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### 2021-07-07 dial 1 800 flowers dot com

A note: Apologies for the long time without content, I have been on a road trip across the southwest and have suffered from some combination of no internet and no motivation. Rest assured, I am back now.

A second note: apologies that computer.rip was down for a half day or so, there was a power interruption at the datacenter and as a Professional DevOps Engineer I am naturally incredibly haphazard about how I run my personal projects. There was a problem with the fstab and the webserver didn't nfs mount the Enterprise Content Management System directory of text files when it rebooted.

You've gathered by now that I'm interested in telephone numbers, and we have to date discussed the basic structure of phone numbers in the NANP, premium rate ("900 numbers"), and some special purpose exchange and NPAs (555, 700, etc). As promised, it's time to come back around to talk about the best known special-purpose NPAs: toll-free numbers.

Toll-free are commonly referred to as 1-800 numbers, although this is a bit anachronistic as toll-free telephone numbers in NANP now span 800, 888, 877, 866, 855, 844, 833, and they'll get to 822 before you know it. Originally, though, they were all in the 800 NPA, and it's said that there is still a degree of prestige conferred upon actual 800 numbers. There's not a lot of actual reason for this, as while 800 numbers are in relatively short supply there are still many fly-by-night operations that hold them. In the end, though, toll-free numbers today serve almost purely as prestige devices because the majority of consumers are using cellular phones with unlimited long-distance calling, and so the number called barely even matters.

Let's teleport ourselves back in time, though, to the wild past of the early '60s. Direct dialing was becoming the norm, even for long distance calls. The majority of telephone owners, though, paid for calls in two basic tiers: calls to the local calling area are effectively free (included in the normal monthly rate for the line), while calls to outside of the local calling area were charged per minute at a stupidly high rate.

This whole issue of "local calling area" is a surprisingly complex one, and perhaps the simplest answer to "what is a local calling area" is "whatever your phone company tells you when you ask, and maybe specified in the front of the phone book." The local calling area in cities sometimes coincided with the NPA (e.g. all calls within the same area code were local), but this was not at all guaranteed and there were many, many exceptions.

The local calling area is better defined in terms of *rate centers*. A rate center is a

geographical area that serves as the smallest organizational unit for telephone tolling purposes. A call to another person within the same rate center will be a local call. A call to another person in a different rate center could be either local or long-distance (toll), depending on the carrier's definition of the local calling area for your rate center. This typically depended on the geography. Further complicating things, the local calling area was not necessarily the same across telephone users within any given person's local calling area.

Let's work an example: You live in Hillsboro, Oregon, so you are in the Beaverton, OR rate center (RC). Beaverton RC has local calling to the Portland, OR rate center. I live in Oregon City, OR, which is in the Clackamas, OR rate center. Clackamas RC has local calling to Portland. We can both call our friend in Portland and it will be a local call. Our friend in Portland can similarly call both of us, as the Portland RC has both Beaverton and Clackamas in its local calling area.

However... Beaverton does not have Clackamas in its local calling area, and neither does Clackamas have Beaverton. To call each other directly would be a long-distance call [1]. This makes some intuitive sense as the distance between the suburbs and the city is smaller than the distance between two suburbs on different sides, and of course residents of the suburbs call residents of the city frequently. However, it has some odd results.

A phone number in the Portland RC is a *better phone number* than one in Beaverton or Clackamas, because it has a better local calling area: all of the suburbs, rather than just the city and the suburbs to one side.

This is a common situation. Rate centers which are major cities or in general more populous areas are more desirable, because they are local calls for more prospective customers. The problem is that back in the '60s you didn't really get to shop around for a rate center, it was just determined based on wherever your point of service was. This placed businesses based in suburbs at an inherent disadvantage: for people on the other side of town, they would be a long distance call.

The first major method of improving this situation was simply moving one's point of service into the city. One common method was the use of an answering bureau. A business in Beaverton could hire an answering bureau in Portland and list it as their contact number. It would be a local call for all prospective customers, and the business could return calls to customers at their expense. This came at the obvious downside that customers would always have to leave a message when they called, which was irritating--although answering bureaus were very common at the time, especially since prior to mobile phones many small businesses that worked "in the field" (tradespeople for example) would not have anyone in the office to answer calls most of the time.

A later and more complex solution was the use of a *foreign exchange service*, also called FXS. Under the FXS arrangement, a business in Beaverton would pay the telephone company to essentially run a miles-long jumper from their local loop in a Beaverton exchange to an exchange in Portland. This effectively "moved" their phone service to the Portland office and the Portland rate center. Early FXS were literally this simple, with the telco using a spare pair on a long distance line to splice the customer's line to a line at the other exchange. This service was expensive and has fallen out of use, although the terminology FXS and FXO (which originated as a description for the two ends of an FXS line) have remained stubbornly common in the world of VoIP--analog bridges despite being archaic and confusing [2].

You can see that both of these approaches are unsatisfactory, and there seems to be an obvious solution: businesses should be able to pay more to just expand the local calling area of their phone, without needing awkward hacks like an FXS.

In fact, there had basically been a solution just like this earlier. So-called “Zenith” numbers were special telephone numbers that did not correspond to a normal physical exchange [3]. Instead, when an operator was asked for a Zenith number they understood it to be a special instruction to look up the actual number and connect the call, but if the call was long-distance they would bill it to the callee instead of the caller. This was toll-free dialing just like we have today, but it required manual effort by the operator who, at the time, would fill out billing tickets for calls by hand. The trouble was that this didn’t work at all with direct dialing, the only way to call a Zenith number was to dial zero for the operator and read the number. Customers found this annoying and the telephone companies found it expensive, so there was mutual motivation to find an automated solution.

Although surprisingly janky, a sort of solution was developed quickly for outbound calls: WATS, or Wide Area Telephone Service. WATS was introduced in the early ’60s as a simple scheme where a business could pay a flat monthly rate to add additional rate centers to their local calling area, for the purpose of outbound calling only. This could save a lot of money for businesses with clients or offices in other towns. It seemed obvious that the problem of calling areas and Zenith numbers could best be approached by taking WATS and setting it to suck instead of blow. And that’s exactly what they did.

In 1967, AT&T introduced inward WATS or InWATS. Much like outbound WATS, InWATS allowed a customer to pay a (large) monthly fee to have their number constitute a local call for customers in other rate centers, even nationwide. It was important that consumers understood that these calls would not incur a toll, and for technical reasons it was desirable to be able to route them differently. For this reason, InWATS numbers were assigned to a new NPA: 800.

While InWATS was similar to our modern toll-free system, it had substantial limitations. First, the rates for InWATS numbers were still based on geographical distance to callers, and InWATS customers could choose (in terms of “bands” or “zones”, much like in some transit systems) what distance to pay for. This amusingly maintained the situation where it was worthwhile to strategically place telephone numbers, as an InWATS number in the middle of the country could receive calls from nearly the entire country at a lower rate than an InWATS number located on one of the coasts.

More significantly, though, the technical reality of the phone switching system meant that InWATS was implemented by effectively overlaying the geographical NANP routing system on top of the 800 NPA. For most telephone calls, NPAs identify the physical region of the country to which the call should be routed. For calls to the 800 NPA, the NXX (exchange code) identified the physical area of the country, standing in for the NPA since the NPA was already used to indicate InWATS.

The idea that 800 numbers are “non-geographical” is largely a modern one (and they are not technically “non-geographical” numbers in the sense of 700 and 500). With InWATS, toll-free telephone numbers were still just as geographical as before, just using a second-level “sub-numbering” scheme.

Even more maddeningly, much like WATS before it InWATS handled intrastate and interstate calls completely differently (this was quite simply easier from a

perspective of toll regulation). So InWATS numbers subscribed for interstate use actually did not work from within the same state as the subscriber, creating an incentive to put InWATS services in states with small populations in order to minimize the number of people who needed to use a special local number [4]. Although I do not have direct evidence, I will speculate that the confluence of these factors is a major reason that several major national enterprises have located their customer service centers in Albuquerque.

InWATS was replaced in the '80s by a new AT&T service which took advantage of digital switching to eliminate many of the oddities of InWATS service. The major innovation of "Advanced 800," rolled out in 1982, was the use of a "mapping database" that allowed 800 numbers to effectively be "redirected" to any local number. Because tolling was handled digitally using much more flexible configuration, calls to these 800 numbers could be toll-free for all callers but still redirect to any local number. This completely divorced 800 numbers from geography, but for the most part is surprisingly uninteresting because it was really only a technical evolution on the previous state.

A more fundamental change in the 800 number situation happened later in the '80s, as the breakup of the bell system and related events substantially eroded AT&T's monopoly on telephone service. Competitive long distance carriers like MCI had to be allowed to enter the toll-free service market, which meant that a system had to be developed to allocate toll-free numbers between carriers and allow mapping of toll-free numbers to corresponding local (or actual routing) numbers across carrier boundaries.

Two things happened at once: the simple technical reality of needing to manage toll-free numbers across carriers required a more sophisticated approach, and competitive pressures encouraged AT&T to invest in more features for their toll-free service offering. These changes added up to flexible routing of toll-free calls based on various criteria. Further, while 800 numbers were initially distributed between inter-exchange carriers (IXCs, like AT&T, MCI, Sprint, etc) based on number allocation ranges, the inherent "stickiness" of toll-free numbers posed a challenge. Toll-free numbers are often widely published and used by repeat customers, so businesses do not want to change them. This prevents a competitive carrier trying to win their business away, and created a desire for number portability much like had been achieved for local numbers.

This issue broke for toll-free numbers basically the same way it did for local numbers. The FCC issued an order in 1993 stating that it must be possible to "port" toll-free numbers between inter-exchange carriers. Unlike local numbers, though, there was no inherent or obvious method of allocating toll-free numbers (the former geographical and carrier mappings were not widely known to users). This encouraged a completely "open" approach to toll-free number allocation, with all users pulling out of a shared pool.

If this sounds a touch like the situation with DNS, you will be unsurprised by what happened next. A new class of entity was created which would be responsible for allocating toll-free numbers to customers out of the shared namespace, much like DNS registrars. These were called Responsible Organizations, which is widely shortened to RespOrgs.

The post-1993 system works basically like this: a business or other entity wanting a toll-free number first requests one from a RespOrg. The RespOrg charges them a fee and "assigns" the telephone number to them by means of reserving it in a shared database called SMS/800 (the SMS here is Service Management System, unrelated to the

other SMS) [5]. The RespOrg updates SMS/800 to indicate which inter-exchange carrier the toll-free number should be connected to. Whenever a customer calls the toll-free number, their carrier consults SMS/800 to determine where to connect the call. The inter-exchange carrier is responsible for routing it from that point on.

In practice, this looks much simpler for many users as it's common (particularly for smaller customers) for the RespOrg to be the same company as the inter-exchange carrier. Alternately, it might be the same company or a partner of a VoIP or other telephone service provider. Many people might just use a cheap online service to buy a toll-free number that points at their local (mobile or office perhaps) number. They don't need to know that behind the scenes this involves a RespOrg, an inter-exchange carrier, and routing within the inter-exchange carrier and service provider to terminate the call.

The situation of DNS registrars has been subject to some degree of abuse or at least suspicious behavior, and the same is true of RespOrgs. It is relatively easy to become a RespOrg, and so there's a pretty long list of them. Many RespOrgs are providers of various types of phone services (carriers, VoIP, virtual PBX, etc.) who have opted to become a RespOrg to optimize their ability to assign toll-free numbers for their customers. Others, though, are a bit harder to explain.

Perhaps the most infamous RespOrg is a small company called PrimeTel. War-dialers and other telephone enthusiasts have long noted that, if one dials a selection of random toll-free numbers, you are likely to run into a surprising number of identical recordings. Often these are phone sex line solicitations, but sometimes they're other types of content that is uninteresting except for the fact that it appears over and over again on large lists of telephone numbers. These phone numbers all belong to PrimeTel.

Many words have been devoted to the topic of PrimeTel and most notably an episode of the podcast Reply All. I feel much of the mystique of the issue is undeserved, though, as I believe that one fact makes PrimeTel's behavior completely intuitive and understandable: 47 CFR § 52.107 forbids the hoarding of toll-free numbers.

That is, toll-free numbers are a semi-limited resource with inherent value due to scarcity, particularly those in the 800 NPA as it is viewed as the most prestigious (unsurprisingly, PrimeTel numbers are more common in 800 than in other NPAs). This strongly suggests that it should be possible to make money by speculatively registering toll-free numbers in order to resell them, as is common for domain names. However, the FCC explicitly prohibits this behavior, largely by stating that toll-free numbers cannot be held by a RespOrg if there is not an *actual customer* for which the number is held.

So PrimeTel does something that is pretty obvious: in order to speculatively hold toll-free numbers, it acts as customer for all of those numbers.

Since it's hard to come up with a "use" for *millions* of phone numbers, PrimeTel settles for simple applications like sex lines and other conversation lines. It helps that PrimeTel's owners seem to have a historic relationship to these kinds of operations, so it is a known business to them. Oddly, many of the PrimeTel "services" don't seem to actually work, but that's unsurprising in light of the fact that PrimeTel is only interested in the numbers themselves, not in making any profit from the services they connect to. From this perspective, it's often better if the services don't work, because it reduces PrimeTel's expenses in terms of duration that callers stay on the line.

The case of PrimeTel is often discussed as an egregious example of speculating on (often called warehousing) toll-free numbers, although they are not the only RespOrg accused of doing so. The surprising thing is that the FCC has never taken action against PrimeTel, but, well, the FCC has a reputation for never taking action on things.

Ultimately the impact is probably not that large. It's easy to obtain toll-free numbers in the "less popular" toll-free NPAs such as 844. I have observed that some telecom vendors have zero availability in 800, but that seems to come down to a limitation of the RespOrg relationships they have as the VoIP trunk vendor I use (which is itself a RespOrg) consistently shows tens of 800 numbers available. I tend to like 888s, though. 800 wouldn't get you anything on a slot machine.

In a future post, I will dig a little more into the issue of number portability as it's a major driver of some of the complexity in the phone system. Another topic adjacent to this that bears further discussion is the competitive inter-exchange carriers, which are a major part of the broader story of telephone and technology history.

[1] I had originally tried to construct this example in New Mexico, but this state is so sparsely populated that there are actually very few situations of this type. The Albuquerque RC spans nearly the entire central region of the state, and essentially all calls between RCs are long-distance calls in NM. NM still illustrates oddities of the distance tolling scheme, though, as there are rate centers that clearly reflect history rather than the present. Los Alamos and White Rock are different rate centers despite White Rock being effectively an annexed neighborhood of Los Alamos. They each have each other in their local calling areas.

[2] A related concept to an FXS line was the DISA, or Direct Inward System Access. A DISA was a system, typically a feature of a key system or PBX, that allowed someone calling into a phone system to be connected to an outside line on that same phone system. This made it so that an employee of a company in Portland, at home in Beaverton, could call the Portland office and then access an outside line to make a call... from the Portland rate center. A number of businesses installed these because they could save money on calling between offices (by "bouncing" calls through a city office to avoid long-distance tolls), but as you can imagine they were highly subject to abuse. I used to run a DISA on a telephone number in the Socorro rate center so that I could use "courtesy" local-only phones on the college campus to make long distance calls (at my expense still, but that expense was miniscule and it was useful when my phone was dead).

[3] Why Zenith? The answer is fairly simple. The letter Z was sufficiently rare as the start of a word that it was not included on most telephone dial labels. So, in the time when direct-dialing of calls was done by using the first letters of the exchange name, a customer seeing a "ZENith" number would quickly realize that "ZE" was not something they could dial, which would direct them to call the operator. By the same token, of course, there are not many words to use as exchange names that satisfy this requirement, so Zenith became pretty standard.

[4] This situation somewhat persists today in an odd way. Toll free numbers cannot be the recipients of collect calls, but there is no international toll free scheme. Take a look at the back of your credit card, most major banks will list a toll-free number for use within the US, but a *local* number for international use, because they will accept collect calls on that number. International toll-free calling remains an unsolved problem except that the internet is increasingly eliminating the need.

[5] SMS/800 is actually operated by a company called Somos, under contract for the FCC. Somos is also currently the NANP Administrator (NANPA), meaning it is responsible for managing the allocation of NPAs and other elements of administering NANP. There's a whole little world of the "telephone-industrial complex." For example, the role of NANPA formerly belonged to a company called Neustar, formerly a division of Lockheed Martin, which still manages cross-carrier systems such as the STIR/SHAKEN certification authority. Neustar has hired executives away from SAIC/Leidos which has had critical roles in both telephone and internet administration at various points. The whole world of grift on the DoD is tightly interconnected and extends well to grift on other federal agencies.