

Abstract: Next Generation 9-1-1 (NG9-1-1) finds public safety officials at the state and local levels at a crossroads. State officials have access to funding and are interested in unifying emergency communications statewide. But local officials need the autonomy and control to address their communities' unique needs. There is a path forward in pursuing a thin state layer for a NG 9-1-1 network that simultaneously provides public safety answering points (PSAPs) with the flexibility and autonomy they need via a "system-of-systems" approach. Recognizing there is no cookie cutter solution, various options and operating models are presented.

Migration to NG9-1-1 in States with Local 9-1-1 Authority Autonomy

Introduction

This paper discusses one path to a Next Generation 9-1-1 (NG9-1-1) "system-of-systems" deployment within a state. It is consistent with the NENA i3 architecture, allows for counties, or emergency communications districts (ECDs) to act independently, but still provides options for smaller or less financially capable ECDs to participate in the migration to NG9-1-1. This paper is also offered as a discussion document for states that want or need to deploy NG9-1-1 at a county or ECD level.

Next Generation 9-1-1 defined

The Next Generation 9-1-1 System defined in the NENA standard (08-003) implements a "system of systems" approach to a nationwide, tightly integrated, emergency call network. NENA recommends a state level system with interoperability between neighboring states for three reasons:

1. Cost. NG9-1-1 takes advantage of commercially available, off-the-shelf computer and networking hardware components, reducing component costs. However, the costs for a jurisdiction-by-jurisdiction approach to deploy and maintain such a system rapidly become onerous, making a centralized, cloud-based approach the best economic model.
2. Allocation of staff and the need for specialized skills. Dedicating staff resources to oversee and/or operate separate NG9-1-1 system siphons off resources that would otherwise be used for mission-critical purposes. Leveraging a specialist in data and network security at a state level is more efficient use of scarce resources.
3. Regulatory regime and government oversight. It is common for states to have a Wireless 9-1-1 Board or a unified 9-1-1 Board. These entities typically have the authority to make decisions and implement NG9-1-1 systems including the allocation of funding. In most cases, local authorities retain control over the systems used for answering and responding to 9-1-1 calls but hold little additional authority.

Some responsibilities are still best left at a state level.

Any NG9-1-1 system implemented by a government entity begins with the delivery of a call from an Originating Service Provider (OSP). State PUCs certificate and oversee CLECs and ILECs and have authority to implement rules governing the operation of Wireless and VoIP Service providers. State governing bodies therefore are in the best position from a regulatory standpoint to manage the participation in a NG9-1-1 system by the OSPs.

The OSPs prefer interconnecting to a NG9-1-1 call routing system in as few points as possible. If the interface to the OSPs is addressed at a state level, these interconnection points can be reduced to two aggregation points (for redundancy), significantly limiting complexity and cost. Since many of the OSPs receive cost recovery, the state and all ECDs within the state benefit financially from limiting the number of call aggregation points. This is especially true while OSPs are not required and/or not ready to interface with the NG9-1-1 system directly.

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All NG9-1-1 systems use a Legacy Network gateway (LNG) to connect to the OSPs, which among other functions provides a standardized interface point to convert the OSP's TDM network to the NG9-1-1's SIP network. Because LNGs are expensive, locating them at two aggregation points is a simple and cost effective solution.

The LNG cannot determine which PSAP should receive a call. To accomplish this, a "thin" NG9-1-1 call routing system must be deployed. This thin system requires:

- An Emergency Call Routing Function (ECRF) to correlates caller location to a particular destination
- An Emergency Services Routing Proxy (ESRP) to performs the actual routing of a call to the destination.

Because it is a "system-of-systems," a destination can be any Public Safety Answering Point (PSAP) or another NG9-1-1 System via interconnections with neighboring states. This dual purpose satisfies both objectives of a NG9-1-1 System.

Figure 1 below shows the thin, state-level, NG9-1-1 System architecture. Once the "thin" NG9-1-1 System is deployed at a state level. Local Emergency Communications districts have multiple options available for the migration to NG9-1-1.

Option1 – Implementation of a Local NG9-1-1 System.

The first option available to the ECDs is the deployment of a full NG9-1-1 System. Calls collected at the "thin" state-level NG9-1-1 System are delivered to the local NG9-1-1 system at the local ESRP. In this option, the local NG9-1-1 system is responsible for the delivery of the call to the appropriate PSAP. Call routing to the PSAP in this option is handled entirely by the local NG9-1-1 System. Note that for this discussion, we acknowledge three types of PSAPs call handling systems.

1. A hosted call handling system. This system centralizes most of the call handling functions in a server that is "hosted" with the local NG9-1-1 System. Equipment at the PSAP is reduced to a personal computer, monitors, and headphones for each call taker position. This deployment is the most economical and simplest to maintain.
2. The more traditional, on-site system that places all call handling functionality at the PSAP.
3. Non-NG9-1-1 PSAPs. To accommodate PSAPs that cannot move to a NG9-1-1 call handling system, the local system must support legacy call handling systems using a Legacy PSAP Gateway (LPG). Figure 2 shows this option.

Option 2– Shared use of the State-Level Call routing System.

The second option available to the ECDs is piggybacking onto the state-level system. Since all NG9-1-1 call routing components are deployed at the state level, a small ECD could opt-in to services from the state system. In this option, the local ECD is still responsible for their choice of PSAP call handling equipment. The local ECD can deploy hosted or stand-alone call handling systems. They can also avoid purchasing a new call handling system by deploying a LPG. Figure 3 shows this option.

Option 3 – Shared use of a State-Level Hosted Call Handling System

The third option available to local ECDs is the use of a shared, state-level hosted call handling system. These options will be most attractive to small and/or financially constrained ECDs where the state implements a hosted call handling system that ECDs can opt into. The cost is lowest if one and only one hosted call handling system is implemented and shared. To provide choice, a second vendor's hosted call handling system can be deployed,

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however, the cost per user will go up. Three or more hosted call handling systems may be deployed but any cost benefits diminish rapidly. Figure 3 shows this option.

Network Options

The deployment of NG9-1-1 call routing components is important, but so too is the underlying network. Some states have a statewide IP network that can be considered for use by a NG9-1-1 system. These networks must meet reliability, resiliency, capacity, security and affordability requirements, but are options. The network from the statewide IP system to the PSAPs must also be deployed. Local ECDs have the option of allowing the state to procure, deploy, and manage the “last mile” to the PSAP or taking responsibility for it themselves. The same reliability, resiliency, capacity, security and affordability requirements must be met for the last mile. Even if a statewide IP network exists, ECDs should have the option to procure, deploy, and manage the network from the state-level NG9-1-1 call routing system to their own system. This is not as cost efficient as sharing bandwidth on the statewide IP network but is still affordable given competition in the network market.

Different Permutations and Combinations of Options

The options mentioned above are not mutually exclusive for any particular ECD. Once the state-level thin NG9-1-1 Call routing infrastructure is established all other options are available at any time. One ECD can choose to implement their own NG9-1-1 system to support most of their PSAPs but rely on the state level system to support others. An ECD that deploys their own NG9-1-1 system can use the state level system as backup if their fail. An ECD can begin by using the state-level system and then migrate to a local NG9-1-1 system over time. These options are all available while still adhering to the NENA standard. Vendors that participate in the NENA Industry Collaboration Events provide the ECDs with the added comfort of knowing that they have tested with the other leading vendors in NG9-1-1.

Technical Complexities

The options outlined above and the figures that depict those options are fairly high-level. When deploying NG9-1-1 systems, many other components come in to play and create complexities that must be dealt with. For example, in a NG9-1-1 system, calls are targeted to a particular PSAP based on caller location. However, if the target PSAP is unavailable or has reached its capacity, calls must be diverted to an alternative PSAP. The creation and implementation of the Policy Routing Function (PRF) and the attendant Policy Routing Rules (PRR) is complex even when implemented only at the state level.

Implementing the PRF and PRRs at the local level adds significant complexity. Similarly, network and system security becomes significantly more complex since each system must be responsible for ensuring it is protected from other systems. Finally, system troubleshooting becomes much more complicated with the addition of sub-systems. None of these complexities should deter a state from implementing a multi-level NG9-1-1 system, however, these issues must be anticipated and addressed.

Governance and Financial Matters

Planning, implementing, and governing any statewide system requires close cooperation and collaboration between the state authorities and the ECDs, especially true in a state that gives autonomy to the local ECDs.. Perhaps the most sensitive of issues is the sources and uses of funds. The more complex and diverse the NG9-1-1 deployment options available to the ECDs, the more complicated the collection and distribution of 9-1-1 fees and other sources of funding. The technical options outlined above may need to be limited to what governance and funding system can accommodate.

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Note that there are many models of governance and funding available. A state could fund any of the options above but governance of the system can be shared between the state and local authorities. Funding can also be done by the local authorities with the state playing a key management role.

Summary

NG9-1-1 as defined by NENA allows for many deployment models. These options allow for state and local level 9-1-1 authorities to determine the best deployment option for their state given state regulations, the structure of 9-1-1 authority boards, the authority granted to local ECDs, and the realities of funding. While implementations of NG9-1-1 call routing at the state level are most cost effective, deployment at the local level is an option. The one aspect of NG9-1-1 that should be held at the state-level is the creation of two OSP 9-1-1 call aggregation points. Building the two 9-1-1 call aggregation points and deploying the LNGs and a “thin” NG9-1-1 system at the state-level is strongly recommended as a first step. It simplifies the migration, frees up local ECDs to decide how they would like to proceed, fulfils the state’s obligation to interoperate with neighboring states, and is the most cost-effective option available.

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