Your Partner In Critical Communications

WHITE PAPER

The Challenges of Deploying a Statewide NG9-1-1 Solution

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Introducing a New Paradigm

Surveying what one might call the history of innovation, one can arguably come to the conclusion that introductions of new technologies fall into one of two categories—those that are incremental improvements over what currently exists, and those that represent a more fundamental change in the way affairs are conducted or services are delivered. The former are usually extensions of an existing idea, while the latter are generally truly new innovations.

But then there are some changes that represent so great an extension of an existing construct that they should be viewed as representing a true sea change in operations. Such a characterization becomes valid in the presence of two major aspects, magnitude and complexity. Implementing changes in technology of this sort is often more daunting than even inventing them because it is in the implementation process where the idea confronts all the implications of the change, as well as those factors that form natural barriers even to the most desirable of innovations.

We've come a long way

Implementing Next Generation 9-1-1 in its entirety on a statewide basis is an example of just such a major innovation. Like the first introduction of Basic 9-1-1 services, NG9-1-1 represents a fundamental shift in how public safety answering point (PSAP) authorities and planners will provide and support emergency communications services. Basic 9-1-1 was an innovation of the first order of magnitude. And no one argues with the success of the idea—millions of calls handled per year, likely thousands of lives saved over the last several decades. Since then, we have witnessed a series of improvements—Enhanced 9-1-1, Cellular 9-1-1, etc. These improvements stand as brilliant adaptations of a fundamentally great idea, yet they remain simply extensions of that idea.

NG9-1-1 is of a magnitude equal to the introduction of the service so many years ago. As the industry foresaw, the basic platform could only be improved so far before it would have to be replaced, as market forces provided the public with new means of communications that could no longer be supported by existing 9-1-1 technology. It was also now understood that the process of technological innovation would continue and so the 9-1-1 industry needed to establish a totally new model that would possess the flexibility that could accommodate yet unforeseen needs.

Complexity

This objective of a technical platform that must be open not only to a growing variety of call types but also to whatever may come in the future, combined with two other aspects of NG9-1-1 to render an unprecedented level of complexity to the overall system architecture. Those added factors are the change in routing based on location in a geographical systems context rather than a simple database file, and the practical reality that changing from E9-1-1 to NG9-1-1 on a statewide basis represents a migration made over several months, and not simply a one-time event.

These factors impact the architecture by requiring a number of new components that must be designed and integrated to all work together on any given 9-1-1 call:

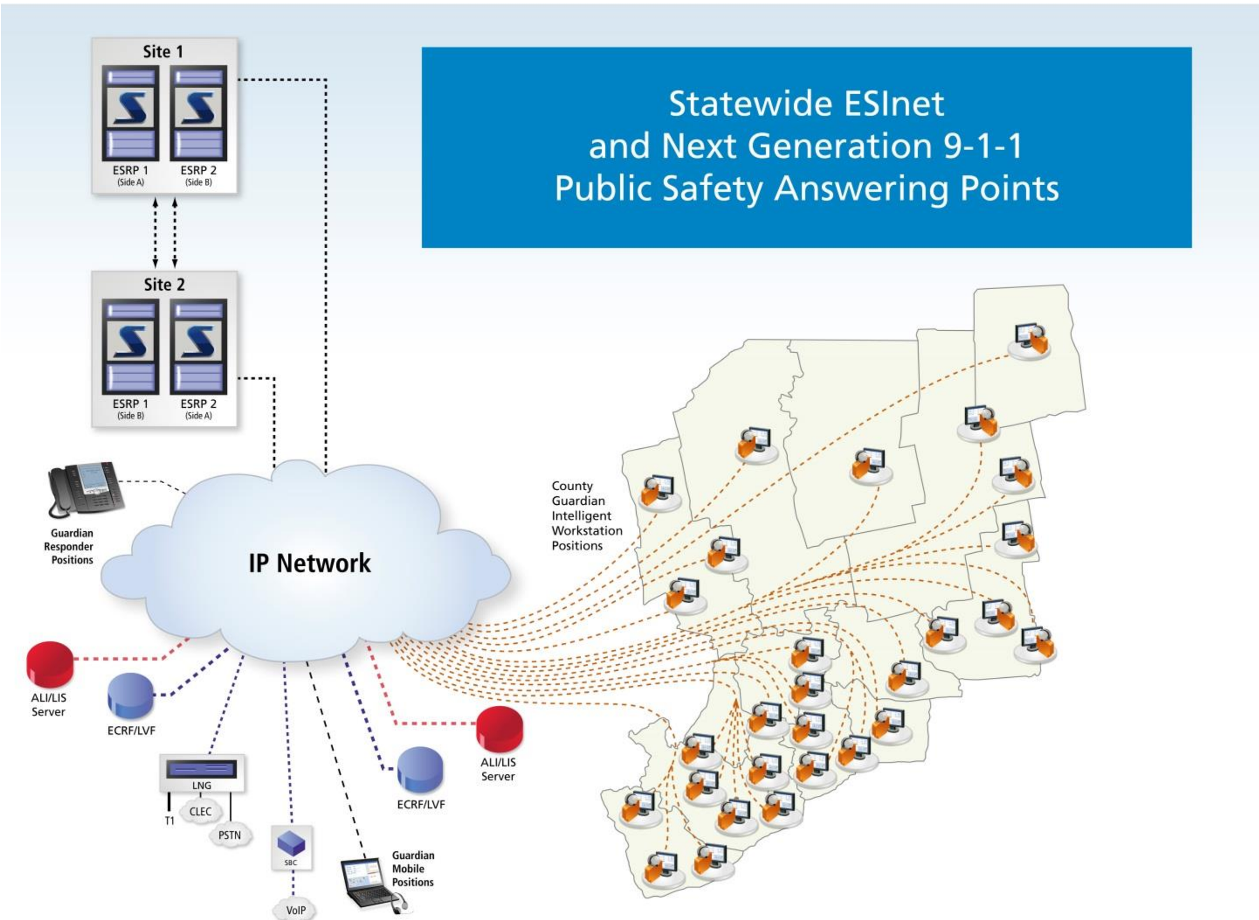
- Legacy Network Gateways (LNGs) and Session Border Controllers (SBCs) provide the access points for callers coming in on different types of trunks: CAMA, SIP, SS7. These major subsystems provide the protocol conversion and—of great necessity, the security—to bring callers into the Emergency Services IP Network (ESInet), which is the backbone of the overall service.
- Emergency Communications Routing Function (ECRF) servers and the Emergency Services Routing Proxy (ESRP) work with the Automatic Location Identification (ALI) database to route calls to the right PSAP, be they wireless or wireline.
- All components are duplicated and located in geographically separate sites so as to provide full diverse redundancy, thus adding to the complexity of configuration and set up.

A system change of such magnitude has an impact not just on features, but on all aspects of service provision: design, configuration, implementation, training, organizational responsibility, maintenance and support, and integrating the utilization of the features into current practices. That the project is a matter for life safety, thus requiring the highest levels of reliability at all stages of the development and deployment process, as well as requiring failsafe security of communications, only amplifies the complexity and magnitude of the effort.

Design Imperatives

The NENA technical requirements for Next Generation 9-1-1 are among the basic, driving parameters for the design, and result in a multiplication of components for redundancy. Using highly reliable sub-systems, hardware and software, geo-diverse core network elements, and a plan for backing up PSAPs are all essential to maintaining 99.999% system availability. The core data center capabilities that control the service (routing policies, network and legacy system interfaces, ALI) must be built such that the architecture provides not only redundancy but also geographical diversity. Solacom's approach to this requirement is to equip two full data centers with duplicated components or redundant components such that they are diversely related to each other. Independent SBC and LNG functional elements are deployed at both data centers. The terminating ESRP are diversely related, thus the "A" side of ESRP platform Number 1 is in one city (call it Center 1) and the "B" side is in another one (Center 2). Likewise the A side of ESRP 2 is in Center 2 and the B side is in Center 1. Every call taker workstation in every PSAP is connected to both, one ESRP as primary and the other as secondary. The ECRF platforms co-exist in a similar geo-diverse scheme in each data center. This provides not only full geo-diverse redundancy for on-going services, but enables upgrades and changes to be implemented in a graceful way that precludes any system down time.

This connectivity schema can become a challenge in itself, depending upon the available facilities to all of the locations involved. Not every location will have fiber all the way to the PSAP and some locations will require facilities from different carriers as well. That condition will require a variety of network options used, as mentioned above. While providing those options is not difficult, it adds some complexity to the job of optioning equipment, configuration, testing, documentation and troubleshooting. Well detailed documentation and a close familiarity with the underlying network are at a premium in maintenance and service.



Another design aspect related to redundancy is providing each PSAP with back-up options in the event the PSAP becomes inoperable, which can happen for any one of a number of reasons. Great pains were taken to ensure that no call is lost across the entire service area. Fortunately, NG9-1-1 allows a great deal of flexibility for setting up back-up routing in the ESRP. The fact that the move from E9-1-1 to NG9-1-1 is a migration of PSAPs from the legacy platform to the new one, rather than a total flash cutover, requires an extra step in setting up a back-up plan for the initial PSAP cutover where there will have to be a legacy back-up and then setting up the long term back-up plan. Another requirement is to test to ensure all back-up routing for all PSAPs is correctly provisioned when cutting over the first PSAP and not after each PSAP.

Migrating to the New Model

As pointed out above, the change from E9-1-1 to NG9-1-1 on a statewide basis—twenty plus PSAPs, a lab, and a training center requires a carefully planned migration. The first order of priority is to ensure that the organizational infrastructure can support the new services. It is important to remember that the core platforms are a wholesale replacement—legacy CPE controllers, IP servers, routers, switches, etc., replacing #5ESS switches. This technology shift requires a corresponding shift in support staff capabilities and knowledge. Training requirements on configuration, testing, maintenance, and support for central office personnel are extensive and may impact IT organizations that have had little experience with what might be called the "culture of 9-1-1."

From our experience, a statewide implementation also impacts the field service technicians of the 9-1-1 provider. Solacom's architecture allows for a more centralized, "cloud-based" control of user configuration and administration than in older 9-1-1 architectures. This shift in where capabilities are located means that many of the configuration and administration responsibilities shift to the data center support personnel and not the local PSAP support. That implies changes in overall job descriptions as well as changes in procedures for moves, adds and changes.

As a result, organization and training need to be planned out very carefully and well in advance. Moreover, we felt it necessary to make the first step in the installation of the core to include a lab site which could be used off-line for testing and a rather large training facility. The lab facilitated early and cost effective training of installation personnel. The lab will continue to be a valuable resource for testing upgrades and other system elements prior to deployment on the active system.

The training center was configured as two separate PSAPs, each connected to a different primary data center—ECRF/LNG/ESRP. This enabled us to fully test inter-PSAP calls, fail-over scenarios, etc., in addition to providing a very realistic environment for training call takers.

Another essential task requiring careful planning was the integrating of Solacom's service monitoring and alarm capabilities and ticketing procedures with those of the local 9-1-1 service provider. Besides being a new vendor with new procedures, Solacom's NG9-1-1 architecture would be novel to the carrier's personnel, from what is alarmed to what performance indicators need to be. Likewise, we at Solacom needed to incorporate service objectives, processes, and preferences into our operation. With full cooperation between parties, this task took several months to complete.

Deployment Challenges

Fine-tuning organizations, setting up training, designing a hardened core with a robust, redundant network, and manufacturing and configuring high reliability systems was all preparatory to the actual deployment. The staging of the implementation next had to account for the fact that every site was already providing critical, life safety communications on a 24 x 7 x 365 basis. The physical deployment had to be scheduled with the constraint that installer and (more importantly) user training had to occur as close as possible to the transition date, so user knowledge would be fresh when they moved to the new Guardian system. Too early training would require a refresher. This requirement meant that slips in the date of any stage of the implementation would have a ripple effect. Thus the constraints on system availability are reflected in the availability of the human resources also.

And with system reliability having such a high premium, we require the most thorough testing prior to transition. The testing really falls into several broad categories. First is the component testing of the different major sub-systems. Second, once their basic functionality is determined as acceptable, we move to integration testing of the core as a whole. This testing incorporated the full range of features at the PSAP level validated at the training and lab facilities, which were configured as PSAPs. It was only at this stage that call flows could be tested for proper performance. The next stage was to test the integration of the Layer 2 network with the ESInet on which the Guardian PSAP Host environment resided.

On our statewide implementation, at the conclusion of that round of tests, we placed the entire core system into "soak" for several weeks, where added testing and re-testing was performed. Shortly after that point we began to schedule our training—technicians in the lab and call takers in the training center.

In parallel, we shipped and began the serial installation and transition of the PSAPs themselves. At each one the local network, equipment, call-flows, and back-up needed to be tested. On the day of transition for each PSAP, traffic would be diverted to the back-up PSAP, and, after final testing, moved over from the 5ESS to the Solacom Guardian platform. Even at this late stage we had to conduct new tests as the system had to be integrated with the CAD and recording systems that varied widely across the PSAPs. For even with a standard for the interface, the actual interoperability could not be tested until the time of the cutover.

The need for extensive testing, the desire for flexibility in the event a situation arose at a site, and the finite limit of resources all determined the rate at which we could reasonably cut PSAPs over to the new Guardian system. We were able to maintain a conscientious pace of about two PSAPs per week. This rate allowed for the inevitable situations where something had to be suspended until the following day. Once on the track, we kept to the overall schedule with an amazing reliability, completing the PSAP part of the implementation by the objective date. Nevertheless it took about three and a half months for the conversion of all twenty six PSAPs.

Conclusion

Complexity, new technology, and magnitude all created great challenges in the implementation. The tools to meet those challenges were good planning, meticulous care in configuration and all aspects of testing and implementation, and the one most important quality was close cooperation amongst several critical technology providers. The project was remarkable perhaps in this dimension more than even in its complexity. There was absolute trust and confidence and support among the many suppliers of the component systems. And there was a total absence of finger-pointing as we worked through the inevitable vagaries that arose. Patience was essential as all of the systems were more or less new to one another. This spirit of cooperation and flexibility was a testament to the commitment by all parties to make the implementation a success.

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