



Technology That Delivers Reliable Communications When Disaster Strikes

white paper



Introduction

By 2010, it is estimated that 96 percent of Americans owned cell phones.¹ Yet the early years of the 21st Century have provided ample examples of natural and man-made disasters where cellular communications failures have been part of the story. Instances abound of cellular service disruptions and delays that have impacted cities and entire regions for the minutes, hours and days following a disaster – just when the need for reliable communications was most urgent.

For the general public, these cell service interruptions and failures are an inconvenience, at best. For first responders and emergency personnel, lack of reliable communications can mean the difference between life and death for the public they serve during a crisis.

The shortcomings of the cellular network during emergencies first captured national attention in 2001 following the 9/11 terror attacks. Analysis of first responder communications found that cell phones were of little use during the early hours of the crisis and that paging was the most reliable form of communication.² Four years later, Hurricane Katrina showed how a natural disaster could decimate an entire region's mobile phone service. A post-Katrina independent panel recommendation to the Federal Communications Commission (FCC) provided solid support for the reliability of pagers during that disaster over the cellular networks.³

Despite improvements made by cell providers, more recent events clearly show that the cellular network is still not a dependable technology for critical messaging. Cellular systems were not designed for the delivery of mission-critical communications. Paging technology, however, is uniquely suited to meet the demands for critical messaging during a disaster. This paper examines key cellular technology weaknesses during a crisis and compares the suitability of paging and cellular technologies for professionals who require reliable disaster communications.

A Force of Nature

Natural disasters, such as tornadoes and hurricanes, can dramatically impact the infrastructure required to provide cell phone service. Unlike paging that uses satellites to transmit signals, cellular signal transmission is terrestrial-based, using a series of transmission towers. If one tower is destroyed or disabled, that often causes a string of service failures for that area with no redundancy built into the system to cover the signal loss. Following Katrina, more than 1,000 cellular towers were out of service, which combined with the disabling of 3 million telephone lines, impacted the coordination of emergency workers and public safety officials. Because the paging transmitters are individually controlled over satellite links and do not require a physical land line, paging service during and following Katrina was virtually uninterrupted.⁴

Cell service providers are increasingly using cellular sites on wheels (COWS) to provide interim service to customers when transmission towers are disabled. While effective at restoring coverage, it often takes hours or days before COWS arrive at the scene and are allowed access to areas restricted due to safety concerns as well as search and rescue efforts.

Following the May 22, 2011 EF 5 tornado in Joplin, Missouri, COWS were utilized by several companies to restore cell service.⁵ Re-establishing cell service in many areas took up to four days in Joplin. It was a different story for Joplin's paging service. Even though the paging transmitter and antenna on top of St. John's Medical Center were blown off the building, paging service was uninterrupted. Nearby transmitters were able to provide continuous coverage and paging service to medical personnel inside the hospital as well as to first responders throughout the Joplin area.

This scenario has become familiar for those who call Tornado Alley home. On May 20, 2013, another EF 5 tornado ripped through Moore, Oklahoma. The devastation disabled cell service until COWS could be brought into the area to restore service. For first responders and public safety personnel who need reliable, immediate communication when tornadoes hit, pagers continue to be their primary mode of communication.

A Rush to Communicate

Even when cellular transmitters are unharmed, local service can be disrupted or delayed by increased call volume. With public adoption of cell phones at near saturation level, available bandwidth to service customers is adequate for normal usage but is often overloaded when disaster strikes.⁶ This can prevent users from making voice calls and may also cause delays in the transmission of text messages when crisis strikes.

The jamming of mobile service during a local disaster garnered national attention on August 1, 2007 following a rush-hour bridge collapse in metro-Minneapolis, Minnesota. Both emergency workers and the general public experienced significant disruption in the ability to make or receive cell phone calls in the hours following the disaster that involved close to 100 vehicles. Local authorities even asked the public to stay off their cell phones out of concern that call volume would hamper rescue efforts.⁷ Four years later, cell service in metro-Indianapolis was similarly disrupted when a concert stage collapsed at the Indiana State Fair and fair-goers and family members rushed to use their phones to contact loved ones.

According to the Telecom Supervisor at Hennepin County Medical Center, which handled many of the injured in the bridge collapse, “In the day to day work of the medical world, quick, accurate, confidential communication is critical to providing patient care. We have found the use of pagers to be an invaluable tool in facilitating this communication.”

Concern over mobile phone systems’ capacity was again front page news following the 2013 Boston Marathon bombings which created widespread problems with cell phone service due to increased call volume. Networks of three major cell providers were quickly overwhelmed by the surge in usage – leaving race participants and fans unable to reach family and friends or receive incoming calls.⁸

Cell providers face three significant challenges in building network capacity to meet sudden spikes in usage during a disaster. First, the added capacity would go unutilized 99% of the time. Second, since the nature of the events is unpredictable, wireless companies have no way to know where they need to focus their efforts to build capacity. Third, the significant cost to increase bandwidth would likely be passed along to the consumer.⁹

A Device with Limitations

The smartphones that use the cellular network also have limitations that can make them unreliable during a disaster. Power failures often coincide with a crisis, making it difficult or impossible to recharge a cell phone. The media was filled with images following superstorm Sandy of people seeking power sources to charge their mobile phones.¹⁰ For emergency responders, having a smartphone tethered to a charger isn’t practical during emergency situations. This is not an issue for pagers, as their disposable battery generally lasts 3 to 4 weeks and is easily replaced.

Smartphone interfaces can require users to take a number of steps to read a critical message, which can be difficult during emergencies. With a pager, critical messages do not compete with e-mails, text messages, streaming video and other information received by a smartphone. Paging devices are easy to use and solely designed to meet the demands of critical messaging.

The CDMA networks used by five of the top seven U.S. cellular carriers mean those users can’t receive messages or texts when making a voice call from their phone.¹¹ For a first responder relying on their cell phone during a disaster, this could result in missing a critical message in a life or death situation just because he or she took a phone call. Lastly, keep in mind that many smartphones are also subject to malware and virus attacks that can render them unusable.

Paging vs. Cellular Technology

Paging systems seemed more reliable in some instances than voice/cellular systems because paging systems utilize satellite networks, rather than terrestrial systems, for backbone infrastructure. Paging technology is also inherently redundant, which means that messages may still be relayed if a single transmitter or group of transmitters in a network fails. Paging signals penetrate buildings very well, thus providing an added level of reliability. Additionally, pagers benefited from having a long battery life and thus remained operating longer during the power outages. Other positive observations concerning paging systems included that they were effective at text messaging and were equipped to provide broadcast messaging. Finally, although it is unclear whether this function was utilized, group pages can be sent out during times of emergencies to alert thousands of pager units all at the same time.

(Independent Panel Reviewing the Impact of Hurricane Katrina on Communications Networks. Report and Recommendations to the Federal Communications Commission, June 12, 2006, p. 10.)

Time and time again, when disaster strikes, paging technology shows that it is still unsurpassed in its ability to provide reliable critical messaging. As the examples cited in this paper illustrate, the issues of physical damage and strained bandwidth experienced by cellular technology are not an issue for paging technology. A closer look at the two systems' technology helps explain why paging succeeds when cell phones are likely to fail.

Paging networks outperform cellular networks when it comes to broadcast power. With up to seven times the power of cellular networks, paging systems provide better signal penetration in buildings and more reliable message delivery. A single paging transmitter site typically covers 176 square miles, while a typical cell site covers only 10-15 square miles. Pager systems typically provide better coverage in rugged and remote terrain than cellular networks.

How signals are transmitted also differs between technologies – with cellular networks handing off signals from tower to tower, like a daisy chain. If a hand-off is unsuccessful, or if a transmission tower in the chain is disabled, then calls can be dropped or service disrupted. The paging network sends a message over every transmitter in the network at exactly the same time. This is called simulcast technology – it is unique to paging and provides a high level of reliability for critical message delivery. Because multiple transmitters receive the message, and those transmitters have a broad coverage range, the loss of one or more paging transmitters usually does not impact the ability to send or receive critical messages.

Paging systems also have the distinct capability to set up a common group address in any pager so that the same message is sent and received at exactly the same time to as many people as needed in a group. A hospital's Stemi and Code teams are generally set up this way. Mass message delivery with cellular networks are sequential, meaning different delivery times for each receiver, often measured in minutes that can be critical for emergency personnel and first responders.

Regarding message capacity, experience clearly shows that cell systems are not designed to handle the increased volume that often accompanies a disaster. In fact, many cellular carriers provide a disclaimer and caution users not to rely on their system for the delivery of critical messaging.¹² Paging systems, which are used almost exclusively by first responders, public safety workers and emergency medical staff, have ample bandwidth to handle peak load demands during a crisis and are not impacted by public use.

Conclusion

Cellular phones and technology are a communications staple for consumers as well as countless professionals whose job it is to provide a variety of important public services. However, recent natural and man made disasters have shown the weaknesses in the cellular system – issues that will likely be unresolved for many years. Experience and technology both confirm that, during times of disaster and crisis when reliable, immediate communication is paramount – nothing beats paging technology.

References

- 1 http://www.cbsnews.com/2100-201_162-20102546.html
- 2 Arlington County After-Action Report on the Response to the September 11 Terrorist Attack on the Pentagon, page 9.
- 3 Independent Panel Reviewing the Impact of Hurricane Katrina on Communications Networks, “Report and Recommendations to the Federal Communications Commission, June 12, 2006,” p. 10.
- 4 <http://www.braddye.com/newsletters/2006/n10mar2006a.html>
- 5 http://newsroom.sprint.com/article_display.cfm?article_id=1912, <http://www.verizonnjcommunityupdate.com/giving-back/134-tornadoes-strike-joplin-verizon-springs-into-action>
- 6 <http://www.fastcompany.com/3008458/tech-forecast/why-your-phone-doesnt-work-during-disasters-and-how-fix-it>
- 7 Chicagotribune.com, “As bridge failed, so did phone network,” Jon Van, August 5, 2007.
- 8 <http://www.bostonglobe.com/business/2013/04/16/cellphone-networks-overwhelmed-blast-aftermath/wq7AX6AvnEemM35XTH152K/story.html>
- 9 http://www.computerworld.com/s/article/9045438/In_emergencies_can_cell_phone_network_overload_be_prevented_
- 10 http://www.huffingtonpost.com/2012/11/04/wireless-cell-service-sandy_n_2072287.html
- 11 <http://www.pcmag.com/article2/0,2817,2407896,00.asp>
- 12 <http://www.wireless.att.com/businesscenter/popups/general/enterprise-paging-terms.jsp>