Photos courtesy Mission Critical Partners

The State of NG 9-1-1 in the U.S.

Much has been accomplished in the NG 9-1-1 migration, but there is plenty of work still to do.

By Glenn Bischoff

It seems universally accepted that the birth of next-generation 9-1-1 (NG 9-1-1) service in the United States occurred when the National Emergency Number Association (NENA) released its "E9-1-1 Future Path Plan" document in 2001. Ever since then, state and local 9-1-1 authorities, with support from the federal government, have strived to implement NG 9-1-1 technology, which represents a quantum leap forward in terms of service delivery compared with legacy 9-1-1 systems.

IP-based and broadband-enabled NG 9-1-1 systems enable the delivery of text, video, images and other forms of rich data to public-safety answering points (PSAPs), also known as emergency communications centers and 9-1-1 centers, when calls are made from wireless devices. This is important because NENA estimates that more than 80 percent of 9-1-1 calls are generated by such devices. The key result from NG 9-1-1 system implementations is expected to be enhanced situational awareness that will enable emergency responders to perform their jobs better and more safely.

So, two decades later, how is the NG 9-1-1 migration faring? Based on data published by the National 911 Program in its latest "National 911 Annual Report," which is based on 2019 data, the migration clearly is a work in progress. Data was collected from 48 jurisdictions — 46 states, the District of Columbia and Puerto Rico — on a voluntary basis. The following are a few key indicators:
- 33 states have developed NG 9-1-1 plans that address governance, funding, system components and operations.
- 2,152 PSAPs reported being connected to an emergency services IP network (ESInet), which is used to deliver emergency calls to NG 9-1-1-capable PSAPs, a 19 percent increase compared with 2018 data. An NG 9-1-1 system is comprised of one or more ESInets and next generation core services (NGCS), which enable NG 9-1-1-compliant PSAPs to handle emergency calls and dispatch emergency response.
- Eight states reported that at least 100 PSAPs in their jurisdiction are connected to an ESInet; only 10 states reported that no PSAPS are connected to an ESInet.
- 141 ESInets are deployed across 34 states.
- 14 states reported the existence of two or more ESInets, while another 20 reported at least one.
- However, only six states reported that 100 percent of their PSAPs are connected to an ESInet.
- Only 11 states reported that 100 percent of their PSAPs are capable of processing and interpreting NG 9-1-1 caller and location information.

As often is the case, the numbers cited above appear to tell two different stories regarding the current state of the NG 9-1-1 migration. To gain a deeper understanding, we asked three leading subject matter experts (SMEs) a series of topic questions.

What is the current state of NG 9-1-1 service in the United States?

Flaherty: We continue to move forward nationwide, though admittedly not at the rate that we would like. However, we collect voluntary data from the states every year, and that data continues to show progress, not only in the building blocks required to move NG 9-1-1 forward, but also in each state's migration.

We look at data points such as how many states have converted their legacy master street address guide (MSAG) data to geographic information system (GIS) data. Or, how many states have 100 percent of their public-safety answering points (PSAPs) connected to emergency services Internet Protocol networks (ESInets).

States generally fall into three categories: early adopters, those that are moving toward NG 9-1-1 and those that are considerably behind in their migration. When we analyzed the 2019 data, we found that most states that are not early adopters were poised to leap forward into the next category. We found that very encouraging.

We are sifting through the 2020 data now — that report is expected to be published by the end of this year — and it will be interesting to see what impact the grant program that is jointly administered by the National 911 Program and the National Telecommunications and Information Administration (NTIA) has had on NG 9-1-1 implementations. At the end of the day, what we want is a nationwide interconnected system of systems.

Sutton: We started our NG 9-1-1 project in 2011, which was before the NENA i3 standard came out, so we were focused solely on Tennessee. Once i3 emerged, we tailored our implementation to that new standard. We currently are migrating to AT&T's nationwide ESInet from the stand-alone network that we created. This will enable interconnectivity with other states and will provide us with greater flexibility. This will be the third iteration of our NG 9-1-1 implementation. This is noteworthy because many states are just starting their migrations.

Our successful migration has created a template that other states can follow and benefit from the lessons that we learned. Right now, Tennessee is ahead of nearly every other state in terms of the NG 9-1-1 migration because of our early adoption.

Speaking nationally, Tennessee is not the only state that has found NG 9-1-1 success. Several states have statewide NG 9-1-1 systems, and other states with populations like ours, such as Indiana and Massachusetts, have statewide text-to-911 capabilities, which Tennessee does not have. However, Tennessee has text-to-911 capabilities in local districts. States that are starting their migrations or may be trying to accelerate their implementations can develop a good road map by following other states' examples, including Tennessee.

Chiaramonte: Incredible progress has been made in a relatively short amount of time. NENA released its "future path" plan for NG 9-1-1 in 2001, so the concept has been established for a couple of decades, and while that might seem like a long time, it really is not, especially when one considers the evolutionary path taken by legacy 9-1-1 service. In the last few years, several states have made some amazing strides regarding their NG911 implementations. For example, we know of states that are implementing their second or even third generation of ESInet. In addition, several other states have started the procurement process or have begun to implement an ESInet. In the last five years, more progress has been made than in the previous 15 years.

Can you briefly describe the evolutionary path that NG 9-1-1 has taken?

Flaherty: This is difficult to characterize because every state is different. There are four basic building blocks to an NG 9-1-1 implementation: the ESInet, NGCS, GIS and the call-handling equipment. Depending on each state's particular circumstances, it will decide how to best approach those components. One state

Meet Our Panel of Experts

Laurie Flaherty

Laurie Flaherty, director of the National 911 Program, which was created to provide federal leadership and coordination in promoting optimal 9-1-1 services

Curtis Sutton

Curtis Sutton, executive director of the Tennessee Emergency Communications Board (TECB), which provides support to 100 emergency communications districts and oversees the statewide ESInet

John Chiaramonte

John Chiaramonte, president of the consulting division of Mission Critical Partners, which supports the National 911 Program and works with TECB to plan, design and implement Tennessee's statewide ESInet, among a variety of public-safety clients.

---

might decide to focus first on the ESInet, while another might choose to tackle the GIS piece first and so on.

But it is safe to describe the path as one that has experienced a lot of fits and starts, and that primarily has to do with governance and funding. The technology is the easy part. The challenges start to occur when the conversation turns toward who is going to be in charge and who is responsible for paying for it.

That is why our self-assessment tool has been so valuable. Certain things need to happen in a logical progression to move NG 9-1-1 forward, i.e., certain things need to be in place before you can move to the next step. This

tool enables states to clearly discern where they are on the continuum. It also offers consistent terminology and framework for working with other jurisdictions.

Sutton: Tennessee's years-long effort to establish NG 9-1-1 largely has been driven by the need to upgrade equipment on the part of local 9-1-1 centers and the adoption rate of the i3 standard in the vendor community. The 9-1-1 centers are responsible for procuring their own equipment. While the state helped fund those purchases, we do not mandate specific types of equipment, and that has resulted in some uncertainty. Meanwhile, vendors needed to be able to connect into an

NG 9-1-1 system that is based on the i3 standard. Another challenge arose when vendors promised that they were i3 compliant but were not.

Yet another challenge is that NG 9-1-1 is a relatively new technology that is evolving rapidly. Every year we see improvements and new capabilities. It is important that we remain flexible so that we can take advantage of each technology advancement—we must be able to evolve as the technology evolves. But this also depends on the readiness of the NG 9-1-1 vendors and the state's 9-1-1 centers.

Traditionally, there has been some hesitancy on the part of some centers to migrate from the

familiar copper environment to an IP environment, which brings new responsibilities, such as addressing the cybersecurity risks that are intrinsic to IP networks. Change always is difficult to achieve; some people simply are more comfortable operating the way they always have since 9-1-1 service arrived in Tennessee. We largely have overcome that, but it has contributed to the years of work. It works similarly with vendors; some are better than others at keeping up with innovation.

Cybersecurity is a new thing in the public-safety community that PSAPs have not had to worry about before. To help allay their concerns, we launched a program using federal grant dollars to conduct cybersecurity assessments at every PSAP to help them identify and mitigate their vulnerabilities. But it is important to note that, to advance public safety and to advance 9-1-1, new responsibilities like this one are going to emerge. That's part of growth. And, with the new things that we can do in an IP environment, driven by broadband, it certainly is worth taking on those responsibilities.

Chiaramonte: The evolutionary path that NG 9-1-1 has taken very closely resembles the "diffusion of innovations" theory espoused in 1962 by Everett Rogers, an assistant professor of rural sociology at Ohio State University. Rogers identified five classes of innovation adopters: innovators, early adopters, early majority, late majority and laggards. The NG 9-1-1 migration clearly is moving from the early adopter phase to the early majority phase. That is why the 9-1-1 community has made more progress, faster, regarding the NG 9-1-1 migration than ever before. There are more vendors in the marketplace. There is a history of successes across the nation. In fact, several

statewide ESInets are delivering 9-1-1 calls to every PSAP in the state. That would have been unusual five to seven years ago. NG 9-1-1 no longer is theoretical. It is real.

When we consider an NG 9-1-1 "roadmap," we think in terms of four key aspects: technology, operations, governance and funding. Each has different challenges, and progress is measured differently for each. And, each has evolved differently. From a technology perspective, we have seen great progress. NG 9-1-1 vendors today are using state-of-the art, best-of-breed technologies, some of which did not exist a few years ago, including cloud-based solutions.

However, regarding operations, several challenges exist. For example, 9-1-1 officials understand the critical benefits that interoperability provides. They not only want but need the ability to transfer 9-1-1 calls seamlessly, with call data intact, to a center in another town, county or state when the need arises, an ability that so far has proved difficult and often costly to implement. Unfortunately, 9-1-1 calls do not respect jurisdictional boundaries. The good news is that the National 911 Program has published four chapters of its Interstate Playbook to address this need.

From a governance perspective, continuity-of-operations (COOP) and disaster-recovery planning is more important in an NG 9-1-1 environment simply because many more entities will be interconnected with an ESInet compared with a legacy 9-1-1 system, so the "field of damage" will be far greater if a cyberattack or other failure occurs. A step in the right direction was the FCC's recent notice of proposed rulemaking (NPRM) regarding 9-1-1 service reliability and outage reporting. It is vitally important that 9-1-1 centers become imme-

diately aware when a problem occurs so that they can take appropriate action, and that is even more important in an NG 9-1-1 environment.

What needs to happen to continue the expansion of NG 9-1-1 nationwide?

Flaherty: At the national level, we are looking at things that will tie the system together, such as the "Interstate Playbook," which provides guidance for interconnecting ESInets on state and regional levels, and the project that is being funded jointly by the National 911 Program and the Department of Homeland Security's (DHS) Science and Technology Directorate (S&T) to establish an interoperability testing model. Another project with the directorate concerns developing an artificial intelligence (AI) capability that will make it easier and more efficient to incorporate multimedia into the call flow. A separate project involves establishing technical requirements for interconnecting NG 9-1-1 networks with public-safety broadband networks.

But we also are really interested in learning what each state needs to move NG 9-1-1 forward, especially in states that are way behind in their migrations. For instance, we have heard that some of these states need a lot of help navigating the grant application and procurement processes. So, we are focused on helping them clear these hurdles. One of the things that we have learned concerns states that had done a considerable amount of planning, coordinating and communicating even before applying for grants. They were able to hit the ground running once they received an award. This is an important lesson for every state.

Sutton: We need to start talking

about interconnectivity of NG 9-1-1 networks on a state-by-state basis. Tennessee is surrounded by seven states. We must be able to transfer 9-1-1 calls and location information, especially in a mobile environment, to the PSAPs in those other states. This is to ensure that callers do not receive lesser service than they would receive if the call had been handled exclusively in Tennessee.

That is not easy because the call must travel from one IP environment to another, totally different IP environment. If every state worked with the same NG 9-1-1 solution provider, this process would be easier, but that is not the case, and it is never going to be the case. So, we must come up with a plan to interconnect those disparate networks. The vision for NG 9-1-1 is that of a nationwide network of networks, but the slow pace of deployments has made this goal difficult to achieve.

Chiaramonte: One thing already has happened, which is that NENA recently released the third version of its i3 (third iteration) standard and has sent it to the American National Standards Institute (ANSI) for accreditation, which is expected. That is very exciting because the latest version of the standard not only introduces new features and updates existing ones, but it also will remove obstacles to NG 9-1-1 implementation and make it easier to achieve ESInet interoperability. Standards are vitally important in all aspects of public-safety communications, but especially regarding the 911 system, because all of us have a right to expect a consistent level of service regardless of where we are at any given moment.

What specific obstacles to expansion exist and how can they be overcome?

Flaherty: Funding always is an obstacle but more so right now because tax and tourism revenue has diminished significantly due to the COVID-19 pandemic. Some states have seen a reduction in 9-1-1 staffing as a result. But, another big obstacle concerns communication, specifically having everyone at the table who needs to be there and then getting them talking with each other. The effort that California made in this regard serves as a shining example of how to do this well. There are 450 PSAPs and the state 911 office made sure that each of them was in on the plan. That is what it is going to take to move NG 9-1-1 forward. In addition, every state should try to discover what other states are doing and then decide what they can replicate. The National 911 Program's bimonthly "State of 911" webinar series is a good place to start.

Sutton: The siloed nature of public safety still is a significant obstacle. One can easily understand why this situation exists. Public-safety agencies feel an enormous responsibility, when a call for help comes in, they want to feel that they are doing something about it, so they do not like to let go of those calls.

Even in Tennessee, if a 9-1-1 trunk or NG 9-1-1 connection were to fail, PSAPs would prefer that the call rolls over to a 10-digit administrative line rather than be transferred to another 9-1-1 center so that they can handle the call and ensure that the appropriate response is dispatched. Developing operational standards and protocols that dictate what happens in such situations will go a long way toward removing this obstacle. It can be done. It has been done on the technology side for more than a decade.

Doing so is vitally important. If we can master the technology but cannot master the operational aspects of using the technology to ensure a competent response, then this effort to migrate to NG 9-1-1 will have been for naught.

Chiaramonte: Funding always is a challenge. Historically, if a state wanted to pursue NG 9-1-1, it had to do so within the bounds of its traditional funding mechanism, essentially subscriber fees, and that has been tremendously difficult. Some states have established grant programs to entice communities to pursue next-generation solutions, but most have not, which has resulted in a piecemeal migration.

NENA estimates that more than 80 percent of 9-1-1 calls are generated by such devices. The key result from NG 9-1-1 system implementations is expected to be enhanced situational awareness that will enable emergency responders to perform their jobs better and more safely.

However, the Next Generation 9-1-1 Act of 2021, introduced in Congress as part of the LIFT America Act, is encouraging because it calls for $15 billion in funding for NG 9-1-1 expansion. This is significant because the "NG 9-1-1 Cost Study" that Mission Critical Partners developed for the National 911 Program a couple of years ago estimated that the cost of implementing NG 9-1-1 service nationwide would be about $12 billion. This is a funding mechanism that is on the level of the nationwide public-safety broadband network (NPSBN) being implemented by the First Responder Network Authority (FirstNet) and industry partner AT&T, so the level of funding proposed in the LIFT America Act is sorely needed, to ensure that all states and territories will be able to implement NG 9-1-1.

Another obstacle concerns the fact that much more data is being generated, driven by the proliferation of multimedia and sensor systems. Broadband-enabled NG 9-1-1 systems will enable that data to flow into 9-1-1 centers. However, raw data without context has no utility, so PSAPs will need to contemplate how to contextualize the data, largely via AI and machine learning technologies, if NG 9-1-1 is to realize its full potential.

A growing concern is that there might not be enough capacity within the vendor community over the short term if the LIFT America Act funding becomes available and a slew of states move quickly to begin or accelerate NG 9-1-1 implementations. The precepts of supply-and-demand economics suggest that supply increases when demand increases, but when it comes to NG911, that ramp up is going to take some time. Consequently, the acceleration of the NG 9-1-1 migration nationwide likely will not happen as quickly as hoped due to a fundamental lack of experienced resources and experts. Even now, some NG 9-1-1 vendors are struggling to meet current demands. How will they handle an exponential increase in procurement requests over the short term?

What will be the state of NG 9-1-1 two years from now? Five years from now?

Flaherty: This also is a difficult question to answer definitively because there are many disparate technical and non-technical considerations. One concerns the LIFT America Act, which would authorize $15 billion for NG 9-1-1 expansion and prevent states that divert 9-1-1 funds to other purposes from receiving any LIFT America Act money. Will the bill become law? If so, will the money be allocated? Predicting how NG911 expansion plays out short- and long-term depends largely on the answers to those questions.

We also are trying to draw

Next-generation 9-1-1 (NG 9-1-1) is providing dispatchers in some areas around the country new ways to interact with the public and responders.

federally operated 9-1-1 centers into the conversation. For instance, the Department of Defense (DoD) has moved from an "if" posture to "when" regarding NG911, which is really encouraging, because when states turn off and decommission their legacy selective routers as they complete their NG 9-1-1 migrations, there will be implications for federally operated 9-1-1 centers. It seems clear that the Department of Defense (DoD) will be engaged, but we also are hoping that other entities, such as the Coast Guard and the National Parks Service, also get on board. If that happens, then decisions will need to be made regarding how state and local NG 9-1-1 systems interact and interconnect with federally operated systems. Again, the ability to predict NG 9-1-1's track over the next two to five years will depend on the answers to questions like these.

Eventually, NG 9-1-1 will become ubiquitous, in part because of the cost- and resource-sharing aspects. But there are a lot of small PSAPs out there, and it likely will take them longer to get across the finish line. Also, up until now, there has not been enough financial incentive to stop states from diverting 9-1-1 funds. Will the Lift America Act break that cycle by appropriating enough money for NG 9-1-1 advancement? If it does not, then the NG 9-1-1 migration of states that are diverting might be slowed. Another big problem is that past funding legislation has required a matching contribution from the states. This has prevented some states from applying, and these are typically smaller states that need the money the most. Ideally, the LIFT America Act, in its final version, would remove the match requirement, at least for smaller states, perhaps based on population.

Despite these hurdles, I still am confident that NG 9-1-1 will be ubiquitous someday. It just might not happen in the next five years.

"The siloed nature of public safety still is a significant obstacle. One can easily understand why this situation exists. Public-safety agencies feel an enormous responsibility, when a call for help comes in, they want to feel that they are doing something about it, so they do not like to let go of those calls."

- John Chiaramonte

Sutton: Two years from now, I think we will see a major leap forward in NG 9-1-1 deployments. Five years from now, we will begin to see interconnectivity between networks, including state to state. We also will see advancements in how NG 9-1-1 networks are interconnected, as well as how devices connect to the 9-1-1 system. For instance, we already have devices in our cars and in our homes that can trigger a 9-1-1 call without any human involvement. More of this type of intelligence will emerge — in an IP environment, the possibilities seem endless — and we must be ready for it. Consequently, NG 9-1-1 networks must continually, if not continuously, evolve to keep pace with new developments, which are going to come regardless of whether we want them to.

Chiaramonte: We can look forward to a continued acceleration of progress but the pace will depend largely on available federal funding and the ability of vendors to ramp up. But, the vendor community will respond, it always does, and so will the states by enhancing their coordination.

The biggest question is whether the federal government will do their part by funding the transition. If the LIFT America Act is not enacted and the promised $15 billion does not materialize, the NG 9-1-1 migration will not accelerate, and it might even decelerate. That is a major concern. Some elements of the legacy 9-1-1 system, such as selective routers, have been in continuous operation for four decades, which exposes the 9-1-1 system to failure. This could be catastrophic during a major emergency. At the very least, it would place citizens at far greater risk because they might not be able to get the help that they need, which is unacceptable.

Therefore, I believe that the states, vendor community and federal government will respond to this glaring infrastructure need and that NG 9-1-1 services will be available coast to coast, and border to border, if not in five years, then certainly within the next decade. ■

Glenn Bischoff is a content specialist for Mission Critical Partners, a State College, Pennsylvania,-based consultancy that serves public-safety and justice organizations. Prior to joining the firm, he was editor-in-chief of Urgent Communications for a decade.

Product Spotlight

The following products include new and improved offerings from leading industry suppliers. To learn more, please visit the company's website or contact them directly.

Don't forget to mention that you saw their product in *MissionCritical Communications.*

A Beep, dba Diga-Talk Plus

The DTPFN-9751 portable push-to-talk (PTT) radio provides a unique sales opportunity for Diga-Talk dealers as the radio is now available on First-Net. Dealer agents can offer one of the only dedicated PTT devices for FirstNet extended primary users. The DTPFN-9751 combined with FirstNet service is available bundled together in an end-to-end solution.
www.digatalkplus.com

Alive Telecom

Alive Telecom's 700/800 MHz vertically polarized omni antenna has a corporate array design for improved pattern control, with multiple beamtilt and null-fill options. The antenna has an omni azimuth pattern of +/-0.25 dB circularity across the entire 746 – 870

MHz band and comes in unity to 12.5 dBd gain models. The product provides 500 W input power and is PIM rated at -150 dBc or better. A new dipole array design creates a 35% wind-load reduction and 25% decrease in weight. The antenna comes in an IP-66 rated enclosure as a standard or inverted mount.
https://alivetele.com/

Assured Wireless

The MegaRange high-power user equipment (HPUE) solution provides America's first responders with significant coverage benefits. Power class 1 HPUE solutions can transmit signals that are about 10 times that of the normal handset. The solution can be used on the high-quality band 14 spectrum set aside by the U.S. government specifically for FirstNet. FirstNet is the only network where public safety can take advantage of the highest power class signaling available in the U.S.
www.assured-wireless.com

Bird

The Master RF Kit provides a wide frequency range from 1 MHz to 6 GHz for cable and antenna testing and a 9 kHz to 6 GHz spectrum analyzer to help users keep up with the everchanging requirements in the communications market. These units house a full range of rich features such as return loss, VSWR, cable loss, distance to fault (DTF) and predefined measurements including channel power, adjacent channel power ratio (ACPR), occupied bandwidth (OBW), phase noise, N dB down bandwidth, field strength and FM demodulation, for spectrum analysis.
www.birdrf.com

Catalyst Communications Technologies

The IntelliLink interworking system establishes communications