Certain commercial equipment, instruments, or materials are identified in this paper in order to specify the experimental procedure adequately. Such identification is not intended to imply recommendation or endorsement by the National Institute of Standards and Technology, nor is it intended to imply that the materials or equipment identified are necessarily the best available for the purpose. This publication is intended to capture external perspectives related to NIST standards, measurement, and testing-related efforts. These external perspectives can come from industry, academia, government, and other organizations. This report was prepared as an account of a workshop; it is intended to document external perspectives and does not represent official NIST positions.
Assistant Chief Anthony Treviño
San Antonio Police Department
Keynote Address
Certain commercial entities, equipment, or materials may be identified in this document in order to describe an experimental procedure or concept adequately.

Such identification is not intended to imply recommendation or endorsement by the National Institute of Standards and Technology, nor is it intended to imply that the entities, materials, or equipment are necessarily the best available for the purpose.
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Glossary</th>
</tr>
</thead>
<tbody>
<tr>
<td>APCO</td>
<td>Association of Public Safety Communications Officials</td>
</tr>
<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>AR</td>
<td>Augmented Reality</td>
</tr>
<tr>
<td>AS</td>
<td>Authorization Server (term specific to the OAUTH spec)</td>
</tr>
<tr>
<td>ATF</td>
<td>Alcohol, Tobacco, Firearms</td>
</tr>
<tr>
<td>BCP</td>
<td>Best Current Practice</td>
</tr>
<tr>
<td>C</td>
<td>Circa/Approximately</td>
</tr>
<tr>
<td>CPSSP</td>
<td>Central Public Safety Service Provider</td>
</tr>
<tr>
<td>CRC</td>
<td>Communications Research Centre</td>
</tr>
<tr>
<td>CSS</td>
<td>Centre for Security Science</td>
</tr>
<tr>
<td>DRDC</td>
<td>Defense Research and Development Canada</td>
</tr>
<tr>
<td>EAS</td>
<td>Extended Area Service</td>
</tr>
<tr>
<td>EMS</td>
<td>Emergency Medical Services</td>
</tr>
<tr>
<td>EMT</td>
<td>Emergency Medical Technician</td>
</tr>
<tr>
<td>ESN</td>
<td>Emergency Services Network</td>
</tr>
<tr>
<td>FIDO</td>
<td>Fast Identity Online</td>
</tr>
<tr>
<td>FOSS</td>
<td>Free and Open Source Software</td>
</tr>
<tr>
<td>FRFS</td>
<td>Fire and Rescue Service</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information Service</td>
</tr>
<tr>
<td>GPM</td>
<td>Gallons Per Minute</td>
</tr>
<tr>
<td>HMI</td>
<td>Human-Machine Interaction</td>
</tr>
<tr>
<td>HTTPS</td>
<td>Hypertext Transfer Protocol Secure</td>
</tr>
<tr>
<td>ICAM</td>
<td>Identity, Credential, and Access Management</td>
</tr>
<tr>
<td>ICSC</td>
<td>Incident Command System</td>
</tr>
<tr>
<td>IdP</td>
<td>Identity Provider</td>
</tr>
<tr>
<td>IETF</td>
<td>Internet Engineering Task Force</td>
</tr>
<tr>
<td>LDAP</td>
<td>Lightweight Directory Access Protocol</td>
</tr>
<tr>
<td>LEO</td>
<td>Law Enforcement Officers</td>
</tr>
<tr>
<td>LMR</td>
<td>Land Mobile Radio</td>
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<tr>
<td>LTE</td>
<td>Long Term Evolution</td>
</tr>
<tr>
<td>MCPTT</td>
<td>Mission Critical Push-to-Talk</td>
</tr>
<tr>
<td>MFA</td>
<td>Multi-Factor Authentication</td>
</tr>
<tr>
<td>NCCoE</td>
<td>National Cybersecurity Center of Excellence</td>
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<tr>
<td>NFC</td>
<td>Near Field Communication</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Protection Association</td>
</tr>
<tr>
<td>NENA</td>
<td>National Emergency Number Association</td>
</tr>
<tr>
<td>NPSCC</td>
<td>National Public Safety Telecommunications Council</td>
</tr>
<tr>
<td>OAUTH</td>
<td>a rights delegation protocol</td>
</tr>
<tr>
<td>OIDC</td>
<td>Open ID Connect</td>
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<tr>
<td>PCP</td>
<td>Pre-commercial Procurement</td>
</tr>
<tr>
<td>PKCE</td>
<td>Proof Key for Code Exchange</td>
</tr>
<tr>
<td>PPDR</td>
<td>Public Protection &amp; Disaster Relief</td>
</tr>
<tr>
<td>PPI</td>
<td>Public Procurement of Innovative Solutions</td>
</tr>
<tr>
<td>PS</td>
<td>Public Safety</td>
</tr>
<tr>
<td>PSAP</td>
<td>Public Safety Answering Point</td>
</tr>
<tr>
<td>PSBN</td>
<td>Public Safety Broadband Network</td>
</tr>
<tr>
<td>PSFR</td>
<td>Public Safety First Responder</td>
</tr>
<tr>
<td>RFC</td>
<td>Request for Comment</td>
</tr>
<tr>
<td>RP</td>
<td>Relying Party</td>
</tr>
<tr>
<td>SaaS</td>
<td>Software as a Service</td>
</tr>
<tr>
<td>SAML</td>
<td>Security Assertion Markup Language</td>
</tr>
</tbody>
</table>
Acronym Glossary

- SCBA = Self Contained Breathing Apparatus
- SDK = Software Development Kit
- SME = Subject Matter Expert
- SP = Special Publication
- SPOC – Single Point of Contact
- SSO = Single Sign On
- SWAT = Special Weapons and Tactics
- U2F = Universal Two Factor
- UAF = Universal Authentication Framework
- UAV = Unmanned Aerial Vehicle
- UICC = Universal Integrated Circuit Card
MANAGING CHANGE
WHY IS IT IMPORTANT?
Open Innovation

Accelerating Results & Engaging Diverse Communities

Heather Evans, NIST
innovation
ACCELERATOR

Prize —
— CHALLENGES

PSCR
Innovation Framework

**Mindset:** Looking at the same things over and over and seeing new possibilities combined with the desire to take action

**Process:** The execution of new ideas that tend to occur at the intersection of ideas
Joy’s Law

“No matter who you are, most of the smartest people work for someone else.”

-Bill Joy, co-founder Sun Microsystems

Picture source www.crunchbase.com
Defining Open Innovation

- **Define a problem** to be solved or a goal to be reached.
- Participation is **open to anyone**, regardless of credentials, experience, connections, or past performance.
- The solver has flexibility to be **creative and innovative** in how they get to the solution.
Methodologies for Open Innovation

- Crowdsourcing
- Citizen Science
- Hackathons
- Prize Competitions/Challenges
Methodologies for Open Innovation

Crowdsourcing

Individuals or organizations solicit contributions from a large group of individuals, trusted individuals, or experts.
Methodologies for Open Innovation

Crowdsourcing

www.backyardworlds.org
Methodologies for Open Innovation

Citizen Science

Open collaboration in which members of the public participate in scientific research to meet real world goals.
Methodologies for Open Innovation

Citizen Science

Credit: Ushahidi Haiti Project

SKYWARN WEATHER.GOV®
Methodologies for Open Innovation

Hackathons

(hack day, codefest, data jam, etc.)

Sprints in which computer programmers and others involved in software development, including graphic designers, interface designers, project managers, and others collaborate intensively on projects.
Methodologies for Open Innovation

Prize Competitions

Challenges that award a cash (or other) prize for the accomplishment of solving a distinct problem

Typically designed to extend the limits of human ability and technology
Methodologies for Open Innovation

Prize Competitions – some history

1700

1800

1900

2000
Open Innovation Track Record

7 years
775+ crowdsourcing & prize competitions
120+ agencies
$250 million in prizes
5 million+ site visits
Visitors from every country
Participants from every state in the USA
What This Means to You
Public Safety Innovation Accelerator

5 years

5 key categories

$100 million for external collaboration

Location-Based Services

Public Safety Mission Critical Voice

Public Safety Enhanced User Interface

Public Safety Analytics

Network & Device Security
Virtual Public Safety Test Environment Challenge

*Design a physical measurement environment that uses immersive virtual reality tools for testing new first responder technologies.*
Virtual Public Safety Test Environment Challenge

Results:

- Open for 64 days
- 703 community members
- 103 competitors
- 21 entries
- 793 votes cast
- $45,000 in prizes
- 6 winners

Pay for Success

Diverse Skills

Accelerated Results

MultiVRse
What’s Next?
Open Innovation Opportunities

- Prototyping
- Ideation
- Data
- ..... 

Happening now:

PerfLoc Prize Competition

*Using NIST test data from four buildings, develop an indoor localization and tracking app*

*$35,000* in prizes and trip to Japan for IPIN Conference

[https://perfloc.nist.gov/](https://perfloc.nist.gov/)
A Grand Challenge for 2021:

Z-Axis & 3D Indoor Mapping
Get Involved

Open means that YOU are invited!

- Align with areas of interest
- Join working groups
- Submit solutions and solve problems

Follow & compete: Bit.ly/PSPrizes
Sign up for the newsletter: PSCR.gov
Contact us: PSPrizes@nist.gov
Public Safety LTE goes Global

An update from international partners on their public safety LTE deployments
Speakers

• **Moderator: Jason Kahn** – PSCR Research, Testing, & Evaluation Group
• **Joe Fournier** – Canada's Federal Government Centre for Security Science (CSS)
• **David Lund** – Public Safety Communication Europe (PSCE) Forum
• **Gordon Shipley** – UK Home Office Emergency Service Mobile Communications Programme (ESMCP)
Public Safety Broadband Activity in Canada

Joe Fournier
PSCR 2017 PS Broadband Stakeholder Meeting
San Antonio, TX
June 13, 2017
Oh Canada!

Shrink Canada by 100x!
700 MHz Public Safety Broadband Network (PSBN)

- A transformational national capability
- Canada very active since 2010
- Key tenets – Interoperability, affordability, sustainability, efficient use of spectrum, 24/7 availability
- Band 14 (758-768 MHz D/L, 788-798 MHz D/L)
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”
- **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.”
- **April 2015**: Government of Canada identified an additional 10 MHz for public safety broadband - total of 20 MHz (Band 14)
- **May 2016**: Federal, provincial and territorial (FPT) ministers responsible for emergency management met in Toronto to discuss national priorities.

“Ministers agreed on the creation of a public-private advisory group to inform the way forward on this important, yet complex initiative.”
Deployment Options & Governance

Dedicated Public Safety Broadband Network
- Public safety use only
- Dedicated public safety broadband spectrum

Shared Public Safety – Commercial Network
- Both public safety and commercial usage
- Designated public safety broadband spectrum

Commercial Network
- Public safety service on commercial networks
- Spectrum obtained through auction

24/7 Service Availability  Interoperability  Affordability  Sustainability
Efficient Use of Spectrum  Information Access and Sharing  Common User Experience
Use Cases & User Requirements

Use Case sources: Canada TAG, CSS, FirstNet, NPSTC
PSBN Task Team – Key Deliverables

- Bandwidth Requirements
- Use Cases / User Requirements
- Implementation Model
- Business Considerations

Service Delivery Model

- Network Architecture
  - Comparing PSBN Architectures
  - Impact of NG-911 on PSBN

- Operational Requirements
  - Network Identifiers
  - Priority and Preemption
  - MCPTT-over-LTE vs LMR

- Interoperability Requirements
  - Layered Interoperability
  - Access and Info Sharing
  - User Experience
  - Real-time Communications

- Security Requirements
  - ICAM
Leverage Extensive Work on PSBN since 2010

- **Technology**
  - 700 MHz Spectrum Requirements for Canadian Public Safety
  - Technical Advisory Group (technical reports, technical advice)

- **Test and evaluation capabilities**

- **Experiments**

- **Collaboration with the US**
  - Canada-US IWG
  - Technical Annex for CSS/CRC – PSCR collaboration
  - Chair the Deployable System Work Group
  - DHS S&T / FirstNet / NPSTC
  - Texas A&M

- **Operational/governance initiatives**
  - Industry Canada consultation 2012
  - Montreal Model
  - FPT IWG
  - IWG Governance Sub-committee
  - Economic Analysis
PSBN – Recent Supporting Initiatives

• Test and evaluation capabilities

• PSBN Pilots
  • Ottawa region PSBN pilot network
  • Calgary Police Pilot
  • Yukon / British Columbia deployable LTE Systems

• Experiments
  • Ottawa Fire Services
  • Regina Stadium
  • CAUSE Resilience

• Other Projects
  • Public safety broadband applications – University of Regina
  • Emerging wireless for public safety
  • In-building broadband wireless
Communications Interoperability Research Test and Evaluation Centre

FirstNet - Boulder
BRiC – Regina
Deployable PSBN - Simon Fraser
CIRTEC – Ottawa
Advanced NPSBN research - PSCR Boulder
PS LTE Testbed - Texas A&M
PS Apps – Regina

Public Safety Broadband Test and Evaluation Ecosystem
Canada-US Enhanced Resiliency Experiments

CAUSE III

CAUSE IV

Public Safety LTE U.S.

Public Safety LTE Canada

CAUSE V
PSBN Pilot Projects

Ottawa

RF Coverage service areas proposed:

- Downtown Gatineau
- Parliament & Special Events
- CRC
- Ottawa Hospital
- Ericsson Lab Sites
- Airport
- Ottawa-Gatineau Wide Area
Broadband LTE Experiments

Ottawa Fire (HazMat)  |  Deployable Systems  |  Regina Stadium

LTE Coverage

Ottawa Paramedics
Thanks!!

DRDC | RDDC

SCIENCE, TECHNOLOGY AND KNOWLEDGE
FOR CANADA’S DEFENCE AND SECURITY

SCIENCE, TECHNOLOGIE ET SAVOIR
POUR LA DÉFENSE ET LA SÉCURITÉ DU CANADA
European Interoperable Broadband for PPDR

PSCR Public Safety Broadband Stakeholder Meeting
13 June 2017

David Lund, PSCE Forum

www.broadmap.eu

@BroadMap_H2020
Public Safety Communications Europe Forum - PSCE

• Established as a result of a European Commission funded project in 2008. Evolved into a sustainable independent forum,

• Public safety user organisations, industry and research institutes

• Discuss and exchange ideas and best practices, develop roadmaps and improve the future of public safety communications.
Public Safety End Users
Saving Lives!
Managing Strategy, Tactical Planning & Operations
Running, Managing & improving the effectiveness
of Public Safety Communication Processes

Would this new idea work for you?

We have this problem or limitation, can you find a solution?

Collaboration to develop new Applications, Services, Devices and Networks

New and improved Communication Applications, Services, Devices and Networks

Researchers
Research and Development of novel improvements for Public Safety Communication - Legal, social, Process and Technology

Industry
Development and Supply of Communication Applications, Services, Devices and Networks

We want to improve our products and services
EC’s Horizon 2020 Project Call

**Topic Description**

**Scope:**

Specific challenge:

The users/potential buyers participating in the action should agree on specifications, and set standards for the next generation of an EU interoperable radio communication system considering at least three markets: one for broadband network system technology/setup/operation, one for end-user devices and one for applications, taking into account previously EU funded R&D project on the same issues.

Scope:

Different organisation schemes, such as a dedicated EU Mobile Virtual Network Operator for law enforcement agencies, a European Economic Interest Group, national interoperable networks, or any other way will have to be studied.

The participants will propose the best suitable architecture/solution in order to establish the desired EU-interoperable system.

The action will develop the core set of specifications, roadmap for research or tender documents to be used as a basis for national procurements, or the legal setting of alternate organisational solutions taking into account the above-mentioned requirements for interoperable next generation PPDR broadband
**A Cornerstone for European Critical Mobile Broadband Comms**

BROADMAP will inform Horizon 2020’s co-funded procurement process which will likely use the PCP and PPI instruments of H2020 and/or other instruments.

**BROADWAY**
- Applied R&D / Pre-commercial Procurement (PCP)
- Phase 0: Requirements / Solutions / Transition / Roadmapping
- Phase 1: Solution design
- Phase 2: Prototype development
- Phase 3: Original development of limited volume of first test products / services

**BROADNET**
- Public Procurement of Innovative Solutions (PPI)
- Phase 4: Deployment of commercial volumes of end-products
- Wide diffusion of newly developed solutions

---

**2016**
**2018**

**2025** – Commercially Deployed Interoperable Broadband Applications, Services, Networks, Devices for PPDR

---

Also normally multiple sourcing here to keep competition going.
Approach

- Collect, assess and validate the PPDR’s wireless broadband communication requirements
Approach

- Collect, assess and validate the PPDR’s wireless broadband communication requirements
- Establish a core set of specifications to fulfil the requirements
Approach

• Collect, assess and validate the PPDR’s wireless broadband communication requirements

• Establish a core set of specifications to fulfil the requirements

• Define transition roadmaps for research and standardisation for future evolution of European interoperable radio communication solutions, within legal procurement constraints
Approach

- Collect, assess and validate the PPDR’s wireless broadband communication requirements
- Establish a core set of specifications to fulfil the requirements
- Define transition roadmaps for research and standardisation for future evolution of European interoperable radio communication solutions, within legal procurement constraints
- Prepare the ground for a new eco-system to catalyse new applications, services and processes making use of broadband capabilities for Public Safety and Security
PSCE providing project coordination and support, 
Consortium Leader: 
Dr. David Lund, PSCE

15 potential buyers/end users, of which
- 12 represent EU Member States
- 3 represent Associated Countries
- 8 represent the responsible Ministry within their country
- 7 represent end user organizations and/or operators of emergency service networks

48 external supporters
- 7 extra countries

DGFLA providing legal expertise
15 project partner countries
25 workshops - validate user requirements
276 PPDR organisations from 18 countries
600+ practitioners (users) involved

Largest Study ever carried out across Europe regarding Broadband for PPDR
September to November 2016

Translation of Requirements => Specifications
Definition of Candidate Solutions
December 2016 to February 2017

Transition Roadmaps

SpiceNet Reference Architecture
SpiceNet Reference—Standardised PPDR Interoperable Communication Service for Europe

Three layers:

- **The harmonisation layer** enables own organisation schemes to provide PPDR services.
- Flexible harmonisation is achieved by using 3GPP and other standardised technologies and commonly agreed harmonized tuning ranges.
SpiceNet Reference—Standardised PPDR Interoperable Communication Service for Europe

Three layers:

- **The harmonisation layer** enables own organisation schemes to provide PPDR services.
  - Flexible harmonisation is achieved by using 3GPP and other standardised technologies and commonly agreed harmonized tuning ranges.

- **The interoperability layer** defines SpiceNet (Standardised PPDR Interoperable Communication for Europe) as a common PPDR Pan European cross-border interoperability solution.
  - This enables each country to use a set of common services for pan-European interoperability.
  - For national interoperability countries have freedom to use their own operational solutions.
SpiceNet Reference—Standardised PPDR Interoperable Communication Service for Europe

Three layers:

- The harmonisation layer enables own organisation schemes to provide PPDR services.
  - Flexible harmonisation is achieved by using 3GPP and other standardised technologies and commonly agreed harmonized tuning ranges.

- The interoperability layer defines SpiceNet (Standardised PPDR Interoperable Communication for Europe) as a common PPDR Pan European cross-border interoperability solution.
  - This enables each country to use a set of common services for pan-European interoperability.
  - For national interoperability countries have freedom to use their own operational solutions.

- The network and user layer enables common services provided by SpiceNet to be used in all participating countries. These common services can be further extended via agreements between nations.
Next Steps

Pre-Commercial Procurement 2018 – 2021/22

Applied R&D / Pre-commercial Procurement (PCP)

Supplier A
Supplier B
Supplier C
Supplier D

Phase 0
Requirements
Solutions
Transition
Roadmapping

Phase 1
Solution design

Phase 2
Prototype development

Phase 3
Original development of limited volume of first test products / services

Phase 4
Deployment of commercial volumes of end-products
Wide diffusion of newly developed solutions

Supplier(s) A, B, C, D and/or X
Also normally multiple sourcing here to keep competition going

BROADNET
Public Procurement of Innovative Solutions (PPI)

BROADMAP
Co#ordina)on*and*Support*Ac)on*(CSA)*

2016 2018

Circa 2020-2022

2025
Commercially Deployed Interoperable
Broadband Applications, Services, Networks, Devices
for PPDR

2025 – Circa 2020-2022

© PSCE Forum 2017
Thanks for Listening

www.psc-europe.eu

Next PSCE Conference,
14-16 November, Madrid
Hosted by Ministerio Del Interior, Spain

www.broadmap.eu
Emergency Services Mobile Communications Programme

PSCR General Update
17 June 2017
Airwave:
• Was the first national public safety (PS) network
• Is used by all UK Emergency Services and agencies
• Is a private TETRA network with loaned spectrum
• Has c3,800 sites to provide full national coverage
• Includes underground and air-to-ground coverage
• Provides functionality, coverage, availability, security
• National shut down is 31 Dec 2019 with extensions
• Is expensive and cannot support broadband data
• Was bought by Motorola in 2016
Programme objectives

- To replace Airwave with the Emergency Services Network (ESN) by enhancing a commercial mobile network (a carrier) to provide:
  - Integrated broadband data services
  - Public Safety functionality
  - National full coverage (97%/geography; 98%/population)
  - Improved availability through greater resilience
  - End-to-end security
  - Priority access over the general public
  - Greater choice in device types
  - A much cheaper service

- Available in 2018 with transition complete in 2020
- Meet user requirements but not necessarily in the same way
## Programme costs

<table>
<thead>
<tr>
<th>Financial Measure</th>
<th>15 year costs/savings Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Cost (inc/less Income exc NonCash)</td>
<td>£m 5,010</td>
</tr>
<tr>
<td>Total Saving (Base Case less Net Cost i.e. inc Income, exc Non-Cash)</td>
<td>£m 2,895</td>
</tr>
<tr>
<td>Total Investment</td>
<td>£m 1,060</td>
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<tr>
<td>Return on Investment</td>
<td>2.7</td>
</tr>
<tr>
<td>First Year of Saving/Benefit</td>
<td>£m 2,020</td>
</tr>
<tr>
<td>Payback Year</td>
<td>2,023</td>
</tr>
</tbody>
</table>

FBC Forecast (V7.40) reported to ESN Finance Group March 2017
Programme costs

Total ESMCP Costs 2015/16 – 2031/32

- Lot 1 (Delivery Partner): 0.3%
- Lot 2 (User Services): 15.7%
- Lot 3 (Mobile Services): 22.9%
- ESN Management Team: 2.6%
- London Underground: 1.4%
- Air to Ground: 2.8%
- Control Rooms: 1.1%
- Local Users: 1.9%
- Data and connections: 6.3%
- Wave 7000: 0.7%
- Optimism Bias/QRA: 4.7%
- Device Installation: 2.1%
- ESN Management Team: 2.6%
- Extended Area Services: 4.7%

Total ESN “Steady State” Costs 2021/22 – 2031/32

- Lot 2 (User Services): 26.0%
- Lot 3 (Mobile Services): 32.9%
- Devices: 10.2%
- Data and connections: 11.9%
- Optimism Bias/QRA: 6.4%
- Air to Ground: 2.8%
- ESN Management Team: 3.1%
- Extended Area Services: 4.7%
<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract awards</td>
<td>2015</td>
</tr>
<tr>
<td>Motorola acquires Airwave</td>
<td>Feb 16</td>
</tr>
<tr>
<td>Detailed design</td>
<td>May 16</td>
</tr>
<tr>
<td>Reference system</td>
<td>Aug 16</td>
</tr>
<tr>
<td>Test and functional trials</td>
<td>Aug 16 to Feb 18</td>
</tr>
<tr>
<td>Major operational trials</td>
<td>Q2 2018</td>
</tr>
<tr>
<td>Transition commences</td>
<td>Q3 2018</td>
</tr>
<tr>
<td>Transition completes</td>
<td>2020</td>
</tr>
</tbody>
</table>
Programme structure

- Devices (Devices Board)
  - Handheld Devices
  - Vehicle Devices
  - A2G Devices
  - Technical Support
- Coverage (Coverage Board)
  - Extended Area Services
  - Coverage Delivery
  - Coverage Assurance
  - Technical Support
- Mobilisation (Mobilisation Board)
  - US/MS Sponsor
  - Test Assurance
  - Resilience
  - Technical Support
- Engagement (Transition Board)
  - Management
  - Transition Readiness
  - Trials and Pilots
  - User Support
- Management (Management Board)
  - Programme Management Office
  - Technical Architecture
  - People & Engagement
  - Finance & Governance
- Services (Service Board)
  - ESN Service
  - Airwave Service
  - Networks
  - Corporate Security
- Commercial (Commercial Advisory Board)
  - Projects Procurement
  - US/MS Contracts
  - ASL Contract
  - DP/TfL Contracts

Delivery Partner

- Police
- Fire
- Ambulance
SCS structure

- Programme Director
  - DD Devices
  - DD Coverage
  - DD Mobilisation
  - DD Commercial

- Transition Director
  - DD Management
  - DD Engagement
  - DD Services
  - Senior Users (Police, Fire, Ambulance)
Programme scope

- **Emergency Services** User Organisations:
  - 44 Police forces
  - 50 FRS
  - 13 Ambulance Trusts

- **Other** User Organisations:
  - non-Home Office police forces
  - other government departments
  - local authorities
  - Transport agencies and utility companies

- **Control rooms**: c200
- **Vehicles**: c50,000
- **Aircraft**: c115
- **Users**: c300,000
Main procurement lots

• Lot 1 (Delivery Partner) - KBR
  – A Delivery Partner to support the Authority oversee the build out of the network; manage transition; training support services; vehicle installation design and assurance, and delivery support

• Lot 2 (User Services) - Motorola
  – A service provider to provide end-to-end systems integration; public safety functionality; account management; network and IT infrastructure; technical interfaces to all other lots and services user device management; application hosting; customer support; and service management

• Lot 3 (Mobile Services) - EE
  – A mobile network operator to provide an enhanced radio access service with highly available full national coverage using the Extended Area Services; and technical interface to Lot 2
Other procurements

- **Devices**: handheld, vehicle and aircraft (and their installations), and NSS
- **Coverage**: EAS, LUS, General and Special coverage
- **Networks**: Control Rooms, Connections and Interworking
- **Related activities**:  
  - Coverage assurance  
  - Resilience assurance  
  - Security architecture  
  - Testing  
  - Trials  
  - Live Services  
  - Transition readiness and assurance
- **Dependent projects**:  
  - Crossrail  
  - HS2  
  - Network Rail (Telecoms)  
  - New venues
Commercial approach

User Organisations (UO)

Lot 1 provides delivery assurance role in support

Lot 2 provides user access via self-service portal

Lot 3 provides delivery assurance role in support

Vehicle installation

Local vehicle installation

Local training delivery

Local project management

Control room upgrades sub-programme

Control room upgrades is a sub-programme, centrally coordinated with the overall Programme and interfaces with Lot 2 User Services

Contract management

Central ESN Procurement

Other ESN central procurements

Local ESN procurements

Lot 1: Delivery Partner

Lot 2: User Services

Lot 3: Mobile Services

Lot 3: Non-core network airtime

Extended Area Services (EAS)

Core ESN services centrally procured

Non-core ESN services centrally procured

Non-core ESN services locally procured

Central ESN Procurement

Central ESN Procurement provides core ESN functionality, work connectivity plus programme management of the support for Transition to ESN.

Other ESN central procurements

Other ESN central procurements provide additional ESN functionality largely in response to needs and demands that vary between user organisations and that complement the core ESN service.

Local ESN procurements

Local ESN procurements provide additional support for user organisations in the Transition to the new ESN service; there may or may not be a need for individual organisations to procure support services depending on their existing capabilities and/or support arrangements.

Contract management centrally procured contracts and frameworks managed by EMT.
Transition

• Transition is assumed to take 27 months:

• There will be 12 Regional Transition Groups and one National Transition Group
Progress Updates
(Tuesday after Conference in Conference Room 14)

- Mobilisation
- General Coverage
- Extended Area Coverage
- Air to Ground
- London Underground
- Devices
- Transition
- Control Room Upgrades
- Control Room Connections
- Network Interworking
- Special Coverage
Thank you!
FirstNet Update

Jeff Bratcher
FirstNet Chief Technology Officer

June 13, 2017
FirstNet Responsibilities

Middle Class Tax Relief and Job Creation Act of 2012
Public Law 112-96 signed February 22, 2012

“The First Responder Network Authority shall hold the single public safety wireless license and take all actions necessary to ensure the building, deployment, and operation of the nationwide public safety broadband network”
FirstNet Assets

THE LAW
2.22.12
FirstNet becomes law (Public Law 112-96)

GOVERNANCE
FirstNet Board has 15 members that possess telecommunications and public safety backgrounds.

Each Governor appoints 1 Single Point of Contact (SPOC) and a governing body to represent the State’s interests to FirstNet.

43 member Public Safety Advisory Committee (PSAC) advises FirstNet on public safety intergovernmental matters.

FUNDING
$7B authorized to build the FirstNet network – funded via spectrum auctions through 2022.

NATIONWIDE SPECTRUM
20MHz of bandwidth dedicated to public safety in prime 700MHz frequency range (BAND 14).

June 13, 2017
FirstNet’s Journey

2001
- Radio communication challenges impact responding law enforcement, fire, EMS

2004
- Recommends national radio spectrum for public safety purposes
- Public safety unites to advocate for broadband network

2001
- 9/11 Attack

2004
- 9/11 Commission

2012
- FirstNet Created
- Independent agency to deploy Public Safety Broadband Network

2012
- FirstNet Created

2015-16
- Consultation
- Consultation in all 56 states/territories
- FirstNet works with states to collect and validate users and coverage data

2015-16
- Consultation

2017-22
- Deployment
- Nationwide deployment of the Public Safety Broadband Network

2016-17
- Partnership & Plans
- RFP for public-private partnership to build and operate network
- Delivery of State Plans
- Governor’s decision

2012-15
- Outreach
- Outreach to the public safety community
- Governors identify single points of contact (SPOC) for FirstNet

June 13, 2017
RFP Statement of Objectives (16)

Building, Deployment, Operation & Maintenance of 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/State/Tribal/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

June 13, 2017
FirstNet & AT&T: An Innovative Public-Private Partnership To Build Public Safety’s Network

June 13, 2017
3GPP Standards for Mission Critical Services

Release 12 (March 2015) & Release 13 (March 2016)

Release 12:
- Proximity Services (ProSe)
- Group Communications System Enablers for LTE (GCSE_LTE)

Release 13:
- Mission Critical Push To Talk over LTE (MCPTT)
- Isolated E-UTRAN Operations (IOPS)
- enhancements of prior features (D2D and group)

Release 14 (March-June 2017)

Mission Critical Video (MCVideo)
Mission Critical Data (MCData)
Mission Critical Services Common Requirements (MCCoRe)
Mission Critical Push To Talk over LTE - Realignment (MCPTT-R)
eenhancements of prior features (D2D, IOPS, and group)

Release 15 (Nov. 2018) & Release 16 (March 2020)

MCVideo Enhancements
MCData Enhancements
MCPTT Enhancements
MCCoRe Enhancements
5G support for Quality of Service (QoS), Priority, and Preemption
5G support for Dynamic Controller
Improvement of Direct Mode capabilities

June 13, 2017
### Public Safety Device Ecosystem Vision

#### Types
- Smartphones
- Tablets
- Feature phones
- Ruggedized
- All operating systems

- In Vehicle Routers (IVR)
- Hotspots / Mobile Data Terminals (MDT)
- Modems
- Vehicle Network System (VNS)
- Range extension / High Power UE
- Satellite fallback

- Hybrid
- Wearables
- Hands free
- Gloved usage

#### Connectivity
- LTE, 3G, Satellite, 5G
- Wi-Fi, Wi-Gig
- NFC
- Bluetooth
- Tethering
- Direct Mode

- LTE, 3G, Satellite, 5G
- Wi-Fi, Wi-Gig
- Ethernet
- USB
- Direct Mode

- LTE, 3G, Satellite, 5G
- Wi-Fi, Wi-Gig
- NFC
- Bluetooth

All inclusive vision building on economies of scale to target COTS pricing and availability
Public Safety Devices Roadmap Vision

Today

Existing Technology

Band 14 Mission Critical

5G Relay Latency Resiliency Redundancy

Tomorrow

June 13, 2017
Applications

**Strategy**
- Create apps that enable public safety user adoption
- Leverage scale and technologies of the commercial market

**Vision**
- Innovate continuously to meet the needs of public safety
- Support a vibrant public safety developer community
- Enable development of a growing portfolio of public safety apps

**Ecosystem**
- Facilitate the secure coexistence of FirstNet and commercial apps on devices
- Offer best-of-breed solutions
Applications Ecosystem Vision

ICAM
Federated ICAM

App Dev Env
Platform for developers

Test & Cert
Certify = test against criteria

App Store
Coexist with commercial apps

SDP
Application Layer
Open APIs
Service Delivery Platform
Network Services

Cloud Services
Cost-effective agency options

Local Control
Agency controls

Security
App and data security

June 13, 2017
High Priority Applications for Public Safety

- Streamline Incident Documents
- Situational Awareness
- Portable Reporting & Data Access
- AVL/Location-Enabled Tracking
- Internet of Things (IoT)
- Information Synthesis
- Social Media
- De-centralized Operations
- GIS Mapping
- Telemedicine

June 13, 2017
Internet of Things (IOT) Vision for Public Safety

- Human Telemetry
- Variety of Drones and Robots
- Temporary Cameras
- Sensors
- Connected Vehicles
- Temporary Event Installations

June 13, 2017
FirstNet Innovation and Test Lab – Boulder

- State-of-the-art telecommunications laboratory for FirstNet and current/future vendors to validate and test NPSBN public safety specific features and functionality
- Ribbon Cutting held Nov. 9th, 2016

**Focus areas:**
- Quality of service
- Priority
- Preemption
- Mission-critical services, devices, and applications
- R&D efforts with PSCR
FirstNet State Plans

Rich Reed | FirstNet Chief Customer Officer

June 13, 2017
Transforming Public Safety Communications

FirstNet - Dedicated to Excellent Customer Experience (CX)

**MODERNIZED**
- Innovative apps and large devices ecosystem
- Network improvements and upgrades over 25 years
- Multi-layered, proven, cybersecurity and network security solutions

**PRIORITIZED**
- Emergency communications receive highest Quality Priority & Preemption
- Rapid deployment of network
- Instant nationwide coverage leveraging existing infrastructure

**SPECIALIZED**
- Nationwide coverage with access to deployables
- Aggressive pricing for public safety
- Dedicated 24/7/365 public safety helpdesk

June 13, 2017
FirstNet Priorities

State Plans

Core Network

June 13, 2017
June 2017 SPOC Meeting

All 50 states, 5 territories and the District of Columbia met in Addison, TX.
Content of the State Plan Portal

FirstNet Overview
Background and mission of FirstNet, including recap of the acquisition process

Network Architecture
Technical and operational information on the reliable, scalable, secure infrastructure that will be made available through FirstNet

Consultation & Outreach
Recap of the consultation and outreach efforts within the State / Territory that informed the acquisition and State Plan

Coverage
Interactive map of coverage, including phased buildout in the State / Territory

Governor’s Decision
Detailed information on the process for opting-in, as well as all information required to make an informed opt-out decision

Products & Services
Information on the features, applications, devices, and services (including pricing plans) that will be available on the FirstNet network

June 13, 2017
State Plans Timeline

June 7-8: National State Plan Kickoff Meeting
Mid-June: FirstNet State Plan Release
Up to 45 days: State Reviews and Provides Any Comments on State Plan
No later than Aug-Sept: FirstNet Reviews Any Comments
No later than Late Sept: Official Notice to Governor

FirstNet Engagement with States
Evolution of the Chief Customer Office

Current Functions
- State Plans
- Outreach
- Consultation
- Communications

Office of Chief Customer Officer

Governor Decision

Planned Functions
- Product Development / Product Management
- Customer Engagement & Satisfaction
- Branding & Communications

June 13, 2017
FirstNet Quality of Service, Priority and Preemption

PSCR Conference
June 2017
What Is QPP?

• Quality of Service (QoS): Establishes service quality parameters
• Priority: Gives users preferred access to network resources
• Preemption: Terminates or relocates lower priority users to provide access for high priority user
FirstNet QPP

• Standards based solution
• Supported on multiple bands
• Supports
  • Load control mechanism with access priority
  • Traffic management capabilities
  • Admission control priority with pre-emption
  • Scheduling priority
FirstNet QPP Capabilities in a Nutshell

• **Access Class Barring (ACB)**
  • Public safety users will have special Access Class and will be exempt from throttling/barring

• **High Priority Access (HPA)**
  • Public safety users will have HPA and receive priority treatment in various call setup stages

• **Traffic Management**
  • Non FirstNet traffic will be offloaded from Band 14 during high load

• **Admission Control (ARP)**
  • Public safety primary users will have higher Priority Level (PL) and will be Pre-emption capable
  • Certain RAN resources will be reserved for high priority users
FirstNet QPP Capabilities in a Nutshell

Three levels of permanent priority that can be assigned by public safety agencies

A special, temporary “Incident Level” giving top network priority that can be assigned through the Incident Management Tool (IMT) by public safety agencies

- IMT can assign Incident Level priority to their own FirstNet users or FirstNet users in other primary or extended public safety agencies
- Uplift will apply to both on-going and new sessions
- Incident Level “uplift” expires after a predetermined time period

QPP available in AT&T-managed LTE coverage areas
Priority and Preemption

NORMAL OPERATIONS

QPP PARKWAY

ROUTE 14

PRIMARY

EXTENDED PRIMARY

COMMERCIAL
Priority and Preemption

When a crisis occurs, commercial traffic can be preempted from the primary lane. Priority and preemption rules are applied to ensure emergency vehicles can reach their destinations as quickly as possible.
Priority and Preemption

CRISIS WORSENS

QPP PARKWAY

PRIORITY LEVEL

PRIORITY LANE

COMMERCIAL ROAD

ROUTE 14

PRIMARY

ROUTE 17

PRIMARY

ROUTE 2

PRIMARY

ROUTE 4

PRIMARY
User Driven Approach: Identifying Communications and Data Needs from Station to Scene

Mary Theofanos
Yee-Yin Choong, Shaneé Dawkins, Kristen Greene
Ryan Winpigler, Sandra Spickard Prettyman
Introduction
When a thor- 
ecessary,

al Station
or pos-
to his

Relieved:
patrol
releas
proper

Alarms:
took all
report
rigid
pos-

posts
on
the
desk

patrol
will not
use. He
except

occupants of, in any manner may excite sus-
picion. He will take such immediate action as he deems necessary and will report to his commanding officer the facts. He will pay particular attention to motor vehicles of all kinds, observe their numbers and constantly watch for such as have been stolen or which may have been used in the commission of crime, or are not properly licensed or illegally equip-

Section 29. To Give Name and Badge Number: He will give his name and badge number in a re-
spectful manner to any person who may inquire for same.

Section 30. To Relieve Traffic Congestion: When any way becomes blocked by vehicles, he shall use his best efforts to aid drivers in disentangling the same. When a street of travel is continuous, he shall open the way for foot travelers, wishing to cross, especially women, children and aged persons.

Section 31. To Report Cases of Contagious Disease: He will immediately report to his superior officers in case of malignant infections or contagious disease coming to his notice.

Section 32. To Rectify Traffic Signs: A patrol-
man will familiarize himself with the location and purpose of street traffic signs, and if he sees them misplaced, turned around, or tampered with in any manner, rectify same.

Section 33. To Visit Vacant Houses: A patrol-
man will enter in his memorandum book a list of vacant houses on his post, visit each during his tour of patrol, and report at the expiration of his tour such buildings as are not secure.

Section 34. To Report Unlit Street Lights: A patrolman will report street lights which should be lighted but are not.
Technological Changes
Efficient and Effective User Interfaces Require:

• Usability testing environment
  • Where context is as realistic as possible
  • Provides for repeatability and reproducibility
  • Infrastructure and instrumentation for new interaction paradigms such as:
    • Voice/Speech Technology, Gesture, Eye Gaze, Touch/Haptics, Wearable Computers, Electronic Textiles, Bio-Sensors, Vibrations, Heads-Up Displays and Context Aware/Location (Situational Awareness)

• Well-defined methodology based on knowledge of:
  • Users (first responders)
  • Tasks (what first responders do, how and where)
  • Needs and Requirements
Introducing: The Usability Handbook

- Specifically, for Public Safety Communication: Ensuring Successful Systems for First Responders
- Introduces concept of usability and user centered design (UCD)
- Showcases how UCD process can improve a system’s effectiveness, and efficiency, and user satisfaction


Thanks to subject matter experts from NPSTC; PSAC; NFPA; APCO; NIST Fire and Police; FEMA USAR; FBI; Bomb Squad; and Fire, EMS, and Law Enforcement personnel in the northeast corridor.
User Centered View: Users Plus Technology

Context

Age, Gender, Experience, Abilities, Innate Human Limits, Tasks, Goals

User Requirements

User Interface Infrastructure

Technology Requirements
Instructions, Affordances, Capabilities
Four Phases of User Centered Design

• Currently defining the Context of Use
• The users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used
First Responder Input is Necessary

- After Action Reports/Scenarios
- Taxonomy of Users
- Interviews and surveys
- Information Items

Input

(1) Context
(2) Needs
(3) Tasks
(4) Interaction Requirements (use cases)

(Final Deliverables)
- Usability Testing Methodology
- Requirements for Testing Environment
Information and Collection Methods

1. Environments and Scenarios ➔ After Action Reports and Scenarios of Use

2. Types of Users ➔ Certification Bodies

3. Operational information, Perceptions, and facts ➔ From You! (interviews and surveys)

4. Information items ➔ References and one on ones with first responders
User Types

• Based on specialization within PS domain
  • Follows available federal standards – e.g., NFPA, APCO/NENA
  • Official titles depend on Region of the U.S.

• Fire Service:
  • Firefighter, Fire Officer, HazMat, Wildland, Fire Apparatus Operator

• Emergency Medical Services
  • EMT, Paramedic, Tactical Paramedic, Ambulance Vehicle Operator

• Law Enforcement Services
  • Patrol, Investigation (Narcotics, ATF), Tactical / SWAT / Special Ops, K-9

• PSAP / 9-1-1 Services
  • Call-taker, Emergency Medical Dispatch, Triage Telecommunicator
Purpose: user needs analysis
- Research what information first responders need
- Investigate how they use, or would use information

Origin/Foundation: 2015 APCO/PSCR Workshop
- “Identifying and Categorizing Data Types for Public Safety Mobile Applications” (NISTIR 8135)
- 50 participants with diverse backgrounds in public safety
- Discussion framed by 11 scenarios ranging from chemical explosion to traffic stop
- Futuristic scope: imagine the perfect app(s) on the perfect mobile device
- Objective: examine influence on cybersecurity of PS organizations
- Over 100 “data types” identified
### APCO/PSCR Workshop “Data Types” Identified

<table>
<thead>
<tr>
<th>Information Items</th>
<th>Original Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>evacuation routes</td>
<td>body camera data</td>
</tr>
<tr>
<td>event location</td>
<td>building footprints</td>
</tr>
<tr>
<td>event location</td>
<td>chem track</td>
</tr>
<tr>
<td>environmental conditions</td>
<td>common operational picture</td>
</tr>
<tr>
<td>facial recognition</td>
<td>comms</td>
</tr>
<tr>
<td>FF sensors(biometrics and equipment)</td>
<td>completed incident command system (ICS)</td>
</tr>
<tr>
<td>first responder assets</td>
<td>crime scene geographic information system (GIS)</td>
</tr>
<tr>
<td>flight traffic/FAA information</td>
<td>critical infrastructure(CI) around location</td>
</tr>
<tr>
<td>flight traffic/FAA information</td>
<td>critical logistics stations</td>
</tr>
<tr>
<td>fuel sources</td>
<td>critical static locations [shelters</td>
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<tr>
<td>functional roles</td>
<td>critical logistics stations</td>
</tr>
<tr>
<td>geo data / accelerometer</td>
<td>crowd sourced information</td>
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<tr>
<td>ground cover</td>
<td>deployable assets</td>
</tr>
<tr>
<td>hazardous materials</td>
<td>domoof needs assessment</td>
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<tr>
<td>hospital bedcounts</td>
<td>elevation model</td>
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<tr>
<td>hospital capacity</td>
<td>Emergency Response</td>
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<td>images + media from ng911</td>
<td>equipment/smartsensor</td>
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<td>impact map/plume model</td>
<td>ERG - (Emergency Response Guide) and PPE (Personal Protective Equipment )</td>
</tr>
<tr>
<td>incident action plan</td>
<td>medical facility bed count</td>
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<tr>
<td>officer status - sensor monitoring</td>
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<tr>
<td>patient info casualties</td>
<td>patient info</td>
</tr>
<tr>
<td>law enforcement intel</td>
<td>patient triage</td>
</tr>
<tr>
<td>input from social media pre processors</td>
<td>personal protective equipment (PPE) responder</td>
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<td>patient quarantine (no PII )</td>
<td>patient quarantine</td>
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<td>license and plate reader</td>
<td>license plate recognition</td>
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<td>license plate recognition(LPR)</td>
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<th>Body Camera Data</th>
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<td>Street Traffic</td>
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<td>Types of Hazardous Materials</td>
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</tr>
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<td>Medical Facility Bed Count</td>
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**Data Types**
- **Body camera data**
- **Officer status – sensor monitoring**
- **Utility information**
- **Location of responders**
- **Maps**
- **Medical facility bed count**
- **Impact map/plume model**
- **Evac routes and plans**
- **Environment**
- **Weather**
- **Blueprints of the facility**

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Information Items: SME Needs

• Understanding users and their context of use
• Discussions with subject matter experts (SMEs)
  • ASTM Subcommittee E54.09 Response Robot Meeting
    • Fire, HazMat, EMS, Bomb Squad, FEMA USAR, FBI
  • Local first responders
    • Fire, EMS, Police
Information Items: SME Needs – Preliminary Findings

• Asked first responders
  • How would you use this information item?
    • SMEs reflected on previous incident responses to describe use of information items
  • Are there any missing information items?
    • SMEs identified several items (e.g., drone/UAV, SCBA air level, robots, radio codes)

• Found that information needs varied depending on:
  • Domain
  • Location & region
  • Federal, state, local
  • User rank & role
  • User tasks
  • Scope of incident
### Information Items: SME Needs – Preliminary Findings

<table>
<thead>
<tr>
<th>Information Item</th>
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<tbody>
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<td>critical logistics stations</td>
<td>not “boots on the ground” level of responder; useful information on where to resupply water, food, etc. during emergency.</td>
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<tr>
<td>department of transportation (DoT)</td>
<td>In logistics context, for example, hurricanes can destroy entire bridges/roads. If a roadway is damaged, you don’t want to have to backtrack a convoy 20 miles to find alternate route (very hard to maneuver a convoy; can add 30s of hours to response, e.g., happened during Hurricane Katrina). If Local LEO could tag a bridge being out, that would be gold for incident response. It would be great for local LEO to quickly disseminate information to other responding teams.</td>
</tr>
<tr>
<td>logistic info</td>
<td></td>
</tr>
<tr>
<td>elevation model</td>
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<td>More useful for wide open areas, not urban. Maybe use at FDOC level.</td>
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<td>first responder assets</td>
<td>Automation would be great for logistics and turnaround time. If you use equipment from ambulance, could automate keeping track of that and send to logistics desk so it’s ready at hospital for reduced turn-around time.</td>
</tr>
<tr>
<td>hydrants</td>
<td>flow/GPM pressure private vs. city last scheduled checkup</td>
</tr>
<tr>
<td>fuel sources</td>
<td>If it’s operational, locations are known (part of employee orientation). Would be helpful for mutual aid scenarios.</td>
</tr>
<tr>
<td>location of responders</td>
<td>This is a huge issue, especially z-axis information. Currently technology can determine location within 3 meters, but z-axis unknown. This is especially for squad leaders; each squad leader knows location of subordinate.</td>
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<tr>
<td>deployable assets</td>
<td>Assets include: All public safety personnel; Vehicles; People; Robots RFID tags would be good for inventory</td>
</tr>
<tr>
<td>geo data</td>
<td>Use it to get data on location of hydrants, static water sources, addresses, block numbers, road changes name, where roads interrupted by a water source. Currently communicated electronically via MDT (mobile data terminal). If you log onto system, you can see where other trucks are.</td>
</tr>
<tr>
<td>location GPS</td>
<td>This is critical, used for everything. Needed in buildings and canyons, where there are no satellites (e.g., geolocation instead of maps)</td>
</tr>
<tr>
<td>patient info casualties</td>
<td>From a tech search standpoint, helps me in my planning &amp; ability to do triage. For example, if I know there are 3 deceased and 2 potential survivors in a building, that provides info of how bad things are on the inside.</td>
</tr>
<tr>
<td>flight traffic / FAA information</td>
<td>Only useful if a dignitary comes in and the “bird” doesn’t fly. Currently get information watching the news.</td>
</tr>
<tr>
<td>pre-plans (PII)</td>
<td>Especially useful for large agencies. Information included ranges. Current effort to include operational medicine in pre-plans (as EMT on SWAT team).</td>
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<tr>
<td></td>
<td>AKA IAPs (incident action plans) for EMS. We have them for different types of events. For example, in a drowning, what units are dispatched, what people with what skills are dispatched, protocol or paramedic or police. Could disp&lt;addres&gt; with&lt;health&gt; what paramedics would do. If there are template IAPs for large events (e.g., 10k run or walk event runs, polar plunge events). On a scale of 1-10, how would you rate us by their...</td>
</tr>
</tbody>
</table>

---

**Note:** The information provided is a summary of discussions and findings related to information needs in emergency management. The table outlines various information items and how they could be utilized in different scenarios. The explanations are based on critical logistics stations, department of transportation (DoT) logistic info, local LEO needs, elevation model, plume model, impact map, first responder assets, hydrants, fuel sources, location of responders, deployable assets, geo data, location GPS, patient information, flight traffic / FAA information, and pre-plans (PII). Each row in the table highlights a specific information item and how it is valuable in response and recovery efforts.
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- **critical logistics stations**
  - not “boots on the ground” level of responder; useful information on where to resupply water, food, etc. during emergency.
  - In logistics context: e.g. hurricanes can destroy entire bridges/roads.
  - If a roadway is damaged, don’t want to have to backtrack convoy 20 miles to find alternate route (very hard to maneuver a convoy; can add 10s of hours to response) e.g., happened at katrina.
  - If Local LEO could tagged a bridge being out, that would be gold for incident response. It would be great for local LEO to quickly disseminate info to other teams.

- **department of transportation (DoT) logistic info**
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**Table Note:**
- **Information Item** column lists the specific information items.
- **How would you use it?** column describes the potential uses of the information items.

**Additional Notes:**
- The Department of Transportation (DoT) logistic info is crucial in logistics context, for example, hurricanes can destroy entire bridges/roads. If a roadway is damaged, you don't want to have to backtrack a convoy 20 miles to find alternate routes, which can add 10s of hours to response, as happened during Hurricane Katrina. If Local LEO could tag a bridge being out, that would be gold for incident response. It would be great for local LEO to quickly disseminate information to other responding teams.

**Other Information Items:**
- **Flight traffic / FAA information**
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- **Pre-plans (PPI)**
  - Especially useful for large agencies. Information included ranges. Current effort to include operational medicine in pre-plans (as EMT on SWAT team).

- **AKA IAPs (incident action plans) for EMS.** We have them for different types of events. For example, in a drowning, what units are dispatched, what people with what skills are dispatched, protocol (e.g., pediatric), and what protocols would do. If there are temporal events (e.g., events on boardwalk, runs, polar plunge, etc.). On a scale of 1-5 (e.g., "let us by their crew, by their crew, by their crew, by their crew, by their crew")
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**Information Items: SME Needs — Preliminary Findings**
Information Items: Card Sorting

• Goal: to elicit categories and relationships
• First responders in Fire, EMS, and Law
• Procedure:
  • Group information items based on which are closely related or similar to each other
  • Label each group
  • Identify missing information items
Information Items: Card Sorting
Information Items: Card Sorting – Preliminary Findings

**Pre-plans**
- blueprints of the facility
- evacuation plans
- fuel sources
- utility information

**Mass casualty**
- hospital bed counts
- patient quarantine
- patient triage

**Maps**
- critical locations
- elevation model
- GIS data
- hydrants
- street traffic

**ICS**
- first responder assets
- functional roles
- ICS (incident command system) forms / plans
- incident action plan
- incident management
• Goal: Identify scenario-based relationship between user needs and user tasks

• Procedure:
  • Review scenario
  • Select information relevant to scenario from list of items

Information Items: Scenario Mapping – Preliminary Findings

Maps
- GIS data
- hydrants
- street traffic

ICS
- functional roles
- ICS (incident command system) forms / plans
- incident action plan
- incident management
Incident Scenarios Collection

• Compiled from Various Sources
  • DHS SAFECOM Program – *Public Safety Statement of Requirements for Communications & Interoperability, Vol 1, v 1.2*
  • NIST PSCR
  • NISTIR 8135 – *Identifying and Categorizing Data Types for Public Safety Mobile Applications: Workshop Report*
  • After Action Reports (AARs) - summarized and anonymized
Incident Scenarios - *Attributes*

- Vignette
- Region and Location
- Time, day and month of the year
- Incident duration
- Actors
- Resources
- Complicating factors or considerations as the incident unfolds
- Incident outcomes
Incident Scenarios - *Example*

**Incident:** Subway Fire  
**Region:** South: South Atlantic  
**Location:** Metropolitan city  
**Time of year:** Monday in January

At 15:14, an Office of Unified Communications (OUC) operator received a call from a subway supervisor about a debris fire on the tracks near a major subway station. Additional 9-1-1 calls were received reporting heavy smoke at and near the station. A train stopped after encountering an accumulation of heavy smoke while traveling southbound in a subway tunnel. After stopping, the rear car of the train was about 386 feet from the south end of the subway station platform.

Ten minutes later, the OUC operator received a call for medics at the station because people could barely breathe due to the smoke. OUC dispatched a Rail Station Box Alarm to the subway station.

**Considerations:**
- Due to heavy smoke, responders could not see the train in the tunnel until they were right next to it.
- Radio communication was sporadic in the subway stations and tunnels.
- The side door of the train required special keys and would not open for passengers.
- One person on train was found unconscious.
- The following were dispatched: 5 Engine Companies; 2 Ladder Trucks; 2 Battalion Fire Chiefs; 1 Battalion Fire Chief to Operations Command Center; 1 Heavy Rescue Squad; 1 Basic Life Support Unit; 1 Advanced Life Support Unit; and 1 Emergency Medical Services Supervisor.
- Passengers and pedestrians near the subway station were evacuated. Rescue personnel estimated that evacuation was completed by 16:25.
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Region: South: South Atlantic
Location: Metropolitan city
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1 Census Bureau [https://www.census.gov/geo/reference/gtc/gtc_census_divreg.html](https://www.census.gov/geo/reference/gtc/gtc_census_divreg.html)
Incident Scenarios - Example

Vignette

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# Summary – 40 scenarios currently

<table>
<thead>
<tr>
<th>Fire</th>
<th>Law Enforcement</th>
<th>EMS</th>
<th>Multi-Discipline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure fire (2)</td>
<td>Active shooter (4)</td>
<td>Heart attack</td>
<td>Bombings at a planned event</td>
</tr>
<tr>
<td>Subway fire</td>
<td>Barricade standoff</td>
<td>Medical emergency</td>
<td>Earthquake (2)</td>
</tr>
<tr>
<td>WUI fire (7)</td>
<td>Manhunt on shooting suspects</td>
<td>Routine patient services and car crash</td>
<td>Earthquake exercise</td>
</tr>
<tr>
<td>Police ambush</td>
<td></td>
<td></td>
<td>Explosion at a chemical plant (2)</td>
</tr>
<tr>
<td>Rioting</td>
<td></td>
<td></td>
<td>Hurricane (3)</td>
</tr>
<tr>
<td>Search in a national park</td>
<td></td>
<td></td>
<td>Overturned tractor trailer on highway</td>
</tr>
<tr>
<td>Terrorist car bomb</td>
<td></td>
<td></td>
<td>Personal injury collision with hazards</td>
</tr>
<tr>
<td>Traffic stop (2)</td>
<td></td>
<td></td>
<td>Pre-planned event: college football game</td>
</tr>
<tr>
<td>Undercover officer</td>
<td></td>
<td></td>
<td>River flooding</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Winter storms</td>
</tr>
</tbody>
</table>

| 10 | 13 | 3  | 14 |

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PSCR
Incident Scenarios Collection

• Living and evolving
• Long-term goal – Use cases for testing and evaluation
  • Consistent set of attributes

Share your stories with us!
usability@nist.gov
In-depth Interviews

• To understand first responders’
  • Experiences, tasks and context
  • Views on public safety communications technology
  • Technology usage and user interaction with technology
  • Information needs
In-depth Interviews

• Sampling considerations:
  • Fire, Law Enforcement, EMS, and PS officials
  • Urban, suburban, and rural
  • Federal, state, local, and tribal
  • Geographical regions
  • User groups, full-time and volunteer first responders

• Strategic sampling plan

• Phased approach
  • 8 areas in FY17
  • Urban, suburban, and rural
  • “Boots on the Ground”
Geographical Regions
Geographical Regions – 4 Coastal regions
Geographical Regions – 4 Inland regions
Geographical Regions for Sampling – Potential FY17

- San Francisco
- Portland
- Seattle
- Denver/Boulder
- Chicago
- Detroit
- New York
- DC
- San Antonio
- Austin
In-depth Interviews

• More interviews in FY 18
• Perform *qualitative* analysis – interview data
• Lead to *quantitative* large-scale survey

Your voice is critical!

usability@nist.gov
NCCoE: Mobile Single-Sign On

Achieving a secure, reliable, accessible SSO solution for Public Safety & First Responders

2017
PUBLIC SAFETY BROADBAND
STAKEHOLDER MEETING
Introductions

• Paul Grassi – NIST, Applied Cybersecurity Division
• Bill Fisher – NIST, National Cybersecurity Center of Excellence
• Mike Korus – Motorola Solutions
• John Bradley – Ping Identity
• Arshad Noor – StrongAuth
• Mark Russell – Mitre Corporation
Challenge
Mobile platforms offer a significant operational advantage to public safety stakeholders by providing access to mission critical information.

These advantages can be limited if unnecessary or complex authentication requirements prohibit an official providing emergency services, especially when delay – even seconds – is a matter of containing or exacerbating an emergency situation.
Benefits of an NCCoE Solution
NCCoE Benefits – Industry Collaboration

NCCoE brings in Industry experts to design and build the reference design:

Mobile SSO Technology Vendor Build Team:
NCCoE Benefits – Standards Based

NCCoE solutions implement standards and best practices:

Using modern commercially available technology:
NCCoE Benefits – Practical Guidance

• Project will result in a freely available NIST Cybersecurity Practice Guide (SP 1800-x) including:
  
  - Technical Decisions
  - Trade-offs
  - Lessons Learned
  - Build Instructions
  - Functional Tests
Value to Public Safety/First Responder Sector (PSFR) Community
Value to PSFR Personnel

**Efficiency**
Save time and efficiency by reducing the need to authenticate to multiple mobile applications individually

**Simplicity**
Allowing a user to manage less username/password credentials

**Flexibility**
Multiple options for multifactor authentication
Value to PSFR Organizations

Modern
Solution takes advantage of the latest commercially available mobile technology and best practices

Interoperable
Technology uses standard protocols and flows to improve interoperability

Security
Architecture designed with security characteristics as core requirement (more on this later)

Cost Savings
Reduction in costs - NCCoE delivers requirements, architecture and a reference implementation
Solving Mobile Single Sign-On Using Standards
Title: OAuth 2.0 for Native Apps
Implemented via AppAuth Software Development Kit developed
  Developed by OpenID for Android and iOS
  Implements standards such as OAuth and PCKE (RFC7636)
  Free and open source
  Ensures mobile applications do not have access to username/password
  Support identity federation
Benefits of AppAuth

- Securely implements standards
- “Drag and Drop” into a mobile app
- User's password and other credentials are never exposed to the SaaS provider or mobile app
- Apps get an OAuth Token with limited scope of authorization - apps only get access to back-end systems they should be accessing
- IdP policy controls which user attributes are shared with the SaaS provider
- PKCE prevents malicious apps on the device from intercepting the authorization code and using it to get access tokens
Standards Based Multifactor Authentication
Flexible authentication spanning any number of service providers

Passwordless Experience

Second Factor Experience

*slide taken from FIDO Presentation to NCCoE 5/31/2017
MFA using External Authenticator via FIDO U2F

FIDO U2F – External Authentication over NFC

- U2F token used in addition to primary authenticator (e.g., password)
- Authenticators typically have “proof of user presence” (e.g., by pushing a button) but not strong user authentication
- IdP may support the protocol directly (natively or using a plug-in)
- Authenticator attestation sent at time of registration & authentication – IdP can decide whether or not the authenticator is acceptable
MFA using Biometrics via FIDO UAF

FIDO UAF - Biometric

• UAF token may be the sole authenticator once it’s registered with the IdP
• Authenticators typically have stronger user authentication (e.g., biometrics)
• IdP can send policies during initial registration request with a list of accepted authenticator criteria (manufacturer, security characteristics, etc.)
• Typically supported by a FIDO server separate from the IdP
Benefits of FIDO

- No 3rd Party in the Protocol
- No Secrets on the Server Side
- Biometric Data (if used) Never Leaves Device
- No Link-ability Between Services
- No Link-ability Between Accounts

*slide taken from FIDO Presentation to NCCoE 5/31/2017*
Simple Example
High Level Components

Technologies

Software as a Service (SaaS)
- This approach uses centrally-hosted software that is provided “on demand”, includes apps and back-end servers

OpenID Provider
- Server used to manage user identities and roles, and to share user info with other organizations

Authorization Server
- Server used by SaaS provider to communicate with an OpenID Provider and authorize users

Fast Identity Online (FIDO)
- Work-in-progress: This protocol, and hardware that uses it, allows users to sign on w/ tokens instead of passwords

Actors

Central Public Safety Service Provider (CPSSP)
- Represents a SaaS provider that hosts a back-end for mobile apps used by the PSFR community
- This may or may not be the same entity that writes the mobile client apps

Local Public Safety Department (LPSD)
- Represents a local Police, Fire, EMS, or other public safety or first responder organization that uses the services provided by CPSSP
- This organization manages user accounts and has an OpenID Provider for authentication
Simple SSO Scenario

1. User asks for Data
2. User Logs in
3. User Info
4. Return Data

Other SaaS Providers accept initial login and grant access.
Demonstration
Architecture Benefits
Security Benefits:

Security Without Sacrificing Usability

• No need to establish accounts and passwords for each application
• FIDO tokens can eliminate the need for complex passwords
• Seamless single sign-on when switching between apps
• Improved audit/revocation

Secure Implementations of Secure Protocols

• OAuth 2.0, OpenID Connect 1.0, SAML 2.0, FIDO U2F & UAF - all very secure when deployed correctly
• Implementation complies with best practice and security guidance from IETF
• Common OAuth implementation weaknesses addressed
• Credentials, tokens, and codes transmitted over HTTPS
Questions?
Project Resources

• Project Description Document:
  • Document has details architecture and flow diagrams

• Build Team Announcement & Blog:
  • Discusses products used in the build

• PSFR-NCCoE@nist.gov
  • Inquiries go directly to NIST project leads
Join the PSCR Security Community

Q&A session on topics of your choosing within PSCR security research
PSCR Security Community

- Mission Critical Voice Community
- LBS Community
- Analytics Community
- UI/UX Community
- Security Community
PSCR Security is interested in creating a community of stakeholders to provide the following services:

• Stakeholders receive updates on our research projects
• Stakeholders have an opportunity to help select the most critical and promising research areas and help guide the projects
• Stakeholders can participate in certain research projects through partnerships including Federal Funding Opportunities and CRADAs
• First Responders can participate in certain research projects to ensure user requirements are incorporated, and help us collect field data
Results from Conference Application Survey

• How many people have signed up?
• What were the preferred methods of communication?
• What were the top Public Safety Broadband Security topics of interest?
Ways to Sign Up

Sign up through the following methods:

• On the PSCR Conference App
• Email John Beltz, john.beltz@nist.gov
• At the table in the back of this room
• At the PSCR Security Demo Table tomorrow
Over the Air Updates for UICC

Mike Bartock
NIST, Computer Security Division
IT Specialist
SIM Cards and Over the Air Updates

• UICC known as a ‘SIM Card’ is the security anchor for the LTE Network.
• Store sensitive cryptographic keys used for authentication and to protect communication
• Public Safety specific features in LTE may increase the use of Over the Air (OTA) updates to enable features such as Group and Device to Device Communications (e.g., Proximity Services).
• Updates to the SIM card can occur over the air
• Proximity Service information stored on UE in UICC
• Sensitive data may need to be updated using LTE’s existing Over The Air (OTA) mechanism.
• Applied security testing on a critical function that could potentially be used to enable Mission Critical Voice and Device to Device communications
Mobile Network Operator

eNodeB

IP Network

“Let County Officer B in the group”

County A

County A Officer

County B Officer
Project Objectives

- Standards, Specifications, and Vendor Documentation
- Use Cases for OTA Updates for Public Safety Scenarios
- Threat Model for OTA Updates and UICC
- Security Guidance & Best Practices
Benefits

• Gain organizational expertise about the UICC OTA update process and its dependency and/or interconnection with MCV

• Inform Public Safety Community of potential threats and implications to their mission

• Validation that ProSe can leverage current implementations of UICC OTA updates in a secure manner

• Security Guidance that can influence industry implementation and use of the UICC OTA update process

• PSCR may find areas of weakness or improvements that can be made through Grants and Prize Challenges based on outcomes of this research
Mobile Application Security

Michael Ogata
NIST, Applied Cybersecurity Division
IT Security Engineer
A Vulnerable App Can Endanger the Entire Enterprise
What Can Be Done to Strengthen App Security?

Application Vetting
Vetting Early and Late in the App Lifecycle
PSCR Research Goals

• Identify the capabilities of vetting technology and how they can be used for public safety

• Identify strengths and weaknesses in mobile app vetting technology

• Aid in improving the state of the art in vulnerability detection
What is the Benefit to Public Safety?

- Increased trust in mobility as a platform
- Increased protection from threats
- Access to modern mobility functionality
PSCR Research Activities

• NISTIR 8136: An Overview of Mobile Application Vetting Services for Public Safety (January 2017)
  • https://doi.org/10.6028/NIST.IR.8136

• Mobile Application Security Exercise (July 2017)

• Expanding the Static Analysis Tool Exposition (December 2017)
Handset and Wearable Security

Joshua Franklin
NIST, Applied Cybersecurity Division
IT Security Engineer
Importance to Public Safety and the NPSBN

- Mobile devices and wearables will be used on the NPSBN.
- Securing mobile devices and wearables ensures life saving activities can continue.

- What are the security needs for public safety devices?
- How can we provide guidance to architect secure public safety systems?
Public Safety Wearables

- Headgear / AR
- Audio Devices
- UAV
- Watches
- Body Cameras
- Sensors
- Gateway
- First Responder Devices

Research Flow

1. Identify Mobile Security Objectives
2. Analyze Public Safety Devices
3. Gap Analysis and Recommendations
Conclusion

• Interviewing members of the public safety and industry to understand their security needs
• Identify how can industry architect to secure public safety systems
• Review the security posture of phones and wearables built specifically for public safety
• Draft best practices for public safety radio operators to provision, deploy, and manage new cellular devices