JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

5G in Crisis and Emergency Operations

Evolving First Responders, Emergency Response, and National Security to Next Generation Mobile Standards

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https://www.cnet.com/news/how-5g-aims-to-end-network-latency-response-time/

c|net

BEST PRODUCTS REVIEWS NEWS VIDEO HOW TO SMART HO

MOBILE

How 5G aims to end latency

HOW FAST IS 5G?

A SPEED COMPARISON

$1.6 BILLION PLAN
FOR NEXT-GEN 5G

On January 2, 2014 **South Korea** announced that they plan to roll out a next-generation **5G** wireless network. This would be quick enough to download full-length movies in a mere second. The Ministry of Science said it aims to implement the technology, which is about **1.000 times faster** than the current available 4G network, by 2020.

Key features of the network include **Ultra-HD** and **Hologram transmission** as wel as **cutting-edge social networking services.**

WIRELESS SERVICES
JUST HOW **FAST** ARE THEY?

GPRS	EDGE	3G	4G	5G
1997	1998	2001	2009	2020
50 Kbps	250 Kbps	384 Kbps	150 Mbps	6400 Mbps

WHAT SIZE SHOULD YOUR WEBPAGE BE?*

*Based upon studies that have shown the maximum allowed waiting time for a loading webpage is **4 seconds**

MAX	MAX	MAX	MAX	MAX
25 KB	125 KB	192 KB	75 MB	3,2 GB

HOW LONG WOULD IT TAKE TO DOWNLOAD A 800MB MOVIE?

1 days	**0** days	**0** days	**0** days	**0** days
12 hours	**7** hours	**4** hours	**0** hours	**0** hours
24 minutes	**16** minutes	**44** minutes	**0** minutes	**0** minutes
32 seconds	**54** seconds	**27** seconds	**43** seconds	**1** seconds

https://www.techspot.com/article/1582-state-of-5g-wireless/

Crisis and Emergency Operations

- Communications across dynamic coalitions
- Operations without infrastructure
- Sensitive communications
- Richer information to support complex missions

Must put Technologies in Service of Operations

Technology and Integration Demonstrations

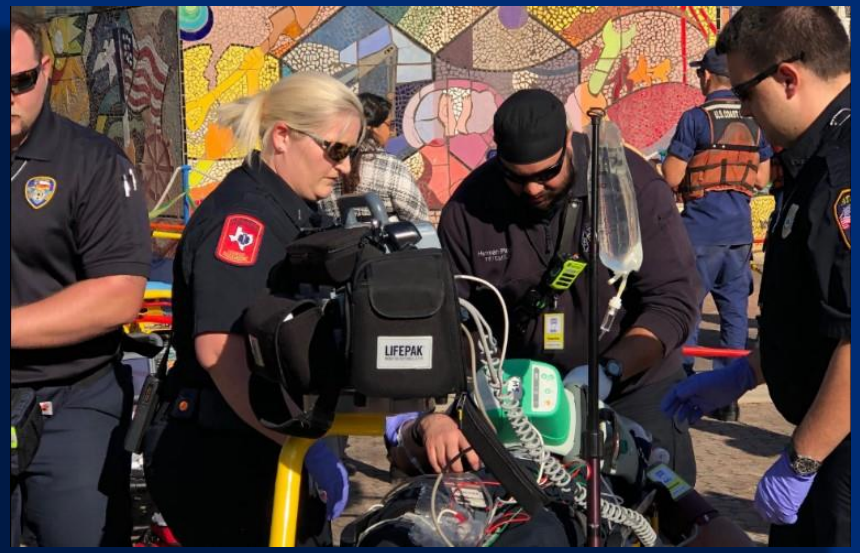
DHS S&T Next-Generation First Responder

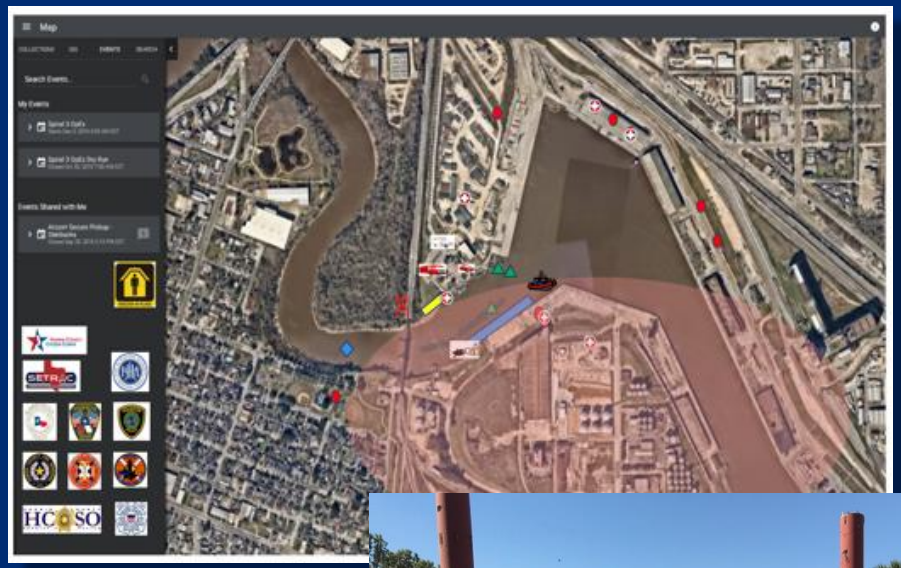
JANUARY 2016 IoT PILOT	MAY 2016 INTEGRATION DEMO	OCTOBER 2016 BOSTON EXPERIMENT	JUNE 2017 GRANT COUNTY (WA) TechEx	DECEMBER 2018 HARRIS COUNTY OpEx	AUGUST 2019 BIRMINGHAM SHAKEN FURY OpEx
An integration test to assess how open-source standards could help integrate various technologies	Highlighted integration of physio monitoring devices, sensors, video-streaming, UASs, wearables and alerting capabilities	Assessed two communications systems ability to allow multiagency collaboration, interoperability to include multimedia data	Partnership with rural agencies to assess integration of technologies with their mission-based needs.	Assessed the ability of multiple NGFR technologies and commercially-available solutions to support and integrate with existing systems.	Assess the ability of NGFR technologies and commercially-available solutions to support and integrate with existing systems & infrastructure.

FOR MORE INFORMATION: https://www.dhs.gov/science-and-technology/ngfr-integration-demonstrations

NGFR HANDBOOK: https://www.dhs.gov/science-and-technology/ngfr/handbook

Harris County Operational Exercise



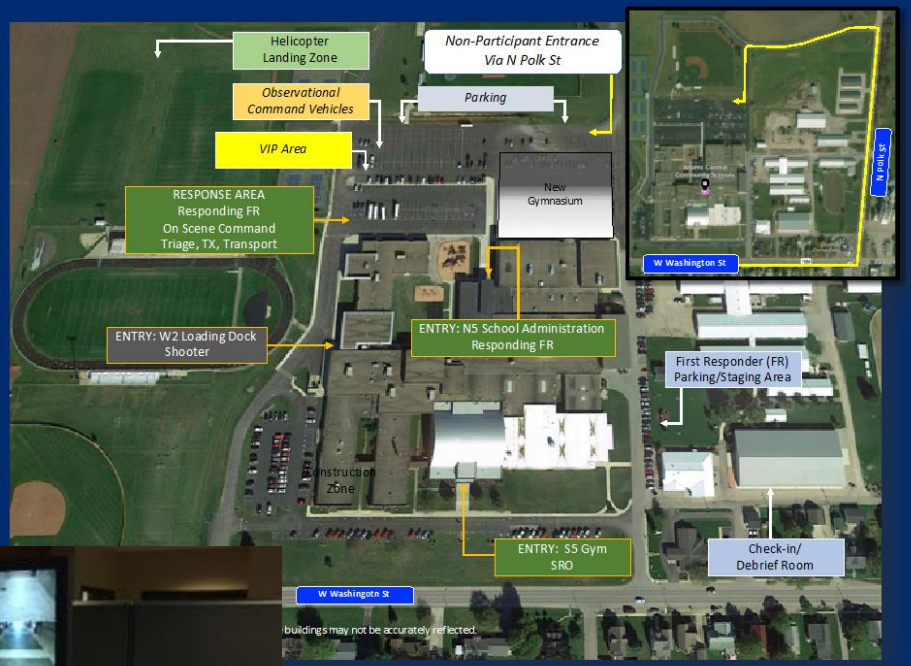


"What we saw during this experiment with on-body sensors for responders and simulated victims, is that we were able to move all that data back to the situational awareness displays for mission critical incidents. . . we're now going from a thousand words to a **'picture that is worth a thousand words.'"**

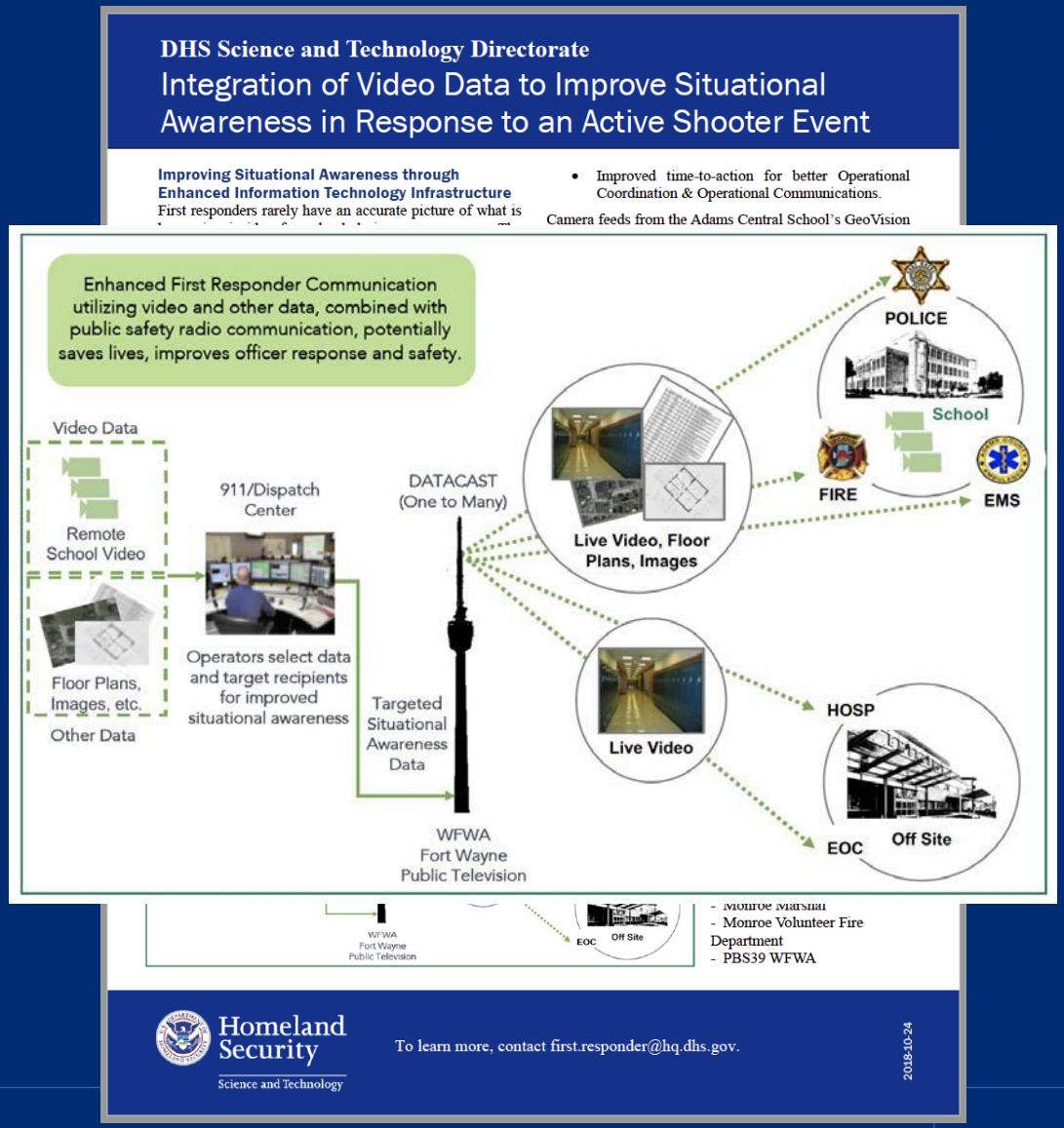
– **Rodney Reed**, *Assistant Chief of Operational Support, Harris County Fire Marshal's Office*

Demonstrating Technologies for Crisis Operations

Adams County Active Shooter Exercise: Decision Support for Incident Response



"Camera feeds from the Adams Central School…integrated into the Adams County 911/Dispatch Center [who] select relevant camera feeds and forward them to the command officers"



DHS Science and Technology Directorate

Integration of Video Data to Improve Situational Awareness in Response to an Active Shooter Event

Improving Situational Awareness through Enhanced Information Technology Infrastructure

First responders rarely have an accurate picture of what is

- Improved time-to-action for better Operational Coordination & Operational Communications.

Camera feeds from the Adams Central School's GeoVision

Enhanced First Responder Communication utilizing video and other data, combined with public safety radio communication, potentially saves lives, improves officer response and safety.

Video Data
Remote School Video
Floor Plans, Images, etc.
Other Data
911/Dispatch Center
Operators select data and target recipients for improved situational awareness
DATACAST (One to Many)
Targeted Situational Awareness Data
WFWA Fort Wayne Public Television
Live Video, Floor Plans, Images
POLICE
School
FIRE
EMS
Live Video
HOSP
EOC
Off Site

- Monroe Marshal
- Monroe Volunteer Fire Department
- PBS39 WFWA

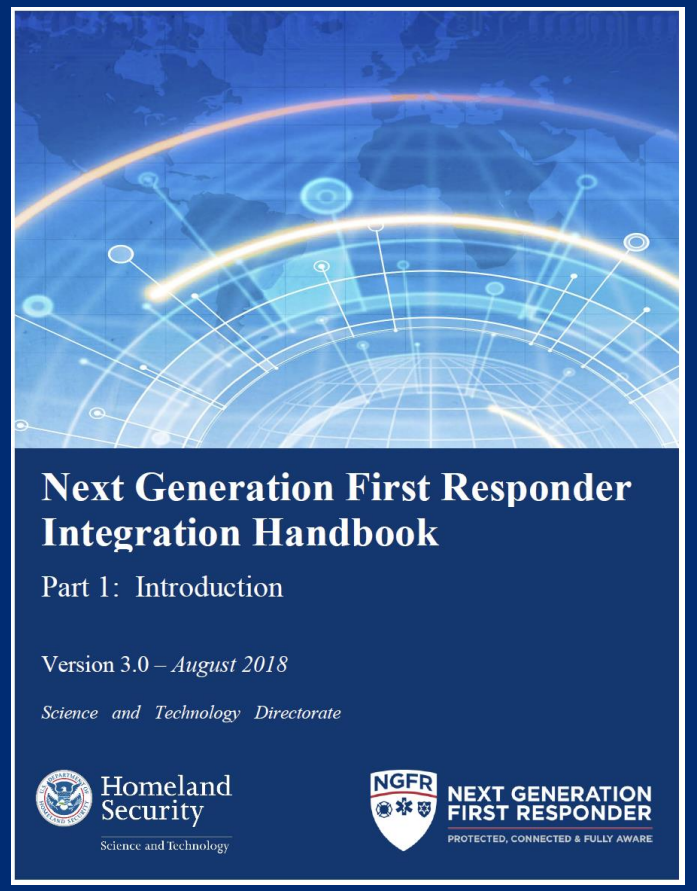
Homeland Security
Science and Technology

To learn more, contact first.responder@hq.dhs.gov.

2018-10-24

Lessons Learned

- Information delivery is not enough
  - Standard operating procedures lacking for richer information feeds
  - Video data management and control burdens operations centers
  - Information overload and poor information delivery can burden more than help
- But the opportunities are huge
  - Improved threat awareness to keep responders safe
  - Sensor integration and operational coordination for containing threats and timely recovery of injured



The right information to the right people at the right time

What's needed?

- Operations in degraded environments
  - Non-Public networks, both standalone and integrated
- Management of communications across coalitions
  - broadcast and multicast group management and communications
- Usability
  - eXtended Reality

Opportunities in 3GPP 5G Standards Development

5G Vertical Industries

Driving new service requirements in 3GPP that can benefit the emergency operations community

Public Safety

Railway

Automotive

Maritime

AV production

Medical

Industry

Logistics

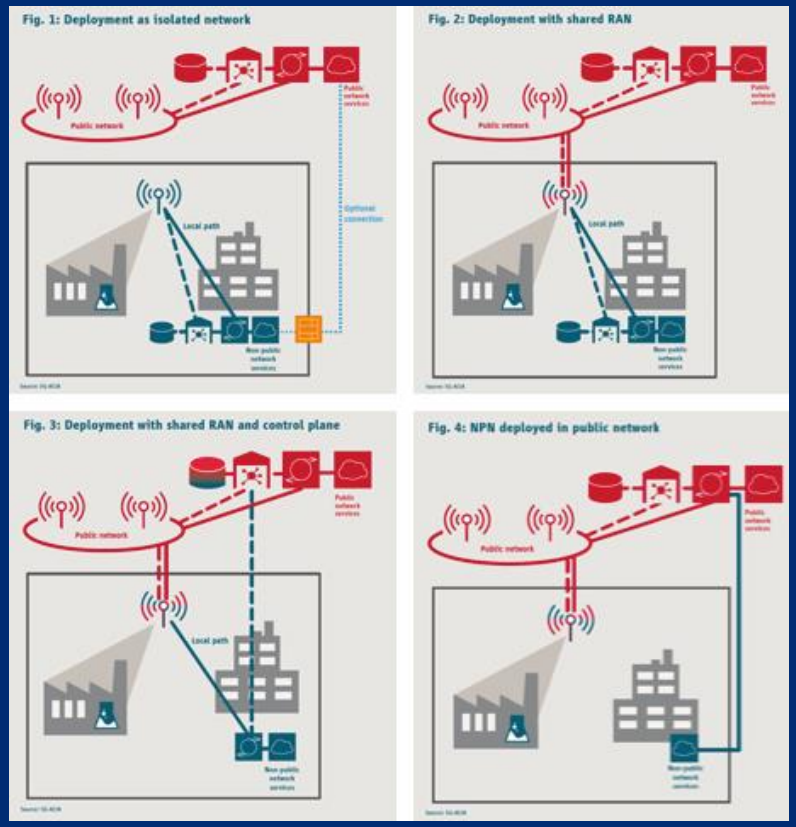
UAVs

Fig Ref: Iain Sharp et al, "ATIS/3GPP Webinar: 5G Standards Development in Release 15 and Beyond," July 31, 2019.

5G Standards

Non-Public Networks

- Industrial IoT is currently a key driver
- 3GPP Rel-16 work areas
  - 5GS Enhanced Support of Vertical and LAN Services (Rel-16)
    - Study complete; Feature in progress
  - NR-Based Access to Unlicensed Spectrum (Rel-16)
- Applicable to Emergency Operations
  - Stand up isolated network when infrastructure is unavailable or destroyed
  - Flexible architecture defined for standalone or integrated operation with public networks
  - Interworking with public networks is supported when native infrastructure comes back online



Opportunities to Adapt to Emergency Operations Use Cases and Deployment Scenarios

Fig Ref: 5G Alliance for Connected Industries and Automation white paper, February 2019

5G Standards

Broadcast and Multicast in 5G Rel-17

- SA1 (Service Requirements): Broadcast / Multicast requirements supporting Mission Critical Services in 5G
  - 0% complete
  - Normative work; Normative service requirements are generally a precursor to future features
- SA2 (Architecture): Study on Architectural enhancements for 5G multicast-broadcast services (FS_5MBS)
  - 80% complete
- SA6 (Mission Critical & Applications): Study on Mission Critical services over 5G multicast-broadcast system

3 Justification

Clause 6.13 in TS 22.261 provides requirements for services based on broadcast/multicast. Currently these requirements do not reflect the needs of the mission critical community. The newly proposed requirements enhance group communications specifically used by mission critical users. These new requirements may also support the work of the currently ongoing studies in SA2 and SA6, as stated in 2.3.

5GS mission critical users would not be able to use group communications efficiently, as only unicast transmissions would be possible.

4 Objective

The goal of this Work Item is to add requirements for broadcast/multicast, to the existing requirements enhancing the capabilities for group communication, supporting in particular requirements for mission critical users.

5G Standards

Extended Reality

- Extended Reality (XR) includes…
  - Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR)
- Service requirement exceed LTE capabilities
- 3GPP SA Activities related to XR
  - 3GPP SA1 (Service Requirements): study and work on Network Controlled Interactive Services (NCIS)
    - Study item & work item (feature) completed in Rel-17
  - 3GPP SA2 (Architecture): **5G System Enhancement for Advanced Interactive Services (5G_AIS)**
    - Rel-17 feature
  - 3GPP SA4 (CODECs): **study on Extended Reality (XR) in 5G (FS_5GXR)**
    - Rel-16 study item
    - Proposed work area in Rel-17
  - 3GPP SA6 (Mission Critical & Applications): **study on application architecture for enabling Edge Applications (FS_EDGEAPP)**
    - Rel-17 study item

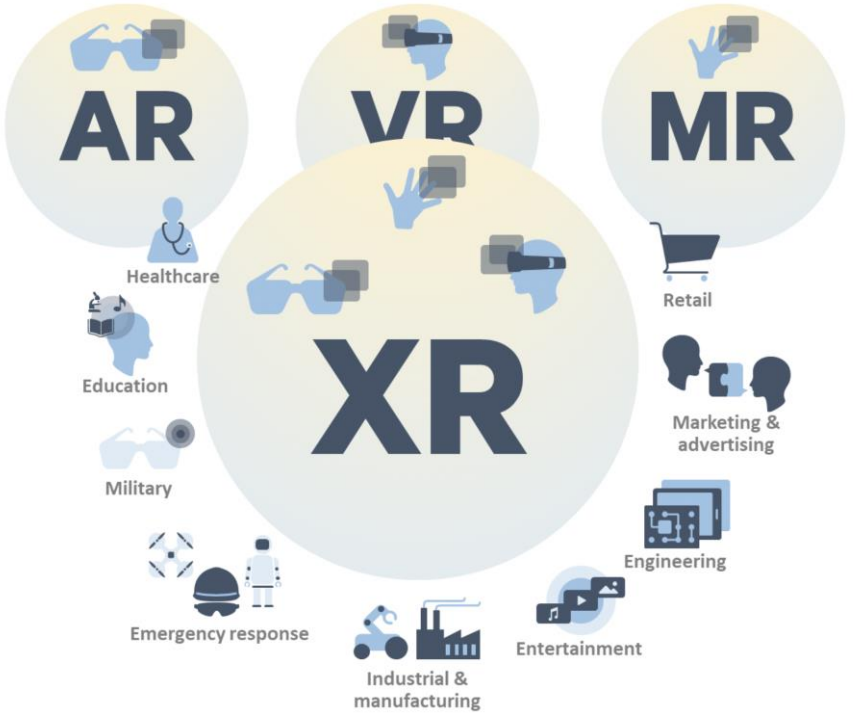


Figure 4.1-1: Different Types of Realities and some applications

Potential to be the ”Killer App” for 5G

Fig Ref: 3GPP TR 26.928, “Extended Reality (XR) in 5G,” Rel-16, draft version 1.0.0, Sept 2019.

5G in Crisis and Emergency Operations

- Technology Demonstrations and Integration with Operations show tremendous opportunities to improve operations
- Requires the right information to the right people at the right time
- Key engagement opportunities in 3GPP

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