

The Premiere Digital Mode: P25

Adapted from October 2024 Presentation to Henderson Amateur Radio Club W7HEN
Bill N4NJJ

P25 (Bill N4NJJ)



- Project 25/P25/APCO-25
- Digital standard for interoperable digital two-way radio in North America
 - Now the interoperability standard in Australia, New Zealand, Brazil, Canada, India, and Russia
 - In theory, all equipment across brands is interoperable
 - In practice, this requires governance, standardization, and politics
- In 1989, APCO Project 25 came into existence with:
 - Association of Public-Safety Communications (APCO)
 - National Association of State Telecommunications Directors (NASTD)
 - National Telecommunications and Information Administration (NTIA)
 - National Communications System (NCS)
 - National Security Agency (NSA)
 - Department of Defense (DoD)

P25 Cont. (Bill N4NJJ)



- Interoperability
 - Established to address need for common digital mode
 - Equipment is authorized (or licensed) under NTIA and/or FCC rules
- Audio Codecs
 - IMBE
 - Improved Multi-Band Excitation
 - AMBE+2
 - Advanced Multi-Band Excitation
 - Codecs were designed by Digital Voice Systems, Inc.
 - High cost of equipment due to voice-codec licensing costs
- Encryption
 - Big plus for the big guys
 - No [legal] benefit to American hams...?

P25 Cont. (Bill N4NJJ)

- Multi-Band Excitation

- Roots go back to MIT in the 1960s
- IMBE
 - P25 Phase 1 Radios
- AMBE
 - Dstar
 - System Fusion
 - Iridium Sat Phones
 - Certain channels on SiriusXM
 - OpenSky (Broken Sky... hihi)
- AMBE+2
 - P25 Phase 2
 - DMR

- Licensing

- \$100,000 to \$1m
- MP3 starts at \$15,000
- IMBE Patent has expired

Why did Public Safety introduce P25 to begin with?

- Cliff Effect
 - Digital works where analog would be unintelligible until you fall off the cliff
- Interoperability
 - It's what was "decided on"
- Encryption
- Spectral Efficiency
 - Phase I = 12.5 kHz; Phase II = 6.25 kHz
- Data
 - Location, text messaging, unit ID, over-air-rekeying
- Trunking

Mostly stuff that hams either (1) Don't care about (2) Aren't allowed to do

System Type	CONVENTIONAL	CONVENTIONAL IP NETWORK	SINGLE-SITE TRUNKING	MULTI-SITE TRUNKING	ENHANCED MULTI-SITE TRUNKING
			NXDN: Type-D TRKG	NXDN: Type-C TRKG P25: PHASE 1/2 TRKG	NXDN: Gen2 P25: PHASE 2 TRKG
					
No. of Radios					
Trunking	N/A	N/A	DECENTRALIZED CONTROL	CENTRALIZED CONTROL	CENTRALIZED CONTROL WITH SERVER BASED ARCHITECTURE
No. of Sites	SINGLE	UP TO 16 (unicast) UP TO 48 (multicast)	SINGLE	UP TO 48	UP TO 1000
Advantages	COST & CAPACITY BASELINE	COST EFFECTIVE COVERAGE	COST EFFECTIVE CAPACITY	CAPACITY AND COVERAGE	CAPACITY, COVERAGE AND CONTROL

Kenwood. (n.d.). *System type recommended systems* [Table]. Kenwood.

https://comms.kenwood.com/en/common/img/system_type/recommend_systems.png

Bare Basics for Hams to Know

- Improved audio quality over other digital modes
 - 2800 bps of total 9600 bps is allocated to error correction
 - IMBE vocoder converts the voice into digital data which is then protected using error correction
- Radios
 - Not going to find Kenwood, Icom, or Yaesu P25 radios branded toward hams
 - Kenwood, Icom, Vertex, et al do have P25 commercial radios
 - This is a break from DMR (and Dstar/Fusion are exclusively marketed toward hams)
 - Higher cost to entry even on used market
 - Secondary weapon
 - Radios are built to much higher physical standards
 - Programming
- Repeaters (as of October 2024)
 - RepeaterBook reports 813 active P25 ham machines in the world
 - RepeaterBook reports 4,561 active DMR ham machines in the world
 - RepeaterBook reports 2,563 active DStar ham machines in the world
 - RepeaterBook reports 3,824 active YSF ham machines in the world

Some Basic Terms

- Radio ID = Just like DMR, you need a radio ID
 - It's recommended to use your DMR ID: <https://radioid.net/>
 - Standalone networks do use own numbering scheme
- NAC = Network Access Code
 - Similar to a PL tone (CTCSS), but signal is outside of the voice frame
- Talk Group = For all intents and purposes, just like DMR
 - In public safety, Henderson PD has Main Dispatch, Info, Narcs, Detectives, Tac, Training
 - For hams, could be a specific club, regional, interest, etc.
- Simulcast = One channel at each of the simulcasting sites transmits the same signal simultaneously at the same frequency
- Multicast = One channel at each of the participating sites transmits the same signal simultaneously at different frequency

Local Users of P25 (for Buffalo audience)

- Erie County Sheriff
- Buffalo Police
- Amherst Police
- Kenmore Police
- City of Tonawanda
- Town of Tonawanda
- Federal Government
 - FBI, FPS, TSA, US Marshals, USCBP
 - All of these are conventional (not trunked)
- Niagara County Sheriff
 - Phase I trunked system

Local Users of P25 (for Vegas audience)

- Southern Nevada Area Communications Council
 - Phase I TRS (Trunked radio system)
 - BCFD, BCPD, CCFD, CCSD PD, HPD, HFD, Paiute Tribe, NLVPD, NLVFD, RTC, SNHD
 - 800 MHz with a VHF simulcast site in Pahrump
- Las Vegas Metro
 - Phase II TRS
 - 700 MHz
- Nellis/Creech AFB
 - Phase I TRS
 - 406 - 410 MHz range
- Federal Government
 - FBI, FPS, BLM, NPS, TSA
 - All of these are conventional (not trunked)

P25 Ham Repeaters in Buffalo

- N4NJJ/K9KVN Repeater on 442.675 MHz in Williamsville (off the air)

P25 Ham Repeaters in Vegas

- 147.210 MHz (PL 107.2/NAC702) - N4NJJ - Centennial Hills
- 147.270 MHz (NAC ___) - KD7MIR - Sunrise Hospital
- 420.850 MHz (NAC702) - N4NJJ - Black Mountain Arden
- 445.375 MHz (PL 107.2/NAC702) - N4NJJ - Centennial Hills
- 447.225 MHz (NAC 293) - N6LXX - Low Potosi
 - Linked full-time to the N6LXX P25 system throughout SoCal
- 447.350 MHz (Mixed DMR/P25/Analog - KG7SS - Lone Mountain
- 448.325 MHz (PL 107.2/NAC702) - N4NJJ - Angel Peak
- 448.425 MHz (NAC 293) - WB6TNP - Angel Peak
 - On the MMDVM P25 Network
- 448.875 MHz (PL 114.8/NAC 293) - K7RSW - Henderson
- 449.700 MHz (PL 107.2/NAC702) - N4NJJ - Low Potosi
- 927.5625 MHz (PL 107.2/NAC702) - N4NJJ - Centennial Hills

How to get started?

- Consider financial investment?
 - Is it worth it? Are these people I want to chat with?
- Apply for Radio ID (or use your DMR one): <https://radioid.net/>
- Get a radio
 - Recommend XTS 2500 with FPP; XTS 5000; APX 4000; APX 6000
 - Midland STP-404A
 - Cheapest option right now on eBay
- Digital hotspot

