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2021-04-26 iPaws

Programming notes:

- I got mad at my commercial landlord for running shoddy political advertising on their buildings and trying to block a homeless shelter and in general being exceptionally bourgeois, and so didn't renew my office lease. My mailing address has changed, the new one is in the footer and other normal places. Righteous outrage is convenient like that. It's a PO box now so the good news is I'll just keep it regardless of the office situation, the bad news is that I will need to routinely enter one of the most depressing places on earth: a New Mexico post office. They did fix the asbestos finally but we'll see about the rat problem. And thanks to everyone who has sent me letters, and sorry for taking so long to respond to them.
- After taking a long time to overcome my electromagnetic hypersensitivity that only reacts to SIP, I spent an afternoon fixing the PBX and will finally resume fax delivery to the vanishingly small list of people who have requested it. One day I'll write a post on T.38.
- I have found that Apple Mail often rejects emails from my AWS SES setup. The SMTP error directs me to a help page with absolutely no useful information, so clearly they're learning from Google's expertise in running a major email service. The funny thing is that I am having no delivery issues with gmail, but I'm pretty sure if I change anything at this point I will. So if you use Apple Mail, I'm sorry, for many reasons. Maybe try fax? I think certain LaserWriters could take a fax modem, if you really want to stay in-ecosystem.

Where we left off, the Emergency Alert System (EAS) had been "replaced," at least in name, by IPAWS: the Integrated Public Alert and Warning System. In fact, it's more accurate to say that EAS is now just one component of IPAWS, and the task of originating alerts (and much of the bureaucracy) now rests on IPAWS.

IPAWS was particularly motivated by Hurricane Katrina, as this large-scale disaster had made it apparent how limited the existing emergency alert infrastructure was. A large portion of people do not receive EAS alerts because they are not listening to the radio or watching television. There are other avenues that exist to deliver alert information but the infrastructure was not in place to get alerts into these channels.

So, IPAWS took the fragmented landscape of miscellaneous government communications options and combined them into one beautiful, happy family that works together in flawless harmony. Let's just pretend.

There are several major components of IPAWS which had existed, at least in some form, prior to IPAWS but had not been unified into one network. These were EAS, NAWAS, WEA, and NOAA Weather Radio. More ambitiously, IPAWS is intended to be easily extensible to include other government and non-government alerting systems, but first, let's talk about the core.

NAWAS

The EAS we have already discussed. Another emergency communications system which dates back to the Cold War is NAWAS, the National Warning System. Wikipedia asserts that NAWAS was established in 1978, but this can't be correct as it's described in an AT&T standard a full decade earlier as an already existing system, with much the same capabilities it has today. 1978 may have been a significant overhaul of the system; it's hard to figure out a whole lot about NAWAS as it had historically been classified and today is obscure [1].

NAWAS serves the purpose of alerting, and more general communications, between government authorities. It is essentially a system of four-wire [3] leased telephone lines that links FEMA and other federal locations with state emergency authorities. Within states, there is typically a subsidiary NAWAS network for which the state authority acts as control and local authorities are connected as users.

An older operating manual for NAWAS has become public and you can read

a great deal about it there, but the basic concept is that it functions as an intercom system over which federal centers such as NORAD or the National Weather Service can read voice messages, which will be heard in all state emergency operations centers. This provides a very rapid way of spreading basic information on a national emergency, and NAWAS is both a descendant and component of systems intended to trigger air raid sirens as quickly as possible after a NORAD alert (more about siren control will likely be a future topic).

Although NAWAS has seen technical improvement in the equipment, it still functions more or less the exact same way it did decades ago, and operating procedures are very simple. If you have ever used a good-quality, multi-station commercial intercom system with a visual alert feature, such as is often used in the theater industry for cues, you would find NAWAS unsurprising... except that the stations span thousands of miles.

NAWAS functions primarily as a party line intercom, but it does support dialing between stations to alert a specific location to start listening. Dialing is based on FIPS codes, and while that's not too strange of a choice from a federal system in general, it's probably not a coincidence that NAWAS stations are alerted using a similar numbering scheme to SAME headers... typically a station like the NWS would be issuing EAS messages and calling state EOCs to advise of the possible damage simultaneously.

WEA

The next core component of IPAWS in arbitrary Wikipedia ordering is WEA, the Wireless Emergency Alert system. WEA is a long-in-development partnership between the FCC and mobile carriers that ("partnership" in that participation is now mandatory) which allows short, textual emergency alerts to be sent to mobile phones throughout a region. This relies in a component of the 3GPP protocol stack that is not widely used (or really used at all) in the US, which essentially allows a cellular tower to send a true "broadcast" message which will be handled by every phone associated with that cell. In this way, addressing is roughly geographical rather than based on station identities.

These broadcast messages trigger special handling in the cell phone operating system, which generally feels a bit awkward and roughly implemented. Typically the old EBS Attention Tone is used as an audible alert and the message is displayed immediately over other applications.

Use of WEA has traditionally been rather heavily restricted, in practice to presidential alerts (e.g. the test conducted some years ago) and AMBER alerts. One might think that there's sort of an odd disparity in severity, between essentially "nuclear attack" and "child abducted somewhere in the same state," and indeed it is a major criticism of the AMBER alert system that emotionally- motivated handling of AMBER alerts as top-priority induces alarm fatigue that may lead to people ignoring or downplaying an actual nationwide civil emergency. If you own a cell phone and live in a state that participates in AMBER alerts you're probably inclined to agree, or maybe our child abduction rates here in the land of enchantment are just substantially elevated.

Weather Radio

The final major component is NOAA Weather Radio, more properly called NOAA Weather Radio All Hazards and often referred to as NOAA All Hazards Radio. This last one, which makes the most sense, is of course unofficial. A great many US residents are amazingly unaware of the NOAA Weather Radio infrastructure, which has been steadily expanded to substantial nationwide coverage. Weather Radio normally transmits a computer-synthesized voice describing the current weather and upcoming forecast, on one of a list of VHF frequencies around 162MHz. The full forecast generally repeats every fifteen minutes. This loop, updated regularly, is occasionally supplemented by outlook statements and other special material.

When the NWS issues a weather warning or alert, however, Weather Radio stations immediately play the alert with SAME headers and footers... much the same as EAS. Special-purpose radio receivers, popular in tornado-prone regions, parse the SAME headers and sound an audible alarm when an alert is issued for the correct region. In fact, the SAME protocol was originally designed for this purpose and was adopted for EAS after its widespread use for Weather Radio.

The relationship between Weather Radio and EAS is substantial. Since the development of EAS, Weather Radio stations now transmit all EAS alerts, not just those issued by the NWS. This is why "All Hazards" was awkwardly appended to the name: it functions as a general purpose emergency radio network, complete with a ready supply of specialized alarm receivers. In a way it is the NEAR concept deployed more successfully, but... well, success is relative. Weather radio receivers are uncommon nationally, despite their low cost [2].

So these are the four basic channels of IPAWS: broadcast radio and television, inter-agency telephone, cellular phones, and the dedicated radio network. IPAWS allows an alert to be simultaneously, and quickly, issued to all of these services. This is particularly important because WEA alerts, although they are length constrained, can encourage people in affected areas to turn on a radio to receive more extensive information via EAS.

IPAWS-OPEN

All of that said, the full scope of IPAWS is considerably more ambitious, which leads to IPAWS-OPEN. IPAWS-OPEN often gets rather grand descriptions as an enterprise, machine learning, blockchain artificial intelligence, but I'm here to cut through the bullshit: it's just a set of servers that broker XML documents.

Specifically, those XML documents are the Common Alerting Protocol, or CAP. CAP is essentially the same concept as SAME but in XML form rather than FSK, and including extensive capabilities to provide multiple representations of an alert, intended for different languages and media. CAP supports encryption and signing, which provides an authentication mechanism as well.

IPAWS-OPEN consists of servers which receive CAP documents and then distribute them onwards. That's basically it, but it is designed to allow for flexible expansion of IPAWS as a wide variety of alerting media can simply participate in the IPAWS-OPEN network. For example, a state DOT's changeable message highway signs could repeat alerts automatically if the control system's vendor implemented an IPAWS-OPEN client.

Although IPAWS, in theory, fully integrates all alerting channels, this obviously has not worked out in practice. Many agencies still operate fundamentally different alerting systems, most notably the NWS which has an old and extensive one, and so various sets of gateways, converters, and sometimes manual processes are required for a message to cascade from IPAWS-OPEN to all alerting channels. That said, in theory IPAWS will complete the EAS vision of flexible origination and targeting. A state governor, for example, can take full advantage of federal systems to deliver an emergency message to their state by using a CAP origination tool to send the message into IPAWS-OPEN.

Public and private organizations are able to access IPAWS-OPEN either through authority of a government agency or via a "public" (after

extensive paperwork) data feed. This can be used to put alerting wherever you want; the government has somewhat comically pursued an internet-based alerting system, for example, for well over a decade without any real progress made. There seems to have been a somewhat fundamental misunderstanding of the way the internet is used, as government officials have often imagined an internet alerting capability as looking exactly like EAS on television stations--that is, the worst popup ever. What the infrastructure to deliver that would look like has remained mysterious, although perennial proposals have ranged from silly to alarming.

That said, Windows tray icon tools to pop up IPAWS alerts are out there, digital signage vendors offer the capability to automatically display alerts, and Google has tossed IPAWS into the Google Now pile. There is some progress, but it is uneven and not often seen in the real world.

the future

For reasons that are partly political and partly historical (that then turned into political), the United States has surprisingly weak infrastructure for the distribution of emergency information when compared to other developed nations. Much of this is a simple result of the lack of a state-owned broadcasting authority that operates domestic media. All national communications necessarily pass through the complex network of commercial journalism; while this may have ideological advantages it is not especially fast or reliable.

The trouble is that, in a way, any centralized, federally-operated system of delivering information to a large portion of the citizenry would be perceived as--and probably be--an instrument of propaganda, in violation of long-held American principles. For this reason, it seems likely that we will always have a fragmented and seldom-used alerting infrastructure.

On the other hand, much of the modern state--primarily the ridiculous effort over years taken to deploy WEA--is a result of systematic underfunding and deprioritization of civil defense in the United States. For the nation with the world's greatest defense budget and a very high, although not first-place, military budget as portion of GDP, civil defense has always been an afterthought. Our preparedness against emergency--whether natural, civil, or warfare--has routinely been judged less important than offensive capability.

During the Cold War, this was a cause of a surprising amount of strife even within the military. Robert McNamera, Secretary of Defense during the key period of the 1960s, routinely objected to investment in missile and even missile defense systems rather than fallout shelters and relocation preparations. Today, absent the specter of the Soviet Union's sausage ICBMs, there is less interest in civil defense as a military strategy than ever before.

Instead, most modern civil defense efforts are motivated by the political embarassment subsequent to a series of hurricanes, most notably Katrina. Unfortunately, public and political reaction to these events tends to end up down very strange rabbit holes and has seldom lead to serious, systematic review of civil defense capabilities. What political will has come about is repeatedly captured by the defense industrial complex and transformed into yet another acquisition project that costs billions and delivers next to nothing.

What I'm saying is that nothing is likely to change. A single successful national presidential alert will continue to be regarded as a major achievement, and the most capabile, reliable technology will continue to be mild evolutions of systems developed prior to 1980.

All of this pessimism aside, next time I return to the topic of civil defense I would like to look at its most pessimistic aspect--the part that McNamera believed to be worth the money. We'll learn about the Federal Relocation Arc and the National Relocation Program. Naturally with a focus on telecom.

[1] An obviously interesting question is "what came before NAWAS?" It's hard to say, and very likely there is no one answer, as the Civil Defense Administration, DOD, and various state and regional authorities had all stood up various private-line telephone networks. This includes federal initiatives such as the "lights and bells" warning system by AT&T which are fairly well documented, but also a lot of things only vaguely referred to by historians who seem to actually know very little about the context. Case in point, this piece from the Kansas Historical Society which repeats the myth of the Washington-Moscow hotline as a red phone while giving no useful information about the artifact. It appears very much like an early 1A2 key system instrument, and the pre-911 emergency number sticker strongly suggests it was just used with the plain-old telephone system. At the time, a red handset was commonly used to indicate a "hotline" in the older sense of the term, that is, a no-dial point-to-point link. This wasn't a feature of the 1A2 system but 1A2 did offer an intercom feature that this phone may have been left connected to.

[2] In a four-wire telephone line, audio in and out (microphone and speaker) are carried on separate pairs. This is generally superior and has long been used within telephone exchanges and long-distance lines, because the “hybrid” transformer which allows for both functions on one pair is a source of distortion and is prone to issues with echos and signal path loops. Moreover, it inevitably mixes the audio each way. On a typical telephone this just leads to “sidetone” which is now considered a desirable property, but for an intercom system with many stations simultaneously active it becomes a tremendous problem as not just the signal but its poorer-quality “echo” from each hybrid transformer ends up being amplified. Two-wire lines are generally run to homes and businesses simply due to the lower materials cost, but for “large-area intercom” systems such as NAWAS, four-wire connections are used. Really the whole thing is somewhat technical and requires some EE, but in general four-wire private lines tend to be used for either very quality-critical applications (e.g. between radio studios) or intercom/squawk box installations (e.g. between control rooms). Obviously intercom over private line is not very common due to the high cost, but emergency operations are a common application. This whole issue of two-wire vs. four-wire telephone connections becomes extremely important in the broadcasting industry, where “hybrid” has its own specific meaning to refer to a sort of “un-hybrid” transformer which separates the inbound and outbound audio again to help isolate the voice of the host from returning via the inbound telephone path. Of course doing this by simple electrical means never works perfectly, and modern broadcast hybrids employ DSP methods to further reduce the problem. This is all another reason that ISDN telephones have found an enduring niche in radio journalism.

[3] Weather alerts aren’t always a matter of life and death but sometimes more simply practical. I’ve twice had cars damaged by the severe hail storms we are prone to, and prompt attention to a severe thunderstorm alert gives an opportunity to move cars under cover. Considering the cost of bodywork the Weather Radio receiver can pay for itself very quickly.