

# **Instructor Notes to Accompany Berks County Trunking Overview Presentation rev. 3**

## **Slide 1 – Title Slide**

This program will assist system users in transitioning from skilled conventional analog radio users to skilled digital trunked radio users by describing trunking system concepts, operation of radios and processing of calls in a trunked system, alerts you may see on your radio and backup features of the radio system.

## **Slide 2 – Title Slide**

## **Slide 3 – Trunking**

Read through slide.

Key messages –

- “the automatic sharing of a small number of communications paths among a large number telephone subscribers”
- “distributes message traffic among the available channels”

These key points highlight the difference between trunking and conventional radio operation.

When every group of users has their own dedicated frequency, channels may be either sitting idle or very busy, causing others to wait before they can communicate.

With a “trunked” system all the channels are available to all the users and are assigned by call. When a call is over that channel becomes available for other users.

## **Slide 4 – Trunking Features**

Faster System Access

Read text then...

Since there is a large “pool” of channels, and radios are organized by “talk groups”, the radio system constantly monitors who is available and who should be talking with whom.

When a radio user presses the PTT button other units in his talkgroup are automatically and immediately assigned to a vacant channel and allowed to communicate

Better Channel Efficiency

There are up to 30 “channels” across the county trunked radio system available for voice communications.

Since transmissions are relatively short, when a call is complete the channel is made available to other users.

User privacy

All radios do not contain all talkgroups. Talkgroups have been assigned by discipline and organize users who rely on each other. Users who don't have a need to monitor those conversations will not have the talkgroups in their radios. Additionally, if a group of users is having a conversation that involves many PTT's, first one person talking, then another, it is possible that during this conversation the talkgroup will be assigned one channel for the first part, another channel for the second part, and even a third channel for another part. The users involved in the conversation won't know that this is happening. And if a non-authorized person is scanning a frequency on the radio system channels they may only hear one part of the conversation.

## **Slide 5 – Trunking Infrastructure**

Earlier, in the Berks County Radio System presentation we saw how the system is distributed across many locations or sites.

They were the Master Site, the Prime Sites and remote radio sites.

Each radio site contains the repeaters that send and receive voice traffic.

All these sites are connected to the prime sites that provide digital communications and control of the repeaters

The prime sites rely on the Master Site for maintaining the database of users and making decisions on who can speak with whom.

When not actively involved in a call every radio in the system is listening to data being broadcast on one channel. This repeater (channel) is called the control channel. Every site has a designated control channel. The control channel's primary function is to keep track of the selected talkgroup of every radio affiliated with the system. The control channel never carries voice traffic. All the other repeaters (channels) at a site carry voice traffic. This data keeps track of all radios and allows the Zone Controller to monitor and control the operation of the system.

## **Slide 6 – Your System**

Before we go into call details lets review some terms that are appropriate to your system.

P25 Compliant

Read then...

As a "standard" this will provide for greater interoperability with other, non-Berks County, users.

Other system users can be temporarily, or permanently, provisioned on the Berks Radio System.

Simulcast and Digital

These may or may not be new terms to you. In the next few slides we'll discuss how they are used with regard to the Berks County Radio system.

## **Slide 7 – Simulcast**

Radio signals have a limited distance that they can travel. A single tower could only cover a relative small area. However, if the same signal can be broadcast from multiple, geographically separated, towers the range could be greatly expanded.

There are some very serious engineering concerns when the same frequency is broadcast from different towers in the same area. These concerns have been addresses and resolved in our system.

Effectively, simulcast greatly expands the coverage footprint of a radio system.

Additionally, while one high-powered repeater could be built that may be able to cover a large geographic area, we are concerned about **two-way** communications. Comparatively low power Portable radios must be able to reach a tower for their transmission to be received by the system. By creating a well engineered simulcast system, portable radios on the street can not only receive the repeaters signal but can be received at the sites and be rebroadcast all the radio sites.

In the graphic on this slide we can see how radio A can be greatly separated from radio B but both radios are receiving the same *simulcast* transmission from the system regardless of their location.

## Slide 8 – Digital vs. Analog

There are 2 topics on this slide

- Conventional vs. trunked
- Analog vs. digital

We've already discussed the major differences between conventional and trunked systems

Conventional – dedicated channels for users, limited channel availability, minimal privacy

Trunked – Channels are assigned as needed, organized by talkgroup, greater privacy

In the new radio system all radios are digital. The radios you may be used to are analog. In analog the voice signal modulates the radio and is transmitted over the air. In digital the voice is converted to a digital signal and then that modulates the radio.

There are advantages and disadvantages to both Analog and Digital radio communications

- Analog – Provides a “natural voice” sound quality but is susceptible to fading and static.
- Digital – Provides a consistent audio quality and allows for background noise cancelling but can get “garbled” at the very edges of the coverage area.

During the hands on technical training sessions you will receive demonstrations of the digital radios and get some tips to ensure your clear communications.

## Slide 9 – Talkgroups

A talkgroup is a group of users that have a common need to communicate.

Rather than selecting a “channel” to communicate, trunked radios turn to a “talkgroup”. When one person in a talkgroup keys their radio, all other radios that have that talkgroup selected are redirected to a voice channel and the conversation begins. There are system settings that determine which site certain talkgroups can communicate on, whether the talkgroup is encrypted, etc. These are transparent to the user but are a function of using talkgroups.

## Slide 10 – Turning On Your Radio

During the affiliation process the system verifies that your radio is authorized on the system, what sites you can communicate with, and what talkgroup you are currently turned to. The Zone Controller logs all this information and ensures that your radio is included in calls designated for you.

All of this “handshaking” is done over the control channel and is performed in less than a second.

Afterward your radio will stay tuned to the control channel and wait for further instructions. However, if you turn on your radio and a conversation is already in progress that should involve your radio, once the

affiliation is complete your radio will be directed to the voice channel with the rest of the talkgroup and you will join the call already in progress.

## **Slide 11 – Call Processing Event Sequence**

Point out that radio 5 is the radio that presses the PTT and requests to talk with other radios in Talkgroup B.

The request comes in to the Central Controller on the control channel.

## **Slide 12 – Call Processing Event Sequence (Con't)**

Step 3: Channel selection is random. Often times systems can be programmed to “prefer” certain channels. Normally, channels are selected to exercise each channel over time. In other words, if you have a 5 channels system, the first call may be assigned channel 5, the second call may be assigned channel 3, over time all the voice channels will be used.

Step 4: upon receipt of the instructions to change channels every radio that is tuned to talkgroup B will internally change frequency to the assigned channel (in this case 5).

## **Slide 13 – Call Processing Event Sequence (Con't)**

The originating radio will hear the “talk permit tones” and will be allowed to start speaking. All the radios in talkgroup 5 are now listening on channel 5 of the system. This all occurs within ½ of a second.

## **Slide 14 – Call Processing Event Sequence (Con't)**

When the conversation is complete, all of the radios return to the control channel. This process can occur multiple times during the transmissions of a specific conversation.

If there are times in the transmissions when no radio is keyed, the radios return to the control channel. The radio users never know the specific channel they are assigned. They just need to know that if they are selected to the same talkgroup on their radio, that they can communicate with all other radios selected to the same talkgroup that are affiliated with the system.

In the Berks system, if one person stops transmitting and, shortly after, another transmits on the same talkgroup they will stay on the assigned voice channel and the conversation will continue. Whether the radios stay on the assigned voice channel or revert to the control channel for reassignment it will be transparent to the users.

## **Slide 15 – Trunking System Design**

Trunking systems are designed based on the concept that it is highly improbable that a large percentage of users will key up at exactly the same time and that most conversations are relatively short. Just like the example of the telephone company; the telephone company does not have one “line” for every user

on it's system. They are confident that not everyone will be speaking at one time. The amount of "lines" available far exceeds the "normal" amount of conversations **that occur at any given time**, as is with the Berks radio system.

Additionally your system has a "Time out Timer" set to 60 seconds. If the radio user presses and holds the PTT button continuously for 60 seconds, at 56 seconds they will begin to hear a tone, and at 60 seconds, the call will be ended and the channel will be taken away from the user. At this time you will have to rekey the radio to get a new channel assignment. This is designed primarily for the radio that gets lodged down beside the seat with the mic keyed. This means that a frequency will not be locked out of the pool for longer than 60 seconds (demonstrate tone). Knowing this, it's important to make your transmission concise and to the point.

## **Slide 16 – Talkgroup Unavailable**

In a trunking system, only one radio can transmit at a time.

It is very important that the radio user LISTENS before attempting to transmit on a talkgroup. If a radio is transmitting on a specific talkgroup and another radio keys up on the same talkgroup, the second user will hear a "Prohibit Tone" (demonstrate tone). The user should de-key the radio and listen. If they hear an on going conversation, the user should wait for the transmission to end and then re-key the radio. In the radio system data available to the System Managers this is indicated by a "Busy: User not allowed to interrupt" message.

However, if no conversation is heard, the user may be out of range on the system. "Out of range" will display on the radio and the user will hear the same tone. (demonstrate tone).

## **Slide 17 – Talkgroup Unavailable (Con't)**

System busy means that all frequencies have been assigned and there are no frequencies remaining in the "pool" to assign. When this occurs the user receives a System Busy Tone (demonstrate tone). The user should de-key the radio. The system puts the radio user's request into a queue and when a frequency is available, Talk Permit Tones (demonstrate tone) are sent to the radio. After the user receives the Talk Permit Tone, they have 3 seconds to key up the radio or the frequency will be assigned to the next user in the queue.

NOTE: If the user re-keys the radio before receiving the PTT tones, their initial request is cancelled and they are then placed back in the queue. To clarify, the busy queue assigns the next available channel to the person at the top of the queue. If you rekey your radio while in the busy queue you will go to the bottom of the list.

## **Slide 18 – Introduction to Radio System Backup Modes**

The radio system has many levels of redundancy. Failure of any one switch, router, base station, etc will transparent to the end user. i.e. if a base station fails that channel will not be assigned.

If something major happens to the infrastructure that causes a failure of multiple sites, more than half the channels, the Zone Controller, etc the system will fall back into one of its back-up modes; Site Trunking or Failsoft

## Slide 19 – Site Trunking

In normal operations the Berks system can be described as a group of sites connected to the Zone Controller. If the Zone Controller loses communications with it's Sites it goes into Site Trunking.

While in Site Trunking the North Site will continue to function properly; the South Site will continue to function properly. However, communications **between** these sites will not be possible. In other words, talkgroups that were previously able to communicate on both the North and South Sites will be limited to one or the other.

Unfortunately, the Zone controller views the dispatch consoles as a **site** as well so communications with dispatchers will not be possible in Site Trunking. However, every dispatch position has 2 portable radios; one for the North Site and one for the South Site. In this manner they will still be communicating with their talkgroups.

## Slide 20 – Failsoft

As mentioned the Berks radio system has a tremendous amount of redundancy to avoid ever having a communications failure. However, should a catastrophic event occur that causes failure of both Prime Site controllers AND their redundant Prime Site Controllers, or all four control channels in both the North and South sites, or all Voice Channels to fail across the county, the system has a “last ditch effort” to maintain communications. This is called Failsoft. In this mode the entire system reverts to conventional system operation and users are assigned to one frequency (channel) to perform their operations. Talkgroups will no longer exist and the channel you are turned to will determine which frequency (channel) you will be communicating on.

(Read through each of the items in “What Happens to the radios in Failsoft?”

During this type of failure it is important to stay on your assigned failsoft channel. Your radio will be operating in a conventional mode (i.e. you will be sharing a channel with other users and you will not be reassigned channels as you are in trunking.) It is important to know that during this time the radio system technicians will be working to restore normal communications as quickly as possible. You should maintain critical communications only to provide channel available to all users.