

**Comparison of Short Term Solutions
to Text Mobile Communicator Access to 911
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Reason for the analysis

Currently people who cannot use speech to accurately communicate with 911 centers do not have any effective mechanism for communication with 911 when they are mobile. When we complete the NG 911 rollout, these centers will accept voice, video, and text as standard mechanisms for interactive communication with the caller. At that time, individuals who cannot speak clearly or hear well or at all will be able to use either text or sign language, or some combination of speech and text to communicate.

Until this day arrives however, the mechanism needs to be deployed to allow these individuals to be able to communicate in text to the 911 centers. It simply will be too long before NG 911 begins that can provide a way for these groups to call 911, and even longer until it reaches all 911 centers.

This comparison is provided to assist in the process of selecting an interim mechanism that can be quickly implemented to allow individuals who rely on text to be able to communicate with 911 centers during planning, and roll out periods for NG 911.

Criteria

First the key criteria for evaluating the short-term text communication options are summarized. The criteria are then applied against the known major approaches. However this is done in a fashion that the analysis can be applied to other approaches that might be advanced.

1. **Deployable in 12 months.** – It is extremely urgent to get a working solution in place for this function. It must be very easy to set up. And there will be some delays in making the decision to go.
2. **Uses the same techniques that people use daily** - In an emergency people operate on reflex and do things the way they are used to doing things. It is not a time when they either think to use something new or are able to master or remember how to use something new. The mechanism for communicating with 911 centers should therefore be as natural and typical as possible.
3. **Work throughout the nation including rural areas** - The technique should work wherever the individual is at the moment – including travel in rural areas.
4. **One number works nationally** - Calling for help should be possible using the same exact technique and number or code no matter where in the US that person is at the

moment and it should connect them with the closest 911 center to them. The individual should have the same ability as voice callers to contact the local center without having to know or look up a local number.

5. **Not require special technologies or training at local 911 centers** - If at all possible the process should be transparent to the local 911 centers and not require that they purchase additional equipment or receive additional training. It is unlikely that either will occur in a majority of the centers in a reasonable timeframe.
6. **Not require significant network change** – This document is focused on near-term roll-out to quickly to fill a gap. Any significant network change will meet with resistance and delay. Since this is posed as a temporary measure, networks are likely to protest any significant costs for something that is not permanent. If it is posed as permanent then it will likely get rolled into the NG 911 planning and rollout -- and defeat the purpose.
7. **Not require significant change or cost to phone manufacturers** – Again, this document is focused on near-term roll out to quickly to fill a gap. Any significant changes to phone software will delay rollout, especially any changes to call control software of the phone that is not just a phone app update. Also, since this is posed as a temporary measure, manufacturers are likely to protest any significant costs for something that is not permanent. If it is posed as permanent then it will likely get rolled into the NG 911 planning and rollout -- and (again) defeat the purpose.
8. **Not require special training of users** - As discussed above this is unlikely to be effective in the emergency. Also, deploying a training program to all consumers in a short time span is also unrealistic and unfunded.
9. **Support centers who want to set up direct text communication** - Some 911 centers will want to support direct text communication. The system established should support this but not assume that all or even a majority of centers will want to do this before NG 911.
10. **Provide GPS or other location data to 911 center** - The system should provide what positioning data are available to the 911 center.
11. **Work with phones that do not have GPS or other location system**- It should be possible to get location information in some way.
12. **Simple to understand and use** - It should be simple and not require technical expertise.
13. **Feasible to use without support from electronic phonebook** – It should be a simple number or address, easy to announce, easy to remember.
14. **Work on low-cost phones** - It should work on any phone that can send text, not just expensive high-end phones.
15. **Confirmed reception** - It should be clear when the individual did or did not get through to 911, or if any one of the messages in the conversation fail to arrive (as may happen in heavy traffic or disaster) so user can try again.
16. **Multiple simultaneous calls** – The system must be able to handle multiple simultaneous calls from different users who need to use text to communicate and keep the conversations separate.
17. **Phase over to distributed solution**- The system must be able to gradually let local PSAPs handle their own direct text traffic as they become ready for full NG 911.

18. **Funding mechanism** – There must be a quick funding mechanism that can be put in place or tapped to fund the system. Trying to establish a new funding mechanism could delay this for a long time.
19. **All PSAPs** – It must work for all PSAPs. The text-user will not know where they will have an emergency and the solution must work at the PSAP where they are located.
20. **Good performance** – It must not have higher risk for garbling than one percent of the characters and character transmission must not add any substantial time to the total call handling. If any transmission time is added for each message it must not be more than 10 seconds for an SMS-sized message and preferably not more than 5. In this use, these are not messages so much as running conversation – in an emergency situation.

It would be useful if the same mechanism could be used to ALSO roll out real-time text, allowing people to use real-time text to place emergency calls anywhere, regardless of whether they support real-time text or not. The real-time text call would automatically go to the 911 center if it is set up for NG-911 (which supports real-time text), otherwise to a text relay operator. Thus the system would provide the same roll out capability for Real-time text that it did for SMS.

Passing location data to PSAPs

Unlike with voice calls to 911, special measures must be taken to pass the user's location to the PSAP since it is not automatic with SMS. Some possibilities are:

- “Find my phone”-style apps that use the phone's built-in GPS hardware to transmit its location in response to a remote query by the responder.
- Location services that require the user to register his/her phone, and allow the service to track it. This method works with phones that have no built-in GPS.
- Modify SMS/IM/Email program on user's phone to send a message with encoded location data taken from GPS automatically upon connecting to emergency services.
- The responder sends a message to the user (SMS, email, or IM), requesting him/her to click on a link that uses the HTML 5 geo-location features and transmits the result to the PSAP.

With the exception of obtaining location information from a voice call, these technologies require the responder side to implement new features to support them. The comparison matrix featured below indicates where specifically such support would need to be implemented.

Systems profiled

The systems currently profiled include:

- 1) Central All-Text (Central All-text)
- 2) Home PSAP based Relay (Home PSAP)
- 3) Intrado 911 Solution in Iowa (Intrado 911)
- 4) Canadian SMS Solution (Call first)
- 5) SMS to TTY gateway (SMS to TTY)

These are described using the currently known/described features for them. As features are added or become known – these charts will be updated. We will also add other major approaches as they are proposed. For the latest version, please check at:

- <http://trace.wisc.edu/911text>
- <http://tap.gallaudet.edu/911text>

#1: Central All- Text Router/Relay for Emergency Mobile Text Calls (CAT) (not proprietary)

A centralized center is proposed to serve deaf, hard of hearing, and speech impaired users for emergency calls. The system allows users to communicate with it using SMS, email, Real-Time Text (RTT) or any popular IM program. Programs should be modified to change 911 into proper code (911911 for SMS, 911@xxxxxx.US for email, 911 for RTT and 911relay for IM) to allow simple connection. It is important to make such a modification to make it simple to message 911 in an emergency. For older clients the user can still access 911 by remembering the appropriate long code to make the connection, or use his/her phonebook.

SMS and email messages receive instant acknowledgment message when received at CAT. Newer phones may be updated with modified SMS/Email program that alerts user if acknowledgement is not received for any message. The SMS/Email program also sends any location data in the SMS message (compressed and encoded in characters).

In phones where the SMS/Email program cannot be updated the user would instead get instructions on how to simply get location info by a key press. RTT and IM work in normal fashion. CAT receives text and location information, looks up local PSAP and calls the PSAP center on its voice line.

If the local PSAP is equipped for the type of text coming into CAT and the PSAP has informed CAT that it wants to take over direct text communication for this type of text all, the text call is instantly connected to that PSAP and CAT drops out. Or, at PSAP's request, CAT can monitor the conversation to see if a deaf user is using ASL structured English text that might be difficult for the local PSAP to understand. If the local PSAP is not set up for that type of text or is not trained for deaf syntax, CAT acts as a text-to-voice relay for the user in communicating with the 911 center and calls the PSAP on their regular 911 voice line.

A central facility can have special text language translation and multiple location systems that would not be practical to establish and maintain at all the local PSAPS. Since there is no standard text format yet, the central facility could support SMS, IM (all popular formats), email, and real-time text on VoIP. As the nation moves to a NG911, users could use 911 but instead of going to a central location for text – the text would go directly to the local PSAP. Thus users do not need to learn something new during transition.

TTY Transcoding

The central facility could also provide a “TTY transcoding” service allowing calls that come in any text format to be transcoded into TTY and sent directly to the local PSAP as TTY. This approach would have the disadvantages of TTY (no simultaneous communication, user can block ability of 911 operator to say anything by continuing to type without stopping, rapid typing rate not supported, garbling possible on VoIP, etc). In addition there would be a typing rate mismatch that could cause users, on fast text messaging technologies to think 911 operators (on TTYs) are unresponsive (when in fact the 911 operator is just waiting for the TTY to all play out since the 911 operator cannot type until the entire line is received). If the caller is on a fast text device and becomes impatient they may send a second message further jamming the 911 operator.

#2: HOME-PSAP-based Relay:

This simple approach starts with an assumption that each PSAP would secure either a cell phone or computer with SMS service and has a database of all the other PSAPs in the US. A deaf user registers with their local (HOME) PSAP to get the PSAP’s SMS number, email address, texting number, and/or IM screen name. The user records these. Each PSAP has its own unique number, screen name, etc. When an emergency arises, no matter where in the US the deaf person is located, the deaf person sends a message to their HOME PSAP asking for help.

The deaf person tells the HOME PSAP their current location. The HOME PSAP looks up the PSAP for that location and calls that PSAP by voice and then relays the text messages by voice as if the HOME PSAP is a hearing friend/family member or text relay service.

Each PSAP center needs to be equipped with either a smartphone or a portable computer with full Internet or a 3G wireless card. Use of a portable device is necessary in order to share the phone/computer with any PSAP personnel available when the call comes in. The use of a separate device would avoid security concerns at some centers in using their desktop systems for Internet communications.

This technique is based on the Sacramento 911 center that has been using this approach to serve deaf residents for many years (They use a Blackberry to receive SMS and Email messages. No IM is supported). With off-the-shelf phones, like the Sacramento Blackberry, this approach assumes that two emergencies never occur at the same time since there is only one address and the two (or three or many) streams of messages will all be arriving intermixed with each other at the same SMS address (on the same device) requiring the single operator to multitask. To avoid this a special SMS routing system at the PSAP would be required.

#3: Intrado 911 SMS Solution

Networks are modified through the installation of special hardware and data service in each LEC. Users can then send an SMS to 911 while in that area using any SMS program and it will be directed to the proper local PSAP. If the person sends an SMS to 911 when they

are not in an area where the networks have been changed, the SMS will not go out. So this approach assumes that all carriers implement the changes and install the special routing hardware, and that PSAPs in all areas modify their systems to accept SMS.

This approach also provides an easy transition to NG 911 since users would continue to call 911.

#4: Canadian SMS Solution

The deaf user first makes a voice call to 911. When the 911 operator does not get any response to their request for the user to respond (silent call), the 911 operator then sends an SMS back to the number that made the voice call to see if the person cannot talk but can SMS. The caller then replies to the text message and begins a back and forth text conversation with the PSAP. The voice call is left running to help PSAP to get the user's location and listen to sounds around the caller.

Since this starts with a voice call it can use the same call in – call routing – and location mechanism as all other voice phone calls.

911 operators need to be trained to respond to users who don't talk by sending the SMS. The PSAP must be able to quickly move the text phone or laptop to whichever 911 operator receives the silent call (and have enough of them to handle multiple simultaneous calls) unless all operators' stations are able to send and receive SMS messages.

Some phones are locked into an emergency voice mode during and immediately after a voice call to 911 that prevents them from sending out SMS. These phones would need to be modified under this solution.

#5: SMS to TTY Calls

With this approach a gateway converts the SMS message to TTY and sends the call into the standard TTY line for the local PSAP. This could be done with a gateway connected to each carrier that could send SMS messages to the proper 911 center as a voice call and use the regular TTY service at the PSAP to have text dialogues. No relay or middle person is used in this.

The approach still requires that the SMS call be routed to the right PSAP. The central mechanism of approach #1 could be used (and this technique is a subset of options to #1), or the method of #3 could be used. It is also subject to the same disadvantages of TTY technologies described under approach #1 above. Finally, there can be problems created by have the gateway act as an "SMS to TTY Relay operator" that is not human. For example, there is no ability for the gateway to be sure the 911 operator knows what is happening. 911 operators, who do not realize that there is a TTY gateway between them and an SMS user, may be confused by TTY dialog that comes in spurts – and then has no response for a long time after the 911 operator responds. If the gateway sends along a message explaining what is going on to start with, and the 911 operator responds with a

question – the emergency SMS user can be confused when the question from the PSAP shows up on their SMS (without them knowing that it was intended for the gateway and not for them in response to the gateway message that the emergency caller did not see).

Comparison table

<First Draft Table – if you see errors or omissions please send to 911text@gallaudet.edu>

Criterion	Central All-Text Router/Relay for Emergency Mobile Text Calls (CAT) (Non-Proprietary)	HOME PSAP Paging	Intrado 911 SMS Solution	Canadian SMS solution (Voice first, Text both ways)	SMS to TTY Gateway
Deployable in 12 months in U.S.	Yes – from date of decision and funding. No action on part of PSAPS required.	Yes but would require regulation requiring all PSAPS to implement and large training effort involving all PSAPS	No. Better suited for NG911	Yes but would require regulation requiring all PSAPS to implement and large training effort involving all PSAPS	Probably longer to get all gateways in place.
Uses the same techniques that people use daily	Yes Would support SMS, EMAIL, RTT and IM)	Yes (Could support SMS, Email, IM)	Yes SMS is used as normal to send message to 911. SMS goes to local PSAP. Only works with SMS	No Requires text users to make a voice call in an emergency and wait for an SMS.	Yes (SMS only)
Work throughout the nation including rural areas	Yes – Requires only central service be established. Works with all PSAPs from day one without training because all accept voice 911 calls	Yes – But requires DOJ to order all PSAP centers to add this service	Yes – But requires DOJ to order all LECs to install new equipment. A risk for some gap coverage for travelers during rollouts	Yes – but requires DOJ to orders all PSAP to train for this and set up SMS send-receive at voice stations	Yes- but requires establishment of central system (as #1) or requires DOJ to order all LECs to install new equipment as in #3
One number works nationally	Yes	Yes & No: Users have one contact (address book required) for their home PSAP to get help anywhere. But number is different for people in different places.	Yes – 911	Yes (911 voice dialing first)	Yes -911
Not require special technologies or training at local 911 centers	No training required. Incoming call is a voice call. (unless PSAP support direct text calls in that format)	Does require special training for all HOME PSAPs to act as relay operators for people who are deaf. Not something PSAP operators are trained for or usually do.	Local centers need training to receive SMS calls. But similar to very slow TTY.	Requires training of all PSAP personnel to send SMS if they get a no-answer call.	Training is required to understand why “TTY user” is very slow to respond each time they finish their message. SMS flow of conversation is very different from TTY flow of conversation, and no live person is available to hold hands with PSAP.

Criterion	Central All-Text Router/Relay for Emergency Mobile Text Calls (CAT) (Non-Proprietary)	HOME PSAP Paging	Intrado 911 SMS Solution	Canadian SMS solution (Voice first, Text both ways)	SMS to TTY Gateway
Not require significant network change	No network change	No network change	Significant network change required.	No network change	Gateways must be installed for each carrier plus network change for accepting 911
Not require significant change or cost to phone Manufacturers	Requires no change to phone but does require change to SMS, Email or IM program for full function. No hardware cost.	No change to phone	If using 911 numbering, it may require little change to phone if SMS client doesn't accept less than 5 digits	No change - -OR- Change SMS client to voice dial to 911 on voice line automatically when 911 is entered as destination for SMS message Some phones' SMS functionality is blocked during or immediately after a call to 911. These phones need to be updated.	May require little change to phone if SMS client doesn't accept less than 5 digits
Not require special training of users	No special training required. User can just SMS, EMAIL, RTT or IM to 911	Users must be trained to remember or be able to look up the special number/ address for the text service at their HOME PSAP.	No special training required Just SMS to 911	If no phone software changes above: Require special training of this specific procedure	No special training required Just SMS to 911
Supports centers who want to set up direct text communication -	Yes (in fact this would work with centers using any of the other techniques listed here)	Yes - any center who wants to accept SMS can.	Yes - All centers are required to support SMS	Yes - All centers are required to support SMS	Yes - text comes in as TTY
Provide GPS or other location data to 911 center	If location finding technologies are supported by central relay.	If location finding technologies are supported by all home PSAPs.	If location finding technologies are supported by all PSAPs.	Yes, PSAP obtains information from silent voice call.	If location finding technologies are supported by gateway.
Works with phones that do not have GPS or other location system	Yes but user needs to know where they are	Yes but user needs to know where they are	Yes but user needs to know where they are	Yes	Yes - but user needs to know where they are
Simple to understand and use	Yes	Yes	Yes	If no phone software change: Complicated If phone auto dials voice 911 on first 911 text sending, then easy to use	Yes

Criterion	Central All-Text Router/Relay for Emergency Mobile Text Calls (CAT) (Non-Proprietary)	HOME PSAP Paging	Intrado 911 SMS Solution	Canadian SMS solution (Voice first, Text both ways)	SMS to TTY Gateway
Feasible to use without support from electronic phonebook	SMS: Yes Email: Yes IM: Yes	SMS: No Email: No IM: No	SMS: Yes	Yes	SMS: Yes (if using 911 numbering)
Work on low-cost phones	Yes	Yes	Yes	Yes	Yes
Confirmed reception of each message	Yes – for each message user is alerted if it does not arrive or is delayed	No. If any message in the conversation is dropped there is no notification	No. If any message in the conversation is dropped there is no notification	No. If any message in the conversation is dropped there is no notification	No. If any message in the conversation is dropped there is no notification
Multiple simultaneous calls	Yes – essentially any number of simultaneous callers can be handled	No. Not as currently implemented Would require each PSAP to install special sorting and routing equipment to allow separation of simultaneous SMS messages from different users to the same SMS number	Yes	Yes - if there are multiple SMS send capabilities	Yes – if PSAP has multiple TTYs
Simple Phase over to auto 911 distribution when NG 911 rolls out.	Yes – User continues to call 911 number and it just handled differently	Complicated to reach all users to inform that local number closes down.	Yes – User continues to call 911 number and it just handled differently	Yes – User continues to call 911 number and it just handled differently	Yes – User continues to call 911 number and it just handled differently
Funding mechanism –	Relay service fund pays for central service. No cost or change to network or PSAPs	HOME PSAP pays it	Local PSAPs or network required to pay for changes to network.	PSAP funds training & phone manufactures funds SW changes	Carriers fund the gateways
All PSAPs	Yes. Since it uses simple voice call to all PSAPs (and text only to those who want it)	Yes – Local PSAP makes simple phone call to remote PSAP if the user is traveling	Only if all PSAPs in country are set up to accept and sort SMS message streams	Yes	Yes
Suitable for deaf users using non-standard English?	Yes (relay trained)	Only if PSAP trained	Only if PSAP trained	Only if PSAP trained	Only if PSAP trained
Good performance	Yes As good as SMS is	Yes As good as SMS is	Yes As good as SMS is	Yes As good as SMS is	No, not when TTY transport is used – introduces additional delay of up to 30 seconds on top of normal SMS delays

Criterion	Central All-Text Router/Relay for Emergency Mobile Text Calls (CAT) (Non-Proprietary)	HOME PSAP Paging	Intrado 911 SMS Solution	Canadian SMS solution (Voice first, Text both ways)	SMS to TTY Gateway
Other Notes	In addition to handling any text – this could easily expand to cover other forms of conversation including real-time text, total conversation, mobile video with GPS if regular VRS doesn't support this yet etc.			Phone SW change is strongly recommended for easy contact to 911	Gateway needs to implement traffic control and queuing, to ensure that only one side sends at a time because the TTY protocol does not support full duplex. Simultaneous send and receive causes garbling)

This document will be updated from time to time to reflect new information or to make corrections. Please check back and be sure you have the latest version (see title for version number of this document).

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