the world** we live in
- monitor and improve **traffic, critical infrastructure, and our oceans, land, weather, and wildlife**
- **cars drive themselves** and **robots interact with the world**
- diagnose **disease and learning disabilities and assisting in telemedicine**
- keep us, places we drive to, walk around, shop in, visit, and work in **safe**
- **fight and solve crimes**
- **improve commerce**
- us **improve our game, our gaming experience, and our education**
- us **remain independent as we age**
- and **many more!**

Why now?

- Computing power, networking, and storage have reached levels that support this technology and wireless communication has become pervasive.
- Public Safety network that can support data communications is taking form.
- Consumer camera technology and mobile phone technology are booming and leading the way for a surge in Public Safety technology
- Sources of data are exploding and on the move. Video is being massively adopted in the Public Safety community (CCTV, BWCs, dash cams, UAS, …)
- Neuro-inspired technologies for “teaching” software to understand the complexity of the world are emerging.
- Research in computer vision and multimedia understanding technologies are coming into their own

➢ Big data is “last year”. We are now entering the era of *Big Thinking.*

Where do Video Analytics come into play in the future Public Safety Video Ecosystem?

Almost Everywhere!

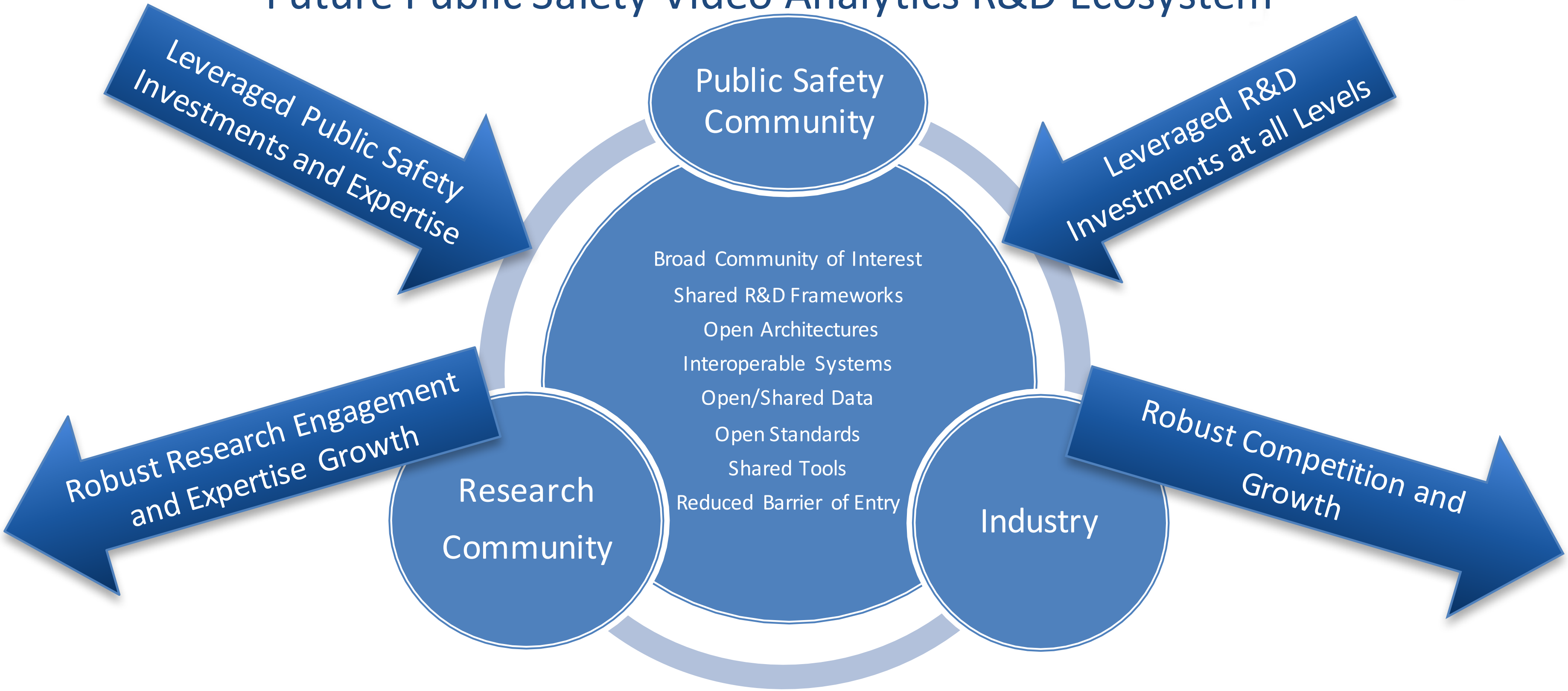
Capture → Encoding → Compression → Transmission/ Communications → Broadcasting/ Distribution → Alerting → Triage → Forensics → Data Storage and Management

Video Analytics will enhance workflow at all levels by leveraging an understanding of video content

Public Safety Video Challenges/Needs Themes

- Coordinated use of video, analytics, tools, and systems in the context of a scalable, maintainable, and interoperable ecosystem that supports huge amounts of video from many sources.
- Access to state-of-the-art technology and greater engagement with R&D.
- Analytics solutions to hard content-centric problems supporting increasing demands for video use in situation awareness, triage, and forensics.
- A robust and mindful R&D-to-deployment community and strategy.
- Increased collaboration within public safety community and with public safety technology R&D stakeholders.

Future Public Safety Video Analytics R&D Ecosystem



VAPS Workshop Strategic Goals

- Foster cross-community education and strategic cross-cutting discussion and engagement between technical stakeholder groups regarding R&D, measurement, standards, technical education and outreach, and collaboration.
- Create a strategy-focused workshop report that will inform a wide variety of stakeholders.
- Kickoff a VAPS Community of Interest (CoI) to provide a diverse forum for continued engagement on key topics that emerge from the workshop.

VAPS Workshop Format

Focused on Education and Strategic Discussion

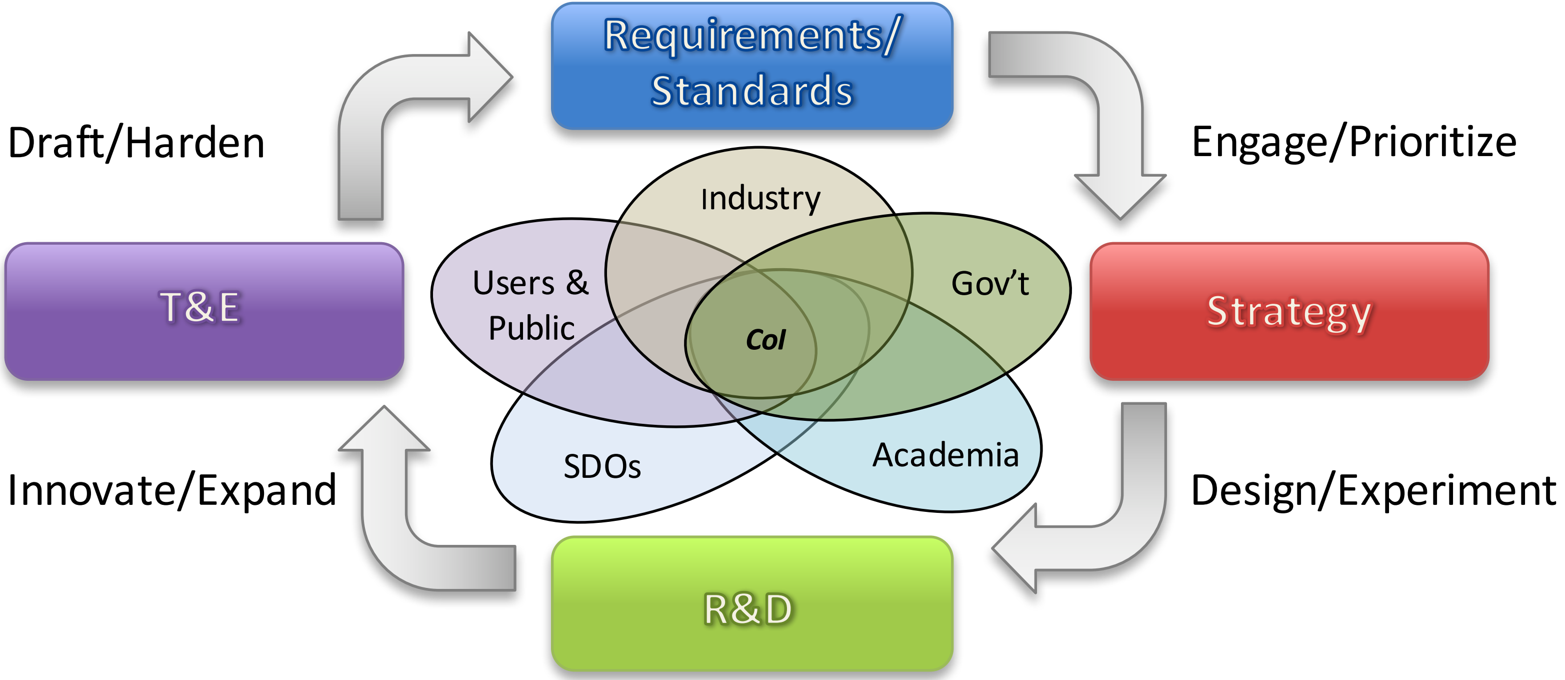
- Pre-workshop virtual panels to begin strategic thinking process and develop primers for all workshop participants from:
  - Public Safety/Transportation Safety Community
  - Academic Video/Multimedia Analytics Research Community
  - Public Safety Technology, Physical Security Technology, Video Technology, and related Industries
  - HCI/Human Factors/Visualization Research Community
  - Legal/Policy/Social Considerations Community
- Lessons learned from pioneers in cross-cutting R&D collaborations
  - Jonathan Lewin, Deputy Chief, Chicago PD
  - Martin O'Farrell, Program Manager, UK Home Office CAST
  - Jason Thornton, Senior Researcher, MIT Lincoln Labs
  - William Schrier, CTO, Seattle PD
- Deep dives in poster/demo session
- Cross-cutting strategic breakouts focused on emerging priority topics in technology, R&D, standards, education and outreach, and collaboration

Workshop Strategic Questions

- What are the emerging needs for video analytic technologies in public safety (spanning the entire workflow)? What are the considerations and how should we prepare?
- Who are the stakeholders? What are their unique needs, constraints, and concerns? What does the ecosystem look like now? What should it look like in the future?
- Where are we now in terms of research, technologies, policies, best practices, standards, workforce, and collaboration? What are lessons learned? What technologies are near and far and why?
- What are the needs and drivers with regard to R&D, measurement, standards, workforce, education and outreach, and collaboration? What should the priorities be? What are the potential mechanisms and timelines?
- How can we best work together? Does a CoI make sense? What should it include and seek to achieve? What resources are needed?

Analytics R&D-to-Standards Lifecycle

Honing the Model for Public Safety Video Analytics



First Look at Workshop Take-Aways

- The stakeholder communities can’t be islands. Robust collaboration is essential.
- Public safety has a laundry list of video analysis technologies they’d like to have. Technology to support data management and analysis is critically important now.
- Data drives R&D and representative data is needed to both attract and focus the research community on the hard problems.
- Hard challenges including video redaction, multi-camera analytics, distributed analytics, and mobile camera analytics are going to require new R&D approaches.
- Understanding the human factors related to video use, scaling, and bias are important to consider. Analytics should be used to support interfaces and generate visualizations that reduce cognitive load.
- Both legal and social considerations must be comprehended in public safety video analytics systems – analytics should be leveraged to increase privacy.
- Standards and R&D frameworks that foster interoperability are essential for the future video analytics ecosystem.

Some emerging ideas from the workshop on path forward

- Develop datasets and data sites.
- Work with public safety community to develop challenge evaluations and infrastructure to support R&D collaborations.
- Create cross-cutting pilot projects between public safety and researchers to support collaborative deep dives, develop R&D incubators and regional centers of gravity.
- Begin activities focused on best practices, interoperability, and scaling with regard to future standards.
- Develop expertise and information network and create ongoing workshop series to continue broad engagement and knowledge exchange.

Speakers

Neal Fishman IBM, Director, Analytics Group

Industry Perspective

NEAL FISHMAN

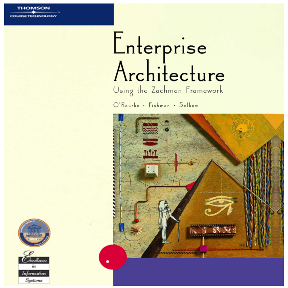
“Nowadays, of course,
I won’t even get out of bed
if it’s less than a petabyte.”

- Program Director, Data Based Pathology
- IBM Cognitive Solutions – Public Sector

- Senior Certified IT Architect – IBM
- Distinguished Chief/Lead IT Architect – Open Group

- Author of several books including
  Viral Data in SOA and
  Enterprise Architecture Using the Zachman Framework

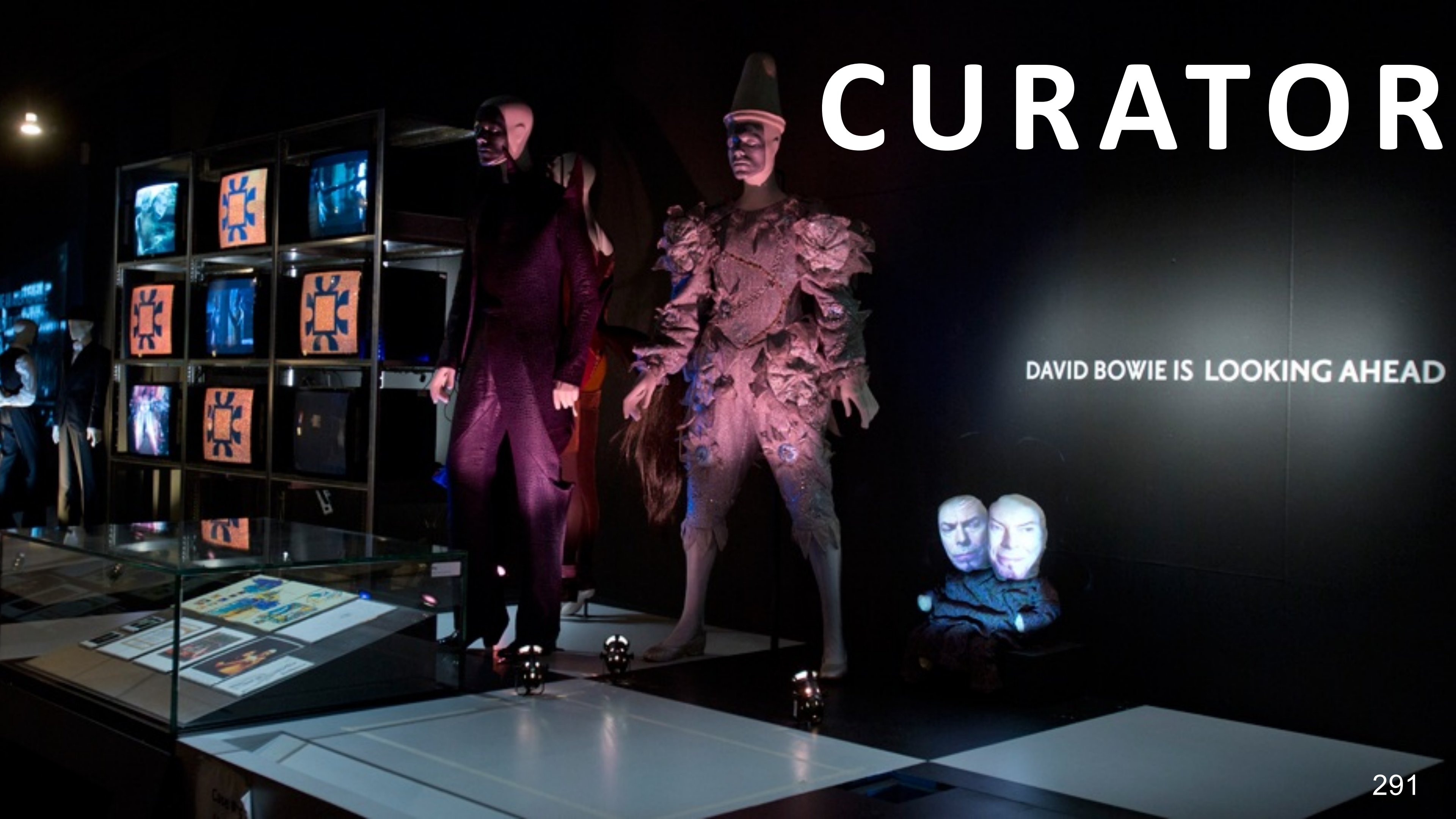
- nfishman@us.ibm.com
- (646) 457-0798

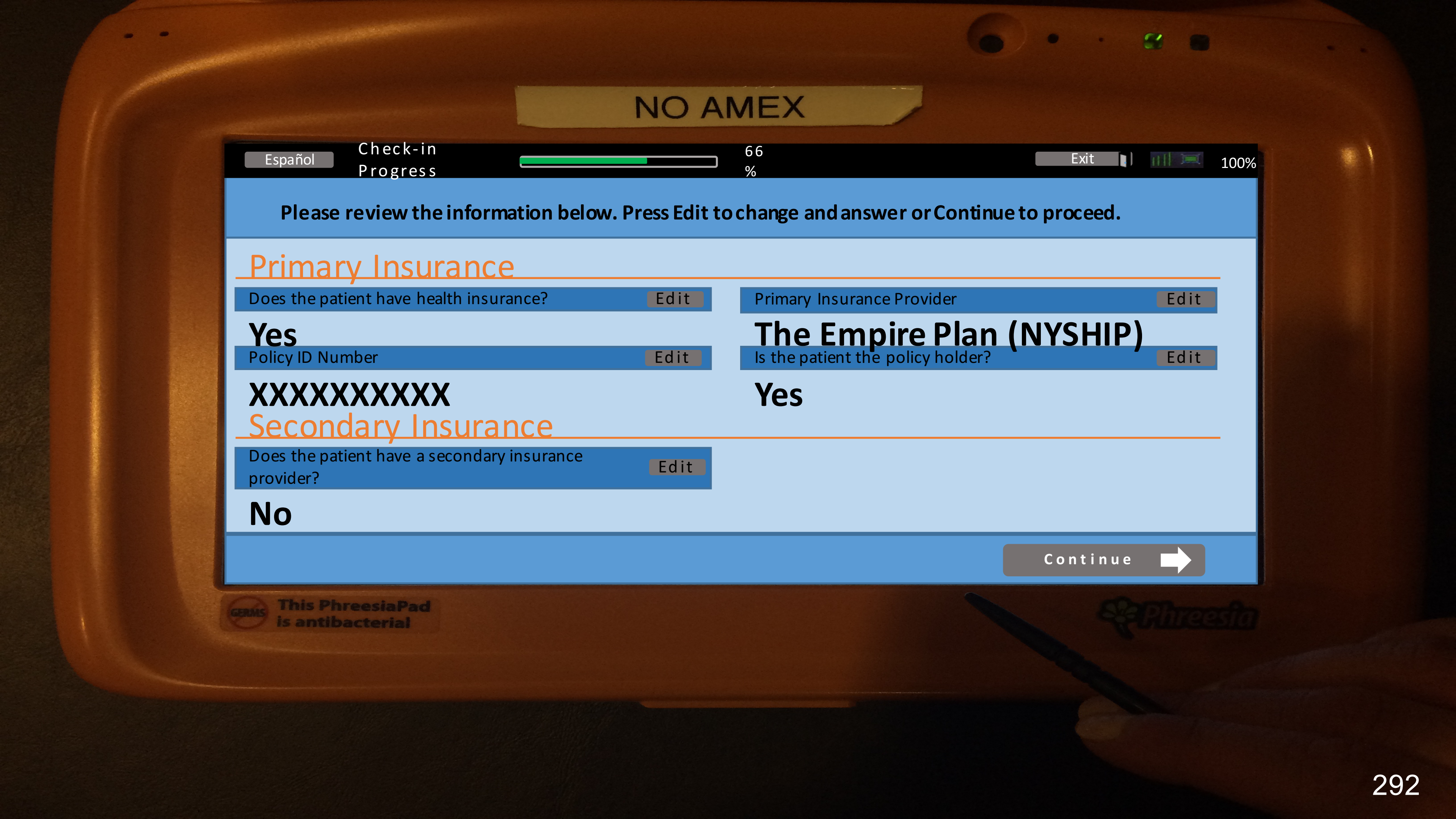


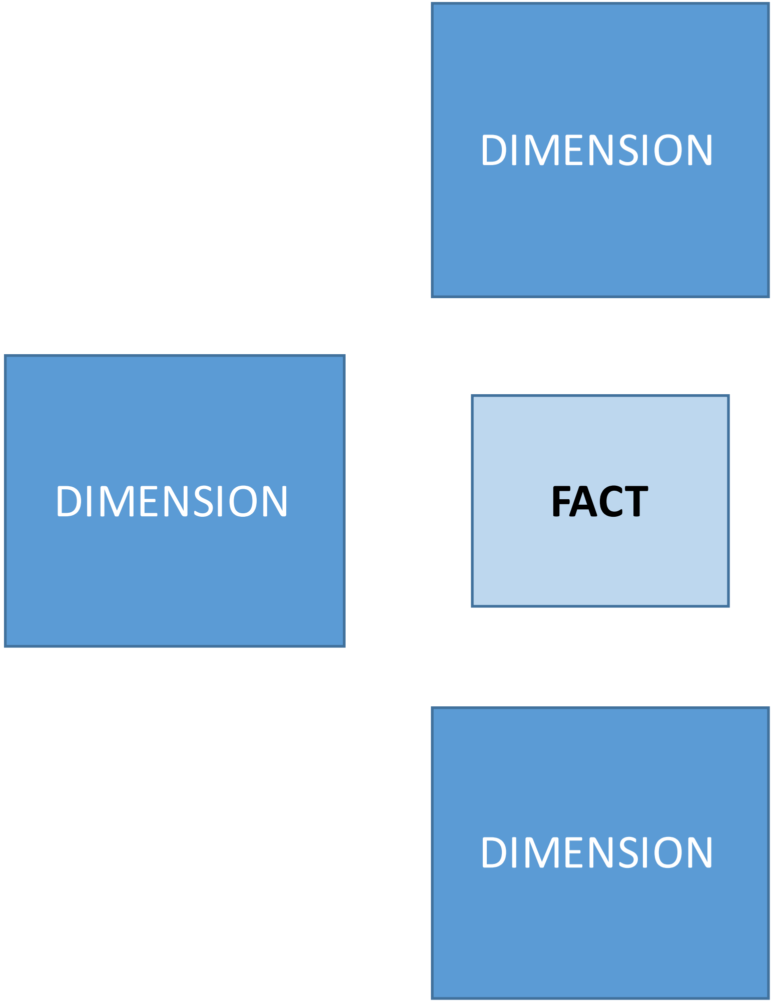
In Summary,
The Industry Perspective

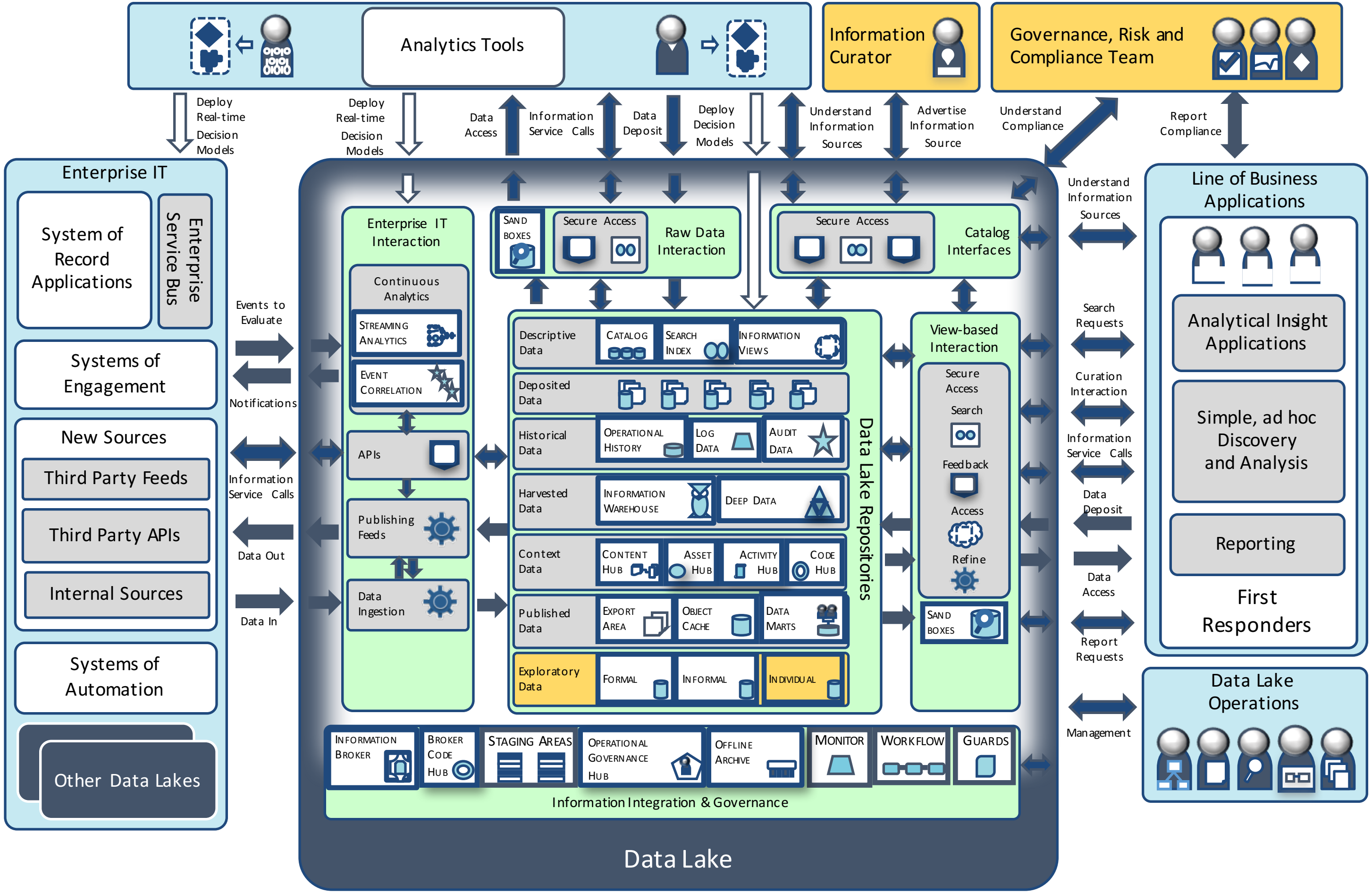
CURATE

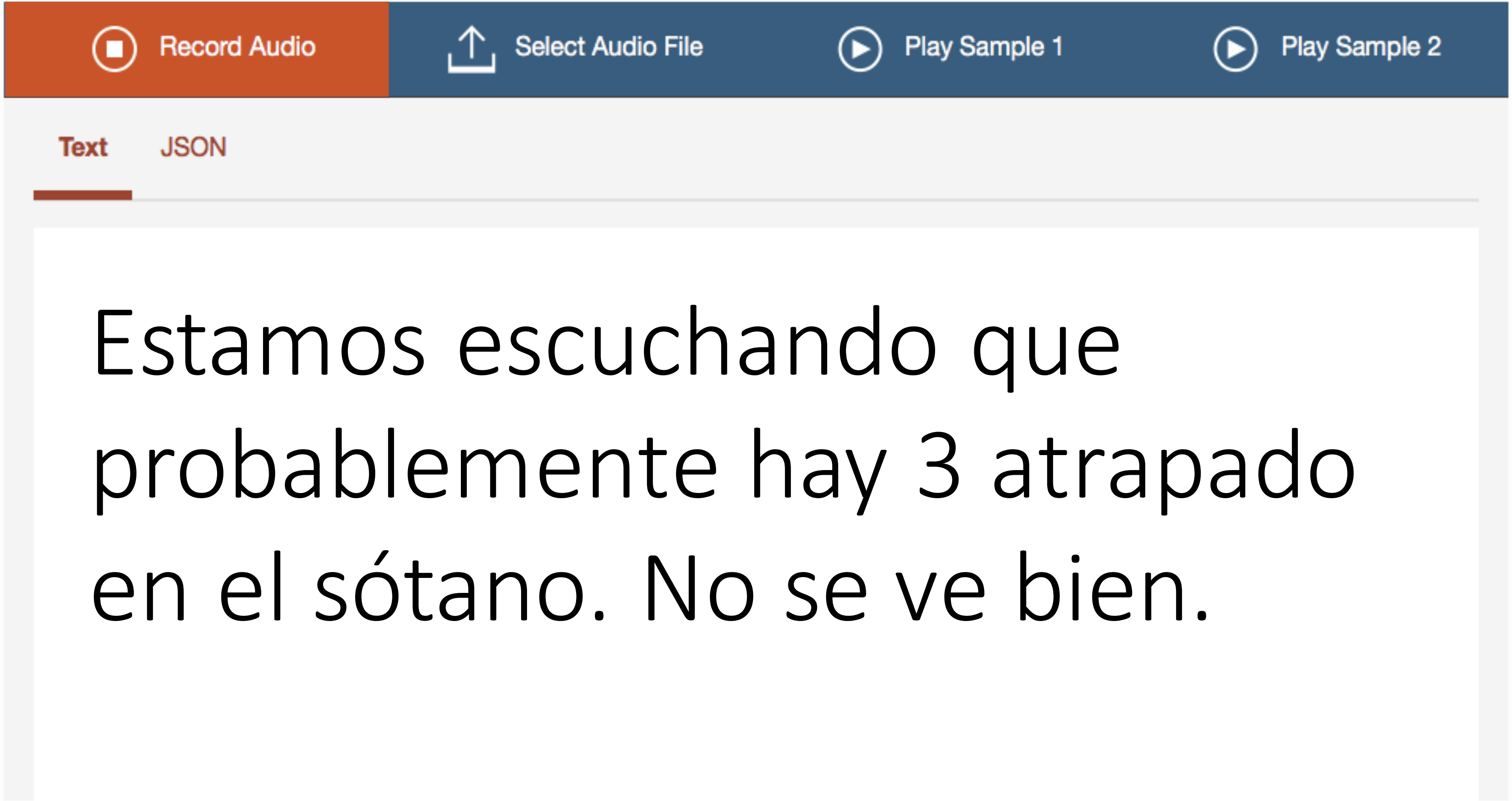
CURATOR




NO AMEX
Español
Check-in Progress
66 %
Exit
100%
Please review the information below. Press Edit to change and answer or Continue to proceed.
Primary Insurance
Does the patient have health insurance?
Edit
Yes
Primary Insurance Provider
Edit
The Empire Plan (NYSHIP)
Policy ID Number
Edit
XXXXXXXXXX
Is the patient the policy holder?
Edit
Yes
Secondary Insurance
Does the patient have a secondary insurance provider?
Edit
No
Continue
This PhreesiaPad is antibacterial
Phreesia


DIMENSION
DIMENSION
FACT
DIMENSION


Analytics Tools
Information Curator
Governance, Risk and Compliance Team
Deploy Real-time Decision Models
Deploy Real-time Decision Models
Data Access
Information Service Calls
Data Deposit
Deploy Decision Models
Understand Information Sources
Advertise Information Source
Understand Compliance
Report Compliance
Enterprise IT
System of Record Applications
Enterprise Service Bus
Systems of Engagement
New Sources
Third Party Feeds
Third Party APIs
Internal Sources
Systems of Automation
Other Data Lakes
Events to Evaluate
Notifications
Information Service Calls
Data Out
Data In
Enterprise IT Interaction
Continuous Analytics
Streaming Analytics
Event Correlation
APIs
Publishing Feeds
Data Ingestion
Sand Boxes
Secure Access
Raw Data Interaction
Secure Access
Catalog Interfaces
Descriptive Data
Catalog
Search Index
Information Views
Deposited Data
Historical Data
Operational History
Log Data
Audit Data
Harvested Data
Information Warehouse
Deep Data
Context Data
Content Hub
Asset Hub
Activity Hub
Code Hub
Published Data
Export Area
Object Cache
Data Marts
Exploratory Data
Formal
Informal
Individual
Data Lake Repositories
View-based Interaction
Secure Access
Search
Feedback
Access
Refine
Sand Boxes
Information Broker
Broker Code Hub
Staging Areas
Operational Governance Hub
Offline Archive
Monitor
Workflow
Guards
Information Integration & Governance
Data Lake
Understand Information Sources
Search Requests
Curation Interaction
Information Service Calls
Data Deposit
Data Access
Report Requests
Management
Line of Business Applications
Analytical Insight Applications
Simple, ad hoc Discovery and Analysis
Reporting
First Responders
Data Lake Operations


Record Audio
Select Audio File
Play Sample 1
Play Sample 2
Text
JSON
Estamos escuchando que probablemente hay 3 atrapado en el sótano. No se ve bien.

Input

Enter or paste text from a passage.

Spanish detected

Text | Rest API

Estamos escuchando que probablemente hay 3 atrapado en el sótano. No se ve bien.

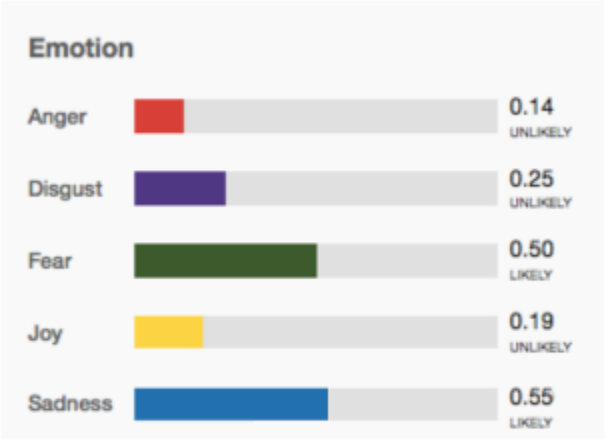
Output

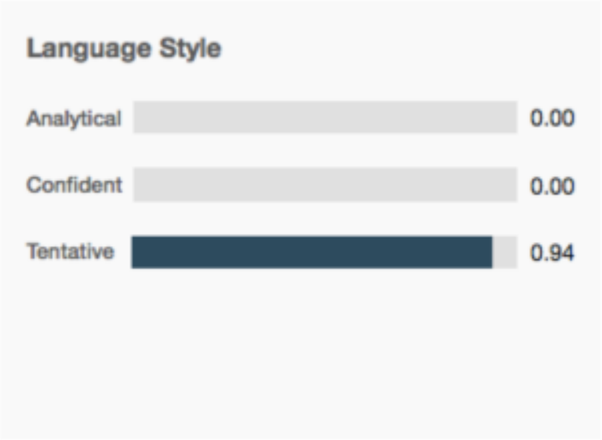
Copy output from this field to clipboard.

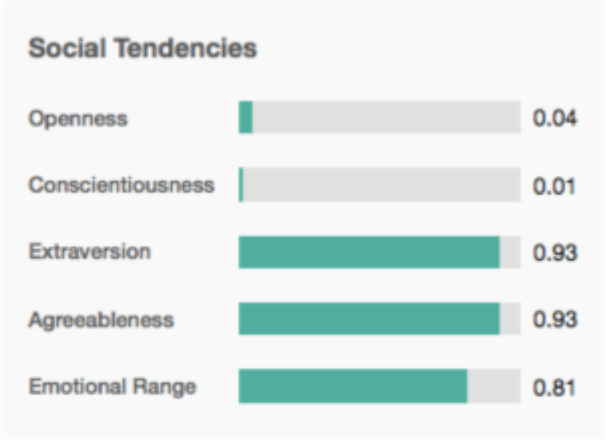
English

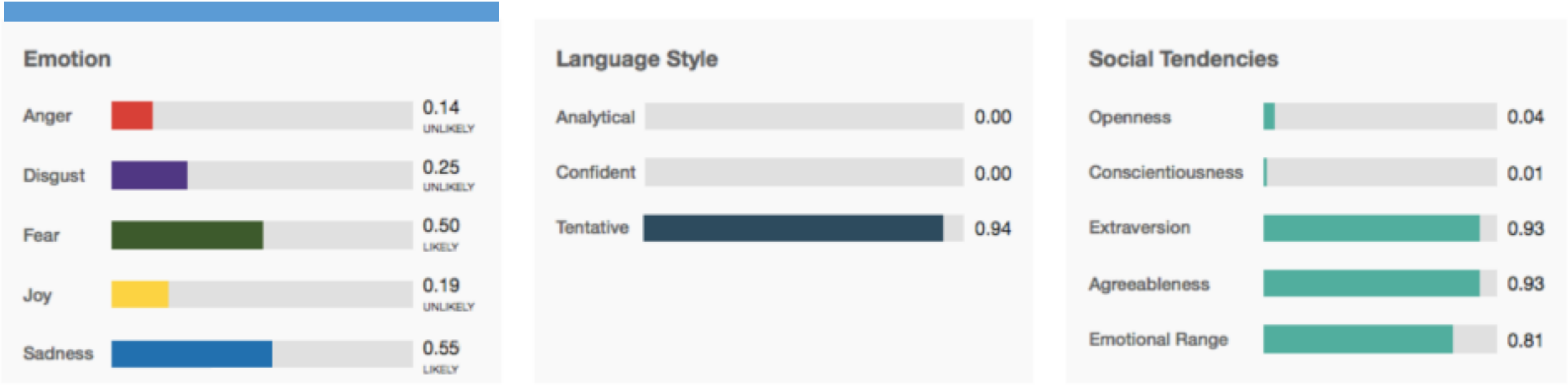
Text | JSON

We're hearing that there are probably 3 trapped in the basement. It does not look good.

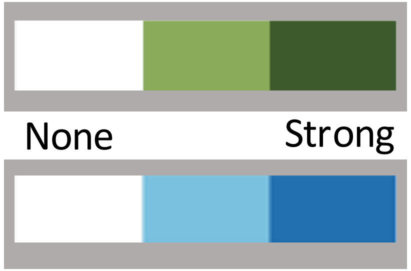

Emotion
Anger
0.14
UNLIKELY
Disgust
0.25
UNLIKELY
Fear
0.50
LIKELY
Joy
0.19
UNLIKELY
Sadness
0.55
LIKELY


Language Style
Analytical
0.00
Confident
0.00
Tentative
0.94


Social Tendencies
Openness
0.04
Conscientiousness
0.01
Extraversion
0.93
Agreeableness
0.93
Emotional Range
0.81

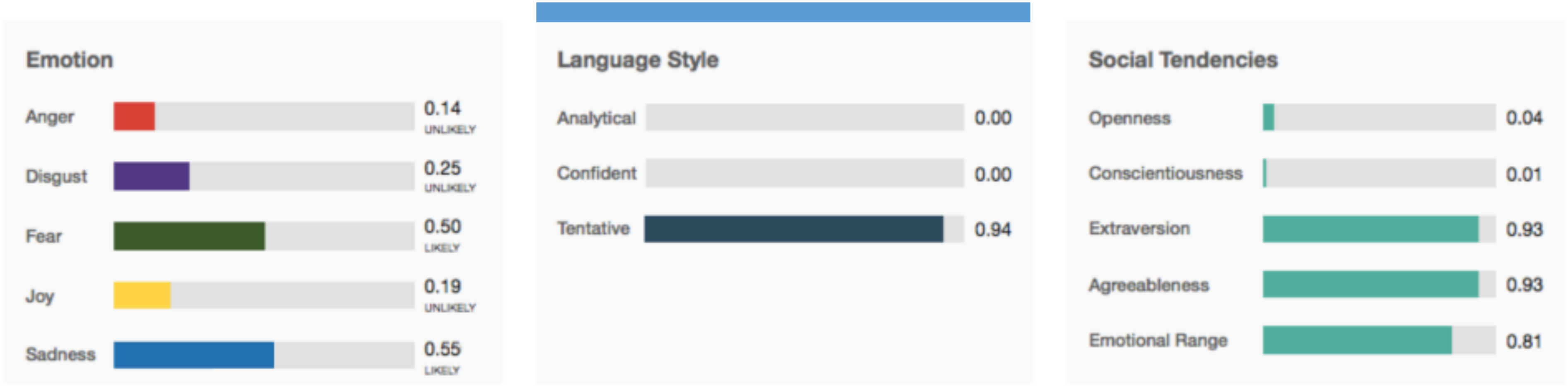


In context



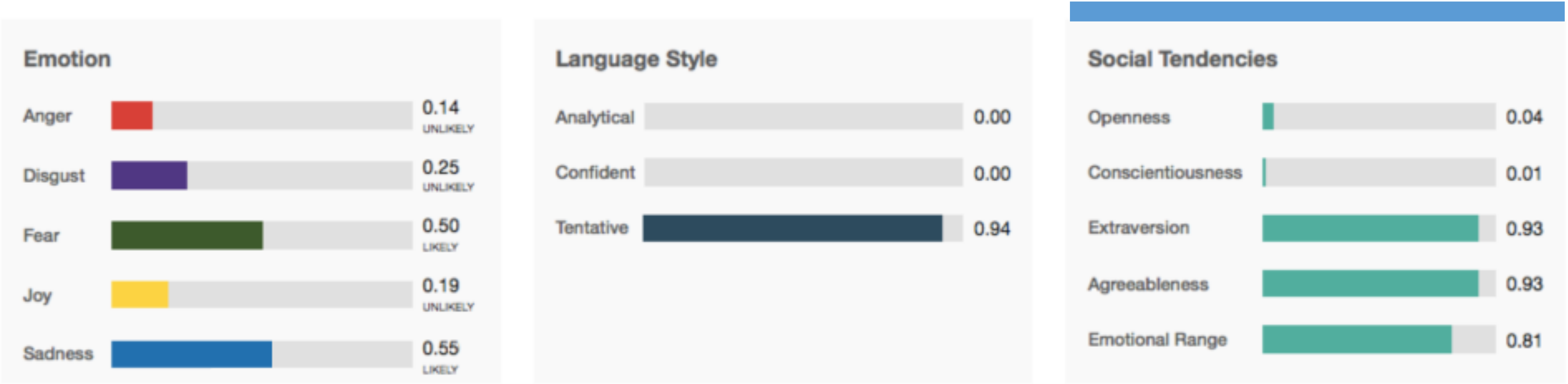
We're hearing that there are probably 3 trapped in the basement.

It does not look good.



Ranked by score

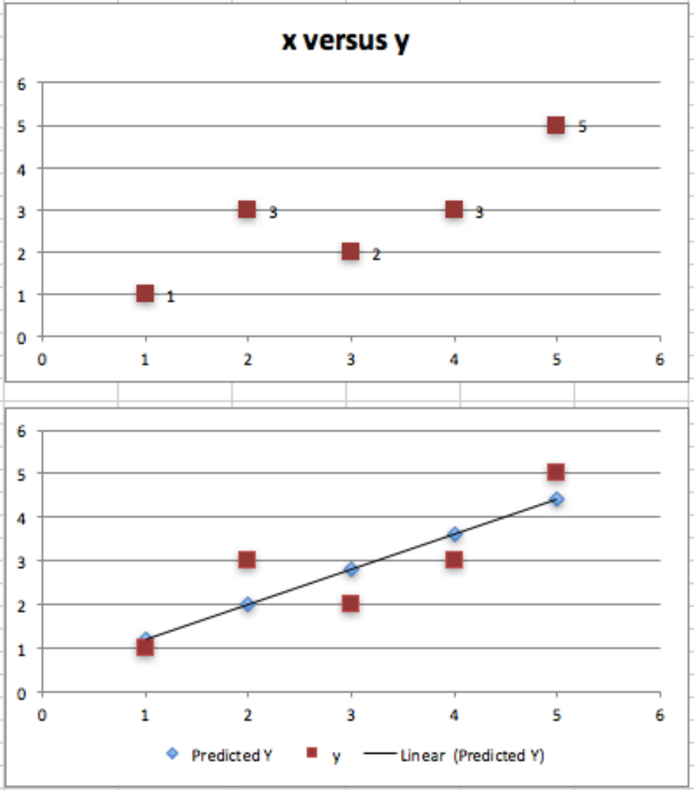
0.61	We're hearing that there are probably 3 trapped in the basement.
0.00	It does not look good.



JSON


```
                    "tone_name": "Agreeableness"
                  },
                  {
                    "score": 0.81,
                    "tone_id": "emotional_range_big5",
                    "tone_name": "Emotional Range"
                  }
                ],
                "category_id": "social_tone",
                "category_name": "Social Tone"
              }
            ],
            "className": "original-text--sentence_fear-low"
```

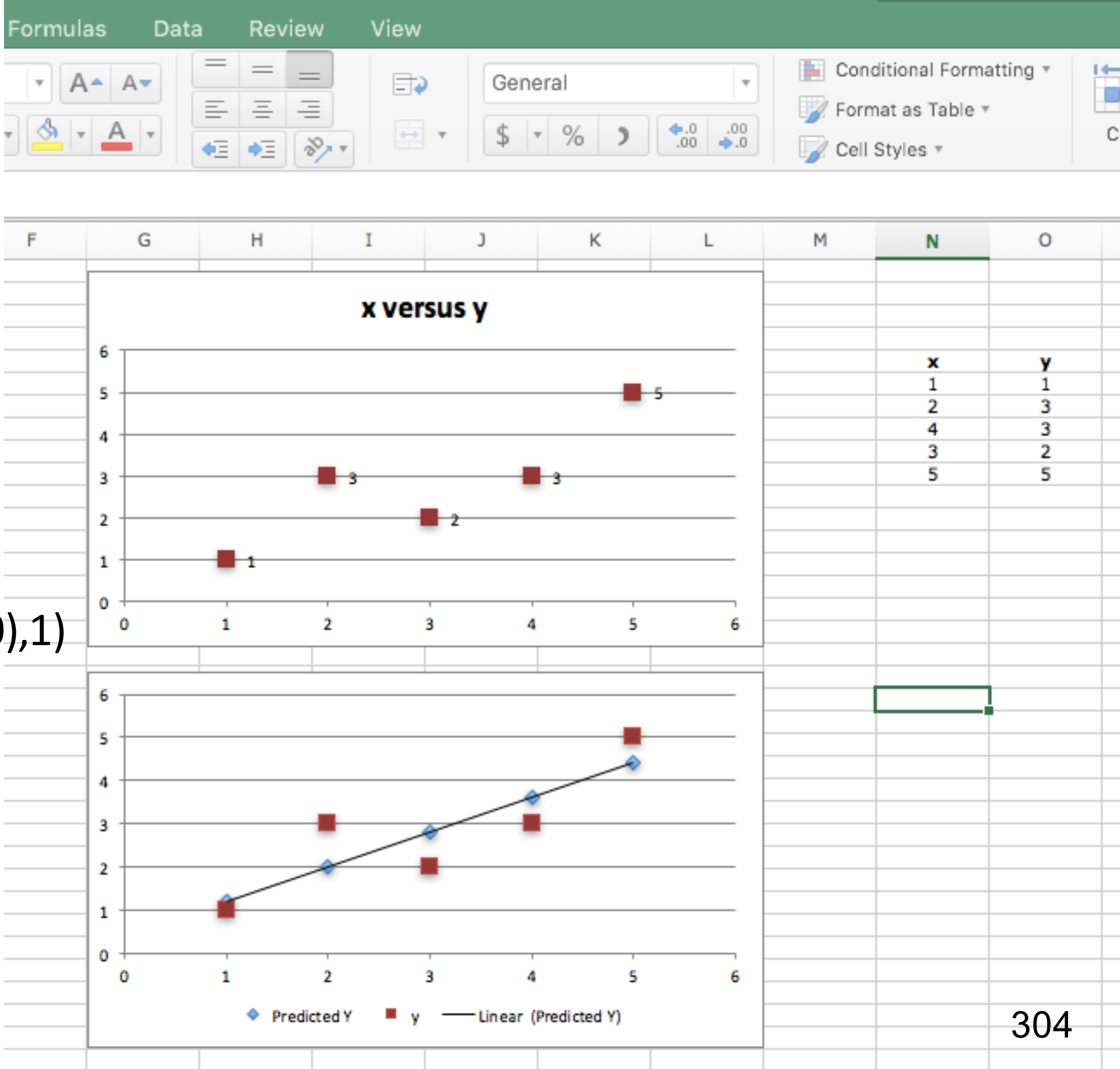
$$y = B0 + B1 \times x$$



x	y
1	1
2	3
4	3
3	2
5	5

$$y = B0 + B1 \times x$$

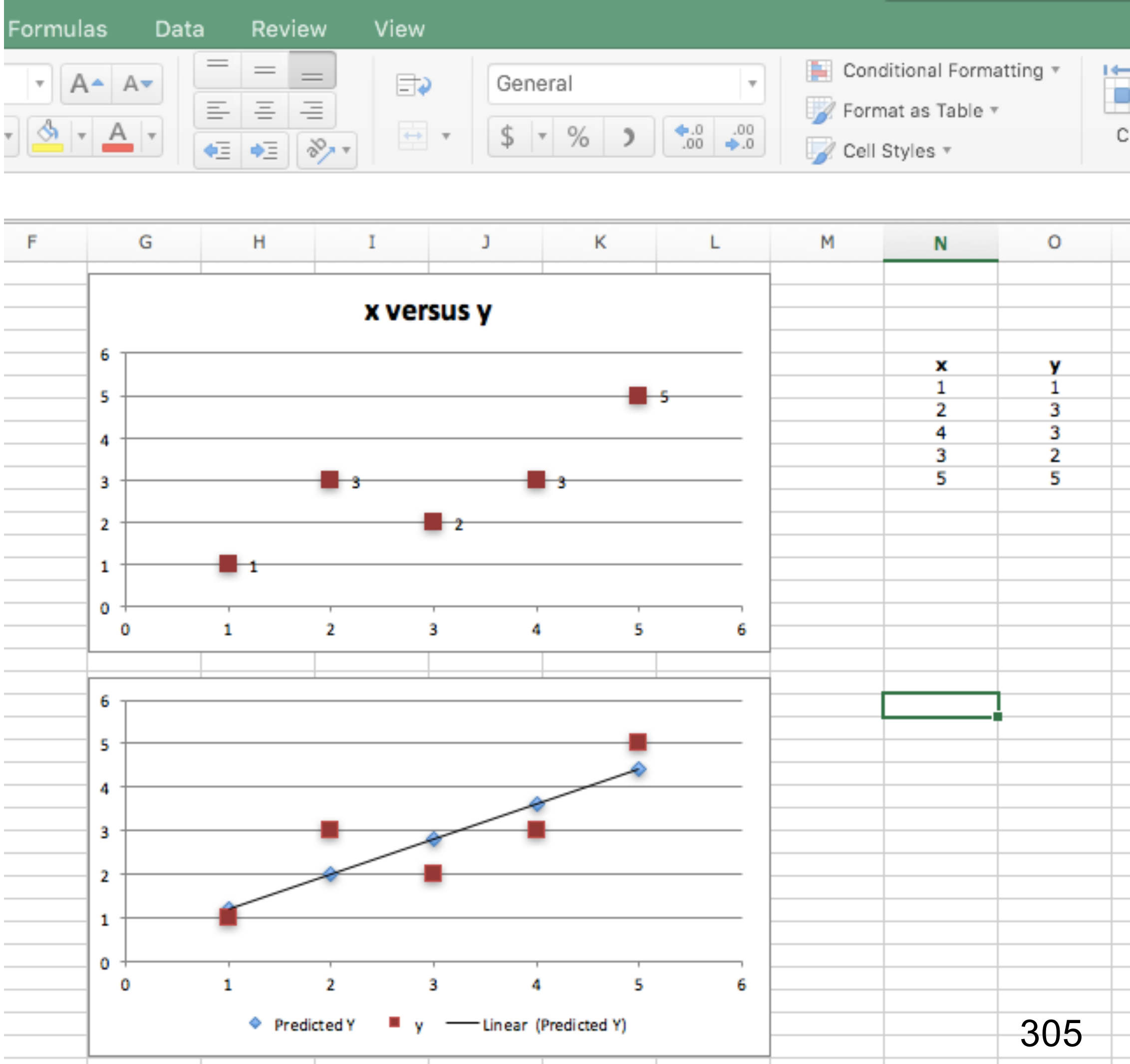
0.8 =TRUNC(PEARSON(N6:N10,O6:O10),1)



$$y = B0 + B1 \times x$$

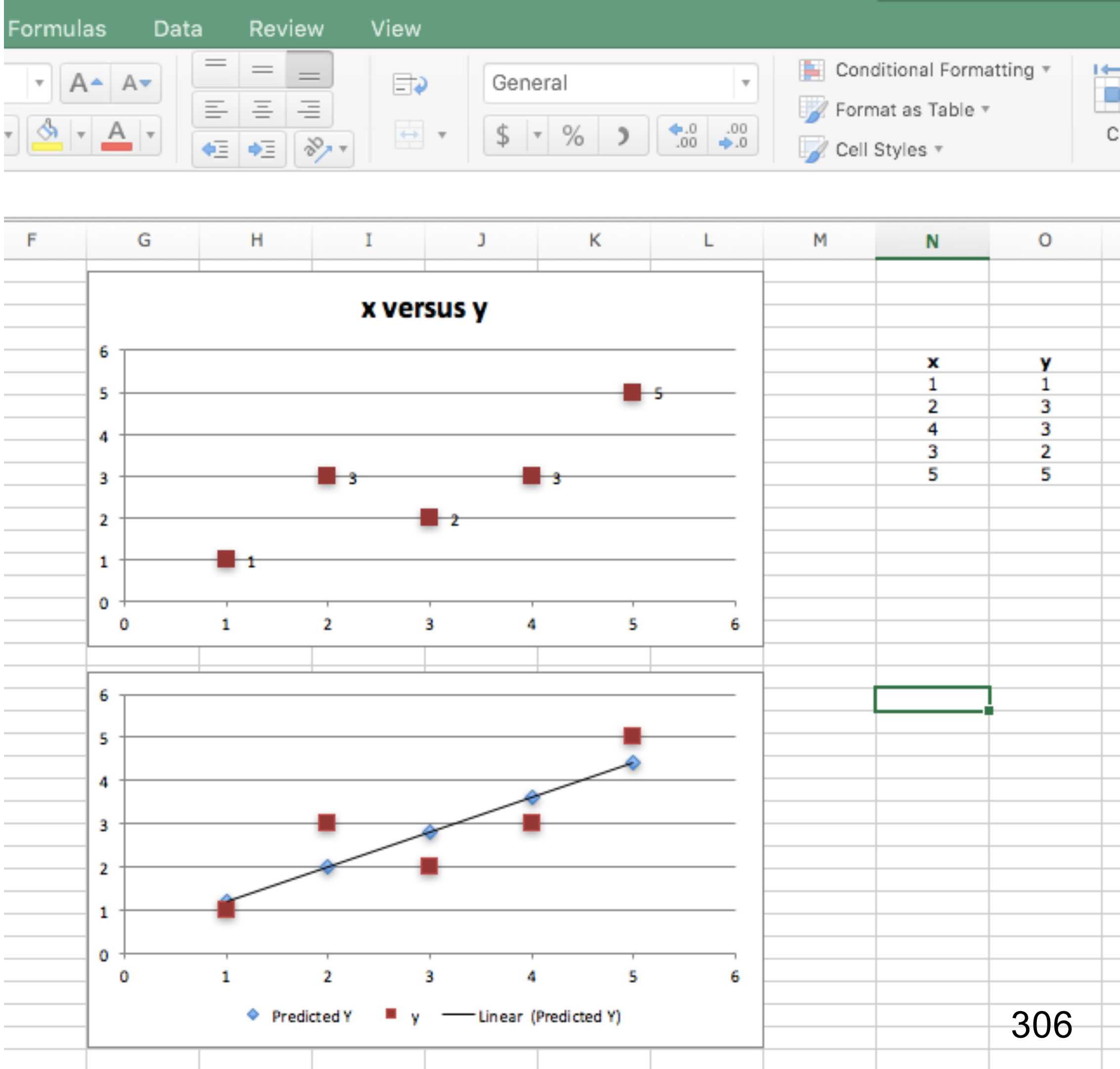
$$B0 = mean(y) - B1 \times mean(x)$$

2.8	=AVERAGE(O6:O10)
0.8	=B1
3	=AVERAGE(N6:N10)
2.4	= 0.8 * 3
0.4	= 2.8 - 2.4



$$y = B0 + B1 \times x$$

1.2	=	0.4	+	0.8	*	1
2	=	0.4	+	0.8	*	2
3.6	=	0.4	+	0.8	*	4
2.8	=	0.4	+	0.8	*	3
4.4	=	0.4	+	0.8	*	5



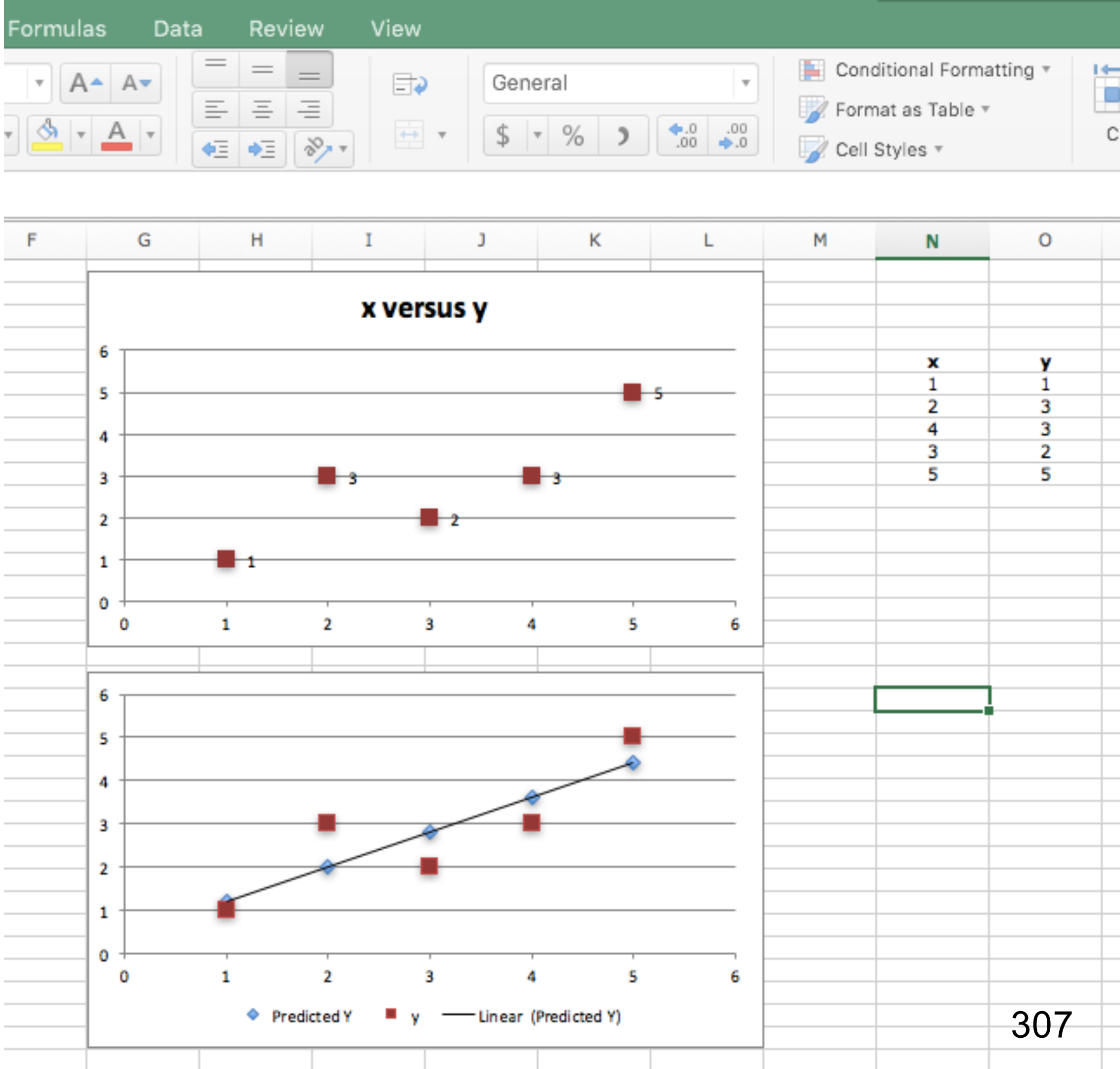
Root Mean Squared Error

0.2 = 1.2 – 1
-1 = 2 – 3
0.6 = 3.6 – 3
0.8 = 2.8 – 2
-0.6 = 4.4 – 5

0.04 = 0.2^2
1.00 = -1^2
0.36 = 0.6^2
0.64 = 0.8^2
0.36 = -0.6^2

2.40

0.692 = 2.4 / 5



Summary

- Curate / Curator
  - Data Lake
    - Exploration Zone
  - Data Ingestion
  - Metadata
    - Lineage
    - Provenance

- Video Analytics
- Speech to Text
- Language Translation
- Tone Analysis

- Machine Learning