

Digital Scanning: a New revolution in P-25,
and why your scanner won't hear that new 700 mhz system.

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As many readers are aware, numerous public safety systems in the area will be migrating to the 700 mhz system within the next few years. As they do, many scanners will no longer be able to decode the signal. Some systems such as the city of Philadelphia, and Burlington County are using P-25 phase 1 systems, which for the fortunate can be decoded by use of a "Digital Scanner" such as the Radio Shack Pro-96 or GRE PSR-500 to name but a few. These scanners however will not be able to decode the new 700 mhz systems when they go online as a new codec will be used.

A codec simply put is the combination of hardware and software which is responsible for taking audio and translating it to a digital signal, and then being able to take a received digital signal and reconstruct it back into intelligible audio. The codec employed in the Phase I systems which are currently in use and are nearing end of life expectancy are using an algorithm known as Improved Multi Band Excitation, or IMBE for short (which has a sub-component known as C4FM.) Some of the readers from the Trenton area may even be familiar with the precursor to IMBE which was known as VSELP (pronounced Vee Selp.) This was not too popular of a format and therefore was quickly abandoned by all but a few agencies in favor of the much clearer and more intelligible IMBE.

In the Phase I system, FDMA or Frequency Division Multiple Access is employed, which means that there are "slots" which are frequency dependent, usually reserving one voice path or "slot" per frequency. The audio is digitized using a method known as IMBE or C4FM which stands for Continuous 4 level FM. (A lengthy explanation on the C4FM architecture can be found online, but due to space constraints here, will not be discussed further.)

An aside: A large portion of "P-25" trunked systems in our Philadelphia area are not actually fully P-25 compliant! The APCO Project-25 standards specify parameters as to how a trunked radio system is to operate, to include signaling, and even baud rates for the control channel. What most systems in the area (to include the Burlington County p-25 public safety system) are doing is taking an existing Motorola Type-2 smartnet system and simply digitally encoding the audio using C4FM or IMBE. In this scenario, they are NOT fully P-25 compliant as they are disregarding some standards set fourth for the execution of the trunking.

The new APCO P-25 Phase II system will be utilizing the AMBE 2 (Advanced Multi Band Excitation) for the digital audio encoding, and then layering it upon TDMA or Time Division Multiple Access (for multiplexing.) AMBE 2 is similar to AMBE which is used in DSTAR, however a few tweaks and improvements were made to the codec which yielded AMBE 2. As a side note, the changes in code from AMBE and AMBE 2 are significantly different which precludes the monitoring of a Phase II signal from a DSTAR portable. Besides not being able to decode the audio, the slots which were frequency dependent in the Phase I system (single slot per frequency) will now be multiplexed allowing for two talk channels per frequency. This is due to the fact that in the TDMA method, *Time*, rather than *Frequency* is the slot determining factor. Thus, in TDMA we can have **multiple talk paths or slots per frequency**.

As we can now start to see, the Phase II migration then, is accomplishing two major upgrades:
1: (taking a new digital codec (AMBE-2,) and

2: marrying it with a new multiplexing system to allow for more talk paths per channel.

To add to the confusion, the new P-25 Phase II standard applies only to trunked radio systems. There is no provision currently for simplex based P-25 Phase II. There is controversy within the ranks of radio techs as to if tactical communications (simplex or talk-around) will use narrow-banded analog FM mode, or if they will revert back to P-25 Phase I digital audio. Literature on the Motorola APX portables seems to indicate that they are programmed with both Phase I and Phase II codecs which would allow for digital simplex communications, or even digital non-trunked communications such as a conventional P-25 repeater.

Though the above may be confusing, the general take-away from this article should be this:

1. Public Safety didn't necessarily start encrypting their traffic, rather, it is an entirely new language being spoken.
2. If you have a digital scanner, keep it for now, see what happens. If you do NOT have a digital scanner, save your money and hold off on purchasing a new scanner. As the systems are rolled out, and Phase II becomes more pervasive, the new Phase II codecs may be installed in the new scanners sold.
3. At this point in time, sit and wait appears to be the name of the game. At over \$525 a pop for the new scanners, this author will wait until the bugs are worked out of the scanners before he purchases one.