

# **The Special Needs of National Security and First Responder Communications**

## **Implications for 5G Evolution**

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# Trends

- Technology Evolution
  - More Commercial Technologies in critical government operations
- Disaster and Contingency Operations
  - reconstitution
  - reallocation of resources
  - infrastructure-free operations
- Security and Resilience
  - Operations in contested environments

Use Cases and Field Experiments for National Security and Emergency Response





# UNITED STATES FREQUENCY ALLOCATIONS

## THE RADIO SPECTRUM

**RADIO SERVICES COLOR LEGEND**

AERONAUTICAL MOBILE	INTER-SATELLITE	RADIO ASTRONOMY
AERONAUTICAL MOBILE SATELLITE	LAND MOBILE	RADIO TERMINATION SATELLITE
AERONAUTICAL RADIOLOCATION	LAND MOBILE SATELLITE	RADIOLOCATION
AMATEUR	MARITIME MOBILE	RADIOLOCATION SATELLITE
AMATEUR SATELLITE	MARITIME MOBILE SATELLITE	RADIO NAVIGATION
BROADCASTING	MARITIME RADIOLOCATION	RADIO NAVIGATION SATELLITE
BROADCASTING SATELLITE	METEOROLOGICAL	SPACE OPERATION
EARTH EXPLORATION SATELLITE	METEOROLOGICAL SATELLITE	SPACE RESEARCH
FIXED	MOBILE	STANDARD FREQUENCY AND TIME SIGNAL
FIXED SATELLITE	MOBILE SATELLITE	STANDARD FREQUENCY AND TIME SIGNAL SATELLITE

**ACTIVITY CODE**

FEDERAL EXCLUSIVE	FEDERAL/NON-FEDERAL SHARED
NON-FEDERAL EXCLUSIVE	

**ALLOCATION USAGE DESIGNATION**

SERVICE	EXAMPLE	DESCRIPTION
Primary	FIXED	Capital Letters
Secondary	Mobile	1st Capital with lower case letter

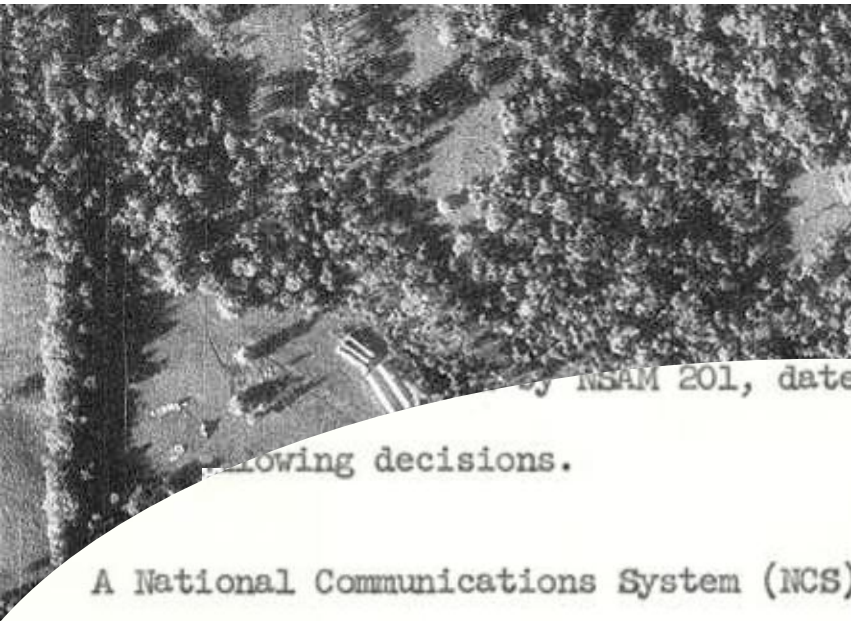
The chart is a graphic representation of the Table of Frequency Allocations used by the FCC and ITU. It is not a map or complete list of all services, a function and exact channel number for all frequency allocations. Therefore, for complete information, users should consult the Table to determine the correct radio frequency allocation.

U.S. DEPARTMENT OF COMMERCE  
National Telecommunications and Information Administration  
Office of Spectrum Management  
JANUARY 2016



PLEASE NOTE: THE ONLY OFFICIAL SOURCE FOR THE SPECTRUM MANAGEMENT INFORMATION SYSTEM (SMIS) IS THE NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION (NTIA) WEBSITE.





~~CONFIDENTIAL~~

✓ 16

(Proposed Revision of Budget Bureau Draft of November 15, 1962)

NATIONAL SECURITY ACTION MEMORANDUM NO.

TO: The Vice President  
The Secretary of State  
The Secretary of Defense  
The Secretary of the Treasury  
The Attorney General  
The Director of Central Intelligence  
The Director, U. S. Information Agency  
The Administrator, National Aeronautics and Space Administration  
The Chairman, Federal Communications Commission  
The Administrator, Federal Aviation Administration  
The Administrator, General Services Administration  
The Director of the Budget  
The Director, Agency for International Development  
The Director, Office of Management and Organization  
The Director, Office of Science and Technology Policy

by NSAM 201, dated October 20, 1962, and the following decisions.

A National Communications System (NCS) shall be established and developed by linking together and improving the communications facilities and components of the various Federal agencies. The objective of the NCS will be to provide necessary communications for the Federal Government under all conditions ranging from normal situations to international crises and national emergencies, including nuclear attack.

CUBA

40779

Federal Register  
Vol. 77, No. 133  
Wednesday, July 11, 2012

## Presidential Documents

Title 3—  
The President

Executive Order 13618 of July 6, 2012

### Assignment of National Security and Emergency Preparedness Communications Functions

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

**Section 1. Policy.** The Federal Government must have the ability to communicate at all times and under all circumstances to carry out its most critical and time sensitive missions. Survivable, resilient, enduring, and effective communications, both domestic and international, are essential to enable the executive branch to communicate within itself and with: the legislative and judicial branches; State, local, territorial, and tribal governments; private sector entities; and the public, allies, and other nations. Such communications must be possible under all circumstances to ensure national security, effectively manage emergencies, and improve national resilience. The views of all levels of government, the private and nonprofit sectors, and the public must inform the development of national security and emergency preparedness (NS/EP) communications policies, programs, and capabilities.

**Sec. 2. Executive Office Responsibilities.**

**Sec. 2.1.** Policy coordination, guidance, dispute resolution, and periodic in-progress reviews for the functions described and assigned herein shall be provided through the interagency process established in Presidential Policy Directive-1 of February 13, 2009 (Organization of the National Security Council System) (PPD-1).

**Sec. 2.2.** The Director of the Office of Science and Technology Policy (OSTP) shall: (a) issue an annual memorandum to the NS/EP Communications Executive Committee (established in section 3 of this order) highlighting national priorities for Executive Committee analyses, studies, research, and development regarding NS/EP communications;

(b) advise the President on the prioritization of radio spectrum and wired communications that support NS/EP functions; and

(c) have access to all appropriate information related to the test, exercise, evaluation, and readiness of the capabilities of all existing and planned NS/EP communications systems, networks, and facilities to meet all executive branch NS/EP requirements.

**Sec. 2.3.** The Assistant to the President for Homeland Security and Counterterrorism and the Director of OSTP shall make recommendations to the President, informed by the interagency policy process established in PPD-1, with respect to the exercise of authorities assigned to the President under section 706 of the Communications Act of 1934, as amended (47 U.S.C. 606). The Assistant to the President for Homeland Security and Counterterrorism and the Director of OSTP shall also jointly monitor the exercise of these authorities, in the event of any delegation, through the process established in PPD-1 or as the President otherwise may direct.

**Sec. 3. The NS/EP Communications Executive Committee.**

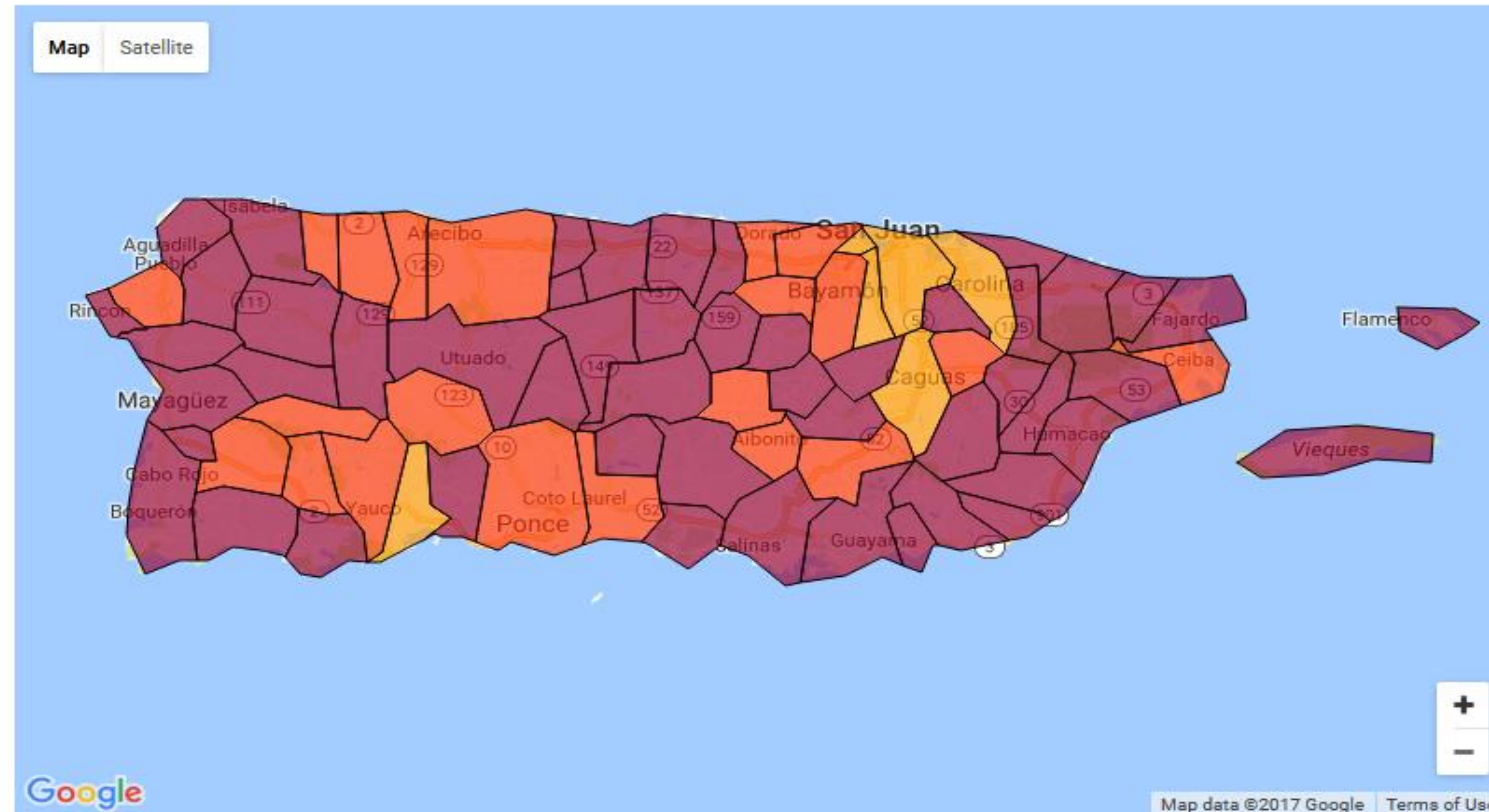
**Sec. 3.1.** There is established an NS/EP Communications Executive Committee (Executive Committee) to serve as a forum to address NS/EP communications matters.

# Capabilities for public-sector needs

Disaster and Contingency Operations

## Percent Cell Sites Out-of-Service By County

10/15/2017 11:04:32 AM



# Capabilities for Emergency Response

Situational Awareness via Video Distribution for Public Safety

- Experiments of commercial technologies with State and Local Public Safety
- Tests have been performed/are planned in the following cities
  - Houston July 2015
  - Chicago August 2015
  - Houston February 2016
  - Houston January-February 2017
  - Grant County WA – June 2017
  - Adams County IN – 2018
  - Salt Lake City -- 2018

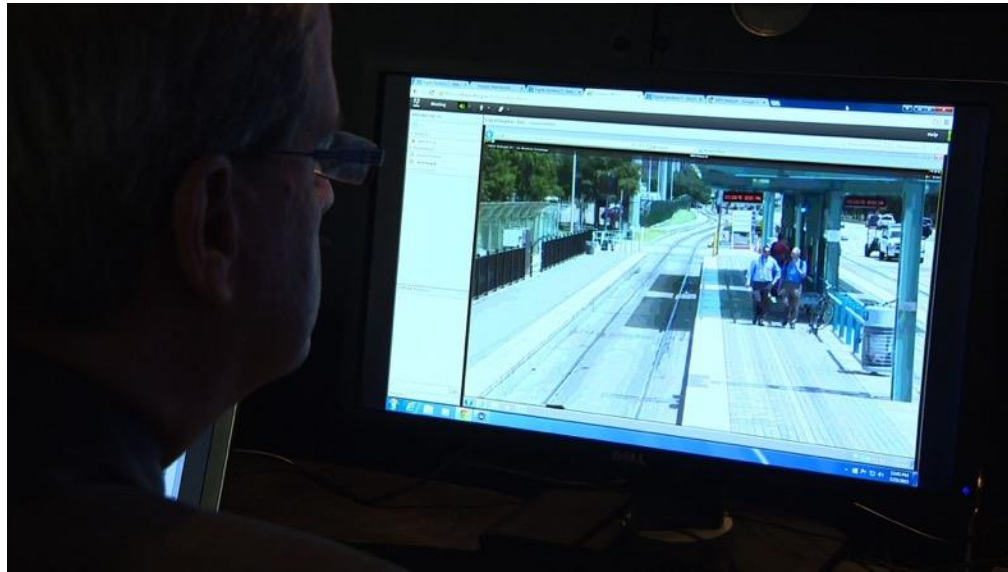


First Responders Group  
Office of Interoperability and Compatibility

**Integrates commercial LTE, deployable LTE, and ATSC with operations centers**



# In Houston





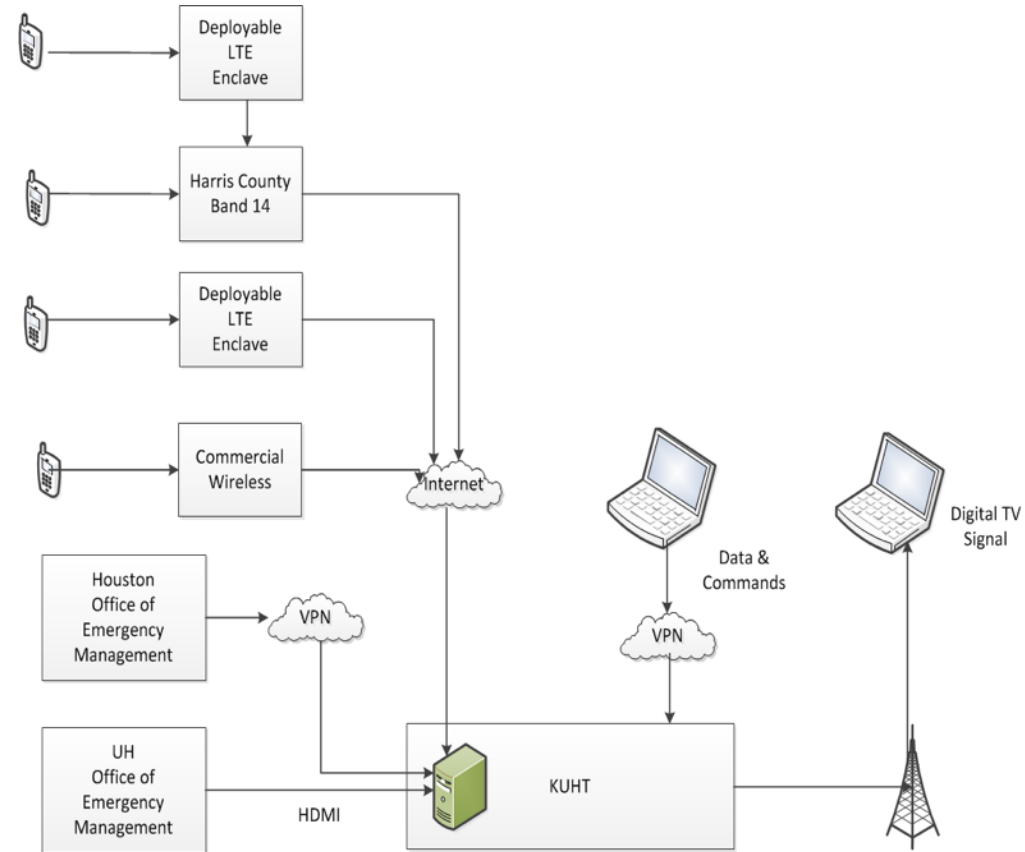
# Houston: February 2016

- **Objectives:**

- Evaluate integrated network consisting of ad hoc LTE backhaul and datacasting
- Evaluate datacasting performance under stressing conditions

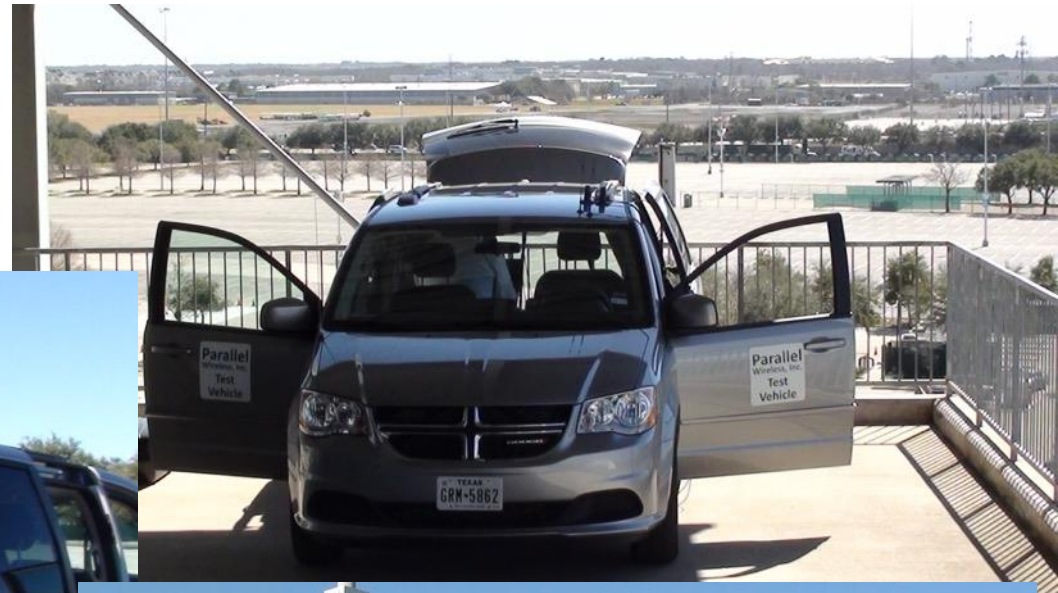
- **Results:**

- Successfully integrated a deployable LTE system with Harris County's Band 14 network and the Internet.
- Successfully integrated Band 14, commercial wireless and public Internet with datacasting
- Successfully maintained system performance under load



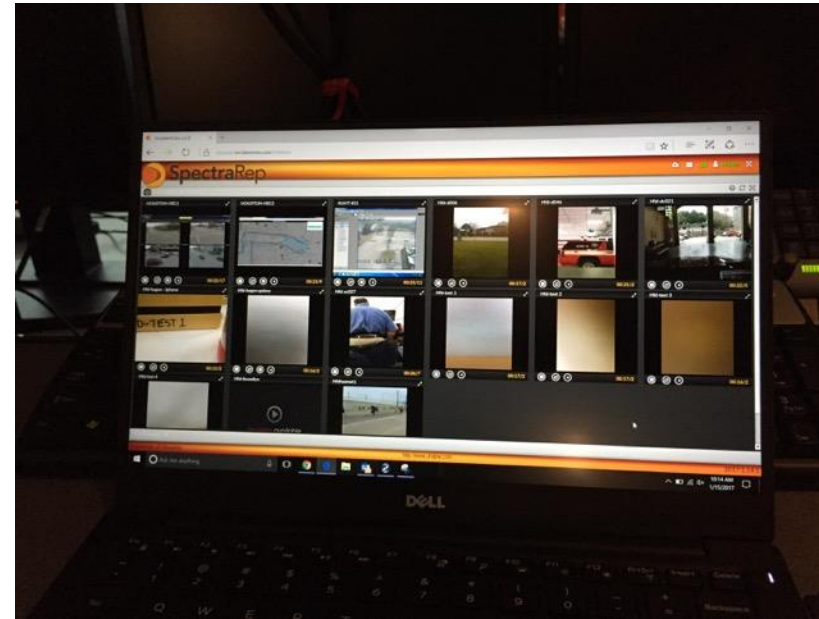
Integrated Test Configurations

# At NRG Park



# Unplanned Test Event

Severe Traffic Accident outside Stadium





# On Lake Michigan



# Chicago: August 2015

- **Two scenarios:**
  - Rescue on Lake Michigan
  - USCG Operations on Lake Michigan
- **Objectives:**
  - Verify datacasting coverage
  - Validate utility in maritime operations
- **Results:**
  - Validated ability to receive high quality range on Lake Michigan; datacasting reception continued after loss of cellular coverage (with USCG)
  - Datacasting reception was strong, even at speeds of 30 knots
  - Rescue scenario with Chicago Police Dept. (CPD) and Chicago Fire Dept. (CFD) limited due to priority needs
  - Presented capability to CPD and CFD and received positive feedback

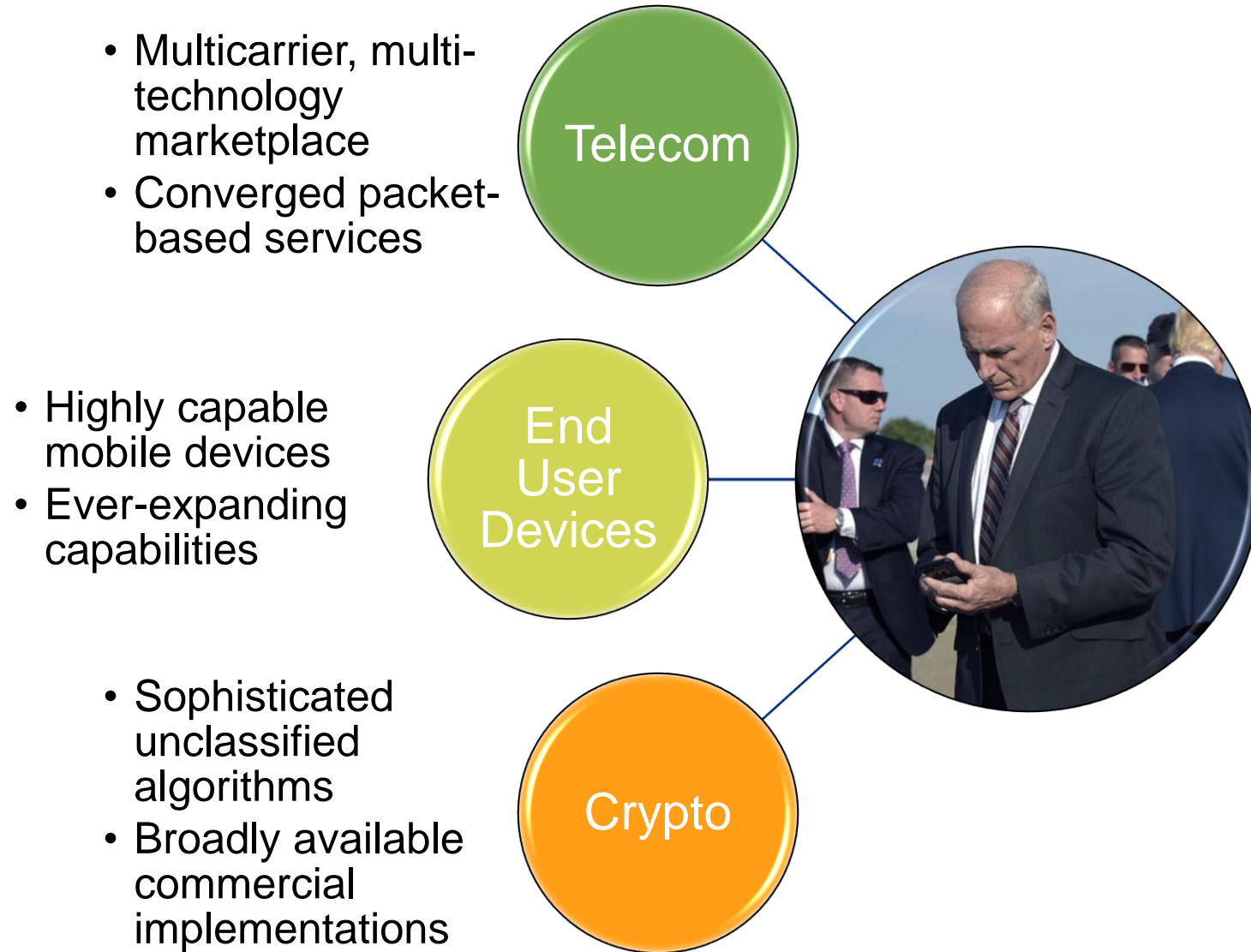


Datacasting Laptop on United States  
Coast Guard (USCG)  
Ship on Lake Michigan

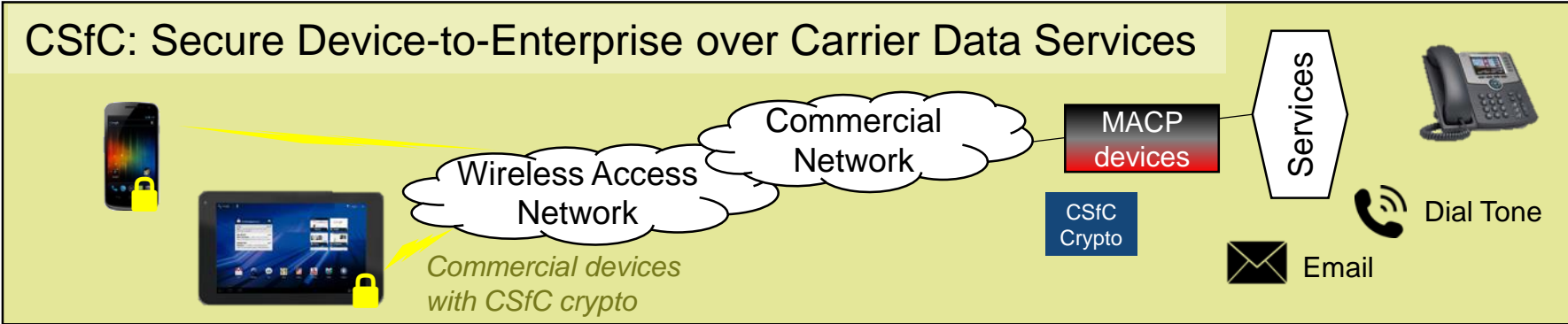
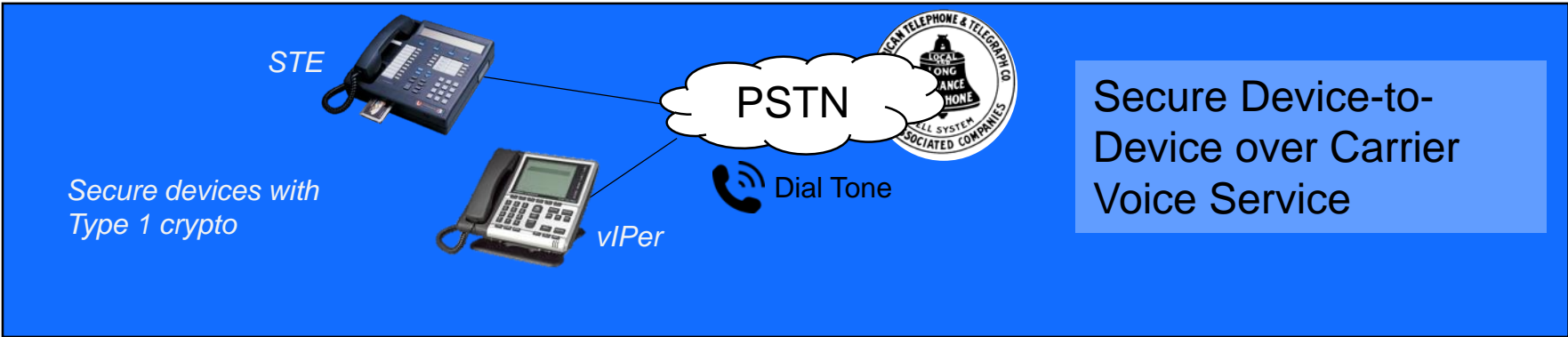




# The Changing Secure Mobile Landscape



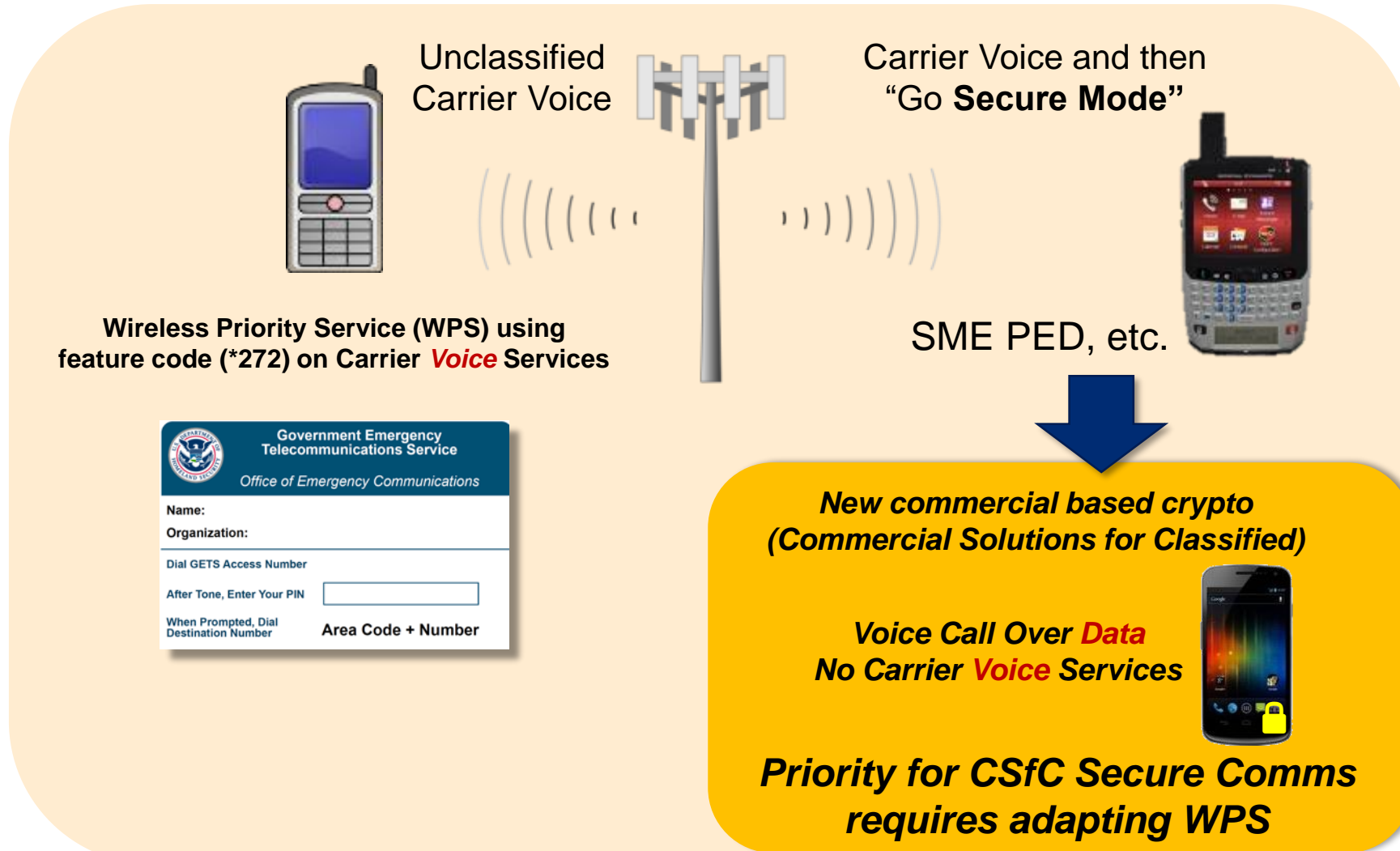
# Evolution of Secure Mobile Solutions



# Priority Services and Secure Mobility

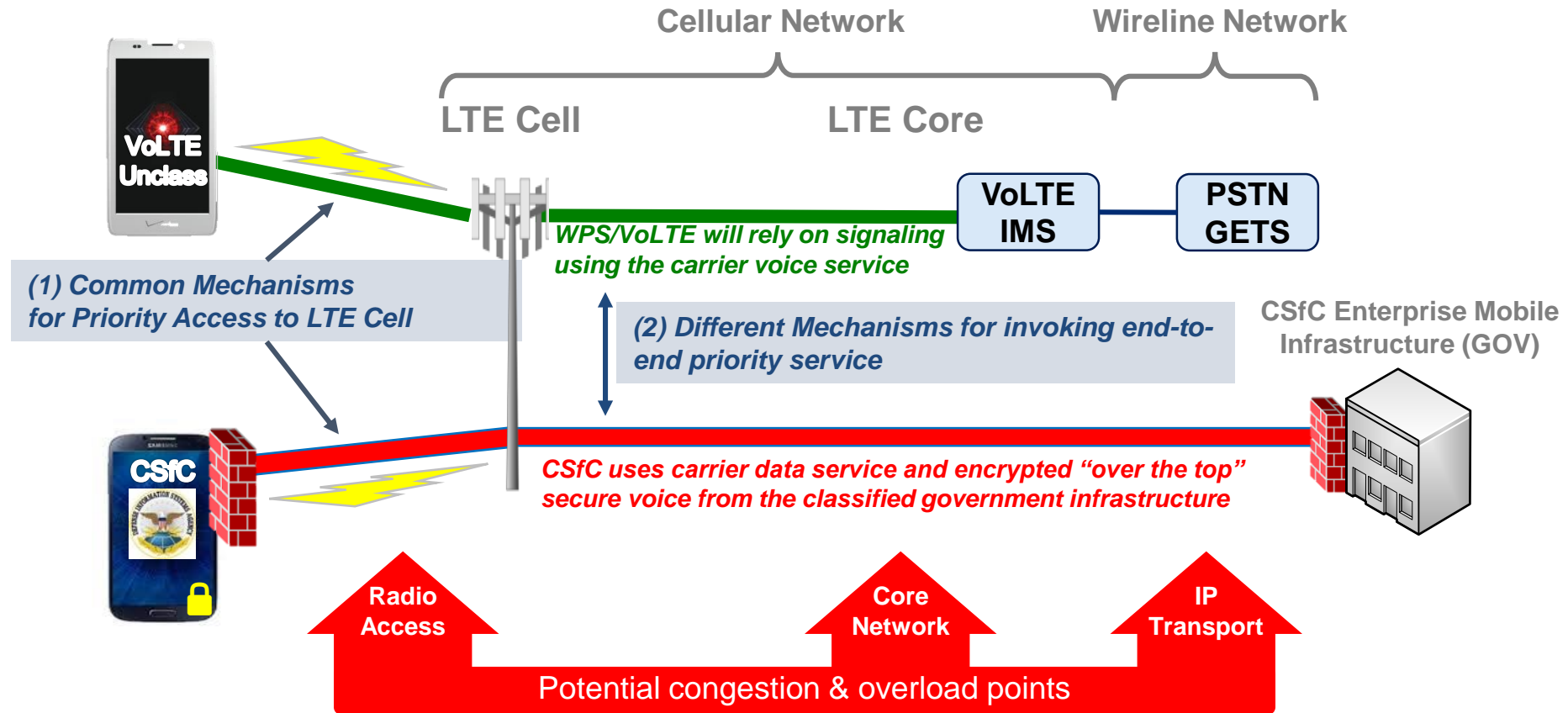
## Unclassified Mobile Calls

## Legacy Secure Mobile Calls





# LTE Priority Services for Secure Communications



**CSfC will require additional mechanisms in carrier networks and end user devices to support end-to-end priority services**

IMS: IP Multimedia Subsystem  
PSTN: Public Switch Telephone Network



# Evolution of the 5G Ecosystem

## National Security and Emergency Response

- Technology Evolution
  - More Commercial
  - CSfC
- Disaster and Contingency Operations
  - infrastructure-free operations
  - reallocation of resources
- Security
  - Operations in contested environments
- Experimentation
  - Scenarios





JOHNS HOPKINS  
APPLIED PHYSICS LABORATORY

# Summary

- Secure communications is shifting away from SCIP to a new architecture based on CSfC
- CSfC secure voice and other secure services are delivered as extensions of a secure enterprise
- CSfC uses IP-based commercial cryptographic protocols
- New mechanisms under study for WPS to provide end-to-end priority for secure services based on CSfC

# Major Findings

- Datacasting is easy to install and easy to use and provides highly reliable content delivery
- Integrated communications architectures with cellular backhaul feeding datacasting are feasible
- Integrated architectures with disparate communications technologies and an application friendly ecosystem provide enhanced resiliency and situational awareness
- Although service providers can augment capacity in venues during major events (using COWS, etc.), areas on the periphery may remain congested. Datacasting can be used to alleviate congestion in these areas.
- Use of video is highly desired by the first responder community; first responders cited the added confidence associated with being able to view incidents visually
- Reliable delivery of video from airborne platforms is critical



# Final Thoughts

- **Full value of datacasting likely will not be realized until ATSC 3.0 standard is adopted**
  - ATSC 3.0 will enable datacasting reception using handheld devices
  - Datacasting could provide unique ability to simultaneously disseminate data content (maps, images, evacuation plans, video) to hundreds of first responders with handheld devices during a major event
  - Datacasting could enable public safety community to disseminate data to the public
- **Datacasting (with ATSC 3.0) can help mitigate loss of communications due to power grid failure**
  - Based upon observations from US Virgin Islands and Puerto Rico following Hurricane Maria
  - There are cases when it would be easier to provide electricity and/or fuel for generators to a handful of television stations than power/fuel thousands of cell sites
    - There are 2600 cell sites in Puerto Rico; 3100 in Harris County TX (Houston)
  - Ability to provide basic information – location of water, shelter, damaged infrastructure – to the public would be a useful capability

## Final Thoughts (2)

- There is a need for improved quantitative metrics for assessing the utility and performance of networks
  - The team was highly dependent on subjective end user evaluations
  - This is true both for utility and for video quality assessment

# Other DHS Activities with Datacasting

- Datacasting was also successfully used by the City of Houston during the following events
  - 2016 GOP Presidential Debate
  - 2016 NCAA Men's Basketball Championship Finals
  - 2016 Fourth of July Celebration
  - 2015 Memorial Weekend Flooding
  - 2016 "Tax Day" Flood
  - Hurricane Harvey 2017



# DHS Datacasting Experiments

- The Department of Homeland Security (DHS) Science and Technology (S&T) Directorate First Responders Group (FRG) Office of Interoperability and Compatibility (OIC) has conducted a series of critical experiments to evaluate the effectiveness and utility of datacasting for public safety
- Tests have been performed/are planned in the following cities
  - Houston July 2015
  - Chicago August 2015
  - Houston February 2016
  - Houston January-February 2017
  - Grant County WA – June 2017
  - Adams County IN – 2018
  - Salt Lake City -- 2018

# Situational Awareness for First Responders

- Datacasting leverages available capacity in a broadcast signal to provide a resilient additional communications channel for first responders
- Television stations are allocated bandwidth sufficient to achieve a continuous capacity of approximately 20 Mbps
  - The capacity required to broadcast audio and video programming varies
  - On average, there are approximately 2 to 2.5 Mbps capacity available
- Digital content is Internet Protocol (IP) encapsulated, encrypted, and multiplexed into the digital television signal and broadcast
- Broadcast signals can be captured via a UHF/VHF antenna and receiver and converted back to understandable content
- Access controls are appended to the digital signal to limit access to targeted end users
- The signal can be encrypted to required standards to ensure security

# Potential Benefits

- Datacasting is a broadcast technology; it provides efficient one to many transmission and is infinitely scalable
  - It represents an efficient method for wide dissemination of content (for example, datacasting is well adapted to transmitting large files or videos to a large number of recipients)
- Datacasting leverages Public Broadcasting System infrastructure and is therefore highly reliable
- Datacasting operates on licensed frequency and a portion of this bandwidth can be dedicated to public safety
  - Datacasting does not compete with commercial wireless services
  - Allocation can be increased during emergencies
- Upon adoption of the ATSC 3.0 standard, it will be possible to datacast content directly to handheld devices – both those of first responders and the public



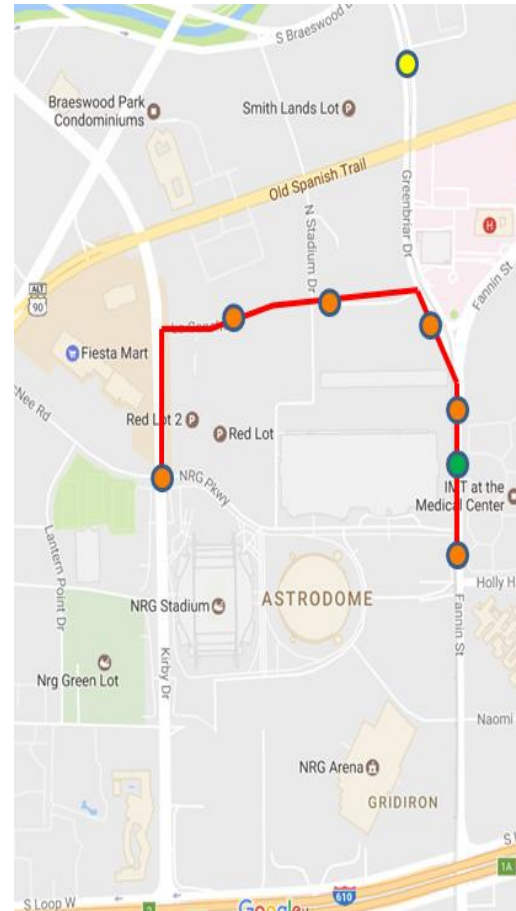
# Houston: January/February 2017

- **Objectives:**

- Observe and evaluate the integrated communications capabilities – including datacasting, Band 14 and application enhanced situational awareness – implemented by Houston and Harris County for Super Bowl LI

- **Results:**

- End to end video solutions developed to support datacasting used effectively to support emergency response to serious accident outside NRG Park
- Observed enhanced situational awareness – collaboration, ge-locations, video streaming – achieved using applications
- Identified potential areas of congestion in around downtown and NRG Stadium



Map of LTE Congestion around NRG Stadium during Super Bowl LI

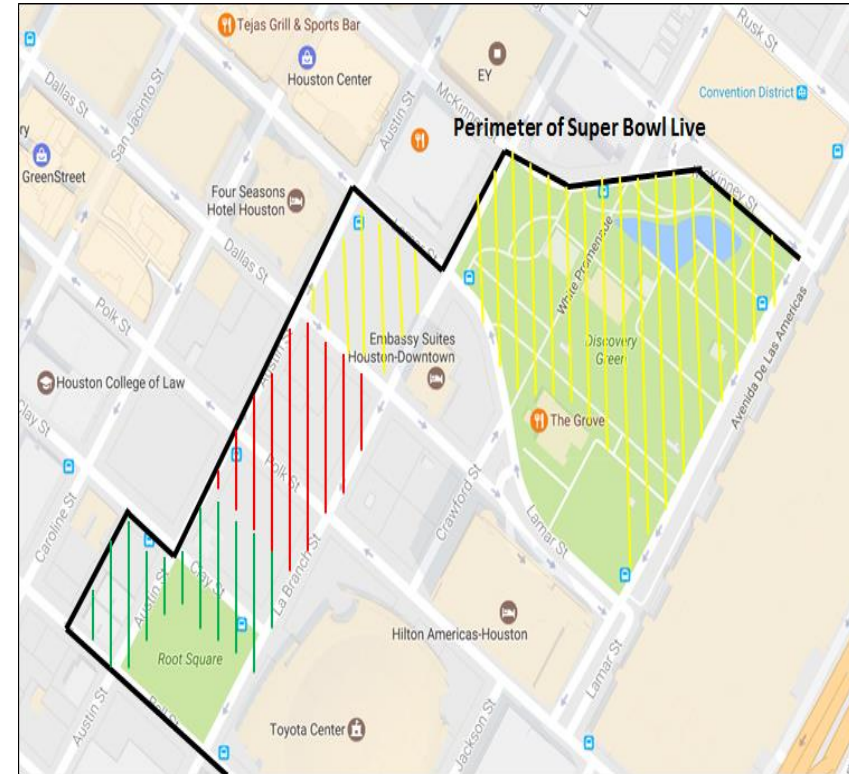
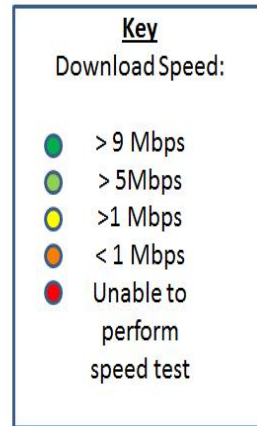
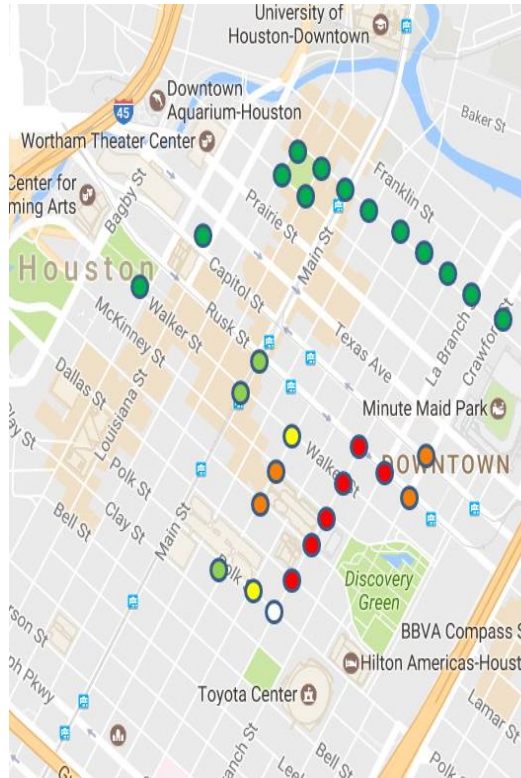
# Houston: July 2015

- **Two scenarios:**
  - Incident on University of Houston Campus
  - Incident at NRG Park; pursuit on Houston Metro Light Rail
- **Objectives:**
  - Assess feasibility of datacasting in simple, representative scenarios
  - Obtain end user feedback regarding utility
- **Results:**
  - Successful integration with UH EOC and dissemination of video from Houston Police Department (HPD) cameras
  - End user observers expressed interest in obtaining capability especially the ability to observe events inside a building before entering



University of Houston (UH)  
Emergency Operations Center (EOC)

# LTE Congestion in Downtown Houston



Service providers were able to augment capacity within the venues (NRG Stadium and Discovery Green Park); however cell service on periphery, where first responders would likely deploy, remain heavily congested

# Questions?

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Cuong Luu

DHS S&T Program Manager

Communications

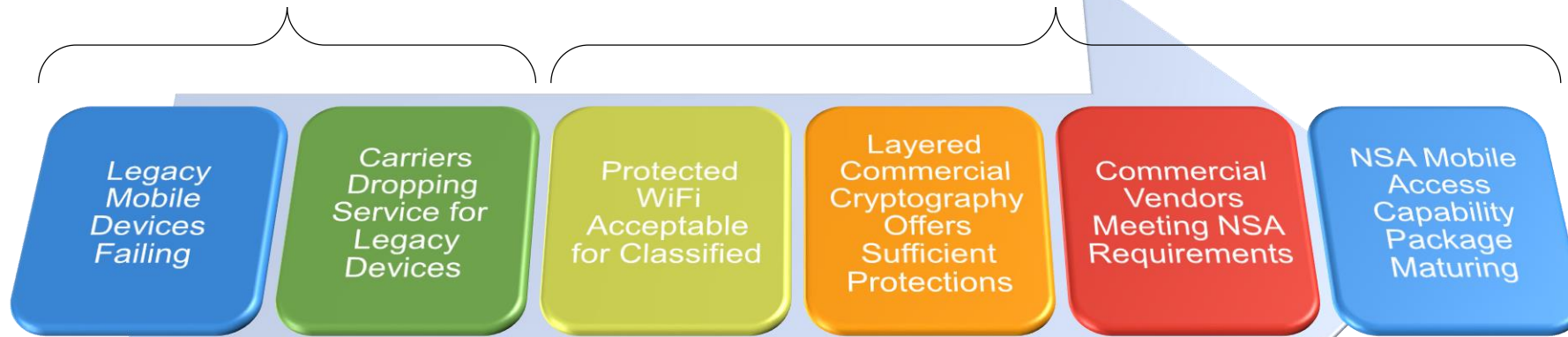
[cuong.luu@HQ.DHS.GOV](mailto:cuong.luu@HQ.DHS.GOV)



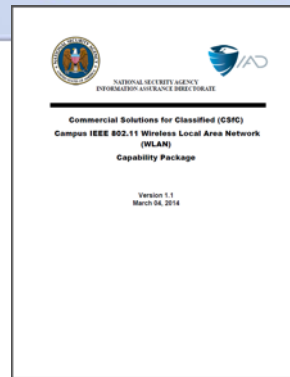
# Why a new architecture for secure mobile?

Mobile network evolution makes legacy secure mobile obsolete

New NSA Direction for Protecting Classified Communications

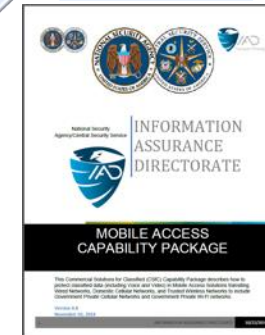


Legacy Secure Comms Interop Protocol (SCIP) Devices

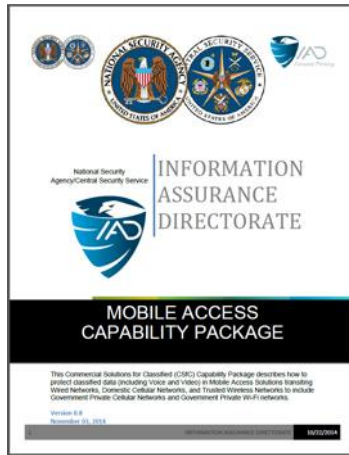


Commercial cryptography approved to protect NSS systems up to the TOP SECRET level

Algorithm	Function	Specification	Parameters
Advanced Encryption Standard (AES)	Block cipher used for information protection	FIPS Pub 197	Use 256 bit keys
Elliptic Curve Diffie-Hellman (ECDH) Key Exchange	Asymmetric algorithm used for key establishment	NIST SP 800-56A	Use Curve P-384
Elliptic Curve Digital Signature Algorithm (ECDSA)	Asymmetric algorithm used for digital signatures	FIPS Pub 186-4	Use Curve P-384
Secure Hash Algorithm (SHA)	Used for computing a condensed representation of information	FIPS Pub 180-4	Use SHA-384



# New Communications Architecture for Secure Mobile

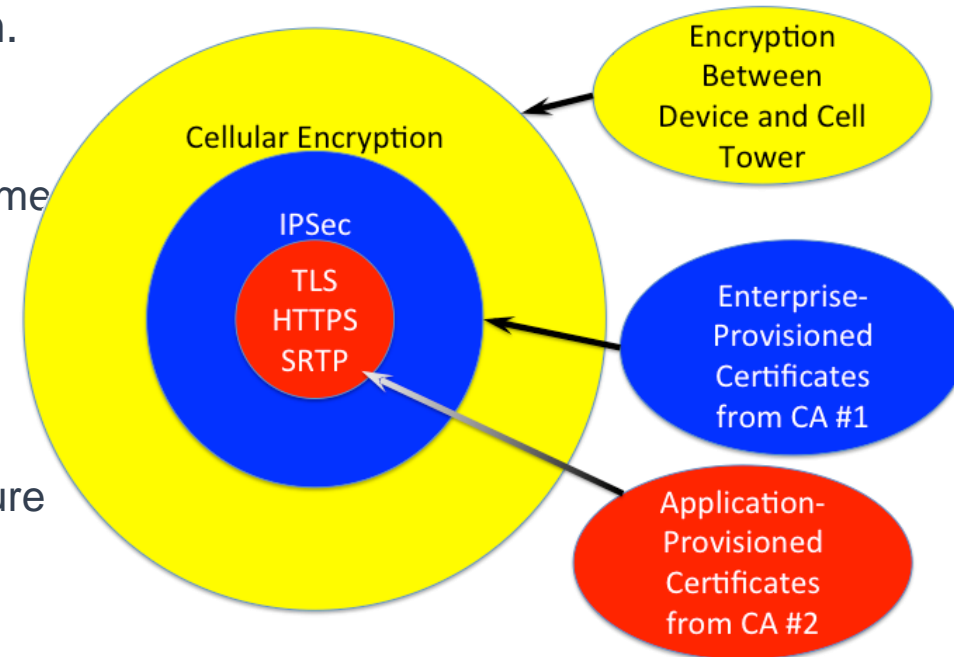


## Building on NSA's Commercial Solutions for Classified

- **Uses commercial products to protect classified data**
- **Solutions designed using “Capability Packages” of approved off-the-shelf user devices, commercial infrastructure and unclassified implementations of cryptography**
- **Allows a secure enterprise to field new solutions quickly**

- CSfC Uses a Layered Security Approach.

- Hardware/Software Vendor Diversity
- Layered Encryption using IP-based commercial cryptographic protocols
- Multiple Authentication Layers
- Unclassified (Suite B) Cryptography
- Carrier Network Pass-Through to a Secure Enterprise Service Environment



# Gorge Amphitheatre, Grant County, Washington

- **Objectives:**

- Evaluate integrated network consisting of 17 technologies
- Evaluate potential solutions for operations in remote environments

- **Results:**

- Successfully integrated datacasting using a portable white space transmitter with other technologies
- Successfully demonstrated ability to disseminate UAS video
- Successfully validated utility of distributed UAS video in firefighting scenario – utility validated by firefighters on hand



# Datacasting Architecture in Grant County

