VIEW POINT

ENTERPRISE E911 SOLUTION – CHALLENGES AND BEST PRACTICES

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Abstract

Enterprises must provide Enhanced 911, also known as E911, service for all 50 states in the USA and all provinces in Canada. With enterprises rapidly moving to UCaaS and users working on or off premises, the expectation is to handle 911 calls in the same way for all users, no matter their location. Therefore, it is vital to have accurate location information of the 911 caller to dispatch the emergency services to the right location. With VoIP, softphone and wireless technologies, the user's location is dynamic. The emergency location must be sent to an Emergency Routing Service (ERS) provider, which maintains a registry of public safety answering points (PSAPs) and routes the call to the correct PSAP. In addition, the enterprise's local security desk or kiosk must be notified, as they could very well be the first responders.

Laws and regulations for emergency calls are evolving in the US. The two most important federal laws are Kari's Law, enacted in February 2018 and RAY BAUM'S act of 2018, amending the Federal Communications Commission's (FCC) Communication act of 1934. In addition, there are state laws that further enhance these laws. The deadline to implement RAY BAUM'S act for fixed line telephones was January 6, 2021. The laws required compliance for non-fixed telephone services, including VoIP, softphones and wireless handsets, by January 6, 2022. In addition, the Canadian Radio-television and Telecommunication Commission has emergency service obligations for local VoIP service providers in the Telecom Decision CRTC 2005-21, dated April 4, 2005. The European Union has a similar system called E112, a location enhanced version of 112 calls. This regulation for mobile phones sold in the EU came into force on March 17, 2022. The laws in these different jurisdictions mandate that enterprises implement E911 or E112 as an obligation for the health and safety of their employees.

This article discusses challenges and best practices specifically for E911 based on our experiences with platforms and technology. We conclude with a road map for Next-Gen 911 (NG911), an evolution from E911. This article shows the importance of E911 and how we can help implement the right strategy for an enterprise.

What are the new regulations?

Kari's Law and RAY BAUM'S Act for fixed line phone systems have existed since 2018. However, since January 2022, these regulations also apply to multiline-line phone systems, including VoIP, softphone and wireless handsets. What do these laws imply from a compliance standpoint?

Kari's Law requires that any building with a multi-line telephone system (MLTS) must allow callers to dial 911 directly (without needing to dial "9" to get an outside line). When a 911 call is made, the system must notify a central location, like a front desk or security kiosk and include a callback number and information about the caller's location. This legislation was enacted because of the tragic story of Kari Hunt. Kari Hunt was attacked in a hotel room and needed emergency help. She instructed her nine-year-old daughter to call 911 from a phone in the room. Not knowing that she needed to dial "9" first to get an outside line, the daughter could not get the help needed and save her mother's life. This tragedy could have been avoided in multiple ways. The first is to not require dialing "9" or any other prefix number. Also, perhaps for a nine-year-old who had no idea of the room number, a simultaneous notification to the hotel security desk would have helped the emergency responders.

RAY BAUM'S Act requires a "dispatchable location" to be sent with every 911 call to a PSAP, regardless of the technology platform. A dispatchable location means a validated street address of the caller and additional information such as a building, suite, room, or floor number. With non-fixed telephones, softphones and VoIP phones, determining the correct dispatchable location become a challenge. For example, consider a worker working from home on some days and from the office on other days using a softphone client or a mobile device at home and a VoIP desk phone at the office. The worker has a single phone number regardless of location or platform. It will be very difficult to determine the user's exact location without the aid of technology which can automatically acquire and send it with the call. A PSAP responder feels extremely helpless when taking a call and recognizing that someone is having a medical emergency but cannot speak or tell their exact location.

Dispatchable location requirements can be found in www.911.gov/assets/Dispatchable_Location_Requirements_Oct_2020.pdf. Both federal laws are designed with public safety in mind, and states may further enhance compliance requirements regarding accuracy. For example, state laws may define the maximum distance of the caller's location in a large open area.

E911 call routing architecture

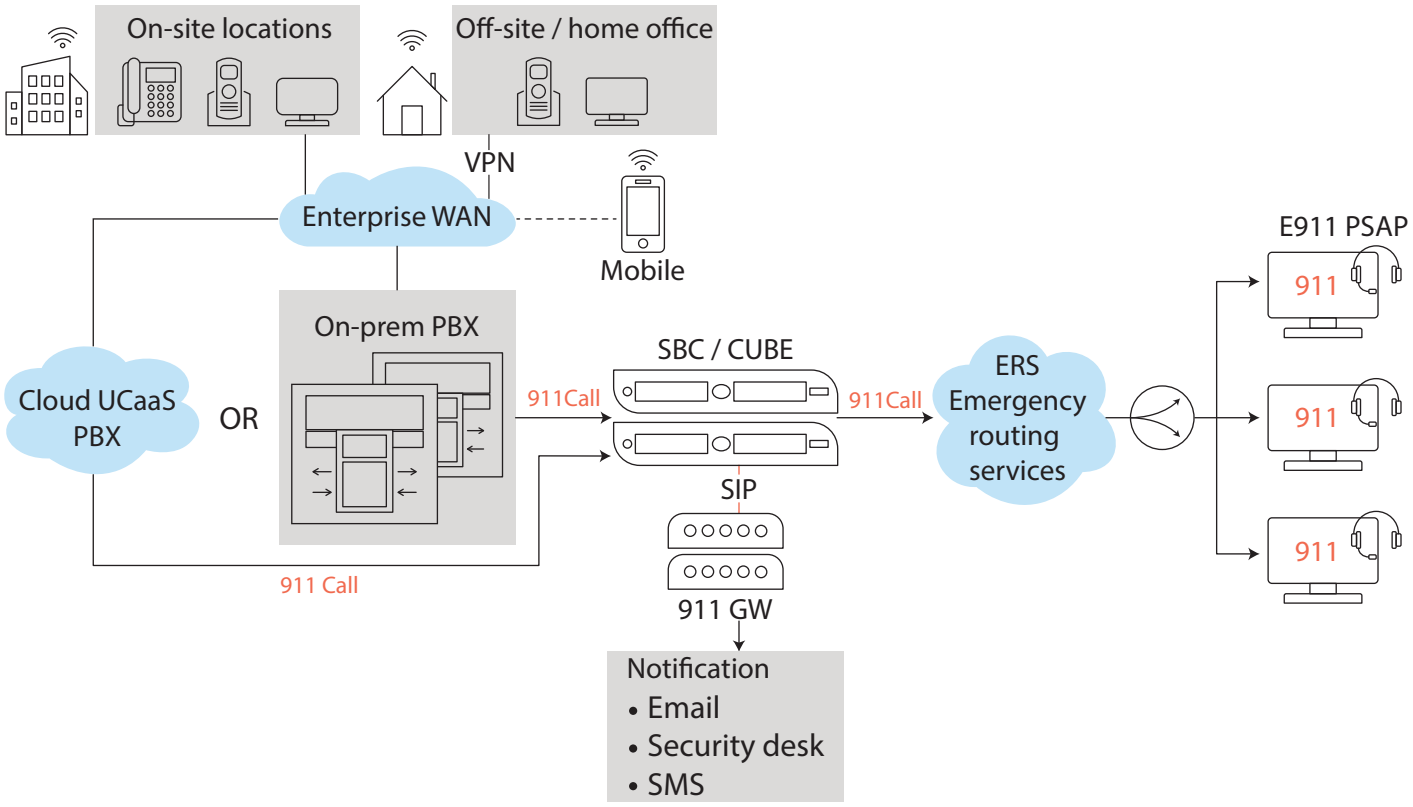
Considering the complexity of determining the location and routing the call to the local PSAP, here are some known best practice architectures. First, let us consider two cases where the multi-line phone system is cloud or on-premise. One example of a cloud-based phone system is the Microsoft Teams phone system. Cisco Unified Communications Manager (CUCM) is another example of an on-premise, multi-line phone system. A common architecture in both cases is to use an emergency call routing service (ERS) provider for triaging and relaying calls when the caller's location is unknown. There are many ERS providers supporting cloud based or on-premises platforms. For example, some ERS providers today are Bandwidth, Bulk Solutions, Intrado, RedSky and Telnet Worldwide. These ERS providers have agents at emergency response centers (ERC) manually taking the location information and routing the call to the caller's local PSAP. RAY BAUM'S Act requires the prevention of this manual triaging and relaying when the location information can be obtained automatically. When the location information is available automatically but with limited accuracy, the system should try to validate it as the best effort; otherwise, the calls are screened at ERC before relaying to the PSAP.

The picture in Figure 1 shows a commonly adopted E911 routing architecture.

Figure 1 shows a user from on-net or off-net, meaning working at the office or off-site, making a 911 call. For VoIP calls, the user's location must be determined dynamically. Unlike traditional fixed phones, the caller may be logged in from multiple devices, like a fixed line, wireless, or softphone client. The user's location must be determined dynamically and accurately in all cases. The location is determined based on network parameters and largely depends on the UC solution. Irrespective of the UC platform, the two main goals of this architecture are:

1. Maintain accurate phone location service regardless of the endpoint used and whether the endpoint is on-site or remotely connected over VPN from the home office.
2. Ensure 911 calls are delivered to the correct PSAP based on the caller's location. For example, if the caller with an office in the city is now working from home, the 911 call must reach the PSAP near the caller's home.

Figure 1 - E911 call routing architecture



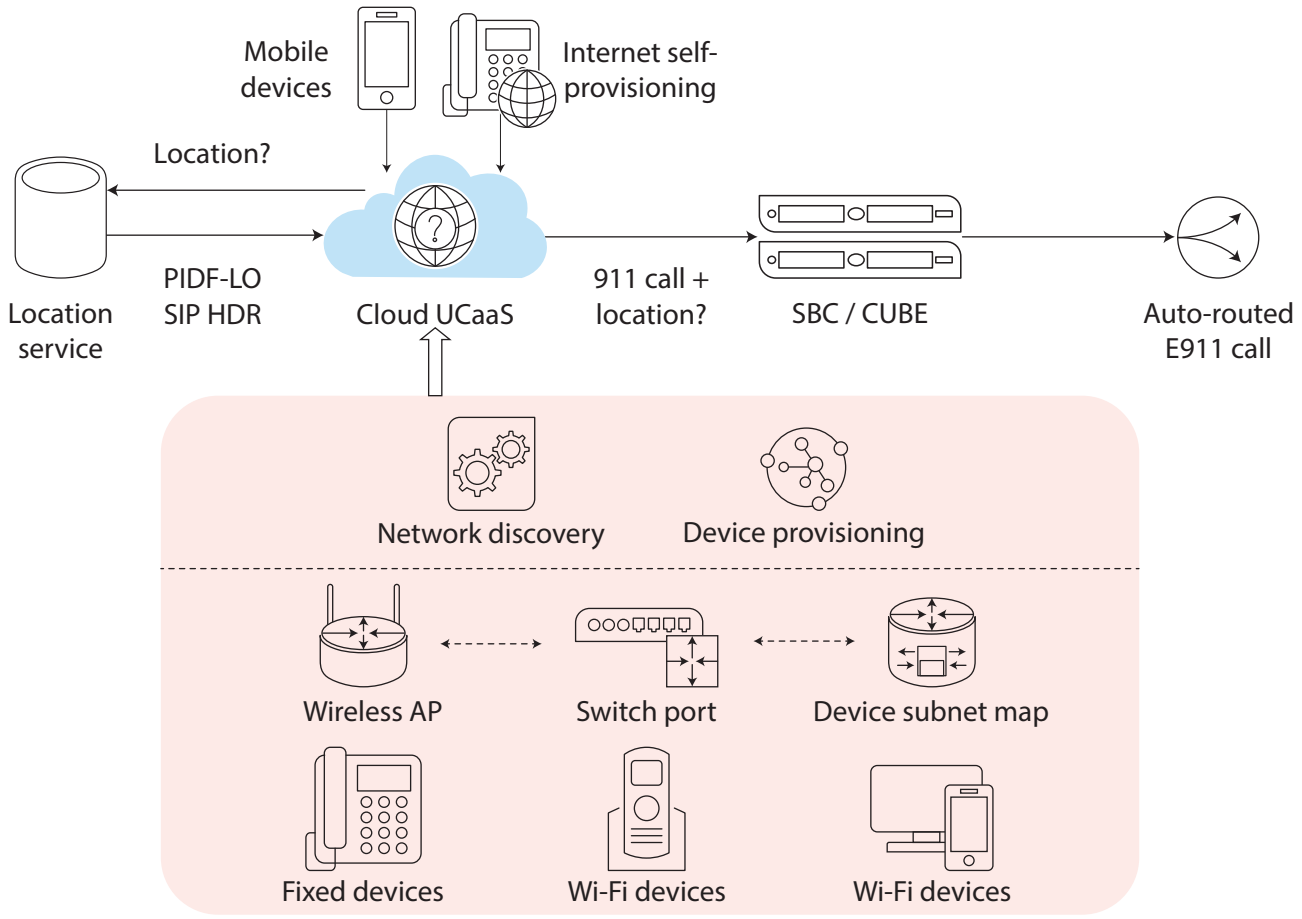
E911 location management

Meeting the above goals in an ever-changing environment requires a proactive approach and automation. Improper E911 location management will make the organization vulnerable to regulatory liabilities and civil lawsuit risk and, more importantly, enhance the risk to employee health and safety. Consider the three main E911 location management categories: fixed lines, Wi-Fi based and cellular. Each category has unique network identifier requirements to determine the device's location.

1. Fixed lines are identified by mapping the network switch port to a building floor, wing or room number. Network subnets are sometimes used if a department is on a floor with a unique subnet. The subnet map is granular and less accurate in a large floor area.
2. Enterprises may have multiple overlapping wireless LANs in the same airspace. Users would choose the SSID to connect to their WLAN corresponding to their service profile, such as an employee or a guest. However, as users roam in the building, the wireless signals are handled by different access points within their WLAN. Users are unaware of the basic service set identifier (BSSID) of the access point to which their devices are connected. This BSSID information is key to the location of the user. By mapping the wireless access point (WAP BSSID) coverage to the floor plan, we can accurately determine a location in a building.
3. Cellular devices (cell phones) have GPS to send the caller's coordinates. In addition, a service provider may use A-GPS and cell tower trilateration to determine device coordinates. As of March 17, 2022, the EU Delegated regulation 2019/320 came into force regarding the application of essential requirements for emergency caller locations for mobile devices. Another regulation adopted by the US FCC is the z-axis requirement for vertical location metrics inside multi-floor buildings. By April 3, 2023, the US cellular service providers must deploy a z-axis dispatchable location for the top 50% of their cellular market area (CMA).

A typical reference diagram for location management is shown in Figure 2.

Figure 2 - Provisioning E911 location management



The strategies for provisioning accurate location information depend on the platform. For example, provisioning Microsoft Teams E911 location information service (LIS) for fixed devices could be automated using protocols to discover the network topology. Similarly, in Cisco Emergency Responder (CER), the automatic location information (ALI) database could be auto-provisioned. The network subnet or chassis port number is discovered for fixed lines using automated scripts for LLDP or CDP. Another strategy for Wi-Fi BSSID is to download the access point coverage map from the WLAN controller. In cellular, the endpoint's location coordinates are converted by a map application to the caller's civic address or street address. Z-axis information may be used for floor information. It is best practice to incorporate best-in-class E911 location management procedures in IT organizations. This will account for endpoints being added, moved or removed. For example, when building a new site, the site's floor plan and network map should be used for automated provisioning.

Self-location provisioning is another option available for certain situations. When a home office or cellular user starts a softphone client or periodically after starting or if network connectivity changes, the client sends a query with its network identifiers to the location service. If a location match is found, the presence information data format location (PIDF-LO) for the endpoint is returned. If there is no match, say when the user starts a session off-net at a coffee shop, then depending on the emergency calling policy assigned by the administrator, the user may voluntarily choose to enter their current location (self-provisioned location). However, this information must be further validated using other network identifiers.

The emergency location identification number (ELIN) is a number that is deployed for specific locations. The PSAP can use ELIN to call back if the emergency call disconnects. For endpoints that have direct inward dialing (DID) numbers, the ELIN is the same as the DID. When a phone with no inward dialing or if SIP URI is used, an ELIN is assigned by the session border controller (SBC). Enterprises often deploy ELIN based on their phone numbering plan or dial plan. The SBC maintains a table that maps ELIN to the actual extension. This table is cached for 30 to 40 minutes after an E911 call is disconnected. As often happens in emergencies, multiple callers report it from a location and may then disconnect. The PSAP must call back each of these callers. Therefore, it is best practice for an enterprise to deploy an ELIN capable SBC.

E911 dispatchable location

Most UC solutions provide special software to validate and confirm the dispatchable location provisioned in the location database. For example, from Reference 1: "Microsoft Teams direct routing sends the LIS matched location in a SIP Invite to the SBC". The SBC must be set with "PIDF-LO Supported" and have the emergency routing service (ERS) provider's interface, and ELIN configured. When the SBC receives an E911 call with location information coded in the SIP invite, it is relayed to the ERS provider. In some situations, the emergency location address may differ from where the call originated. Therefore, it requires careful analysis and accurate configuration of the E911 location data depending on network topology and organizational security policy. In the case of Microsoft Teams, the precedence for location is an ordered matching of network identifiers from most accurate to least accurate:

- Wireless access point
- Network switch/port
- Network switch
- LAN subnet

In addition, further screening may be performed at the emergency response center (ERC) as shown in the precedence table of Reference 1 below:

The above table shows that dynamic emergency address validation is performed for Teams E911 calls before sending them to PSAP. The best practice here is to configure the available network parameters accurately. The off-net users must also verify their location when starting the application. Screening emergency calls take time, and determining the location often poses a challenge when the caller cannot speak.

Type of emergency address	Emergency routing verification method
Dynamically acquired emergency address defined by the administrator	No further verification is needed; route directly to PSAP
Emergency address obtained from the operating system without confirmation for accuracy by the user	Screen at the ERC and transfer to the correct PSAP
Emergency address obtained from the operating system with confirmation for accuracy by the user	No further verification is needed; route directly to PSAP
Emergency address obtained from the operating system, after that edited and confirmed by the user	Screen at the ERC and transfer to the correct PSAP
Emergency address entered and confirmed by the user	Screen at the ERC and transfer to the correct PSAP
Emergency address statically assigned to the user or extension (e.g., static ELIN)	Screen at the ERC and transfer to the correct PSAP
Null	Screen at the ERC and transfer to the correct PSAP

Reference 1 - https://learn.microsoft.com/en-us/microsoftteams/emergency-calling-dispatchable-location

NG911 evolution from E911

Without a doubt, location accuracy is a key challenge for E911. Next Generation 911 addresses these issues and presents other avenues of coordinated emergency communication. A good source for information on NG911 can be found at www.911.gov/projects/ under the topic NG911. Figure 3 shows the areas in NG911 for leaders in state and local authorities, fire services, EMS, law enforcement and telecommunicators.

Some of the use cases in Figure 3 apply to enterprises, while others are consumer use cases:

Figure 3: NG911 enhancement for EMS leaders

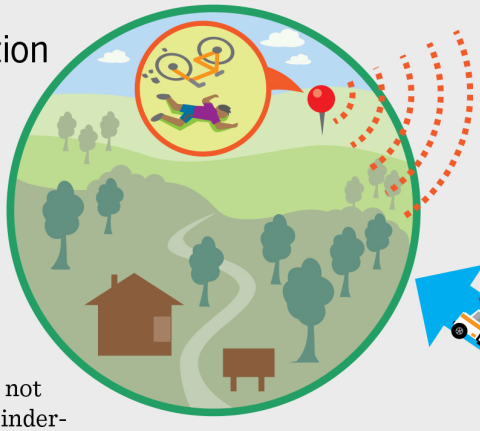
NG911 FOR EMS

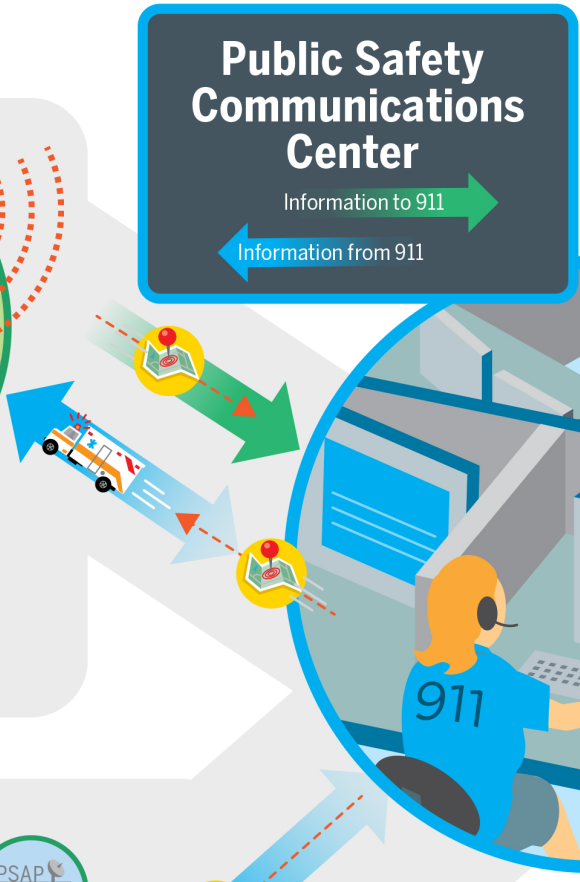
How EMS Benefits from Next Generation 911

Next Generation 911-related technologies will provide new opportunities to keep EMS providers and communities safer. The following scenarios provide a non-technical depiction of how new technologies will provide information leaders need to ensure safe, efficient and effective responses to a variety of incidents.

Improved Location Accuracy

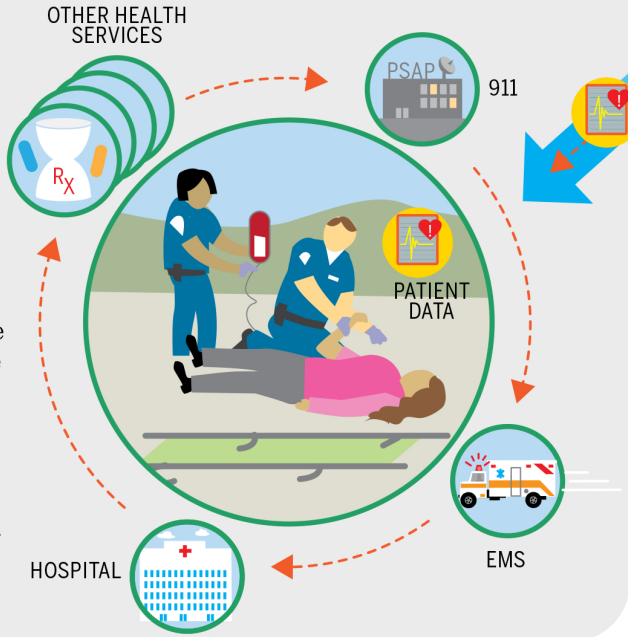
With improved location accuracy, responders will reach victims sooner and triage the scene more efficiently. This is especially important in challenging environments like rural areas or parks, densely populated urban areas or on freeways. Mobile callers may also not be aware of their exact location, hindering first responders' ability to reach them quickly. Because minutes count with critical patients, faster treatment improves outcomes and survival rates.

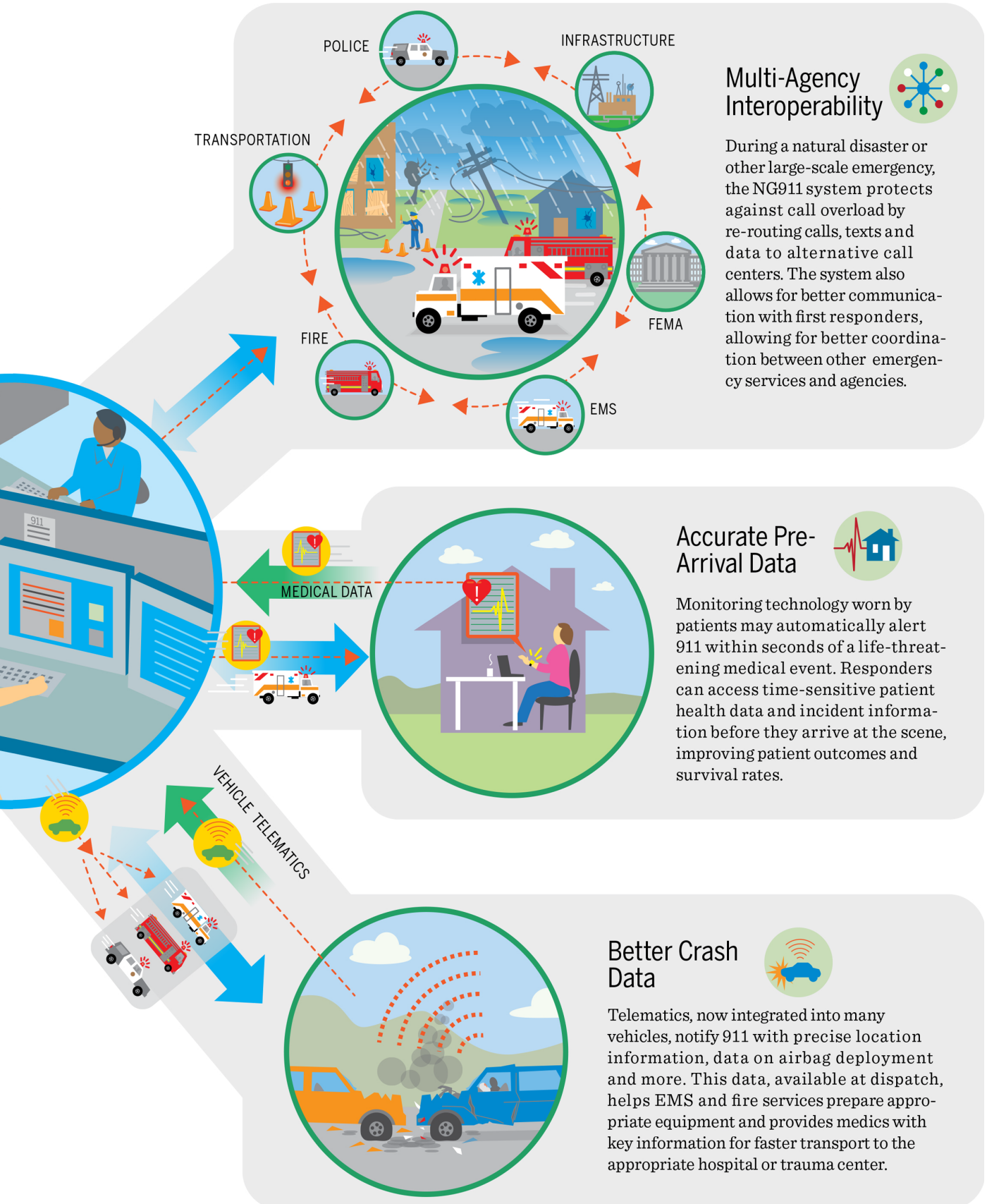




Continuity of Patient Data

In the NG911 environment, EMS would have access to more detailed medical history for a patient. In the future, the ability to merge medical data with 911 call data will give providers better on-scene information to improve patient care. Including outcome data within the patient record will provide a more complete picture to support performance improvement. Better data would translate to better overall patient care as well as the advancement of entire EMS systems.





Multi-Agency Interoperability

During a natural disaster or other large-scale emergency, the NG911 system protects against call overload by re-routing calls, texts and data to alternative call centers. The system also allows for better communication with first responders, allowing for better coordination between other emergency services and agencies.

Accurate Pre-Arrival Data

Monitoring technology worn by patients may automatically alert 911 within seconds of a life-threatening medical event. Responders can access time-sensitive patient health data and incident information before they arrive at the scene, improving patient outcomes and survival rates.

Better Crash Data

Telematics, now integrated into many vehicles, notify 911 with precise location information, data on airbag deployment and more. This data, available at dispatch, helps EMS and fire services prepare appropriate equipment and provides medics with key information for faster transport to the appropriate hospital or trauma center.

Reference 2 - NG911 Guide https://www.911.gov/projects/ng911-for-public-safety-leaders/ng911-guide-for-telecommunicators/

NG911 Enterprise Use Cases

- Improved location accuracy – the challenges were discussed earlier in this paper
- Multi-agency interoperability – in case of disaster recovery, a coordinated multi-agency response is required
- More accurate scene data – helps fire services to assess the scene and the building
- Improved firefighter safety – technology to access building sensors and potential victim location
- Improved officer safety – in a hostile situation, information from cameras inside the building for law enforcement officers

NG911 Consumer Use Cases

While consumer use cases for NG911 are outside the scope of this paper, some are applicable depending on their business. For example, the following are applicable for a transportation business emergency vehicle crash data:

- Accurate pre-arrival data –related to wearable technology worn by the patient that may help the EMS responder
- Better crash data – for vehicle crash victims
- Continuity of patient data - the medical history that may be available to help EMS
- Safer communities – data for law enforcement as video feeds
- More ways to help all types of callers and handle emergencies.

Conclusion

Business leaders need to take steps to prepare for emergencies. It is now mandated by law that all employees, vendors, contractors and guests, when on-premise, must be able to make emergency calls and get the response at their precise location in a very short time. Therefore, the enterprise must not just comply with E911 for on-premises users but also help employees off-premises local authorities, fire services, EMS, law enforcement and the community at large to respond to an E911 call effectively. If the E911 system is not designed properly, it is only a matter of time before an incident will cause serious losses of property or life. Worse, the organization is likely to face damages lawsuits and penalties. To avoid such situations, steps must be taken to design and deploy a fully operational E911.

With a rich history of developing and provisioning the right emergency calling solutions, Infosys can help organizations of all sizes with E911. Expertise from Infosys is available through an organizational journey from basic 911 to E911 to NG911. Please contact <*Infosys contact email needed*> to learn more about Infosys E911 solutions, best practices and roadmap for NG911.

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