How has text messaging evolved and what is its role in public actions?

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Key Take-Aways

There are a few things to remember today:

Ø Existing SMS/MMS text messaging, social networking, and email were not designed to support real time robust communications

ØThere are no appropriately-robust and effective way to use the Commercial Mobile Radio Service (CMRS) for emergency alerts *today*

ØThere is an effective way coming soon, and that's the cell-broadcast *Commercial Mobile Alert System* (CMAS) which the industry & government has standardized over a 22 month period and is in the 28-month development phase
   ØCMAS is not "SMS" text messaging

ØSocial studies are required to fully understand impact of the CMAS service offering

Cell Broadcast CMAS has been adopted by the industry

Text Messaging History

Original ideas started in the early 1980s

    SMS concept à developed in 1984 by Friedhelm Hillebrand and Bernard Ghillebaert

SMS à *Short* is the key, optimized for GSM telephony

    Unused resources in the system could be used to transport messages when the system was not processing calls

Because SMS is using "unused" resources à forces a limit to 160 character messages

    Messages have to fit in the existing signaling formats

For the trivia buffs ....

    The first SMS message was sent over the Vodafone GSM network in the United Kingdom on 3 December 1992

Why SMS in the first place?

Initially, SMS was envisioned for network notifications to be sent to mobile phones

  E.g. inform the user of voice mail messages

Consumer text messaging was first offered in 1993

  "Beepers" were popular and this offered a comparable service on the cell phones, although most devices did not have the capability
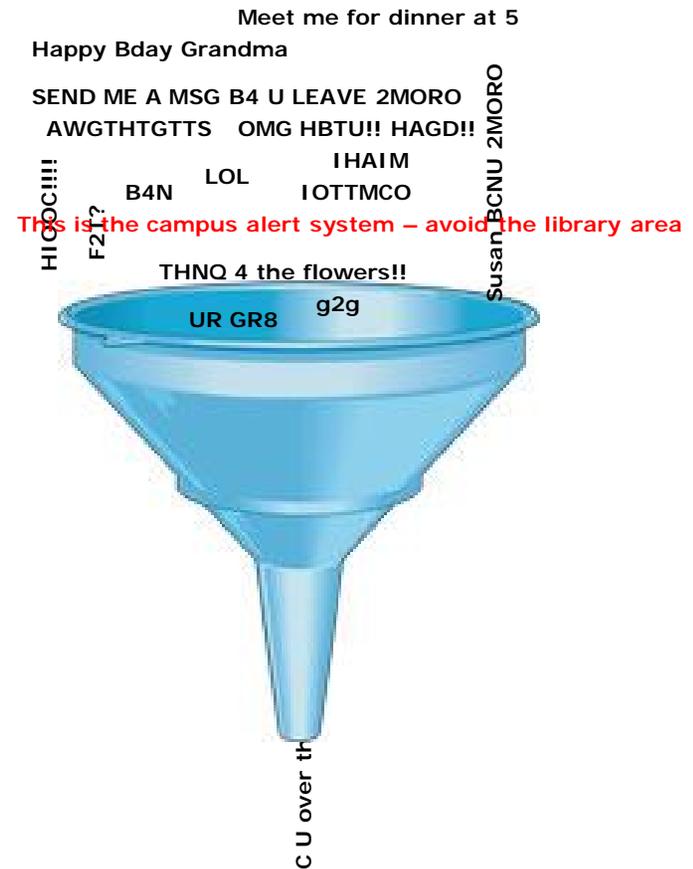
Initial popularity was low

  1995 à average customer sending 0.4 messages per month

Where is SMS today?

In the U.S.[1] in 2009:

Annualized SMS Messages à 1.56T

Monthly SMS Messages à 152.7B

Meet me for dinner at 5

Happy Bday Grandma

SEND ME A MSG B4 U LEAVE 2MORO

AWGTHTGTTS   OMG HBTU!! HAGD!!

IHAIM

B4N   LOL   IOTTMCO

HI OC!!!!   F2T?   This is the campus alert system – avoid the library area   Susan BCNU 2MORO

THNQ 4 the flowers!!

UR GR8   g2g

C U over th

Each SMS is Contending for that "Unused" Space

Wireless e-mail Text Messaging

Wireless e-mail text message notifications use a protocol called SMTP (Simple Mail Transfer Protocol), which can deliver e-mails as text messages via SMTP gateways

- SMTP gateways were never intended to support urgent or time-critical messaging and are not capable of delivering the level of reliability and performance suited to notification services

SPAM is a huge concern for operators

- SMTP messaging gateways are the target of millions of SPAM messages each day

A significant amount of SMS requests via email are SPAM

Operators are aggressive managing this problem through sophisticated SPAM detection & filtering

SPAM detection mechanisms include:

- Number of messages sent from an originator
  - X messages over a Y period
- Source of message

Accepted Messages

Messages IN

Message Center

SPAM Messages
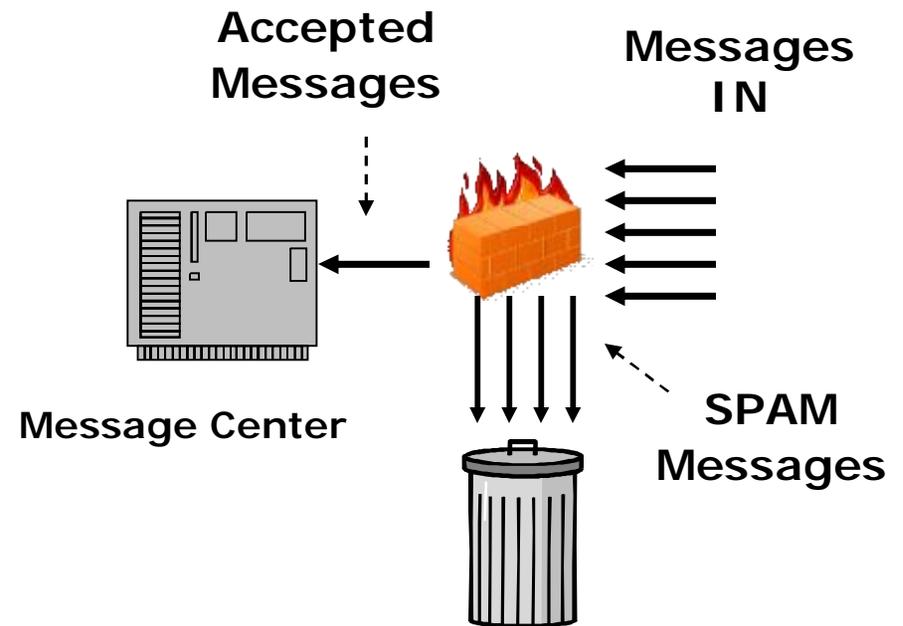
Multimedia Messaging (MMS)

Sends multimedia content to
mobile phones

Delivered in a completely
different way than SMS

- Uses both SMS and the data network for
  delivery of the message
- Not every phone or subscription supports
  MMS

SMS 'control message' is sent to
the device with a URL to trigger
the device's browser to open a
data connection and receive the
multimedia content

- Additional messages are exchanged to report
  status of the retrieval
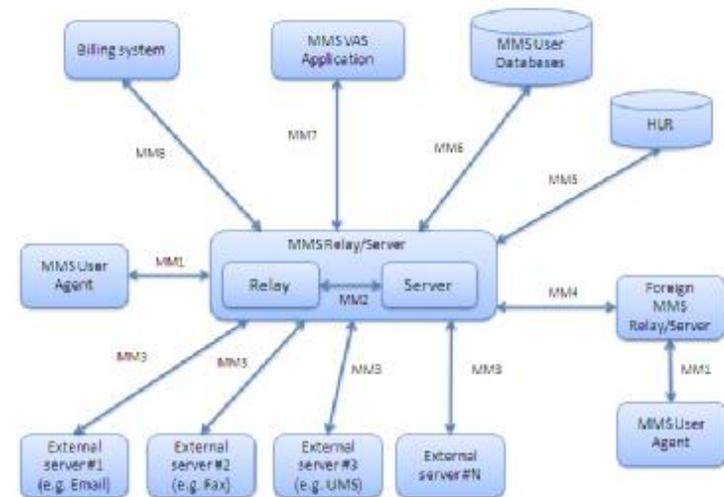
MMS requires significantly more network resources than SMS

Remember ....

- The wireless network is a **shared** infrastructure..
  - With almost 300 million wireless subscribers in the U.S., it is physically impossible to dedicate network resources & radio channels to everyone that has a mobile phone

- Given the shared nature of the wireless network, operators must design the networks to handle anticipated traffic loads
  - Engineering is typically done based on the number of calls & messages during the "**busy hour**"

- Exceeding the "busy hour" causes **congestion** (Mother's Day, New Year's Eve)
  - Congestion leads to blocked calls
    - Fast busy tone
    - "We're sorry, you call cannot be completed at this time"
  - Blocked messages
    - Messages can be delayed significantly (minutes, hours) as a result

Key Points from the history ....

SMS was more of an "afterthought" allowing unused bits on the signaling channel to be used to send messages

- It was not intentionally designed into the system as a robust, real time communications medium

SMS can be viewed as an "accidental success" which took the mobile industry by surprise

The explosion in message volume has put a significant load on the networks

- But SMS is designed, operated, and disclosed as a best effort service, so delays/lost messages are to be expected

SMS-Based Emergency Alerts Issues

- Message Delays
  - SMS emergency alert message delivery times can exceed 1 hour, and may require multiple to tens of hours for delivery
- Network and radio interface congestion to the point of blocking voice calls
  - "By examining the Washington, DC, and Manhattan scenarios, it can be concluded that, if SMS were used extensively during a crisis, a significant SMS load could be placed on a network. Individually, the voice load and SMS load are multiple times higher than the engineered capacity at each sector. This analysis has not considered several factors that might increase load, such as messages originating from other sources (e.g., the Internet) and terminating in the congested area. It has also not considered message re-send attempts after failures, which add to network load." (NCS SMS over SS7, TECHNICAL INFORMATION BULLETIN 03-2, December 2003)
- SMS Lacks Security à Spoofing and Denial of Service Attacks
  - "For mobile terminated national emergency messages it would be possible for spam either from a mobile phone or from the Internet to create malicious emergency messages and cause a panic reaction for many mobile subscribers. (ETSI TR 102 444 V1.1.1 (2006-02)
  - "ability to deny voice service to cities" ("Exploiting Open Functionality in SMS-Capable Cellular Networks")
- Lack of Geographic Targeting

All this adds up to a confused recipient and ineffective alerts

Real-life SMS Alert Experiences

- SMS glitch mars testing of new tsunami warning system (Pacific Wave '06 exercise)
  - Delayed SMS messages in Thailand marred otherwise successful trial of a regional tsunami warning system by dozens of countries across the Pacific.
  - Of more concern to test organisers was news later that plans to alert emergency coordinators to tsunami threats failed to work in Thailand when busy cell phone networks took hours to deliver key messages.
  - "The problem we faced was with communications. We have no idea whether our messages sent to local operations chiefs by fax and SMS arrived on time or not, and by midday some of them said they did not receive the SMS," Pakdivat Vajirapanlop from the National Disaster Warning Center told AFP. ....
  - "We need to know whether they have received our messages. What can they do if the messages don't arrive on time? Then the warning is useless," said Pakdivat, the center's deputy operations chief.

- Hoax text message spreads tsunami terror in Indonesia (June, 2007)
  - Thousands of people fled their homes in panic on the Indonesian coast after hoax text messages spread warning them that a tsunami will hit the region, journalists and officials said Wednesday
  - "The possibility is that a tsunami may take place on June 7," said part of a short telephone text message (SMS) that is widely circulating in various coastal areas of Nusa Tenggara province, local journalists said.

Real-life SMS Alert Experiences

- Finnish Communications Regulatory Authority Working Group Report on Use of Text Messaging in Public Safety Alerts, September 2005

  – "The most significant benefit of the SMS system is that an emergency alert sent through it can be received by all mobile stations without any special arrangements. **The greatest disadvantage is that the system is slow, and the greater the number of recipients, the greater the disadvantage**. ….. It follows that it would take about 1.5 hours to transmit 100,000 messages."

- SMS tsunami rumor hits Sumatra (May 2005)

  – Rumors that a volcanic eruption had sent a tsunami crashing toward the coast spread through a seaside town on Indonesia's Sumatra Island early Tuesday, **prompting thousands of panicked residents to flee to high ground**

  – "It was unclear how Tuesday's rumor began, **but it quickly spread by word of mouth and SMS text message**, the state news agency Antara Antara reported. By about 2.a.m., almost all the mosques in the town were broadcasting tsunami warnings from their loudspeakers along with religious verses, it said.

Real-life SMS Experiences

"It was the text message read 'round the country. But many had to wait minutes, and some for hours, to receive the announcement of Sen. Joseph Biden as Sen. Barack Obama's running mate… some awaiting word were complaining on various blogs and social networking sites … as of 3 p.m. Saturday, *nearly 12 hours* after it was originally sent, Micah Sifry [co-founder of TechPresident, a group blog covering the intersection of politics and technology] still hadn't gotten the text. 'I didn't really mind not getting it, but I do know people who got it at 3 a.m. An older friend of mine e-mailed me at 4 a.m., saying he couldn't sleep and asking, 'Why wasn't this thing sent at 5 p.m.?'"

Source: WashingtonPost.com, August 23, 2008. "Obama's Text: Message Received, With a Few Garbles", Jose Antonio Vargas

Minneapolis I35W Bridge Disaster - 2007

The Minneapolis bridge collapse has illustrated the ironic twist to cell phones:

Just when people need them most, they might not work.

Cell-phone companies say their networks aren't built

to handle the extra load during emergencies.

- Minneapolis Star Tribune, August 6, 2007

"Jay Reeves, 39, was one of the first people on the scene after the collapse.

He tried calling 911, but all the lines were jammed."

- CIO, August 3, 2007

Cell-phone congestion blocked some calls near the collapsed bridge site Wednesday evening,

causing Minneapolis police to ask people to get off their phones.

Police needed to use the cell-phone networks themselves to mobilize doctors,

the Red Cross and other emergency workers who don't have police radios, said James Farstad,

a city telecommunications consultant.

"Cell-phone networks are not designed for everybody who has a

cell phone to use it at the same time,"

- Minneapolis Star Tribune, August 6, 2007

Most Recent Example of SMS Alert Reality

AlertOC system has its limitations -- March 4, 2010

http://www.dailypilot.com/articles/2010/03/04/publicsafety/dpt-alertoc030410.txt

"When Newport Beach public safety officials activated the AlertOC system to notify residents of a possible tsunami surge that never materialized Saturday, they said they were erring on the side of caution.

However, as the system tried to dial out to an estimated 109,000 home and business land lines simultaneously, about 34,000, or 30%, of those calls initially succeeded because the network was overloaded, officials said…"

"…Eing said authorities chose to broadcast instructions to stay away from the beaches to every number in Newport Beach.

Instead, only a fraction of those lines were reached because the local phone switches couldn't handle the influx of outgoing calls, she said.

About 75,000 numbers didn't receive the first call. A second round of calls connected an additional 15,000. Still, about 60,000 people were not given instructions to avoid the coast…"
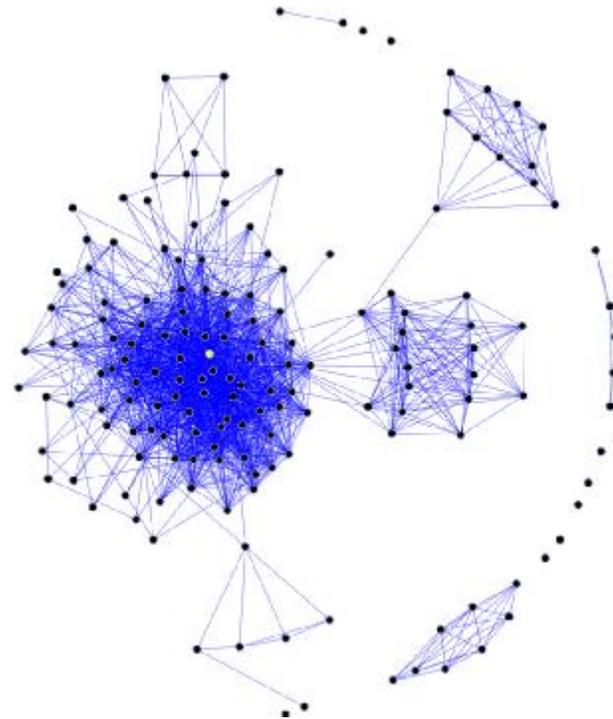
Social Networking ....

From a technology perspective, social networking applications have similar network impacts as SMS/MMS:

- Social Network Diagram is made up of numerous point-to-point connections
- Require a data connection to access the application

Social networks are increasingly becoming the first way people learn about something

Some agencies incorporate Facebook, Twitter, MySpace, etc. into their emergency notification system

Not a viable way to summon aid; interactivity and automated location information provided by voice 911 calls still essential

An example of a social network diagram.

The node with the highest betweenness centrality is marked in yellow

Text to 911

- There are efforts in the vendor community to design and advocate text-to-911 functionality both as a future technology and a retrofit to existing networks

- "It's been done (on a small-scale trial)" does not translate to scalability for national or even large regional carriers; equally true for major metropolitan PSAPs

- Text-to-911 has utility for certain communities (e.g., hearing-impaired)

- AT&T is working with the industry and researchers on limited-application text-to-911 applications

- However, for the general community, text-to-911 is NOT ready for prime time:
  - No substitute for real-time voice interactivity between caller and 911 call taker
  - Ditto for other information obtained via voice call; e.g., background noises that suggest potential risks to first responders
  - Automatic location information for text messages is in its infancy

So what is a better solution?
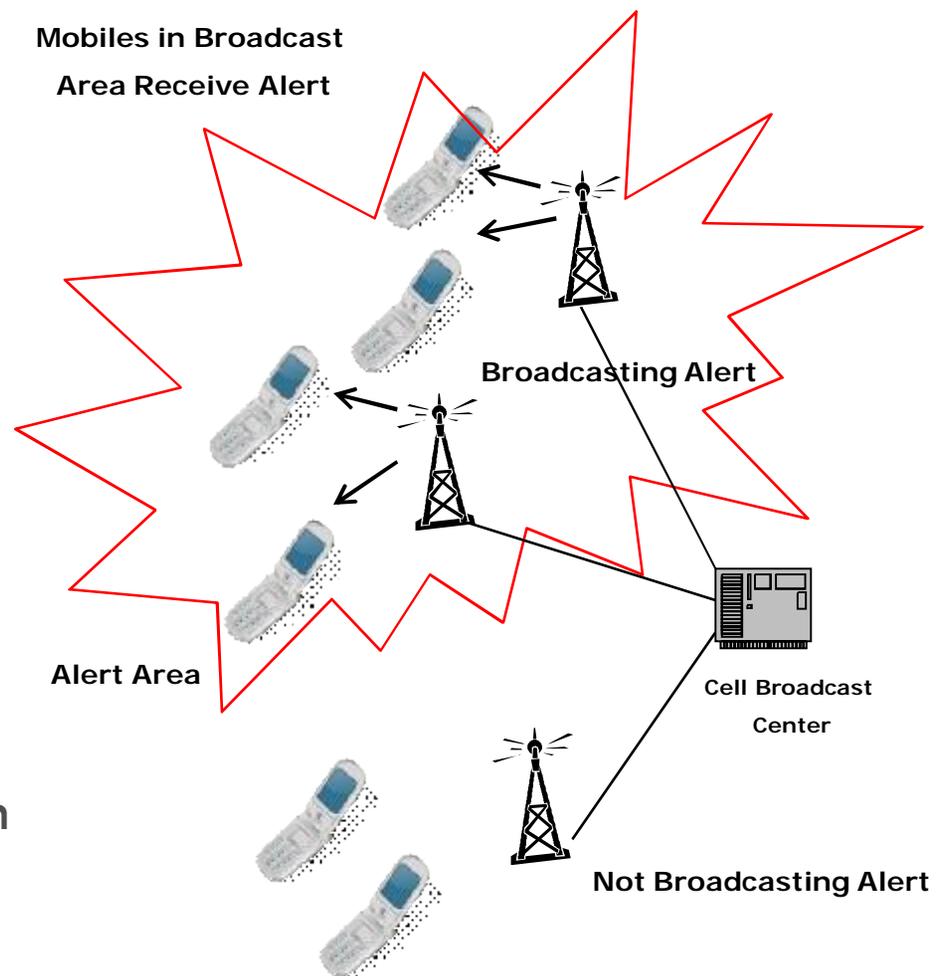
Cell Broadcast

You may see it referred as "Short Message Service – Cell Broadcast" or "Broadcast Text"

Don't confuse this with point-to-point text messaging

Cell Broadcast *broadcasts* messages to all devices capable of receiving the messages within the broadcast area

GSM/UMTS/LTE - Messages can be up to 15 "pages" of up to 93 characters per page

Minimally affected by traffic load, thus has higher chance of being usable during a disaster with high traffic loads are on the network

Mobiles in Broadcast Area Receive Alert

Broadcasting Alert

Alert Area

Cell Broadcast Center

Not Broadcasting Alert

Cell Broadcast

- Cellular broadcast technologies will eventually provide the best solution for large-scale emergency notification on mobile wireless networks

- CMAS will use Cell Broadcast

- "State of the Union" of Cell Broadcast Service (CBS)
  - Currently has limited deployments and trials in the U.S.
  - Most handsets deployed *today* do not have cell broadcast capability
    - CBS menus are not visible to subscribers
    - Software for CBS may or may not exist in the handset
    - CBS in handsets have never been tested or validated

- **Future** capabilities may include multimedia broadcast
  - Multimedia Broadcast Multicast Service provides a broadcast capability for multimedia in LTE
    - Maps, video & audio clips, still pictures, graphics, etc.

CMAS Alert Message Content

Format designed to ensure that the most critical information is succinctly and clearly communicated in a manner most compatible with the technical attributes of wireless networks

Contents of the message:
- What's Happening (Event Type or Event Category)
- Area affected (in this area)
- Recommended action (Response description)
- Expiration time with time zone (Represented as a distinct time – e.g., until 09:30 AM EDT)
- Sending Agency (agency type, i.e. police, fire, national weather service, etc.)

Message does not contain phone numbers or URLs
- Would encourage mass access of the wireless network causing severe network congestion

Responsibility for the content of alerts will remain with initiators and the federal government—not wireless carriers

Concerns Regarding Lack of Social Studies

Limited social science or focus group studies have been performed

What triggers a decision to provide an alert via CMAS, given the potential widespread notification of citizens that occurs?

What will be the end user reaction to receiving these alert notifications?
- Will CMAS alerts be viewed as credible?
- End Users "clogging" emergency services or operator customer care services for more information?
- Reaction when receiving alerts while driving, for example
  - What if 1000 people on a congested major interstate receive the messages simultaneously?
- How do "text while driving laws" impact alerting?
- How do we insure people get the information they need beyond CMAS?

Social studies are required to fully understand impact of the CMAS service offering

What kind of citizen and alert originator education programs should be established prior to CMAS deployments in 2012?

Social issues cannot be solved by technology

Exposing Fallacies of Alerting Myths[1]…

First, the public simply does not panic in response to warnings of impending disasters.

Second, the public rarely if ever gets too much information in an official warning.

Third, the effectiveness of people's response to warnings is not diminished by what has come to be labeled the "cry wolf' syndrome, if they have been informed of the reasons for previous "misses".

Forth, people at risk want information from a variety of sources and not from a single spokesperson.

Fifth, most people simply do not respond with protective actions to warning messages as soon as they hear the first warning.

Sixth, most people will not blindly follow instructions in a warning message unless the basis for the instruction is given and that basis makes sense.

Last, people do not remember what the sounding of various siren signal patters means, but they may try to find out the reason for the siren if it continues to sound or is repeated.

Under normal everyday conditions, current wireless networks are very good at delivering services, such as voice, data and messaging.

However, it is important to recognize that wireless voice, messaging and data services are not fail-safe forms of communication, and that no single wireless product is a complete solution for a crisis.

THANK YOU

Contacts:

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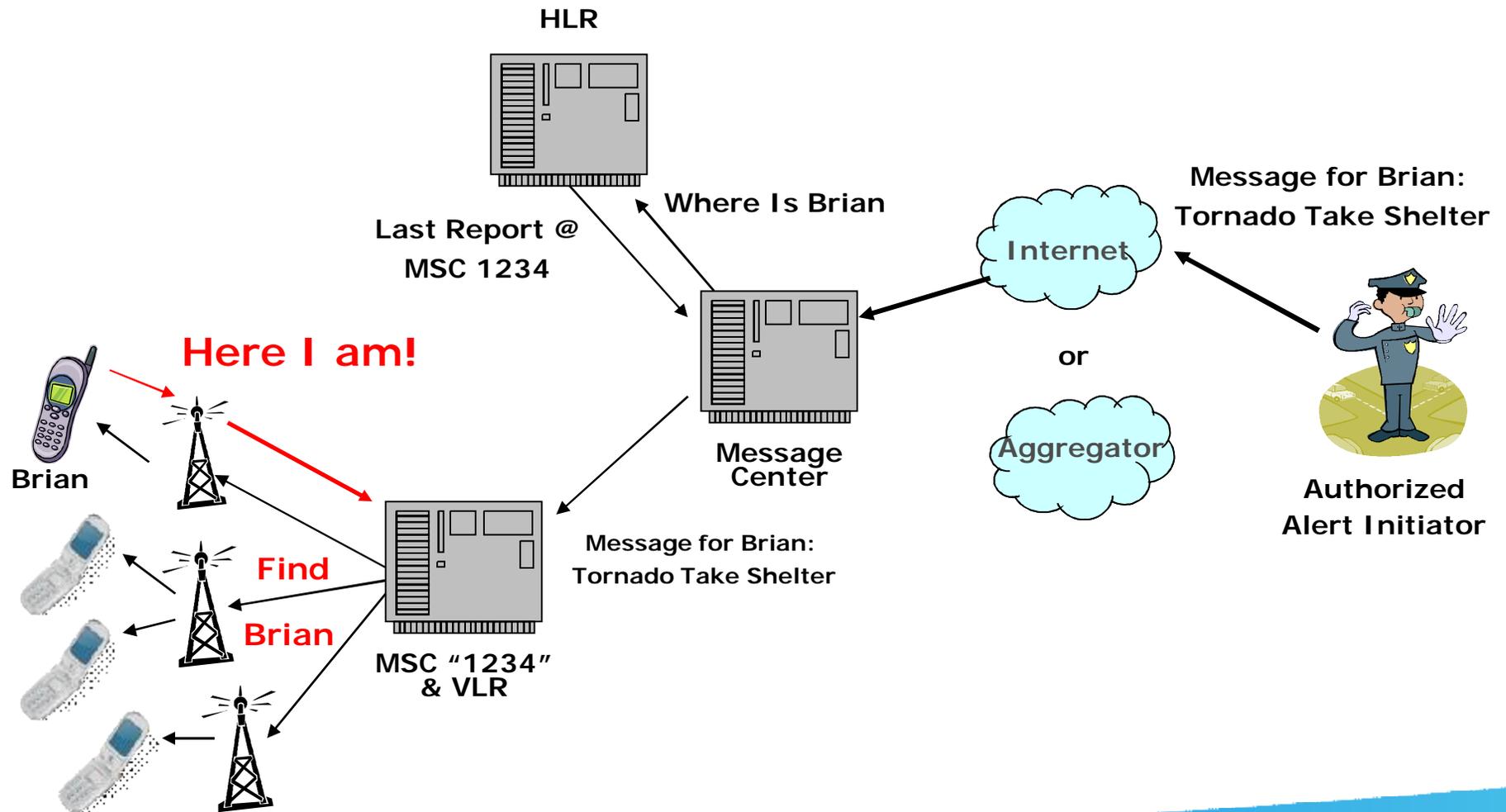Executive Director, Public Policy

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BACKUP

How SMS works – Step 1 "Find Brian"

HLR

Where Is Brian

Last Report @
MSC 1234

Message for Brian:
Tornado Take Shelter

Internet

Here I am!

Brian

or

Aggregator

Message
Center

Find

Brian

Message for Brian:
Tornado Take Shelter

Authorized
Alert Initiator

MSC "1234"
& VLR

How SMS works – Step 1 "Deliver Message"

Message from Brian:
Acknowledged

Brian

Message for Brian:
Tornado Take Shelter

OK I can get rid of message.
No retries needed

Message Center

**MSC "1234"
& VLR**

Message from Brian:
Acknowledged
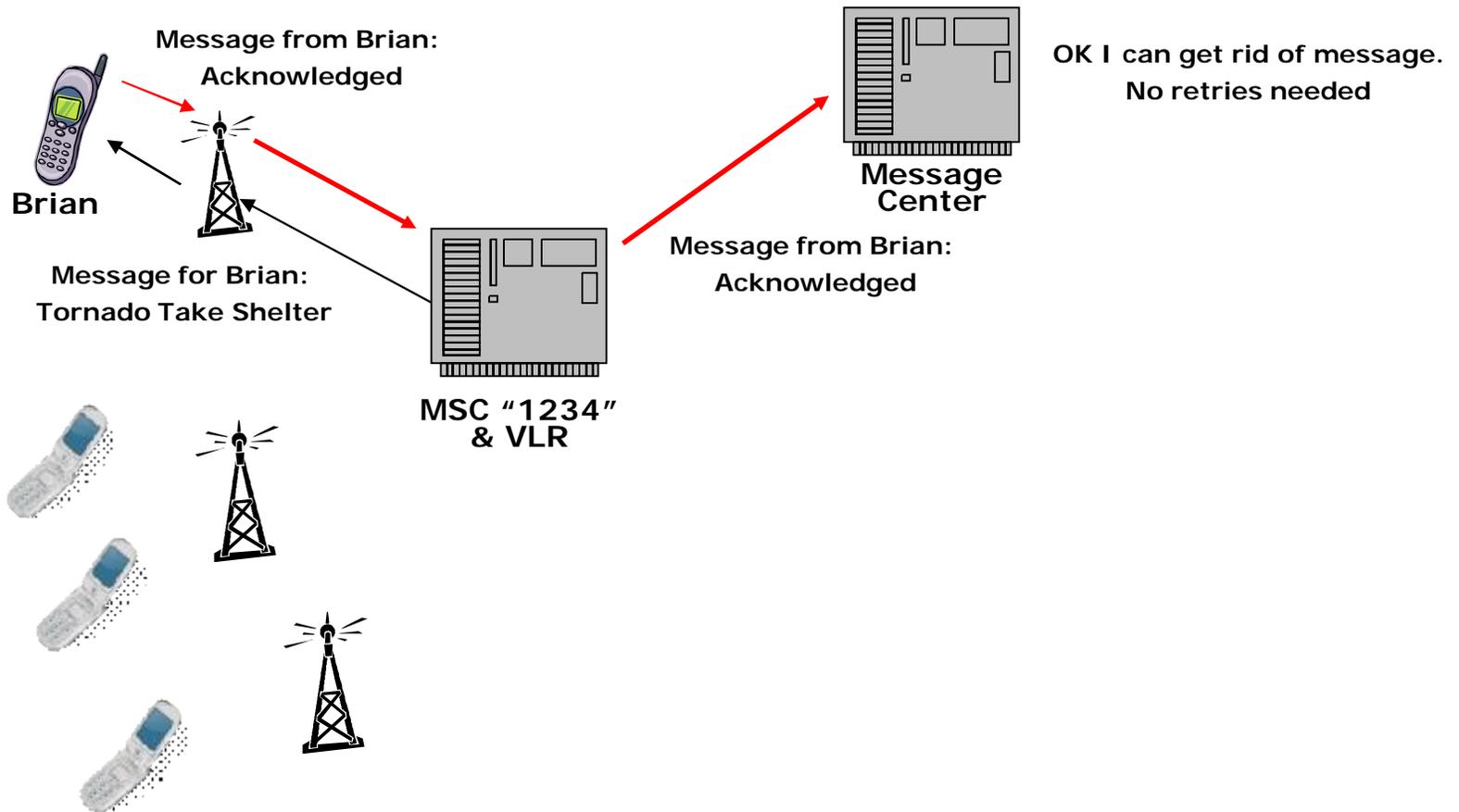
Points to Note

- The "Find Brian" process is the same whether the network is delivering a voice call or an SMS
  - Limited number of channels available to "page" subscribers
  - If paging channels get congested à subscribers will miss voice call or SMS pages

- The more subscribers there are in a particular cell or sector, the greater the chance of congesting the paging channels
  - especially in disaster scenarios or trying to send too many SMS messages to that cell/sector

- There is a physical limit on the rate at which SMS messages can be delivered on the radio channels
  - typical rates at which the actual SMS message may be delivered is 2 SMSs per second per sector

- If Brian can't be found, the message center stores the message for later retry