Instructor Notes to Accompany Berks County ASTRO P25 System Overview Presentation rev. 2

Slide 1 – Title Slide

The intention of this presentation is to introduce the participant to the new radio system and provide a high level understanding of its construction and capabilities.

Slide 2 – Berks County System Overview

The System is actually comprised of many sub-systems that function together in order to accomplish the overall goal of communication with and among agencies in and outside of the Berks County.

Each subsystem will be discussed in further detail.

What is TDMA? We are used to technology where a radio transmission uses a full channel/frequency. When someone is transmitting on a frequency, it cannot be used by anyone else. TDMA (Time Division Multiple Access) technology allows that one frequency to be broken into two "talk paths." This means that double the number of conversations can happen on a given number of frequencies.

All system subscribers are Motorola APX family radios and are currently part of the 4XXX, 6XXX, and 7XXX series. Additional APX series are being released and the ability exists to authorize other P25 compliant radios on the system as need arises and after appropriate technical vetting.

A small number of Futurecom brand digital vehicular repeaters are also being deployed.

Slide 3 – ASTRO 25 Trunked System – 700 MHz

Primary subsystem (this is what most of think of when we talk about the new radio system).

Consists of 2 simulcast Sites (also sometimes called cells or zones).

Each Site is made up of multiple radio tower locations (remote sites) that broadcast the signal simultaneously in order to provide coverage.

The coverage of the North and South Sites is different.

> Some locations in the County cannot get coverage from the North Site but have South Site coverage and vice versa). Some locations in the County get coverage from BOTH Sites.
>
> Many talk groups in the system are broadcast in BOTH cells to overcome this limitation, but this takes up limited system resources, so some talk groups are broadcast in only one cell or another. Anytime a talk group has a name that is XXXX **S** or XXXX **N**, that means it is broadcast S or N only. Anytime a talk group has a name that is XXXX CW, that means it is broadcast in both Sites (CW=countywide). Many talk groups (especially City of Reading and County Agency TGs) don't include that designation and users must know this based on training. See SOPs Appendix E Column "Sites" for this information for all talk groups.

Slide 4 – Radio Propagation by Site

This exhibit shows where each Site provides coverage (where you can hear the system and where the system can hear you).

Talk groups that are broadcast in both Sites can be heard anywhere there is color on the map. North Site TGs can be heard where there is blue or green and South sites where there is yellow or green (green is overlap – LOTS of overlap). The map is showing portable on street on hip at DAQ 3.0 (very usable signal). Map is in SOPs Appendix D.

The performance guarantee of the system is DAQ 3.4 with 95% coverage within the county as measured by portable radio worn on hip and used outdoors. In addition to this, there are certain designated areas of the county in which the coverage must be higher for in-building use.

Slide 5 – System Map – Remote Radio Sites

This exhibit shows the location of each of the County's radio transmission sites that are a part of the 700 MHz trunked system. Note that the Centre site is not labeled because there are not 700 MHz trunked resources at this site. There are only conventional resources deployed at this tower site.

Slide 6 – System Map – Master and Prime Sites (Control Sites)

Certain tower sites in each system Site are special. They provide the control and management of the other tower sites. In essence, these locations have the "brains" needed to operate the system.

They are called Prime Sites. These prime sites are important because w/o them the system is unable to act in a coordinated way.

Without them, the radios system falls back into a number of different levels of reduced functionality which are discussed later. For now, suffice to say that we want them to always be functional. For this reason we actually have 2 (a redundant) Prime Site in each System Site.

The "super brain" of the system is called a Master Site. The Master Site actually controls the Prime Sites in each System Site. Again, the functionality of the equipment at this location is so crucial to full featured operation of the system, we have 2 of them.

Slide 7 – System Map – Backhaul

In addition to having the actual remote sites up and running, for the system to work properly, we have to have everything connected together so that radio transmissions on one end of the county can be received, sent to the other end of the county, and be rebroadcast from a tower near the mobile/portable recipient.

This is accomplished through backhaul. Today, most of our backhaul is through telephone lines. They are low speed, low reliability, at risk of physical damage, and reliant on a third party (Verizon) who views our usage as barely more important than the usage of a residential customer.

In the new system, our backhaul is through high speed microwave (directional radios) that shoot the signals around three interwoven rings. Note how a break in any one ring, or even two rings, and in many cases all three rings cannot totally sever communication because the signals will find another path

using multi-protocol label switching (MPLS) technology in the network. This degree of inter-connectivity coupled with MPLS results in the microwave connections having "5 9s reliability" or 99.999% reliability. This is less than 5.26 minutes of downtime/year/hop.

Slide 8 – Conventional Subsystems

In addition to the 700 MHz trunked subsystem, there are a number of conventional (standard radio) susbsystems that are part of the new radio system.

Analog Conventional Interop Subsystems

These subsystems, available in low band, VHF, UHF, and 800 MHz are the way our neighbors coming into the county will be able to communicate with our system users. They will use primarily federally designated interoperability channels that are reserved for interoperation use.

There are also a few channels (2 VHF and 33.94) that will be part of the new system. These channels were included because many of our existing mutual aid partners already have these channels in their radios. Their prior use has no effect on their future use (eg. 155.295 is one of them – it was an EMS channel, but it may be used for many things in the new system).

Because they are not intended to provide the same density of coverage as the 700 MHz sub-system (no enhanced in-building coverage), and because the physics of these other bands of spectrum are different, they each require a differing number of transmit and receive sites.

All of these overlays are engineered to DAQ 3.4 with 95% coverage within the county as measured by portable radio worn on hip and used outdoors.

DES Subsystem

4 VHF single site repeaters will continue to be maintained in the county

Main Paging

Fire and EMS Dispatching will continue to be transmitted over a 151.220 MHz simulcast system. The total number of sites in this system is being increased by (2) to (12) to improve coverage.

Backup Paging

A backup paging system will continue to be maintained (also using 151.220 MHz). This system will operate just like the current back-up system (single site paging with highly reduced coverage), but (4) additional sites are being added to enhance coverage.

Slide 9 – Site System Matrix

This exhibit shows which sites have which subsystems located at them. Where applicable, T= Transmit, R= Receive, T/R = Transmit and Receive. Take note that there are a number of receive only sites. That is because the "weak link" of the inbound/outbound communication is the portable inbound to the tower. To overcome this, there needs to be a larger numbers of towers "listening" for portables than there does towers "talking" out to portables.

Slide 10 – Dispatch/Console Subsystem

There are three designated dispatch sites in the system including BCCC/911, City Hall, and Courthouse. Courthouse is a limited capacity backup capability (6 positions) but, in conjunction with CAD machines and emergency telephone capability, represents the first time ever that Berks County will have a back-up 911/dispatch center. Except for the fact that they use a disparate CAD, this facility could also act as a backup to the City Police Communications Center.

Slide 11 – Logging Recorder Subsystem

All aspects of communications into and out of DES are logged. This includes all radio and telephone communications. Storage is redundant to prevent loss of data. Recordings will be available as per policy for a minimum of six months.

Slide 12 – Network Management, MOSCAD, and Security

This is the behind the scenes stuff that makes DES able to run the radio system effectively.