DVSI AMBE+2 v1.60

Project 25 Compatible radio equipment utilizes a standardized algorithm that converts analog audio signals from the radio microphone to a digital bit stream for transmission over the P25 Common Air Interface. At the P25 radio receiver, these digital signals are then converted back to analog signals and presented to the radio operator via the unit's speaker. For voice signals, this process is called vocoding, and the mathematical algorithm that converts the analog signals to/from digital is called a Vocoder. Vocoder is short for voice coder/decoder.

In order for all P25 radios to be interoperable, a standardized vocoder was selected for P25 back in the early 1990s. Selection of the vocoder was based on listening and performance tests comparing various vocoder algorithms in typical public safety environments. This testing resulted in the selection of Digital Voice System Incorporated's (DVSI) Improved Multi-Band Encoder (IMBE) for use in Project 25 radio products. Testing included both audio environments (background noise like gunshots, sirens etc) and radio propagation impairments (fading, multi-path, etc).

Since selection of the IMBE Vocoder, there have been a number of developments in the LMR industry. For example, Digital Signal Processors (DSPs) and associated memory have increased in performance with corresponding decreases in power consumption and price. This has enabled DVSI to include numerous improvements in the baseline IMBE vocoder.

Additionally, deployment of P25 digital radio products in real world scenarios has resulted in the need to improve the audio performance of digital transmission in some of these use cases. For example, fireground communication scenarios with high background noise environments or other audio interference (such as PASS Alarms or SCBA Masks) drove the need for improvements to the audio processing in digital radios. Operational use indicated a need for more robust methods of passing typical audio signaling such as DTMF. Since the P25 Vocoder was optimized for voice signals, audio tones were not transmitted with enough fidelity to allow existing decoders to process these signals. These scenarios did not necessarily identify problems with the IMBE Vocoder per se, but did highlight the importance of optimizing the analog audio signal prior to vocoding and providing methods to process non-voice signals.

Since the selection of the IMBE vocoder back in the 1990s, DVSI has made significant improvements in the IMBE vocoder as well as offering optimized audio processing to improve the overall audio performance of the P25 radio. These improvements maintain interoperability among all P25 radios, regardless of the vocoder version. DVSI generally refers to the improved vocoder algorithms as Advanced Multi Bane Encoding (AMBE). Currently P25 Phase 1 radios can implement three different vocoder implementations while still remaining interoperable. These three versions are generally referred to as:

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1. Baseline – This is the original 1993 Version of the P25 Vocoder. Selected based on providing the best performance in public safety scenarios among four candidate vocoders. Provides roughly equivalent performance to analog FM radios.
2. Enhanced Full Rate- This provides improved performance in the presence of RF channel interference. This version provides more robust performance in a variety of real world radio transmission environments due to propagation effects. Primarily based on DVSI's AMBE+2 family of vocoders.
3. Enhanced Full Rate with System Improvements- System improvements are generally considered to be improvements to the audio processing prior to vocoding to improve the overall audio performance. This includes provisions to process audio signaling such as DTMF, provides Automatic Gain Control (AGC), improved performance in high-frequency noise such as a PASS alarm.

P25 Standards do not require that a radio manufacturer use DVSI furnished products. However in practice, most manufacturers have chosen to provide one of the above vocoder versions from DVSI. Based on age of product, available memory or available DSP processing, manufacturers have fielded product with various vocoder versions. It is also important to note that some manufacturers have chosen to implement vendor specific versions of the vocoder options. Proprietary vocoder implementations do not impair interoperability, but can be problematic because the system improvements may or may not be optimized to operate with DVSI software. Also, proprietary improvements are not necessarily verifiable, where as the solutions offered by DVSI have been subject to public review.

RELM BK Radio's KNG Series mobile and portable radio products implement the most recent version of DVSI's Enhanced Full Rate Vocoder with System Improvements. DVSI refers to this software implementation as the AMBE+2 Dual Rate Mode Vocoder Version 1.60.

By utilizing the Enhanced Vocoder with system improvements, the KNG Series radios provide the best performance in a variety of public safety use cases. Utilizing software vocoder implementations from DVSI ensures the KNG Series radios implement optimized audio processing that has been carefully matched to the DVSI Vocoder. Therefore, KNG Series Radios deliver best in class audio performance for public safety users.

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	DVSI Vocoder Version (Per Data Sheet)		
Radio Model	Baseline	Enhanced	Enhanced with System Improvements
KNG Series-Mobile and Portable			DVSI AMBE+2 v1.60
Datron Guardian	IMBE		
Motorola XTS-1500/2500/5000	IMBE		
Motorola XTL-1500/2500/5000	IMBE		
Motorola APX-7000/7500			DVSI AMBE+2 v1.60
Midland STP/STM	IMBE		
Kenwood TK-5210/5310, TK-5710/5810	IMBE		
Harris Unity			DVSI AMBE+2 v1.60
ICOM		AMBE+2	
EFJohnson-5100 ES/5300 ES			DVSI AMBE+2 v1.60
Tait TP-5100/TM-5100	IMBE		
Vertex VX-7100/7200, VX-P920/P820	IMBE		