

Agilent Testing Push-to-talk Over Cellular

Application Note

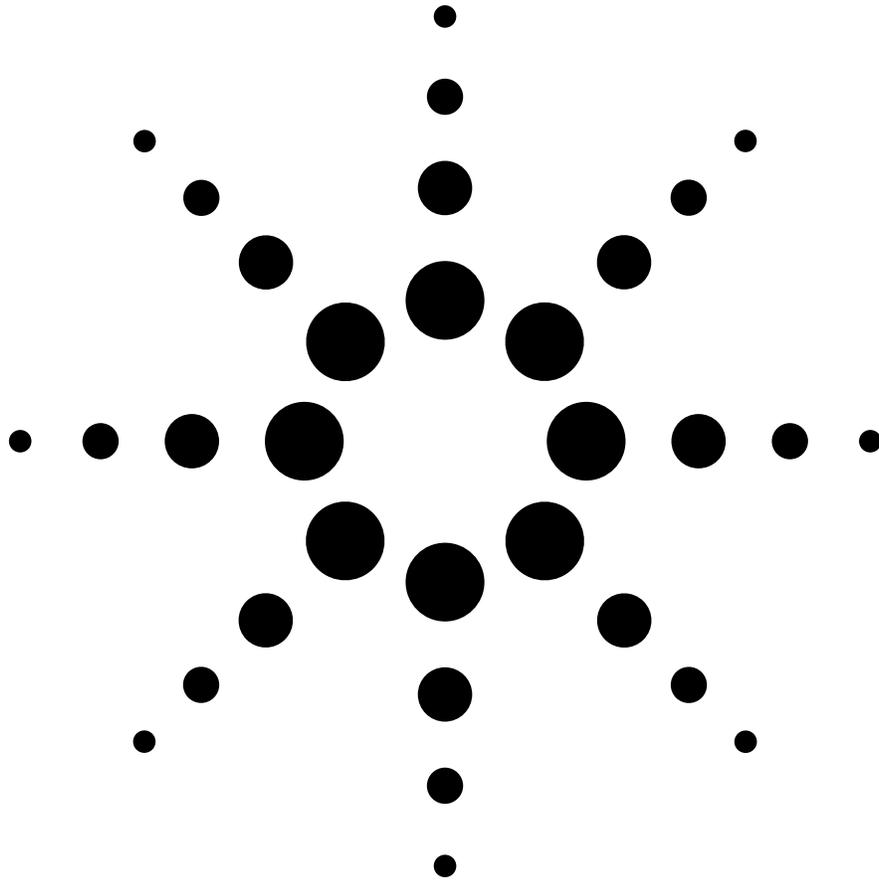


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Introduction

Wireless service providers are counting on push-to-talk over cellular (PoC)—today’s sophisticated version of the walkie-talkie—to have a wide appeal to consumers and business customers. However, PoC has thus far faced the stumbling block of interoperability. Because current PoC services are proprietary, subscribers can’t connect to “buddies” on other mobile networks, and the selection of suitable mobile devices has been limited. What’s more, it’s been left up to the individual service provider to ensure the compatibility of these mobile devices and the network elements that support them.

Thanks to the Open Mobile Alliance (OMA), a unified set of standards now brings together the many, diverse capabilities of push-to-talk (PTT) systems. The new PoC standards have been adopted by the Global Certification Forum (GCF), which has released a suite of conformance tests to which all PoC devices and network elements must comply. Together the standards and tests are meant to ensure that a PoC mobile phone from one manufacturer works with a PoC server on any network. For the first time, cross-network communication, world-wide access, and PoC roaming are possible. This standardization should stimulate an increase in PoC usage and improve revenues from the service.

However, as with any new service, first impressions are critical. Subscribers’ first experiences using PoC will be a major factor in determining the service’s long-term success. Push-to-talk technology employs packet-switched data, half duplexing, and voice over IP (VoIP), and a lot of things can go wrong. Delayed messages, extended connection procedures, lost or delayed packets, dropped connections, poor voice quality—any of these can send subscribers back to existing low revenue, circuit-switched voice connections. To prevent this from happening, thorough testing and debugging of the network elements and user equipment (UE) is a crucial early step.

New Network Elements

Push-to-talk over cellular gives subscribers the ability to talk almost instantaneously to a scattered group of family members, friends, or colleagues all at the same time. Participants can join, leave, and rejoin a session at will.

To implement the service, PoC requires new network elements and functions that will have to comply with the standards.

- *PoC server*, which controls the “floor” allowing only one user at a time in any session to be talking. The PoC server also provides billing information to the service provider.
- *Presence server*, which maintains a list of all users, their availability, and “do not disturb” status.
- *Group and list management function (GLMF)*, which subscribers use to manage groups, contact lists, and access lists. This function initiates fast setup of group sessions, instant talk sessions with users and groups in the contact list, and controls who can initiate group sessions and receive PoC presence information from other users.
- *IMS core*, which handles essential authentication and authorization security features. The IMS core also is responsible for Session Initiation Protocol (SIP) signaling and some elements of billing reporting.

Additionally, while the network requires new functionality, the user equipment (UE) also must have a suitable PoC client installed. In most cases this client is provided by the network hosting the UE, and clients can differ significantly from provider to provider. Although the PoC client usually comes pre-installed on the UE, subscribers may be able to download new versions using *Bluetooth*[®] or other suitable over-the-air (OTA) transport mechanism—for example, multi-media messaging service (MMS). Today’s proprietary PTT clients will most likely have to be updated to operate with new, OMA-compliant PoC services.

Error Sources

To execute a PoC service, the UE packages voice information as IP datagrams. Because the technology is bearer-independent, any high-speed wireless medium—GPRS, EGPRS, W-CDMA, HSDPA, or cdma2000—can be used to transmit the datagrams to a base station.

In the network, IP transmission is protected, so the voice traffic should always get through. However, throughput can be reduced because of poor radio transmission conditions, interruptions during cell transitions, or excessive PoC server traffic, causing some major problems such as fragmented voice traffic. Throughput is also affected by the radio bearer. All of the usable bearer formats have more than enough bandwidth to provide seamless PoC operation; however, if a cell becomes congested, the bandwidth or priority allocated to the PoC user may drop to a level low enough to impair the throughput.

Measuring the quality of PoC therefore requires not just answering basic questions such as “does the phone connect?” and “can I start a PoC session?” It also requires testing the functionality and performance of the UE under conditions in which the RF connection is impaired.

Testing the Links

To test PoC equipment under real-world conditions, we can use the Agilent 8960 Wireless Communications Test Set running the E6701E GSM/GPRS Lab Application. The test set can deliberately impair the downlink by injecting errors into the downlink blocks. It can also lower the cell power to a level close to the UE’s receiver sensitivity inducing receiver block errors.

This setup also can simulate uplink impairment. By sending transmission not-acknowledged messages (NACKs) to the UE even when a transmission has been received correctly, the E6701E can force the UE to re-send blocks of information. Any re-transmission will cause delays, and packets will be sent and received out of order. Thus the overall system performance will be challenged.

Simulating Cell Transitions

We know that traditional circuit-switched voice calls are most challenged when RF conditions are poor, normally at the edge of the cell or during cell transitions. This is true of PoC as well. However, a circuit-switched voice call is virtually continuous across cell transitions, with connection maintained between the UE and at least one base station. Packet-switched data connections such as PoC are not continuous. The UE drops from one cell and attempts to connect to the next cell while the network handles the re-routing of packets in transit through the network. As a result, data packets may be delayed or re-ordered. This behavior, although acceptable for most data downloads, can interrupt real-time voice delivery to an extent that is noticeable to the PoC user.

Testing PoC performance during cell transitions can be a challenge because the conditions are difficult to simulate. It can be done, however, using the E6701E and 8960 combination. In this case a single UE is connected to two 8960 test sets using an RF splitter/combiner, and the relative cell powers and RF transmission properties are set such that the UE is forced to move from one cell to another. Details of this test procedure are contained in the Agilent application note, *Testing Mobile Station Cell Transitions and Handovers*, part number 5989-3949EN.

Signaling Tests

A considerable amount of signaling is required to connect a UE to a PoC server, and even more signaling is needed to start and operate a PoC session. This creates many opportunities for signaling or connectivity errors, which can be extremely difficult to trace and de-bug. The E6701E has a protocol analysis and debug tool, the Wireless Protocol Advisor (WPA), which can log all protocol layers from the RLC/MAC to IP.

Because the lower level signaling should be fully tested by the time PoC is added to a UE, the WPA in this case is used mainly to check connectivity and transmission at the IP layer. WPA can simultaneously log, in a single file, all PoC messaging between two UEs and two test sets. An example of such a log is shown below. The message numbered 21 is an IP datagram sent from one UE (IP address 156.141.106.212) to the PoC server (IP address 156.141.106.48). Message 22 is the same IP datagram being transferred from the server to the second UE (IP address 156.141.106.179).

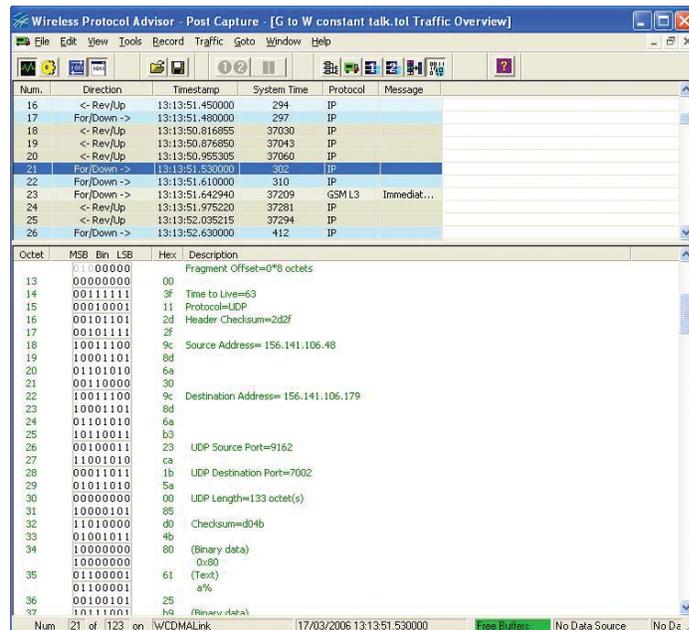
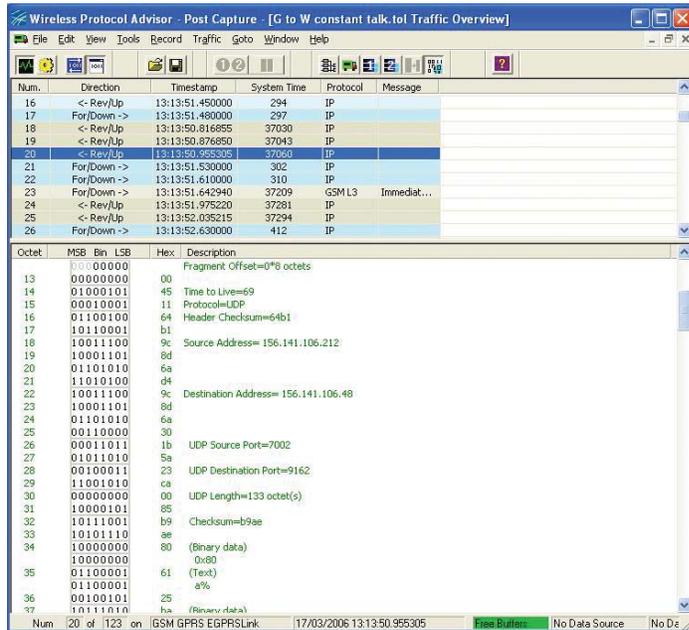


Figure 1. Log of PoC messages

Inter-service Testing

What happens to a PoC session when an incoming circuit-switched voice call is received? In GSM, GPRS, and EGPRS networks, the subscriber is notified of the incoming voice call, and if the call is accepted, the UE suspends (disables) the PoC session and, in the case of a one-to-one session, notifies the second person that User 1 is no longer available and the session is being terminated. When the circuit-switched voice call ends, the PoC session should resume; however, any PoC voice traffic between the two users after the arrival of the voice call will have been lost and the session actually has to be restarted.

These scenarios can be tested using the E6701E capability. The E6701E can also test the interaction of PoC with short message service (SMS), MMS, and other packet-switched services such as wireless application protocol (WAP) browsing and instant messaging.

Smoothing the Way to Compliance

Testing the compliance of PoC to the standards can be a challenge. Using a real network for testing allows access to only that PoC server selected by the network operator. The network generally does not provide a repeatable test environment with constantly varying radio conditions, varying traffic conditions, and all the associated error sources.

Using a conformance test system to test PoC allows the UE to be validated for network use, but this approach is expensive and the equipment often is not readily available to individual developers.

Pre-conformance testing with a test set allows simulation of the many possible user experiences and offers a more practical way of ensuring a smooth path to a fully validated UE. Although the ultimate judge of the UE is in its conformance, using a test solution such as the 8960 and E6701E during product development provides much needed confidence and a greater likelihood of passing the tests without a lot of rework. With nearly 200 GCF conformance and interoperability PoC test cases existing today, this confidence is absolutely essential.

The Agilent solution is also exceptionally flexible for PoC testing independent of the PoC or PTT standards. This single system tests both proprietary and OMA-compliant equipment, addressing common sources of error in the RF connection. It provides pre-conformance assurance as well as the inter-service interoperability tests that are necessary to ensure complete user satisfaction.

Test Setup

Now let's take a closer look at how the 8960 test set and E6701E lab application are used together for PoC testing.

Figure 2 illustrates the test setup. Connect the PoC server (which may be a presence server, although this is not required for testing), two or more 8960/E6701E test sets, and two or more UEs with PoC clients installed. The PC used for protocol logging in this setup is optional.

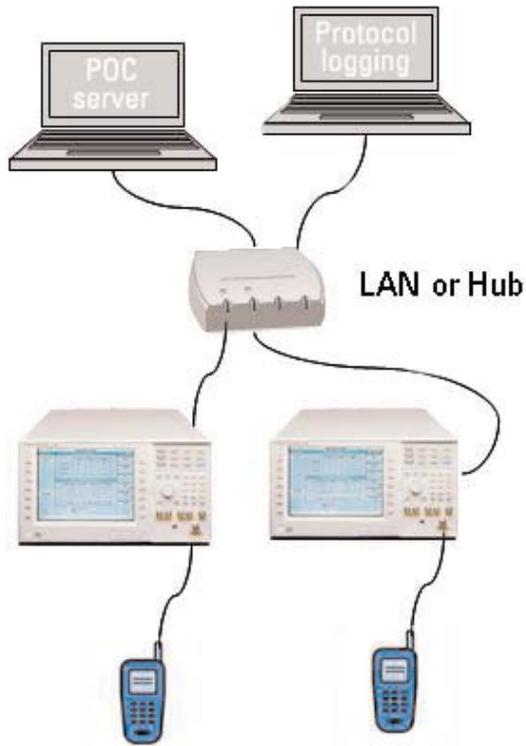


Figure 2. PoC test setup

In Figure 2, all PCs and instruments are on the same subnet. Agilent recommends that the first three fields of the IP addresses of all connected components be identical: for example, 156.141.106.xxx and 156.141.106.yyy.

On the instruments, the IP addresses and subnets can be changed by pressing the **System Config** button, then **Setup** (F1).

The IP addresses of the UE can be set from the front panel of the 8960/E6701E by pressing the **More** button on the menu at the left of the screen, scrolling to page 3, then selecting **DUT PDP Setup**. The DNS addresses on this page (E.00.08 and later) also need to be set, otherwise an advisory notice will appear on the screen each time the instrument exchanges IP addresses with the UE. If you do not know which DNS address to use, set the DNS address of the UE to that of the instrument.

Knowing the connection parameters is essential if you are testing PoC under adverse RF conditions. Set the RF In/Out Amplitude Offset by pressing **System Config**, then **F5**. Then you can adjust the RF cable losses between the instrument and the UE.

RF Impairments

The RF link can be impaired by adjusting the BCH power level using **Call Setup** and then selecting **F7 Cell Power** or the PDTCH levels using **Call Setup** and then selecting **F9 PDTCH Parameters**.

You can set block errors to force downlink re-transmission requests by pressing **Call Setup**, selecting **More** (menu 2 of 3) from the left side of the screen, and then selecting the following:

F4 Protocol Control

F1 layer 1

F1 PDTCH Downlink Corruption

Adjust the error sequence to suit the test scenario.

Even if the UE transmits the uplink blocks successfully, the test set can force the UE to re-transmit them by not acknowledging (NACK) the good uplink blocks. Uplink NACK can be set with the following sequence:

Call Setup

More, menu 2 of 3

Protocol Control F4

RLC/MAC F2

More, menu 2 of 2

NACK Good Blocks F2, settable in %

You can run more complex RF test scenarios, such as connecting one UE through two test sets running E6701E to simulate a cell transition. Further information is contained in the application note *Testing Mobile Station Cell Transitions and Handovers*, part number 5989-3949EN.

TBF Adjustments

A temporary block flow (TBF) is the physical connection in GPRS/EGPRS which is open for as long as it takes to transmit a number of data blocks. When the last block has been transmitted (and received), the TBF ends. As soon as a user removes his finger from the talk button, the TBF is dropped. If, however, the user immediately presses the button again wishing to append a few more words, the UE will have to go back through the process of re-establishing a TBF. A typical TBF setup time can be on the order of 0.6 to 1.0 seconds. If another user has already requested to talk, then this delay could result in the user having to wait in the talk queue before being able to speak again.

There are several TBF adjustments that can affect PoC operation in which the TBF is repeatedly started and stopped.

It is possible to set the amount of time by which the delayed downlink TBF and extended uplink TBF settings delay the release of the TBF, thus preventing the TBF from being instantly dropped. However, it's worth noting that while the use of these settings can improve the PoC experience for the person talking, they also frustrate other users who now have greater difficulty getting floor control. Using these TBF settings also results in dead time that occurs when the person with floor control has nothing more to say and floor control cannot yet be passed to the next person wishing to speak.

You can set TBF control for delayed downlink TBF by selecting the following:

Call Setup
More, menu 2 of 3
F4 Protocol Control
F2 RLC/MAC
F5 TBF Control

Extended uplink time cannot be set until **Extended Uplink TBF State** in **Cell Parameters** has been turned on. This is a broadcast command on the BCH and therefore cannot be set until the cell is turned off. Extended uplink TBF also specifically requires the UE to support this feature.

To set Extended Uplink TBF, select the following:

Call Setup
Operating Mode F1
Cell Off
Call Setup
F6 Cell Info
F2 Cell Parameters
Extended Uplink TBF State On
Cell Setup
More, menu 2 of 3
F4 Protocol Control
F2 RLC/MAC
F5 TBF Control

For TBF re-configure, select these commands:

Cell Setup
Left, menu 2 of 3
F4 Protocol Control
F2 RLC/MAC
F5 TBF Control

Conclusion

With nearly 200 GCF conformance and interoperability PoC test cases now in existence, it is imperative to ensure that the UE can pass these tests before the UE is certified.

Using an Agilent test set running the E6701E lab application is the most flexible way to test PoC independent of the PoC or PTT standard. It is possible to test both proprietary or OMA-compliant solutions with a single system. You can assess end-to-end PoC delay and test PoC interaction with other services such as SMS/MMS, instant messaging (IM), and WAP browsing. RF impairment, cell transition testing, deliberate block errors, and uplink NACKs provide extensive delay and throughput test opportunities.

Not only does the test set and E6701E solution offer this pre-conformance assurance, it also provides the necessary inter-service interoperability tests necessary to ensure complete user satisfaction.

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