ZipDX®

April 28, 2014

Via ECFS

Marlene Dortch
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

Re: WC Docket 13-39, *Rural Call Completion NPRM* and DA 14-526

Dear Ms. Dortch:

I submit these comments in response to the WCB's recent call for comment on clarification of Appendix C of the RCC order.

I thought it might be instructive to provide some "real life" data regarding network signaling in attempt to shed light on how problematic it can be to distinguish among "ring-no-answer," "busy" and otherwise failed calls.

ZipDX is not a carrier, but we do place and receive quite a few telephone calls via our carrier partners and other providers.

We reviewed signaling data for thousands of recently-placed outbound calls. In this analysis, we looked first ONLY at calls that were actually ANSWERED.

Our statistics on these recent calls is consistent with what we have seen for years: in a large number of cases, even though a call was ultimately answered, it was never signaled, prior to answer, that it was "ringing."

Segmenting the data according to the carrier we selected for the outbound call, we find:

- Carrier A: 97.0% of calls were answered; of those, 41% never signaled ringing
- Carrier B: 97.2% of calls were answered; of those, 82% never signaled ringing
- Carrier C: 95.9% of calls were answered; of those, 63% never signaled ringing
- Carrier D: 95.1% of calls were answered; of those, 30% never signaled ringing

Note that in this sample, the universe of called destinations was nearly identical for all four carriers (we were not doing route selection based on called number), and the percentage of calls answered (which is what we are most concerned about operationally) was fairly consistent (but not as close as we might like).

If we never get a "ringing" indication for a call, and it were then to go unanswered, there is no way to know if the call was "ring-no-answer" or if it failed to actually get through to the called destination.

The data raises at least two questions:

1) Why are so many (otherwise successful) calls failing to signal ringing?
2) Why is there such tremendous variation in signaling from one carrier to another?

The answers to these questions are complex, but a big part of both answers is because the signaling ACTUALLY EXPERIENCED IN THE NETWORK is often not exactly according to the specification or textbook or even Wikipedia.

According to the specs, a digitally-signaled call SHOULD look something like what is shown in the table below (some ACK-type messages are omitted and other variants are possible). I've included ISDN, because many business calls terminate to PBX's which are then responsible for returning the ringing indication.

	SS7	SIP	ISDN
1. Caller Places Initial Call	→INITIAL ADDRESS MESSAGE	→INVITE	→SETUP
2. Network is Processing Call	←CALL PROGRESS	←100 TRYING, 183 SESSION PROGRESS	←CALL PROCEEDING
3. Far end is ringing	←ADDRESS COMPLETE	←180 RINGING	←ALERTING
4. Far end answers	←ANSWER	←200 OK	←CONNECT
5. Either end hangs up	→/←RELEASE	→/←BYE	→/←DISCONNECT

The table looks very deterministic and ideally everything would work as shown (more or less; there may be some oversights – hopefully minor – in my summarization). However…

The PSTN is a “network of networks.” This is similar to the Internet, which is also described using that phrase. In the Internet, all the networks use the Internet Protocol, so messages flow fairly seamlessly between the networks. However, in the PSTN, there are many protocols in use: the three in the table above, plus other “legacy” protocols.

Because the protocols are different, they have to be “interworked” when call signaling is handed back and forth between networks. According to our table, interworking should be fairly straightforward and consistent between these three protocols. But each protocol is more complex than what is shown here (with many “information elements” or “headers” or other morsels of data underneath the basic messages shown in the table). Different equipment will interwork in different ways, and network operators can also configure their equipment (either accidentally or on purpose) to invoke specific interworking behavior.

The three protocols in our table all are “out-of-band” protocols, meaning that the messages are sent digitally and are separate from the audio transmissions that we normally think of when we imagine a phone call. However, as the telephone network has evolved over the past hundred-plus years, there’s been the requirement to maintain compatibility with “legacy” protocols, including “in-band” signaling that includes the audio “busy signal” and “ringback signal” that we are used to hearing in our ears.

Imagine a call that digitally signaled all the way from origin to destination via one or more of the three out-of-band protocols in our table (sometimes called “end-to-end-ISDN”). When the originating switch receives back an “address complete” (or similar) message, that originating switch plays to the calling party the familiar ringback tone.

However, if the call is NOT fully digitally signaled (NOT “end-to-end-ISDN”) there may be an indication as part of the digital message at step 2 in our table that “in-band tones or announcements are available” (or, in SIP, “early media”). In this case, the originating switch is expected to cut through to the caller the audio signal from the far end, so that they can hear a ringback tone, or busy tone, or some other announcement which is played from that far end. The digital signaling messages in this case likely will not distinguish between the various call outcome possibilities. The caller will listen, and will decide whether to hang up, or to continue waiting (if they hear ringback) for the call to be answered. Step 3 is SKIPPED in this case.

In this modern era, we would expect virtually call calls to be end-to-end ISDN, wouldn’t we? And yet our call data on page 1 indicates this is often not the case. Without analyzing the specific details for each call, we can’t say for certain why we are seeing so many calls fail to send a proper digital ringing indication. However, there are many possibilities:

- When a call is placed to a business PBX, the ringback signal may come from the PBX. The PBX may be connected to the network via ISDN or SIP (per our table), or it may use some legacy form of connection, including T-1 digital trunks with channel-associated signaling, or analog wink-start trunks, or ground-start trunks. I won't go into all the details (because I don't have the expertise), but with legacy trunking there are more interworking issues and less likelihood of getting the full digital message detail that we would like.

- For certain services, a call may be answered as soon as it is presented, without the answering end ever returning a "ringing" indication; e.g., some calls routed directly to voice-mail.
- When a call is placed to a mobile telephone, there is a whole different set of digital signaling protocols that get invoked and need to be interworked. And there are "policy" decisions that the carriers and the mobile telephone network equipment makers have to resolve: Do we indicate that the mobile phone is ringing when we have actually made over-the-air contact with the mobile terminal and gotten an acknowledgement that it is playing ringing to the subscriber, or do we signal alerting back to the caller at some earlier point (such as when the mobile switching center or base station controller receives the call and starts trying to reach the mobile terminal)?
- Even though the 21st-century network engineer always prefers digital signaling, many MODERN systems still use the legacy "in-band tones or announcements" approach rather than sending a digital ringing/alerting message. There are several reasons for this: the desire to play a distinctive "ring-ring" or "ring-beep" tone to the caller, to let them know that, for example, call-forwarding or call-waiting has been invoked at the called party's end; or to support a feature called "custom ringback" where a customer-selected jingle or tune is played back to the caller.
- The four scenarios just cited all have to do with the terminating end of the call and help answer Question 1 on page 1. But any intermediate carrier (or other provider) involved in the call path can muck up the signaling. Maybe there's a legacy trunking protocol in use between two carriers; or maybe a carrier has misconfigured (again, on purpose or by accident) the interworking function as they go between protocols; or maybe the software or equipment they are using is defective. Or maybe some providers are sending "false ringing" when they shouldn't have (and we just lucked out that the call was actually answered.) These are our best guesses in answering our Question 2 on page 1.

While we wish that call signaling were deterministic per the specs, it just isn't, as demonstrated here with our "simple" example regarding the ringing indication.

Let us now consider in more detail the calls that are NOT answered; these would be the ones of most interest in the RCC situation. Looking at our sample data for thousands of calls, we find (aggregating across all of our providers):

- 3.4% were explicitly signaled as busy
- 32.7% were explicitly signaled as ringing; then we abandoned them after a time-out period
- 19.3% were explicitly signaled with some other failure (e.g., not in service or network failure)
- 2.0% were signaled with a failure AFTER being signaled with ringing (this should not happen)
- 42.6% timed out without any specific digital signaling as to status/cause

The 42.6% category could be busy, ring-no-answer, or other; all with signaling similar to this:

	SS7	SIP	ISDN
1. Caller Places Initial Call	→INITIAL ADDRESS MESSAGE	→INVITE	→SETUP
2. Network is Processing Call	←CALL PROGRESS	←100 TRYING, 183 SESSION PROGRESS	←CALL PROCEEDING
3. Caller eventually gives up	→RELEASE	→ CANCEL	→DISCONNECT

These calls usually have in-band audio information. The signaling alone does not reveal what happened.

From a rule-making standpoint, the FCC is going to have a very difficult time mandating what the "correct" methodology is for tracking certain call states at the messaging level. Yet if you leave it up to the individual carriers, then you are going to get widely varying interpretations and you won't have apples-to-apples data that you can legitimately compare.

But it is also apparent that even if you had everybody interpreting the messages the same way, there are an abundance of situations where you simply CANNOT KNOW from the signaling data what the actual outcome of a call was. This fundamental signaling uncertainty will overwhelm whatever statistical variations you might be trying to discern regarding rural vs. non-rural calls.

Looking at the spreadsheet in Appendix C of the Order, it is apparent that there is a missing column or two. In addition to "Answered," "Busy", "Ring-no-answer" and "Unassigned Number" there should also be a column for "Network Failure" (circumstances such as "all circuits busy" still occur, and are distinct from "User Busy"). This is one of the key things you're looking for regarding RCC. Importantly, there also needs to be a column for "Call was unanswered and we don't know what happened."

The "cause code" suggestions listed in Appendix C are oversimplified; Verizon and Level 3 are correct in raising their concerns.[1] But they have only touched the tip of the iceberg. As stated in the Order and reiterated in the Public Notice: *"the call answer rate is the data point least susceptible to variations in data reporting or to differences in the quality or accuracy of signaling: the called party either answered the call or did not answer the call."* Beyond that, aggregated data is going to be meaningless. And you aren't going to be able to draw many conclusions from the call answer rate alone, for reasons discussed briefly in the Order at paragraph 70. (We would note, additionally, that "false answer supervision" is a known issue in the network and undermines the accuracy of even the call answer rate.)

For these reasons (as well as others) I continue to firmly believe that the data collection mandated in the RCC Order will prove to be mostly ineffective, non-actionable and wasteful. In evaluating the cost/benefit ratio of the Order, the carriers have already complained loudly about the numerator being way too big. I am suggesting that the denominator is also way too small.

Rural citizens, as well as their providers and the telecom ecosystem in general would be better served if the resources were invested in developing efficient, near-real-time methods and systems for quickly investigating and resolving call-completion problems on a case-by-case basis as they are reported.

Obviously, the carriers participating in this docket have signaling data about far more calls than do I, and as carriers, they may have more complete signaling than what I get as a (wholesale) end-user. It would be instructive if some of them would do a quick analysis (my effort took part of a weekend) of whatever sample data they have readily available (e.g., a million recent calls each), to see what sort of numbers they get for the columns in the Appendix C spreadsheet (including the two additional columns I have suggested) – regardless of rural OCN or not. That could serve to support or invalidate my contentions here.

Regards,

David Frankel, CEO
ZipDX LLC
Los Gatos, CA
dfrankel@zipdx.com

[1] Level 3 correctly points out that "answered" calls are determined by receipt of the SS7 ANSWER message, or SIP 200-OK or ISDN CONNECT. Contrary to what Appendix C and Verizon seem to suggest, "Answer" is not determined by "cause codes" but is instead an explicitly signaled event in every relevant protocol.