Technology Spotlight

Next Generation 9-1-1 Case Studies and Best Practices

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IDC GOVERNMENT INSIGHTS OPINION

This document explores Next Generation 9-1-1 (NG9-1-1) and advanced emergency dispatch/incident management best practice knowledge regarding the incorporation of texting, social media, and image and video transfer tools by a number of Canadian and international public safety organizations.

Canadian public safety and security practitioners, intelligence, operational, and planning entities will be able to leverage the case studies, best practices, and specific advice resulting from this study to assist in getting started with incorporating readily available information technology into 9-1-1 and dispatch services. The promise of NG9-1-1 is that first responders and emergency management stakeholders will ultimately become more situationally aware, facilitate faster response times, maximize resource utilization, and improve community resilience to man-made emergencies and natural disasters.

NG9-1-1 has been a matter of considerable global attention in public safety communities recently. The objectives of NG9-1-1 initiatives are to provide a new communications infrastructure to allow the general public to make a 9-1-1 "call," using any real-time communication, be it voice, text, or video, from any wired, wireless, or IP-based device. They will also allow the emergency services community to take advantage of advanced call delivery, and rich media information transfer leveraging all types of data, through new Internet technologies based on open standards. NG9-1-1 has profound integration implications for emergency response, investigations, trial results, and archive processes. NG9-1-1 will change procedures and workflow dramatically, and will be an evolutionary process over the next 10 years and beyond. Arguably, the evolution of NG9-1-1, as with many enabling information and communication technologies, will be never-ending.

FINDINGS AND CONCLUSIONS

NG9-1-1 Journey

- **Plan and prepare for a lengthy journey.** As several case studies revealed in this study, the time from planning NG9-1-1 to implementation is considerable, ***often as long as a decade or more!*** By their very nature, standards and technologies for NG9-1-1 will continue to evolve long past implementation, **necessitating constant attention to change and improvement**.

Overall State of Deployments

- NG9-1-1 is in the **very early stages of deployment**. With the exception of the State of Texas, Calgary, and Vancouver, the case studies profiled here revealed very nascent implementations of NG9-1-1 tools.
- Canada, while somewhat behind Europe and certain U.S. states/cities, is currently rolling out network IP interconnection across the country as the initial step for the future NG9-1-1 architecture.
- Initial operational NG9-1-1 tools have been tested or implemented on the system side (Finland, Alberta, and Texas) or in the area of Text to/with 9-1-1 (Finland, Sweden, Virginia, Alberta, E-Comm 9-1-1). Finland, Sweden, E-Comm 9-1-1 and Alberta have moved past pilots and offer this service to deaf, hard-of-hearing, and speech-impaired communities. Virginia is testing a full citizen launch of this service.
- Investigative NG9-1-1 deployments focus on the collection, analysis, and use of photo and video evidence for major crimes. Most jurisdictions studied don't have this capability yet but look to this as a future area of expansion. In Canada, Vancouver and Montreal both analyze photo and video evidence for investigative purposes.

Key Drivers

- **Government mandates** to provide Text to/with 9-1-1 for the deaf, hard-of-hearing, and speech-impaired (DHHSI) community was a key driver in the majority of the case studies as organizations globally become cognizant of this unacceptable service delivery gap.
- **Technological obsolescence of legacy communications** and the PSAP's telephone and CAD systems were key drivers for both Finland and Texas.
- First responders are acutely aware of implications that **the proliferation of mobile and video technology has for response and investigation**. Ubiquitous photo, video, and GIS capabilities – all of which are both IP and wirelessly enabled – are game changers and first responders in all jurisdictions are intent on leveraging these tools.

Investment

- **Investment costs are highly varied**, from $0 to C$90 million in initial investments.
  - Text to/with 9-1-1 pilots required little upfront investment in equipment but manpower and training are required. Yet the cost of IP interconnection in order to facilitate the Text to/with 9-1-1 deployment in Calgary alone is estimated at C$2.9 million.
  - Photo/video forensics in Vancouver required an investment of about C$1 million plus ongoing costs for storage, manpower, and software maintenance fees.
- **NG9-1-1 capable system deployments are costly** and require significant up-front capital. In the cases of Finland, Texas, and Virginia, government funding was provided to assist with the implementation.

Next Generation Communications Deployment

- Emerging standards, notably the draft NENA i3 Architecture standards, specify that NG9-1-1 is dependent on next generation network IP technologies.

    - **VoIP telephony platforms have emerged as an important precondition** on the journey toward NG9-1-1 and need to be compliant with evolving NG9-1-1 standards.
    - **Session initiation protocol (SIP) is a critical underpinning of the i3 NG9-1-1** draft standard requiring next generation SIP trunk connections, which are not yet available in all areas of Canada from leading carriers. Also of note, the standard for a 9-1-1 SIP interconnection is still evolving and inexorably linked to future NG9-1-1 architecture standards.
- Vendors must be aware of, and create, product suites that expeditiously manage workflow and evidence across response, primary and secondary investigation, disclosure, archive, and compliance. Currently vendors are only providing isolated components of the solution.

Challenges and Barriers to Adoption

The case studies highlighted a number of significant barriers to adoption, including:

- Lack of effective governance mechanisms
- Inadequate legislative framework
- Privacy and security hurdles (i.e. network storage of data / evidence)
- Ownership and funding complexity
- Evolving technical standards
- Lack of qualified or trained staff (i.e. equally skilled with telephony and IT)

The following sections elaborate on each of the above specific challenges and barriers to adoption as gleaned from our case studies.

NG9-1-1 Governance and Compliance

- Governance has been a topic of considerable interest and due attention in Canada, and in June 2013 a two-day pan-Canadian workshop was held with 70 of Canada's leading experts in the field. It is important to note that governance stood out as a significant area lacking focus. Working in tandem with international subject matter experts from APCO and NENA, the workshop created a strategic plan to move forward, including recommendations specific to many of the lanes of the Canadian interoperability continuum (governance, operations, technology, and funding). For more information please see the *CITIG Action NG9-1-1 Status Report* found at www.citig.ca.
- The lack of an NG9-1-1 master plan to communicate a single vision of the NG9-1-1 system for all stakeholders engaged in its development and deployment is currently impeding adoption.

Challenges With Text to 9-1-1

- Both the Swedish and Finnish case studies demonstrated that texting can negatively affect response times as typical exchanges can be 10 to 20 times slower than voice or video; both studies recommended embedding prepopulated phrases and similar shortcuts in the application to reduce response times.
- Participants noted that text misunderstandings are more common compared to voice calls, and that texting lacks some of the contextual information captured on a voice call. For that reason,

study participants lauded Canada's strategy to have the DHHSI community establish a voice call first (i.e. Text with 9-1-1).

- Participants cautioned that DHHSI community members are exposed to potential information delays in situations where there is a network overload; some implementations leverage a direct connection that is not subject to delays during a network overload.
- CAD systems that lack integrated SMS functionality result in workarounds where dispatch has to block and copy into the CAD system.

Challenges With Photo and Video Forensics

- The City of Vancouver case study noted considerable privacy concerns with the incorporation of new media. Privacy laws prevented law enforcement from leveraging video footage of crimes sent in from citizens to help identify suspects.
- Processing data in the manner required by Crown attorneys proved problematic as only three video formats of the numerous available are permissible for evidence for the Crown.
- Participants stressed the issues involved in managing the volume and variety of information sources, in addition to the storage burden for video, and seek greater clarity in understanding regulatory requirements regarding storage.
- First responders noted concerns around privacy and liability issues with other crimes captured on video during the 2011 Vancouver hockey riots.
- First responders are also struggling with how to best use citizen photographic or video information; there is still little understanding of best practices with regard to how and where to manage the information. Dispatch and call takers are concerned with the number of ways that feeding rich media into 9-1-1 directly could overwhelm the PSAP. There are workplace trauma issues to consider as well: working in a 9-1-1 call centre can be traumatizing as call takers are in constant contact with citizens in distress; adding an extra graphical layer to that process will need to be managed. Additionally, it was repeatedly noted that feeding videos or photos to police responding to an emergency could lead to increased distraction in the police car.

Funding

- While the value of advanced analytics and IP-enabled telephony and CAD systems are obvious to many of those involved in NG9-1-1, there are serious, and frequently voiced, concerns over who has funding responsibility to deliver. Much of public safety budgets reside in the municipalities and in many cases, the budget of first responders.

Challenges With NG9-1-1 Compliant Systems

- IDC Canada believes the pace of NG9-1-1 system deployments will progress in step with system replacement. As older systems (telephone, management information systems, recorders, CAD, interfaces, etc.) are retired and replaced, first responders will install systems that have NG9-1-1/digital capabilities. The exception to this will be in jurisdictions that have funding and a requirement for NG9-1-1 systems for specific events or as a result of specific events. While the technical capability for NG9-1-1 solutions exists, without legislation, governance, and the development of SOPs and finalized standards, implementation of NG9-1-1 capabilities beyond Text to/with 9-1-1 will be limited, putting citizens and first responders at significant disadvantage.

- Implementation of large new NG9-1-1 systems comes with its own operational and change management challenges as there are new processes to leverage, manage, and disseminate information.
- Participants noted the need to prioritize all types of emergency "calls" fairly to ensure there are no shortcuts.
- Implementation of NG9-1-1 compliant systems can be more complex than vendors and stakeholders assume.
    - In Alberta, communication providers incurred difficulties provisioning new circuits for PSAPs and the network feed for Text with 9-1-1.
    - Texas noted the lack of skills and experience that comes with relying on a single vendor.
    - In the Texas case study, participants noted a lack of complex project management skills required by both the vendor and the Texas Commission on State Emergency Communications (CSEC).
- Real-time communications centres require that operational silos be integrated, necessitating a migration to more of a matrix organization which can conflict with traditional hierarchical policing / emergency dispatch structures.

Summary of Operational Considerations

When we look across the aforementioned challenges from an operational perspective the following areas stood out consistently:

- Funding
- Connectivity
- Network resilience and responsiveness
- Data storage
- Technology selection and refresh cycles
- Change management and process redesign
- Integration
- SOPs
- Training
- Response times
- Consistency of service (service expectations), and available tools

Best Practices

Governance, Legislative, and Interoperability

- The U.S. has benefitted considerably from passing the Next Generation 9-1-1 Advancement Act and the creation of the Office of the Coordination; Canada would do well to create a similar pan-Canadian governance body to oversee implementation of NG9-1-1 initiatives.

- As seen in the U.S. National Capital Region case study, there is significant benefit to involving all stakeholders early, and communicating broadly to cultivate an ecosystem of stakeholders. This works to ensure interoperability and works toward developing effective SOPs and, where applicable, employing consistent service models.

Text-to-9-1-1

- Training the DHHSI community on how to initially call 9-1-1 (Canada specific).
- Training PSAP staff and citizens on the use and receipt of SMS hotkeys with prepopulated phrases to shorten the overall call length.
- Wireless providers need to develop a service communications plan and education program that can be used to inform subscribers and the general public of the Text Messaging 9-1-1 service. In Canada, details announcing new 9-1-1 features were addressed on January 24, 2014. For more details please see here.

Photo and Video Forensics

- The City of Vancouver's forensics lab is a best practice example that should be leveraged in other major metropolitan cities such as Edmonton, Saskatoon, Regina, Winnipeg, Toronto, Ottawa, Montreal, and Halifax. Vancouver now leverages video analytics as part of almost all of its major crime investigations.
- Leverage the Law Enforcement Video Analytics accreditation processes to maximize analytics investments.

RECOMMENDATIONS

Given the nascent state of many NG9-1-1 deployments, the following near-term recommendations are provided:

- **Redirect NG9-1-1 conversation away from technology.** Change the conversation from a technologically fixated discussion (this is not the issue) to a discussion on governance and value to first responders and citizens.
- **Create a national NG9-1-1 coordinating body.** Stakeholders recommended the creation of a national coordinating body to develop, in collaboration with all stakeholders, a vision of NG9-1-1 including guidance on interoperability, Canadian standards, and mechanisms to oversee and coordinate NG9-1-1 deployments. The CRTC's Emergency Service [9-1-1] Working Group (ESWG) is already tasked with defining the Canadian standards for NG9-1-1 capabilities foundational pieces like the Emergency Services IP-enabled Network (ESInet).
- **Establish a governance mechanism.** The CITIG NG9-1-1 Governance Status Report recommended that a new institution be established to provide governance to the 9-1-1 "brand" in Canada. It is further recommended that this institution's mandate would cover 9-1-1 issues such as a standard set of 9-1-1 services, a standard technical interface across the country, and a standard set of statistical reports that would allow cross-country comparison of service levels provided by PSAPs. The recommendations outlined in the CITIG NG9-1-1 Governance Status Report align with the key recommendations in this report based on the case studies:

    - Create an organization to plan and coordinate implementation of the deployment and operation of the NG9-1-1 system (i.e., along the lines of the Texas Commission on State Emergency Communications [CSEC]).
    - Create an advisory committee to ensure the views of all stakeholders are represented and that the relevant terms of interconnection will be developed and revised in collaboration with all 9-1-1 entities.
    - Create national and/or provincial Emergency Services IP-enabled Networks (ESInets).
    - Develop an NG9-1-1 master plan to communicate a single vision of the NG9-1-1 system and the transition effort for all stakeholders engaged in its development and deployment.
    - Establish a set of minimum and standardized operational protocols, standards, and training requirements across the country. Again, for further detail on the CITIG NG9-1-1 Governance Status Report see www.citig.ca.
- **Within CSSP, create a Technical Advisory Group (TAG).** There is a need for constant innovation and knowledge sharing in the area of NG9-1-1 solutions as a result of the evolving technological issues such as future versions of social media.
- **More attention has to be paid to sustainable funding of NG9-1-1 solutions from the municipal to the federal level.** The Canadian public, and in particular certain younger demographics, expect to be able to access emergency services via text and other social/rich media channels. All levels of government and first responders need to address this delivery gap immediately.
- **CRTC ESWG should educate the general public and DHHSI community on the Text to 9-1-1 program.** Many Canadian citizens erroneously believed and/or expected that access to the Text to/with 9-1-1 (T9-1-1) service would be available to all Canadians on January 24, 2014. Similarly many members of the DHHSI community mistakenly believe that the T9-1-1 service will be automatically and instantly available to them rather than requiring registration. Irrespective of the type of deployment, the case studies contained here consistently point to the need for a consistency in service across the country. On January 24, 2014, Canada published detailed information on the scope of SMS service. See here.
- **Expand Text to/with 9-1-1 channel to the general public.** First responders globally believe that there is an inevitability, and a distinct utility (scenarios involving burglaries, school shootings, abductions, etc.), to provide broader adoption of texting to/with 9-1-1 for all citizens. This seems a natural evolution of steps already undertaken for the DHHSI community; however, a broader deployment needs to be managed carefully with a focus on workload and workflow for PSAPs.
- **Communicate to the general public that social media is not monitored by first responders.** Social media is generally leveraged by first responders as a means of communication to the public and as part of investigation; monitoring Facebook, for example, for postings for emergency help is not something public safety can feasibly take on.
- **Lobby governments for privacy and liability clarity related to NG9-1-1 issues.** Stakeholders frequently noted the lack of a solid policy framework to address privacy and liability concerns relating to the incorporation of new rich media sources into both response and investigation.
- **Ensure technology upgrades are NG9-1-1 compliant.** Use the refresh cycle to upgrade telephone systems, management information systems, recorders, CAD, interfaces, etc. with SMS, photo and video in mind (integrated SMS, ability to send photos, videos).

- **Leverage the existing forensic video and photo centres.** Leverage the existing knowledge base as it relates to forensic video and photo analytics solutions already deployed by larger cities (Vancouver, Calgary, etc.). Investment has already been made and should be leveraged instead of replicating the expertise/investment. These can become centres of excellence and a hub for deployment and storage management. Given the speed at which video and photo analytics moved from homicide investigations to virtually all major crime, organizations in larger metropolitan cities should begin making the case to invest in forensics labs. Very few organizations are advanced enough in their NG9-1-1 implementations to fairly comment on managing rich media within the PSAP. Until that is possible, organizations should adopt systems like that in Los Angeles, where citizens call into 9-1-1 and are supplied with a reference number and an email to transfer the information over to police.
- **Consider offering real-time video translation services to the DHHSI community.** Sweden's extensive Total Conversation initiative demonstrated clearly that adding real-time video translation services was extremely valuable to the DHHSI community as it both created better response and reduced response times. Given the pressing demand for the service, but relatively small numbers, adoption should be considered in the context of a shared resource to constrain costs. The CRTC is currently conducting a proceeding on video relay service (VRS) See here.

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IN THIS STUDY

This study provides a detailed assessment of NG9-1-1 and advanced emergency dispatch/incident management best practice knowledge regarding the incorporation of texting, social media, and image and video transfer tools by a number of Canadian and international public safety organizations that have already been making progress in these areas. More specifically, this study will create awareness about the technological realities affecting dispatch and response, highlight available opportunities, and uncover the specific regulatory, legal, and high-level technological challenges when leveraging NG9-1-1. The study also identifies operational best practices across the events studied and highlights similarities and differences across regions and organizations.

This study provides case studies on how Canadian and global organizations have leveraged NG9-1-1 related technologies and advanced emergency dispatch/incident management in operational approaches to enhance public safety, and offers an understanding of the challenges faced and overcome, and the overall benefits achieved. A summary of key findings, followed by recommendations on the immediate and near-term next steps to ensure progress is made in Canada, and areas of future research needed to advance NG9-1-1 adoption, implementation, and practices in Canada, round out the study.

Case studies include:

- Alberta
- Finland
- Sweden
- State of Texas
- U.S. National Capital Region
- City of Vancouver
- eCall
- E-Comm 9-1-1
- City of Montreal
- City of Calgary Real-Time Crime Centre

The case studies are based on interviews conducted with subject matter experts in each of the organizations as well as secondary research. IDC would like to sincerely thank the individuals that gave their valuable time to participate in the study. IDC would also like to thank the following study partners for their time, insights and contributions to this study:

- John Pare - London Police
- Chris Kellett - Chris Kellett & Associates Ltd. / Alberta E9-1-1 Advisory Association

- Lance Valcour - Canadian Interoperability Technology Interest Group (CITIG)
- Michael Sullivan - City of Ottawa / Canadian Association of Fire Chiefs (CAFC)
- Eldon Amoroso – supporting the Canadian Association of Chiefs of Police (CACP)

The study allows first responders and various public safety organizations to:

- Leverage the lessons learned by global organizations that are currently utilizing next generation 9-1-1 and advanced emergency dispatch/incident management tools and operational practices to accelerate their deployment in Canada.
- Assess the importance of next generation information sources, potential benefits, and the magnitude of the current challenges so that business cases for implementation of NG9-1-1 technologies can be more easily developed.
- Assess how incorporating rich data sets into 9-1-1 and dispatch enhances first responder situational awareness in order to enable improved first responder assessment and dispatch to emergency incidents.
- Identify similarities and differences across the jurisdictions studied in order to ensure that best practices are developed, with the goal of improving community safety and resilience.
- Drive consensus and create plans to further operationalize NG9-1-1 information sources, with the aim of creating momentum.
- Identify priority areas to progress the adoption of NG9-1-1 and advanced emergency dispatch/incident management operations locally.
- Identify areas of future research needed to advance NG9-1-1 practices.

The information in this study will play a role in assisting the first responder community to build effective and mature business cases toward the implementation of next generation 9-1-1 services.

SITUATION OVERVIEW

Today's 9-1-1 environment is inherently flat, limited to the transfer of voice calls, and is similarly lacking in value-added information such as geospatial location, video, images, etc. Rich media has the potential to provide public safety organizations with an opportunity to dramatically improve situational awareness and bolster community safety. Text, for example, can be used in situations where a victim needs to remain silent, such as a home invasion in progress, active school shooting, or an abduction. Sending an image or video of a tractor trailer rollover can ensure first responders send the correct heavy equipment to save lives and clear the area quickly. Indeed, it is increasingly clear that citizens and corporate organizations leveraging basic consumer technologies in mobile phones, for example, have more information at their fingertips than the organizations charged with the responsibility to respond to incidents. The first responder community increasingly feels constrained, rather than empowered, by their existing legacy 9-1-1 and dispatch systems — systems that by design are uni-dimensional and unable to incorporate common personal communication tools like texting, social media, and image and video transfer.

However, there are many questions about the governance, operational procedures, technical and legal requirements, implementation, and funding for NG9-1-1 solutions. According to the NENA Master Glossary definition, NG9-1-1 is defined as "an IP-based system comprised of managed IP-based networks (ESInets), functional elements (applications), and databases that replicate traditional 9-1-1 features and functions and provide additional capabilities." NG9-1-1 is designed to provide access to emergency services from all connected communication sources, and provide multimedia data capabilities for PSAPs and other emergency services organizations.

Continued Evolution of 9-1-1 With Wireless

> "The world of communications is definitely changing and wireless 9-1-1 has caused us some concern"
>
> William Blair, Chief of the Toronto Police Service

The combination of new advanced wireless network technology, growing dependency by the public on wireless communications, and development of in-vehicle telematics and connectivity affords new opportunities to extend the reach of emergency 9-1-1 while also posing new challenges to public safety entities.

Wireless is now the preferred method of communicating the world over. Wireless is the most popular and widespread personal technology on the planet, with more than 6.4 billion wireless subscriptions at the end of 2012, or 96 per 100 people, according to statistics from the UN's Geneva-based International Telecommunication Union (ITU). More than three-quarters of all Canadians (or almost 28 million consumers) now have a wireless device. Canada's wireless penetration rate reached 80% of the population in 2012.

The need for public safety organizations to know the location of emergency wireless callers will become even more important. "Fewer people have fixed phones today and I believe wireline communications will become an exception in the near future," said Richard Finn, Superintendent and Officer-in-Charge of Information Services for York Regional Police, in a previous interview. "So the need to locate callers with a reasonable degree of accuracy will be even more critical because of wireless substitution."

Wireless Substitution

An increasing number of people are completely cutting their tethered landlines – a phenomenon termed wireless substitution.

More than a third (36%) of American homes had only wireless telephones at the end of 2012. That is a 4 percentage point gain from a year earlier when 32% of American homes had only wireless telephones (see Stephen J. Blumberg and Julian V. Luke, *Wireless Substitution: Early Release of Estimates From the National Health Interview Survey*, July-December 2012, U.S. Centers for Disease Control and Prevention, Division of Health Interview Statistics, National Center for Health Statistics, Atlanta: June 2013).

IDC Canada believes a quarter of all Canadians had cut the wired cord and more than a third of the youth demographic (18 to 34 year olds) at the 2012 year-end. We estimate that 30% of Canadians were wireless substitutors at the end of 2013. Wireless substitution is also occurring in the workplace: IDC Canada's most recent annual Business Telecom Survey found that almost a half (44%) of Canadian businesses say they have at least one employee who is completely reliant on wireless at work with no traditional wireline phone or extension (see Lawrence Surtees and Thomas Dyer, *Canadian Wireless Services 2013-2017 Forecast and Analysis: Wireless Wars 10*, IDC Canada #CA12TM13, November 2013).

In addition to the growing popularity of wireless among Canadians, more consumers are also embracing text and video-friendly smartphones. Almost three-quarters (71%) of mobile phones being purchased are now smartphones, according to recent IDC Canada research. Smartphone use grew to 55% from 22% in just two years from 2011 to 2013.

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Wireless and Public Safety

Location, location, location! That familiar mantra of the real estate industry also describes the essence of new wireless emergency communications services. Termed wireless enhanced 9-1-1 (or "E9-1-1"), this technology to automatically transmit a caller's location has become of paramount importance to public safety and first responder emergency organizations, particularly given the increasing use of wireless communications, and is an essential component of NG9-1-1.

The new features inherent in Phase II wireless E9-1-1 are "critical must-haves," according to Vera Danyluk, Mayor of Ville de Mont-Royal, Que., and Vice Chair of the Public Security Commission of the Agglomeration Council of Montréal.

But some public safety communication experts also caution that wireless E9-1-1 technology is not a panacea for every case.

The increased reliance on wireless communications, especially as the sole means of voice communication, has posed a major new problem for public safety officials, namely, how to locate a caller to effectively dispatch emergency response services when 9-1-1 calls are made on wireless devices.

And the number of calls made on wireless devices to 9-1-1 emergency has skyrocketed along with the soaring use of wireless. More than a half (51%) of all 9-1-1 calls in the Greater Vancouver Region and Sunshine Coast of southwest British Columbia, for example, have been placed from wireless devices since 2009, according to statistics reported by Emergency Communications for Southwest British Columbia Inc. ("E-Comm 9-1-1"), the region's consolidated central emergency communications PSAP centre (see E-Comm 9-1-1, *News Release*, Vancouver: June 25, 2009).

9-1-1 calls are typically routed to a single public safety answering point (PSAP), which is a facility equipped and staffed to receive 9-1-1 calls. The PSAP then passes the call to the required first responder dispatch centre. On wired line calls, systems have evolved over the years in North America

to route a 9-1-1 call to the correct PSAP based on knowledge of the phone number (automatic number identification, or ANI) and its linked static address (automatic location identification, or ALI). Enhanced 9-1-1 refers to the necessary network switching, database, and elements for delivering the voice call to the proper PSAP along with the associated ANI and ALI information.

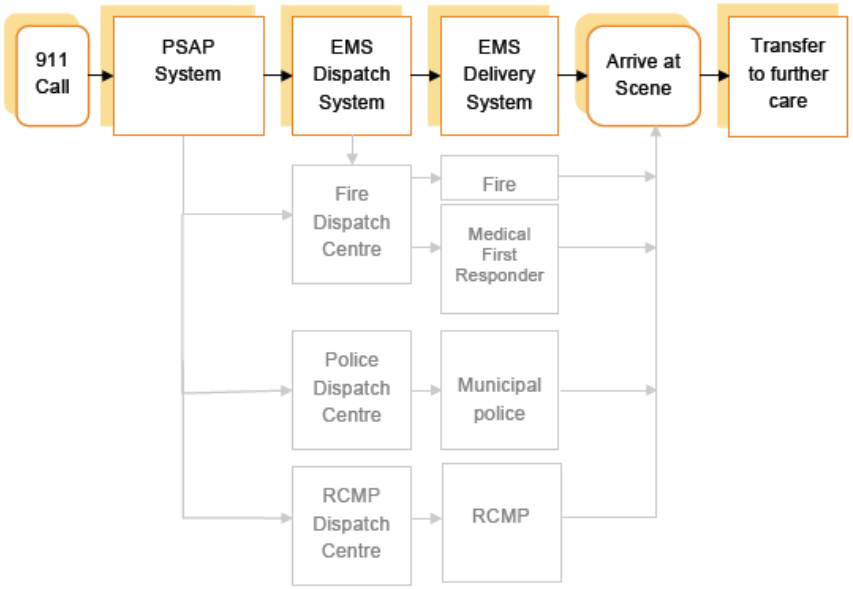
ALBERTA HEALTH SERVICES EMS

Context

Alberta Health Services began consolidating the province's multiple EMS dispatch systems in early 2009 and intended to have a single province-wide system to ensure that the closest available ambulance is sent to emergency calls no matter where they occur in the province. The term EMS describes a system of ambulance services and trained practitioners that provide pre-hospital care to the sick and injured in a variety of settings, and which often includes the transfer of patients to a hospital or between healthcare facilities. The EMS system is supported by a complex communication system linking dispatch centres and EMS providers. The EMS system must also link with other public safety agencies, such as police, fire, and other medical first responders. The EMS process is triggered by a 9-1-1 call from someone needing help in a medical emergency. The 9-1-1 call is handled by the PSAP system and then transferred to an EMS dispatch centre. The ground EMS critical path beginning with a 9-1-1 call through to a transfer from EMS to further care is illustrated in Figure 1.

FIGURE 1

Ground EMS 9-1-1 Call Critical Path



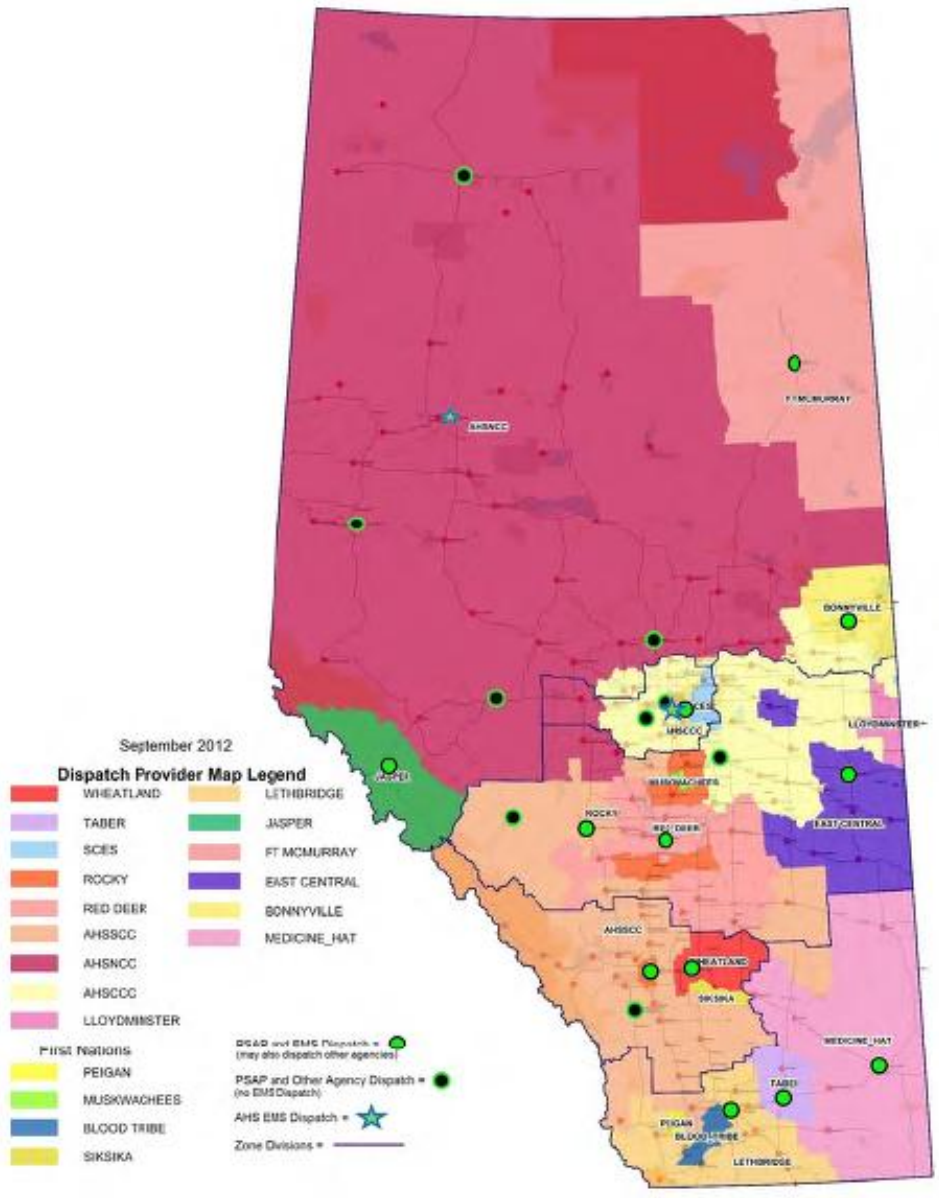
Source: Health Quality Council of Alberta; IDC Government Insights, 2014

Prior to 2009, EMS in Alberta was run by municipalities, and restricted by geographic boundaries. Ambulances belonged to individual municipalities and it was rare that they ever responded to emergencies outside of their community. However, in 2010 the Minister of Health and Wellness at the time halted the consolidation of Alberta's EMS dispatch due to concerns raised by some EMS stakeholders and municipalities. As a result of the 2010 decision, a variety of EMS dispatch centres

and services that are either owned and operated by AHS (direct delivery) or are operated by providers under contract to AHS have operated in Alberta (see Figure 2). Alberta Health Services was given a mandate from the provincial government to consolidate 35 existing dispatch centres to three, and completed this consolidation at the end of 2013.

FIGURE 2

Alberta PSAP, EMS, and Other Dispatch Agency Locations



Sources: Alberta Health Services, Sept. 2012; IDC Government Insights, 2014

The consolidated EMS dispatch centres are responsible only for the EMS call taking and evaluation of EMS events for the downstream PSAP. They currently handle about 400,000 calls a year. Emergency event management is based on a virtualized dispatch model between two of the centres through the automated computer-aided dispatch (CAD) system. TELUS' infrastructure is used to send information to responding units.

VoIP Foundation of NG9-1-1

Although Alberta Health Services has yet to articulate a vision or path to evolve to NG9-1-1, it invested in a new voice-over IP (Internet Protocol) based telephony solution when it started the new consolidated EMS dispatch centres in 2010. The Alberta Health EMS dispatch consolidation illustrates the role and potential importance of adoption of a new IP-based telephony system that is also NG9-1-1 compliant. VoIP telephony platforms have emerged as an important precondition on the journey toward NG9-1-1.

VoIP telephony platforms have emerged as an important precondition on the journey toward NG9-1-1.

Alberta Health EMS dispatch uses the i3-based Guardian IP platform provided by emergency communication system vendor **Solacom Technologies Inc**. The Guardian suite consists of four elements, all of which are NG9-1-1 compliant: The Guardian Next Generation E9-1-1 Controller; Guardian Intelligent Workstation; Guardian Emergency Services Routing Proxy (ESRP); and Guardian Emergency Gateway. The Alberta Health Services EMS dispatch centres in Peace River and Edmonton are currently on the same Solacom switch and province-wide geographic CAD systems. Alberta Health Services currently contracts with the City of Calgary to provide EMS dispatch in southern Alberta, but AHS is currently in the process of building its own centre there, and all three centres will then be on the same IP telephone platform (see Solacom Technologies Inc., *News Release*, "Solacom system to host second Alberta Health Services dispatch centre," Gatineau, QC: October 17, 2012).

NENA i3 Standard (Architecture)

Emergency dispatch planners point to an essential difference between what is meant by Next Generation 9-1-1 versus i3 compatibility. Next Generation 9-1-1 is more of the envisioned end state to describe a future feature-enriched system, whereas i3 compatibility is applicable to the components that make up the future NG9-1-1 architecture (which is still being defined through the standards development process).

The i3 standard was released in June 2011 by the U.S.-based National Emergency Number Association (NENA) and introduces the concept of an Emergency Services IP network (ESInet) which is designed as an IP-based inter-network (network of networks) that can be shared by all public safety agencies that may be involved in any emergency. The i3 Public Safety Answering Point (PSAP) is capable of receiving IP-based signaling and media for delivery of emergency calls conforming to the i3 standard. The i3 solution supports end-to-end IP connectivity; gateways are used to accommodate legacy wireline and wireless origination networks that are non-IP.

Implementing an i3 solution means emergency organizations will have to go through a transition from existing legacy originating networks and 9-1-1 PSAP interconnections to next generation interconnections. This so-called "end state" after a migration from legacy TDM circuit-switched telephony, and the legacy E9-1-1 system built to support it, to an all IP-based telephony system with a

corresponding IP-based Emergency Services IP network is described in NENA standard 08-003 v1 (for an example of a proposed ESInet, see the State of Texas case study in this report). Key aspects of the NENA standard-based ESInet include:

- All calls entering the ESInet are *SIP based*.
- Since the legacy circuit-switched TDM network will very likely continue to be used for the foreseeable future (both wireline and wireless,) the i3 architecture defines a legacy network gateway (LNG) to interface between the legacy TDM network and the ESInet. Gateways are outside of, or on the edge of, the ESInet. IP services that are not native SIP based have protocol interworking to SIP prior to being presented to the ESInet.
- Access network providers (e.g., DSL providers, fiber network providers, WiMax providers, long term-evolution/LTE wireless carriers, etc.) have installed, provisioned, and operated some kind of location function for their networks. Location functions are critical for 9-1-1 calls originating on an IP network because it provides a 9-1-1 valid location to IP clients that bundle their location in the SIP signaling to the ESInet.
- All calls entering the ESInet will normally have location (which might be coarse, e.g., cell site/sector) in the signaling with the call.
- 9-1-1 authorities have transitioned from the tabular MSAG and ESNs to GIS-based location validation function (LVF) and emergency call routing function (ECRF).
- 9-1-1 authorities have accurate and complete GIS systems which are used to provision the LVF and ECRF. A change to the 9-1-1 authority's GIS system automatically propagates to the ECRF and LVF and immediately affects routing.
- Civic location will be validated by the access network against the LVF prior to an emergency call being placed. This is analogous to MSAG validation.
- Periodic revalidation of civic location against the LVF is also needed to assure that location remains valid as changes in the GIS system that affect existing civic locations are made.
- The transition to i3 is complete when the existing selective router and ALI are no longer used. Even after that time, some PSAPs may not have upgraded to i3. The i3 architecture describes a legacy PSAP gateway (LPG) to interface between the ESInet and a legacy PSAP. The LPG supports the origination of an emergency call through the ESInet to a legacy PSAP as well as the transfer of an emergency call from/to an i3 PSAP to/from a legacy PSAP.
- Federal, state/provincial, and local laws, regulations, and rules may need to be modified to support NG9-1-1 system deployment.
- While NG9-1-1 is based on international protocols, the specific protocol mechanisms, especially interworking of legacy telecom and ESInet protocols, is North American–specific and may not be applicable in other areas.

Importance of SIP

SIP is a critical underpinning of the i3 NG9-1-1 standard.

Session initiation protocol (SIP) is a critical underpinning of the i3 NG9-1-1 standard, underscored by the fact that all calls entering an ESInet are SIP-based. SIP is an open standard protocol published by the Internet Engineering Task Force (IETF). SIP is the third major Internet protocol following HTTP (worldwide web) and SMTP (email). SIP has emerged as the de facto IP-based standard for next generation IP call control and

uses symbolic addresses to represent people who wish to communicate. A SIP session is any interactive communication that takes place between two or more entities over an IP network, from a simple two-way telephone call or an instant message exchange, to a collaborative multimedia conference session. The advent of SIP-based trunk lines provides distance-insensitive transport for existing TDM phone systems over a packet WAN that also carries data traffic. Dynamic allocation of bandwidth between voice and data traffic enables a more cost-efficient networking resource, enables insource/outsource options for applications (e.g., voicemail, conferencing, presence, and call centre), and smoothes migration to hosted services.

SIP is much more, however, because it is also the critical protocol that allows users to make the transition to a converged IP network. "SIP is really another application on the Internet and has become the standard for all real-time Internet communications," said Dr. Henry Sinnreich, a founder of the SIP protocol and former distinguished engineer at MCI (now part of Verizon Communications), in an earlier interview.

SIP session management is the key to enabling IP-based natural communications between people, not devices. By using SIP, users may locate and contact one another — regardless of media content or number of participants — using disparate computers, phones, and handheld devices. This feature of SIP is known as real-time presence and is central to the SIP architecture.

TELUS 9-1-1 Trunks

A next generation 9-1-1 system based on a full SIP architecture requires next generation SIP trunk connections. Although most major Canadian communication service providers have begun to offer SIP trunks (including MTS, Bell Canada, Primus, Rogers Business Solutions, TELUS, and TeraGo Networks), TELUS currently only provides non-SIP analog 9-1-1 trunks to public safety entities in Alberta and British Columbia, which will limit potential availability and access to NG9-1-1 applications. However, because the Alberta Health EMS Guardian switches are NG9-1-1 compliant, they will be able to interface with new SIP-based 9-1-1 trunks when TELUS, as the 9-1-1 connectivity service provider, starts to move forward with NG9-1-1 provisioning.

CAD to CAD (Computer-Aided Dispatch)

The Health Quality Council of Alberta 2013 report, *Review of the Operations of Ground Emergency Medical Services in Alberta*, recommended the Government of Alberta ensure communication infrastructure exists to enable communication between different public safety agencies across the province. Alberta Health Services, along with 9-1-1, police, and fire dispatch centres, use CAD software when managing requests for these services in most of the communities throughout Alberta. CAD to CAD refers to the linking of two or more separate emergency service responders (i.e., EMS, Police, Fire) CAD systems. This allows the seamless sharing of event-related information instantaneously over a network connection between the linked centres. The information shared includes location, access, patient status, and hazards related to the scene of the emergency. For example, AHS EMS shares information on over 20,000 requests for service a year with Edmonton Fire on a CAD-to-CAD link. AHS EMS is currently working with the cities of Lethbridge and Red Deer to establish CAD-to-CAD links as part of dispatch consolidation. An opportunity to connect AHS to other agencies will occur after EMS dispatch consolidation is completed early in 2014.

Future Plans

Alberta Health EMS dispatch planners believe they are well positioned to accommodate any changes that are coming in the future related to NG9-1-1 because of their i3-based Guardian IP platform. However, they haven't yet undertaken any active planning to implement NG9-1-1, or begun in-depth analysis of what the implications are for EMS dispatch in the province. They note that a first step would be to ask what requirements they would have or need as a secondary PSAP. But Alberta Health Services EMS has yet to look at what the benefits and the risks are of implementing NG9-1-1.

Wireless

Wireless applications would likely be a necessary and important requirement, however. The Alberta Health Services EMS dispatch centres currently handle cellular-based location data with a 90% confidence in range (X, Y coordinates) presentation. Almost a third (30%) of all calls handled by EMS dispatchers in Alberta are currently made from a wireless device.

SMS — Text Messaging for the Deaf and Hard of Hearing

Alberta's primary PSAPs will begin providing Text-to-9-1-1 to the deaf and hard-of-hearing community in late March 2014 to meet the mandate from the Canadian Radio-television and Telecommunications Commission (CRTC). All Canadian telephone and wireless companies were required to upgrade their networks to support this new feature by January 24, 2014. The national SMS 9-1-1 rollout follows three months of trials in Vancouver (E-Comm 9-1-1), Toronto, Montreal, and the Peel Region spearheaded by the Canadian Hearing Society's 9-1-1 improvement project.

The SMS 9-1-1 upgrade will be ongoing, with an estimated cost of C$2.9 million for IP upgrades required to implement in Calgary alone, according to the City of Calgary's Capital Projects office. Eventually the general public will be able to text 9-1-1. Public safety officials say there are certain situations – such as when there is an active shooter – where contacting 9-1-1 dispatchers silently is invaluable. SMS use has exploded in the past decade and Canadians sent 96.5 billion text messages in 2012, and more than 270 million text messages are now sent each day, according to statistics from the Canadian Wireless Telecommunications Association.

But the popularity and ubiquity of SMS has created a problem for public safety organizations identified by the CRTC Emergency Services (9-1-1) Working Group (ESWG). Many consumers erroneously believed and/or expected that access to Text With 9-1-1 (T9-1-1) service would be available to all Canadians on January 24, 2014. And the ESWG notes that many members of the DHHSI mistakenly believe that the T9-1-1 service will be automatically and instantly available to them rather than requiring registration. The ESWG has urged the wireless industry and CRTC to issue a statement promptly to clarify any mistaken expectations or misinterpretations that the hearing- and speech-impaired community have regarding T9-1-1. And the ESWG has reaffirmed the CRTC's previous stipulation that wireless providers need to develop "a service communications plan and education program that can be used to inform subscribers and the general public of the Text Messaging 9-1-1 service."

Other limitations with SMS will need to be addressed if it is to become a reliable means for emergency communications for the entire general public:

- SMS is an asynchronous messaging service that does not provide a means for the sender to know whether and when the message has reached its destination.
- Each SMS text is independent of its predecessors, making it difficult to ensure that messages within the same logical conversation are routed to the same destination.
- Latency inherent in the SMS delivery mechanism results in frequent delays to message receipt. On average there is a 20- to 60-second delay in receiving text messages, but some messages may not be received for several hours or even days.

Video

Alberta Health Services EMS is also potentially interested in incorporating video into NG9-1-1. The main driver of this is to have an attending emergency physician in the dispatch centre available for real-time consultation.

Challenges for Implementation

> ... The transition to NG9-1-1 is the microcosm of the transition from the old telephone system, with its hundred years of obligations and rules, to an Internet-driven world.
>
> Timothy Denton, CRTC, July 2013

Training and Resources

Alberta's EMS dispatch planners believe there's probably a greater need for in-depth training required for using backup legacy systems than for VoIP-enabled NG9-1-1 systems. But future NG9-1-1 application adoption will also be dependent on new resource requirements because someone in the dispatch centre or PSAPs will have to evaluate the additional information and decide how important it may be for a particular emergency call. Experts believe this will be a greater issue for police departments since they handle the bulk of Canadian emergency calls.

Governance

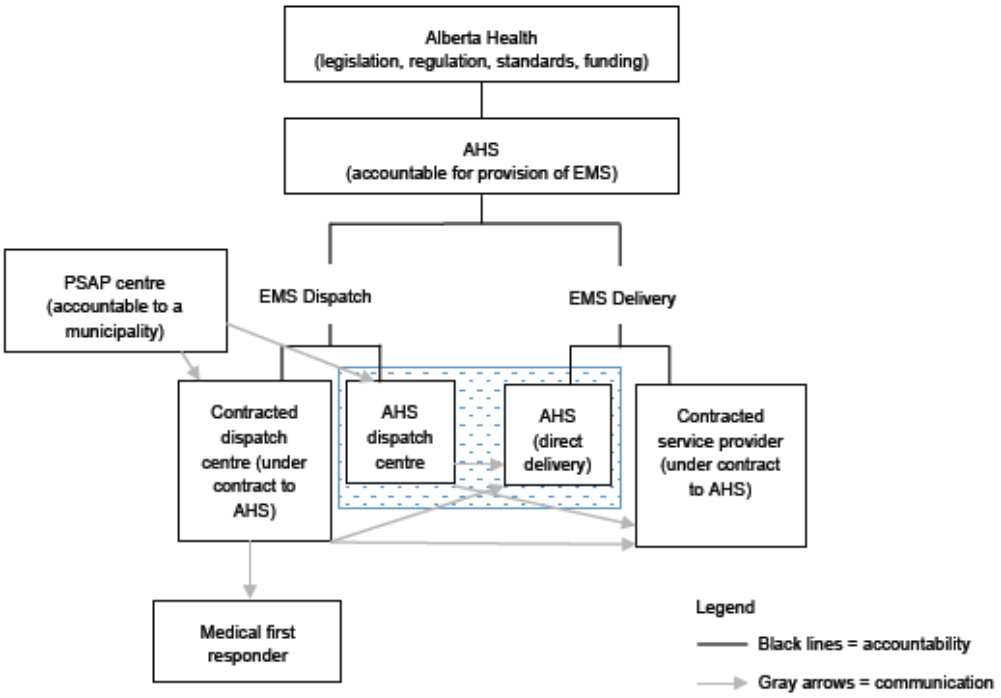
As in other jurisdictions and case studies in this study, governance emerges as a critical issue impacting NG9-1-1 adoption – not only for Alberta Health Services EMS, but by all stakeholders in the 9-1-1 delivery chain including PSAPs and communication providers.

Governance emerges as a critical issue impacting NG9-1-1 adoption.

And oversight of EMS dispatch in Alberta is further complicated by the province's March 2010 decision to halt EMS dispatch consolidation. That decision left the province's EMS system as an overly complex patchwork, according to the 2013 Health Quality Council of Alberta report on the province's ground ambulance system (see Figures 2 and 3).

FIGURE 3

Governance and Operation of the Alberta EMS System



Sources: Health Quality Council of Alberta; IDC Government Insights, 2014

Need for Canadian Standards

Alberta EMS officials also point to **the absence of Canadian NG9-1-1 standards as a significant impediment to planning and implementation**. Canada's NG9-1-1 group is not moving as quickly as planners in the United States and Europe, arguably in part because Canadian stakeholders must wait to see how NG9-1-1 standards in the United States develop.

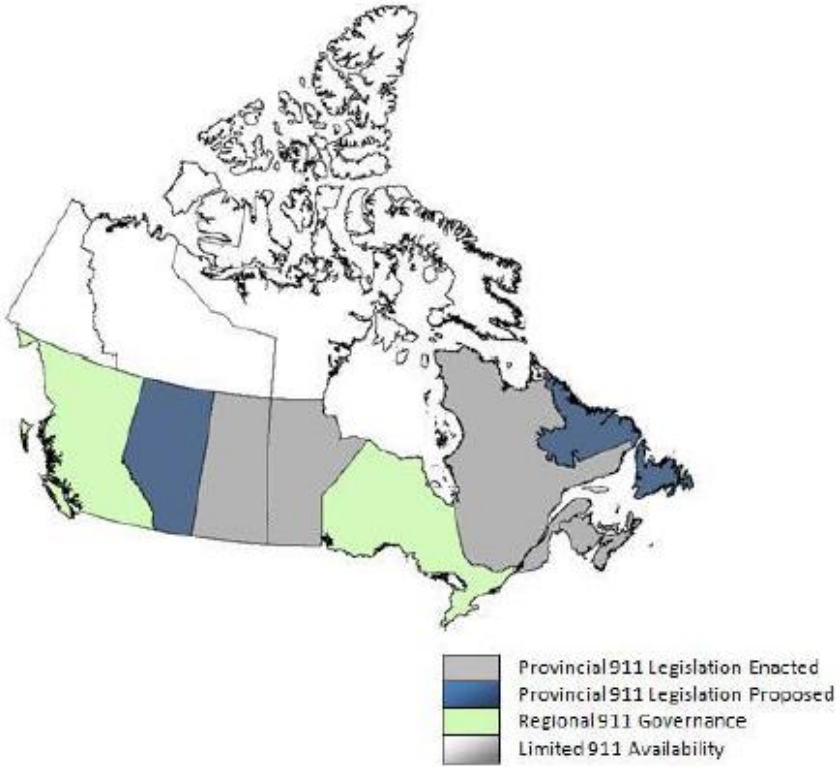
The CRTC plans to examine the future of Canadian 9-1-1 services in the 2014–2015 timeframe. To prepare for that review, the CRTC appointed National Commissioner Timothy Denton to conduct research on current 9-1-1 services and the issues related to the provision of such services on next generation telecommunications networks. His recommendations contained in his July 2013 report will be taken into consideration when the CRTC begins its review (see Canadian Radio-television and Telecommunications Commission, *A Report on Matters Related to Emergency 9-1-1 Services, Report by Commissioner Timothy Denton, Inquiry Officer*, Gatineau, Quebec, July 5, 2013). There is some uncertainty regarding how this will progress as Commissioner Denton's post was not renewed and key staff have left the organization.

The primary obstacle to NG9-1-1 adoption identified by Commissioner Denton arises from the multiple and fragmented jurisdictions (federal, provincial, territorial, municipal) for 9-1-1 administration, which

has many adverse consequences for the planning and delivery of emergency 9-1-1 services in Canada, notably the siloed mandates within and between jurisdictions (see Figure 4).

FIGURE 4

9-1-1 Governance in Canada



Source: Canadian Radio-television and Telecommunications Commission, 2013; IDC Government Insights, 2014

Commissioner Denton's primary conclusion is worth citing in its entirety:

> ***The basic problem with all of 9-1-1 in Canada at this time is institutional, not technical***. 9-1-1 in Canada lacks a policy forum that gathers the appropriate people and agencies in a multistakeholder institution. Everyone grasps their part of the elephant, and even if they know intellectually that they are only grasping a part, the means of coming to grips with the whole of the beast is made impossible by the various silos in which everyone is forced to operate: the Commission, the provinces and territories, the PSAPs, the carriers, Public Safety Canada, the first responder organizations (police, fire, and ambulance). That is just the public sector side. There are also the carriers and the suppliers of other equipment and services to PSAPs to consider. ***Some kind of multistakeholder institution where the relevant discussions can take place needs to be created***. [emphasis added]

CITIG has also identified governance as a significant area lacking focus. For more information please see the *CITIG Action NG9-1-1 Status Report* found at www.citig.ca.

IDC Canada concurs with Commissioner Denton's principal recommendation that "the CRTC needs to participate in the establishment of a national policy forum for 9-1-1." This forum has recently been created by CITIG and its partners.

FINLAND

Context

Finland began tendering for its new emergency response centre information system, "ERICA," in 2008; with estimated costs of €60 million upon completion, implementation began in 2011 and is scheduled to be fully operational by 2015/2016. While the new system, from Finnish vendor Insta, is fully NG112 capable (the European equivalent to 9-1-1), at the moment Finland is only providing SMS service to the deaf and hard-of-hearing communities via a dedicated number.

FIGURE 5

ERICA — Geographical Scope

Source: http://www.eena.org/ressource/static/files/riga_erca-finland.pdf

The need for a comprehensive, nationwide, interoperable NG112 system was in essence catalyzed by the following three key drivers. First, there was a globally recognized need to provide a suitable channel to provide critical emergency services to deaf and hard-of-hearing communities – communities which have been unable to utilize the traditional voice channel. This has been recognized across North America as well. Second, the consumerization of IT has radically changed citizen expectations about the various channels citizens would like to use to contact emergency services, and what types of rich media sources they could capture and send in to dispatch to help with response. At the same time this has created challenges regarding citizen automatic location identification (known in emergency services as ALI).

Unlike traditional landline telephones, mobile or cellular phones are not necessarily linked to an ALI database that provides accurate geolocation information. Mobility by its very nature necessitates a rethinking of how a citizen's location is determined. One of the key issues for Finnish first responders was how to be able to seamlessly leverage the technology already embedded in citizens' mobile phones.

The third driver was the adoption of eCall, by all 28 member states of the European Union, an initiative mandating that by 2015 all new cars will be equipped with M2M technology that contacts 112 directly and provides data about the crash, such as the number of passengers, the severity of the crash, etc. While eCall opens up the voice contact from the vehicle to the call taker, "Even if no passenger is able to speak, e.g. due to injuries, a 'Minimum Set of Data' is sent, which includes the exact location of the crash site" (see here, and the eCall section at pp. 43-46 of this study). While certain automobile manufacturers (Volvo, Mercedes, etc.) have built-in proprietary systems that perform similarly, this has in fact created complications as the nationality and language spoken by the passenger (Finnish, for example) was not the same as the nationality and language of the proprietary dispatch (German, for example).

SMS — Text Messaging to the Deaf and Hard-of-Hearing Population

As mentioned above, Finland has recently incorporated SMS to 112 for its deaf and hard-of-hearing population. The total number of instances a year is relatively small, only about 100 cases, given Finland's relatively small population of 5.5 million and because in most cases where deaf people have been in accidents or have emergencies they are with someone on the scene who can talk to 112.

SMS-Related Operational and Technology Challenges

A number of challenges were noted in the Finnish case. First, the response time is inherently slow given the need to type out questions and answers. "Having to ask and answer 4-7 questions to be able to conduct a proper risk analysis is inherently slow" (interview with a Finnish emergency management professional). Second, the risk of misunderstanding the caller increases when using SMS messaging. Third, there is a lack of contextual information generated by simply being able to hear the caller. Typically, dispatchers are trained to identify certain medical risks associated with blocked airways, asthma, etc. Lastly, it was noted that if there was a major event and the network was overwhelmed, the actual text message could be delayed for a long time before it reached its destination. This would be more of a challenge if SMS were to be extended to the general population as opposed to the relatively narrower deaf and hard-of-hearing community. To address these issues, Finnish dispatchers have new tools for call takers in the new system and pre-typed question categories so that the dispatchers can just use some kind of predefined texts when handling an SMS call.

More broadly, one of the key challenges with the new implementation of the entire 112 system was adapting to a consolidated approach to interoperability where the same system is used for all stakeholders (112 centres, maritime rescue, fire, paramedic, emergency social services, etc.). Information is filtered or triaged so that an individual user has specific rights and access to certain information. However, all databases will be integrated in this new system.

Managing Rich Media and New Channels for 112

While there were minimal technology concerns associated with the SMS deployment in Finland, other concerns were raised with regard to broader adoption of NG112. First, interviewees noted that it was imperative that all channels into 112 be treated equally; that is, new media cannot become a shortcut compared to the traditional voice channel. Different types of 112 "calls" should therefore go to the same call queue and IT system for call takers must have integrated features for all different channels. Interviewees were also concerned about the management of information created through social media. Where does the information reside physically? Who owns it and how should it be incorporated into response and investigation?

When asked about the types of risks that a given organization would take when trying to leverage new rich media sources, the conversation shifted to being able to secure the risk being managed. However, the benefits of leveraging new media sources, when connected to saving lives, were seen as key. "Our priority is to bring safety to people – not to the system we are using," said the interviewee.

Barriers to Adoption

Staffing, training, privacy, and security issues were the most notable inhibitors to leveraging new media sources and multiple channels for 112. "Privacy issues are involved especially when considering social media or other services where the servers are not managed by authorities." Security concerns are considered to be by far the biggest barriers to NG112 adoption in Finland. While they are endeavoring to build a security network for all state agencies to address issues like cyber-terrorism, network diversions, etc, there is still a wide chasm between recognizing the need to be able to leverage new technologies and perceiving them simply as security threats. "We have a lot of discussions with the people that are pinpointing ICT security issues, and they see these ideas about video, eCall, 112 SMS, smartphone applications – they see them simply as security threats."

Lessons Learned

One key takeaway should be noted in the Finnish case study. First, the response times for SMS "calls" into 112 are relatively long (sometimes up to 10 minutes) compared with less than 60 seconds via traditional voice calling. The process of relaying SMS messages with citizens in emergencies needs to be expedited as much as possible to hasten exchange of information. As noted earlier, to this end, Finnish emergency management professionals have created a series of pre-existing questions and answers. SMS pilots in Sweden noted similarly lengthy response times because of the slow speed of typing (findings of up to 20 minutes).

SWEDEN

Context

Sweden's 112 system is undergoing a fairly major review as the country responds to modernization demands given greater service delivery complexity, as well as responding to a number of questionably handled dispatch decisions recently. As a result, it is evaluating a proposal to further centralize the 112 service which is currently managed for most of the country by a company called SOS Alarm, though the company is in fact owned by the Swedish state, municipalities, and councils. As a result, many of the strategic plans and recommendations for NG112 initiatives are in limbo.

Key Drivers

Like many of the other countries profiled for this study, key driver toward NG9-1-1/NG112 activities are twofold: a recognition of the challenges faced by the disabled population and the consumerization of IT. Sweden has been engaged in three NG112-related activities in recent years. First, after years of pilots and trials, Sweden officially deployed Text to 112 for registered members of the DHHSI community in 2009. In many ways this makes Sweden a next generation pioneer. Second, Sweden was a pilot country in the "Reach 112" project which augmented 112 telephony with video and texting capabilities for the DHHSI community. Third, Sweden is one of the member countries of the in-vehicle emergency call initiative, eCall, detailed information for which can be found in a separate, dedicated case study in this report. Sweden is also part of the Harmonized eCall European Pilot Project (HeERO). Briefly, HeERO is a pilot project spanning eight EU member states (Czech Republic, Finland, Germany, Greece, Italy, the Netherlands, Romania, and Sweden) and Croatia, preparing countries to seamlessly roll out eCall. "The objective of the Swedish element of HeERO was to test the approved standards for the different parts of HeERO which is what's in the vehicle, the IBS, the mobile network, and at the PSAP side. There are standards for all three parts and one Swedish focus was to test if they work together more or less," according to our Swedish interviewee.

SMS to the DHHSI Community

Sweden formalized its SMS for the DHHSI community in 2009 after several years in a pilot phase. Currently there are over 2,000 registered users making 130 calls a year. There was very little specialized technology necessary to roll that out to the DHHSI community, so costs were negligible.

Challenges

As a small test, 112 system operators opened up the texting availability to the general public but didn't broadcast it as a publicly available service. As mentioned earlier, the volume of 9-1-1 and 112 calls has skyrocketed because of accidental pocket calls. Currently in Sweden half the calls to 112 are not emergencies and, perhaps strangely, SMS proved to have similar error ratios. According to our interviewee: "Thus it was decided that this should only be for the deaf and hearing impaired, and I know that the Swedish parliament has had suggestions two or three times that it should be allowed to the general public, but they have denied it each time."

Reach 112/Total Conversation

Sweden was one of the countries that took part in the Reach 112 project, a three-year project that ended in June 2012, involving 3,000 DHHSI individuals in Sweden and a further 22 partner organizations and pilot countries, to enhance traditional voice telephony with video relayed sign language assistance, and texting capabilities, through a solution called "Total Conversation." According to the project's final report: "The extended conversational service concept is intended to suit a wide range of situations in conversational settings over distance, and especially situations that appear when one or both communicating parties has a communication related disability causing a need to communicate in other modalities than speech, or complementing speech with other modalities." (see here)

Registered DHHSI individuals, leveraging basic available consumer video-based technology, would call into 112, and at that point two calls were transferred, one to the on-call sign language interpreter and the other to the 112 operator. This allowed the deaf person to speak fluently in sign language to the interpreter, and the interpreter to speak in turn directly to the dispatch. Two separate IP telephony terminals were added to the 112 dispatch to accommodate the Total Conversion solution.

Benefits

In addition to improved accessibility of 112 services for people with disabilities, Sweden found the solution enhanced person-to-person communications, and was much more efficient when compared with texting. "On average, a text message took about 21 minutes to handle, back and forth. Video-relayed sign assistance on the other hand took about 6–7 minutes, so there was an enormous difference between the two," the interviewee said. Sweden ran a real-time pilot for 12 months during the project, and in that time there were 38 Total Conversation calls into 112.

Challenges

Cost and funding were called out as the biggest challenges to implementation. Total Conversation is expensive as you need to have a sign language interpreter on call 24 hours a day, which amounts to US$300,000 a year. According to the final report reviewing the project across Europe, Sweden's costs to run this program a month were approximately €14,000, or €5 per beneficiary.

The next phase of Reach 112 was to deploy a mobile solution. A 2013 government review of the project recommended that it continue, but it is currently awaiting the decision of the broader 112 review, and interviewees expect further delays given that it is an election year. Lastly, while sharing this type of resource across a broader geographical scope is possible, Sweden has its own native form of sign language and thus could not take advantage of the shared resource pool.

One of the expectations from the Total Conversation pilot was that the video link would be able to provide good visual data as to the caller's health, colouring, breathing regularity, etc. However, this was not the case. "You have to have very good lighting where you sit and dial 112, and we've experienced that the picture was not very clear often. If the lighting was off, sometimes you could just see the shadow of the person dialing."

Lessons Learned/Next Steps

There are obvious quality-of-service and time-saving benefits involved in video uptake for the DHHSI community. According to our interviewee, "When you have the sign interpreters, you relay in real time. It's a fluent kind of conversation or communicating. With SMS, the first person has to write something, send the SMS, it has a certain time of travelling of course, the operator gets it, reads it, has to type the answer, and send it, and so on, and I think it's this kind of back and forth communication with short sentences that takes a lot of time." When asked which rich media he would prioritize gaining access to, our interviewee said he would like to deploy video and photo tomorrow if possible.

Another interesting observation was that the DHHSI community is not particularly well-versed in the written word, possibly because they are so heavily reliant on sign language. As a result, video was clearly a more suitable medium for them.

Moving forward, Sweden had high hopes for the better situational awareness gained by a mobile-enabled video solution. "We were expecting some advantages in people being able to show some streaming pictures of the person lying on the ground or the fire in a building. A picture is worth a thousand words."

During the Reach 112 project, the Swedish project team discovered that the sign for the word "road" and the sign for the word "street" were the same and this led to instances where responders were going to the wrong address. To rectify, it was recommended that the individuals text the address to the 112 system as that circumvented the error.

Liability and privacy issues are frequent concerns for those engaged in NG9-1-1; for Sweden the only privacy issue noted was the preference of the dispatchers to remain anonymous despite the visual nature of the Reach 112 project. "This was unfortunate as the deaf person calling is used to seeing someone who's talking to them," said our interviewee.

Our interviewee stressed the benefits of looking to other countries for lessons learned; Sweden specifically is interested in the former Baltic States (Latvia, Lithuania, Estonia) as they have recently become thought-leaders and technology pioneers as it relates to 112, mainly because they were starting essentially from scratch and had little infrastructure to migrate.

In the first six months of 2014, Sweden is looking to deploy a proactive disclosure system akin to the Smart9-1-1 offering in the U.S. Smart9-1-1 is a software program that has citizens enter a profile for their household with whatever information they would like 9-1-1 to be in possession of in the event of an emergency; for example the number of people living in the household, physical or mental disabilities, chronic disease, pets, etc.

Lastly, when asked to compare NG9-1-1 (NG112 in the European Union) with other public safety initiatives, our interviewee felt it was their highest priority.

STATE OF TEXAS

Texas is one of a half-dozen U.S. states at the vanguard of early planning and adoption of NG9-1-1 technology. (In addition to Texas, leading early adopters include the states of Virginia, Minnesota, Tennessee, and Washington as well as New York City.) The Texas experience underscores the length of time required for the NG9-1-1 journey. Planning began in earnest in 1999 and while Texas has begun to implement NG9-1-1 technology, which includes converting the current statewide analog 9-1-1 system to a digital one, this process is expected to take six to eight more years (with completion between 2017-2019).

The Texas experience underscores the length of time required for the NG9-1-1 journey.

Texas CSEC Creation and Role

Created in 1989, the Texas Commission on State Emergency Communications (CSEC) was charged a decade later by the State Legislative Assembly as the planning and implementation coordinating body for the deployment and operation of the Texas NG9-1-1 backbone system. The CSEC will facilitate the definition of roles and responsibilities of local, regional, and state government through stakeholder involvement. However, the roles and responsibilities of 9-1-1 stakeholders from PSAPs to state government will evolve as NG9-1-1 matures.

CSEC is responsible for the development and implementation of the shared components of the Texas NG9-1-1 System, primarily the state-level ESInet, its core functions and services, and NG9-1-1 databases, on behalf of all Texas 9-1-1 entities. CSEC also works with the Texas Department of Information (DIR) to deploy the state-level ESInet backbone to provide interstate connectivity and with the Texas Governor's Office of Homeland Security to support state needs for public safety radio interoperability.

In addition to its NG9-1-1 roles, CSEC also:

- Contracts with 24 Regional Planning Commissions (RPCs) to provide 9-1-1 service to about a third of the population in Texas in mostly rural areas. Emergency Communications Districts and Municipal Emergency Communications Districts provide 9-1-1 service to the rest of the state.
- Administers the Texas Poison Control Network (TPCN), including funding and overseeing the activities of the state's six regional poison control centres that provide treatment information through a toll-free number to anyone suspecting a poisoning or toxic exposure.

Key Drivers

The impetus to NG9-1-1 in Texas was expansion of the CSEC. The commission identified two key drivers for the Texas decision to rip-and-replace the legacy analog 9-1-1 system with an NG9-1-1 system: First, the existing legacy 9-1-1 system is based on outmoded and "convoluted" technologies that were established more than four decades ago; and second, the legacy 9-1-1 network is a barrier to creating an integrated emergency call management system that would have the ability to exchange voice, data, text messages, photographs, and live video through the 9-1-1 emergency communications centre (see Table 1 for a comparison of legacy and NG9-1-1 systems).

TABLE 1

Attributes of Legacy and Next Generation 9-1-1 Systems

Legacy 9-1-1	NG9-1-1
40-year-old legacy technology	Future oriented
Difficult to adapt to change	Plug and play
Proprietary	Based on open standards
Analog	Digital
Fixed-detailed	Dynamic — multipurpose
Primarily voice	Advanced data capability
Limited data capability	Text, images, crash notification
Local access	Long-distance access
Limited transfer and backup	Expanded transfer and backup

Source: Texas Commission on State Emergency Communications, 2013; IDC Canada, 2014

These capabilities would assist law enforcement, fire departments, and emergency medical services in tailoring their response to conditions at the scene of the emergency. An advanced, integrated 9-1-1 system would also provide the ability to quickly and easily reroute emergency calls to another call centre when the primary answering point is unavailable or overloaded.

Complex Migration

The adoption of NG9-1-1 in the State of Texas will require an overhaul of all aspects of 9-1-1 from governance to the delivery of services. Implementation of NG9-1-1 will also require significant investment, detailed planning, and close cooperation among the public and private sector entities responsible for the operation of 9-1-1 systems.

The transition from the current 9-1-1 system to the Texas NG9-1-1 system will require CSEC and 76 9-1-1 entities to coordinate and collaborate on the transition of 573 PSAPs. To reduce the level of complexity of the Texas NG9-1-1 System and leverage economies of scale, 9-1-1 entities must collaborate to form regional Emergency Services IP-enabled Networks (ESInets). CSEC anticipates a minimum of eight and a maximum of 14 regional ESInets. The NG9-1-1 Master Plan released by CSEC in 2009 detailed four main stages to the migration path to a full NG9-1-1 system (see State of Texas, Commission on State Emergency Communications, *Next Generation 9-1-1 Master Plan*, version 2.0, Austin, July 2009). They are:

1. Single hierarchical-level ESInet, closed system
2. State-level ESInet and regional ESInets, closed system
3. State-level ESInet and regional ESInets, open system
4. Removal of legacy 9-1-1 network components

CSEC NG9-1-1 Plan

The CSEC NG9-1-1 Master Plan was developed to communicate a single statewide vision of the Texas NG9-1-1 system and the transition effort for all stakeholders engaged in its development and deployment.

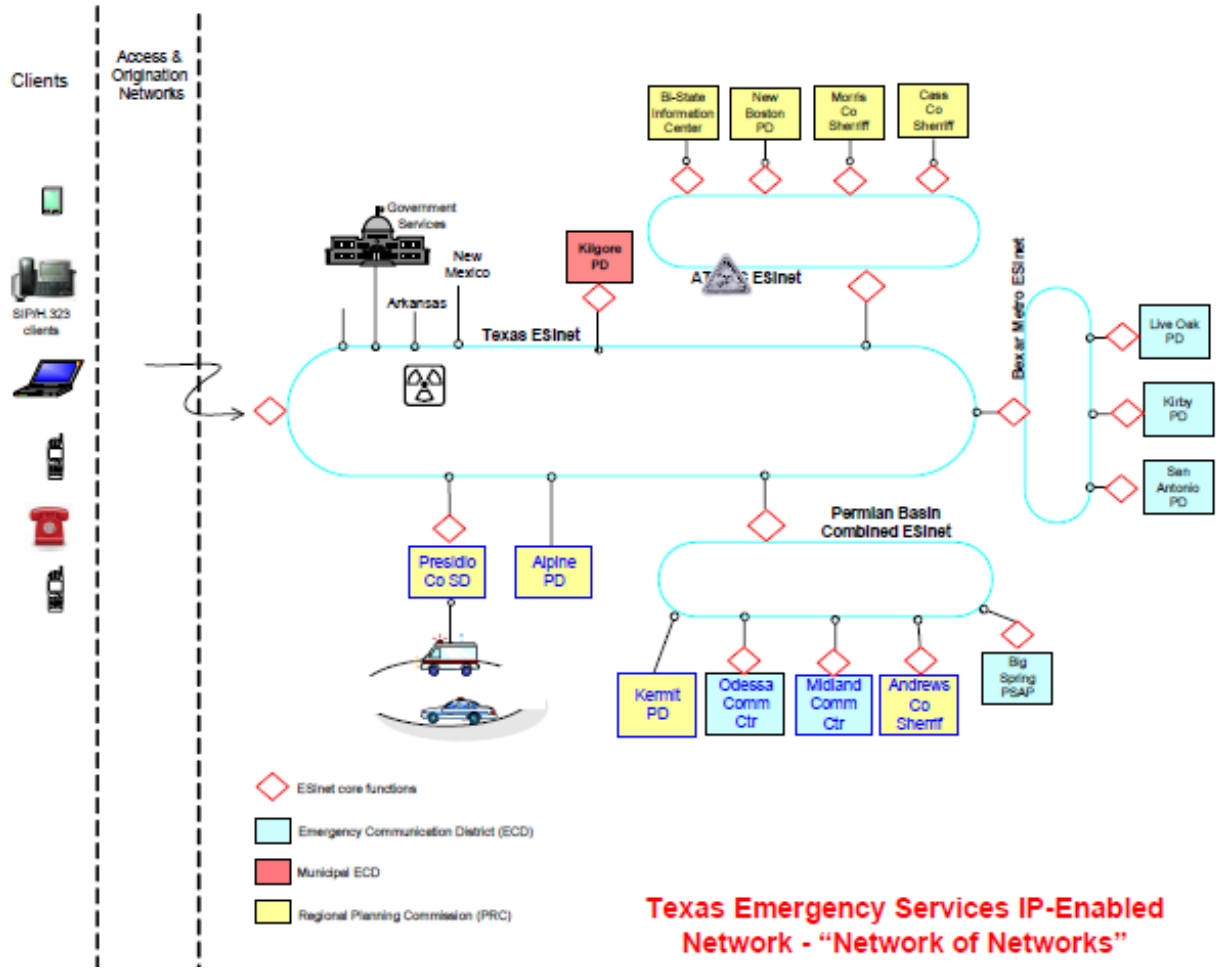
Architecture Vision and ESInet

The Texas NG9-1-1 System will be realized with the implementation of a statewide Emergency Services Internet Protocol (IP) enabled Network (ESInet) that will interconnect regional ESInets and individual PSAPs. The ESInet will enable call access, transfers, and backups among and between PSAPs within Texas and eventually with other public safety entities throughout the United States. It will also allow flexibility in call-taking such that call takers no longer will have to be physically constrained to a specific communication centre. Additionally, the ESInet will enable access to and backups from other emergency services organizations such as Texas Poison Control and the Federal Emergency Management Agency (FEMA). Thus, it is an interconnected and interoperable system of local, regional, and national emergency services networks (see Figure 6).

The ESInet will enable access to public emergency services by any personal communication device regardless of its mobility and/or technology. This includes emergency "calls" using SMS text messages, instant messages (IM), voice and video from handheld, laptop, and desktop computers, and wireless and wireline phones. The ESInet will have the capability to accept information to improve response, such as a photographic image of an accident scene.

FIGURE 6

Texas NG9-1-1 ESInet Vision



Sources: Texas Commission on State Emergency Communications; IDC Government Insights, 2014

ESInet IP Backbone

An IP-enabled network infrastructure will be used to interconnect individual PSAPs, regional ESInets, and emergency services networks serving the regions, both within and beyond Texas. As such, it must be engineered and managed to provision the bandwidth necessary to carry the volume of traffic for all 573 PSAPs in Texas.

Some PSAPs will be connected directly to the ESInet backbone. The remainder will be connected to the ESInet backbone via regional ESInets. In order to evolve the ESInet to provision other emergency services, the network infrastructure must be easily and seamlessly scalable and extensible. Furthermore, the network infrastructure must be public safety grade. It must meet a higher standard of availability, resiliency, reliability, security, and survivability than non-mission-critical enterprise network infrastructure.

The Texas state-level ESInet backbone will be built on the Texas Department of Information's (DIR) IP Communications Platform, a statewide IP/VoIP infrastructure. The DIR IP platform uses advanced network technologies such as multiprotocol label switching (MPLS), virtual private networks (VPNs), and quality of service (QoS). The DIR IP platform currently supports multiple agency networks, including the Texas Poison Control Network. Texas has budgeted US$7 million for the first phase of providing IP connectivity between all PSAPs.

State-level ESInet application operator(s) will provide core services related to generic IP-enabled networks such as address allocation, domain name systems, services broker, and network monitoring and management. State-level ESInet application operator(s) will also provide multimedia services such as bridges, loggers, media servers etc. Regional ESInets may choose to assign some or all of the core and multimedia services to the state-level ESInet application operator(s).

ESInet Core Functions

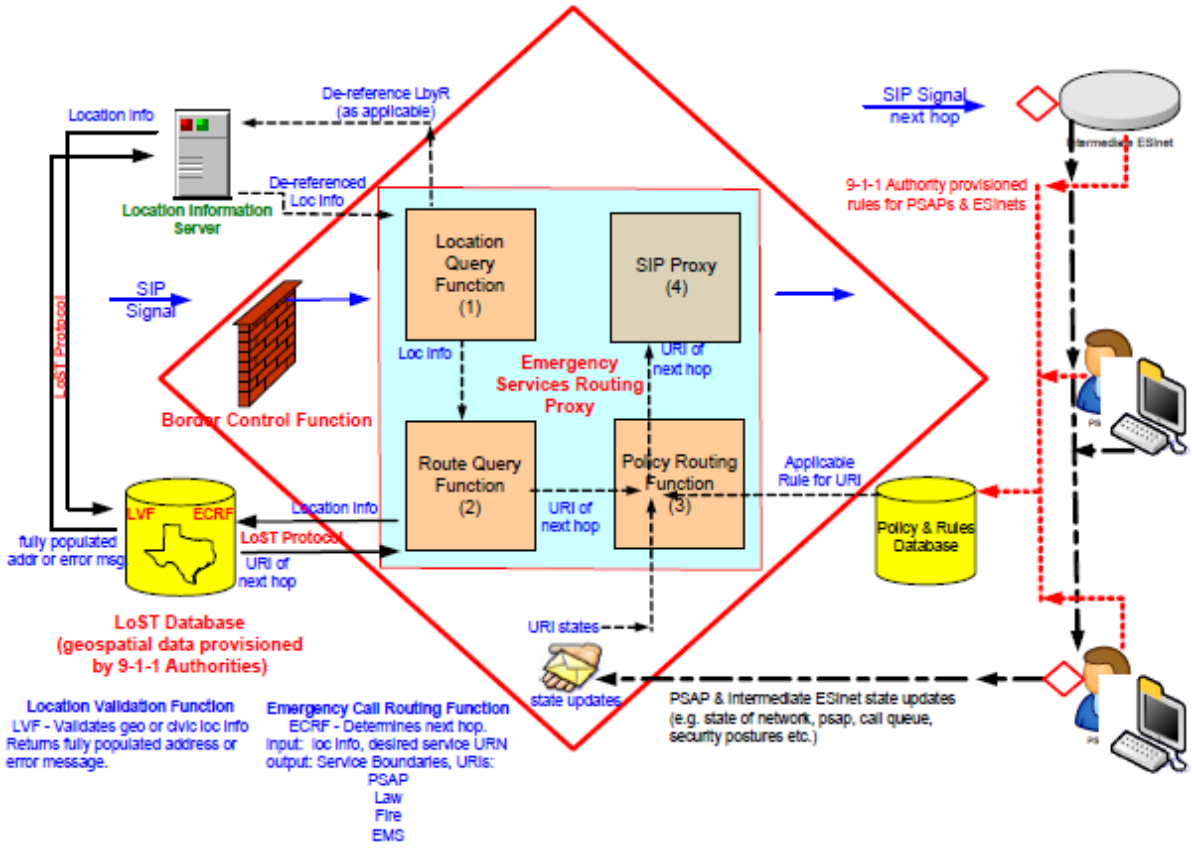
Calls presented to an ESInet by carriers, enterprises, or other entities must follow many of the protocol standards promulgated by the Internet Engineering Task Force (IETF). Furthermore, services and devices used to make emergency calls must also be built to IETF emergency calling protocol standards such as NENA i3 (see the discussion in the Alberta case study above). The IETF protocol standards are consensus standards incorporating requirements from a wide variety of nations, carriers, industry associations, and vendors.

The IETF emergency calling protocol standards applied to specific NG9-1-1 requirements provide the core functionality of the ESInet. The ESInet core functions are illustrated in Figure 7. CSEC NG9-1-1 core functions and services and NG9-1-1 database management services will be acquired as managed services where possible.

It is important to note that, unlike in Canada, 9-1-1 call handling from communication service providers (CSPs) to PSAPs in the United States is largely centralized. **Intrado**, based in Longmont, Colo., provides 9-1-1 database management and 9-1-1 call routing services to the majority of U.S.-based CSPs including all major incumbent local exchange carriers (ILECs), competitive local exchange carriers (CLECs), wireless carriers, and VoIP service providers (VSPs). (A unit of **West Corp.**, Intrado also has a major location in Montreal.)

FIGURE 7

ESInet Core Functions



Sources: Internet Engineering Task Force; Texas Commission on State Emergency Communications; IDC Government Insights, 2014

In the Texas NG9-1-1 system configuration, the state-level ESInet will act as the primary input point for all calls in the state. The state-level Emergency Services Routing Proxy (ESRP), shown in Figure 7 above, is the first element to make routing decisions. The ESRP determines routing based on location and policy, and forwards the call to the next hop. The next hop is either an intermediate ESRP (i.e., an ESRP for a regional ESInet) or a terminating ESRP (i.e., an ESRP for a PSAP). The state-level ESRP is also the terminating ESRP for PSAPs directly connected to the state-level ESInet.

GIS Initiative

Dissemination and access to geospatial information is critical to NG9-1-1 systems and a key driver of the Texas initiative, according to CSEC officials. Preparation of location data is an essential pre-condition of the NENA i3 NG9-1-1 standard and has been undertaken by a statewide geospatial database initiative. Texas has earmarked an additional US$5 million for CSEC's NG9-1-1 geographic information system (GIS) database that is separate from the network and connectivity funding.

Security and Border Control Function (BCF)

The Border Control Function (BCF) acts as the security clearinghouse for the ESInet for all incoming calls and data. It is an outer defensive perimeter to prevent deliberate and malicious attacks on PSAPs. In addition to firewalls, the BCF exerts control over the signaling and the media streams involved in setting up, conducting, and tearing down calls. Although IP networks are managed, it should not be assumed they are secure. Hence Texas will expect every ESInet to deploy a BCF at its edge and firewalls will be deployed at the edge of every PSAP. However, the state-level BCF is expected to be the most robust with large amounts of IP bandwidth between the sources of call and the PSAPs.

Lessons Learned

Cassidian Trial

Cassidian Communications, an EADS North America company, announced it achieved NG9-1-1 Emergency Services IP Network (ESInet) connectivity based on the NENA i3 standard during its ESInet trials with the Texas CSEC and the Brazos Valley Council of Governments in August 2013 (see Cassidian Communications, News Release, *Cassidian Communications Participates in ESInet Connection Trials to Advance Public Safety Communications in Texas*, Temecula, CA, August 20, 2013).

Texas planners singled out governance as the single most important issue related to NG9-1-1 adoption & implementation.

Although the result of the trial was seemingly positive, state officials characterized it as "a big eye opener." Among the key lessons learned were:

- Difficulties that communication providers incurred in new circuit provisioning for PSAPs
- Limited skills and experience associated with a single vendor
- Lack of complex project management skills required by both the vendor and CSEC

Texas CSEC officials said a principal lesson learned is the need to use a systems integration approach to NG9-1-1 system implementation. "This is so much bigger than DIY [do-it-yourself]," said one CSEC executive.

Challenges

Interoperability

The requirement for interoperability among multiple institutional stakeholders including the Texas PSAPs and between regional centres and with the CSEC has been identified as an essential but complex task. Yet ***the development of new national and international technical standards for NG9-1-1 systems does not of itself guarantee full interoperability***. "Interoperability depends on requirements for interconnection which need to be defined and agreed to by all public emergency stakeholders using the NG9-1-1 system," said a CSEC official.

Governance

Texas planners singled out governance as the single most important issue related to NG9-1-1 adoption and implementation. They note that the NG9-1-1 environment differs considerably from the current 9-1-1 environment with changes not limited to standards and technology. They include the governance, management, and operation of the system and the delivery of services. The functional requirements of the ESInet core functions and services, its interoperability, access, security, and performance standards must all be defined in collaboration with 9-1-1 entities and in adherence to appropriate standards. Hence the planning and transition to NG9-1-1 will be an extensive, multiyear effort.

The Texas CSEC provides a model for a state or province-wide NG9-1-1 coordinating body.

The Texas CSEC provides a model for a state- or province-wide NG9-1-1 coordinating body.

The CSEC has a statutory mandate to establish the requirements for interconnection to the state-level ESInet. PSAPs and regional ESInets will have to meet the established requirements and adhere to appropriate standards in order to interconnect to the state-level ESInet. At the same time, the CSEC recognizes that local and regional entities want to preserve their independence. Cooperation and agreement among all stakeholders is also essential. To achieve that goal, the CSEC has created the Emergency Communications Advisory Committee to ensure the views of all stakeholders are represented at the Commission and that the relevant terms of interconnection will be developed and revised in collaboration with all 9-1-1 entities.

Costs

The Texas NG9-1-1 System will be a shared system comprising multiple systems and components funded by disparate sources, of which 9-1-1 is one of several emergency services. The initial US$10.8 million implementation cost has been financed by a federal grant with matching state funds. Annual operation costs are currently budgeted at US$3.3 million.

CSEC intends to adopt a fair share methodology of cost allocation, based on population, among all Texas 9-1-1 entities. The same cost allocation methodology is also applicable to other emergency services sharing the system with 9-1-1. This enables economies of scale that will enable parity of emergency services capabilities, interoperability, increased efficiency, or cost savings within all aspects of emergency communications.

Privacy

With the availability of more data associated with the 9-1-1 caller and his/her location, including video images and health record exchange, the confidentiality of personally identifiable information (PII) must also be examined and protected. The CSEC will facilitate and coordinate this effort with its stakeholders.

U.S. NATIONAL CAPITAL REGION

Context

The U.S. National Capital Region encompasses the Washington-Arlington-Alexandria metropolitan statistical area, containing the city of Washington, the nation's capital, the Virginia county of Arlington, and the city of Alexandria. As of the 2012 U.S. Census Bureau estimate, the population of the Washington capital region area was estimated at 5,860,342, making it the seventh-largest metropolitan area in the country. Governance and operations are therefore complicated, with the region's large population spread across two states, and a number of overlapping PSAPs. This creates certain logistical interoperability challenges regarding NG9-1-1 management. For example, "From my window here, I can see the state of Maryland, and that's another state, and if you're on a road that's also in eyesight of my building here, you're going to hit a PSAP in Maryland instead of one here in Virginia." (U.S. National Capital Region interview.)

Key Drivers

Alexandria, Virginia's adoption of NG9-1-1 has been catalyzed by a number of recent events. To begin with, first responders are keenly aware of the implications of the consumerization of IT on emergency response. Relentless adoption of prevalent technologies like texting, photo and video capture, and location-based services means that whenever there is a major incident, masses of citizens take out their smartphones and immediately snap photos, record video, and text and/or call the PSAP. "We need to change the way we accept and provide emergency response communication because the public has changed the way they communicate." (U.S. National Capital Region interview.) Indeed we are at the vanguard of a technological shift, and there is a clear sense that the public will begin demanding change soon.

The consumerization of IT has interesting demographic variances. In the U.S., teens send and receive 3,339 texts a month on average, or six per hour they are awake. 94% of teen subscribers self-identify as advanced data users, turning to their cell phones for messaging, Internet, multimedia, gaming, and other activities. Moving beyond smartphones, there is keen interest in younger demographics for smart glasses that can access the Internet, present information through the lenses, listen to phone calls and music through an embedded speaker, and take and record audio, video, or pictures of what they are seeing. All of which is relayed simply to underscore the point that the prevalence and ubiquity of technology is increasing.

The second catalyst driving NG9-1-1 awareness was a very-high-profile criminal case in the National Capital Region where a female victim was abducted by force and placed in the trunk of a vehicle. What the abductors did not know was that she had her cell phone with her, and while she was in the trunk of the vehicle, she was able to call 9-1-1 and alert them to her initial location, the type of vehicle, and approximations of the location they were heading. While she was able to provide 9-1-1 call takers with some very basic information about her location, police were also able to use the GPS in her phone to track her location as they sped down the highway. However, for the victim, voice calling in to 9-1-1 was risky. Increasingly citizens have their cell phones, or even the house phone, with them, but it is obviously very dangerous to talk in certain instances. These incidents, and other incidents where for

example a victim is hiding in a closet during a burglary, or a school shooting such as at Virginia Tech, underscore the need to bring text and other rich media into 9-1-1.

NG9-1-1 Initiatives and Priorities

Alexandria, Virginia, is just in the planning phases of its NG9-1-1 deployment. While it is beginning to test implementation of citizen-wide texting into the PSAP directly, it has yet to implement any NG9-1-1 specific software or hardware. Though nascent, its deployment approach is three-staged. First it intends to deploy text capability into 9-1-1 on a regional basis, meaning that deployments will not be constrained by state boundaries. The reason for the regional approach is that the National Capital Region has numerous overlapping PSAPs and currently, when a citizen calls 9-1-1 on a wireless phone, the call inevitably goes to the wrong cell tower, ends up at the wrong PSAP, and has to be rerouted. Strategically, a regional approach is the only option. It plans to run a series of internal tests with police, fire, and ambulance fielding emergency texts, and from there leverage public service announcements to communicate the availability of the service broadly to the public. The second phase will address the incorporation of photos into response, which it intends to roll into the CAD system directly and to all officers (as opposed to having a separate unit feed the information to first responders). "Obviously we think that if someone's taking a photo of a suspect or some other critical piece of information that can be captured in a photo, and a dispatcher can see that and relay that it's a white male wearing a black jacket with red tennis shoes, that's a very clear description to give to the officer responding to the scene," said our interviewee. Lastly, it intends to incorporate video information into the CAD system. However, video poses the greatest concern for it given the bandwidth, storage, and training issues involved. "We're really just trying to push out the most basic element of NG9-1-1 and then just start to feel our way; obviously the horizon, and the frontier after the first phase, is going to be photos and then videos."

Virginia is currently able to leverage 3G and 4G technology in its mobile units to push photos out to its police force. For example, in the case of a domestic dispute where the suspect has left the scene, there is typically a hard copy photo of the suspect somewhere in the residence, and this will be digitally uploaded and sent to all units. "Officers will quickly take a digital photo of that hard copy photo, go back out to the car, quickly hit submit to all units, and within a matter of minutes, all my units get a picture of the person they're looking for. It is wildly successful, but a very manual process."

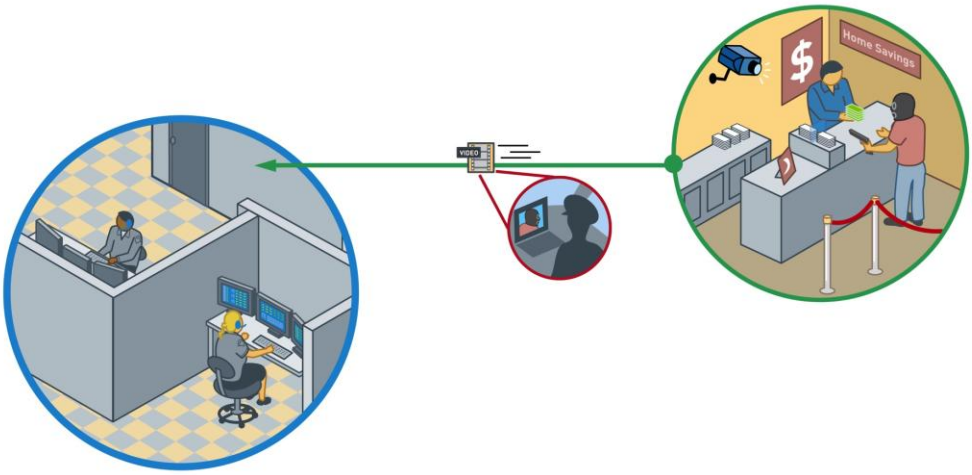
NG9-1-1 Business Benefits

While a number of study participants have noted a lack of clarity or understanding of the business benefits of NG9-1-1, Virginia noted several concrete business uses:

- **Improved officer safety.** The example cited here was a video feed direct from an in-progress bank robbery providing more (and better) data to officers about the number of hostages, the number of suspects, their location, status, etc.

FIGURE 8

Improved Officer Safety

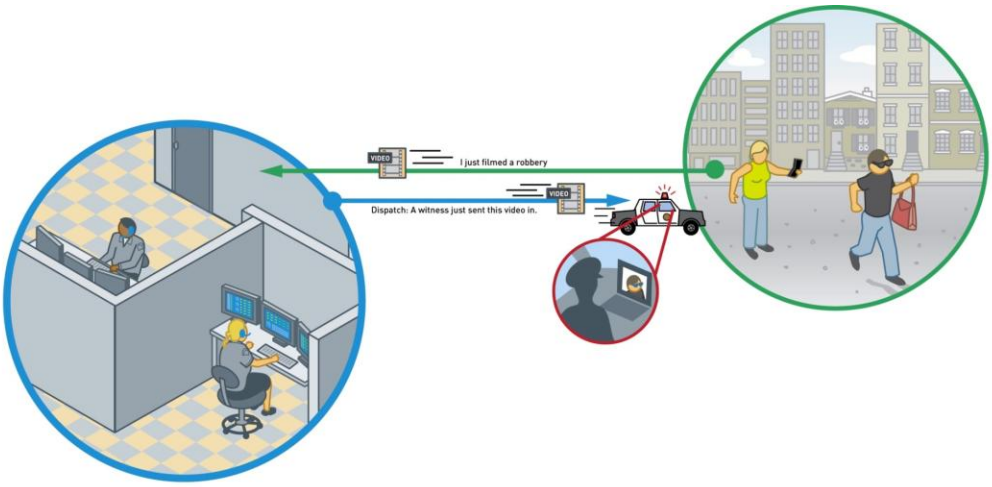


Source: Courtesy of Deputy Eddie Reyes, Alexandria Virginia Police Department

- **Robust, immediate evidence and situational awareness.** Eyewitness accounts for a small crime can be much improved with the ability to share photos and video directly to a PSAP, and then directly to an officer en route with NG9-1-1 capability.

FIGURE 9

Robust, Immediate Evidence and Situational Awareness

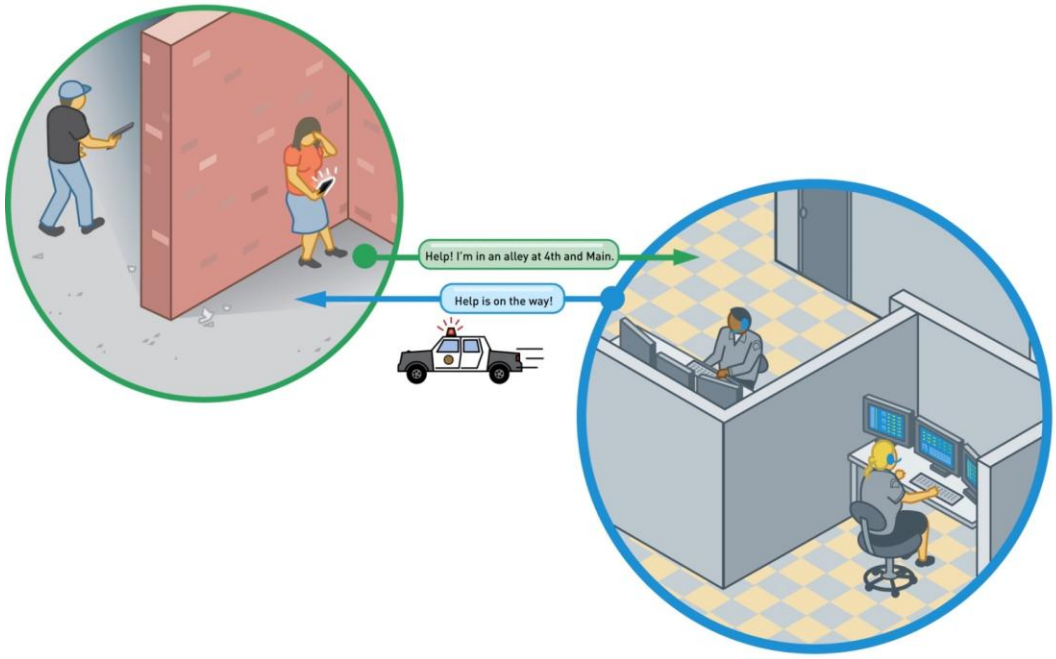


Source: Courtesy of Deputy Eddie Reyes, Alexandria Virginia Police Department

- **Increased citizen safety.** Texting can increase the safety of the public. For example, during the Virginia Tech shooting, many students tried to text for help – a safer and more viable option when a voice call isn't possible or is risky. Currently, however, individuals who try to text do not reach a PSAP for assistance.

FIGURE 10

Increased Citizen Safety — SMS to 9-1-1

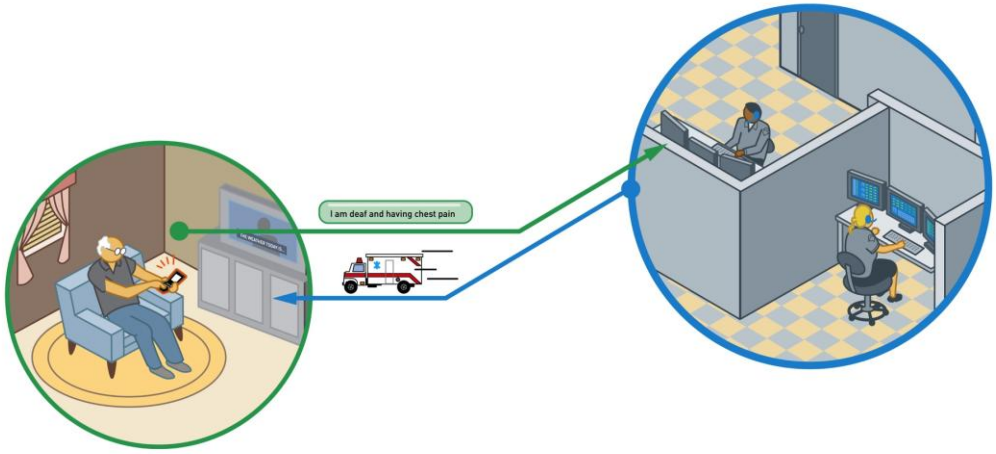


Source: Courtesy of Deputy Eddie Reyes, Alexandria Virginia Police Department

- **Better service to special-needs communities.** NG9-1-1 will also allow better service to the deaf and hard-of-hearing, speech-impaired, and elderly communities.

FIGURE 11

Better Service to Special Needs Communities

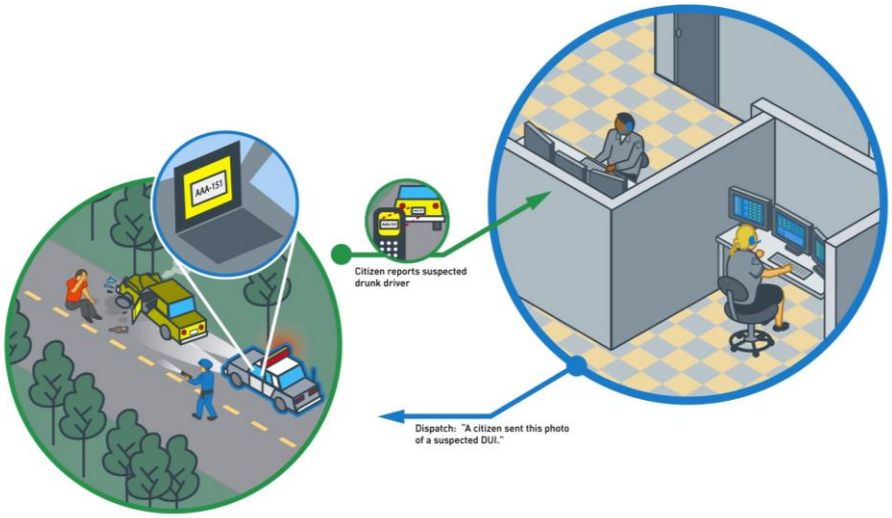


Source: Courtesy of Deputy Eddie Reyes, Alexandria Virginia Police Department

- **Proactive response.** With NG9-1-1, the public will be able to share data with first responders in real time. For example, a driver might identify an erratic driver, capture the license plate, and send that directly to a PSAP. Officers are able to respond, possibly even before anyone is injured.

FIGURE 12

Proactive Response

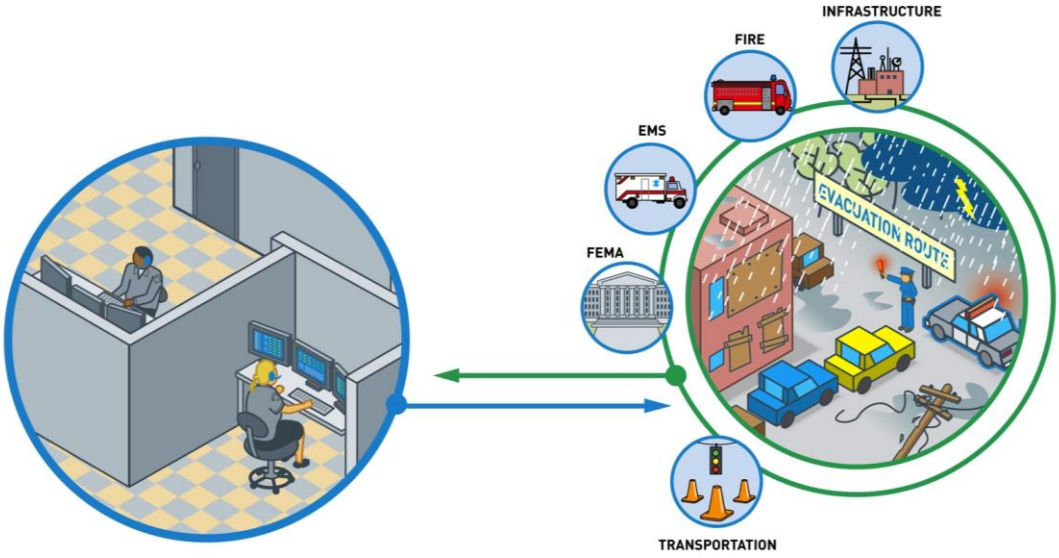


Source: Courtesy of Deputy Eddie Reyes, Alexandria Virginia Police Department

- **Redundancy/interoperability.** With NG9-1-1, the ESInet provides a secure and redundant network for all emergency responders, which is capable of handling overload. In the case of a natural disaster, that can increase efficiencies and communication; providing texting avenues can be helpful when networks are overwhelmed by natural disasters, extreme weather, etc.

FIGURE 13

Redundancy/Interoperability



Source: Courtesy of Deputy Eddie Reyes, Alexandria Virginia Police Department

Barriers to Adoption

In its overview of NG9-1-1 issues in the U.S., the Association for Public-Safety Officials (APCO) cites equipment upgrades, software changes, training challenges, funding hurdles, and just "keeping up" as key challenges experienced by U.S. organizations trying to harness NG9-1-1. The National Capital Region stressed that technology was not a barrier to adoption – the technology exists to make NG9-1-1 possible right now – but what is preventing implementation is a lack of:

- **Standards.** While there is some movement toward adoption of the I3 standard, standards have not been established or universally endorsed yet.
- **Funding.** It is estimated that funding for new NG9-1-1 initiatives will add 20%-30% to existing NG9-1-1 budgets. Once up and running, however, NG9-1-1 isn't expected to cost much more than the legacy system, but new infrastructure costs, to migrate from a copper-based system to an IP-based system, will be a factor initially. Additionally, the National Capital Region expects to have to add one full-time employee to manage the evidentiary value of real-time photographs into the PSAP. "We believe it's going to get to that volume where it can't be an auxiliary job for someone to manage that. It's going to become a full-time dedicated job for a person to catalogue all that evidence." The incorporation of video poses yet another challenge given that it has to be maintained at court-level security.

- **Legislation.** Legislation to support and guide new NG9-1-1 initiatives does not yet exist, nor do plans for NG9-1-1 governance.

Lessons Learned

Coordination is Key

In 2012, the United States Congress enacted the Next Generation 9-1-1 Advancement Act of 2012 (see here), authorizing the activities of the 9-1-1 Implementation Coordination Office. The Office is focused on coordination, sharing information and resources, and providing the assistance that emergency responders need to make NG9-1-1 a reality within their region.

The Office has been charged with improving coordination and communication among all stakeholder groups involved in the provision of 9-1-1 services; developing, collecting, and disseminating information concerning practices, procedures, and technology used in the implementation of 9-1-1, E9-1-1, and Next Generation 9-1-1 services; overseeing grant application and implementation processes, including advising eligible entities as well as receiving, reviewing, and recommending approval or disapproval of applications when funds are available; and advising and assisting eligible entities in the preparation of implementation plans.

Collaboration Helps

As mentioned, the National Capital Region is an amalgam of a number of key cities spanning two states; as a result, the PSAPs interface regularly, and this has led to fairly extensive and well-used collaborative processes. "I think if we do anything well at all here it is collaboration with other PSAPs on a very regular basis; we're having regional PSAP meetings because we interface, and we inter-operate with each other every single hour." Collaboration becomes even more critical in the NG9-1-1 environment as PSAPs are less geographically defined.

Agreement on an NG9-1-1 Standard is Critical

The National Capital Region is actively working with APCO and NENA to determine an NG9-1-1 standard to endorse. Interest is constellating around NENA's i3 standard. Basically, the i3 standard describes the end-state network, components, and interfaces required to provide NG9-1-1 service. Critical to the i3 architecture is the Emergency Services IP network (ESInet), which is in essence an IP-based network of networks shared by public safety organizations in the event of an emergency. In the i3 architecture, PSAPs are no longer siloed from one another, but can communicate seamlessly using the SIP communications protocol. Location information is no longer provided by the master street address guide (MSAG) but rather fed by geographical information systems. Location information is passed to the emergency services routing proxy (ESRP) which is responsible for routing the call to the best PSAP. (For further information on NENA's i3 standard please see here and here.)

Reframe the Discussion

NG9-1-1 leadership in the National Capital Region is trying to shift the focus of NG9-1-1 discussions away from technology-related issues toward issues of first responder business and community value. As noted earlier, technology is not perceived as a barrier to adoption, whereas funding models, governance structures, and interoperable standards are in need of consideration.

CITY OF VANCOUVER

Context

On Wednesday June 15, 2011, the Vancouver Canucks hockey team lost in Game 7 of the NHL Stanley Cup Series. Fuelled by disappointment and alcohol, a riot ensued, with disgruntled fans damaging property, burning cars, smashing windows, looting, etc. — 112 businesses were looted or damaged, 122 vehicles were damaged or destroyed, and net losses exceeded C$3.4 million. According to an independent review of the riots and police response, the problem in Vancouver in 2011 was that "essentially the city core became a stadium holding 155,000 people but without resilient infrastructure, time, or capacity to manage the crowd."

Given the history of this type of event (there was a similar hockey-related riot in Vancouver in 1994) the Vancouver Police Department (VPD) was on alert to the possibility of having to manage a large-scale event; what was surprising about the 2011 riot was that it was one of the first major incidents captured during the cell phone era. The VPD initially received around 5,000 hours of photographic and video footage in all kinds of different forms from citizens, fans, and witnesses; the material was collected post-response, not fed directly into the PSAP. "Ordinary citizens in Vancouver became vigilantes by taking pictures and video of apparently red-handed rioters for sharing with police. Now, here was something new! It was as if most of the participants were carrying their own broadcast device and using it to report, communicate, photograph, and record," according to the review (see *The Night the City Became a Stadium: Independent Review of the 2011 Vancouver Stanley Cup Playoffs*, September 1, 2011). Further search warrants requests added a further 2,500 hours of footage from media sources. To assist in prosecution, the material was tagged and analyzed at the University of Indianapolis's LEVA (Law Enforcement Video Analytics) lab. The investigation is perceived by many to be the largest and most sophisticated video forensics investigation of its kind in the world. It is important to note that Vancouver is not leveraging real-time photographic or video inputs directly in its CAD systems, but rather houses this function in a separate video analytics lab.

Reviews of the 1994 riot pointed to a lack of interoperability between fire, police, and paramedics as key failings in the response. This led directly to the creation of E-Comm and its enhanced capacity to manage various information sources. "The city's permanent Emergency Operations Centre located in the E-Comm facility … has an audio-video display system that can show numerous video inputs — satellite and cable television, CCTV, traffic cameras, computer feeds. Its computer network links police, fire, ambulance, and 9-1-1 on a routine basis and transit, health authorities, and provincial emergency officials when required," according to the review.

E-Comm 9-1-1 (E-Comm) is the regional emergency communications centre for southwest British Columbia, located in Vancouver B.C.; it provides 9-1-1 service for Metro Vancouver, the Sunshine Coast Regional District, Whistler, Squamish, and the Squamish-Lillooet Regional District (south). E-Comm provides dispatch service for 30 police and fire departments, and it owns and operates the wide-area radio network used throughout the Lower Mainland by police, fire, and ambulance personnel. As such, it is one of the largest multi-agency public safety radio networks in North America. In any given year, E-Comm answers close to a million 9-1-1 calls.

Social Media, Video Analytics, and Investigation

First responders found themselves in a different situation in 2011 – suddenly faced with a massive outpouring of evidence from citizens in the area and fans in attendance, and with no formal mechanism to receive said evidence, the VPD turned to social media and video analytics to help manage response and investigation.

The VPD created a private YouTube account to which citizens could submit video and photographic evidence; further on in the investigation the VPD also created a website with pictures of suspects, asking citizens for help in identification. Interestingly, privacy laws prevented the VPD from leveraging video footage of crimes sent in from citizens to help in identifying suspects. While the VPD was able to work around this by creating its own video sources, this further exhausted resources and created delays. While there is considerable discussion in law enforcement about how criminals leverage social media to fuel a large social incident, there was no evidence of that factoring in during the 2011 riots.

Managing the Data Deluge

The VPD found itself ill-equipped in 2011 to manage the volume and variety of video sources received from citizens, so after examining its various options it transported all of the video and photographic evidence to a video forensics lab in Indianapolis where its LEVA forensics video analysis response team could assist. According to one interviewee for this study, this lab was "the only place in North America that could handle the volume and do the things we needed to do. Otherwise, five to ten years from now we would still be working on video."

Conducting the analysis was costly and extremely time-intensive, as charges of rioting require multiple instances where the same individual is engaged in criminal behaviour. Additionally, "They had to build and learn to run a new $500,000 forensic video unit, paid for by the province, and undertake the massive job of 'tagging' 65,000 individuals who were in the streets that night." (see here)

The lab is LEVA 3 certified, and uses industry standard Avid video and image analytic software, in conjunction with Omnivore, a portable thumb drive video extraction tool which also harmonizes file formats, and is to certify the authenticity and integrity of the videos. It took a team of 24 investigators three weeks, 24 hours a day, to tag, process, convert, redact, and authenticate the video for prosecution. While the tagging process is time-consuming as one is numerically coding, for example, 25 different types of Vancouver Canucks jerseys and hats, once complete it generates a "score" for a particular individual, and that allows investigators to quickly narrow down suspects. "You can go from 30,000 people to 10 possible suspects fairly quickly. So if you see someone in a video with a backpack, a hat, Canucks jersey, it hives off people until you get the ones and then your video people can say yes, that is him in this photo," said our interviewee.

The VPD now has its own local video forensics lab which leverages the same software suite via eight networked (versus standalone) systems that people can work with simultaneously.

The Result

The Integrated Riot Investigators Team (IRIT) produced 674 charges against 225 rioters by 2012, and of those the Crown approved 276 criminal charges, including 27 assault charges, against 104 rioters,

according to the VPD. 70% of arrests were of people not from Vancouver (but rather from surrounding suburbs), and were typically men averaging 24 years of age. (see here)

Information Management Challenges in 2011

Crown-Approved Video Formats

Processing the data in the manner required by the Crown proved problematic. The VPD received over 300 types of video formats, but the courts in BC only allow three types as evidence, so a huge conversion effort was undertaken. The VPD had to convert all those images with disclosure that was acceptable for the Crown. To manage that process, they converted only the applicable parts of the video – five minutes before and after the relevant section. A further difficulty was ascertaining who took the video, where it was taken, and when, as well as whether it had been compressed or compromised in any manner.

Redaction

Substantial time and effort was put into redacting parts of the videos to protect citizens' privacy. If the VPD was going to post a video of a suspect for identification purposes, it had to redact all of the images of the people around the suspect. According to our interviewee: "Redacting takes a lot of extra time and effort in processing that. Those are resource hours."

Storage Space and Archive

The VPD does not currently have a digital evidence management system and has coped with the extra volume by purchasing C$200,000 of extra storage space. Video file sizes are an increasingly large challenge for police departments in North America; moreover, because they come in a very wide variety of file formats, each video requires a separate thumb drive. "The problem with that is thumb drives are costly and they sit in the property office for several months before we start to process them." The VPD cited a recent protest at a new, upscale Vancouver restaurant (it was opening in a previously ungentrified area of Vancouver) and in that case alone the VPD received 13.5 terabytes of video from citizens (1 terabyte is comparable to 280 million books). Because of the ongoing issues with storage, the VPD is currently investigating outsourcing CD duplication services. Participants interviewed for this study expect the availability and volume of video to increase given an uptake in use by certain demographic groups, particularly those under 25. "Look, I have teenagers and the first thing they do about anything is take video," said an interviewee. It is in this context also that questions emerged about the storage implications of archiving responsibilities. "So, if they get six hours of video but they only really need the 10 minutes for the Crown, do I have to store the six hours for 99 years?"

Changes to Day-to-Day Operations in the VPD

Video capture has woven its way into day-to-day operations for the VPD. Utilization of the software has progressed beyond large-scale events like the riots into major crime investigations to the point where video capture teams are now part of the initial immediate investigation team. Typically, now investigators will start at the crime scene, working their way out as people identify video sources, capturing video as far as 8 to 10 blocks out. The VPD has purchased additional extraction computers for its IT section, loaded with the most common forms of codecs to manage the various video sources.

Interviewees noted the role that increasingly common home security systems are playing in criminal investigations. "For example if we are investigating a burglary, there could be 17 downstream security systems catching the car, or the perpetrator leaving, and the investigators get access to all that," according to one interviewee. "That's part of the investigators' work flow now, which is crazy that they have to go and capture all that video. That's like day-to-day operations now."

Benefits

Better Evidence

Although exceedingly time-consuming, video analytics produces a very convincing, precise, and therefore incriminating time-line sequence of activities. "Instead of showing [a suspect] smash one window with a hockey stick, we show him roll two or three cars, assault people, break into stores, and set fire to a car, and we get him on the Sky Train leaving with stolen goods." (see here). Additionally, software allowed investigators to connect subjects in new ways. The process of tagging individuals in the Avid software suite allowed investigators to identify subjects wearing balaclavas; at some point their balaclava would be removed, but because the clothing stayed the same they were identified.

Similarly, video analytics allows for sophisticated recreations of criminal activity that helps more precisely determine the plausibility of alibis and validate evidence. "We had a sexual assault trial where the suspect left the scene and we had to do a video comparison on that and recreation and we've done video comparisons for a number of years and it's not absolute but it helps corroborate stories, evidence, etc."

Better Quality Situational Awareness

Interviewees frequently commented on the potential that video analytics and other rich media have for the quality of response and the sophistication of analysis. The following characterizes the role rich media sources can play in the quality of response: "Obviously, for first responders, the more information we have the better. If I can see the site, see what is going on, see photos of where we are looking, where we should go, where the bad guy is, etc., it enhances our response." This next quotation depicts a scenario where teams can leverage more advanced knowledge bases: "If you have video of fire wouldn't it be nice if you already have the technical ability to analyze the colour of the smoke to determine if it's chemical or not. I don't need to see it. You send me it and you say hey, that has all the makings visually of a chemical fire. Oh now I'm paying attention to that, right."

Broader Challenges With NG9-1-1

Privacy

A number of vexing privacy issues are raised by NG9-1-1. One of the central issues pertained to the intended purpose and shelf life of the evidence collected. For example, "I can track a car that was involved in a robbery, right, but as I track that car I'm also seeing 10 other cars on that street. Can I go back a week later because there's been an incident there and look at your car sitting on the street, which I happened to get a picture of as I tracked the stolen one going by?" Similarly, if your neighbour's home security system captures a break-in, are investigators able to mine that data later for other purposes or investigations?

Liability

Liability concerns are also vexing issues for organizations engaged in NG9-1-1; managing the sheer volume of information available to first responders and investigators is problematic from both a resource and process perspective. "Is there a liability issue now when I have video of somebody that was breaking into your house next door and I didn't look at it, and I didn't do anything? We have to find a way to deal with it."

Information Overload

Crime units across the country are currently overwhelmed by cell phone images and evidence as it relates to other major crimes (homicide, sexual assault), as well as additional forensic demands from computer evidence captured during child pornography investigations. As a result, a given homicide department might wait nine months for a phone to be examined, and for its video to be forensically recovered.

Workforce Impacts

There is considerable discussion in the PSAP, from both dispatchers and call takers alike, around the appropriate management and incorporation of rich media sources into the response to a given incident. Interviewees frequently commented on this being a double-edged sword, and struggled with trying to find the appropriate balance between providing dispatch with enhanced information, and providing them with a work environment where they are able to remain calm, focused, and neutral. Dispatchers can "become too close to the problem and we need them to maintain cool, calm. They are the voice of reason on the radio and it's because they are not involved with the scenario unfolding that they can maintain that composure." Interviewees also noted that dispatch is already working with three or four screens, and adding another would be both distracting and unmanageable.

Interviewees also worried about the impact of a sudden flow of potentially disturbing images on the call takers and/or dispatch in the event of a very graphically violent incident like the Boston marathon bombing. Stated alternatively: "If you're watching a video of a child being run over by a vehicle you're not going to maintain your neutrality and your composure on the other end of the radio; you're going to be totally caught emotionally into that call and potentially to the detriment of your officers and the rest of your calls on your board."

Interviewees stressed the need for technology solutions to expedite the incorporation of critical information without compromising the primary function of response. "The dispatcher needs to know when that video is valuable. I don't know how they have the bandwidth to view it, digest it, and then make decisions on it. So, I think we're missing a little piece of technology that has the technical ability to do the analysis for the dispatcher. Or even the patrol members. We have to stop asking them to go find information and we have to design systems that tell them the information they need to know."

Impact on Day-to-Day Operations for Responding Officers

There are many questions about the impact of rich media sources on responding officers and their reaction to an emergency. Interviewees frequently questioned, or commented on, how to practically and safely provide response officers with video or photographic input. For example if an officer is

responding to a burglary, how does he or she drive to the incident and watch the video without delaying the response. "So if it's a critical incident, something in progress, I cannot be looking at my computer screen because I am trying to watch traffic, making sure I'm not hitting pedestrians etc." Admittedly this is more so an issue when there is only one officer in the vehicle.

Escalating Demands From the Crown

The BC Crown will request audio recordings of 9-1-1 calls to decide on further investigative matters. Currently the transfer process has E-Comm take the call, create a wave file, copy it to CD, and deliver it to the Crown. However, the Crown recently decided that it would like to have far more access to a 9-1-1 call recording prior to issuing subpoenas, and this has inundated the VPD with requests for which it does not have the staff to process. "What would be practical for us is when the call is coming into the CAD, if the CAD could just attach the caller's wave file, or we could attach it to CAD seamlessly." Having a secondary process such as that described above is much more labour intensive; in a perfect world, the VPD would have a digital evidence management system that could automatically transfer files to the Crown.

Next Steps

As with other case studies in this report, most of our study participants felt that there was a certain inevitability to citizen-wide SMS to 9-1-1 given how much a part of day-to-day communication texting plays. "I think it has to be text for the general public; there's an expectation, you know, the 25 and under crowd, they can do it. It's the only way they communicate … so, to me, it's a requirement."

While social media was not used in an alerting capacity during the hockey riot in 2011, the VPD would like to be able to leverage social media and other forms of advanced communication to alert the public about an event or an incident. "We'd like to be able to use systems where we'd send a text to say 'there's an incident going on here, and we'd appreciate it if you could leave the area by this bridge or that bridge'."

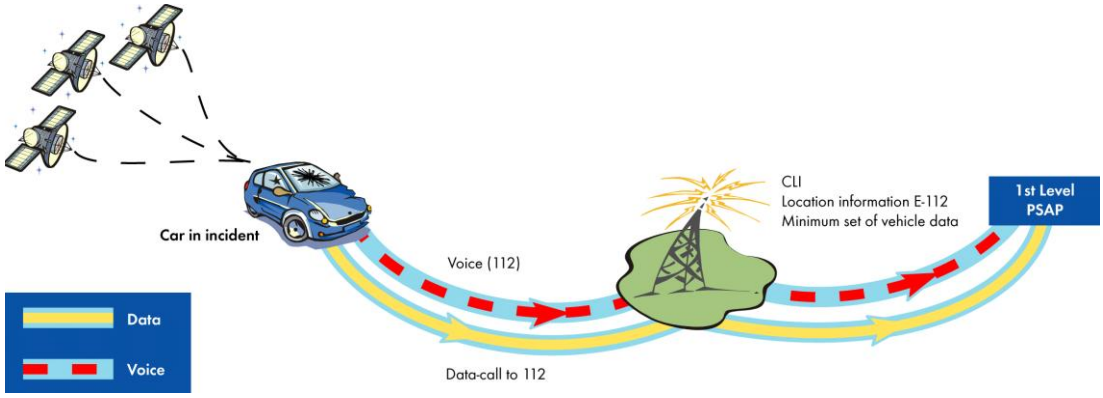
The VPD is keeping an eye on the development, and sophistication, of facial recognition software. Often asked why it didn't use it in this investigation, the reality is that the software requires a near-perfect picture (perfect lighting, straight on, etc.) to work. Next generations of facial recognition will hopefully be able to link suspects and evidence across multiple events; for example tracking a serial bank robber over a couple of years.

Vehicular 112 eCall Standards

The EU has moved ahead of North America in embracing a new system that will allow all vehicles in Europe to make an automatic 112 emergency call with relevant data about an accident or major incident. Dubbed eCall, the interoperable in-vehicle emergency call service was initially envisioned to be introduced and operated across Europe on all new vehicles in 2015 (see Figure 14).

FIGURE 14

European Vehicular eCall System Overview



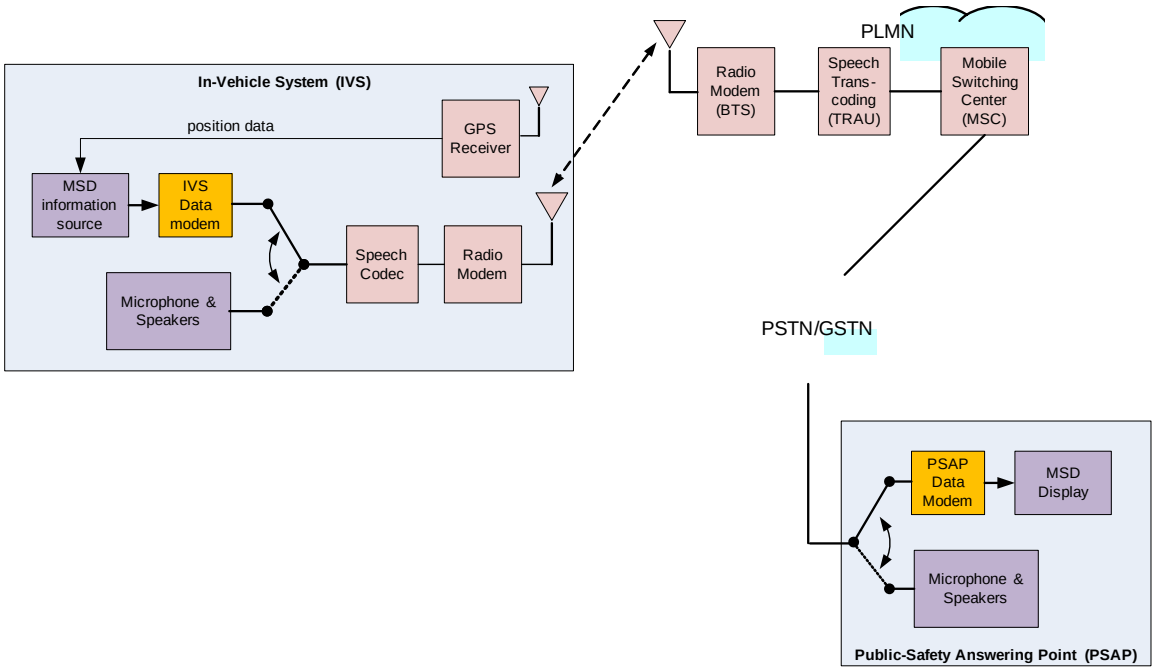
Sources: 3GPP 3rd Generation Partnership Project; IDC Government Insights, 2014

In the event of a vehicle collision, the eCall in-band modem is used in an automatically or manually established emergency voice E112 call from the vehicle (IVS) via the cellular network to the local emergency agency's PSAP. The eCall modem transfers a data message from the IVS over the cellular network to the PSAP which is denoted as the eCall Minimum Set of Data (MSD).

The overall eCall cellular system architecture, including the IVS and PSAP data modems, is illustrated in Figure 15 below.

FIGURE 15

eCall and Cellular System Architecture



Source: 3rd Generation Partnership Project; IDC Government Insights, 2014

The eCall MSD information will be sent either immediately following the establishment of the voice call or at any point later during the voice call. The integrity of the eCall data sent from the vehicle to the PSAP is ensured by the specified modem. The MSD can include:

- Vehicle location information
- Time stamp
- Number of passengers
- Vehicle identification number (VIN)
- Other relevant accident information

"The minimum set of data includes the vehicle identification number, the position, the direction of the vehicle, and what kind of fueling system it has, so that the rescue forces can prepare to get passengers out of the vehicle" (interview with eCall stakeholder). There are also optional data sets on the number of seat belts used in the car at the time of the crash as a loose indicator of the number of passengers in the car at the time of the crash. The eCall system is similar to the 9-1-1 Assist service offered by Ford Motor Co. 9-1-1 Assist, part of an upgrade to Ford's Microsoft SYNC system, will place a call directly to a local 9-1-1 emergency operator in the event of an accident involving either an airbag deployment or fuel shutoff. In a situation when an occupant cannot respond, SYNC plays a recorded message to the 9-1-1 service and alerts an operator that a crash has occurred. "The focus is on the

right amount of information, and the right information instead of too much" (interview with eCall stakeholder).

Unlike other crash notification services, such as General Motors' OnStar, 9-1-1 Assist does not require the customer to sign up and pay a monthly service subscription; SYNC uses a customer's existing mobile phone. The system is ready when a cell phone is properly paired, turned on, and connected to SYNC – designed to occur every time the driver enters the vehicle with their cell phone. A key advantage of the system is speed, as calls are placed directly to the nearest local 9-1-1 operator – not a third-party call centre (see Ford Motor Co., News Release, *9-1-1 Assist*, Dearborn, MI, May 20, 2009).

The E9-1-1 initiatives in the United States and E112 initiative in Europe are being implemented in strikingly different ways yet both require wireless carriers to be able to inform emergency services of any caller's location using high accuracy technology.

In Europe, the EC has brought together standardization bodies, the automotive industry, mobile telecommunication industry, public emergency authorities, and others in the eSafety Forum initiative which has identified high-level requirements, recommendations, and guidelines for the pan-European eCall service. The eSafety Forum assigned the European Telecommunications Standards Institute (ETSI) to standardize those parts of the eCall service that affect the mobile communication system and the development of the eCall standard was further delegated to the 3rd Generation Partnership Project (3GPP). That work was completed in March 2009 and presented for formal approval as a European regional requirement by the European standards organization (see 3rd Generation Partnership Project, Technical Specification, *eCall Data Transfer; In-Band Modem Solution; General description* [Release 8]," Valbonne, France, March 2009).

Recent announcements by automotive manufacturers and wireless carriers in North America point to growing consumer interest for in-vehicle connectivity which has implications for 9-1-1 public safety agencies.

GM Chevrolet Accelerates Vehicle 4G Wireless

General Motors announced earlier this year that the majority of the 2015 Chevrolet lineup in the U.S. and Canada will have a 4G LTE connection built in at vehicle launch. The 2015 Chevrolet Corvette, Impala, Malibu, and Volt will be the first General Motors vehicles to come optionally equipped with OnStar 4G LTE, Chevrolet announced at the Consumer Electronics Show in Las Vegas in January 2014 . Those vehicles will be followed by the Equinox, Silverado, Silverado HD, Spark, and Spark EV. In the Canadian market, OnStar with 4G LTE will be introduced on the Chevrolet Trax as well. More models will be announced later in 2014.

Rogers Wireless Offers Sprint Velocity to Canadian Vehicles

Rogers Wireless announced an agreement last fall enabling U.S. wireless carrier Sprint to bring a comprehensive in-car infotainment and telematics solution to Canadians. Through the agreement, auto manufacturers deploying Sprint Velocity in Canada will be able to use Rogers' wireless networks to connect vehicles on the road. Canadians driving vehicles that use the Sprint Velocity solution will have

access to services including infotainment (news, weather, sports, etc.), navigation, climate control, security, emergency services, and vehicle diagnostics, all available with an in-dash touch screen. Sprint Velocity also provides connectivity for mobile devices in the car including smartphones and tablets. More information about Sprint Velocity is available at www.m2m.sprint.com/velocity.

Implications of In-Vehicle 9-1-1

Canadian public safety experts are divided on the potential impact of in-vehicle wireless 9-1-1. One EMS dispatch manager believes it will not be an added burden or pose problems for PSAPs as long as it's set up properly on the front end. Pointing to the delivery of 9-1-1 call events by GM's OnStar emergency call centre in Detroit, he noted that one could argue "it takes some of the work load off of us." But one other 9-1-1 communication system expert believes in-vehicle wireless "could be a huge problem for PSAPs if enhanced wireless 9-1-1 requirements are not rolled out across Canada." Gaps in geographic coverage as well as a recent four-hour network outage incurred by Rogers Wireless also point to the need to educate consumers about the limitations of wireless for emergency service.

Challenges

One of the challenges encountered in the EU with regard to eCall is that the suites of technologies involved in delivering the service have different life cycles, and need to be replaced and coordinated anew at a different pace, potentially causing gaps in the ability to deliver the service. "The vehicle has its life cycle. The mobile network has its life cycle, and the PSAP has yet another," said our interviewee.

Another concern relates to what would be the in-car equivalent of "pocket-call" to 112. eCall provides two different means by which emergency calls can be made from the car: one is an automatic call that occurs when the security systems have been triggered and a crash has been noted by the car, and the other is by manually pushing a button in the car. A number of member states are very concerned about the increased burden on the PSAP that could be caused by the accidental triggering of the button.

Lessons Learned

Organizations need to test at the level they intend to inter-operate. Testing for eCall needed to ensure that there was seamless service delivery irrespective of where the car originated from and the location (possibly in a completely different country) of the call: "This is supposed to work regardless of where the vehicle is driven. So, somebody from Sweden vacationing in Greece, driving their car there, it would work seamlessly all over Europe, and for somebody to tell their own position in a country where they don't speak the language is very difficult. So the language issue is of course one thing here."

Try, where possible, to leverage economies of scale. Deployment of solutions for smaller segments of the population, as in the SMS for the DHHSI communities, is much more economically feasible when deployed regionally or nationally: "It would be not a good business case for the car manufacturers to do it differently in different countries. Not to mention the procedures to take care if a vehicle moved or were sold from one country to another."

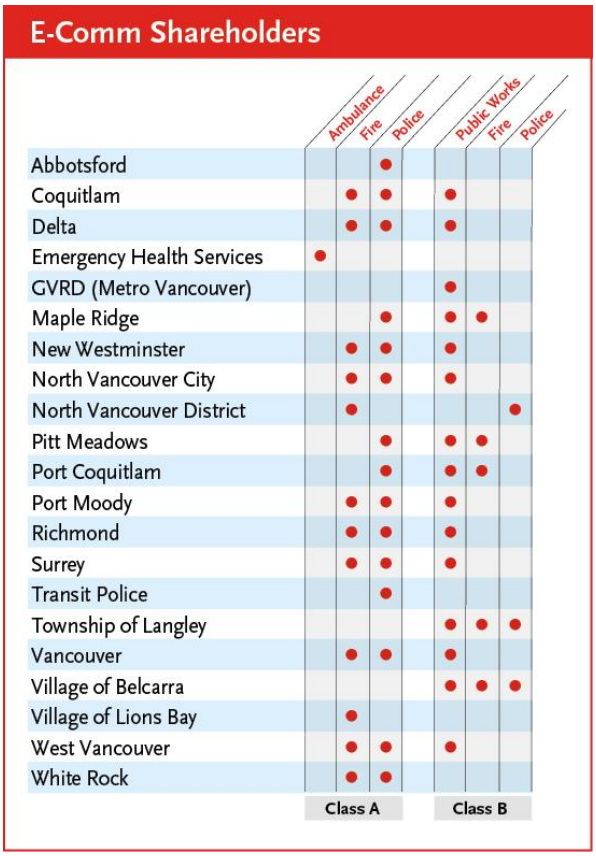
E-COMM

Context

E-Comm 9-1-1 (E-Comm), the emergency communications centre for southwest British Columbia, is located in Vancouver B.C., and provides 9-1-1 service for Metro Vancouver, the Sunshine Coast Regional District, Whistler, Squamish, and the Squamish-Lillooet Regional District (south). E-Comm provides dispatch service for 30 police and fire departments, and it owns and operates the wide-area radio network used throughout the Lower Mainland by police, fire, and ambulance personnel. As such, it is one of the largest multi-agency public safety radio networks in North America. In any given year, E-Comm answers close to a million 9-1-1 calls. E-Comm's governance structure, while comprehensive, is somewhat complicated.

FIGURE 16

E-Comm Governance Structure



Source: IDC Government Insights, 2014

SMS Pilot to the Deaf, Hard-of-Hearing, and Speech-Impaired (DHHSI) Population

The CRTC mandated Text with/to 9-1-1 access for the DHHSI community in Canada on January 24, 2014. While progress has been made in making the service available, deployment will likely be staggered across the country, spanning into 2015. Specific details of the service and rollout can be found on the Canadian Wireless Telephone Association (CWTA) T9-1-1 website at http://textwith911.ca/. SMS pilots have been conducted in Toronto, Ontario's Peel region, Montreal, and Vancouver – all of them were considered successful.

E-Comm conducted a controlled SMS trial for the DHHSI community in British Columbia in the summer of 2013. Technologically, the pilot was limited to outbound texting to the DHHSI community; there was no texting directly into the PSAP. The texting application used to text out to callers was "Agent 511" and Bell provided a secure and redundant dedicated National SMS gateway. E-Comm's wireless service providers implemented the technology for the test texting environment at no additional cost.

For the pilot, DHHSI community participants had to pre-register with their wireless service provider; the wireless service providers were then able to include DHHSI-specific demographic information to dispatch. For this pilot, and for broader texting rollout to the DHHSI community in Canada, participants were required to make an initial voice call into 9-1-1 (just to make a voice connection), and once that had occurred, the PSAP could then initiate an SMS with the caller. Through the initial 9-1-1 voice call, PSAP officers and the call takers could see through the automatic number identifier (ANI) and automatic location identifier (ALI) the main location and phone number of the caller. While the DHHSI community did not have to download the Agent 511 application (they already have an SMS application in their smartphone), the PSAPs on the other hand needed a secure application to communicate with DHHSI community participants. The texting environment used for the pilot differs from off-the-shelf texting applications. When the general public sends a text message using an off-the-shelf application, the system stores the message into the service provider's queue, and then forwards it on to the appropriate recipient. The Agent 511 application, conversely, is direct; there is no queuing or priority – the text goes straight to the caller, obviating many of the concerns stakeholders have with leveraging off-the-shelf texting applications for DHHSI 9-1-1 calls.

Making the initial voice call into the PSAP proved to be more of a challenge than stakeholders anticipated given that the DHHSI community is in essence unfamiliar with making voice calls, really only using the smartphone for SMS or data. Thus, participants had to be trained on how to make a 9-1-1 voice call.

Challenges With the SMS Pilot

In addition to the extra training required to teach the DHHSI community how to make an initial voice call, the only other challenge noted was around training people in the use and receipt of SMS shortcuts (to shorten the overall call length).

Given the contained scope of the pilot, information management was not a major issue. Its CAD vendor, Versaterm, does not actually have the SMS application embedded in the system so it will be launched separately and the content from these types of transactions will be cut and paste into the

CAD. It will take a couple of releases before the CAD will have the application actually integrated in the system.

Funding for NG9-1-1 Features

E-Comm is responsible for the adoption, implementation, and funding of NG9-1-1 related features and infrastructure. For the pilot, there were only two key pieces of technology required (SMS and ICLU) and both were provided for free by the CAD vendors. However, looking longer term, it was noted that both primary and secondary PSAPs in BC are concerned about costs of infrastructure upgrades, and the costs to pay for services firms to build and design the solutions.

Challenges With Broader NG9-1-1 Initiatives

E-Comm cited governance, funding, and ownership issues as the three biggest challenges to broader NG9-1-1 adoption. The organization stressed that moving into this next generation will require substantial infrastructure investments, and as yet there have been only preliminary discussions about who pays for, owns, and manages the system. Currently Canada's 9-1-1 network is based on old 1980s copper technology, which is managed and maintained by the telecom companies and is paid for by citizen telephone bills and taxes. Moving forward, there is very little sense of the governance and funding structure necessary to support these new offerings. Technology was not cited as a challenge to broader NG9-1-1 implementations. Additionally, the following challenges were noted in this case study:

Response Times

A repeated concern voiced by participants in this study was the effect that additional information sources could have on response times. Currently, it takes 1–2 minutes to dispatch a response for the average voice call into 9-1-1, and the concern is how to manage and triage the information to make sure that response is still as expeditious as possible. There has not been a lot of discussion or evaluation/assessment of this component of NG9-1-1 as the conversation has been more technology-driven.

Privacy

While there was nothing specific to the pilot with regards to privacy, there is a general concern with the implications of the supplementary content that could be delivered (evidence, voice call, radio calls, CAD events, etc.). There are situations where call takers and dispatchers testify in court and are questioned in terms of what they said and how they responded.

Liability

Interviewees from this pilot did not have concerns with liability. From a liability perspective, E-Comm has legislation under the emergency communications cooperation act that eliminates that liability as soon as a 9-1-1 call is placed.

Security

While people typically cite concerns with security in the new NG9-1-1 environment E-Comm participants felt that in fact the current system is more exposed or vulnerable than one would be in an IP environment. Similarly, another frequently voiced security concern is the ability to overload the network with calls, referred to as Denial of Service attacks. However, it was noted again that in an IP network, it is easier to create protected virtual networks.

Lessons Learned

Considered the first step of a larger T9-1-1 implementation, the pilot gave E-Comm an opportunity to work through the processes and to manage the unknowns on a smaller scale.

The E-Comm pilot addressed head-on SMS short codes, different training for call takers, and even the workload process internally in terms of how to manage the content into their records. Through the trial E-Comm then developed the training materials and SOPs, but it expects further challenges to emerge during a full rollout of the system.

Given that the structure followed by E-Comm was that being adopted across Canada, the biggest eye opener was that the hearing-impaired community simply does not know how to make a voice call. Otherwise, the pilot ran smoothly given that texting is so common these days. Additionally, the application was easy to use, and the instant messaging back and forth was proficient however took longer.

Suggestions for Next Steps

While there has been a lot of talk about the multitude of technologically mediated opportunities available currently and in the near term, there has been far less time spent talking with the business side of the equation (police, fire, paramedics, or the PSAPs) about what operational tools would be useful and what supplementary information would benefit them from an operational perspective. "I can't honestly say I've heard a lot from the operational side [which] specific applications would really be of benefit to emergency response," according to one interviewee. This organization felt it would be very useful to conduct research into the business value of NG9-1-1, both from a first responder and from a citizen perspective. Specifically, for the general population, there is interest in getting a better demographic understanding of how people would handle an emergency, whether they would prefer to text or call into the PSAP, under what circumstances they would like to send photographic or video evidence, etc.

"It would be really interesting to understand what various demographic groups believe the 9-1-1 service is capable of. And going beyond that, understanding how would they would use it in the future if they didn't have any technology constraints – how would you actually use it?" In this light, Text with/to 9-1-1 for the broader population seems inevitable: "I think texting is another priority because it seems to be another common method of communication." While the strategic goal of the CRTC and the Government of Canada is to limit this initially to the DHHSI community, there is the expectation that this will be extended to the broader Canadian population in the future.

Although in-call location was in theory made available as of September 2013, 9-1-1 organizations have not been able to use it because they have yet to complete IP interconnection with their telecom providers. E-Comm is currently in a holding pattern with regards to the ICLU feed from TELUS. Texting for the DHHSI communities awaits this development in BC. Once TELUS has completed the feed, Versaterm (its police CAD vendor) will test the system end to end, and at that point E-Comm will also be able to roll out the ICLU for police agencies, providing location updates every 35 seconds for in-progress wireless 9-1-1 calls.

Moving forward, E-Comm intends to promote broader adoption of the service in the DHHSI community by leveraging the CWTA communications group. Additionally, the wireless service providers will conduct their own advertising and follow-on training on how to contact the PSAP via voice call to initiate an SMS session.

CITY OF MONTREAL

Context

Of all of our case studies, Montreal is perhaps the most nascent but had some interesting commentary on the challenges regarding in-call location in urban settings as it wrestles with deploying the T9-1-1 solution to the DHHSI community and, likely, to the broader citizen population.

For the past two years, the Montreal police department has begun to capture photo and video evidence of large-scale events. The Montreal student protests of 2012 provided another instance where law enforcement agencies were leveraging new and rich media sources in day-to-day operations and investigations. It should be noted, however, that video and photo capture in Montreal is vastly different from that in Vancouver, where there is a dedicated forensics video lab and deployed advanced analytic software. Law enforcement in Montreal is in a much more reactive predicament.

Leveraging new media sources is managed in the Montreal Crisis Centre, located adjacent to police headquarters and central dispatch. For large-scale events, the Montreal police open the Crisis Centre to "remove any crisis from the call centre; that's the reason why we have a Crisis Centre to have the big crisis managed by specially trained police officers and communicators," according to an interviewee. A lot of the video received during this particular event was obtained from the local media's helicopter cameras, which were in fact trying to film instances of police misconduct. The Crisis Centre feeds any and all information sources possible, including transport ministry cameras, police surveillance, and media footage. Currently the Montreal police force has one person designated to monitor social media like Twitter to twig to early indications of trouble.

Concerns With Broader NG9-1-1 Initiatives

Montreal noted some specific concerns with in-call location update capabilities, specifically as it relates to what it refers to as the "urban canyon," the "uncertainty radius" involved in pinpointing locations of mobile phones, the "Z coordinate," and timing issues.

Urban Canyon

In essence, the urban canyon refers to the signal blockages created by high-rise buildings; recent tests conducted in Prince Edward Island (hardly the high-rise capital of North America) revealed very poor location precision and led the CRTC to direct wireless carriers to upgrade their infrastructure to accommodate this imperative. The problem in built-up and dense metropolitan areas like Montreal, Vancouver, and Toronto is that the entire downtown area is situated in an urban canyon, and as such the ability to pinpoint location suffers greatly.

The Uncertainty Radius

The uncertainty radius refers to the degree of certainty that first responders have about the location of the call, as provided to them by the telecom companies. However, the uncertainty radius might be up to 1.5km, which could in fact be the entire radius of downtown Montreal.

The Z Coordinate

The issue of the so-called Z coordinate – location information about one's height (or altitude) in a given building – is also problematic as most smartphone GPS do not indicate verticality, and this is a particularly vexing issue in metropolitan areas.

Timing

The last issue noted with regard to mobile phone location determination was the timing of location information. Currently, a wireless 9-1-1 call first relays the address of the cell tower that relayed the call, followed by longitude and latitude of the phone, all of which might take up to 50 seconds to relay, but generally it is within the first 20 seconds. If after 50 seconds they cannot locate the call, or meet uncertainty thresholds, an error message is sent.

Montreal, and organizations like ESWG in Canada, note that ICLU has become a more pressing issue in recent years given the rapid growth of 9-1-1 calls since 2010, extremely rapid growth of dropped calls, and the growth in wireless phones without legitimate call back numbers (see CRTC Interconnection Steering Committee, Emergency Services Working Group, *Wireless E9-1-1 Phase II Location Accuracy Report to the CRTC*, v.1.0, Ottawa, January 16, 2014, Consensus Report ESRE0064).

Text to the DHHSI Community

Montreal similarly plans to deploy texting to the DHHSI community but stressed that it would be problematic if deployed city by city. According to one interviewee, "I wouldn't like to explain that to a citizen that the other city has it and we don't."

Broader Challenges With NG9-1-1

Again there were considerable concerns with having call takers receiving disturbing videos and photos, but at the same time the need to make available the information to the call taker or dispatch on an as-needed basis. "They have a job to do, and I don't want to have call takers that are in shock, and have got to leave their job because they received a photo that was too much for them."

Funding

Interviewees estimated that the staffing requirements to house a real-time video and photo analytics service would amount to a 30% increase in budget in the 9-1-1 call centre. Building that out, estimated costs for Texting with/to 9-1-1 alone are going to be about C$100,000 for 200 call takers in Montreal. Estimates for training alone to implement a new CAD system are around C$250,000 with the actual hardware, software, and services for a city the size of Montreal totaling about C$4 million to C$5 million.

CALGARY

Context

Calgary's journey toward its Real-Time Operations Centre (RTOC) began in 2005, in response to a wave of gang violence that ultimately saw more than two dozen people killed in eight years. While a number of task forces were periodically created to address the issue, the violence would start anew as soon as the task force was disbanded. In 2005, the police force recognized that the lulls were indeed temporary and that formalizing a permanent strategy to thread together intelligence across its units and bureaus was necessary. From 2005 to 2009, Calgary police ran a series of large-scale real-time operations initiatives to better understand the value and potential impact of real-time operations, integrating multiple databases, managing information strategically, and leveraging predictive analytics to prevent crime. Calgary police began tendering for its RTOC in 2009.

The Real-Time Operations Centre

Today, with an annual operating budget of C$6.5 million, Calgary's RTOC coordinates response across three key bureaus: community policing, special investigations, and organized crime and intelligence. Coordinating information across these three bureaus in particular had been historically challenging given information silos. Moving to a new location in 2010 gave it the opportunity to build a state-of-the-art facility.

The RTOC is staffed by four operations teams, working in 12-hour shifts, comprising the following personnel:

- Investigative coordinator (who predominantly reviews search warrants, provides support to investigative units)
- Intelligence coordinator (works directly with detectives/officers to connect ongoing investigative efforts)
- Directed patrol coordinator (an offender management coordinator)
- Analyst (tactical analytical work looking at incident trends)
- Information coordinator (gathers information for real-time situational awareness and decision making)
- Duty inspector (in charge overall)

Technological Underpinnings

CAD

Calgary uses Intergraph's I-Dispatcher console which allows for a number of next generation features (although not in operation at this time), including SMS support allowing the PSAP to add emergency text messages directly into the CAD workflow. In response to the CRTC requirement to provide Text with 9-1-1 capabilities for the DHHSI community, the RTOC plans to have Agent511 installed by October 2014.

Advanced Analytics

The RTOC uses Palantir software as its analytics and data integration platform. Chosen through a competitive bid process, the RTOC did a side-by-side proof of concept comparing two qualified vendors and selected Palantir given its sizeable advantages in both performance and cost. Palantir got its start in the U.S. intelligence field post-9/11 and its technology offerings are particularly well regarded for striking a balance between information access to combat terrorism and the protection of civil liberties.

The Palantir platform integrates eight different databases (with plans to absorb a further two to four in the short term) and allows the Calgary Police and the RTOC to see its information completely differently, in a way that unearths opportunities to reduce and prevent crime. "The systems that we have are the first step toward what I'll call a cognitive system that allows you to pick the needles out of the hay stack." To illustrate this point, the RTOC is able to draw real-time data on the total number of calls for service in a given week, filter by the type of request, and then to use that information to strategically deploy resources or to understand whether they align with community service requests. The software allows the organization to "... overlay databases, and confirm that we are enforcing where the community wants us to be involved. Previously we wouldn't have had the opportunity to do that because the steps were so tedious."

The RTOC will launch a pilot project using the Palantir Mobile solution on Samsung devices for approximately 100 officers in the third quarter of 2014. While the mobile solution has less functionality than the desktop version, officers are able to verify information and conduct searches from the mobile device, directly entering into the Palantir layer of the database. "When officers are doing a high-risk vehicle stop, RTOC analysts or information coordinators would be able to access mug shots, or look at the associates of a vehicle." Currently, information gets pushed to an html file, and is shared with officers through email. The RTOC is in the process of integrating the database containing mug shot photos. Calgary has in-car digital video that it can live-stream to the ROTC and to its helicopter down link.

In addition to Palantir, the RTOC recently acquired facial recognition software from NEC. While previous incarnations of facial recognition have been constrained by a limitation known as the "still-face" issue (meaning the angle and illumination of the photographed face had to be straight on and motionless, which made real-time or mobile-enabled utilization of the software difficult) newer versions of the software can recognize a face regardless of vantage point or facial changes like glasses, facial hair, etc.

Rich Media/Social Media

Outside the RTOC, Calgary police's public affairs division manually manages citizen photographic and video evidence, as well as tracking social media trends (searching for keywords and alerting police to emerging incidents) using Radian6. It also has a presence on Facebook, Twitter, and Foursquare, and uses social media actively as a communications channel with the public. Last year alone it sent out 9,600 messages to citizens. While it has not had a large incident to test mass input of real-time photographic evidence, akin to what occurred in Vancouver, there is a manual process to manage it. Currently if a citizen sends in a photo or a video clip to public affairs it undergoes the same kind of process as a regular call for service, with police assigning a priority 1, 2, or 3 designation. "We've had

situations, particularly around suicides, where people express that they're going to kill themselves, and our social media will receive that, fire it off to response, and then we'll do a work-up, ping the individual's phone, unearth that they're associated with a given house, and deploy resources. We've been able to intervene in a number of situations like that." This year's strategic planning exercise identified the gap between the function of the RTOC and the role that public affairs plays in managing social media as an area needing attention going forward.

Moving Forward

The RTOC continues to evolve and is currently undergoing its strategic planning processes for 2015-2018. Part of the focus moving forward is on closing the gaps or lags in real-time information delivery on the mobile framework, focusing on creating automatic alerts and workflows that allow officers to move through the responding and investigative phases all the way through to disclosure at the standard that is required.

Challenges

Legal and Privacy Challenges

While legal issues have been challenging for public safety in recent years, the RTOC has full-time in-house legal advisors to help navigate the privacy and legal issues emerging from mobile technologies. "As the Supreme Court of Canada, or the provincial courts, issue decisions that we need to consider, we look at informing our Incident Command right off the top so we're able to respond very quickly." For example, the Supreme Court recently issued a decision requiring separate authorization to search a smartphone when a warrant has been issued for a particular location, because of how much personal information is contained on the device. This changes operating procedures considerably.

Information Management Concerns

Concerns with data volume are very real for the RTOC, though currently it has an operational workaround for complex investigations where its tactical operations centre would take over if an event exceeded RTOC capacity.

Funding Concerns

Given competing priorities in public sector service delivery, funding concerns stood out as the biggest area in need of attention, as organizations constantly need to demonstrate ROI. "Our revenue stream is from tax payers' dollars, and in as much as we want to do these things, there are big costs to them."

Governance and Operational Challenges

Moving from a hierarchically structured organization to more of a matrixed, organic structure that is integrated across the bureau silos has been challenging. "Our rank structure basically goes superintendent, deputy chief, and then chief, and the whole idea and construct of the ROTC is that it is a horizontal integrator for the entire service, but ... I'll sum it up as 'I have four bosses even though I directly report to the chief'."

Recommendations

A number of key recommendations emerged from examining Calgary's RTOC:

- First, technology is simply the enabler; business is the driver. Organizations need to understand that and design their implementations via proof of concept.
- Second, moving forward, organizations need to look at these issues as complex ecosystems.
- Third, vendors must be aware of and create product suites that expeditiously manage workflow and evidence across response, primary and secondary investigation, disclosure, archive, and compliance.

FUTURE RESEARCH AREAS

The following list of research areas has been identified:

- Governance was repeatedly noted by first responders in this study, and in others that preceded it, as the most critical success factor to NG9-1-1 implementations. Further research needs to be conducted to identify best practice governance models for NG9-1-1. As Canada searches for a workable national governance model, it will be important to draw insights from the international community so as to capture strengths and to avoid repeating mistakes made elsewhere
- Progress being made in the former Baltic States (Latvia, Lithuania, Estonia) as they have recently become thought-leaders and technology pioneers as it relates to 112.
- Operational best practices for those cities/states engaged in texting to 9-1-1 for the broader civic population.
- Talk to first responders to get a crystal clear picture of when/where/to whom this supplementary information is mission critical.
- A well-reasoned privacy and liability framework.
- Revisit the jurisdictions included in this study in 12 to 24 months to assess their progress on NG9-1-1 initiatives.

APPENDIX A

The Need for Wireless Enhanced 9-1-1

Coincident with the development of NG9-1-1 and the rising popularity of wireless is the need to develop new systems to locate a wireless caller because the billing address associated with a cell phone is not necessarily the location to which emergency responders should be sent, since the device is portable. The provision of effective location-based emergency dispatch services to wireless users by PSAPs is termed wireless enhanced 9-1-1, or E9-1-1. The ability of NG9-1-1 systems to make greater use of information from wireless devices means the provision of effective E9-1-1 systems is even more critical.

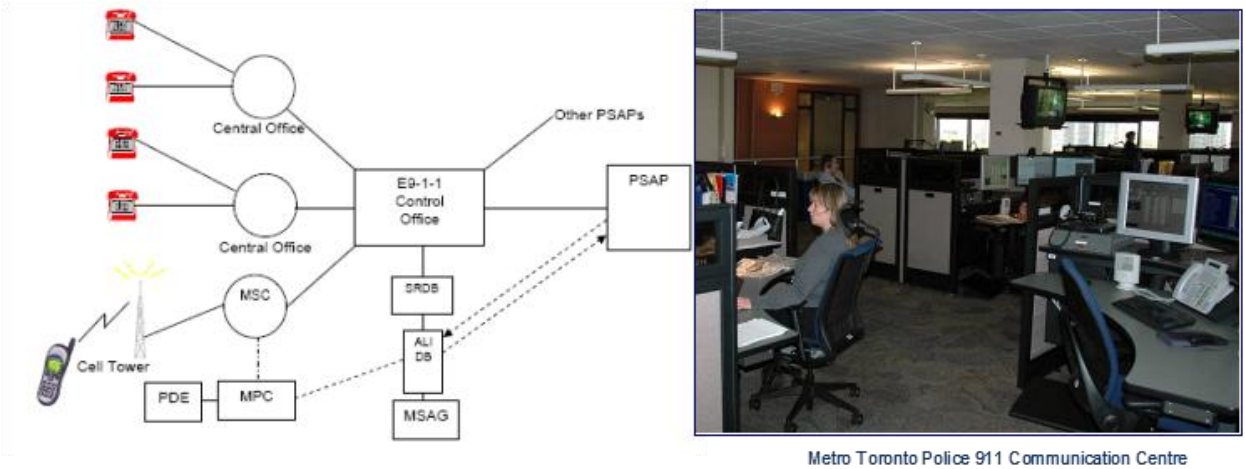
Network Versus Handset Solutions

There are two types of E9-1-1 solutions: network-based solutions and handset-based solutions.

- In network-based solutions, receivers at known locations (i.e., at cell site base stations – one per cell sector) measure the direction or the time of arrival of the signal emitted by the mobile unit. In the case of the latter, having a timing reference and knowing the speed that the radio signal travels is a constant, it is possible to very accurately estimate the range of the mobile unit from the various base stations. With a minimum of three base stations (cell site/sectors) at known locations making the measurements, it is possible to unambiguously triangulate and estimate the location of the mobile unit.
- In a handset-based solution, the situation is reversed with the handset making the measurements and the calculations. In one approach, the handset measures the time of arrival (TOA) of signals transmitted from GPS satellites and uses a similar triangulation technique to calculate its position. In the most commonly used approach, known as assisted GPS (A-GPS), some of the required processing is actually carried out in the network to improve the performance of the system. A-GPS provides very accurate locations (sometimes within 10 metres) when the handset can "see" three or more satellites – often in suburban or rural locations. Generally, in urban environments and within buildings, A-GPS fails to provide any location measurement or provides inaccurate locations since the handset can't see at least three satellites. Height, or altitude determination, is especially problematic in dense urban environments. A-GPS also requires a special chipset be built into the handset, hence older or less expensive phones often lack the requisite chipset to enable accurate A-GPS location.

FIGURE 17

Architecture of Wireless Enhanced 9-1-1



Source: ColoCommGroup; Metro Toronto Police; IDC Government Insights, 2014

Canadian Implementation of Wireless E9-1-1

A two-phase process to implement wireless E9-1-1 has been adopted throughout North America:

- Phase I enables the 9-1-1 call centre to receive with a wireless 9-1-1 call the subscriber's wireless phone number and the location of the wireless cell site serving that customer.
- Phase II allows the 9-1-1 call centre to receive with a wireless 9-1-1 call the subscriber's wireless phone number and accurate location (latitude and latitude or "X, Y" coordinates) of the caller.

But the approaches to implementing E9-1-1 adopted by Canadian and U.S. regulatory authorities vary significantly. The CRTC opted to deploy wireless Phase II E9-1-1 features in two stages (see Canadian Radio-television and Telecommunications Commission, CRTC Telecom Regulatory Policy 2009-40, *Implementation of Wireless Phase II E9-1-1 Service*, Ottawa, February 2, 2009). Stage 2, to provide wireless Phase II E9-1-1 location coordinates of roamers and unsubscribed (or prepaid) handsets, plus mid-call location updates, was deferred to an unspecified time frame.

The CRTC mandated wireless service providers (WSPs) to provide PSAPs with more precise locations of wireless handsets making 9-1-1 calls by enabling the determination of the approximate latitude and longitude (lat/long or X, Y) of wireless subscriber handsets calling 9-1-1. This network upgrade was completed by February 2010. There are 11 facility-based wireless carriers currently operating in Canada where E9-1-1 is deployed, each having to provide uncertainty measurements even while using distinct location determination system technologies. The current Canadian wireless E9-1-1 Phase II requirements are to provide the caller's lat/long coordinates and uncertainty calculated with 90% confidence.

- The ultimate objective when dealing with any item of concern for location determination is and must remain "to allow the PSAP get better locate, more often, more quickly," according to a recent report by the CRTC Interconnection Steering Committee's Emergency Services Working Group (see *Wireless E9-1-1 Phase II Location Accuracy Report to the CRTC*, v.1.0, Ottawa, January 16, 2014, Consensus Report ESRE0064). The CRTC has noted the general levels of location accuracy available with location equipment on the market (10–300 metres), but did not prescribe any precise requirements for location accuracy nor mandate testing of accuracy levels in its previous decision.
- The ESWG proposes the use of the uncertainty value as Location Performance Criteria, which marks a pivotal shift from the Location Accuracy Performance method used in the United States where wireless carriers measure and validate the expected outdoor accuracy based on *simulated* drive testing values, coverage percentage waivers and exceptions for either a handset-based (GPS) or network-based (triangulation) environment. Bell Mobility recently demonstrated a wireless network integrity testing model for the CRTC ESWG (see contribution ESCO0432 re: Bell Mobility Project) and that method is recommended as a model for other WSPs. Contrary to the U.S. drive testing scheme that provides data in a controlled environment, the Canadian approach embraced by the ESWG provides true outdoor accuracy measurement.
- A major goal is to develop standards for the level of wireless 9-1-1 calls delivered to a PSAP with appropriate Phase II location data, and assess its reliability. Until those standards can be developed, however, the ESWG agrees with all stakeholders that national location threshold and target range value benchmarks be set as best practices to provide measurable values, and WSPs maintain properly tuned location determination system and equipment.
- The CRTC ESWG has also proposed three categories of uncertainty value-based benchmarks enabling PSAPs to:
  - Understand consolidated indoor and outdoor accuracy performance (data to be gathered from the 9-1-1 Platform providers, where and/or when data processing capability exists)
  - Sustain network and location determination integrity through WSP network testing (e.g., using "passive" and random drive testing, etc.)
  - Set a threshold for the percentage of calls delivered with wireless E9-1-1 Phase II lat/long coordinates

Many other pending wireless E911 functions not fully determined by the CRTC have been identified by the ESWG and are being worked on in the Stage 2 of the Phase II process including:

- **Roaming.** The issue of whether roaming subscribers will be able to accept wireless 9-1-1 service in Canada.
- **Mid-call location updates ("rebids").** The ability to "rebid" or check a caller's location in the middle of a call (e.g., for a call from a moving vehicle). This functionality allows a caller to be found even if on the move, whether in the trunk of a car, or lost in a forest.
- **Unsubscribed handsets.** Provision of location information for 9-1-1 calls made on unsubscribed (or prepaid) handsets.
- **Calls associated with short duration.** By design, wireless 9-1-1 calls do not support any E9-1-1 call control feature, thus allowing a caller to terminate the call at any time. In addition, when short in duration, these calls are usually not associated with a valid call-back number (CBN)

and Phase II location data is generally not available. As data management technology evolves, the ESWG states "an increasing number of such instances are expected to reach those PSAPs which could create havoc in emergency call management, especially for call centres where the call taker is expected to investigate every 'dropped or abandoned' emergency 9-1-1 call." Thus, new processes and procedures will need to be developed to manage voiceless, call control featureless and partial ALI data calls.

Finally, there is a widely recognized need among the Canadian public safety community for the CRTC to take a definitive leadership role in cooperation with all stakeholders in setting national wireless E911 policies and standards for the public safety community.

APPENDIX B

EU Continent-Wide 112 Emergency Number

The directive of the European Union on universal access to telecommunications services imposes requirements on all member states to provide access to emergency telephone services. The increased integration of the member states within the European community, coupled with the explosive growth of wireless throughout Europe, has given further impetus to efforts by the European Commission to implement a single EU-wide emergency telephone number. This 112 number, established in 1991 to operate alongside existing national emergency numbers, will also facilitate ubiquitous access to a single emergency number by wireless roamers. Since the end of 2008, it has been a requirement for all EU member states to ensure that anyone can call the emergency services from fixed and mobile phones by using the 112 number.

Adoption of the 112 emergency number at the national level has led to two categories of countries:

- Group 1: 112 is the sole/main emergency number. 112 has become the main national emergency number, promoted as the number to be used to contact all emergency services (i.e., police, fire, and ambulance), in seven EU member states (Denmark, Finland, Malta, the Netherlands, Portugal, Romania, and Sweden).
- Group 2: 112 is in operation alongside other emergency numbers. Most (20) EU member states, however, have decided to introduce 112 as a number that will work alongside their national emergency numbers. Both 112 and national numbers are in service as a way of contacting some or all emergency services. In the U.K., for example, citizens can either call 112 or the national number 999 in the event of an emergency. In some other EU countries, 112 is the only emergency number for certain emergency services (such as Estonia and Luxembourg for ambulance or fire).

Availability of 112 When Out of Coverage of Home Mobile Network

The possibility for domestic mobile users to access 112 when they are out of their home network coverage by using another available domestic mobile network, which may be referred to as national "emergency roaming," can be particularly relevant in areas of the national territory with limited mobile network coverage, for example in areas where only one of a country's several mobile network providers has rolled out its network; 25 member states confirmed that such national emergency roaming is available. The only exception is the U.K., which indicated that discussions have started on

the introduction of this facility, while Belgium reported that this facility is currently only available on two of the three available national mobile networks. In addition, Estonia specified that the user must first remove the SIM card to benefit from this facility. In contrast, Cyprus and Romania, which provided negative replies on this issue during the first data gathering round, now report having enabled national emergency roaming (see Table 2).

TABLE 2

Implementation of 112 in European Union

Member State	112 Can be Called From Fixed and Mobile Phones	Caller Location Available for Mobile
Austria	Y	Y
Belgium	Y	Y
Bulgaria	N	N/A
Cyprus	Y	Y
Czech Republic	Y	Y
Germany	Y	Y
Denmark	Y	Y
Estonia	Y	Y
Spain	Y	Y
Finland	Y	Y
France	Y	Y
Greece	Y	Y
Hungary	Y	Y
Ireland	Y	Y
Italy	Y	N
Lithuania	Y	N
Luxembourg	Y	Y
Latvia	Y	Y
Malta	Y	Y
Netherlands	Y	N

TABLE 2

Implementation of 112 in European Union

Member State	112 Can be Called From Fixed and Mobile Phones	Caller Location Available for Mobile
Poland	Y	N
Portugal	Y	Y
Romania	Y	N
Sweden	Y	Y
Slovenia	Y	Y
Slovakia	Y	N
United Kingdom	Y	Y

Source: European Commission, Directorate-General XIII, Telecommunications, Information Market and Exploitation of Research, *Survey on Implementation of 112*; IDC Canada, 2014

EU member states were also invited to indicate how national emergency roaming is achieved, in particular whether it is a consequence of allowing SIM-less 112 calls in general or a consequence of specific obligations placed on or arrangements made between mobile operators. SIM-less 112 calls were reported possible in 21 member states. Article 26 of the EU Universal Service Directive (Directive 2002/22/EC) further obliges member states to ensure that:

- Access to 112 is available in addition to any other national emergency call numbers, free of charge, to all end users of publicly available telephone services including users of public pay telephones.
- Calls to 112 are answered appropriately and handled in a manner best suited to the national organization of emergency systems and within the technological possibilities of the networks.
- For all calls to 112, public telephone network operators make caller location information available to authorities handling emergencies, to the extent technically feasible.

An overview of mobile caller location capability and characteristics in EU states based on member replies to an earlier European Commission COCOM Survey is listed in Table 3.

TABLE 3

Attributes of Mobile Caller Location Identification in EU Countries

EU State	Method and Time Needed for Request	Type of Location Information	International Roamer Info	National Roaming	Reg'd Address Availability
Austria	Pull; up to 30 min.	Cell ID/sector ID	Yes	Yes	Yes (except prepaid)
Belgium	Pull	Cell ID/sector ID	Yes	No	Yes
Bulgaria	Push	Cell ID	Yes		No
Cyprus	Push	Cell ID/sector ID	Yes	Yes	Yes
Czech Republic	Push	Area (1 or more cells) with radius 1km/70% to 5km/70%; base station 700m/70% to 1,500m/70%	Yes	Yes	Yes
Denmark	Push	Cell ID	Yes	Yes	Yes
Estonia	Pull; avg. 23 sec.	Coordinates	Yes		No
Finland	Pull; avg. 3–30 sec.	Cell ID/sector ID	Yes (manual request)	No	Yes
France	Pull; avg. 10–30 min.	Cell base station postal code	Yes	Yes	No
Germany	Pull; avg. 5 min.	Cell ID/sector ID	Yes	Yes	Yes
Greece	Pull; est. 7–60 min.	Cell ID	Yes		Yes
Hungary	Pull; 20–30 sec. to 2–3 min.	Cell ID	Yes	Yes	No
Ireland	Pull	Cell ID	No	Yes	Yes
Italy	Push in Salerno prov. only	Cell ID	Yes	Yes	Yes
Latvia	Pull; avg. 10.3 sec; win 1 min. 98.17%	Cell ID/sector ID	Yes	No	No
Lithuania	Pull in Vilnius PSAP; 1.5–10	Cell ID	Yes		Poss. in 1 network

TABLE 3

Attributes of Mobile Caller Location Identification in EU Countries

EU State	Method and Time Needed for Request	Type of Location Information	International Roamer Info	National Roaming	Reg'd Address Availability
	sec.				
Luxembourg	Push	Cell ID	Yes		
Malta	Pull; up to 1 hr.	Cell ID	Yes		Yes if reg'd sub.
Netherlands	Pull on KPN network; <1 sec.	Cell ID; My SOS within 5 meters	Planned	Planned	Yes (not prepaid)
Poland	Pull; est. avg. 13 sec.	Cell ID/sector ID; 100m–1km	Yes	Yes	Yes
Portugal	Push	Cell ID; 100m urban; 30km rural	Yes		No
Romania	Push	Cell ID/sector ID	Yes	Yes	Yes
Slovakia	Push (Telefónica O_2); pull (Orange; T-Mobile); avg. 2–20 sec; win 1 min. 94.5%	Cell ID/sector ID	Yes	Yes	After Sept. 1, 09
Slovenia	Push on Mobitel, T-2, and IZI; others pull; 15 min–1 hr.	Sector ID	Yes	Yes	No
Spain	Push in 15 PSAPs; pull in 3; avg. 30 sec.	Cell ID/sector ID	Yes except 5 PSAPs	Yes exc. 4	Yes
Sweden	Pull; avg. 3–5 sec.	Cell ID	No	No	Yes
United Kingdom	Pull; max. 2 sec.	Cell ID	No	N/A	Yes (except prepaid)

Source: European Commission *COCOM Survey*, 2009; IDC Canada, 2014

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GLOSSARY

- 3GPP – 3rd Generation Partnership Project; regional forum that sets European wireless standards
- 4G – Fourth-generation wireless; broadband public wireless communication network based on global LTE standard offering download speeds greater than 54Mbps
- AAIMS – Alberta Ambulance Information Management System
- AEAA – Alberta E9-1-1 Advisory Association
- A-GPS – Assisted GPS
- ALI – Automatic Location Identification Database
- ANI – Automatic Numbering Information
- APCO – Association of Public Safety Communications Officials
- BCF – Border Control Function
- CAD – Computer-Aided Dispatch
- CISC – CRTC Interconnection Steering Committee
- CITIG – Canadian Interoperability Technology Interest Group
- CLEC – Competitive Local Exchange Carrier
- CRTC – Canadian Radio-television and Telecommunications Commission
- CSEC – Commission on State Emergency Communications, Texas
- CSP – Communication Service Provider
- CSRIC – Communications Security Reliability and Interoperability Council
- CSS - Centre for Security Science, DRDC

- CSSP - Canadian Safety and Security Program, a federally-funded program led by DRDC
- DHHSI – Deaf, Hard-of-Hearing, and Speech-Impaired
- DRDC - Defence Research and Development Canada, Department of National Defence
- E9-1-1 – Enhanced 9-1-1
- EC – European Commission
- eCall – In-vehicle emergency call service envisioned by EC to be introduced and operated across Europe
- ECRF – Emergency Call Routing Function
- EENA – European Emergency Number Association, Brussels
- EMS – Emergency Medical Services
- ERTEE - Emergency Responder Test and Evaluation Establishment, DRDC, Regina
- ESInet – Emergency Services IP-Enabled Network
- ESRP – Emergency Services Routing Proxy
- ESWG – Emergency Services [E9-1-1] Working Group of CRTC CISC; participants include wireless carriers, 9-1-1 service providers, public safety answering point organizations, representatives of hearing- and speech-impaired persons, and other interested parties
- ETSI – European Telecommunications Standards Institute
- EU – European Union
- FCC – Federal Communications Commission, U.S.
- FEMA – Federal Emergency Management Agency, U.S.
- GIS – Geographic Information System; integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographic data
- GPS – Global Positioning System; satellite constellation that uses triangulation to calculate position in latitude and longitude
- ICLU – In-Call Location Update
- IETF – Internet Engineering Task Force
- ILEC – Incumbent Local Exchange Carrier
- IM – Instant messaging; type of online chat which offers real-time text transmission over the Internet
- IMS – IP Multimedia Subsystem; an IP standard architecture for converged SIP-based wireless service
- IP – Internet Protocol
- IP VPN – IP-Based Virtual Private Network
- LTE (Long-Term Evolution) – Fourth-generation wireless standard

- MPLS – Multiprotocol Label Switching, variant of IP VPN
- MSAG – Master Street Address Guide
- MSD – Minimum Set of Data
- NENA – National Emergency Number Association, Alexandria, VA
- NG9-1-1 – Next generation 9-1-1
- p-ANI – "pseudo-ANI"
- PSAP – Public Safety Answering Point
- PSBN – Public Safety Broadband Network
- PSTN – Public Switched Telephone Network
- QoS – Quality of Service
- RTCC – Real-Time Crime Centres
- RTOC – Real-Time Operations Centre (Calgary)
- SBC – Session Border Control
- SIP – Session Initiation Protocol, IETF standard protocol to set up voice communication sessions including basic telephone, conferencing, and multimedia, via an Internet connection. SIP may also be used for other communication functions, such as instant messaging and application mobility that allows services to span various networks, including wired and wireless, and multiple user devices
- SMS – Short Messaging Service; a wireless messaging service that permits the transmission of a short text message between digital mobile devices and to PSAPs via T9-1-1
- SRDB – Selective Router Database
- T9-1-1 – Text-with/to-9-1-1
- TDM – Time Division Multiplex or "legacy network" used to refer to the older TDM-based telephone network, which generally does not use TCP/IP protocols when transferring voice and data information
- TSP – Telecommunications Service Provider
- VoIP – Voice Over IP
- VSP – VoIP Service Provider
- X, Y – Geographic map coordinates in decimal degrees format similar to latitude/longitude

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