Future first responders and FirstNet: Response to a multiple-vehicle accident (MVA) scenario

Abstract:
How future first responders can leverage the FirstNet LTE network for improved situation awareness and response at an MVA incident is explored.

Clint Smith, P.E.
csmith@nextgconnect.com

The first-responder community in the United States soon will have a unique communication system placed at its disposal: the Long Term Evolution (LTE) wireless network that FirstNet is designing for public safety. The public-safety LTE network will use 10 MHz x 10 MHz dedicated broadband spectrum assigned to public safety in the 700 MHz Band 14 airwaves, which includes the D Block swath that Congress reallocated to public safety in 2012. The network will be a broadband communication system that can and will transform how first responders respond and work an incident.

So far, talk regarding the LTE network for public safety has been centered on the need to build this network and how it will be funded. But noticeably absent from most discussions to date is what the first-responder community will do with the LTE broadband network once it is operational.

One very important question that needs to be answered is: How will public safety leverage some of the vast capabilities that this new communication system can deliver? It is important that informed dialog about this fundamental question begin now, so public-safety entities can integrate these new broadband capabilities into its operations when the network is available in their areas.

This article will provide a glimpse into how Future First Responders (FFRs) can utilize the public-safety LTE broadband. When deployed, this LTE broadband network can and will improve response effectiveness through enhanced situation awareness and the vast array of communication enhancements that are possible.

In the article, we present a simple scenario to illustrate some of the communication enhancements possible with LTE. In the course of describing this scenario, a variety of communication-system improvements that can be achieved with a LTE system will be described. The situation described in the course of this article will not cover everything that occurs at an incident. The objective of this article is to help illustrate how the LTE broadband network can be used to help the Future First Responder at an incident.

The example involves a multiple motor vehicle accident (MVA). A variety of communication devices or platforms and their associated apps will be discussed. The communication devices and the associated applications either exist today or are not far from reality.

Before diving into the actual situation, a few items will be helpful in terms of how this new LTE system can greatly enhance the first-responder community. Figure 1 is different than current first-responder communication systems, because it depicts the entire first-responder ecosystem in a unified communication network, instead of separate communication systems.

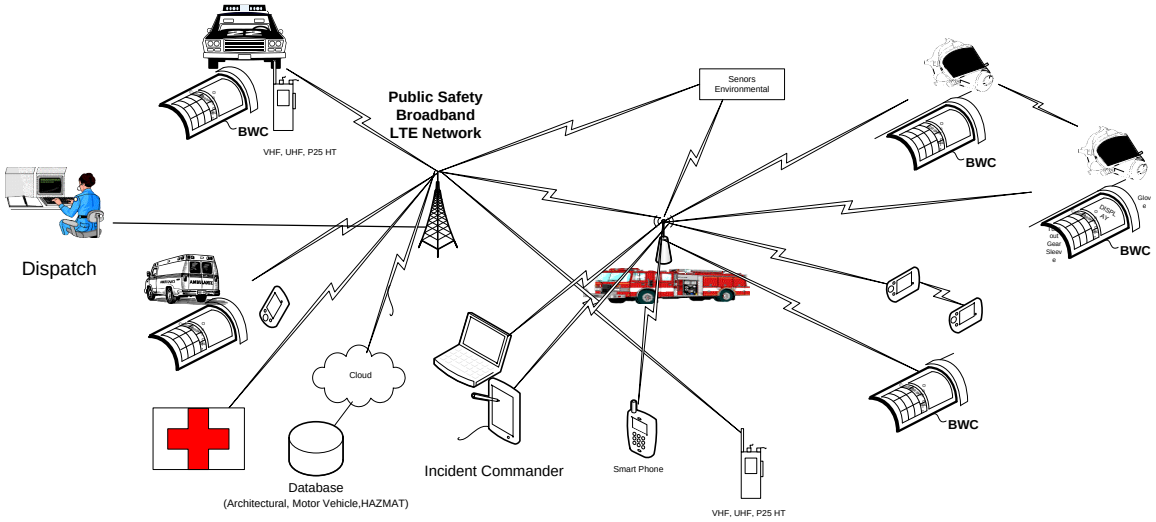


Figure 1: Future First Responder (FFR) Ecosystem

Figure 1 also shows that the existing Land Mobile Radio (LMR) communication systems used today will continue to have a vital role in incident response. As embedded enhanced communication systems advance throughout the first-responder community, LMR systems either will play a secondary role or—in some cases—will be discontinued at some point in the future.

The Future First Responder (FFR) ecosystem in Figure 1 shows how Fire/EMS, Police, Department of Public Works (DPW), utilities and other agencies can all be integrated into a unified communication network. The unified communication network is enabled through the new LTE network, with its ability to provide broadband coverage to the edge of the network. For first responders, the edge of the telecom network is the incident scene itself.

First responders are all too aware of how complex and unpredictable incidents are. The complexity of responding to incidents continues to grow, thanks to the ever-changing environment that we are in. Proper training, equipment and effective communication let first responders handle the complex incident responses. All of those responding always need good communication for situation awareness. However, the amount of information that needs to be quickly processed by the incident commander and responding personnel to effectively respond, coordinate and resolve the incident with safety of life and minimizing property damage continues to grow.

Law enforcement has seen the most prolific acceleration of technology and advanced communications capabilities in the course of their daily job. Additionally, the improvements to medical responses also have many time-critical elements pertaining to improved diagnostic/treatment capabilities at the scene, as well as telemetry feeds while en route to the scene or transporting victims to a hospital.

Other agencies and departments are often involved during an incident response. These include DPW, Hazmat, public utilities, state agencies and—occasionally—federal resources. Therefore, the need to

improve communication between responding groups—as well as affiliated groups, such as hospitals—is a challenge. Coordination with other first-responder agencies and a more integrated approach are needed.

When the dedicated public-safety broadband system is available, FFRs will have a variety of communication platforms that are based on LTE communication equipment capabilities. Some of the LTE communication devices used for this scenario include:

- LTE Tablets
- MicroLTE network (eNB/ microEPC)
- Wearable computers with LTE radios
- LTE smartphones
- Computers with LTE air cards
- LTE Mobile Command System (MicroLTE Network)

The incident is an MVA situation that requires Mutual Aid (MA) from other districts and departments. The local Fire Department is responsible for fire and rescue operations and, in this scenario, is an all-volunteer organization with an unmanned station.

Scenario: The multiple-vehicle accident

A citizen in a car hurriedly calls 911 from her cell phone and reports that there is a crash involving several cars and a truck. The caller describes the rough location with no cross street, just an estimate of distance from one location. The caller then hangs up before the caller ID and GPS location can be determined.

911 personnel dispatch police and fire to the scene, indicating that a possible multiple-vehicle accident (MVA) was reported with the approximate location. In this situation, EMS is alerted separately, because it is not integrated with the fire department in this jurisdiction.

Fire personnel receive a page and text message that a caller has reported an MVA with unknown injuries. The approximate location is also provided in the message sent to the fire personnel.

The Critical Information Display (CID) is activated in the Home Monitor station and a ticket, tear or run sheet, is generated both physically and electronically, with the latter displayed on all the monitors in the fire station.

The fire chief arrives at the scene within one minute of being dispatched and remains in his vehicle. He presses the icon on his Incident Command System (ICS) display, which informs dispatch that he has arrived at the scene. A live video feed from the chief's vehicle is commenced and relayed over the LTE network to his Home Monitor station and dispatch as the chief arrives.

Still in the vehicle, the chief does a quick assessment and notices that there is an overturned propane (LP) truck and what appears to be two additional vehicles involved. Using his ICS LTE tablet, the chief taps an icon selecting the desired preplan. The preplan selected automatically informs his Home Monitor station and orders rescue and fire apparatus, in addition to requesting a tanker to scene.

The chief grabs his ICS LTE tablet in addition to his two-way radio, exits his vehicle on foot, accesses the situation and notes:

- Overturned propane truck
- Two passenger vehicles badly damaged, one of which is flipped and is in a ditch
- Injuries and entrapment evident
- One victim is visible on road—apparently ejected from one of the vehicles—and is not moving
- Electrical lines are down, because one of the vehicles hit the utility pole; electrical wires on are on the vehicle
- Another victim is lying next to the passenger vehicle with the power lines
- Civilians are present at the scene

The chief orders the civilians to get back and not attempt to rescue anyone.

Using the mutual-aid (MA) icon on the tablet, the chief selects the MA preplan. The MA preplan selected automatically informs dispatch to request EMS and indicates that this is an MVA alarm 2, requesting mutual aid to the scene of the incident.

At the fire station, fire personnel enter the apparatus and the CID system is activated. As fire personnel enter the apparatus and take seat assignments, their accountability tags identify who is on the apparatus. The chauffer for each apparatus updates the CID screen, where members are identified to specific seat assignments. The information is then relayed to the chief, dispatch and the Home Monitor.

A heads-up display shows the chauffer for each apparatus the tactical data needed to reach the scene, including road conditions and any known hazards. Suggested ingress and egress paths are provided. Weather conditions are also displayed, including wind direction and velocity.

Returning to his car, the chief opens the incident-command system (ICS) application (Figure 2) on his tablet, which displays the arriving assets from the fire company, with their locations on a map and their estimated times of arrival to the scene, as well as the information about the skill sets (trained) and rank of those responding

Chief sends a notification to the Home Monitor to respond to the incident with rescue and fire apparatus, indicating first-due and second-due apparatus as called for in the preplan. Dispatch, the chief and the Home Monitor are automatically informed when each apparatus leaves the fire station to respond.

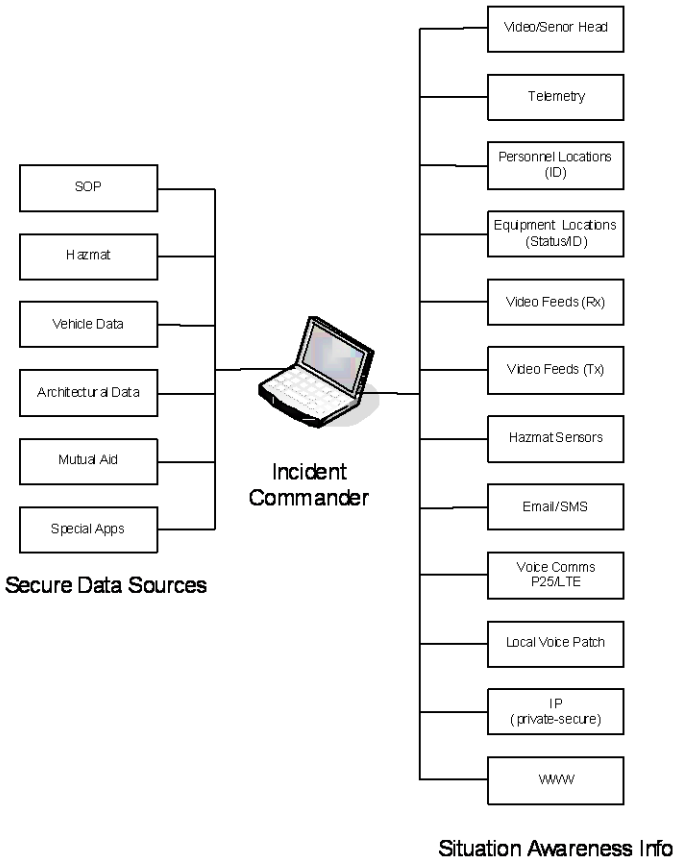


Figure 2: ICS Application Suite

The chief opens the back door of his vehicle and, based on the signal level detected for the macro LTE public-safety network, the MicroLTE network—a vehicle-mounted deployable—is enabled to provide local autonomous communication, Figure 3.

The MicroLTE network is run on a rugged laptop and has a 5W base station with it. Depending on the local RF conditions, the MicroLTE network can operate as either a client, relay cell or self-contained LTE network functioning as a vehicle mounted deployable.

The MicroLTE network operates as a client, if the coverage from the fixed Public Safety LTE network is good. In the client mode, the MicroLTE network will use an LTE air card to connect to the Public Safety LTE network and not operate as an LTE cell site or network.

However, if coverage is limited or there is a need to enhance coverage and capacity, then the MicroLTE network can work as a relay cell site to the macro Public Safety LTE network. In relay mode, the MicroLTE network will act as a remote eNodeB to enhance coverage and capacity.

If needed, the MicroLTE network can also operate as a self-contained LTE network, with its own evolved packet core (EPC) and single 5W eNodeB when the Public Safety LTE network is unavailable. In this configuration, the MicroLTE network can use a commercial network for its backhaul. But, when operating in a standalone configuration, the MicroLTE network can also work without any backhaul and function as a localized LTE network providing communications within the incident area itself.

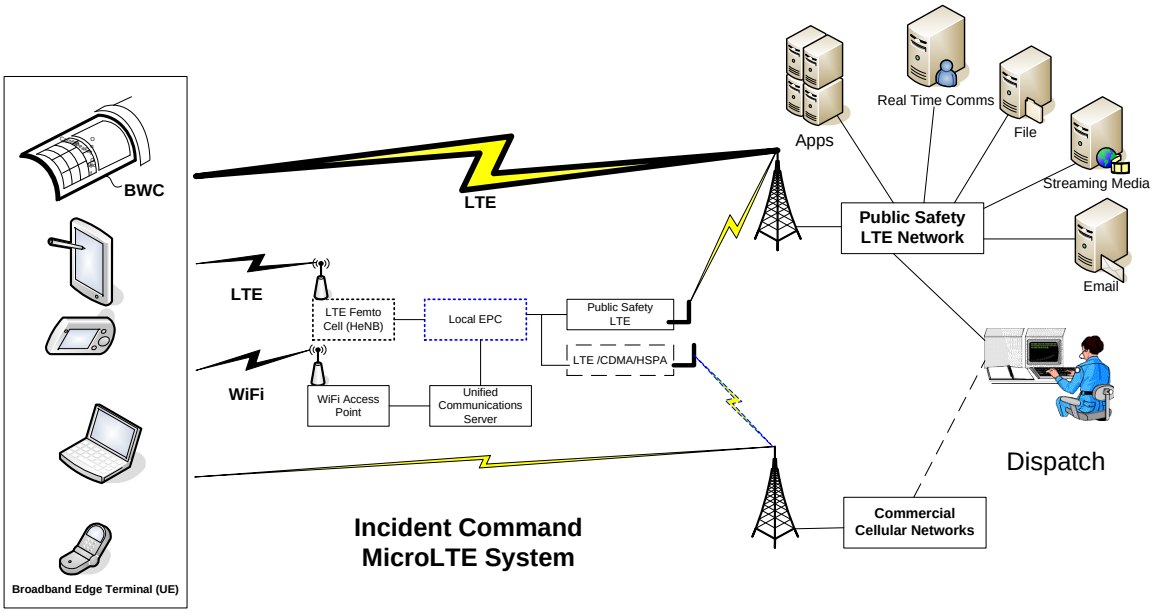


Figure 3: MicroLTE System

Scenario: Response resources requested

Dispatch notifies the chief—on his tablet—which the mutual-aid assets are ready to respond and requests authorization to send those assets to the scene following the MA preplan. The chief then looks at the total responding assets and determines that the MA level 2 alarm for the box area is needed. The chief is informed that the following are identified as being ready for responding and are properly manned.

- Two rescue apparatus requested
- One fire apparatus requested
- Two tankers requested

The chief acknowledges the MA level 2 request, and this is automatically conveyed to dispatch, as well as to the Home Monitors for both the initially responding fire department and the MA fire departments.

Also, the EMS icon—automatically highlighted, based on the preplans selected already—prepares the following actions:

- Two ambulances requested
- MobileAir alerted
- Estimate of number injured that will be sent

The chief also selects the public-utility icon and informs utility officials about the situation via the following steps:

- Utility-pole damage selected
- Location of the chief is shared, which is sent to aid in dispatching utility personnel, and the estimated location of the damaged pole

The chief acknowledges, and dispatch replays MA request following preplan guidelines.

A visual map informs the chief and dispatch when the MA apparatus are en route. Each apparatus is identified and has a color code that indicates if it is responding or available. The number and type of personnel en route—along with the ETA for each—is included.

From his local command post, the chief controls the camera on his vehicle and pans the area, enabling a 30-second video clip to be sent to all those responding. The video clip is uploaded to the 911 center and is broadcast to all responding units

Live video from chief's vehicle continues, with a high-definition feed being transmitted to the 911 center and responding units that are within 2 miles of incident. Lower-resolution feeds are provided to all other responding units, including mutual-aid units. Incident updates regarding hazards also are displayed, including wind direction.

Based on the preplan, a map for the incident area is displayed on all apparatus, providing updated information and overlaying fire-plug locations, hazard-material locations and other key attributes for the area, such as weather. If conditions are different than reported, the officer in the first apparatus to arrive updates the data. This update is then sent to all involved with the incident.

As each apparatus approaches the incident area, its corresponding icon in the ICS application changes from solid to flashing. The chief is able to acknowledge the asset, and the icon changes from flashing to red, indicating it is on scene. To acknowledge the asset, the chief uses the ICS tablet and taps each approaching apparatus and defines where they should be positioned: where to stage, manpower assignments, following seat positions along with ingress and egress considerations. The requested staging area, as well as manpower assignments, can be adjusted based on skill levels and the incident situation.

The chief then uses the ICS tablet to select the location for Police or Fire Police to block off the additional civilian traffic. This is relayed to Police and dispatch. Additionally, the primary and secondary roads to the incident are highlighted for closure using a street-closure application.

The chief then uses the incident map to select the location of each MVA vehicle and the type of vehicle class that they are (passenger, truck, fuel). He then assigns each arriving apparatus to a vehicle involved in the crash. This information is then displayed to the responding units and personnel that are en route.

The chief also uses the ICS tablet to request initiation of an evacuation procedure, following a preplan. Parameters are defined based on the location of propane truck and the preplan steps. The initial perimeter for evacuation is defined based on the hazmat manual, and a geo-fencing circle is created from the center of the approximate location of the LP truck.

To do this, the chief executes the following steps on the ICS tablet:

- Map of current location appears, with roads
- Chief touches with quick pull-down windows identifying approximately where each of the crashed vehicles are and their type (truck, fuel, passenger)
- Location of vehicles is displayed to responding units and personnel
- Identifies primary road-closure locations (uploaded to Police and Fire Police)
- Requests that the evacuation-procedure possibility be initiated, with the parameter defined based on the location of the propane truck
- Designate where to stage each apparatus, manpower for helping, ingress and egress considerations

This request is relayed to the Police and the department of public works (DPW). Police and DPW acknowledge the request and inform the chief that assets are being deployed. Police and Fire Police later update this information, indicating which intersections are manned for traffic diversion and which ones are not.

As part of the preplan, the prioritization of DPW on the LTE communication system is elevated for the response. Additionally, Fire Police are dispatched to a preplan landing-zone area for Medevac and secure the area, including placement of cones to define the landing zone.

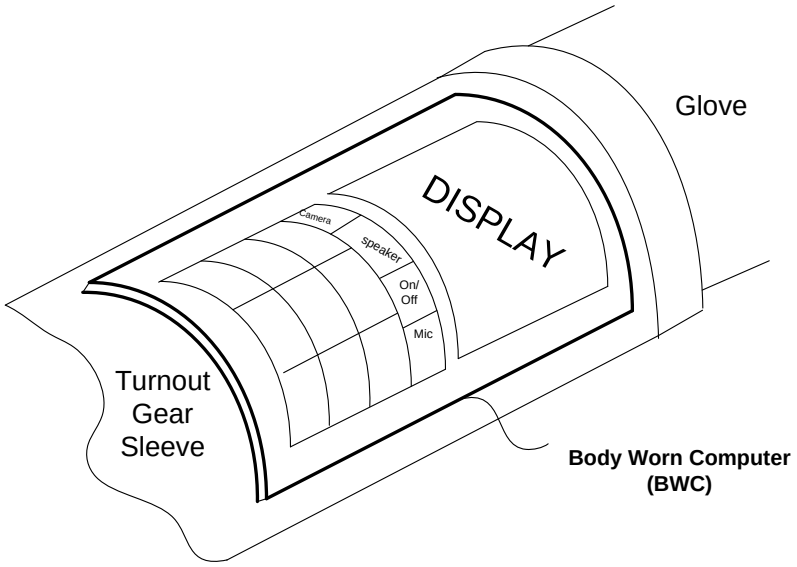
Medevac gets landing coordinates (waypoint) via wireless, as well as a video feed and the current CID information.

Part of the personnel information reported includes the rescue/fire personnel and which seat they occupy in an arriving vehicle. RFID tags embedded into their Personal Protection Equipment (PPE), along with pairing for seat assignments, are used.

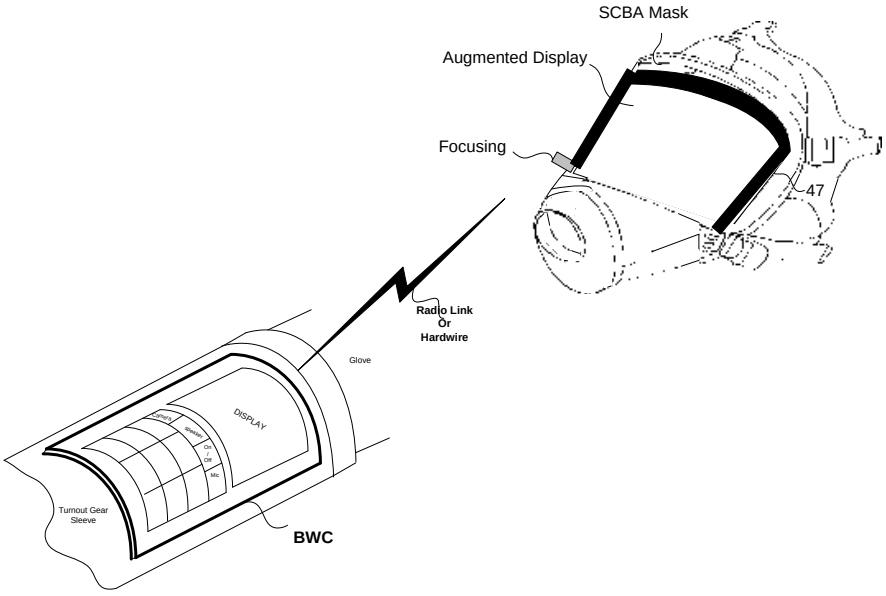
As part of the accountability program, when the fire/rescue personnel enter the apparatus they are identified as being in the apparatus either when reporting to the scene or returning from the scene. When they exit the apparatus during a call, the chief is informed that they are on the scene.

The use of Body Worn Computers (BWC) integrated into the PPE equipment provides a host of communication and information capabilities. BWC systems outfitted with LTE capability (shown in figure 4a) are on every fire/rescue personnel's PPE.

The BWC is able to provide telemetry feeds to the chief when personnel don their gear. The telemetry feed not only establishes a communication link, but it also activates the biometric and environmental sensors that are worn. The BWC is an intrinsically safe (Class1 Division1) device. EMS and Police use similar BWCs as part of the communication ecosystem.



(a)



(b)

Figure 4: Body Worn LTE Device (class1dev1) (a) BWC with LTE radio (b) BWC with LTE radio linking with SCBA with augmented display

Information that can be displayed on the BWC includes video feeds from other first responders, infrared-camera display, sensor data, building schematics and the relative position of other rescue personnel.

Figure 4b shows the self-contained breathing apparatus (SCBA) mask outfitted with an augmented display that will show a host of tactical data to the firefighter. The information displayed on the SCBA mask can be the same that is displayed the BWC display, but the information will be shown on the SCBA augmented display once the SCBA mask is donned.

All the information is displayed on the BWC or SCBA augmented displays is controlled by the BWC on the PPE or by remote control from the chiefs ICS tablet.

Using the public-safety LTE network, officers, drivers and fire personnel are therefore able to have a holistic situation report, as well as task assignments before arriving on scene, which speeds the response. As part of the situation information, the video feed and clip are displayed in the apparatus using the CID in several locations, along with other tactical feeds for improved information. The officer in the apparatus also has a read-only display of the chief's ICS tablet with the ability to send updated information about the status of arriving apparatus.

Scenario: EMS responding

EMS apparatus and personnel are en route and consist of two ambulances from the local ambulance corps. The EMS vehicles are identified as assets that are en route, and their icons on the ICS tablet identify their locations and ETAs.

While en route to the incident, each EMS apparatus is provided a telemetry and video link to improve their situational awareness. The EMS Coordinator instructs the various EMS apparatus where to pre-stage their vehicles before advancing on the scene, so fire can secure the location. The triage and rehab locations are identified by the EMS coordinator, and this information—along with the pre-stage location—is sent to the chief via a pop-up message, with the locations identified on his visual map.

Knowing that apparatus and personnel are en route, along with the MA assets requested, the chief indicates on the ICS tablet where the fire apparatus should be placed, including the staging area for rescue equipment. The fill location for water is reconfirmed as the tanker fill team arrives and confirms a good draft is achieved. This information is also sent to dispatch and broadcast to all responding assets.

The chief assigns officers to each of the motor vehicles involved with the MVA and continues to monitor the situation as apparatus and personnel arrive.

Fire and Rescue apparatus, as well as the Police, arrive on scene. Fire rescue is instructed via CID to remain at a distance, while the first fire apparatus secures, and the second apparatus protects the scene.

The chief re-verifies the apparatus assignments and makes no changes to the original order. The officers for the first and second apparatus exit the vehicles with BWC and officer tools.

The First-Due Fire Apparatus is assigned to the LP Truck, with the following personnel assignments:

- Fire Officer 1: Accesses LP Truck
    - Provides video feed to chief and reports via radio using an LTE intrinsically safe device on BWC with a throat microphone.
        - Driver seriously injured, conscious but speaking French
        - Odor of propane detected
- Fire Team 1 (nozzle and back-up)
    - Pull 2.5" hose and get into position with charged line
    - SCBA donned, no mask
- Fire Team 2 (irons and can)
    - Establishes backup 2.5" hose line and gets into position with a charged line (filled with water)
    - SCBA donned, no mask
- Engine Officer (chauffer) mans pumps (after securing vehicle)

Second-Due Fire Apparatus (tanker)

- Establishes water supply to First-Due apparatus
- Sets up pool

Two fire personnel arrive on scene with their own vehicles. They activate their BWCs and await instructions. The chief is informed of two more personnel arriving on scene, and he assigns them to the first-due rescue team. The first-due rescue officer is informed of additional resources over LTE radio through his BWC.

All personnel are informed of the situation, and Fire Police and Police are instructed to quickly secure road and help clear the existing civilian vehicles in the incident area.

Fire Team 1 dons SCBA masks with the augmented thermal display active (Figure 5) and begins applying a water curtain to the LP truck near the suspected rupture. The augmented display giving thermal imaging is displayed on SCBA mask. At same time, the fire officer approaches the LP truck cab and is able to open door, reaches over the victim and turns off vehicle and secures keys.

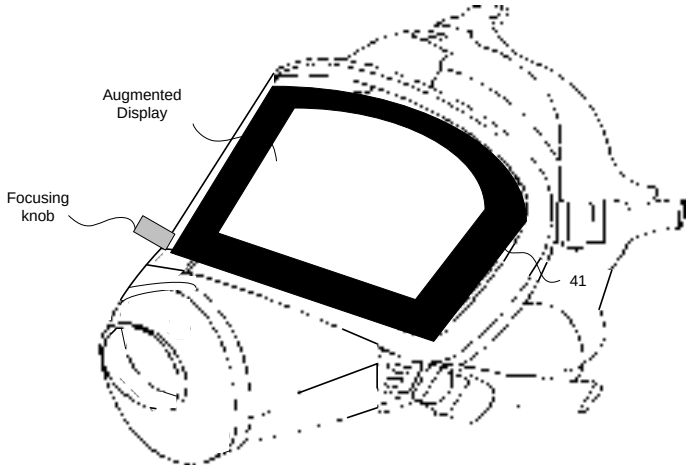


Figure 5. SCBA augmented vision

The SCBA image is relayed to chief, as well as to with the first and second fire officers. The first-due fire officer is able to see the thermal image on his BWC display. Upon seeing the lack of a defined heat signature, the fire officer dons SCBA, approaches the truck and is able to turn off valve, which was slightly opened in the accident. The team continues to douse the area with a water curtain to disperse propane for a few minutes.

Fire officer 1 reports leak secured to chief.

First-due fire team 1 is told to still continue applying the water curtain on the LP truck, and first-due fire team 2 remains as backup.

The tanker and vehicle 1 are approachable, and it is decided to begin extrication of both.

First-due rescue gets into position for extraction efforts.

First-due rescue officer exits the apparatus, assesses multiple vehicles and provides video link to chief, which are then relayed to both EMS and dispatch.

The first-due rescue officer reports:

- The ejected person not conscious
- Passenger Vehicle 1
    - Vehicle is a Toyota Camry
    - Driver door jammed
    - Driver trapped (foot and steering wheel)
    - Front passenger not conscious
    - Airbags deployed
    - Need to secure and stabilize vehicle (disconnect power and chock vehicle to keep it from moving)
- Passenger Vehicle 2
    - Not accessible due to power lines

    - 2 victims, both conscious
    - 1 victim outside of vehicle possible electrocution
    - Power lines touching victim and arcing
    - Vehicle appears to be Prius Hybrid
    - Vehicle is on side and partially in ditch
- No other victims visible, search of area needed

With this information, personnel for the first-due rescue Team 1 (Nozzle and Backup) don SCBA, with no mask. They grab irons—an ax and a halligan—and approach vehicle to obtain a purchase to create openings for tools to grab.

Meanwhile, first-due rescue Team 2 (Door and Chauffer Assist) take the following actions:

- Don SCBA, no mask
- Establish 1 ¾" Precautionary hose line and do not charge it
- Begin staging extrication tools on tarp
- Set up cones in front of civilian vehicles (no flares are used, because of the LP truck)

Car traffic on the road has not been stopped yet. Several cars are in the road and stopped. Motorists are told to stay in their vehicle until instructed otherwise.

First-due rescue officer, via BWC radio, assigns the two arriving firefighters to do a quick search of the area for additional victims. The rescue officer warns the firefighters of the live power-line issue and to pay extra attention for trip hazards. The search does not find any more victims, and this is reported to both the rescue officer and the chief via BWC.

The EMS Coordinator arrives on scene and reports to the chief using his BWC device. The EMS Coordinator, via the BWC, confirms with the chief where the triage and rehab location will be placed

The chief then asks for EMS assistance in the extrication efforts to assess victims.

EMS first checks the unconscious person, and it is determined the individual is deceased. A blanket is requested and then placed over victim.

First-due rescue officer informs chief that the extrication efforts for passenger Vehicle 1 is beginning.

The first-due rescue team and EMS arrive at Passenger Vehicle 1 and take the following steps:

- Rescue team notices and reports both airbags deployed.
- Verbal communication is established with the driver victim
- The vehicle is stabilized, and this is reported to chief
- Vehicle identification (scanning VIN remotely to read the type of passenger vehicle)
- Vehicle schematics and extrication plan are displayed on BWC
- Vehicle battery is disconnected and airbag locations identified
- A sensor is placed on the driver victim and medical telemetry is fed to smartphones

- After the passenger door is opened, EMS personnel place a medical senor on the passenger, with the medical telemetry information fed to smartphones
- The sensor indicates that potential internal injuries have occurred.
- The medical telemetry and video feed is sent to the EMS team, the local hospital and Medevac
- The two arriving firefighters (Team 3) assist EMS with extricating the passenger onto a backboard and moving the passenger to a triage area
- The Rescue 2 team removes door and frees foot of driver victim
- Driver victim is moved by returning Team 3, placed onto backboard and is taken to triage location
- Trunk checked and nothing found
- First -due rescue officer informs the chief that the extrication is complete.

Second-due rescue (MA) arrives at the scene and proceeds to their assigned staging area. The second-due rescue officer requests confirmation that the original orders assigning second-due rescue to the LP Truck are still valid. The chief confirms by acknowledging the pop-up icon on his ICS display.

The second-due rescue officer—using the first-due fire officer's assessment—begins his own brief assessment of the LP truck.

Second -Due Rescue Team 1 (Nozzle and Backup)

- Don SCBA, no mask
- Grab irons and approach vehicle to obtain a purchase

Second -Due Rescue Team 2 (Door and Chauffer Assist)

- Don SCBA, no mask
- Begin staging extrication tools on tarp

Second -Due Rescue officer informs Chief that extraction efforts are about to begin.

Second -Due Rescue team and EMS (1) arrive at LP Truck

- Vehicle door usable and opened
- Bill of lading found and contents of vehicle verified
- Communication with driver; however, not possible, due to language
- Smartphone (LTE) used with Language APP for communication (French)
- Sensor placed on driver and medical telemetry fed to smart phones
- Video feed sent to EMS team
- EMS reports to Chief Sit Rep and requests backboard
- Victim is removed to triage location
- Second-Due Rescue Officer informs Chief that extrication is complete.

Scenario: Overloaded public-safety LTE network

Shortly after, the chief gets an overload message from LTE network, indicating that 90% of the capacity in the primary cell sector on the LTE public-safety network is being consumed by first responders.

The overload message is also received at dispatch, which then invokes a priority override of the commercial systems sharing the network in the cell sector (technically possible, although it has not been done to date) to allow priority access of first-responder traffic over the commercial network.

Following a preplan priority scheme, DPW and Police are given priority on the commercial LTE network and roam onto the commercial network using a Tiered Priority Access (TPA) override, so their movement to the commercial network occurs without session interruption.

Personnel from the electric utility arrive to the scene. While the electric-utility vehicle is en route, dispatch dynamically elevates their communication tiered prioritization to enable communication with the chief. While en route, the locations of the smart devices used by the responding electric-utility team are displayed on the incident map for the chief.

When at the scene, the electric-utility personnel use their LTE smart phones with the ICS application to communicate with the chief via a video/audio bridge, requesting an update on what is needed. The chief informs them of the need to cut power to the area. The electric utility disconnects power to the section of the grid affected. The electric-utility team/company reports to the chief that the power has been cut, and it is safe to proceed.

After this, the electric-utility personnel remain on the network, but they are moved to a lower level on the priority scheme.

The third-due rescue team arrives and—after confirming with the chief—begins staging for extrication efforts.

Third-due rescue Team 1 (Nozzle and Backup) members don SCBA, with no mask. They grab irons but do not approach the vehicle.

Third-Due Rescue Team 2 (Door and Chauffer Assist) members don SCBA, with no mask. They establish a 1 ¾” hose precautionary line and do not charge it, and they begin staging extrication tools on tarp.

The chief then informs the Third-Due Rescue team (MA) and EMS that they can begin extrication of passenger vehicle 2.

EMS approaches the victim on the ground and takes the following steps:

- Establishes that the victim is still alive (electrocution victim).
- EMS begins prep work on this individual for potential Medevac.
- Med sensor placed on victim and telemetry feed given to Medevac, which has just arrived, in addition to Tier 1 hospital designated by Medevac team.
- Victim is moved to triage location

While this is transpiring, someone claiming to be the parent of one of victims arrives on scene and begins obstructing EMS and Fire personnel. Two fire personnel are redirected to keep the parent away from the scene. It is not known if any of the MVA victims are related to the parent.

Media personnel arrive on foot—bypassing barricades—and begin taking pictures. The press tries to get comments from the fire personnel, but they follow National Incident Management System (NIMS) protocol and do not respond, or they tell the press to talk with the chief and give no other comments.

Additionally, some onlookers have come onto the scene. None are in the way.

At the triage location, the EMS coordinator requests an additional Medevac unit, because of the severity of injuries to two victims. However, the EMS coordinator is informed that this is not possible, because other potential assets already are engaged with another incident. As a result, only one victim can be transported via Medevac at this time.

Using his BWC, the EMS coordinator talks with staff at the receiving hospital, which is getting medical telemetry feeds on both severe patients. It is decided to Medevac the victim from passenger car 1, based on vital signs.

The EMS coordinator informs the chief via his BWC that one patient is being moved to the Medevac landing zone and the other is going to the local hospital via ambulance. Both victims are loaded into ambulances using the rescue personnel from first-due rescue, which arrived later on scene. One ambulance proceeds to the LZ while the other ambulance goes to the local hospital.

The Fire Police manning the LZ are informed on their BWC, as well as Medevac, that a victim is now en route to their location.

The electrocution patients' telemetry feed—as well as the Medevac's estimated time of arrival—are sent to the hospital trauma center.

While this is transpiring, a brush fire breaks out near vehicle 2 as a result of smoldering grass due to the downed power lines. The Door and Chauffer Assist man the precautionary line from third-due rescue. The line is charged, and team members don their SCBA masks. Water is placed on the fire, and it is extinguished.

Immediately after the fire is extinguished, third-due rescue and EMS approach passenger vehicle 2. They take the following steps:

- Verbal communication is achieved with driver and passenger
- Occupants are frantic and cannot open doors, which appear to be jammed
- Doors are checked and will not open
- Occupants are not responding to requests to turn off vehicle
- A third person is noticed in the back of the car and is not moving
- The vehicle is stabilized, and this is reported to chief
- Vehicle identification (scanning VIN remotely)
- Vehicle is identified as a hybrid car
- Vehicle schematics and extrication plan are displayed on BWC

- Master cutoff is in trunk of car identified by the schematic,
- The trunk is opened, and the master power switch is turned to off
- Air-bag locations identified on the schematic are shown on BWC
- The passenger-door window is breached, and the door is opened
- One passenger begins to flee vehicle and is tackled by Police, who perform field biometric scan using fingerprint and facial recognition. Police confirm that the victim is a wanted suspect with outstanding warrants and is considered armed and dangerous.
- Driver climbs out via the passenger door and says that the person in the backseat has been out since the accident
- EMS gains access to the backseat of vehicle, and a sensor is placed on the victim to gain medical telemetry data
- Using a backboard, the backseat passenger is removed from the vehicle through a back-passenger door
- The medical telemetry and video feed is sent to both the EMS team and the local hospital
- The victim is taken to the triage location, regains consciousness and is taken to local hospital.
- Third-due rescue officer informs chief extrication complete.

Ambulances clear and multiple tow vehicles arrive on scene. Fire continues to command incident and both passenger vehicles are removed. A larger tow truck arrives later and rights the propane truck. During the righting of the LP truck, both fire Teams 1 and 2 are in ready position.

The chief delivers the all-clear signal to dispatch by pressing the icon on the ICS screen and verbally confirming this with dispatch. When the all-clear message is given, Police inform residents that it is safe to return.

Dispatch removes priority override of commercial wireless networks.

EMS checks all fire personnel who donned SCBA for rehab and all are cleared.

Fire and EMS apparatus exit the location. The chief verifies that all personnel responding the incident have been accounted for. This is done by updating the personnel in each apparatus and confirming that the two arriving firefighters are reporting to the station, as well using the location-awareness capability on the BWCs.

Roads are reopened and all personnel report back to their stations.

Summary

In the scenario described, a host of communication enhancements were identified with the purpose of improving situational awareness, as well as assisting in the preservation of life and property. We saw that fire or other first-response apparatus can operate as a cell site or standalone network using LTE. They used video and real-time telemetry, including tracking of assets and personnel for incident command and control, with the use of LTE and body-worn computer systems. These are similar to standard smartphones, but they are integrated in PPE and are Class 1 Division 1 devices.

Automatic capacity management for the wireless system was also discussed, using a tiered priority scheme within the public-safety network. The concept of using the commercial wireless networks to assist in capacity overload of the public-safety network following a tiered priority scheme to handle localized area also was advanced.

The first-responder community needs a standard set of applications for uniformity and function. Most of the applications discussed in the scenario put forth are either available today or can be implemented with existing technology. For example, BWCs are becoming more prevalent, leading to their adoption within the first-responder community.

A variety of applications and functions can—and will be—enabled by the public-safety LTE Network, resulting in a truly integrated response. The following applications and functions were covered in the scenario. A single asterisk has been placed next to the items that are not currently available but could be.

1. **Incident Commands (Fire Chief)**
   - Maintain situation awareness (Incident, Personnel, Apparatus, etc.)
   - Location awareness of all personnel (1-meter resolution) *
   - Access to preplan data in a visual format, linked to dispatch
   - Allocate and reallocate recourses as needed
   - Communicate with other agencies (mutual aid)
   - Hazmat information
   - Send alerts to all or selected members in incident area
   - Obtain news-footage feeds (not discussed)
   - Prioritize and or reprioritize communication assets*
   - Video feeds (streaming and Clips)
   - EOC/911center status updates (automatic and user selected) *
2. **Fire Personnel**
   - Situation awareness
   - Provide/Obtain real-time information, if needed, about mission in incident area (video and voice) *
   - Fellow firefighter video feeds*
   - Chemical interaction information (not discussed)
   - Location of self and team members*
   - Biometric data
   - Sensor data (personal and telemetry source)
   - Motor vehicle data (including barcode or VIN reading)
3. **EMS**
   - Situation awareness
   - Provide/Obtain real-time information, if needed, about mission in incident area (video and voice) *
   - Location of self and team members*
   - Biometric data
   - Sensor data (personal and telemetry source)
   - Telemetry and video feeds to and from hospital/trauma centers (HIPAA Compliant) *

4. **Police**
   - Situation awareness
   - Provide/obtain real-time information about mission in incident area
   - Location of self and team members *
   - Criminal database access
   - Facial recognition
   - Fingerprint scanning
   - DMV records
5. **DPW**
   - Obtain/provide real-time information about mission in incident area*
   - Obtain instructions for incident commander (non voice) *
6. **Public Utilities (Electric)**
   - Coordinate response with incident commander*
   - Provide/obtain real-time information about mission in incident area*
7. **Commercial Wireless Networks**
   - Capacity offloading of the Public Safety system for peak demand in a localized area. *

In summary, the new LTE communication network can and will greatly improve response effectiveness by first responders. To take full advantage of the new LTE communication system, it is recommended that various standard operating guidelines used by first responders need to be enhanced, so this broadband network can be utilized to its fullest potential.

Clint Smith is a solutions-focused Senior Technology Executive with success wireless telecom and engineering management. His broad areas of expertise include product development, technology management, software design, innovation, due diligence, mobile devices, budgeting, and tech company start-ups.

His recent technical focus has been on cybersecurity for 5G wireless and IoT devices.

Presently he has earned over 145 patents with more than 125 additional patents applied for. He is also the author of 9 wireless engineering books published by McGraw-Hill.

Clint holds a Bachelor of Engineering from Stevens Institute of Technology (SIT) and an MBA from Fairleigh Dickson University. He is a licensed professional engineer in NY and NJ. and has also been an Adjunct Professor at SIT since 2002. He is a Board Member with Rivada Networks and a non-profit WVRG. He is also an active Volunteer Firefighter.

www.nextgconnect.com

Acknowledgements:

This paper would not have been possible without the help and guidance from two of my Officers at the Pine Island Fire Department (PIFD) in Pine Island, N.Y.—PIFD Training Officer Fred Hroncich and PIFD Chief Pete O'Connor. As well as some keen editing by Donny Jackson.

I trust that you found this article useful.

Clint Smith, P.E.
Next G Connect
CTO
csmith@nextgconnect.com

Who we are:

NGC is a consulting team of highly skilled and experienced professionals. Our background is in wireless communications for both the commercial and public safety sectors. The team has led deployment and operations spanning decades in the wireless technology. We have designed software and hardware for both network infrastructure and edge devices from concept to POC/FOA. Our current areas of focus include 4G/5G, IoT and security.

The team has collectively been granted over 160 patents in the wireless communication space during their careers. We have also written multiple books used extensively in the industry on wireless technology and published by McGraw-Hill.

Feel free to utilize this information in any presentation or article with the simple request you reference its origin.

If you see something that should be added, changed or simply want to talk about your potential needs please contact us at info@nextgconnect.com or call us at 1.845.987.1787.