



IHS Markit®

Transforming Emergency Services Communication in the age of IP Multi-media

Enhancing NG9-1-1/112 with Total Conversation



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Executive summary

Emergency Communications Centers - ECCs (also known as Public Safety Answering Points – PSAPs) face more responsibilities today than ever with the growing complexity and scale of emergency incidents and the availability of new technologies. As cases become more complicated, police, fire and emergency medical services must be able to collaborate faster and more seamlessly. With the availability of new data sources and rich media, such as video from smartphones, it is critical that emergency services organizations can leverage this information to improve preparedness and make faster, more informed and effective operational decisions.

This means emergency services networks need a new approach to keep pace and enhance both usability and data capacity of the systems they use daily. Prior to the construction of mission-critical LTE networks, first responders generally relied on wireline time division multiplexing (TDM) technology to receive emergency information from the public and radios (typically TETRA and P25) to communicate with first responders in the field. This meant the communications were primarily voice based, limiting the forms of information that could be transmitted and leveraged. Today, global standardized IP-based technologies address the interoperability and integration issues of proprietary technologies and enable “Total Conversation emergency calls¹” (voice, video, real-time text, and other multimedia communications services) between citizens, PSAPs, and first responders, very similar to what citizens expect using smartphones and other smart devices.

There are two main architectural options emergency response authorities can use to implement the architectural platform for next generation emergency services.

1. A SIP-based solution architecture developed by NENA (NENA i3)
2. A 3GPP Internet Protocol Multimedia Subsystem (IMS)-based solution architecture developed by ATIS

Both architectures are viable candidates for emergency services networks. On one hand, 3GPP IMS systems have long been used in the consumer sector to deliver IP-based multimedia services to mobile users. On the other hand, NENA i3 systems have been developed exclusively for emergency response networks since the mid-2000s. This paper will compare these architectures and explore their benefits and discuss the integration and interoperability with mission-critical LTE.

¹ ETSI TS 1011 470: "Emergency Communications (EMTEL); Total Conversation Access to Emergency Services".

A New Era of Public Safety Communications Capability

Modern telecommunications capabilities now leverage Internet Protocol (IP) connections as a cost-effective, high-performance foundation for voice, video and data traffic transmission. The shift from legacy circuit switched connections over copper and optical links for landline communications is matched by a comparable wireless evolution enabled by LTE. As the worlds of landline and wireless communications have converged on IP-based architectures, new avenues for transforming the end-to-end emergency services communications environment become possible.

An end-to-end view of public safety communications systems extends from a citizen's first point-of-contact with the emergency services agency to the wireless communications units operated by responding emergency services workers. In the middle are emergency communications centers, incident command centers and supplemental consulting resources (e.g., a medical facility or hazardous materials information center) that assist in phases of the emergency response.

Initiatives are underway today across the globe to enhance the flow of information across this end-to-end continuum of emergency response. For the citizen's access to emergency service resources via a Public Safety Answering Point (PSAP), Next Generation 9-1-1 (NG9-1-1) and Next Generation 112 (NG112) architectures set the stage for data-rich engagement with smartphones and computer systems. On the responder front, new mission-critical LTE mobile wireless networks offer a data-rich link to the emergency responder in the field. New mission-critical networks, such as FirstNet in the United States and the Emergency Services Network in the United Kingdom, ensure that voice, video and data traffic flows reliably to emergency responders even when a cellular network is under heavy load due to a local crisis.

This paper reflects on the significance of the IP-enabled transformation that is now underway across the end-to-end chain of communication resources supporting emergency response. In particular, we will examine important work that remains to be done to ensure a "Total Conversation emergency call" is possible between citizens reporting incidents to those responders sent to address an emergency situation.

Communications gaps and how they affect emergency responders today

There is currently a major gap between communications technology available in the consumer sector versus those used by emergency communications services. New applications available in the consumer sector require more bandwidth for data communications than what is currently supported by emergency services networks. Having access to high bandwidth and low latency multimedia data such as video, photos, enhanced messaging and other rich multimedia content (often submitted by citizens themselves to emergency response services) is critical to shorten the incident response time, provide 360-degree situational awareness, and improve the effectiveness of first responders.

Additionally, it is essential that citizens' expectations around interfacing with first responders is bridged. This means that emergency services must be capable of supporting and receiving videos, photos, enhanced messaging, and other IP-based multimedia communications services.

Some of the major communications challenges facing emergency responders are as follows.

Challenges faced by today's emergency services

1	Aging infrastructure and changing citizen expectations	– Much of the emergency communications technology in place to date is based on outdated wireline time division multiplexing (TDM) infrastructure – Citizens are increasingly using text, images and videos to communicate and are expecting PSAPs being able to receive such data (e.g. in the United States, the total number of text-to-911 messages based on 25 reporting States was 251,068)
2	Increasing data volumes	– Officers often carry multiple devices to access the information they need in the field – The need to send IP broadband multimedia data such as videos and images from and to the PSAP – Need to speed up identification and documentation processes
3	Collaboration between agencies	– Difficulties communicating across agencies and share data because of the disparity in communications technologies and networks – Accessing incident or records data from other agencies needs to be seamless

Infusing information into the call for help

Currently, emergency services networks use legacy telecommunications infrastructure to route and process calls from the public and to dispatch first responders. This has resulted in dispatching to inaccurate locations, long emergency call waiting times and overloaded emergency communications centers. For this reason, there has been so much emphasis to upgrade these legacy networks to NG9-1-1 networks and mission-critical LTE networks which are more robust, flexible and can handle various forms of contact from the public towards the PSAPs and first responders.

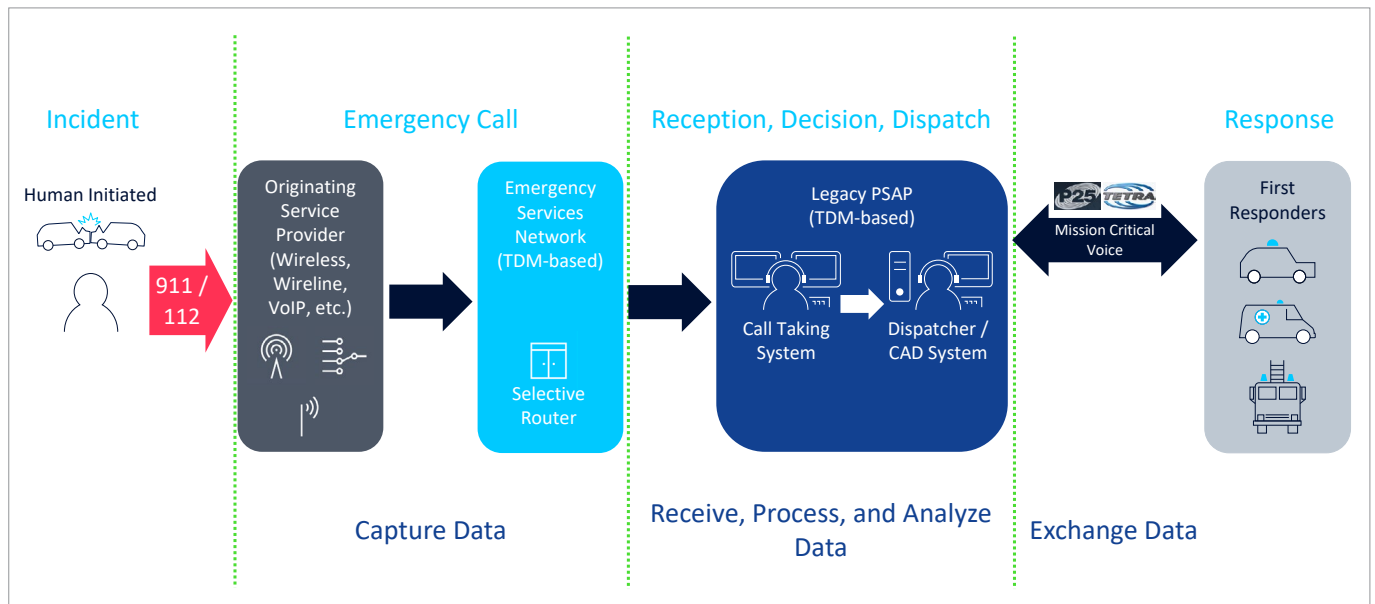


Figure 1. Legacy E9-1-1 Network

The deployment of 3GPP IMS-based networks and systems to provide voice, video, enhanced messaging, and other IP-based multimedia communications services has fueled the growth of new multimedia applications that are device, services, and access agnostic allowing end users to share IP-based multimedia content regardless of the device, service provider, or access network (fixed or mobile).

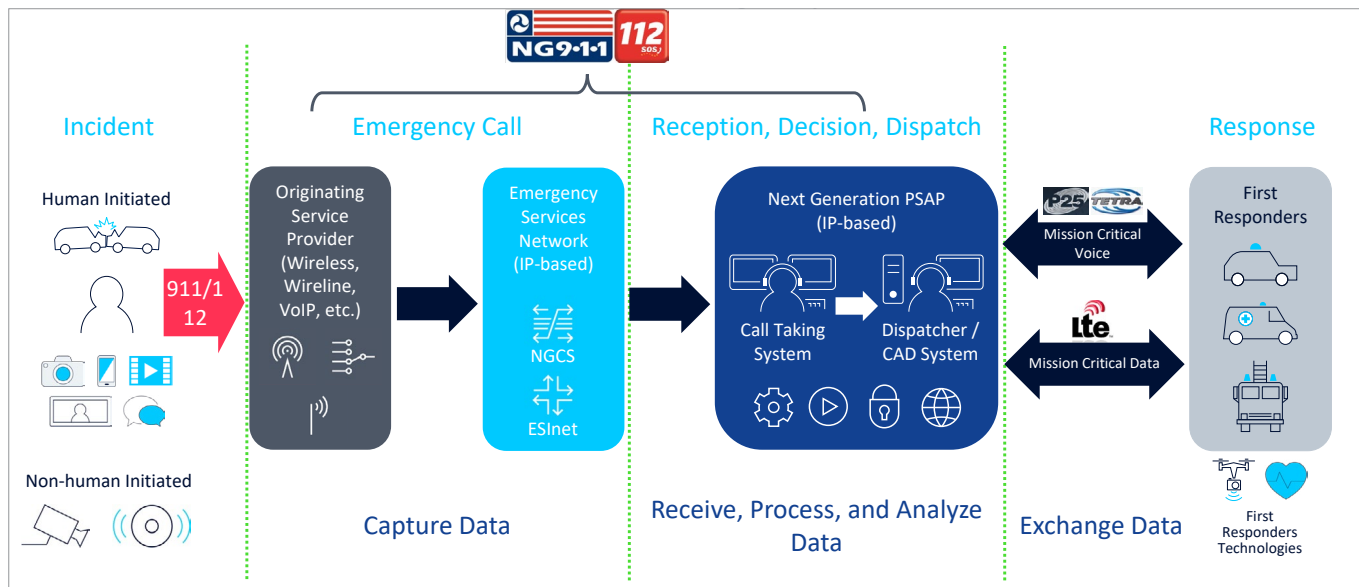


Figure 2. Future NG9-1-1 Network: Multimedia Emergency Sessions (MES)

Mission-critical LTE networks leverage IMS platforms to deliver all IP-based multimedia communications services such as voice over LTE (VoLTE), video over LTE (ViLTE), enhanced messaging as well as new mission critical communications services such as mission-critical push-to-talk (MC-PTT). Mission-critical LTE networks rely on the same IMS platforms available in commercial 3GPP wireless and wireline networks and which allow the convergence of voice, video, enhanced messaging, and other IP-based multimedia applications.

The application of 3GPP IMS functional entities to implement NG9-1-1 emergency services networks has been evaluated by the NENA i3 standard version 1, which proposed two architectural options for the implementation of NG9-1-1 Core Services (NGCS) functional elements: a generic SIP-based architecture and an 3GPP IMS-based architecture.

There are benefits and challenges to each architectural option (NENA i3 generic SIP-based architecture and a 3GPP IMS-based architecture), but what emergency response agencies must understand is that both can offer a suitable platform for providing enhanced multimedia emergency services. While NENA i3 standard is geared toward public safety and has been developed by both industry and end-users alike, IMS has been widely used in the consumer space, and is essentially the basis of citizens multimedia communications services, making the architecture a viable framework for emergency communications services as well.

Automated emergency calls and alerts

Emergency incidents today are more complex than ever, often involving multiple agencies, technologies and collateral damage on victims. The additional bandwidth available from using wireline and wireless broadband networks increases the opportunities for public safety or commercial organizations to deploy greater numbers of wireless sensors to control processes or report data. For emergency response organizations, sensors could also receive sensor data from third parties to indicate the presence and severity of an incident.

With the proliferation of the Smart Cities trend, the use of telematics and smart sensors and devices in emergencies has become particularly important, especially to initiate emergency calls where human intervention may be impaired or in some cases not possible. This would allow for earlier detection of events improving situational awareness and ideally mitigating collateral damage.

Connected vehicle in a car crash – eCall and similar services

This idea has been around since the early 2000s and has been pushed through initiatives such as eCall. As of April 2018, the device is now mandatory in all new cars sold in the European Union. With mission-critical LTE, the data types routed to emergency responders could be expanded tremendously. For instance, live video and victim vitals could be pulled from the scene shortly after a crash. Emergency medical services would be provided this data on the way to the scene, which means they could be much better prepared than in the past to assist.

It was estimated eCall could reduce emergency response times by 40% in urban areas and by 50% in rural areas. With the expansion of mission-critical LTE, and more automated services and data types provided, it is clear emergency response times could be improved even further.

These aforementioned applications improve not only the speed at which citizens and emergency responders can exchange information, but also the situational awareness of responders when addressing an incident. Improved situational awareness leads to better prepared emergency responders. This means that they can more effectively solve the issue at hand and mitigate potential peripheral or collateral damage. Not only does this reduce risk for the affected victims and first responders, but it also reduces risk for society.

Mobile broadband comes to the emergency responder

While emergency responder communications remains rooted in voice communications, advances in mobile multimedia capabilities create valuable opportunities to modernize first responder communications and enrich situational awareness during all phases of an emergency incident. A citizen expects to share texts, pictures and video with friends, family, and work colleagues. Emergency responders should have the same expectation for their communications systems.

Voice communications will always serve as the dominant avenue for information exchange between citizens and ECC telecommunicators, or between the ECC and emergency responders. For most people, voice communications is the easiest way to deliver essential information quickly. A structured interview with a calling party -- even someone under stress -- can quickly surface the essential information a telecommunicator needs to start help on the way. Yet words alone may not be sufficient to communicate visual details as seen by the caller. With IP-based multimedia communications services now in the hands of both the calling party and an emergency responder, a complete end-to-end chain of rich multimedia emergency communications flow can rapidly deliver an extensive visual picture. This total conversation multimedia emergency service creates maximum situational awareness for emergency workers responding to an incident.

Bringing rich information sharing capability as part of emergency response technology is the logical next step in the evolution of NG9-1-1/112 systems. With the addition of mission-critical LTE communications networks in the United States (FirstNet), the United Kingdom (Emergency Services Network), Korea (SafeNet), and elsewhere, emergency responders have the foundation for rich multimedia communications in the field.

Mission-critical LTE can provide a multitude of benefits to first responders and citizens alike. Since most of these networks are being built out currently, many of these benefits and the true value of these networks will be realized over the next 10-15 years. However, the overarching value is this: better access to data improves situational awareness and thus the speed, reliability, and confidence resolution of emergency services resulting in safer and happier citizens and societies.

How emergency responses benefit from mission-critical LTE

Mission-critical LTE networks help boost operational effectiveness during an emergency response. Rich data enhances field operations across all domains: law enforcement as well as fire, rescue and emergency medical services. As the emergency services communications gains capabilities found in consumer LTE devices, new mission-critical LTE application opportunities emerge. Examples include:

Mission critical LTE application offering	Effects on operations
Voice communications – group and individual	Essential for operations
Location data: Emergency Centre communication, GPS	Faster location arrival
Operational information: Mobile Command and Control	Closest patrol found, increased situational awareness
Operational information: Patient monitoring	First aid possibility
Multimedia: Video on location, Body-worn video, photo	Situational awareness
Automated Person Identification in Video	Identification of suspects
Online database enquiry: Information database, download of maps and building drawings License plate video tracking	Fast access to location documentation Automatic plate checking, runaway identification
Office applications: Mobile office	Police officers spend more time on the street, not at HQ

With the operational model enhanced by mission-critical LTE, a number of interesting scenarios becomes possible. These new approaches include:



Drone based surveillance can provide an aerial view of the incident before arriving to the scene helping the control room officer determine the resources needed and the plan of action to address the incident



Environmental sensors can detect potential fires, gas leakages and e.g. harmful dust levels, automatically without human interaction well before them causing wider damage. Control room officers can then warn the relevant people located in the affected area with the help of emergency alert solution.



First responders can wear smart clothing equipped with sensors monitoring data like heart rate, oxygen levels, temperature and GPS/ location services including 3d building maps allowing the control room officer to monitor the situation more carefully and to ensure that the personnel are not at risk while carrying out the operation. Also, body worn cameras increase the situational awareness in the control room. The control room officer can wear VR goggles and receive 360-degree video from the accident scene e.g. from a firefighter's helmet camera and observe in real time what's happening.



Virtual emergency response: always available no matter the location. Virtual emergency response center capability enables emergency notifications to be handled by the local control room in normal situations, but in times of congestion, other centers located elsewhere can automatically provide extra support in call handling. All centers are provided with a unified view of the situation and can access the same data to improve cooperation and efficiency, locally and regionally.



Video calls from the citizen, CCTV feed combined with video analytics from the area of the incident help the control room officer to identify the number of people involved in the emergency and better plan the course of action.



Autonomous driving: crash data is immediately sent to the PSAP and the vitals of the passengers are routed to nearby hospitals and emergency medical services personnel, better preparing personnel to help the victims



Building automation: fire alerts and access control can immediately notify police of threats inside buildings



Improved reporting and auditing capability: alerts and time to response are tracked and updated in real time. This means that PSAP operators can improve their standard operational procedures resulting in faster and more effective dispatching.



Establishing the End-to-End communications chain

It is important that government officials in charge of public safety communications systems recognize the role IMS-based systems plays in fixed, mobile, cable, and broadband wireless next generation networks. It is the IMS common service platform in LTE networks that make voice over LTE (VoLTE) and video over LTE (ViLTE) communications possible, thanks to a flexible architecture that integrates SIP and RTP multimedia communications capabilities with mobile network mechanisms. Because such a large proportion of emergency calls originate from mobile networks, an important opportunity exists to tightly interconnect these modern high-performance IMS-based systems with NENA i3 systems. The resulting boost in situational awareness capabilities should make this a high priority goal.

Government officials, however, will need to provide leadership to drive an end-to-end situational awareness capability from the citizen to the first responder. NENA i3 systems today fall short addressing the interoperability and integration with the caller's mobile network and the responder's mission-critical LTE IMS-based network. Moreover, no universal SIP based emergency calling client for devices has yet been specified. Government officials must take the lead in advocating for change that leads to a total conversation emergency service that spans the citizen to the PSAP to the first responder.

Even without device support, however, there are good reasons for PSAP officials to call for effective integration of IMS and NENA i3 architectures. Many of the NENA i3 standard functional elements to process multimedia calls and data can be implemented using 3GPP IMS functional entities which are already field proven and commercially available. This approach helps reduce the number of system elements, ensure interoperability, and provides a solid foundation for a future where IMS-based emergency services networks deliver end-to-end total conversation multimedia emergency services.

Choosing the architecture model is a complex decision dependent on many factors including the vendors that the agency is working with and what technologies and architecture partner agencies or surrounding governments are implementing. Many vendors for instance are already deploying NENA i3 transitional solutions (e.g. IP selective routers). Similarly, large telecommunications infrastructure providers have been deploying commercial systems based on 3GPP IMS around the globe for years.

Because the technological and operational requirements of global agencies are unique, there is no one solution for every agency. Ultimately a comprehensive assessment of vendors and their offerings, collaboration opportunities with potential partner agencies and rigorous cost benefit analysis must be undertaken before approaching a NG9-1-1/ NG112 network implementation.

Begin by conducting due diligence on agencies who have a similar use case. Speak with their vendors and integrators and assess your agency's needs before selecting a path forward.

The following section discusses some of the progress of NG9-1-1/NG112 globally and the trends driving uptake.

Overview of the NENA i3 standard

The National Emergency Number Association (NENA) has developed the i3 standard to support evolution of E9-1-1 systems to an all IP-based emergency communications system in North America. The NENA i3 standard has introduced the following building blocks:

- NG9-1-1 PSAPs with multimedia emergency sessions capabilities
- Emergency Services IP Network (ESInet) - privately managed IP transport network connecting all Public Safety agencies involved in the emergency and provides the foundation for NG9-1-1 services
- Next Generation 9-1-1 Core Services (NGCS) - set of functions that process, route, and control the delivery of multimedia emergency sessions to PSAPs

NG9-1-1 enables the public to request emergency assistance via voice, real-time text (RTT), images, video or other multimedia data. NG9-1-1 also enables the PSAPs to share this rich information with emergency responders in the field to provide 360-degree situational awareness, shorten response time, and improve incident management.

Several U.S. States and the entire nation of Canada are employing NENA i3 standards as a basis for Next Generation Emergency Services. Various public safety and industry bodies have developed the standard over the past 12 years in accordance with the unique characteristics of North American emergency response networks. Among the primary drivers is the high number of PSAPs (~6,000) and the many different methods for conducting emergency response.

Key benefits provided by the NENA i3 standard include:

- The i3 standard is the universally-acknowledged basis for public safety deployments of NG9-1-1 systems and was used as the basis for Europe's NG112 standard during various pilot programs
- The industry is producing products and services based on the i3 standard and dozens of RFPs have been issued by public safety agencies for i3-compliant equipment
- Several U.S. states have deployed i3 transitional solutions on a state-wide level and are planning the deployment of i3 compliant solutions to enable multimedia emergency services.
- Canada has adopted the i3 standard and is planning to have NG9-1-1 networks to be ready to provide NG9-1-1 voice service by June 2020.

Overview of IP Multimedia Subsystem (IMS) architecture

IMS is not new. It has undergone over 15 years of development with substantial work completed by the 3rd Generation Partnership Project (3GPP) and has been heavily deployed into mobile network operators by the largest telecommunications infrastructure vendors such as Ericsson, Huawei, Nokia (incl. former Alcatel-Lucent). In the commercial sector, IMS has become the de facto standard for voice services over LTE (VoLTE).

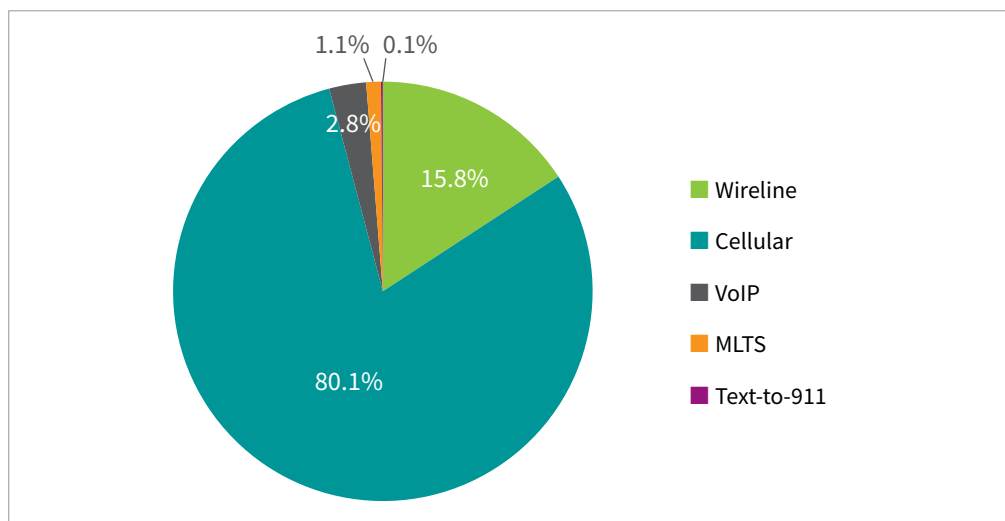


IMS can be viewed as the glue that will bridge heterogeneous networks together and as such is generally accepted as a core component of virtually all next generation, IP-based multimedia communications networks. It is designed to assure convergence of multimedia services across these interconnected networks run by service providers. IMS provides a common service platform capable of delivering all the traditional telecommunications services as well as new mission critical communications services used by emergency responders. IMS delivers these traditional and new services via an application server (AS). Examples of IMS enabled services are voice over LTE (VoLTE), mission critical push to talk (MC-PTT), rich communications services (RCS), etc.

Over the past four years there has been significant traction in the transition to Voice over LTE (VoLTE), which has been the number-one driver of VoIP and IMS market growth, along with voice over WIFI (VoWiFi) and other mobility services. In a service provider survey conducted by IHS Markit in mid-2018, 73% of respondents cited VoLTE as a strong driver in the migration to IMS. As of 15 May 2018, 121 operators had commercially launched VoLTE across 61 countries according to the GSMA. VoWiFi was a top driver as well, albeit at 60% of respondents. VoWiFi is widely seen as a complement to VoLTE but hasn't yet gained as much market traction, with 71 commercial launches.

To provide a sense of scale and growth of IMS users, in 2017, there were 939.4M worldwide IMS-based subscribers, with 78% of those from mobile services. IHS Markit estimates there were 1.4B IMS-based subscribers worldwide in 2018, with 85% of those from mobile services. The number of worldwide IMS subscribers is forecast to grow to 3.6B in 2022 at a CAGR of 30.7% over 2017–22.

In North America, over 80% of emergency calls come from mobile phones, as shown in the figure below. The wireless networks on which mobile phones operate are powered by IMS platforms, which can ensure interoperability between the originating service provider's (OSP) IMS-based networks and NG9-1-1 IMS-based networks.



US 9-1-1 Call volume distribution, 2016
Source: 911.gov / IHS Markit

NG9-1-1/NG112 and mission-critical LTE are the two pillars of Next Generation Emergency Services, enabling Total Conversation emergency calls (i.e. simultaneous exchange of voice, video, enhanced messaging, and other multimedia communications services) between citizens, PSAPs, and first responders.

IMS provides a standardized, IP multimedia communications services network architecture with open interfaces, which is currently available in commercial 3GPP wireless and wireline networks. Another value of IMS is that the technology is access, network, and device agnostic, field-proven, and provides a future-proof evolution to new IP-based broadband communications services.

As public safety officials consider why IMS must be factored into PSAP operations, they should consider the following:

- IMS is already widely used by standards bodies (3GPP, ETSI, and PacketCable) that enables convergence, interoperability, and economies of scale.
- IMS is being adopted further by telecommunications firms and within the consumer sector. This means existing infrastructure in place at telecommunications service providers, could be leveraged.
- IMS is a customer friendly and vendor agnostic technology: a caller can communicate with emergency services in a similar fashion to citizen to citizen communications (e.g. via FaceTime, WhatsApp or other mediums) without an additional application or layer.
- National public safety broadband networks, like FirstNet are based on IMS.
- IMS also benefits of new technologies such as network function virtualization (NFV) and software defined networks (SDN) to enable cloud-based deployments.

Modern NG-9-1-1/112 systems require blended NENA i3 and IMS capabilities

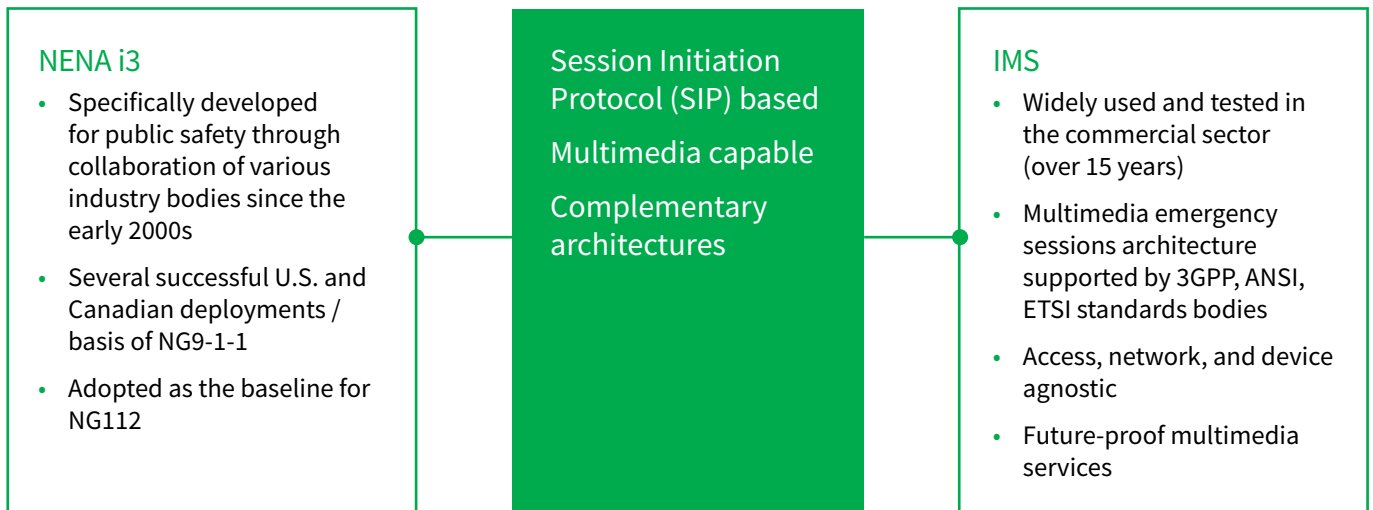
NENA i3 architecture is based upon a strong SIP call processing foundation, as does the 3GPP IMS architecture supporting Voice over LTE (VoLTE). As the high volumes of mobile-originated emergency calls continue to grow, interconnecting these two similar, but different, architectures becomes a high priority. For many networks, the legacy selective routers are nearing end-of-life. Government officials and mobile network operators must work together to ensure the next evolution stage brings a full range of IMS-enabled capabilities enabling total conversation multimedia emergency sessions between citizens, the PSAP and the first responders. Without this push, NG9-1-1/112 systems will fail to deliver on their original promise of flexible information flow from citizens to emergency responders.

By reusing IMS functional entities which are already widely deployed in service provider networks to implement the emergency services call routing roles of NENA i3 NGCS functional elements the following benefits are achieved:

- Economies of scale, a global, accredited, and non-proprietary standard solution including the robustness, proven interoperability, and rich features of the 3GPP IMS ecosystem
- IP broadband multimedia emergency services between the public, PSAPs, and first responders
- Full interoperability and seamless integration between 3GPP IMS-based wireless and wireline networks, NG9-1-1 networks, and 3GPP IMS-based Public Safety Broadband Networks (PSBN)
- By leveraging robustness, proven interoperability, and the many use-cases of 3GPP IMS-based networks in NG9-1-1 Emergency Services Networks (ESNs), 9-1-1 authorities will ensure seamless operation and interoperability across local, regional, state and national NG9-1-1 ESNs



Network architecture highlights



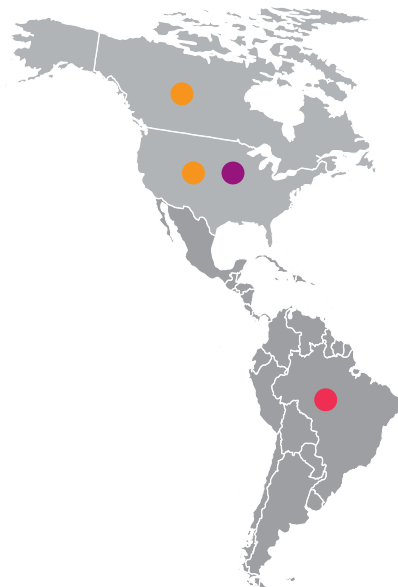
Next generation communications for emergency services are taking hold around the globe

A confluence of factors globally is driving upgrades to improve emergency response capabilities and communications systems. Most aim at improving the data receiving and processing capability of command and control centers / PSAPs and the capacity of emergency response networks to facilitate communications between citizens, dispatchers and emergency services.

Americas

Next Generation 911 ●

Currently, the migration of emergency communications networks from legacy technologies to global standardized IP-based technologies is a very slow process. In the United States for example, only 4 of 37 states reporting on NG911 progress, use 100% of their customer premises equipment (CPE) to handle IP-based emergency calls (voice only). This is well behind the consumer market, where based on a 2013 study, about 47% of U.S. households had shifted from wireline (TDM) to wireless based phone services. It is evident that public safety needs to catch up. Nevertheless, this is a technology shift well on its way although completion may take 5-10 years.



FirstNet ●

The U.S. Congress created the First Responder Network Authority (FirstNet) of the United States under the Middle-Class Tax Relief and Job Creation Act of 2012 (MCTRJCA) as an independent authority within the National Telecommunications and Information Administration (NTIA). The purpose of FirstNet is to establish, operate, and maintain an interoperable public safety broadband network. \$7 billion and 20 MHz of valuable radio spectrum has been allocated to build out the network to fulfil these objectives.

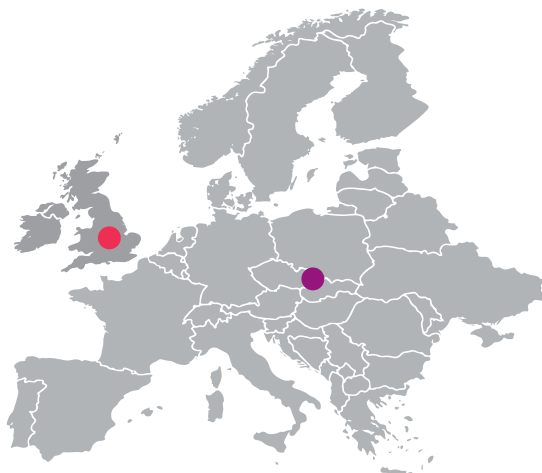
Shift toward IP and data-centric emergency response ●

There has been shift away from traditional voice communications in Latin America as well, especially in rapidly developing, economically strong countries like Brazil and Mexico. Price points are playing a notable role in this shift as users look toward smartphone-like devices running on broadband networks in lieu of expensive digital radios.

Europe, the Middle East and Africa

Next Generation 112 ●

Like North America, PSAPs in Europe face several challenges which Next Generation 112 seeks to address the aging emergency response infrastructure in Europe. The aims of NG112 include a completely IP-based infrastructure with open standards ensuring interoperability across borders, agencies, and different supplier systems. NG112 would also allow citizens to access emergency services through devices such as mobile phones or tablets via applications.



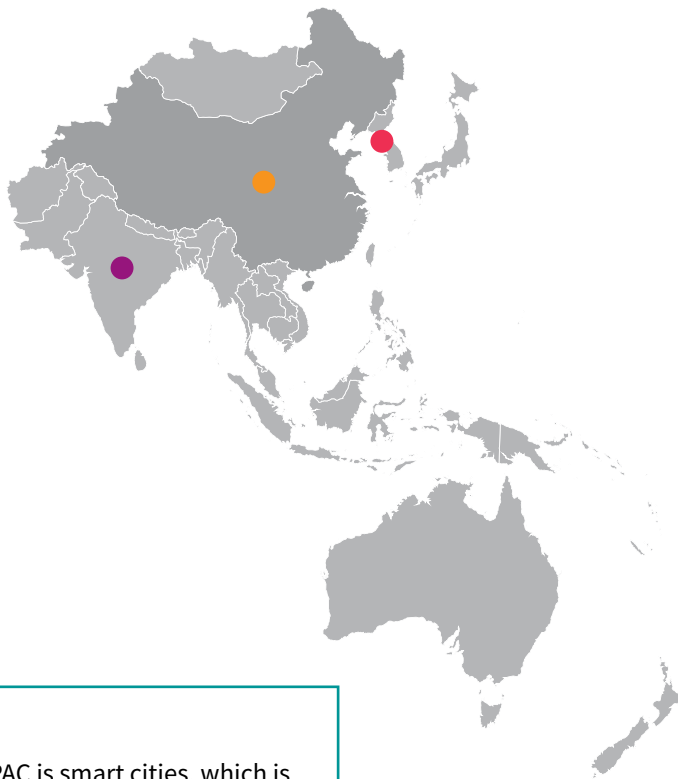
United Kingdom Emergency Services network ●

The United Kingdom plans to replace voice services, now provided by Airwave, with a national voice and broadband mobile communication service called the Emergency Services Network (ESN). The UK plan is to deliver a next-generation communication system capable of providing new data-based services for police, fire and rescue, and ambulance and other public safety users.

Asia Pacific

SafeNet ●

There has been significant traction over the last few years. In 2014, South Korea (after selecting the 700 MHz band for public safety broadband) announced plans to build a nationwide, dedicated public safety LTE network, known as SafeNet. In 2017, South Korea's minister of public safety and security began the operation of SafeNet (PSS broadband network in South Korea).



Data centrality and shift away from voice

APAC is also undergoing a shift away from solely voice-centered emergency response toward data centrality. What this means is, that emergency response is not solely based on licensed mobile radio (narrowband) networks anymore and is increasingly evolving toward emergency services that are broadband LTE based.

Smart cities

A major trend underway in APAC is smart cities, which is mainly because of the rapidly growing populations and increasing pressure on cities to improve operations and become more efficient. Smart Cities are an important driver to the uptake of Mission Critical LTE because communications must be secure and first responders require transmission of high bandwidth data such as video, which cannot be transferred by narrowband alone.

100 Smart Cities ●

India has many cities involved, especially with its strong focus on its 100 Smart Cities Program.

Mega surveillance networks ●

In China, several large cities have invested heavily in surveillance networks.

Conclusion

Emergency services networks today require a revamp. Technology available in the commercial and consumer sectors can provide critical information to emergency services, but the infrastructure on which emergency services currently run are not always capable of processing information submitted via smartphones, applications and communications mediums besides telephony.

Next generation 9-1-1/112 and Mission Critical LTE are they key pillars supporting Next Generation Emergency Services. Both are required in order to access critical incident and collateral information from both emergency callers and collateral sources such as traffic data and environmental sensors and at the same time, submit this information to the emergency call center and route to emergency responders in the field. With this data in hand, first responders can be much better prepared to tackle incidents.

It is critical that emergency services and public safety facilitate a transition to broadband LTE-based emergency services networks. To do so, these networks must be built using multimedia architecture such as the NENA i3 standard or IMS. With this telecommunications infrastructure, emergency services can access vital data from citizens, provide a better platform for communications to citizens and other first responders, and most importantly improve the capabilities of emergency response networks resulting in fast time to incident and more efficient use of resources.

Benefits to citizens / society	Benefits to emergency responders / PSAPs
• Multiple ways to contact emergency services (9-1-1/112/999 etc.) such as text, video and social media • More efficient call processing, which means police can arrive on scene faster and better prepared • Preventative policing and crime deterrence means less incidents in the first place	• Multiple ways to receive incident data from citizens and the control center resulting in increased situational awareness • Less time spent on paperwork and manual processes making personnel more effective and focused on the real work • Interconnected PSAPs mean seamless back-up capability in case of outages or over flow in call volume

Appendix

1. Supporting standards bodies and other organizations

Organization	Background
NENA Public Safety US focused	NENA is the National Emergency Number Association based in the United States. Within the public safety sector, NENA is recognized as the standard setting organization for emergency services. NENA played a significant role in developing the i3 standard, which is a non-proprietary, consensus-based standard, developed according to strict process requirements. This standard describes protocols, interfaces, and systems to locate users who contact 9-1-1 via voice, video, text, data, and other means, route their 'calls' to the appropriate Public Safety Answering Point (PSAP), and allow for easy transfers, failovers, and multi-party calls.
APCO Public Safety Global	The Association of Public-Safety Communications Officials (APCO) is the world's oldest and largest organization of public safety communications officials. With regard to next generation emergency services, APCO provides support around funding, legislation, interoperability and opportunities related to improving Next Generation 9-1-1. In the United States, APCO has worked with governments, from local to federal, to ensure lawmakers accelerate the transition to NG9-1-1. At the same time, the organization is also working to ensure PSAPs take advantage of the benefits of interoperability so that cost and functionality benefits can be realized as efficiently as possible as the transition to NG911 takes place.

ATIS Telecoms	The Alliance for Telecommunications Industry Solutions is a standards organization that develops technical and operational standards for the ICT industry. Among its many initiatives and responsibilities, it also promotes advancing location accuracy to help first responders address incidents more rapidly. Many technical standards developed by ATIS committees such as Emergency Services Interconnection Forum (ESIF), Wireless Technologies and Systems Committee (WTSC), Next Generation Interconnection Interoperability Forum (NGIIF), and Packet Technologies and Systems Committee (PTSC) are related to NG911, such as wireless location accuracy, interim text-to-911 and NG911 service and network interactions.
ETSI Europe focused	ETSI is an independent, not-for-profit organization that produces globally applicable standards for information and communications technologies, including fixed, mobile, radio, converged, broadcast, and Internet technologies.
3rd Generation Partnership Project (3GPP) Globally focused	3GPP unites seven telecommunications standard development organizations (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC), known as “Organizational Partners”. The project covers cellular telecommunications network technologies, including radio access, the core transport network, and service capabilities - including work on codecs, security, quality of service - and thus provides complete system specifications.
European Emergency Number Association Public safety Europe focused	EENA is a non-governmental organization with the mission to contribute to improving the safety and security of people. The group seeks to ensure every citizen can access emergency services and receive the appropriate information and care during an emergency or a disaster.

2. Important ATIS standards work

- ATIS has developed a standard for an IMS-based NG9-1-1 Emergency Services Architecture, adopted from and seamless interoperable with NENA i3 Solution Architecture, to support the delivery of emergency calls to legacy and NG9-1-1 PSAPs.
- ATIS-0500032 standard provides additional details to the 3GPP IMS specifications to support the application of IMS functional elements in Emergency Services Networks (ESNs). The standard addresses interconnection from origination networks (IP-based and TDM-based) and emergency call delivery to legacy and NG9-1-1 PSAPs.
- ATIS-0500032 standard also ensures 3GPP IMS-based NG9-1-1 Emergency Services Architecture to be fully compatible and seamless interoperable with NENA i3 Solution Architecture. This ensures an NG9-1-1 PSAP should find no difference whether the NG9-1-1 PSAP interconnects to a NENA i3 Solution Architecture or interconnects to an IMS-based NG9-1-1 Emergency Services Architecture.
- ATIS is not creating new requirements that will take long cycles to be implemented but reusing IMS networks elements which are already part of IMS-based originating network to implement the emergency services call routing of NGCS. By reusing field proven, commercial available solutions, interoperability and integration between IMS-based originating networks, IMS-based NGCS emergency services networks, and FirstNet IMS-based networks to support Total Conversation, multimedia emergency sessions between citizens, PSAPs, and first responders can be guarantee by design.

3. Next Generation 112 pilot programs

- **EMYNOS**
The Next Generation Emergency Communications (EMYNOS) project was funded by the European Union and aims to develop a Next Generation platform enabling European citizens to make IP based emergency calls (to police, ambulance, and fire brigade). This platform intersects the NG112 architecture, described in the NG112 LTD2 document, and implements the related functionalities according to the project consortium needs and requirements.

- **NEXES**

NEXES or Next Generation Emergency Services was a three-year project, whose goal was to deliver a next generation emergency communications solution using systems and applications already available on the market. 17 partners worked together to create enhanced communication and end-to-end connectivity between citizens and emergency services and improved interoperability among emergency services.

The project's final recommendations included a roadmap for PSAPs and EROs (Emergency Response Organizations) to assist them in determining the best transition model for their organizations as they integrate IP-based communications, considering cost-benefit analysis, sustainability and procurement models.

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