Bringing the theory of 'diffusion of innovations' to 9-1-1

Going forward, out with the old and in with the new should be the goal—but to do that, the sector will need some help

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The 9-1-1 sector has struggled historically with shedding legacy systems. This report discusses how a "planned retirement" is one way that the industry can buck that trend.

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Background

The public safety sector always has struggled with technology evolution: it takes far too long and the process is far too inefficient. The history of the 9-1-1 sector provides an excellent example of this at work. In 1957, the National Association of Fire Chiefs recommended that a single telephone number be used by the public to report fires. A full decade passed before the President's Commission on Law Enforcement and Administration of Justice recommended in 1967 that a single number be used for all emergencies, not just those that require the fire service to respond.
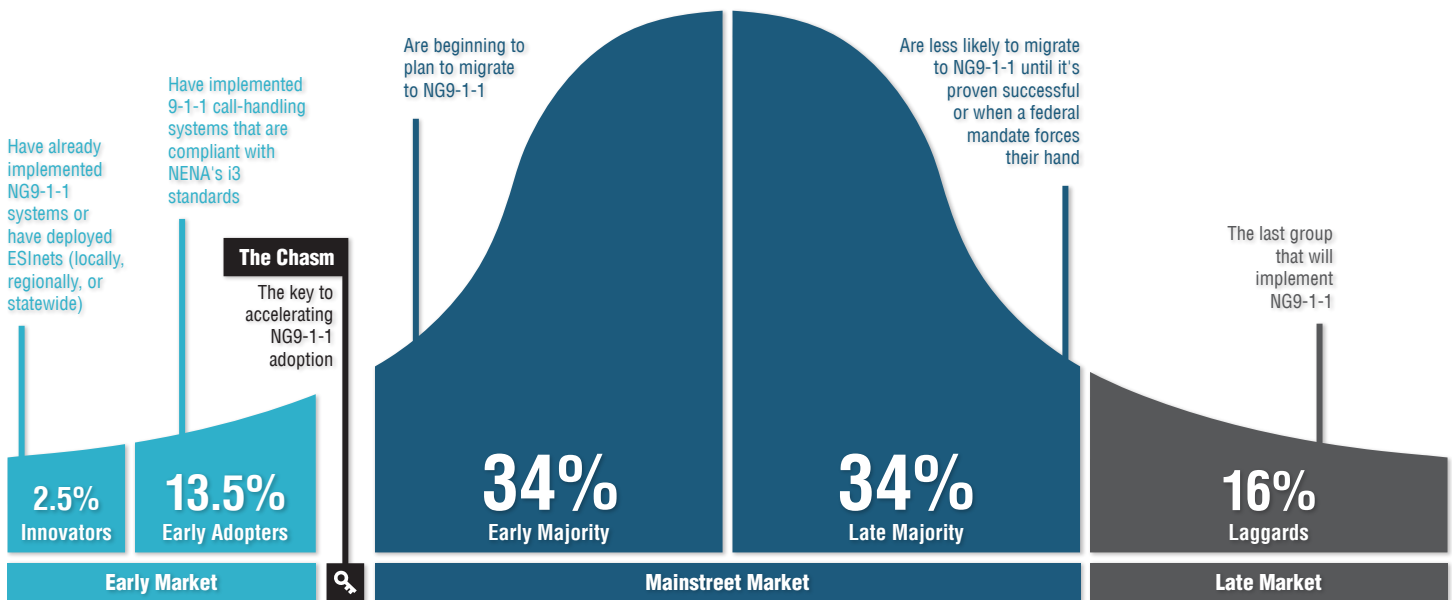
The following year, AT&T, after consultations with the FCC, established 9-1-1 as that number, and the first two 9-1-1 systems went live a week apart in February 1968, the first in Haleyville, Alabama, and the second in Nome, Alaska. It took another 10 years before 25 percent of the U.S. population could take advantage of 9-1-1 service, and yet another decade before 9-1-1 service reached 50 percent penetration. It wasn't until 2009—more than four decades later—that 9-1-1 service was available to nearly the entire country (96 percent).

Today, the 9-1-1 sector is migrating to Next Generation 9-1-1 (NG9-1-1) technology. This evolution represents a quantum leap forward in the level of service that the nation's 9-1-1 centers, aka public safety answering points, or PSAPs, can provide to the public and to first responders. But the migration is being slowed considerably by the sector's inability to shed legacy systems that have been in place for decades, which are vastly inferior to Internet Protocol (IP)-based, broadband-enabled NG9-1-1 systems. Here is an example:

- Centralized automatic message accounting (CAMA) trunks, an analog billing technology adapted for wireline service, still are being used to deliver emergency calls to 9-1-1 centers, as they have since the mid-Sixties. This is wholly inefficient in a world where roughly three-quarters of all 9 1 1 calls are made from wireless devices, which are digital. Any wireless 9-1-1 call that is delivered over a CAMA trunk must go through a digital-to-analog conversion before a PSAP can receive it.

- Over the last 20 years, this legacy 9-1-1 network architecture has constrained the design of the wireless and voice over IP (VoIP) call flows. As a result, only a 10-digit "key" and voice can be delivered to the PSAP. Caller information, including

Next Generation 9-1-1 Technology Adoption Lifecycle

Have already implemented NG9-1-1 systems or have deployed ESInets (locally, regionally, or statewide)

Have implemented 9-1-1 call-handling systems that are compliant with NENA's i3 standards

Are beginning to plan to migrate to NG9-1-1

Are less likely to migrate to NG9-1-1 until it's proven successful or when a federal mandate forces their hand

The last group that will implement NG9-1-1

The Chasm
The key to accelerating NG9-1-1 adoption

| 2.5% Innovators | 13.5% Early Adopters | 34% Early Majority | 34% Late Majority | 16% Laggards |

| Early Market | Mainstreet Market | Late Market |

Adapted from: Rogers, Everett M. 2003. *Diffusion of innovations*. New York: Free Press.

location, must be obtained through a series of database queries. This introduces additional points of potential failure in the delivery of mission-critical information. In contrast, when a wireless 911 call is delivered over a digital transport medium, such as an Emergency Services IP network, no conversions are needed and advanced data about the call, caller, and/or call location may be included in its delivery to the PSAP.

What industry today relies so heavily on technology that first was implemented more than a half century ago, as does the 9-1-1 sector? This is a practice that is illogical and simply needs to end.

Diffusion of Innovations

In 1962, Everett M. Rogers, an assistant professor of rural sociology at Ohio State University, published a theory he described as the "diffusion of innovations," in a book of the same name. Rogers, who later in his career became a distinguished professor emeritus in the communications and journalism department at the University of New Mexico, developed the theory to describe how innovation adoption plays out in any given social group. For this purpose, Rogers broke down the social group into five distinct categories, as follows:

- **Innovators.** These adopters not only are technology enthusiasts—they also are visionaries. They are the ones who queue outside the Apple store in the overnight hours to ensure that they are among the first to obtain the latest iteration of the iPhone. They typically are unconcerned about any uncertainties surrounding the new technology and jump in with both feet—largely because they usually have greater resources compared with the other adopter categories and thus can afford to make a mistake. They represent the first 2.5 percent of those who adopt any given innovation.

- **Early Adopters.** While technology enthusiasts and visionaries in their own right, early adopters also are more cautious and conservative in their thinking—they are prone to do more homework than the innovators. When they adopt a technology, it sends a clear signal that the innovation is for real. They represent the next 13.5 percent of adopters.

- **Early Majority.** These adopters are pragmatists who are quite deliberate in their thinking. While the actions of the early adopters resonate with them, they are more than willing to take whatever time is needed to ensure that the technology's function aligns with its hype. The early majority will adopt a technology as soon as it appears ready for use. They represent the next 34 percent of adopters.

- **Late Majority.** These adopters typically are skeptics and will not embrace a technology until they are certain that it is bullet-proof. The late majority only will adopt technology after it has been proved to be ready for use. Moreover, they often adopt technology only when economic or operational pressures force their hand. They represent the next 34 percent of adopters.

- **Laggard.** These adopters typically are suspicious of innovation and reticent to change; often a lack of resources, primarily economic, plays a key role in their avoidance of technology adoption. They represent the final 16 percent of adopters.

The Theory Applied to the Public Safety Sector

Let's now apply the theory of diffusion of innovations to public safety, specifically the 9-1-1 sector. The innovators within the sector already have implemented NG9-1-1 systems or at least have deployed ESInets; in some cases, these have been deployed on a regional or statewide basis. Meanwhile, the early adopters have implemented 9-1-1 call-handling systems that are complaint with the National Emergency Number Association's i3 standards—which define the underlying architecture for NG9-1-1 systems—and/or are moving toward implementing an ESInet.

The key to accelerating NG9-1-1 adoption is to more quickly bridge the gap—often referred to as the "chasm"—between the early adopters and the early majority. Doing so will create a domino effect that will result in a rapid acceleration in adoption. Generally, a series of change agents is needed to clear the chasm. Just as clearly, the public safety industry, government officials and the public do not want four decades to pass for NG9-1-1 to reach ubiquity, as occurred with legacy 9-1-1 service.

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A plethora of factors exist in the 9-1-1 sector and throughout public safety that make the already difficult task of clearing the chasm much more challenging. One is cultural—many in public safety are reticent to change because lives are on the line, both the public's and the first responders' who are trying to save them and their property. "Mission-critical" means just that—the technology has to work every time, and many in public safety won't transition to new technology until they absolutely are sure that it will.

Funding is another issue—there simply is not enough of it in the 9-1-1 sector. Due to the lack of funding, many PSAPs today are struggling to provide basic services and to keep their legacy systems operational. The funding crunch is exacerbated by the fact that eight states—Iowa, Illinois, New Hampshire, New Jersey, New York, Rhode Island, Washington and West Virginia—and Puerto Rico diverted money collected to support 9-1-1 service to other purposes in calendar year 2015. (The amount diverted totaled $220.3 million, or 8.4 percent of the total 9-1-1 fees collected.) The migration to NG9-1-1 will be expensive. For many PSAPs today, it is beyond their financial reach.

Arguably the most constraining factor that will continue to slow the NG9-1-1 migration is the vast amount of legacy equipment still being used by the nation's PSAPs. This is one industry where a change agent sorely is needed.

What Needs to be Done

Legacy 9-1-1 systems are ill suited for an environment that increasingly is dominated by digital and IP technology. Adding to that, legacy 9-1-1 systems are money pits. Maintaining them requires an enormous amount of money that better would be spent on next-generation technology, a critical consideration when money is in short supply. As these systems get older, they will be even more expensive to maintain. Moreover, they eventually will reach the end of manufacturer support. That's problematic on two levels. First, parts supplies eventually will dwindle. Second, when they do, available parts will become far more costly, driven by the laws of supply and demand.

Keys to crossing the NG9-1-1 chasm for public safety

Confidence
Public safety needs assurance that the new technology will work every time because of its mission-critical nature

Funding
Public safety needs a dedicated source to fund the NG9-1-1 transition

Retirement of legacy equipment
Public safety needs a "planned retirement" of legacy 9-1-1 systems

Consequently, the public safety sector needs to embrace the concept of "planned retirement" as it relates to legacy 9-1-1 systems. There are two elements to this: first, public safety agencies need to set a date for when they will pull the plug on their legacy systems and go live with their replacements; second, money to fund the transition must be available.

It is unlikely that very many public safety agencies will do this on their own, even if they wanted to do so. It will be extremely challenging for many, if not most, to find the necessary funding. Ergo, a change agent must emerge to mandate and then support this approach to technology evolution. And there is only one that has the requisite influence and resources to mandate and support planned retirement of 9-1-1 systems—the federal government.

This has precedence—one only needs to look back as far as June 12, 2009, which was the date set by Congress for broadcast television stations to transition from analog to digital operation. The digital television transition freed up valuable radio spectrum for other purposes, including the nationwide public safety broadband network (NPSBN), which is being implemented under the auspices of the First Responder Network Authority (FirstNet)—which, incidentally, also was created by Congress. The key takeaway is that Congress mandated that the digital television transition be done.

The 9-1-1 sector needs a similar mandate from Congress that requires public safety entities to plan the retirement of the legacy systems currently used in their PSAPs—as important, Congress needs to make the necessary funds available for the transition, just as it did when it provided $7 billion in seed money to FirstNet for the NPSBN. History has shown that unfunded mandates are unworkable.

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Signs are emerging that Congress is thinking along similar lines. A working draft bill emerged at the end of February, sponsored by Sen. Amy Klobuchar (D-Minn.) and Sen. Bill Nelson, that would make the NG9-1-1 migration a national imperative. Two key components of the bill include the creation of a federal grant program that would assist states and localities as they transition to NG9-1-1, and that any state receiving funds from this grant program would need to certify that the money only would be used for NG9-1-1 implementations.

A similarly positive development occurred roughly a month later, when the Communications and Technology Subcommittee of the House Energy and Commerce Committee held a hearing, chaired by Rep. Marsha Blackburn (R-Tenn.), entitled "Realizing Nationwide Next Generation 911." In her opening statement, Blackburn said, "Republicans and Democrats can both agree that having a modern 9-1-1 emergency response system in place is a national necessity."

To be sure, a Congressional "planned retirement" mandate will not be a magical spell that results in NG9-1-1 being implemented from coast to coast overnight—case in point, the digital television transition took seven years to unfold, even with such a mandate. But that's an enormous improvement over the four decades it took for legacy 9-1-1 to reach ubiquity.

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