

PAGING SYSTEMS IN PUBLIC SAFETY



Background: St. Clair County has received a Federal Grant through IEMA to implement an upgrade to their "radio paging system". Specifically, to implement a simulcast, "digital, paging system. The purpose of this paper is to define some relevant terms, to explore some pertinent issues related to paging and to recommend policies and procedures designed to ensure the most effective and standards compliant paging infrastructure and operations for St. Clair County.

Definitions:

Simulcast The electronically coordinated broadcast of an identical radio signal from multiple radio transmitters at the same instant. Using very precise GPS timers, it is now possible to send (via wire) the same message for transmission to multiple radio transmitters, and have them transmit it simultaneously. Simulcast greatly increases the signal "penetration" of any given transmission in that it is emanating from multiple points in the County and the radio signal can "attack" the target receiver from several different directions at once, increasing the opportunity for a given receiver to receive a signal with sufficient power to activate and make it through that receiver's circuitry to its loudspeaker.

Digital Can mean at least two things when referring to paging systems. For the purpose of this paper "digital" will be used to refer to the transmission of alpha or numeric characters to paging devices, in addition to the transmission of human voice to paging devices. In other words, while the radio signal traveling through the airwaves may not be digitized 1's and 0's as in true digital radio, the analog wave is often carrying digits that are intended to become readable displays on the screen of a small belt carried pager.

Today, St. Clair County's CENCOM dispatch center is the call answering and notification/dispatch point for a number of fire departments in the County. In most cases, the responding fire departments are not full time agencies with personnel on duty, in fire stations, awaiting notification of a fire or related call. Rather, they rely on volunteers or paid-by-call responders to either report to the fire station to join a crew and respond in fire vehicles, or respond directly to the scene of the incident. To facilitate these activities, "pagers" were first invented and deployed in the 1960's. In these early days, these "pagers" were literally the size of small briefcases. They were essentially a battery operated radio receiver only (could not talk) which was usually operated in a "standby" mode, meaning that the sounds on the fire radio channel were not heard out of the unit's loudspeaker. Then, when the dispatch center wanted to activate either that specific pager (like the one carried by the Fire Chief in a given town) or a bunch of pagers (like all of those in a given Fire Department) or all fire pagers in the County, the dispatcher would use a paging encoder at the dispatch center to generate tones not unlike musical notes. For example (illustration only) if they wanted to page only Chief Jones, they transmitted sounds like the musical notes C sharp and B flat out sequentially on the Fire Channel. Chief Jones' pager was on and passively listening to the fire radio channel. As it was listening it would receive these two musical notes and submit them to its internal circuitry (but not its loudspeaker). In that circuitry were reeds that were tuned to vibrate when they heard C sharp and B flat. They would start to vibrate when these notes came over the air, and after vibrating for a second or two they would cause the audio circuit of the pager to activate, opening up the pathway to the pager's loudspeaker, thereby permitting the balance of the tones and any of the CENCOM dispatcher's words that would follow to flow out the loudspeaker. In addition to opening up this audio circuit, the vibrating reeds would also trip an internal "beeper" or other noise maker in the pager to alert or wake up the owner and advise them that *"important words are to follow"*.

Obviously if the CENCOM dispatcher wanted a person or group of persons other than Chief Jones, the dispatcher would have to send a different set of "musical notes" out over the fire channel to reach the desired parties. Pagers usually support both individual and "group call" capabilities so that (for example, not only could one page Chief Jones as an individual, but one could also page him as a member of the Anytown Fire Department.)

From this humble and somewhat impractical beginning, pagers have gone through much miniaturization and improvement, but the general concept of "tone and voice paging" has remained the same for decades, and this is how fire paging is still handled in St. Clair County today.

Throughout this document we have repeatedly used the term "fire channel". By this we mean the radio frequency of 154.190 Megahertz (MHz) licensed by the FCC to St. Clair County and many of the fire departments in the county. This radio channel is the primary and only frequency used by CENCOM and the fire departments for which it dispatches for the purpose of performing fire paging, as well as all two way radio communications associated with the response to and management of a fire situation over the radio, until and unless the incident is moved to another radio channel set aside for Fire Mutual Aid Operations with other agencies operating on a different radio system.

This means that the Fire Channel (154.190 MHz) has the inherent potential of being very busy, in that it is the "party line" over which these paging tones and dispatch announcement message must be broadcast in a timely fashion, while at the same time serving as the party line over which all dispatched fire department voice communications must be conducted, often in a very timely manner. The results can be very problematic. To understand this it is important to understand that when two radio transmissions are trying to take place at the same instant, in County, on one radio channel, they will interfere with each other, and (in most cases and most places in the County) the result will be that neither radio transmission "made it through" in a clear and unobstructed manner. And this can be disastrous from both ends. For example, if a CENCOM dispatcher is sending out paging tones for the North Anytown Fire Department at the same time somebody from or near North Anytown is talking on the same fire channel, it is highly likely that the radio signal from the two way radio being used in or near North Anytown will end up being stronger than and overpowering CENCOM's paging signal trying to make it to a pager in North Anytown. The result is that the "musical notes" being sent by CENCOM get there obliterated or altered such that they are no longer "pure enough" to vibrate the reeds in the North Anytown pagers and the pagers fail to activate.

Similarly, if a North Anytown firefighter has a pressing need to talk on the radio at this instant at a fire scene about a life safety issue, and at the same time he tries to talk, CENCOM is sending out paging tones for some other fire department or person on the same fire channel, it is possible that the words of that fire fighter will be all washed out and over-powered by the CENCOM paging tones and not be received by anybody at the fire scene.

Therefore, using a radio channel like the St. Clair County fire channel for both paging and voice talk has its problems. But the solution is not often readily available. First of all, radio channels in the 150 MHz range are very scarce and getting a license for another radio channel is very difficult, and usually impossible, especially in a metro area like St. Louis. But even if another radio channel were to be available, implementing a second radio channel for paging purposes only can also have its own set of problems. Specifically, fire departments over the years have come to rely on the ability of their pagers to also be set to the monitor position to actively receive and output the voice (and paging tone) activity on the fire channel. Via this method, a fire fighter can hear his pager get activated, and then set the pager to MONITOR and listen to what's happening on the channel while he responds (or chooses not to respond) to the incident. This presumes that all voice radio traffic of interest in this matter is coming out over the same radio channel over which the pager is being activated.

As a partial response to this desire, the industry did develop two channel pagers which would permit actively monitoring one channel while being potentially available for another page on a second channel. Unfortunately, these devices are not fool proof and it is an occasional occurrence for individuals to miss a desired page because their pager was tied up outputting voice traffic from the other channel.

The "bible" for the fire services, and a major factor in the awarding of Fire Insurance Ratings by the Insurance Services Office (ISO) is a document known as "NFPA 1221" (National Fire Protection Association) entitled "***Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems***". In NFPA 1221, the very issue we have been discussing above is addressed in Standard 8.1.1.2, as follows: "**The transmission of any signal shall not interfere with the transmission and receipt of alarms.**" In this context, the term "alarms" is defined as the act of alerting a responding agency of an incident to which their response is required. In other words, therefore, NFPA 1221 requires (in order to receive ISO points for a better fire insurance rating) that there be a system or process in place which does not permit the transmission of any radio signal that would or could interfere with the transmission of or receipt of an alarm, as in a set of paging tones. St. Clair County does not comply with this standard in today's operational practices.

Additionally, NFPA 1221, in Standard 8.1.1.3.1 requires that for jurisdictions that "**receive 730 alarms or more per year (two per day) they shall provide two separate and dedicated dispatch circuits as follows:**

- (1) Primary and secondary circuits shall be provided for transmitting alarms**
- (2) The failure of any component of the primary circuit shall not affect the operation of the secondary circuit or vice versa."**

Performing all fire paging and voice dispatching over one radio channel (even if that channel has a back-up transmitter, which it has) would seem to violate the spirit and intent of this standard. And, clearly, CENCOM receives more than 730 alarms per year, and some of the dispatched fire departments themselves may receive over 730 alarms per year.

Having established all of the above, and having examined fire communications operations in numerous small and large agencies, it is our professional opinion that CENCOM should implement several operational changes, as soon as practical and feasible:

1. Move all fire paging over to a dedicated paging only radio channel as soon as one is available.
2. Locate and employ a "fire ground/tactical" radio channel in all fire department radios so that on-scene radio traffic can be taken off 154.190.
 - a. Ideally, this would be a full power channel other than 154.190 on which alternate fire dispatch activity could also be conducted. If no such full power channel is available (or until one becomes available) lower power, mobile only channels could be obtained.
 - b. In general, radio to radio traffic at a scene should take place on a fire ground channel, while a command officer at the scene maintains communications with CENCOM on the Main Fire Channel.
3. Once the above are implemented, those individuals who require that they be paged (as most would) and also desire or require to monitor voice traffic on the VHF voice channels will have to take steps to equip themselves with something like mobile mount or handheld scanners or

portable radios with the channels they want to monitor. These can be had for \$200 -\$400 each.

With the above general operational recommendations in mind, we now return to the implementing of the new paging system flowing from the earlier referenced federal grant:
Specifically, we recommend that St. Clair County implement the following:

- A. Taking "Sheriff's Channel 4/ESDA Channel" (158.835 MHz) out of service for voice dispatching, and relocate its current occupants to either Sheriff's Channel 2 or 3 as appropriate.
- B. Using this 158.835 channel, implement a multi-site (probably 3 or 4) base station, simulcast paging transmitter system with digital paging capabilities
- C. Include remote activation (from remote phones or PCs) of said paging system as an available future option.
- D. Include Optional programming of the receivers in the new paging transmitters to serve as "satellite receivers" on the 154.190 fire channel so as to improve inbound signals from fire radios to CENCOM for voice traffic, and the attendant purchase of a voting comparator for these satellite receivers at CENCOM.
- E. Establish procedures permitting use of this new "paging only channel/system" by any and all legitimate users in County government for both administrative and emergency service paging, with the desired option of assigning priority levels to those who access the system so that emergency pages and all pages generated from CENCOM would take priority.
- F. Deploy "Alpha/Numeric Display Pagers" to those who desire to receive information silently on such a pager.
- G. Permit "legacy" tone and voice paging on this new paging only channel, and, in fact, move all tone and voice paging off 154.190 over to this new paging only channel.
 - a. This would require all legacy tone and voice pagers to be retuned to 158.835, which the County may wish to facilitate via some "group purchase discount" with a local radio shop.
- H. Do not permit fire departments to license up on 158.835 and operate their own remote base stations and do their own paging. If they want to page on the new system, they would have to get into the new system's "head end" via the remote access method described earlier.