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Like many people in my generation, my memories of youth are heavily defined by cable television. I was fortunate enough to have a *premium* cable package in my childhood home, Comcast's early digital service based on Motorola equipment. It included a perk that fascinated me but never made that much sense: Music Choice. Music Choice was around 20 channels, somewhere in the high numbers, of still images with music. It was really ad-free, premium radio, but in the era before widespread adoption of SiriusXM that wasn't an easy product to explain. And SiriusXM, of course, has found its success selling services to moving customers. Music Choice was stuck in your home. The vast majority of Music Choice customers must have had it only as part of a cable package, and part of it that they probably barely even noticed.

This kind of thing seems to happen a lot with consumer products: a little-noticed value-add that starts a rabbit hole into the history of consumer music technology. Music Choice is an odd and, it seems, little-loved aspect of premium cable packages, but with a history stretching back to 1987, it also claims to be the first consumer digital music streaming technology... and I think they're even right about that claim.

The '80s was an exciting time in consumer audio. The Compact Disc was becoming the dominant form of music distribution, and CDs offered a huge improvement in sound quality. Unlike all of the successful consumer audio formats before it, CDs were digital. This meant no signal noise in the playback process and an outstanding frequency response.

Now, some have expressed surprise at the fact that CDs were a digital audio format and yet weren't recognized as a practical way to store computer data for years after. There are a few reasons for this, but one detail worth remembering is that audio playback is a fairly fault-tolerant application. Despite error correction, CD players will sometimes fail to decode a specific audio sample. They just skip it and move along, and the problem isn't all that noticeable to listeners. Of course this kind of failure is much more severe with computer data and so more robust error tolerance was needed.

That's a bit besides the point except that it illustrates a very convenient property of music as an application for digital storage and transmission: it's inherently fault tolerant, and digital decoding errors in audio can come off much the same way that noise and other playback faults did with analog formats. Music is a fairly comfortable way to try the waters of digital distribution, and the CD was a hugely successful experiment. Digital audio became an everyday experience for many consumers, and suddenly analog distribution formats like radio were noticeably inferior.

It was quite natural that various parts of the consumer electronics industry started to investigate digital radio. Digital radio has a troublesome history in the United States and has only really seen daylight in the form of the in-band on-channel HD Radio

protocol, which I have discussed previously. HD Radio launched in 2002, so it was a latecomer to the radio scene (probably a big part of its lackluster adoption). Satellite radio, also digital, didn't launch until 2001. So there was a wide gap, basically all of the '90s, where consumers were used to digital audio from CDs but had no way of receiving digital broadcasts.

This was just the opportunity for Jerrold Communications.

Jerrold Communications is not likely to be a name you've heard before, despite the company's huge role in cable TV industry. Jerrold was a very early cable television operator and developed a lot of their own equipment. Eventually, equipment (head end transmitters and set-top boxes) became Jerrold's main business, and most of the modern technological landscape of cable TV has heritage in Jerrold designs. The reason you've never heard of them is because of acquisitions: in 1967, Jerrold became part of General Instrument. In 1997, General Instrument fractured into several companies, and the cable equipment business was purchased by Motorola in 2000. In 2012, the Motorola business unit that produced cable equipment became part of ARRIS. In 2019, ARRIS was acquired by CommScope, ironically one of the other fragments that spun off of General Instrument in '97.

What matters to us is that, for whatever reason, General Instrument continued to use the Jerrold brand name on some of their cable TV products into the '90s [1].

In 1987 Jerrold announced their new "Digital Cable Radio," which apparently had pilot installations in Deland FL, Sacramento CA, and Willow Grove PA. They expected expanded service in 1989.

In fact, Jerrold was not alone in this venture. At the same time, International Cablecasting Technologies announced its similar service "CD-8" (it's like having eight CD players, seems to have been the explanation for this name, which was later changed to CD-18 to reflect additional channels before they dropped the scheme). CD-8 launched in Las Vegas, and we will discuss it more later, as it survived into the 21st century under a different name. Finally, a company called Digital Radio launched "The Digital Radio Channel" in Los Angeles.

All three of these operations were discussed together in a number of syndicated newspaper pieces that ran in 1987 to present the future of radio. They reflect, it seems, just about the entire digital radio industry of the '80s.

Digital Radio, the company, is a bit of a mystery. Perhaps mostly due to their extremely generic name, it's hard to find much information about the company or its fate. Los Angeles had a relatively strong tradition of conventional cable radio (meaning analog radio delivered over cable TV lines), so it may have helped The Digital Radio Channel gain adoption even without the multi-channel variety of the competition. My best guess is that Digital Radio of California did not survive long and failed to expand out of the LA market. I have so far failed to find any advertisements or press mentions after 1987, and the press coverage in '87 was extremely slim.

This left us with two late-'80s competitors for the new digital cable radio market: Jerrold's "Digital Cable Radio" and ICT's "CD-8." Both of these services worked on a very similar basis. A dedicated set-top box would be connected to a consumer's cable line, either with a passive splitter or daisy-chained with the television STB. The STB functioned like a radio tuner for a component stereo system, allowing the listener to select a channel which was then sent to their stereo amplifier (or hi-fi receiver, etc) as analog audio. CD-8 went an impressive step beyond Digital Cable Radio, offering a

remote with a small LCD matrix display that showed the artist and track title (this was apparently an added-cost upgrade).

I have seen mention that the STBs for these services cost around $100. That's $270 in today's so-called money, not necessarily unreasonable for a hi-fi component but still no doubt a barrier to adoption. On top of that, neither service seems to have been bundled with cable plans. Instead, they were separate subscriptions. Monthly subscriptions seem to have been in the range of $6-8, reasonably comparable to SiriusXM subscriptions today. But once again we have to ponder the customer persona.

SiriusXM is a relatively obscure service but still runs a reasonable profit on the back of new cars with bundled plans, long-haul truckers, and business jet pilots (SiriusXM has a live weather data service that is popular with the business aviation crowd, besides the ability to offer SiriusXM music to passengers). In other words, satellite radio is attractive to people who are in motion, especially since the same channels are available across different radio markets and even in the middle of nowhere (except underpasses). I'm not sure I'll renew my SiriusXM service once I get onto normal post-promotion rates, but still, there is undeniably something magical about SiriusXM working fine in a canyon in the Mojave desert when I have no phone service and Spotify has mysteriously lost all of my downloaded tracks again.

I'm unconvinced that digital audio quality is really that much of a selling point to most SiriusXM customers. Instead, the benefit is coverage: even "in town" here in Albuquerque, SiriusXM offers more consistent coverage than many of the commercial radio stations that have seen some serious cost-cutting in their transmitter operations. But digital radio over cable television doesn't move... it's only available in the home. I don't think a lot of people ever signed up for it as a dedicated subscription.

Still, the industry marched on. By 1990, The Digital Radio Channel seems to have disappeared. But there is some good news: Jerrold's Digital Cable Radio is still a contender and now offers 17 channels. CD-8 has been rebranded as CD-18 and then rebranded again as Digital Music Express, or DMX. And there is a new contender, Digital Planet. It is actually possible, although I don't find it especially likely due to the lack of mentions of this history, that Digital Planet is the same company as Digital Radio. It also operated exclusively in Los Angeles, but had an impressive 26 channels.

Let's dwell a little more on DMX, because there is something interesting here that represents a broader fact about this digital cable radio industry. CD-8, later CD-18 (or CD/18 depending on where you look), was launched by International Cablecasting Technologies or ICT. Based on newspaper coverage in the 1990s, it quickly became apparent that DMX's best customers were businesses, not consumers. In 1993, DMX cost consumers $4.95 a month (plus $5 a month in equipment rental if the customer did not buy the set-top box outright for $100). Businesses, though, paid $50-75 a month for a DMX appliance that would provide background music from specially programmed channels. DMX was a direct competitor to Muzak, and by the late '90s one of the biggest companies in the background music market.

Background music makes a whole lot more sense for this technology. There's a long history of "alternative" broadcast audio formats, like leased telephone lines and FM radio subcarriers, being used to deliver background music to businesses. Muzak had a huge reputation in this industry, dating back to dedicated distribution wiring in the 1930s, but by the 1980s was increasingly perceived as stuffy and old-fashioned. Much of this related to Muzak's programming choices: Muzak was still made up mostly of easy-listening covers of popular tracks, hastily recorded by various contracted bands. DMX, though, offered something fresh and new: the popular tracks, in their original

form. Even better, DMX focused on the start on offering multiple channels, so that businesses could choose a genre that would appeal to their clients. There was smooth jazz for dentists, and rock and roll for hip retailers. The end of "elevator music" as a genre was directly brought about by DMX and its contemporary background music competitor, AEI.

Several late-'90s newspaper pieces describe the overall competitive landscape of background music as consisting of Muzak, DMX, and Audio Environments Inc (AEI). Unsurprisingly, given the overall trajectory of American business, these three erstwhile competitors would all unify into one wonderful monopoly. The path there was indirect, though. Various cable carriers took stakes in DMX, and by the late '90s it was being described as a subsidiary of Turner Cable and AT&T. Somehow, the details are stubbornly unclear, DMX and AEI would join forces in the late '90s. By 2000 they were no longer discussed as competitors. I have really tried to figure out what exactly happened, but an afternoon with newspaper archives has not revealed to me the truth. Here is speculation:

AEI appears to have used satellite distribution for their background music from the start, while DMX, born of the cable industry, relied on cable television. In the late '90s, though, advertorials for DMX start to say that it is available via cable *or* satellite. I believe that at some point in '98 or '99, DMX and AEI merged. They unified their programming, but continued to operate both the cable and satellite background music services under the DMX brand.

For about the next decade, the combined DMX/AEI Music would compete with Muzak. In 2011-2012, Canadian background music (now usually called "multisensory marketing") firm Mood Media bought both Muzak and DMX/AEI, combining them all into the Mood Media brand. This behemoth would enjoy nearly complete control of the background music industry, were it not for the cycle of technology bringing in IP-based competitors like Pandora for Business. Haha, no, I am kidding, Pandora for Business is also a Mood Media product. This is the result of essentially a licensing agreement on the brand name; Pandora itself is a SiriusXM subsidiary. Pandora for Business is a wholly different product sold by Mood Media "in partnership with" Pandora, and seems to be little more than a rebranding of the DMX service to match its transition to IP. Actually SiriusXM and DMX used to have shared ownership as well (DMX/AEI, by merger with Liberty Media, had half ownership of SiriusXM, as well as Live Nation concert promoting, Formula One racing, etc), although they don't seem to currently. The American media industry is like this, it's all just one big company with an aggressive market-segment brand strategy.

So what about those set-top boxes, though? Digital Cable Radio and DMX both relied on special hardware, while the service of my youth did not. Well, the problem doesn't seem to have so much been the special hardware as the whole concept of a separate subscription for digital cable radio. By the end of the '90s, Jerrold and DMX were both transitioning to the more traditional structure of the cable TV industry. They sold their product not to consumers but to cable carriers, who then bundled it into cable subscriptions. This meant that shipping users dedicated hardware was decidedly impractical, but the ATSC digital cable standard offered a promising new approach.

This might be surprising in terms of timeline. ATSC wasn't all that common over-the-air until the hard cutover event in 2009. This slow implementation was a result of the TV tuners built into OTA consumers televisions, though. Cable companies, since the genesis of cable TV, had been in the habit of distributing their own set-top boxes (STB) even though many TVs had NTSC (and later ATSC) tuners built-in. Carrier-provided STBs were a functional necessity due to "scrambling" or encryption of cable channels, done first to prevent "cable theft" (consumers reconnecting their cable drop to the distribution

amplifier even though they weren't paying a bill) and later to enable multiple cable rate tiers.

The pattern of renting STBs meant that cable carriers had a much greater degree of control over the equipment their customers would use to receive cable, and that allowed the cable industry to "go digital" much earlier. The first ATSC standard received regulatory approval in 1996 and spread relatively quickly into the cable market after that. By the end of the '90s, major carriers like Comcast had begun switching their customers over to digital ATSC STBs, mostly manufactured by Motorola Mobility Home Solutions---the direct descendent of Jerrold Communications.

Digital cable meant that everything was digital, including the audio. Suddenly a "digital cable radio" station could just be a normal digital cable station. And that's what they did: Jerrold and DMX both dropped their direct-to-consumer services and instead signed deals to distribute their channels to entire cable companies. Along with this came rebranding: Jerrold's Digital Cable Radio adopted the name "Music Choice," while DMX kept the DMX name for some carriers and adopted the brand "Sonic Tap" for at least DirecTV and possibly others.

As an aside, Sonic Tap's twitter account is one of those internet history gems that really makes me smile. Three tweets ever, all in one day in 2013. Follows DirecTV and no one else. 33 followers, a few of which even appear to be real. These are the artifacts of our contemporary industrialists: profoundly sad Twitter profiles.

Music Choice had always enjoyed a close relationship with the cable industry. It was born at General Instrument, the company that manufactured much of the equipment in a typical cable network, and that ownership transitioned to Motorola. As Music Choice expanded in the late '90s and '00s, it began to give equity out to cable carriers and other partners in exchange for expanded distribution. Today, Music Choice is owned by Comcast, Charter, Cox, EMI, Microsoft, ARRIS (from Motorola), and Sony. Far from its '80s independent identity, it's a consortium of the cable industry, maintained to provide a service to the carriers that own it. Music Choice is carried today by Comcast (Xfinity), Spectrum, Cox, Verizon, and DirecTV, among others. It is the dominant cable music service, but not the only!

A few cable companies have apparently opted to side with Stingray instead. Stingray has so far not featured in this history at all. It's a Canadian company, and originated as the Canadian Broadcasting Corporation's attempt at digital cable radio, called Galaxie. I will spare a full corporate history of Stingray, in part because the details are sort of fuzzy, but it seems to be a parallel story to what happened in the US. Galaxie eventually merged with competing service Max Trax, and then the CBC seems to have divested Stingray (which had operated Galaxie as a subsidiary of the CBC). In the late 2010s, Stingray started an expansion into the US. Amusingly, Comcast apparently delivered Stingray instead of Music Choice for several years (despite being part owner of Music Choice!). Stingray does seem to still exist on a handful of smaller US cable carriers, although the company seems invested in a switch to internet streaming.

Cable is dying. Not just because of the increasing number of "cord cutters" abandoning their $80 cable bill in favor of $90 worth of streaming subscription services, but because the cable industry itself is slowly abandoning ATSC. In the not too far future, conventional cable broadcasting will disappear, replaced by "over the top" (OTT) IPTV services like Xfinity Flex. This transition will allow the cable carriers full freedom in bandwidth planning, enabling DOCSIS cable internet to achieve the symmetric multi-Gbps speeds the protocol is capable of [2].

Consumers today get virtually all of their music over IP. The biggest competitor to Music Choice is Spotify, and the two are not especially comparable businesses. The "linear broadcast" format seems mostly dead, and while Music Choice does offer on-demand services, it will probably never get ahead of the companies that started out with an on-demand model. That's sort of funny, in a way. The cable industry and advanced ATSC features especially introduced the on-demand content library concept, but the cable industry is far behind the companies that launched with the same idea a decade later... but with the benefit of the internet and agility.

It's sad, in a way. I love coaxial cable networks, it's a fascinating way to distribute data. I am a tireless defender of DOCSIS, constantly explaining to people that we don't need to eliminate cable internet---there's no reason to, DOCSIS offers *better* real-world performance than common PON (optical) internet distributive systems. What we need to get rid of is the cable *industry*. While giants like Comcast do show some signs of catching up to the 21st century, they remain legacy companies with a deeply embedded rent-seeking attitude. Major improvements to cable networks across the country are underway, but they started many years too late and proceed too slowly now, a result of severe under-investment in outside plant.

I support community internet, I'm just saying that maybe, just maybe, municipal governments would achieve far more by ending cable franchises and purchasing the existing cable plant than by installing new fiber. "Fiber" internet isn't really about "fiber" at all. "Fiber" is used as a political euphemism for "not a legacy utility" (somewhat ironic since one of the largest fiber internet providers, Verizon FiOS, is now very much a legacy utility). In fact, good old cable TV is a remarkably capable medium. It brought us the first digital music broadcasting. It brought us the first on-demand media streaming. Cable is now posed to deliver 5Gbps+ internet service over mostly existing infrastructure. The problem with cable internet is not technical; it's political. Send me your best picket signs for the cable revolution.

[1] The history here is a little confusing. It seems like GI mostly retired the Jerrold name as GI-branded set-top boxes are far more common than Jerrold ones. But for whatever reason, when GI launched their cable digital radio product in 1987, it was the Jerrold name that they put on the press releases.

[2] Existing speed limitations on DOCSIS internet service, such as the 35Mbps upload limit on Xfinity internet service in most markets, are a result of spectrum planning problems in the cable network rather than limitations in DOCSIS. DOCSIS 3.1, the version currently in common use, is easily cable of symmetric 1Gbps. DOCSIS 4.0, currently being introduced, is easily capable of symmetric 5Gbps. The problem is that upstream capacity in particular is currently limited by the amount of "free space" available outside of delivering television channels, a problem that is made particularly acute by legacy STBs (mostly Motorola branded, of Jerrold heritage) that have fixed channel requirements for service data like the program guide. These conflict with DOCSIS 3.0+ upstream channels, such that DOCSIS cannot achieve Gbps upstream speed until these legacy Motorola STBs are replaced. Comcast has decided to skip the ATSC STB upgrade entirely by switching customers over to the all-IP Flex platform. I believe they will need to apply for regulatory approval to end their ATSC service and go all-IP, so this is probably still at least a few years out.