computers are bad

2022-06-10 analog phones

The greatest trend in telephone technology for the last decade or so has been the shift to all-IP. While this change is occurring inside telco networks as well (albeit more slowly), it's most visible in the form of IP-based end-user communications devices. In other words, the ubiquitous office IP phone.

Office IP phones have gone through various forms as vendors have come and gone, but I still tend to picture the Cisco 7900 series as the prototypical example. Some of this association probably comes from the 7960's starring role in the television series *24,* where the fictional law enforcement and/or intelligence agency and/or paramilitary CTU is absolutely lousy with them and their distinctive ring tone. This is no coincidence, Cisco apparently had a generous promotional consideration deal with the *24* production team that ensured a number of Cisco office telecom products were clearly visible... and audible. I'm not sure how many people can place it, but I think a large portion of people around my age recognize the ringtone.

A Tangent About a Ringtone

One wonders, of course, where the sound known to many as the *24 ringtone* actually came from. I wrote several paragraphs about the history of these ring sounds as I understood it before I did some careful listening and realized I was entirely wrong. Here's the issue: I thought, and from googling some other people seem to think as well, that the "24 ringtone" was a stock ringtone on Cisco 7900 series phones, and that it was a direct copy of a ringtone long present on AT&T/Lucent/Avaya office phones that dates back to the AT&T Merlin.

The Merlin, a historically notable office key system for several reasons, was also AT&T's first serious foray into digital, function-generator-based ringtones. Merlin phones contain a simple sine-wave-only variable frequency oscillator (VFO) to produce various beeps and blorps like keypress confirmation. To produce a pleasing ringing sound, the phone drives this VFO based on a simple "program" that consists of frequencies (in hertz) and time periods (in milliseconds). This system works well enough that it still sees use in telephone today, although the VFO is now software. Such "programs" are often written in a compact text format, and most IP phones today still use this basic approach for things like dial tone, ringback, etc... but for ringing proper, they usually expect a "proper" audio file. Not so with the Merlin, which didn't yet have the hardware to actually play audio samples. Lists of frequencies and durations were all you got.

Someone at AT&T presumably spent a long time messing around with these simple programs

and it was worth it. The original eight Merlin ringtones remain, in my opinion, some of the finest phone ring sounds ever devised, and are still offered by many IP phones today. Western Electric, which manufactured the Merlin, became AT&T Technologies, which became Lucent, which became Avaya. These companies have largely honored AT&T's legacy in this era and Avaya IP phones continue to have a minimalist and commercial-feeling but also pleasing and thoughtful sound scheme... still largely based on simple sequences of one or two tones.

This is of course strictly a matter of opinion, but I am incredibly irritated by the path that phone sound design has taken. A modern smartphone, by default, offers basically zero ringtones that actually sound *like phones*. I realize that this comes from my idea of what a "phone" is having ossified when I was about four years old, but I do think there's a good objective argument for communications devices using simple, short, and highly recognizable notification sounds rather than the sort of bizarre set of one minute compositions you tend to get today.

But let's get back to the first tangent here. It turns out my recollection here was wrong: first, the "24 ringtone" is not actually a default ringtone on Cisco phones, but *is* a "default custom" ringtone that is provisioned to phones by a default installation of Cisco Call Manager (or Cisco Unified Communications Manager later, when Cisco was a major driver of the brief Unified Communications buzzword craze). Cisco IP phones are virtually always used with Cisco Call Manager because they don't use SIP, but rather a Cisco-proprietary protocol called SCCP (commonly referred to as "skinny," which was both an earlier internal name and a reference to SCCP's goal of being simpler and easier to implement on devices than SIP). As a matter of fact Cisco 7900 series phones actually *did* support SIP if you re-provisioned them with a different firmware image that Cisco provided for that purpose, but this was janky and it's not something I've actually seen used outside of my own home.

So, since Cisco 7900s are almost always used with Call Manager and Call Manager, by default, provisions the phones with these "custom" ringtones... they're pretty much default. The issue is pedantic but still sort of interesting, as it leads you to wonder what internal politics lead to additional default ringtones being included as part of the install package for Call Manager.

Second, though, and more importantly, the ringtone in question is *not* a Merlin ringtone. The most widely heard ringtone in 24 is very similar to, but noticeably different from, Merlin ringtone 6. The other ringtones heard in the show (which are other Cisco Call Manager defaults) are also "very much but not quite entirely" like the Merlin options.

This actually addresses a bit of a mystery to me. Cisco got its IP phone business by acquiring (pretty much immediately after founding) a company called Selsius. There is no historic business relationship between Cisco/Selsius and AT&T/Lucent/Avaya, so it would seem surprising for AT&T's classic ringtones to end up in a Cisco product. Well, they didn't, or at least not exactly. Although I can't find solid proof, it seems virtually guaranteed to me that the the Cisco Call Manager default set of custom ringtones are, in fact, ripoffs of the Merlin tones. The 24 ringtone is a fake! Given the '80s era prestige of the Merlin system, the Cisco ringtones are practically the "Louise Vittant" handbag of the telephone world.

To be fair, though, whatever anonymous Cisco employee sat down to copy the Merlin ringtones made some meaningful improvements. The staccato cadence of the Cisco ringtones, as opposed to the Merlin's legato, is very distinctive and probably more recognizable in a loud environment. It also sounds pretty cool, which sure helps with

a TV series about a vague counter-terrorism agency with apparently superhuman abilities.

So here I'm 100 lines in and on a total tangent. I didn't mean to write about ringtones, I just like them. What I actually wanted to write about has to do with the ubiquity of IP phones themselves. Most office workers my age have probably had an IP phone on their desks for pretty much their entire career. I have, with the exception of one large institutional employer where I was lucky enough to be among the last employees issued an ISDN desk phone. This was rare enough by then that the amused telecom technician made a show of blowing the dust off of the "voice terminal" that she had pulled out of a closet junk heap. I actually loved that phone, but I loved it because it was weird and obsolete. Despite their own eccentricities (which are significant enough that IP phones are virtually always segregated to their own VLAN), IP phones are an increasingly pedestrian part of IT infrastructure that lack some of the intrigue of traditional analog and TDM instruments.

Despite the advantages of IP phones, a lot of organizations that make the switch to IP end up with various odd analog phones left over that, for various reasons, are more expensive to replace. It's fairly common to end up keeping landline telephone service to buildings just to support these devices. And here is the real purpose of this post: to tell you about a few cases where you will very frequently find analog phones, even in organizations and facilities that have otherwise switched to IP. The best part is that these are pretty much all *weird* types of phones (that's what makes them hard to replace with IP), and you know I love talking about weird phones.

Emergency Phones

One common category of holdover analog phones are emergency phones. The most common case are elevator phones, intended for use by an elevator occupant if they're stuck. In most cases, code requires elevator phones to use an outside line to call an attended call center. This means that they're usually proper phones hooked up to the PSTN. While IP elevator phones are available, they don't seem to be very common. A big factor here is that the elevator phone is typically hooked up by the elevator installer who will run an analog phone line with the elevator travel cable. Adding ethernet later is a pain on its own.

"Blue light" type emergency phones (whether or not made by the actual company Code Blue) are also often analog, although new installations are likely to use the IP versions.

Alarm Communicators

Burglar alarms historically used landline telephone for reporting almost exclusively. Well, historically meaning since the 1950s or so. Prior to that point there were a lot more private alarm monitoring networks in use that used either dedicated pairs per monitored system or telegraph technology. Today, a variety of burglar alarm reporting methods other than telephone are available, but there are still plenty of landline phone communicators in service.

Alarm communicators are not limited to burglar alarms. Some devices like generators and refrigeration equipment may be equipped with a device for reporting any test

failures or alarms. Like burglar alarms, today these are often cellular and/or IP, but there's still older equipment out there using analog telephone for reporting.

Access Control Systems

It's fairly common for access control systems, that is electronic door locks, to be remotely programmable. This is common in small organizations where the system is fully managed by a locksmith, and in large organizations where it is managed centrally from a corporate office. Once again, newer systems are moving to IP but there's a lot out there that relies on something like a USRobotics modem for external access.

Paging and Radio Bridges

Something that I've personally seen a couple of times is held-over analog phone lines to support audio bridges to an overhead paging system or to a handheld radio service. There are plenty of IP bridges available for these kinds of applications, but this is another area (like elevators) where you run into a disconnect between contractors: if different organizations service the telephone system and the paging or radio system, you can get stuck on analog just because of the lack of coordination (and willingness to pay) for the switch.

Some Miscellaneous Phone Devices

Analog phone lines lead to a lot of odd situations inside of commercial buildings, especially smaller ones, both because they were easy to adapt to many purposes and because adding more lines was pretty expensive. There was an obvious desire to put more than one device on each phone line.

A common way to achieve this was via a device like "The Stick," which picked up phone calls, detected the presence of a fax or modem carrier, and directed the call to different ports as a result. These types of "lightweight switches" produce some interesting opportunities for phone phreaking. With the popular Stick, for example, DTMF sent immediately after pickup can be used to force it to direct the call to a different port. This can reveal devices like modems that otherwise don't "pick up."

The whole reason I personally know about The Stick is that I've seen it used for remote programming modem access to the access control system in two different buildings. There are obvious security implications of this practice.

How Analog Hides Out

So how do organizations that make a switch to IP support these existing analog telephone devices? To some readers it might seem obvious that an ATA (analog telephone adapter) could be used to connect them directly to an IP phone system. In some cases this is true. But it's important to understand that many VoIP systems use speech codecs that do not preserve enough bandwidth for digital signaling to work. This is most commonly encountered in the case of fax machines: a fax machine naively

connected to VoIP via an ATA will likely work unreliably or not at all, depending on the codec selected for the call.

Instead, legacy analog devices are often supported by just keeping conventional telephone service. In a way this is a good solution, since some of these devices are safety or security related, and the telephone network is operated to a higher standard for reliability than most corporate networks. On the other hand, this can become a real headache when a PABX is in use. Although a somewhat extreme example (this was a very large organization with many legacy devices) I have seen one case of an entire 5ESS kept in service basically for analog (and some ISDN) cruft. This is a telephone switch of a scale that it has a staff, albeit now a small one. More commonly, there are definitely some smaller PABX systems that remain installed in commercial buildings to support fire and access control applications. There may be few people with knowledge of these switches and how they're configured.

Well, that was sort of a grab bag of topics but I hadn't written for a while and it was on my mind. I'm in the midst of a remodeling project and life is hectic in general at the moment, so I'm probably going to be following up with some more posts on odd topics. For example, I'm thinking a lot about thermostats right now, and I expect to write a bit on the curious world of HVAC control signaling.