February 13, 2013

WORKING GROUP 10
Final Report
9-1-1 Prioritization

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1 Results in Brief

1.1 Executive Summary

Over the past decade the telecommunications industry has seen unprecedented growth, and as our ability to communicate as a society has evolved, so has the opportunity to enhance the public's ability to contact emergency services personnel during times of crisis.

According to CTIA- the Wireless Association, the number of wireless subscriber connections has increased from 48.7 million in June 1997 to 321.7 million as of June 2012. This equates to over 101% of total US and territorial population (Puerto Rico, Guam, and the US Virgin islands) based on the number of active wireless units divided by the total population.

With this growth, the public's expectation has grown such that the average consumer assumes it can reach public safety personnel wherever they are, and that they will be able to dispatch the appropriate emergency services on any reported event, and be able to locate them based on the technology available today. This capability is dependent upon public safety receiving the 9-1-1 calls and the best possible location information available to them. Challenges arise during emergencies and disasters that may cause congestion to the networks involved in delivering calls to 9-1-1.

Working Group 10 (WG10) was chartered with:

1. **Exploring ways to ensure that 9-1-1 is available when emergencies or disasters cause a surge in mobile network use including considerations of how 9-1-1 traffic might be prioritized in such situations noting operational issues for providers as well as ways for PSAPs to address operational issues**.

Within the scope of the charter WG10 defines unique aspects of emergency/disaster scenarios and the impact on both wireless and wire line traffic. In each of the subsections within Section 5 Emergency/Disaster Scenario Classification, WG10 classify the disaster scenario as widespread or focused, the degree of damage, as well was whether or not there is any capability to provide advanced notice to the public. Each of these variables is important to consider when evaluating the benefits of 9-1-1 prioritization and whether prioritization will benefit the ability for the public to reach emergency service personnel during the specific scenario.

As a background for the WG10 we gathered and reviewed current network architectures to gain an understanding of the actual call paths for wireline and wireless call flows, these diagrams and discussion highlights are contained within Section 4 on Background.

Additionally within the scope WG10 provides documented research published by the Public Safety and Homeland security Bureau in September 2011 that separate PSAPs into categories based on such factors as the number of busy signals and abandoned call ratios are used as indicators to help insure that all calls to 9-1-1 are being answered "on average" within the standards set by the PSAP. Overall the majority, 80% of PSAPs fall within the 'small' PSAP category with one to five call taker positions. Some larger urban PSAP's may have additional telephone positions that can be staffed during large-scale emergencies, but they account for the

remaining 20%, with only 1 % having 50 or more call taker positions. Again, in a major disaster situation, these facilities may be used to handle overflow calls from the 9-1-1 center. But these large urban area options are the exceptions rather than the rule for the majority of the PSAPs around the country. Even where additional call takers can be quickly added, there is still no guarantee that all calls to 9-1-1 can or will be answered. While the anticipated large scale event will provide the PSAP with the opportunity to maximize staffing, rarely will staffing alone be sufficient to meet demands for service.

There has and continues to be discussions about the need and value of "Call Prioritization" to 9-1-1 facilities when networks are overloaded and congested. Most people would agree that emergency calls to 9-1-1 should have priority over non-emergency calls, but the question that remains; will the PSAP have the staff to answer the calls?

It is important to recognize that in today's technological environment the PSAP has a finite number of 9-1-1 call taker positions, and depending on the scale and magnitude of the event some calls may simply not be answered.

2. **Consider ways to reduce traffic load during emergencies, such as encouragement of use of 9-1-1 texts as a lower throughput alternative to 9-1-1 voice.**

WG10 researched and reviewed multiple scenarios which could provide an offload or reduced traffic to the 9-1-1 systems during emergency or disaster events, although not all scenarios may have implemented solutions nationally. WG10 reviews with Section 6; Public Safety Operational Impacts and Considerations, the PSAP environments today, and includes highlights from discussion surrounding the use of PSAP virtual consolidations, virtual call takers, automated pre-plans, texting to 9-1-1, use of social media.

3. **In consideration of arrangements that may give 9-1-1 calls higher priority than most consumer wireless calls, the WG may consider how to coordinate 9-1-1 priority with other priority calling arrangements, including Wireless Priority Service (WPS), and other arrangements that may provide priority for calls for emergency and first responders.**

WG10 provides overviews of existing priority services such as GETS, WPS, NGN-PS, and CMAS with Section 7: Prioritization Services Currently Available.

4. **Address implementations in 4G and earlier generation wireless networks; and will consider both E9-1-1 and NG9-1-1 implementations**.

Considerations for 4G Networks (LTE) and Next Generation 9-1-1 (NG9-1-1) implementations may accommodate increased ability to prioritize 9-1-1 calls into the networks; these technologies are still in their early stages of development and implementations and have been reviewed within several sections for future considerations.

WG10 final analysis, conclusions and recommendations are found within Section 8.

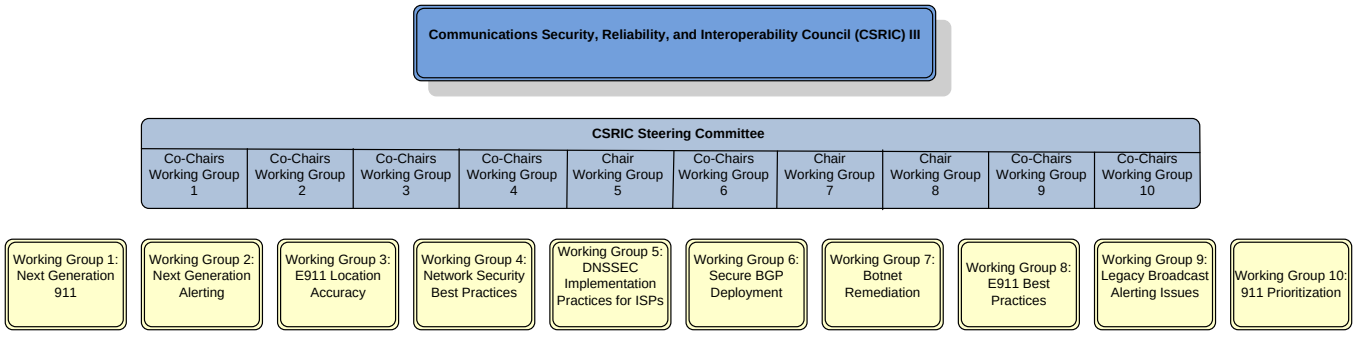
2 Introduction

This final report documents the efforts undertaken by the Communications, Security, Reliability, and Interoperability Council (CSRIC) III Working Group 10 with respect to prioritization. During times of crisis, it is critically important that the public should be able to contact emergency services personnel with a high degree of certainty. In many recent weather related emergencies as well as natural disasters such as earthquakes there was a significant surge in mobile and land line network use. In these extreme events, the surge of network usage can make it difficult to reach emergency personnel.

Working Group 10 (WG10) was chartered with:

1. Exploring ways to ensure that 9-1-1 is available when emergencies or disasters cause a surge in mobile network use including considerations of how 9-1-1 traffic might be prioritized in such situations noting operational issues for providers as well as ways for PSAPs to address operational issues.
2. Consider ways to reduce traffic load during emergencies, such as encouragement of use of 911 text as a lower throughput alternative to 911 voice.
3. In consideration of arrangements that may give 911 calls higher priority than most consumer wireless calls, the WG may consider how to coordinate 911 priority with other priority calling arrangements, including Wireless Priority Service (WPS), and other arrangements that may provide priority for calls for emergency and first responders.
4. Address implementations in 4G and earlier generation wireless networks; and will consider both E911 and NG911 implementations.

2.1 *CSRIC Structure*



2.2 *Working Group 13 Team Members*

Working Group 10 Co-Chairs

Jeanna M Green – Sprint
Thera Bradshaw – TKC Consulting

Working Group consists of the members listed below:

Name	Company
Jeanna Green	Sprint
Thera Bradshaw	TKC Consulting
Charles Cullen	Palo Alto Police Department
Chris Fisher	North East King County Regional Public Safety Communication Agency
William Hinkle	Intrado
Carl Klein	CenturyLink
Joseph Marx	AT&T
Ron Mathis	Intrado
Peter Musgrove	ATIS (employed @ AT&T)
Lawrence Rybar	Verizon
Ray Singh	Applied Communication Sciences
Jim Winegarden	CenturyLink
Kathryn Martin	Access Partnership

Table 1 - List of Working Group Members

3 Objective, Scope, and Methodology

3.1 *Objective*

This document address the deliverables outlined in the CSRIC III charter for Working Group 10; 9-1-1 Prioritization.

The working group shall explore ways to ensure that 9-1-1 is available when emergencies or disasters cause a surge in mobile network use. The work will include considerations of how 9-1-1 traffic might be prioritized in such situations. It also includes related operational issues, including ways for PSAPs to address operational issues.

The WG may consider ways to reduce traffic load during emergencies, such as encouragement of use of 911 texts as a lower throughput alternative to 911 voice calls. If the WG pursues arrangements that give 911 calls higher priority than most consumer wireless calls, the WG may consider how to coordinate 911 priorities with other priority calling arrangements, including Wireless Priority Service (WPS), and other arrangements that may provide priority for calls for emergency and first responders. The WG will address implementations in 4G and earlier generation wireless networks; and will consider both E911 and NG911 implementations.

3.2 **Scope**

This document address the deliverable outlined in CSRIC III WG 10:

1) The Working Group will define/categorize different types of emergency & disaster calls,
2) Public Safety Operational Impacts and Considerations,
3) Report what is being utilized with the network architectures for prioritization today,
4) Reliability & Resiliency within today's networks and the varying congestion points within the call flow.
5) Technological advancements and impacts of Long Term Evolution (LTE) and Next Generation 9-1-1 (NG911)
6) Consumer education

3.3 Operational Procedures

Working Group 10 attempted to meet every other week via conference call(s) to review research and discuss 9-1-1 prioritization. The working group relied on its members volunteering to provide contributions and participating weekly to determine and define the scope, recommendations, and draft the final report. This effort was challenging given the size of the working group, and responsibilities that each member faced in his/her public, private and professional endeavors.

4 Background

4.1 Current Network Architectures

This section looks at the various points in the wireless network that would have to be modified to support prioritization for '9-1-1' traffic during congestion events (hurricanes, earthquakes, tornados, etc.).

4.1.1 Simplified View of 911 Network

Figure 1 below provides a simplified view of the interconnection between wireless and wireline networks and the PSAP that show the natural chokepoint that exists in the current '911' networks. For any individual PSAP, there are normally a number of wireless providers, wire line providers, and VoIP providers that will have traffic destined for the PSAP. Since PSAPs staffing is normally engineered based on average call volume, they limit the incoming trunks at the PSAP to match the staffing levels. In the simple example, there are 2 incoming trunks to the PSAP and each of the wireless and wire line carriers have 2 incoming trunks to the selective router. It is easy to see that during most extreme congestion events, the trunks to the PSAP will fill up very quickly and therefore all new calls delivered over idle trunks from any of the mobile or landline switches would result in some form treatment (e.g., fast busy) to the caller, or alternate routing to another PSAP. The inability of the originating traffic to reach the PSAP will not improve by prioritizing traffic if there is not enough capacity in the PSAP.

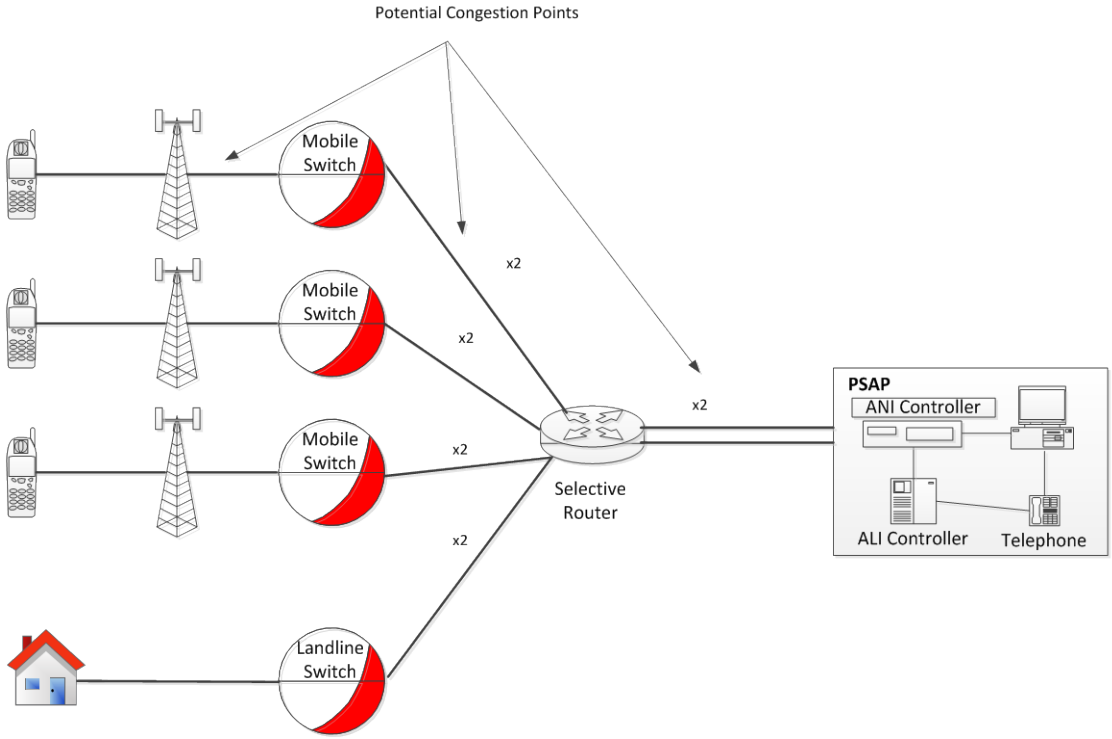


Figure 1: Simplified Network View

4.1.2 **High Level Wireless 911 Architecture**

Figure 2 depicts a high level architecture view of the wireless 911 architecture including the various interfaces to deliver a 911 call to the PSAP. In the following sections, changes required support prioritization of 911 calls for each of these interfaces will be discussed.

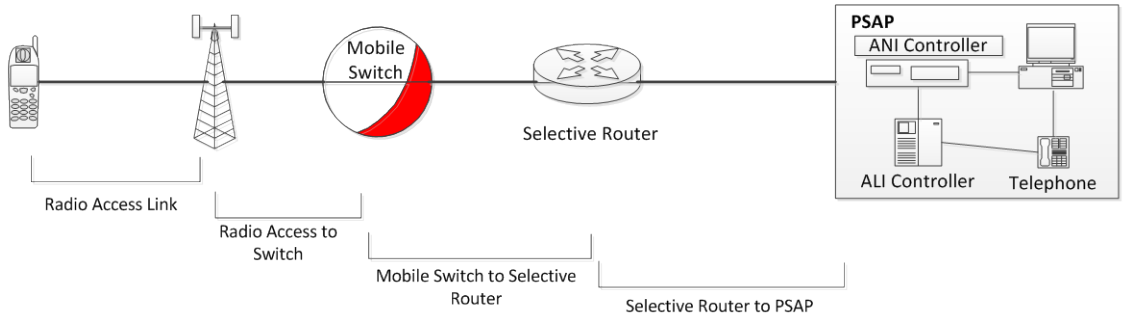


Figure 2: High Level Wireless 911 Architecture

4.1.2.1 Radio Access Link (Handset to Cell Tower)

4.1.2.1.1 2G and 3G Networks

The Radio Access link between the handset and the cell tower is the most challenging interface in the network to change in order to support prioritization of ‘911’ calls. The most widely used

protocols on the radio network do not directly support prioritizations for '911' calls and changing this interface would likely impact existing handsets, which would not be feasible. Therefore on the most widely used networks, an alternative mechanism would be required to signal a priority for '911' calls during congestion.

One alternative mechanism that has been suggested is the reservation mechanism currently used for Wireless Priority Services (WPS), which is currently used by government agencies to obtain priority on wireless networks. WPS is currently a limited service available to a limited subset of subscribers with appropriate authorization. If '911' calls were given priority, then consideration would need to be given as to the relative priority of '911' calls versus WPS calls. Since you are also dealing with a virtually unlimited number of people with the ability to dial '911', there would be contention between access to the reservation queue. There was a significant training effort associated with WPS since you don't immediately get access to a voice channel so the same would be required for '911' calls. The result would likely be confusion for the caller during a very stressful event, resulting in many callers attempting to redial '911' further compounding the usage on the network with the result being that neither WPS users nor '911' callers have access to the network.

Another alternative discussed with prioritization is a reservation system with an associated capacity reserve for '911' calls. This makes very little sense in highly loaded networks since reserved capacity goes unused and is needed to satisfy current demand.
Finally, the need to reserve voice channel capacity in the cell site does little to solve the problem of reaching a '911' operator during a critical emergency if the PSAP is overloaded.

4.1.2.1.2 4G Networks (LTE)

The radio link protocol used for LTE currently provides a mechanism to communicate priority for packet access (as LTE is a packet based network). For example in LTE, Access Class Barring provides a priority to 911. Also, 911 may be assigned a higher ARP to improve call admission. Since the LTE networks are still in an early stage of development, these changes could probably be accommodated but as mentioned in the previous section, it would provide little to no value to prioritize '911' calls on the radio link if end to end priority isn't addressed (including the staffing at the PSAPs to answer prioritized 911 calls).

However, it is conceivable that prioritization of 9-1-1 on LTE networks could be achieved to communicate the priority initiation. This model is similar to the upgrade to Phase II Wireless E9-1-1 that occurred in the early 00s.

4.1.2.2 Radio Access to Switch (Cell Tower to Wireless Switching Network)

With the advent of high speed wireless broadband communication, most of the backhaul between the cell towers to switches has been upgraded to support this data. Therefore, it is unlikely that this would be a bottleneck in the network to delivering priority for '911' calls. In sites where existing backhaul is insufficient, then additional capacity would be required to support prioritized 911 calls**.**

4.1.2.3 Mobile Switch to Selective Router

In order for Wireless 911 Prioritization to have any value, the natural chokepoints in the network

between the originating carriers and selective router would need to be removed. As was highlighted in the PSAP Prioritization section – PSAP Staffing is based on average call volume and overwhelming majority of PSAPs have 2 to 4 call takers. Therefore, if you remove the chokepoint between the originating network and the selective router, then the congestion will occur in the trunks going toward the PSAP still resulting in the treatment (fast busy or alternate routing).

NG911 broadband solutions will ultimately eliminate the legacy selective routers and analog trunk lines into the PSAP and increase 911 capacity as well as the types of data that can be transmitted to the PSAP. These changes will have an operational impact on the PSAPs.

4.1.2.4 Mobile Switching Network

In addition to prioritization in the radio network, it is likely development would be needed to carry priority through the mobile switch between the origination and selection of the outgoing trunk. This would likely be proprietary development from each of the switch vendors to support this priority treatment.

It is unlikely that anything could be developed for legacy switches since the focus of manufacturers is clearly on next generation LTE Networks.

4.1.2.5 Selective Router to PSAP

Again as depicted in Figure 1, the legacy selective routers have been designed to provide a natural chokepoint to protect the PSAPs from overload. If you wanted to add priority into the network for Wireless 911 calls, then additional capacity (additional trunks) would be required from the wireless switches from all carriers to the selective router. Many of the legacy selective routers are shared local exchange offices and adding a significant number of addition trunks may push them over the edge from a capacity perspective. One solution would be to purchase bigger switches but that would be enormously expensive.

In addition to the trunk capacity, it is likely that proprietary development would be required to prioritize the incoming ‘911’ calls over other traffic through the selective router. This is similar to what would need to be done at wireless switches, but given the age of many selective routers this may be a very expensive development.

Finally, if capacity at the PSAP for both staffing and trunking is not expanded to match the capacity from all 911 calls during extreme congestion, all the effort would be a waste since you would have prioritized ‘911’ calls to be given busy treatment.

5 Emergency/Disaster Scenario Classification

In this section, we attempted to classify some of the unique aspects of emergency/disaster scenarios and the impact on both wireless and wire line traffic. In each of the subsections below, we classify the disaster scenario as widespread or focused, the degree of damage, as well was whether or not there is any capability to provide advanced notice to the public. Each of these variables is important to consider when evaluating the benefits of 9-1-1 prioritization and

whether prioritization will benefit the ability for the public to reach emergency service personnel during the specific scenario.

5.1.1 Widespread/Major Damage/Advanced Warning (Hurricanes)

These types of emergency scenarios cover large geographic areas and may result in a significant increase in the amount of emergency traffic to PSAPs. The emergency call traffic will most likely be spread over the entire area as damage is widespread. During the event normal call volumes would be expected on wire line unless there is some damage to the infrastructure of power grid. There is a recent, somewhat surprising trend with power outages that results in increased volumes in wireless calls to report power outages and check the status of repairs on smart phones.

These types of incidents may also allow for advanced planning and emergency personnel have an opportunity to direct the public how to react during the incident including non-emergency reporting and requiring evacuation for areas expected to be hardest hit.

5.1.2 Widespread/Major Damage/No Warning (Earthquakes)

These types of emergency scenarios cover large geographic areas and may result in a significant increase in the amount of emergency traffic to PSAPs. The emergency call traffic will most likely be spread over the entire area as damage is widespread. In addition, call volumes spike on both wireless and wire line networks with significant overload. The overload conditions may last for a long time as people attempt to get status on friends and relatives. These types of incidents occur without any advanced notice and in the time immediately following the event results in mass confusion. This is especially true in areas not experienced with earthquakes (East Coast Earthquake of 2011). There may be wide spread calling from the public to confirm what happened and what people are expected to do.

5.1.3 More Focused Events/Major Damage/No Warning or Minimal Warning (Tornados, Derechos, Bridge collapses, Railroad derailment with Hazardous Materials)

These types of emergency scenarios usually affect smaller geographic areas although in the case of weather events may be fast moving and still cover very large areas over time. The emergency call traffic tends to be more focused as reports come in immediately following the incident but may continue for some time as more damage is discovered or more people need assistance. As with the other weather related incidents, if power is lost then traffic tends to rise precipitously on wireless networks to report outages and check the status of repairs. In the case of a hazardous material spill, the local law enforcement may request an evacuation of a specific area which could lead to additional confusion and more calls to emergency personnel.

5.1.4 More Focused Events/ No Warning (Terrorist Attacks, Mass shooting event)

This covers a broad category of types of attacks from domestic terrorists (University of VA or

Fort Bragg shootings) to the September 11 Terrorist Attacks. They may or may not involve damage but they share a common characteristic of widespread confusion. There is a significant increase in amount of emergency traffic and depending on the size of the event could easily cause overloads for normal traffic on both wire line and wireless networks. This increased traffic could be the result of checking on the status of friends and family in the affected area.

5.1.5 Very Focused Events/ Minor Damage/ No Warning (Automobile Accident, Building Fire)

This category is probably the most common and involves a major auto accident or fire with injuries in a highly traveled area. The resulting influx of calls can be very high until emergency personnel arrive at the scene and have a very visible presence. Although the initial event may be fairly short, the amount of emergency traffic can be very large and can overwhelm the PSAP. As people begin reporting the same incident, the PSAP can quickly shed traffic through manual or automated methods depending on the sophistication of the PSAP equipment.

5.2 *Value of Emergency Calling Prioritization*

In each of these scenarios, emergency call prioritization does very little to improve the likely-hood of originating '911' calls reaching the PSAP as the bottleneck in most cases tends to be at the PSAP. The perfect scenario for emergency call prioritization to have value is the case where normal traffic spikes but emergency traffic remains flat or drops. This would not be the case for emergency or disaster scenarios where calls to PSAP increase dramatically.

6 Public Safety Operational Impacts and Considerations

This provides a general overview of how 9-1-1 calls are currently managed and prioritized when they are delivered to the PSAP during events that create high levels of demand and congestion. This paper also offers thoughts and observations about how the next generation of 9-1-1 technology might provide new opportunities to improve the availability and reliability of access to emergency services during a peak demands for service.

There are 2 categories that might meet this criterion, (a) unanticipated events, such as acts of terrorism, and (b) anticipated events where the PSAP has been pre-warned and has time to prepare for a large-scale event such as a tornado warning.

It is important to note that as a general rule, PSAP staffing is based on an average call volume formula that determines the number of 9-1-1 telephone positions necessary to meet average or normal demands for service in a responsible manner.

The following are categories defined in a white paper; "A Next Generation 911 Cost Study: A Basis for Public Funding Essential to Bringing a Nationwide Next Generation 911 Network to America's Communications Users and First Responders" published by the Public Safety and Homeland security Bureau in September 2011.

Large PSAPs

• Large PSAPs have 50 or more call taker positions; approximately 1% of all PSAPs fall into this category.

Medium PSAPs

• Medium PSAPs are characterized as having between 6 and 49 call taker positions; approximately 19% of all PSAPs fall into this category.

Small PSAPs

• Small PSAPs have between one and five positions; approximately 80% of PSAPs are in this category.

Factors such as the number of busy signals and abandoned call ratios are used as indicators to help insure that all calls to 9-1-1 are being answered "on average" within the standards set by the PSAP. Some larger urban PSAP's may have additional telephone positions that can be staffed during large-scale emergencies. Some may even have fully functional back-up facilities that can be activated and staffed. Some large urban PSAP's may also utilize 3-1-1 non-emergency call centers to reduce loading on the 9-1-1 system. Again, in a major disaster situation, these facilities may be used to handle overflow calls from the 9-1-1 center. But these large urban area options are the exceptions rather than the rule for the majority of the PSAPs around the country. Even where additional call takers can be quickly added, there is still no guarantee that all calls to 9-1-1 can or will be answered. While the anticipated large scale event will provide the PSAP with the opportunity to maximize staffing, rarely will staffing alone be sufficient to meet demands for service.

There has and continues to be discussion about the need and value of "Call Prioritization" to 9-1-1 facilities when networks are overloaded and congested. Most people would agree that emergency calls to 9-1-1 should have priority over non-emergency calls, but the question that remains; will the PSAP have the staff to answer the calls? Generally speaking it would seem that large urban PSAPs that have the ability and resources to quickly activate and staff additional 9-1-1 positions, would benefit the most from 9-1-1 call prioritization. The systems that lack this ability may simply experience additional calls that could go unanswered until they can implement back-up plans to deal with the larger than normal call volumes. It is important to recognize that in today's technological environment the PSAP has a finite number of 9-1-1 call taker positions, and depending on the scale and magnitude of the event some calls may simply not be answered. It would seem that given any PSAPs limitations at the onset of a large scale disaster, where there is a high potential for a multi-casualty event, it may be necessary for the PSAP to prioritize emergencies into life-threatening and non life-threatening categories.

6.1 *PSAPs Today*

In most states, all PSAPs must have a back-up plan to re-route 9-1-1 calls to another PSAP in the event of a system failure. Back-up plans of this nature are required to ensure that emergency 9-1-1 calls are routed to another PSAP in the event of a technology or equipment malfunction. Normally these transfers occur automatically when the system detects a disruption or an inability to complete a call to the PSAP. The automatic transfer of 9-1-1 calls to another PSAP, under these plans, may also occur when the primary PSAP's system is overloaded.

Typically, when a PSAP is operating in an emergency overload mode, 9-1-1 call-takers often begin to abbreviate the call answering process by simply stating "9-1-1 what is your

emergency?" Call-takers will attempt to accelerate the call answering process by rapidly triaging calls in order to get to new or real emergencies. Triaging means that calls are quickly answered, and duplicate and non-emergency calls are terminated. Other potential actions to help reduce call loading on the 9-1-1 system could include issuing a media release requesting that the public only call 9-1-1 if they have a life-threatening emergency. They may also direct or transfers calls to a 3-1-1 system or establish and publicize non-emergency telephone numbers. For a localized disaster, a mobile communications command vehicle may be sent to the scene to help coordinate rescue and recovery operations. But, unless the PSAP has been damaged or evacuated, this is normally done to reduce and coordinate radio traffic and not calls to 9-1-1.

6.2 *PSAPs Tomorrow*

In the PSAPs of tomorrow, IP based Next Generation 9-1-1 (NG9-1-1) systems will have considerably more technical and operational flexibility. PSAPs will have the ability to create more comprehensive pre-plans, where call flow and volume can be more effectively managed. Potential duplicate calls originating from the same localized area (event) could be automatically intercepted and transferred to a recorded message or funneled to designated telephone positions, thus freeing up telephone lines for other emergencies in non-affected areas.
Perhaps the most forward thinking and innovative opportunities for the PSAPs of the tomorrow will be the ability to create "virtual" PSAP's. Whether we are talking about virtual consolidation, virtual call handling, or virtual pre-plans for everyday management of 9-1-1 call disruption or call overflow, the Next Generation of 9-1-1 technology will support new creative opportunities to improve access to emergency communication services.

6.2.1 Virtual Consolidation

To realize the full cost savings of traditional PSAP consolidation initiatives, all personnel and equipment are physically consolidated in one central communication facility. Larger PSAPs may maintain an unstaffed back-up facility, while smaller centers will transfer calls to another predetermined backup PSAP. Oftentimes the idea of consolidation, eliminating some PSAPs has been politically objectionable, often resulting in little or no progress. In the future Virtual Consolidation could provide a less radical alternative to physical consolidation. While the need to modernize equipment and technology are often times the catalyst for plans to consolidate 9-1-1 systems, the immediate and long-term savings usually result from reductions in human resources through improved efficiency. Typically, government officials are more likely to fund the capital cost of equipment, over the forever increasing cost of additional personnel. However, in a NG 9-1-1 world, where there is a strong interest in preserving local government control over the 9-1-1 call handling process, there will be new alternatives. For example, if a county is fully staffing 5 PSAPs and they want to improve 9-1-1 call handling service during high demand without increasing staffing, they can create a virtual consolidated system by using technology to automatically and transparently route emergency 9-1-1 calls to the next available call-taker in one of the other PSAP's.

There are two important technology layers that must be compatible for this system to work properly, the network and application layers. Participating PSAPs would need

to be on a shared high-speed network. In addition all of the virtual PSAPs would need to use a common Computer Aided Dispatch (CAD) System or exchange data via a CAD2CAD interoperability broker. Under this system, the call-taker in PSAP (B) receiving the overflow call from PSAP (A) would simply enter the detail/event information into the CAD system and the information would appear on the appropriate dispatch position back in PSAP (A).

6.2.2 Virtual 9-1-1 Call-Takers

To begin to realize a scenario where the concept of using technology to create Virtual 9-1-1 call-takers, one need only imagine the effects of a deadly pandemic on a metropolitan area. In these scenarios first responders and other emergency personnel are not immune from exposure. And where "shelter-in-place" orders are issued, how many emergency service providers will realistically risk exposing themselves or their families to a deadly contaminate by going to the workplace? Consider the possibility of using technology to route 9-1-1 calls to a cache of dedicated pre-programmed laptop computers that would permit 9-1-1 calls takers to receive and transfer calls to other dedicated computers that could dispatch units over portable radios from their home or other safe locations.

6.2.3 Automated Pre-Plans

A system where calls to 9-1-1 are automatically pre-staged to be routed to another or multiple call centers until additional telephone positions can be activated by the impacted jurisdiction. These plans may also include mobile communications vehicles equipped with call-taker positions, Telecommunication Emergency Reponse Team ("TERT"), Cell On Wheels ("COW"), and other supplemental resources and technologies that can help insure that emergency calls to 9-1-1 can be answered and processed.

6.2.4 Texting to 9-1-1

Persons with speech and hearing limitations will continue to rely on texting as their primary means to access emergency services. As new text to 9-1-1 solutions evolve to improve delivery and accuracy, the general public's reliance on text will increase correspondingly. Text reports to 9-1-1 can be handled by dedicated personnel whose responsibilities are limited to entering and prioritizing the reports into a computer-aided dispatch (CAD) system.

6.3 *Public Education & Notification Systems -*

The national warning system should always include a statement that people should not call 9-1-1 with non-threatening emergencies. It is recognized that all of these opportunities will present a number of operational, technological, and financial challenges, but so did the idea of calling 9-1-1 from a wireless telephone device a relatively short time ago.

The non-emergency number 3-1-1 is a special N-1-1 telephone number available for the public in many communities throughout the United States. 3-1-1 provides quick easy to remember

access to non-emergency governmental services. 3-1-1 can be reached through the web site of the government entity for self service or by calling 3-1-1 to reach an ambassador in the Citizen Service Center. 3-1-1 allows the public to obtain important non-emergency services quickly and effectively.
3-1-1 is intended in part to divert routine inquiries and non-urgent community concerns from the emergency 9-1-1 number. During times of natural or manmade disasters 3-1-1 access through the web keeps the community informed where there is posting of up to date information keeping the community informed and the lines clear for emergency calls. Additionally, calling 3-1-1 is a valuable resource for reporting non-emergency situations that are not life or property threatening but is information the governmental entity will take action on once the emergency situation stabilizes.
Many cities take 3-1-1 comment through internet or smartphone interfaces. On March 3, 2010, US Federal Chief Information Officer announced the creation of a uniform "Open 3-1-1" API for these services. Online 3-1-1 services such as, "SeeClickFix.com" are available across the United States and can be used to report non-emergency issues (reporting potholes, graffiti and other community issues) in specific locations.
3-1-1 service is generally implemented at a local level. Today 3-1-1 is available in many jurisdictions. Harvard University's web site: www.hks.harvard.edu displays where 3-1-1 is available today by following the link and searching '311".

While the concept and value of 3-1-1 services are being implemented in many large urban areas of the country, the majority of PSAPs are still rural and must rely on other methods to help educate the public and "offload" non-emergency calls to numbers other than 9-1-1. It is quite common for agencies to have a ten digit number for this purpose that is publicized to use for calls that are not an emergency or do not need an emergency response. Having one or two "administrative" or non-emergency numbers available to the public with voicemail so they can be directed to leave a message is quite common and effective. This approach keeps the telecommunicators focused on incoming 9-1-1 calls and helps eliminate trunk overload.

7 Prioritization Services Currently Available

7.1 *GETS, WPS and NGN-PS*

This section provides background information on Government authorized priority services Government Emergency Telecommunications Service (GETS) and Wireless Priority Service (WPS), including the migration of these services to the Next Generation network (NGN) environment. National Security / Emergency Preparedness (NS/EP) Next Generation Network Priority Service (NGN-PS) are intended to preserve and extend GETS and WPS, as Service Providers transition their networks to IP-based packet-switched networks.

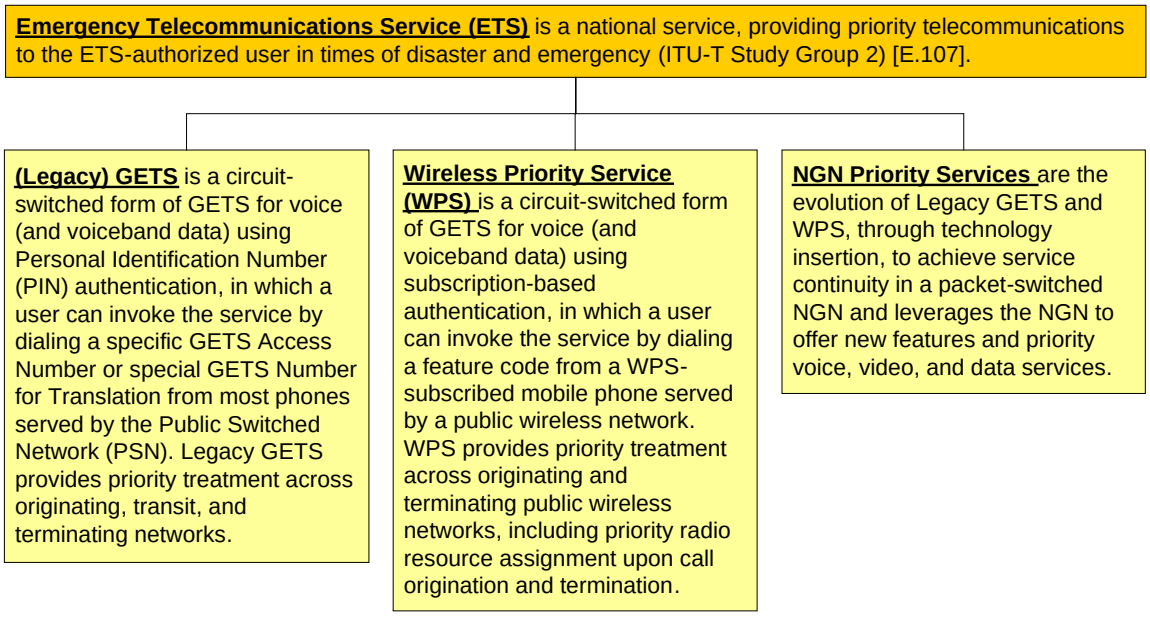


Figure 3 - Relationship of Concepts and Terms for Priority Services

NS/EP NGN Priority Services (NS/EP NGN-PS) is the evolution of GETS and WPS to achieve service continuity in the packet-switched NGN and leverages the NGN to offer new features and priority multimedia services. NS/EP NGN-PS comprise voice, video, and data services that are based on services available from public packet-switched Service Providers and that provide priority treatment in support of National Security and Emergency Preparedness (NS/EP) communications.
NS/EP NGN-PS, Legacy GETS, and WPS are all facets of the U.S.A. instantiation of the international standard for Emergency Telecommunications Service (ETS) [ITU-T E.107]. The relationship of the terms is portrayed in Figure 3.

7.1.1 Government Emergency Telecommunication Service (GETS)

The Government Emergency Telecommunications Service (GETS) is an emergency service designed for use when national security and emergency preparedness (NS/EP) personnel are unable to complete emergency calls through their regular telecommunications means. GETS uses a calling card to provide Federal, State, local government, and industry NS/EP users with a higher probability of call completion during periods of natural or man-made disasters or emergencies that cause congestion or network outages. GETS was implemented in response to Executive Order 12472 issued in 1984. Tariffs for GETS have been accepted by the Federal Communications Commission (FCC) since 1995.

7.1.1.1 How GETS Works

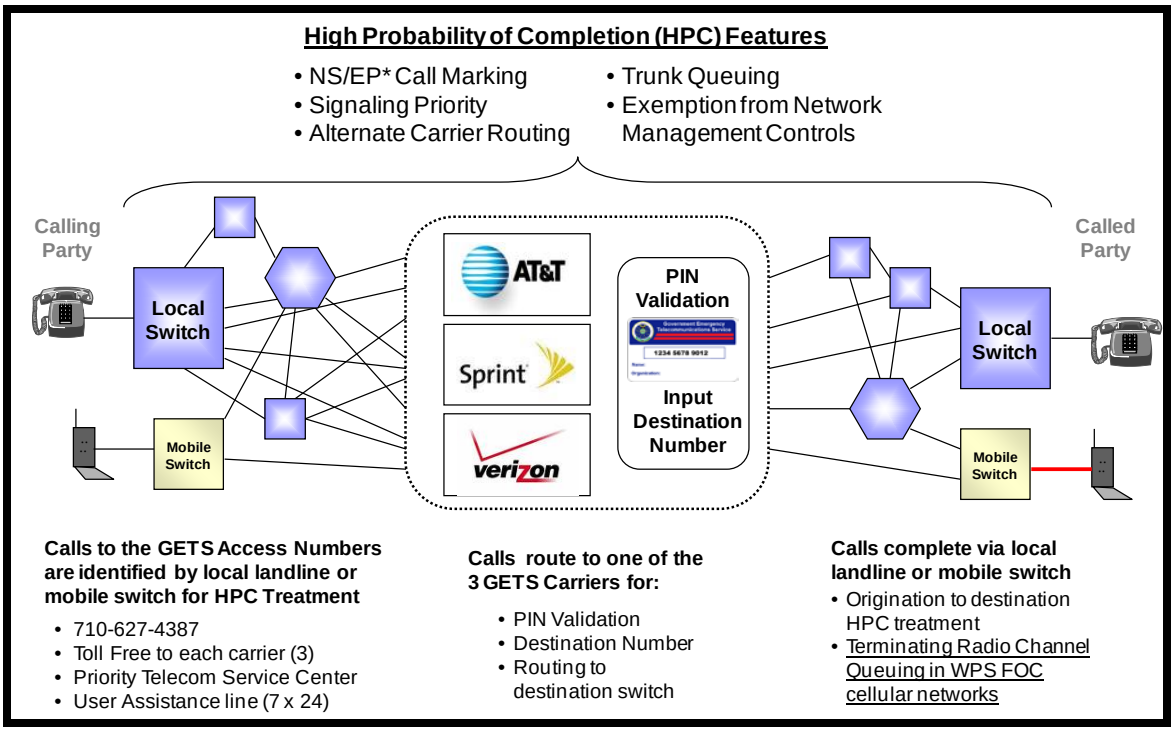


Figure 4 – General Concept of How GETS Works

Authorized GETS calls/sessions are provided with priority treatment over public calls in the network. The priority treatment is provided by High Probability of Completion (HPC) features that include:

- NS/EP Call Marking (i.e., identifying NS/EP call for priority network treatment with applicable protocol identifiers such as SIP Resource Priority Header)
- Signaling Priority (Providing priority to the signaling and control of NS/EP calls/sessions)
- Alternate Carrier Routing (multiple ways to get to long distance service providers) and Enhanced routing alternatives in public networks
- Exemption from Network Management Controls
- Queuing for available circuits during access and egress, including queuing for circuits to Private Branch Exchanges (PBX) during egress.

7.1.2 Wireless Priority Service (WPS)

Wireless Priority Service (WPS) is a priority calling capability that greatly increases the probability of call completion during a national security and emergency preparedness (NS/EP) event while using their cellular phone. To make a WPS call, the user must first have the WPS feature added to their cellular service. Once established, the caller can dial *272 plus the destination telephone number to place an emergency wireless call

.

WPS is based upon, and complies with, the FCC Second Report and Order (R&O) 00-242 (Wireless Telecommunications (WT) Docket No. 96-86) [FCC R&O]. WPS is intended to allow qualified and authorized NS/EP users to obtain priority access to radio traffic channels and Core Network resources during situations when Commercial Mobile Radio Service (CMRS) network congestion is blocking call attempts. The FCC R&O requires that Service Providers adhere to uniform, nationwide operating access procedures.

7.1.2.1 How WPS Works

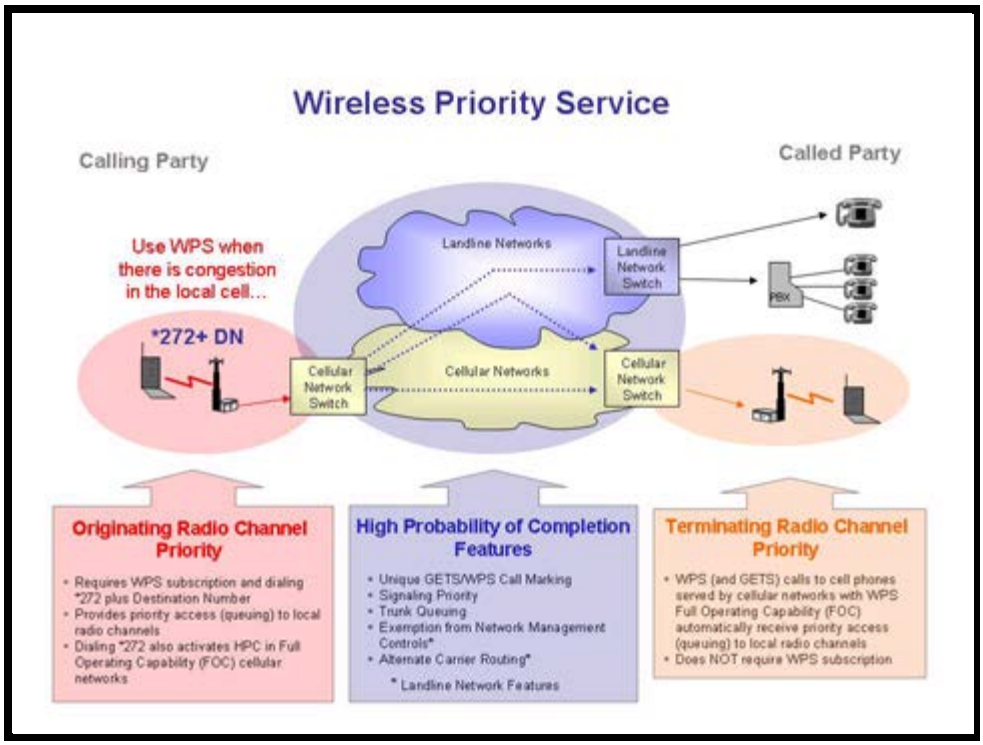


Figure 4 – General Concept of How WPS Works

WPS is an enhancement to basic wireless service that allows your National Security/Emergency Preparedness (NS/EP) calls to queue for priority service in order to complete the call. Together with GETS, WPS dramatically improves “end-to-end” call completion during emergencies.

WPS is an add-on feature subscribed on a per-cell phone basis that works with existing cell phones in WPS enabled cellular networks; no special phones are required. WPS provides priority for emergency calls through a combination of special cellular network features and the same “High Probability of Completion” features used by GETS:

- Originating Radio Channel Priority: WPS addresses congestion in the local radio access channel (or cell), which is often the reason that cellular calls cannot be made during heavy calling periods or when damage to network infrastructure occurs. WPS automatically provides priority access to local radio channels, placing WPS calls in queue for the next available channel if a channel is not immediately available. Originating Radio Channel Priority requires WPS feature activation on the calling

cellular phone. WPS calls do not preempt calls in progress nor will WPS users monopolize all available cellular resources.

- High Probability of Completion Features: When a radio access channel becomes available and the call proceeds, WPS calls are assigned a unique "NS/EP" call marking by the cellular network switching equipment. This marking triggers industry standard High Probability of Completion (HPC) features residing in most U.S. telecommunications networks as calls are routed from the originating cell to the called cellular or landline phone. These HPC features significantly increase the probability of call completion should the call encounter network congestion or blockage beyond the originating cell. Thus, WPS calls receive similar "across the network" priority as GETS calls without having to dial the GETS access number and PIN.
- Terminating Radio Channel Priority: Incoming WPS (and GETS) calls to cell phones served by WPS enabled cellular networks automatically receive priority access to local radio channels, placing incoming GETS and WPS calls in queue for the next available channel if a channel is not immediately available. Terminating Radio Channel Priority does NOT require the called cellular phone to be subscribed to WPS. Incoming GETS and WPS calls do not preempt cellular calls in progress nor will they monopolize all available cellular resources.

7.1.3 NS/EP NGN Priority Services

NS/EP NGN-PS is the evolution of GETS and WPS to achieve service continuity in the packet-switched NGN and leverages the NGN to offer new features and priority multimedia services. NS/EP NGN-PS provides priority treatment to increase the probability of a Service User's NS/EP NGN-PS Voice, Video and Data services being successful over a Service Provider's public network infrastructure. Some form of priority treatment is applied to the NS/EP NGN-PS service invocation and session establishment, and continues to be applied until the NS/EP NGN-PS service is released by the Service User. The priority treatment may be applied before the invocation if needed to give a greater probability of success in receiving, recognizing, and processing the invocation.

7.1.4 Considerations of priority similar to that used for GETS, WPS and NGN-PS

Use of a priority mechanism similar to that used for GETS and WPS is not recommended for the following reasons:

1. Relative priority of '911' calls versus GETS and WPS calls will have to be addressed. Specifically, contention between "911" and GETS and WPS calls will have to be addressed and it will means having to address a number of highly complex technical, operational, regulatory and legal issues.
2. Consideration of a prioritization mechanism like WPS will involve added complexity of addressing the authenticity of "911" calls because uncontrolled or open access by such a large volume of potential "911" callers could create new security problems. For

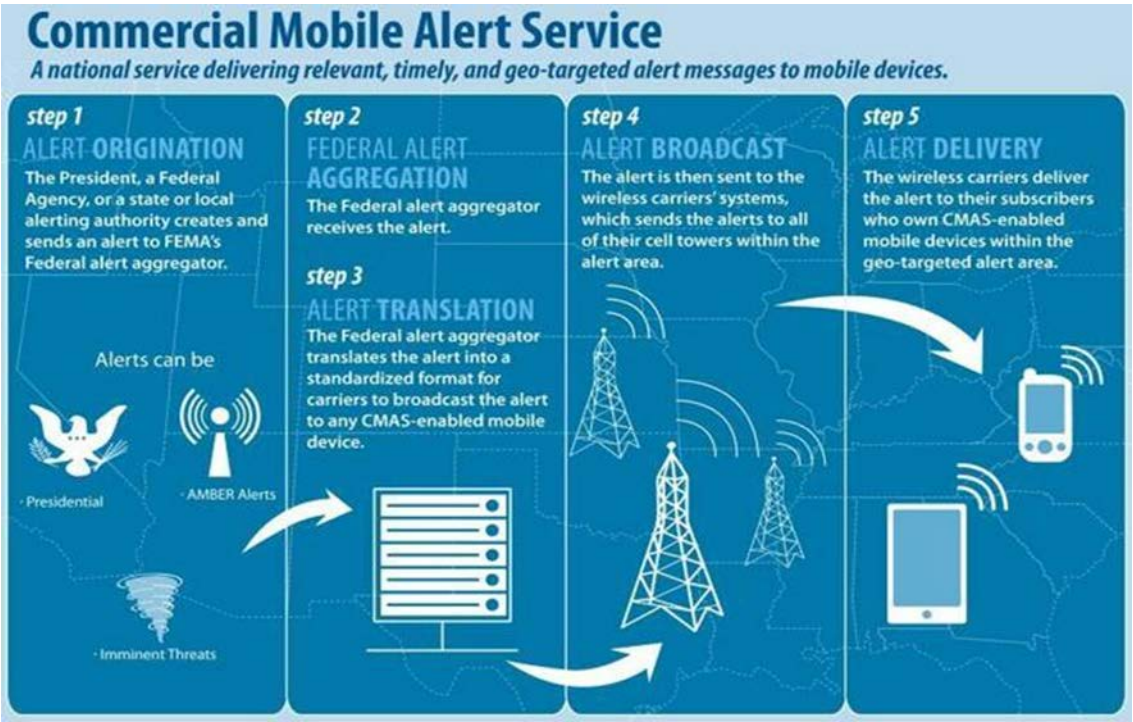
example, necessary control will be needed to prevent such priority mechanism for '911' calls from being used to initiate denial of service and flooding attacks on the public network infrastructure.

3. Consideration of a priority mechanism like WPS will require significant training and education of the '911' callers which will be a daunting task given the large 911 user base (See Section 4.1.2.1.14.1.2.1.1. for detail).
4. A prioritization mechanism will not address the fundamental problem associated with PSAP congestion (See Section 4.1.2.1.14.1.2.1.1. for detail).

7.2 *Commercial Mobile Alert Service (CMAS)*

Wireless Emergency Alerts (WEA), also known as Commercial Mobile Alert Service (CMAS), is a part of a national alerting system called IPAWS (Integrated Public Alert and Warning System) that enables emergency management officials to rapidly disseminate the warnings and safety information via text alerts to wireless phones based on the phones' geographic location.

The Federal Emergency Management Agency or FEMA is responsible for receiving the alerting information and forwarding the alerts to participating wireless carriers. Such alerts may come from the President of the United States; the National Weather Service, state or county public safety officials. This system is integrated into the same national alerting services that serve television and radio today.
From FEMA website: "The IPAWS vision is to ensure that all Americans are able to receive accurate alerts and warnings, regardless of what communications technologies they use. The inclusion of cellular alerts under the IPAWS system reflects the important role that wireless technologies play in consumers' lives today. IPAWS includes a wireless mobile alerting capability into the IPAWS network to better warn citizens. Providing critical alert information via wireless devices will help the public avoid danger or respond more quickly during crisis, and thereby save lives and property.



8 Analysis, Findings and Recommendations

8.1 Analysis

8.1.1 How 9-1-1 traffic might be prioritized during emergencies or disasters

The Committee examined the existing 9-1-1 infrastructure for wire line and wireless 9-1-1 calls and concluded that adding prioritization to emergency calls on the existing access network would be difficult and of limited value as the 9-1-1 call volume is constricted by available trunk lines and the number of personnel on duty to answer emergency calls.

NG911 allows for more opportunities for 9-1-1 call prioritization as it could potentially minimize bottlenecks in the emergency network but adding prioritization technology in the current access networks and the entire end-to-end call path would be overly complicated. Prioritization on 4G wireless networks is a possibility but would require enhancements to both the network and handsets. Legacy handsets could not take advantage of the prioritization feature on the network. As the call capacity of the network is ultimately limited by the call-taker capacity, end-to-end prioritization on 4G networks was not viewed as a good solution.

GETS and WPS were also considered both in the existing infrastructure and on a NGN. Prioritization methods similar to those used to support GETS and WPS could potentially be used to provide prioritization for 9-1-1 calls using radio access queuing and network resource queuing in the existing infrastructure and in an NGN environment, but there are very substantial issues with attempting to use these prioritization methods for 911 calls. GETS and WPS were expressly designed for national security and emergency preparedness (NS/EP) personnel.

Increasing access to these programs would necessitate differentiating between 9-1-1 calls and NS/EP calls and providing another level of prioritization without an underlying limit in the number of potential users. Even if this problem was resolved call capacity is still limited by operations. The GETS and WPS users would notice substantial degradation of their priority service if members of the public dialing 911 were allowed access to the same queuing methods for radio and network resources in times of emergency. See Section 8.4 for additional details on the interaction between GETS/WPS calls and 911 priority calls.

8.2 *Methods for PSAPs to address operational issues related to overload*

The committee identified a number of methods and strategies for PSAP to reduce overload and call volume. A high number of 9-1-1 calls may be either non-emergency or duplicate reports of the same incident. 9-1-1 call-takers must have the ability to redirect the caller to the appropriate resource in the case of a non-emergency call or ascertain if the call is a duplicate report in an emergency.

Operating in the current environment, we identified three potential methods to reduce overload; implementation of non-emergency numbers (3-1-1), public education, and virtual consolidation. 3-1-1 provides the public with access to non-emergency government services and resources and can substantially reduce the number of non-emergency calls to 9-1-1. However, 3-1-1 is usually cost-effective only in large urban areas and is not a viable solution for rural or suburban agencies where government resources are already constrained.

Public education and outreach to the public on the proper use of 9-1-1 and the availability of other resources for information and services can also reduce the number calls to 9-1-1. This is especially critical during major emergencies or disasters when the emergency networks are already strained and the 9-1-1 call-takers need to focus on the extraordinary event.

Virtual Consolidation is a concept that combines the technology benefits of a physical consolidation without the initial capital cost for infrastructure. Utilizing the same public safety applications on a common network gives PSAPs the ability to load share. When one or more of the PSAPs are experiencing high call volume or a critical incident personnel from the other participating PSAP(s) are available to answer 9-1-1 calls that would otherwise be delayed. Network configuration and basic policy alignment are critical to the success of virtual consolidation.

In an NG-911 environment call volume may actually increase given the myriad of devices that will be able to communicate with 9-1-1 and the variety of data that may be transmitted. Text messaging may reduce call volume but those messages will require a response from the PSAP and therefore impact staff availability.

8.3 *Methods to reduce overall traffic during emergencies*

The Committee investigated a number of strategies to reduce overall call volume during an emergency or catastrophic event. Concepts such as Virtual Call Takers, Automated pre-plans and texting to 9-1-1 in addition to the aforementioned Virtual consolidation all could conceivably reduce call volume or at least enhance the ability to manage the traffic. Virtual call takers would increase capacity at the most critical chokepoint - lack of personnel. Automated

preplans show promise but require considerable coordination and advance planning. Automated preplans would enable PSAPs to reroute calls to other PSAPs. In an NGN environment, an alternate PSAP could be in another region or area unaffected by the disaster. Texting to 9-1-1 reduces phone traffic and provides an alternate means of contacting 9-1-1 but still impacts staffing as personnel must respond to the incoming texts.

8.4 *How 9-1-1 prioritization may interact with other priority calling services*

Government Emergency Telecommunications Service (GETS) and Wireless Priority Service (WPS) are priority services provided to certain government users who qualify for the service and are assigned a priority to allow them to participate. Users of these services are typically assigned one of five different priority levels according to their importance in the prioritization hierarchy determined by the government. If 911 callers were given priority access to radio and network resources (when compared to the general public dialing a non-emergency call), a question arises as to what priority would be given to a 911 caller.

If 911 callers were given any priority, a 911 caller would receive a level of priority to allow their call to get higher priority than a member of the public dialing a normal non-emergency call. Should the level of priority given to a 911 caller be more than, less than, or equal to, any of the priorities provided to GETS/WPS users? Government folks who assisted in the development of joint government/industry requirements for NGN GETS/WPS provided the opinion that if 911 callers were provided any priority at all, such priority should be less than any of the five priority levels used for GETS/WPS.

The theory is that first responders with GETS/WPS must have higher priority than members of the public dialing 911, as first responder communications are likely to have a larger impact of saving lives/property than an individual caller of 911. Also, it was theorized that in a large-scale emergency, there are many duplicate 911 calls, i.e., 911 calls from multiple users reporting the same incident to a PSAP. Such multiple reporting of the same incident by 911 callers would warrant a lower priority than a first responder using GETS/WPS.

Let’s assume that if 911 callers were given any priority, they would receive a priority level higher than a normal public network (non-emergency) call but less than any of the five priority levels used for GETS/WPS.

On the surface, it may appear that with the assumption in the paragraph immediately above, 911 callers may not interfere with the GETS/WPS service because GETS/WPS users always have a higher priority level. But additional details about how priority queuing works today must be understood to recognize the problem with the preceding sentence.

For radio queuing in WPS today, only a certain percentage of radio resources are allowed to be “consumed” by GETS/WPS users when compared with the general public. The idea is that government users cannot be allowed to consume all radio resources in an emergency, as paying customers of wireless operators must be provided an opportunity to place a phone call in normal times and in times of emergency.

Similarly, only a certain percentage of radio resources would be allowed to be consumed by 911 callers and by WPS users in times of a large-scale emergency, as paying customers of wireless operators have an expectation of being able to call friends and family during such periods. Radio resource queuing limits placed on GETS/WPS users are likely to be impacted by radio resource queuing limits on 911 callers to ensure that the general public has a reasonable chance of making a phone call.

Most of the above discussion focuses on the radio resource queuing aspects of priority service. Once radio resources are provided to a WPS caller or 911 caller, the call may be marked as a priority call as the call traverses the network, and network resource queuing may take place at the various network nodes through which the call travels. Any prioritization afforded 911 calls via network resource queuing will likely degrade the network resources priority queuing provided to GETS/WPS users, as priority mechanisms in the network may rely solely on a single indication of "priority call" rather than on the designated priority level of the caller. In addition, similar to the radio resource limitations on WPS callers today, network resource prioritization limits may be imposed on users of priority service (including 911 callers).

While the priority schemes theorized above for 911 callers have not been discussed in any great detail by industry bodies or government agencies to date, it is clear that "if everybody has priority, nobody has priority". It is also clear that the existing GETS/WPS service is likely to encounter degraded conditions during large-scale emergencies if 911 calls are also provided priority service (even if the priority of 911 calls is less than any of the GETS/WPS priorities).

8.5 Conclusions and Recommendations

Working Group 10 evaluated ways to ensure 9-1-1 is available when emergencies or disasters cause a surge in mobile network traffic. As part of our analysis, we considered ways to potentially prioritize end to end 9-1-1 traffic in 2G/3G Wireless Networks as well as Long Term Evolution (LTE) Networks in combination with Next Generation 9-1-1. As a result of this evaluation, WG10 recommends that no additional prioritization occur within the 2G/3G networks at this time.
The primary reason for this recommendation is that WG10 concluded that prioritization does very little to ensure the goal of 9-1-1 calls reaching emergency personnel during times of disasters due to the lack of PSAP personnel resources in emergencies and disasters.
WG10 determined that the PSAP actually is the ultimate choke point during these times.. None of the existing wireless networks currently provides end to end prioritization for 9-1-1 calls to the PSAP. Adding this capability to 2G and 3G networks would be a daunting task as the networks they would require major redesigns. LTE Networks does offer some level of prioritization; however it still would require significant development to offer end to end prioritization. In addition, we considered potentially riding on top of existing priority services of GETs/WPS service. We concluded that these services would be significantly degraded if consumer 9-1-1 calls were given priority within the context of these existing services. "If everyone has priority, then nobody has priority"".

WG10 also looked at alternatives to reduce 9-1-1 traffic during disasters. WG10 recommends the FCC, Public Safety, and carriers provide educational tips to the public about

telecommunications services during natural disasters. The public education should stress the need to keep non-emergency calling to a minimum during and immediately after a disaster to provide those people with true life and property threatening emergencies the ability to reach 9-1-1. In addition, the education programs should stress the use of non-emergency services as outlined in this document, such as 3-1-1 or other available social media and communications services, to report issues that are not as critical or life threatening.