application note

P25 Trunking

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Understanding P25 Control Channel Functions

As mobile radio communication systems become more complex and as more users are added to bandwidth-limited mobile radio networks, the implementation of control channel technology will undoubtedly become more commonplace in the future. This application note covers the basics of how the P25 control channel operates and functions.

Why Use a Control Channel?

The control channel is an optional implementation for P25 systems. Using a dedicated control channel is desirable in that it provides additional control of spectrum in larger systems. It allows for the control of system resources and offers added features not available in conventional radio communications.

Control Channel Functions

In understanding control channel functions, we need to remember that control messages are already utilized in some form by many conventional mobile communication systems. The difference is that with a trunked system, a dedicated control channel provides additional management of the system resources.

Usually, the control channel is a separate frequency channel that is designated as the control channel. It is different from the traffic channel in that it functions as a resource allocation and digital communication message bearer and handler between the RFSS (RF Sub System) and the SU (Subscriber Unit).

The P25 Control Channel

The P25 control channel feature for trunking is not specific to a P25 manufacturer or P25 RFSS configuration. All mobiles supporting P25 formats should be able to access a P25 trunking function as either standard configuration or as an option.

In the P25 standard, the control channel maintains compatibility between conventional operation in that the modulation format, the bit rate and many of the control messages are the same. In the case of P25, the control channel is a 9600 baud (data rate) channel using C4FM modulation to impart the digital 1's and 0's to the receiving radio. The difference is that the trunked version uses packet access techniques and requires a request process to a resource controller which coordinates the user's access, while the conventional version permits users to control their own access. An example of how a control channel operates can be seen in figure 1.0.

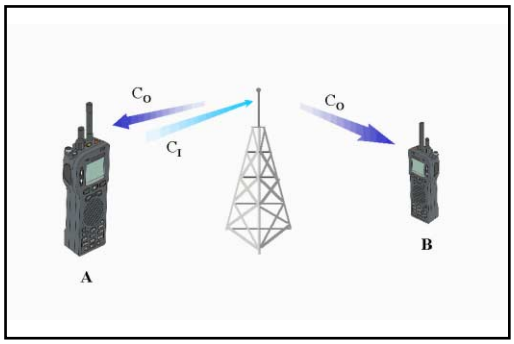

Figure 1.0 Control Channel Operation

As we can see, the repeater is putting out an outbound control channel, (Co) that both mobiles are monitoring. In P25 Trunking systems, the outbound control channel sends information in "packets" and those words are called Outbound Signaling Packets (OSPs).

Let's assume that mobile "A" wants to place a call to another user on the system. Mobile A transmits a request to the repeater on an inbound control channel (CI). In P25 Trunking systems, the inbound control channel sends information words called Inbound Signaling Packets or ISPs. The repeater station and network process the request, and then send an alert on the outbound control channel that the designated user, mobile "B", recognizes as a call that is part of its group or that is designated specifically for itself.

As we can then see in figure 2.0, the calls are assigned to particular voice channels that operate on separate frequencies (f1,f2,f3,f4). The transmit and receive frequencies for the mobiles are offset from each other (f1 and f2) (f3 and f4). This is called duplex offset. In the 800 MHz band, the offset is 45 MHz. Control of these resources is accomplished through the control channel that the mobile unit monitors continuously when not engaged in a communication session with another user or with the network.

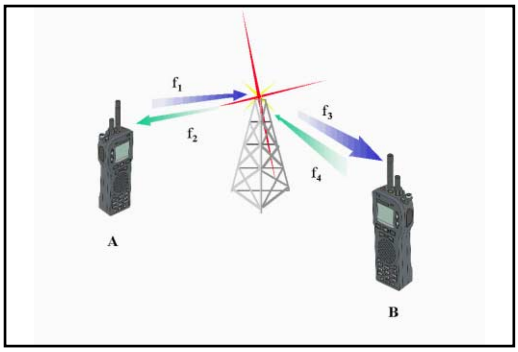

Figure 2.0 Two-way radio communications using trunked operation

Locating a P25 Control Channel

Once the mobile user switches on the SU, how does it actually "find" the control channel? In the P25 standard, the mobile unit will search a particular band dependent upon its own internal programming, look for a valid control channel, verify the NID (Network ID) and

then decode the control channel information.

Outbound Control Channel Signaling Messages - The Key to Communication

Once the SU has found a control channel, what information is being transmitted to the SU? The control channel communicates a variety of information through signaling messages to and from the SU so that proper access to the system can be achieved. Examples of control messages that are sent between the RFSS repeater and the SU include:

Mandatory Outbound Signaling Messages (RFSS to SU)

The RFSS must generate a Network Status Broadcast Message (NET_STS_BCST). The SU uses this information for the registration procedure. These messages are sent continuously.

The RFSS must generate a System Status Broadcast Message (RFSS_STS_BCST). The SU uses this information for the registration procedure and the random access procedure. These messages are sent continuously.

The RFSS must generate an IDEN_UP message informing the SUs of the channel characteristics of the RFSS. This message is sent periodically.

Optional Outbound Signaling Messages (RFSS to SU)

The RFSS may generate System Service Broadcast (SYS_SRV_BCST) messages, informing SUs of the current system services available and currently supported.

The RFSS may generate Protection Parameter Broadcast (P_PARM_BCST) messages informing SUs of the initialization value to be used for the protection process on the control channel.

The RFSS may generate Adjacent Status Broadcast (ADJ_STS_BCST) messages, informing SUs of the existence and status of sites adjacent to this current site.

The RFSS may generate Secondary Control Channel Broadcast (SCCB) messages informing the SUs of the existence and status of secondary control channels at this site.

Registration in a P25 Trunked System

As with most trunking systems, the P25 format requires that the SU register with the RFSS. This is done when the user turns on the mobile radio or when the user moves into a new zone. The primary purpose for registering a SU with the network is to ensure that only authorized users access the network, and that the network can track where the SU is located. This reduces the amount of time and resources that the network needs to locate the mobile, reducing call setup time and control channel loading.

There are two types of registration in a P25 trunked network, a full registration and a location registration. In a full registration the network will check the validity of the SU. A full registration occurs when the SU it first switched on, enters a new registration area, the user selects a new network or when the RFSS requests registration.

During a location registration, the SU monitors the control channel and then performs a location register in the event the user has moved to another site within the coverage area.

In both cases, the registration can be protected (encrypted) for enhanced security. Figure 3.0 shows a typical full registration process. The blue messages are called Inbound Signaling Packets (ISP) and the red messages are called Outbound Signaling Packets (OSP).

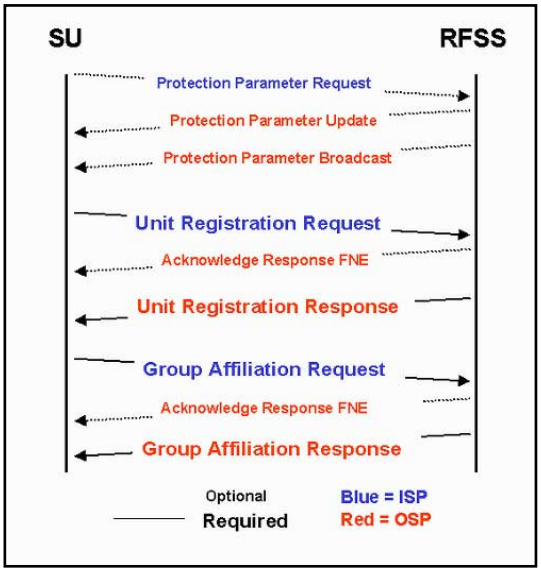

Figure 3.0 Full registration process

Alternative Trunking Modes

Alternative control channel formats can also be used with P25, such as is the case with the Motorola SmartNet™/SmartZone™ control channel. In this situation, a 3600 baud control channel functions to service both a conventional FM 25 kHz (or narrowband 12.5 kHz) channel as well as new 12.5 kHz P25 digital traffic channels. This interoperability between conventional trunked radio systems and P25 is one of the benefits of having a standard that allows two separate technologies to be employed on one system and allows for cost effective migration from one technology to another.

Testing P25 Radios

P25 Trunking systems utilize digital voice channels called traffic channels, controlled by a digital control channel. We do not test the control channel for parametrics, however we do test for some interaction between the control channel and the transition to the traffic channel. These tests are called protocol tests, in which we test the radio's ability to respond to commands from the radio test set.

In order to do this, the test system needs to be able to emulate some of the protocol (OSPs) that the repeater sends out. In addition, the system needs to be able to respond to the ISPs the mobile is sending and react appropriately to get the unit onto a traffic channel for testing. While on the traffic channel, the test system needs to be

able to keep communication with the mobile through P25 specified LDUs (Logical Link Data Units). These data units carry both voice and data information during a "call".

Being a RF based system, these systems also require the ability to test and verify parametric performance including frequency error, power, modulation accuracy and other parameters.

Using the 2975 to Perform P25 Testing

The 2975 provides powerful test features for P25 Trunked systems. Among these tests include the following:

1. The ability to emulate a P25 repeater station and initiate a system originated call. With the 2975, you are not locked into a specific test sequence for the radio. You decide what pass and fail means.
2. The ability to handle a P25 mobile initiated call.
3. The ability to perform full analog test functions.

The 2975 provides access to message elements and fields that other testers do not allow. This gives the operator added flexibility in testing functionality, especially interoperability testing between mobiles and P25 networks.

P25 Trunking Control and Traffic Channel Setup

Setting up the control and traffic channel is the first thing that needs to be accomplished to begin testing P25 Trunked radios. This application note shows how to enable the P25 Repeater Simulator for testing mobiles. In all test modes for P25 mobile systems the instrument should be in the duplex mode. To enable the duplex mode click on the screen selection button next to the time at the very upper left of the screen or select <MODE>, <3> as shown in figure 4.0.

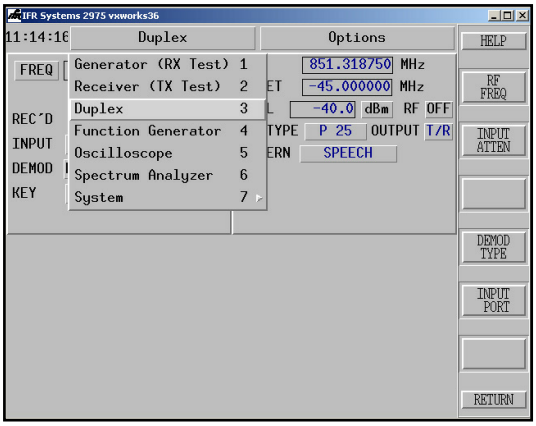

Figure 4.0 Selecting Duplex Mode

From there, we want to enable the Repeater Simulator. To do this, select the "Options" button next to the Duplex display at the top right of the display or select <SHIFT>,<MODE> and then select "P25 Repeater Sim". See figure 5.0 for this selection.

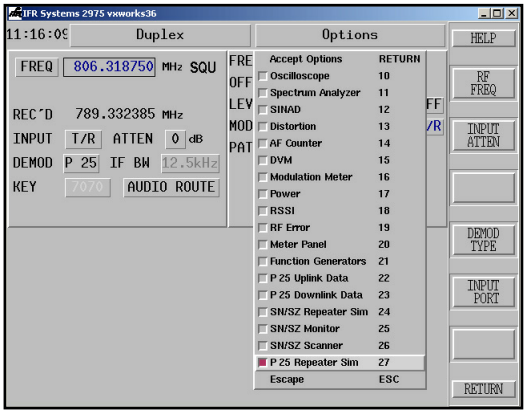

Figure 5.0 Selecting the P25 Repeater Simulator

To enable a valid control channel, we need to set up the proper control and traffic channel numbers. This is fairly straightforward for 800 MHz operation in that the channels are defined with a set frequency assignment. The duplex offset is also standard at 45 MHz. We simply enter the proper channel number or frequency in the CC and VC data fields. See figure 6.0.

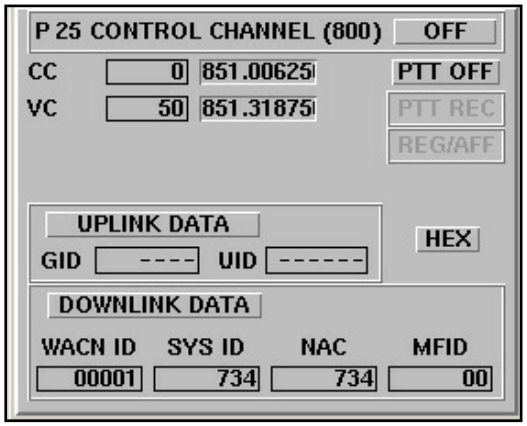

Figure 6.0 Setting up the Control Channel and Voice (Traffic) Channel

Setting Control Channel Protocol Elements

Before we look at the protocol aspects that the 2975 can manipulate, we need to understand how the 2975 is setting up a control channel. There are two messages that are required to be sent continuously that allow a SU to maintain contact with a network. These are the Network Status Broadcast (NET_STS_BCST) and the RFSS Status Broadcast (RFSS_STS_BCST) messages. These messages are broadcast as packets to the radio on a continuous basis with other messaging sent as needed to register the SU and to direct the SU for various actions.

In addition, there are messages that the control channel sends in response to registration and group affiliation requests from the SU. These are the Unit Registration Response (U_REG_RSP) and the Group Affiliation Response (GRP_AFF_RSP).

Network Status Broadcast Message

The Network Status Broadcast message contains fields or

information elements as outlined in figure 7.0.

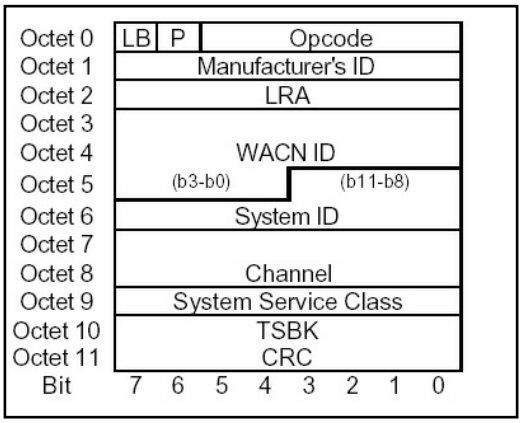

Figure 7.0 The Network Status Broadcast message

The 2975 gives the user the ability to modify these information fields in the message in addition to the WACN ID and the System ID. These fields are as follows:

LB: The LB field is the last block flag. This field indicates whether more TSBKs should be expected in this packet: 0 = other TSBKs to follow for this packet, 1 = last (only) TSBK for this packet. The 2975 does not allow you to modify this parameter.

P: The P-bit is a single bit indicator that states if the remaining portions of the TSBK (Trunked Signaling Block) are encrypted. 0 is not encrypted, 1 is encrypted. See page 12 of TIA/EIA-102 AABB for more details.

Opcode: This field defines the contents of the TSBK. It assigns what type of message the TSBK is (e.g. unit to unit voice service request, system status broadcast, etc.) and defines how the Arguments field will be parsed and populated pertaining to this control channel message. (The opcodes are meant to be system independent definitions with the same opcodes depicting the same information in any system.) Opcodes are not definable in the 2975 since they are specific message elements required to establish and maintain a call.

The MFID or the Manufacturer ID: It identifies the manufacturer for non-standard control channel messaging. The Standard Project 25 Manufacturer's ID is defined as all zeros ($00)($00, where "$" represents a hexadecimal number). This differs in that hybrid systems, such as Motorola's ASTRO 25 SmartNet™/SmartZone™ system that uses a 3600 baud SmartNet™ control channel, with P25 Traffic Channels using a different MFID. Throughout this document the Manufacturer's ID field is to assume the standard Project 25 Manufacturer's ID.

LRA: The LRA defines the region of a registration area in which a subscriber unit may roam without the need to indicate a location update to the network. The registration area may consist of a number of LRAs. The LRA may be a single site or a collection of sites of an RFSS. The exact meaning is up to the system designers. This is a single octet in length with valid entries of $0000 - $FFFF. See TIA/EIA-102 AABC and AABD.

The WACN ID: This field is a 20 bit field that sets the Home network identity which is hard coded into the radio SU through the use of a data interface to set the various parameters within the radio. This dictates the Home network upon which the radio can work. Valid entries are $0 0001 - $F FFFE.

System ID: The System ID identifies the home system in a 12 bit field. The radio may be programmed to operate in up to 8 other systems through the combination of the (WACN ID + System ID). Valid entries are $001 - $FFE.

Channel: This is the actual channel resource that is assigned for a particular service. The 2975 sets this in the P25 control channel tile. See TIA/EIA-102-AABC for details.

System Service Class: This is the 8-bit System Service Class field that indicates basic functions of what the control channel will support. The defined values are:

$01 - composite control channel
$02 - no service requests; update control channel only
$04 - backup control channel only
$08 - reserved for future definition
$10 - data service requests only
$20 - voice service requests only
$40 - registration services only
$80 - authentication service only

These values may be combined to give different service class definitions. A few of the many possibilities are given below for examples. Other values not listed here are also allowed.

$00 - no services, either trunked or conventional

$F0 - all service, not a backup control channel

TSBK CRC: This is a Cyclical Redundancy Check that verifies the reassembled transmitted bits are coded properly. This field cannot be set by the user.

RFSS Status Broadcast

The RFSS Status Broadcast (RFSS_STS_BCST) messages contain fields or information elements as outlined in figure 8.0.

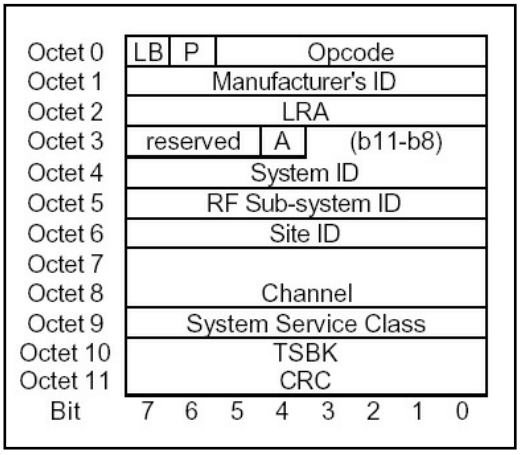

Figure 8.0 The RFSS Status Broadcast message

The RFSS Status Broadcast message provides additional information about the sub-system capabilities. It shares some of the same fields as the Network Status Broadcast Message but also has additional fields as follows:

A. This field in the RFSS_STS_BCST message will specify if the site has an active network connection with the FSS controller; i.e. communication with other sites is possible. A value of 1 will indicate a valid RFSS network connection is active.

RFSS ID. The 8-bit RFSS ID field identifies the RF subsystem in a P25 network. Valid entries are $01 - $FE. See TIA/EIA-102 AABD for more information.

Site ID. The 8-bit Site ID field indicates the identity of the site. The Site ID is unique within an RFSS. Valid entries are $01 - $FE. See TIA/EIA-102 AABD for more information.

Unit Registration Response

These messages include the Unit Registration Response, which includes an assigned source address. This source address is the units new "WU ID" (Working Unit ID). Figure 9.0 shows the Unit Registration Response.

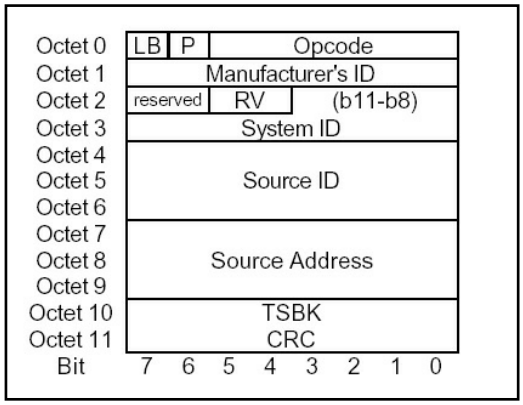

Figure 9.0 The Unit Registration Response message

The Unit Registration Response assigns the new Source address (WU ID) and the RV field. Their functions are defined as follows:

RV: The RV field is a 2 bit field that designates the Registration Value. The following values are defined.

$00 = REG_ACCEPT indicates that registration is accepted.

$01 = REG_FAIL indicates that the RFSS was unable to verify registration.

$10 = REG_DENY indicates that registration is not allowed at the location.

$11 = REG_REFUSED indicates that the WU ID is invalid but the SU need not enter the control channel hunt and the SU may attempt to re-register after a user stimulus.

See TIA/EIA-102-AABC

WUID: Within a Registration Area each Subscriber Unit is assigned a unique abbreviated address known as the Working Unit ID (WU ID). Once a SU has been assigned a WU ID for a Registration Area, the WU ID will normally be used to address the SU. The SU will use a WU ID to identify target addresses whenever possible or appropriate. The WU ID is a 24-bit field.

While within the registration area, a SU will be able to respond to messages that are addressed to its WU ID. Also, while in the domain of the registration area a SU shall initiate messages using its WU ID for that registration area. Valid entries are $00 0001 - $FF FFFD. See TIA/EIA-102 AABD.

Group Affiliation Response

The Group Affiliation Response message assigns the Group Address which is the "WG ID". Figure 10.0 shows the Group Affiliation Response message.

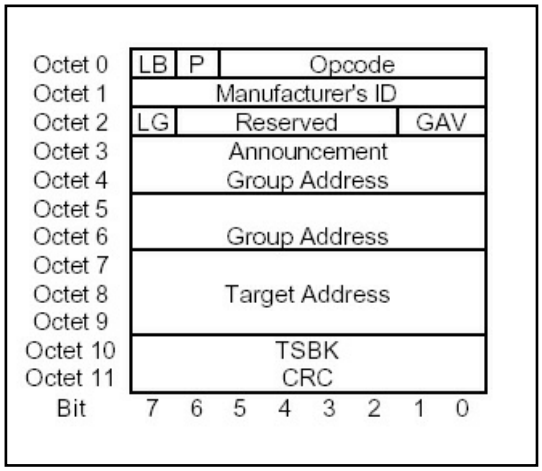

Figure 10.0 The Group Affiliation Response message

Announcement Group Address: This field denotes a special Group Address which addresses a grouping of Groups. This is unique within a System. There needs to be some prior arrangement to associate the Groups to an Announcement Group Address.

WGID: Here the Group Address is now the WG ID. Within a System, a SG ID (comprised of the WACN ID, System ID and Group ID) is assigned a unique abbreviated address known as the

Working Group ID (WG ID). This is a 16-bit field. See TIA/EIA-102 AABD.

A WG ID may be assigned to more than one SU, but will only be associated with a single SG ID at any given time. The 16-bit address space of the WG ID is customer defined to accommodate dynamic address capability. Valid entries are $0001 -$FFFE. See TIA/EIA-102 AABD.

LG: The LG bit indicates Local or Global affiliation.

LG=0 for Local

LG=1 for Global

GAV: The GAV argument is a Group Affiliation Value.

$00 = AFF_ACCEPT indicates affiliation acceptance.

$01 = AFF_FAIL indicates affiliation failure.

$10 = AFF_DENY indicates affiliation denial.

$11 = AFF_REFUSED indicates that the WG ID is invalid and that the SU need not enter the control channel hunt and the SU may attempt to re-affiliate after a user stimulus.

Understanding the Unit to Group Call Sequence

As the call is initiated and managed additional messages are involved in the call sequence. For example, figure 11.0 shows the required messages to establish a P25 unit to group voice call.

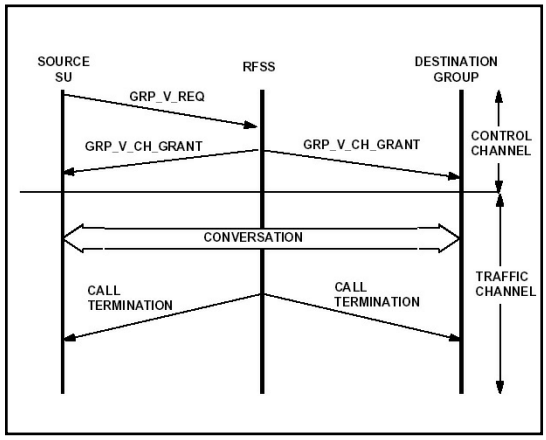

Figure 11.0 Unit to Group Call sequence chart

Once the mobile is registered and has affiliated, the only command that is required to move the mobile to a particular channel is to issue a group voice or unit voice channel grant.

Group Voice Channel Grant

It is important to note that the Group Voice Channel Grant contains both the "WU ID" and "WG ID". The fields are derived from the previous dialog between the SU and the RFSS and ensure that the SU only responds to channel grants that apply to his unique unit and group identifiers. Figure 12.0 shows the Group Voice Channel Grant message.

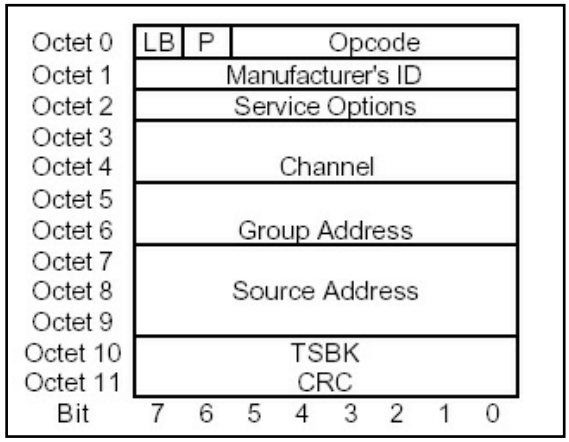

Figure 12.0 The Group Voice Channel Grant message

Now that we understand the control channel broadcast messages, the registration and group affiliation process and the Unit to Group Call sequence we can move on with setting up the 2975 to perform not only parametric tests but also protocol tests. We have the control and traffic channel set up, however, we need to set additional parameters before proceeding. For proper operation we need to enter a valid WACN ID and System ID, which we've already reviewed. We also need to set the NAC.

The NAC is the Network Access Code which is an 8 bit field. Typically the default, per the TIA/EIA-102BAAC standard, is $293. In P25 trunking, the NAC is typically derived from the Control Channel messages and stored temporarily in the unit. The IFR 2975 gives the user added flexibility in allowing this field to be set for various modes of operation, including P25 conventional, SmartNet™/SmartZone™ Astro 25™ and P25 trunking. With P25 trunking systems the NAC is typically the same as the P25 System ID, although they may be configured differently to provide added flexibility for the network operator. Figure 13.0 shows how to setup the WACN ID, NAC and System ID.

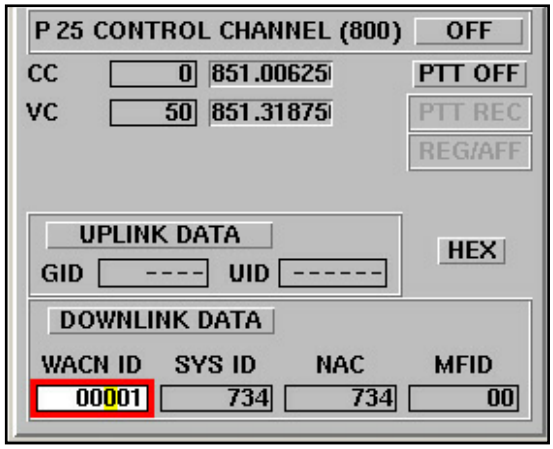

Figure 13.0 Setting the WACN ID, System ID, NAC and MFID

Setting the WACN ID, NAC and System ID is the minimum configuration for testing the mobile unit. Additional parameters for the downlink Control Channel information can also be set with the

exclusive protocol functions of the 2975. Figure 14.0 shows the expanded protocol features that can be set for the downlink control channel and RFSS originated control channel messages.

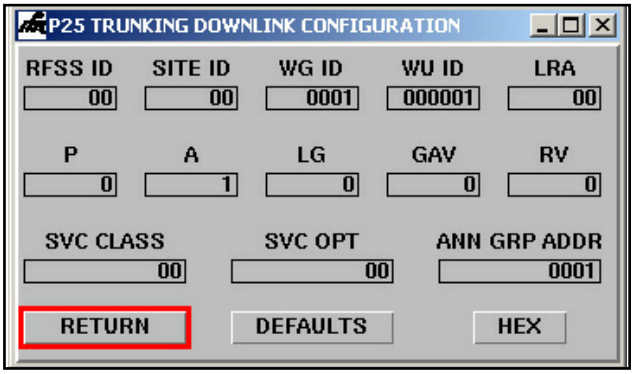

Figure 14.0 Setting additional downlink control channel features

Uplink Data Analysis

The 2975 will automatically decode a number of fields from the mobile when the unit registers and affiliates with the 2975. This feature can be very helpful in determining if the unit has been setup correctly for use on the network. On the primary P25 trunking tile we will see the two indicators for the GID or Group ID used for initiating group calls and the UID or Unit ID. Only the 2975 provides this capability for testing P25 mobiles.

Unit Registration Request and Group Affiliation Request

The decoded information that the 2975 displays comes from the mobile's access messages for the registration process and the group voice request. If we look again at the registration process the basic implementation requires two registration messages, the first being the Unit Registration Request (U_REG_REQ). The detailed Unit Registration Request is shown in figure 15.0.

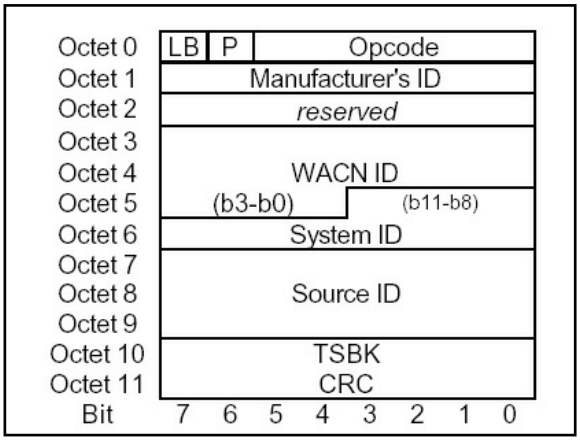

Figure 15.0 Unit Registration Request (Originated from the Mobile Radio)

All the definitions noted earlier for OSPs from the RFSS control channel apply. In addition, there is a new field not previously defined called Source ID.

Source ID: A 24-bit unit identity portion of the unique subscriber unit identity. This field along with the WACN ID and System ID uniquely addresses a subscriber unit.

Note the unit has the appropriate WACN ID reflected back to the network for verification that the SU accepted the Wide Area Communication Network code. As seen with the OSPs from the RFSS this message utilizes the Last Block flag identifier field, the encryption P-Bit and the appropriate Opcode identifying this message as a Unit Registration Request. The System ID is preprogrammed into the SU as is the Source ID (UID). The Manufacturer ID is also shown, which for a P25 system is 00.

Group Affiliation Request

After a registration request the SU will normally attempt a Group Affiliation Request (GRP_AFF_REQ) which is shown in figure 16.0.

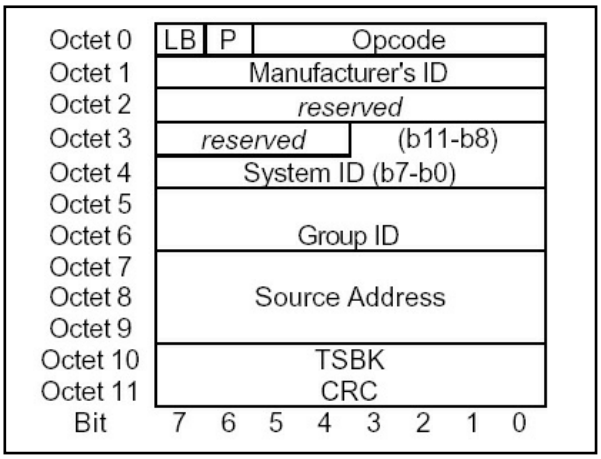

Figure 16.0 Group Affiliation Request (Originated from the Mobile Radio)

The message contains all the fields that the Unit Registration Request contains except that the WACN ID is replaced by the Group ID field. This message can be invoked by the RFSS at any time by broadcasting the Group ID Query command. The Group ID is pre-programmed into the SU.

Group ID: This defines the 16-bit group identifier which together with the WACN ID and System ID uniquely defines a group.

Group Voice Request

The other message that the SU will send is when initiating the Unit to Group call sequence. Here, an additional message is sent, the Group Voice Request (GRP_V_REQ). This message is shown in figure 17.0.

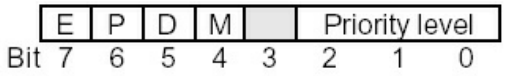

Figure 17.0 Group Voice Request message

Note that this message reflects the newly created WG ID as the Group Address. It also shows new fields as follows:

Service Options: Service requests and service grants allow for special service extensions called the Service Options field. These features provide extended flexibility to tailor the requested service to the needs of the requesting unit or process capability of the system. Figure 18.0 shows the Service Option field definition.

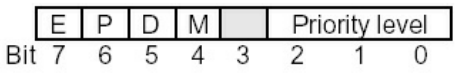

Figure 18.0 The Service Option Octet

The following are definitions for each bit:

7: Emergency - is the status indication to determine if this service is to be specially processed as an emergency service.

0 = Non-emergency - indicates the normal processing status.

1 = Emergency - indicates special processing required.

6: Protected - indicates whether the resources (other than control channel resources) to be associated with this service should be presented in protected mode (e.g. encrypted) or not.

0 = not protected - indicates normal mode presentation for the resource(s).

1 = protected - indicates protection mode presentation for the resource(s).

5: Duplex - indicates the way the channel resource is to be utilized by the unit(s) involved in the call.

0 = Half Duplex - indicates the unit will be capable of transmitting but not simultaneously receiving on an assigned channel.

1 = Full Duplex - indicates the unit will be capable of simultaneous transmit and receive on an assigned channel.

4: Mode - this is the indication of whether this service session should be accomplished in a packet mode or circuit mode.

0 = Circuit mode - will utilize resources capable of supporting circuit operation.

1 = Packet mode - will utilize resources capable of supporting packet operation.

3: Reserved - currently set to null (0).

2-0: Priority level - indicates the relative importance attributed to this service where:

$111 Highest (top)

$110 System definable

$101 System definable

$100 default

$011 System definable

$010 System definable

$001 Lowest (bottom)

$000 reserved

Now that we understand the fields in each of the messages used during a registration and affiliation process and during a unit to group voice call, we can use the 2975 to decode these fields to assist in testing interoperability of various SU's and systems. Figure 19.0 shows the 2975's P25 Trunking Uplink Configuration decode screen.

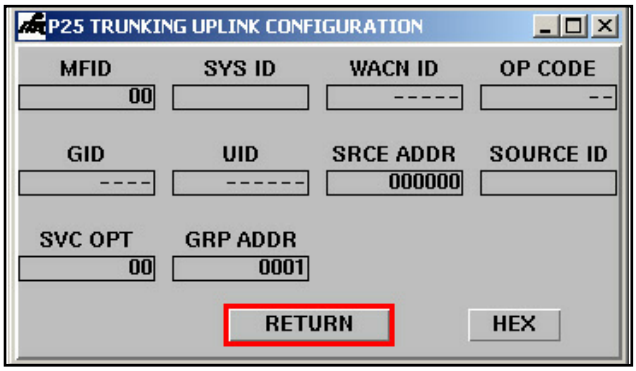

Figure 19.0 The P25 Trunking Uplink Configuration decode screen

Performance Testing with the 2975

We can now perform either a mobile originated call or a repeater originated (user or dispatch originated) call. To perform mobile radio transmitter tests simply key the mobile unit and the 2975 will automatically assign the unit to the proper voice channel for performing parametric tests.

Once we have the control channel set up and running and the mobile is talking with the 2975, we can then select any number of options to run. This includes the O'scope, Spectrum Analyzer, Meter Panel, Power Meter, RSSI Meter and etc. To enable these functions select the "Options" button or select <SHIFT>,<MODE> and select the combinations you wish. Remember that not all screens can be displayed at one time and you will be limited to two-meter screens or one oscilloscope/spectrum analyzer screen when run in conjunction with the P25 Control Channel simulator screen.

The best way to enable multiple displays of various parameters quickly is to select the "Meter Panel" (number <20>). See figure 20.0 for a sample of using the meter panel with the P25 repeater tile enabled.

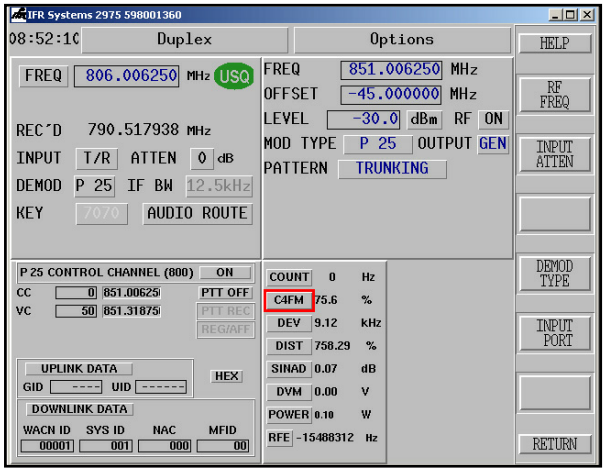

Figure 20.0 P25 Trunking Control Channel screen with the Meter Panel enabled

Figure 21.0 shows the 2975 with the P25 repeater panel with the spectrum analyzer enabled <SHIFT><MODE> <11>. Notice that the PTT REC indicator is lit up and the duplex rec./gen. frequencies have changed since the unit is now on the voice channel with 45 MHz duplex offset.

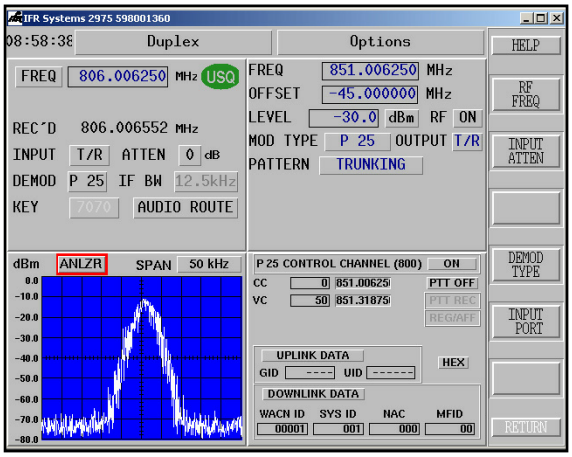

Figure 21.0 P25 Repeater Tile with spectrum analyzer enabled

To perform mobile receiver measurements enable the PTT mode by selecting the PTT button directly below the ON/OFF button on the repeater screen. This will cause a repeater originated call request to be sent to the mobile and the mobile will then be assigned to a voice channel in a "listen" (receive) mode.

We can now enable a unique sensitivity test called the "Speech" mode. The speech mode is a special voice file that provides pre-recorded voice patterns that allow the test professional to quickly determine the receiver's sensitivity. This is accomplished by listening to the pre-recorded audio voice patterns and then reducing the RF sensitivity until the voice starts to break up or sounds slurred. This test is unique to the 2975 and is another way that IFR, an Aeroflex Company, is improving technician productivity. Figure 22.0 shows how to select the speech mode and figure 23.0 shows where to adjust the RF level.

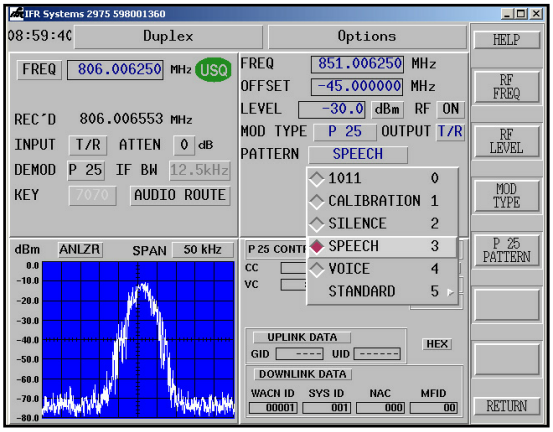

Figure 22.0 Setting the 2975 up for P25 sensitivity testing using the speech mode

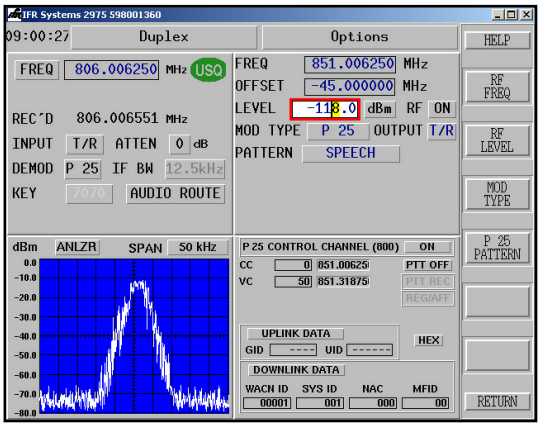

Figure 23.0 Decrease the RF output until speech quality degrades

Conclusion

Using the 2975 provides some of the most advanced testing functions ever presented in a communication test set. For testing P25 systems the 2975 truly allows for dynamic testing through true repeater functionality and through the use of the world's most comprehensive P25 test set.

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