Automatically detect voice channels in wideband VHF/ UHF data and record them for immediate access by analysts.

VHF/UHF VADS product overview

The automated Voice Activity Detection System builds on the energy-detection capabilities of the E3238 Signal Intercept and Collection System, adding two-pass voice channel detection. It dramatically reduces false positive identifications common with systems that only use a single-pass frequency-domain technique. Detected voice channels are recorded to disk. Software tools are included for linguists to very efficiently access and play back recorded voice massages saved to the system disk or a LAN disk.

Key features

- VHF/UHF frequency coverage of 20 - 2700 MHz using the E2730B tuner or 20-6000 MHz with the E2731B
- Identifies language- and speaker-independent FM voice channels
- Uses both frequency- and time-domain voice detection algorithms to reduce false positive identifications
- Scalable from 32 to 96 channels of narrowband voice detection with built-in recording
- Automatic up/down signal detection records the entire signal without wasting disk space
- Voice signals are time stamped
- Records voice channels to system disk or any disk on the system LAN in .wav, .au, or raw time data formats
- Includes independent N6829B Audio Player software application to demodulate and listen to saved voice channels on the system PC or separate PCs on the LAN
- Saved voice signals can be demodulated and saved as .wav, .16t or .au files for easy access and usability across computer platforms
Voice activity detection

Identifying voice signals in the thousands of signals in the RF spectrum is a challenging task requiring extensive signal processing. The Agilent E3238 Signal Intercept and Collection System has the modular, extendable DSP architecture necessary to tackle this task. The automated Voice Activity Detection System (VADS) adds software and hardware components to a standard E3238 to create an automated voice detection system.

E3238 wideband search

The E3238 is known for its ability to detect new signals, even when they are buried in noise or hiding next to extremely large signals. Its wideband search capability allows it to catch signals in its stare bandwidth of 36 MHz for VHF/UHF. It has threshold functions that shape to the noise floor, even as the noise floor changes due to changing atmospheric conditions. Signals exceeding a userspecified threshold are automatically characterized and their parameters are stored in a database to be checked against alarm criteria. When a signal meets the alarm criteria, a user-specified task is performed. A typical task might be to pass the signal to the E9821A DSP module where 32-channel digital down-converters (DDCs) isolate the identified signal and G4 processors run custom DSP algorithms on it. Depending on the outcome of this DSP processing further alarms can be generated, initiating additional alarm tasks.

Two-pass voice detection

The VADS uses the E3238 DSP architecture to implement a two-pass voice detection test, reducing false positive detections that can overwhelm system resources and a user with bad data. The first test utilizes the E3238’s wideband search capability to identify candidate voice signals by their spectral shape. The second test is an extremely DSP-intensive time-domain test. It tests the individually identified signals for the characteristics of spoken voice, providing a final, more conclusive test for voice.

Narrowband recording

During the voice detection process, the signal data is buffered. If voice is detected, the buffered data can be recorded to the system disk. Recordings can be a fixed duration, or can be configured to record until the end of the voice transmission. The recording process supports a variety of common formats including .wav, .au, and raw time data formats for use with a variety of media players and the N6829B Audio Player Software.

Realtime audio option - AU1

Operators often want to listen to audio streams from many different channels in realtime, either to check quality or to be able to assess importance of a particular data stream. In older systems, this has often meant buying dedicated “handoff receivers” to demodulate the signals. The realtime audio option 35688E-AU1 makes it possible to assign some of your unused DDC channels to demodulate realtime audio streams in the same way. Linguists can access the realtime data stream to listen and evaluate signal messages as they occur in one ear, while playing back narrowband recorded data in the other ear. All the controls are conveniently displayed in the voice activity user interface so the operators eyes never have to leave the data panels. Operators can also record the realtime audio sessions they have listened to into a separate file for future reference. When the operator hears something of interest they can quickly tap the record button. Operators can also choose to record all of their monitored audio for a whole day to jog their memory later.

Time-domain voice test. The display above shows the output of the second pass time domain analysis of potential voice channels. It shows 31 channels assigned for voice processing. The 10 channels in Blue are currently assessing signals to determine if voice is present. The 5 channels in RED are detected and intercepted voice signals being recorded to disk. The three channels in ORANGE have aged out and the detectors are in dwell state before releasing the channel back to the pool. All grey channels are unassigned and available. If there are more voice channel candidates than available narrowband channels, they are queued up in priority order and assigned to the first available channel. The signal displayed is for the active channel on 16 which is being recorded and monitored realtime using the realtime audio stream function of the product.
**N6829B Audio Player** (formerly 35682A Snapshot Radio)

Audio Player is a separate file-based software tool used by operators to demodulate and listen to the recorded -VA2 signals. In systems without E3238 hardware, linguists can access the LAN to listen to and evaluate signal messages. Looping and noise reduction can be used to increase audibility and aid translation. Since Audio Player uses raw time data files, center frequencies and bandwidths can be retuned. Extensive snapshot file management features allow multiple linguists to simultaneously sort through hundreds of files quickly and efficiently. Several linguists can remotely access the files simultaneously, increasing productivity.

The example display at the right shows playback looping on the portion of the time-domain signal designated by the blue bar below the upper trace. The signal has been re-tuned using the slider under the wideband spectrum display in the middle “Tuner” pane. To increase audibility, the audio bandwidth of the saved file has been narrowed using the medium bandwidth filter, and Automatic Gain Control has been applied so the volume does not change radically due to different signal levels. Adjustable squelch capability, shown by the red lines in the upper time domain display, provides two important benefits. First, it dramatically decreases user fatigue by removing the noise between transmissions. Second, Audio Player automatically skips over portions of the signal where squelch is applied, saving the linguist’s time.

The middle “Tuner” display shows the full bandwidth file saved by -VA2, while the “Processing” display shows the demodulated spectrum with the voice enhancement filter applied. The selected portion of the retuned, filtered signal can be saved as a .wav or .16t file to share it with others. The .wav files can be played on any industry standard media player application.

**N6829B Audio Player features:**

- Demodulate USB, LSB, AM, and FM signals
- Loop on user-select portions of the file
- Retune recorded signals in real-time while listening
- View the demodulated signal in the time or frequency domain
- Use filters and squelch to improve audibility and speed up signal sorting.
- Save the demodulated files as .wav or .16t files
## N6829B Audio Player file management features

The sheer number of voice files can be overwhelming. The N6829B Audio Player’s snapshot file management capabilities are critical to sifting through the hundreds of files quickly in an operational situation. For very high volume missions, several analysts can work together sorting through files, each using their own copy of the N6829B Audio Player. File management features are optimized for speed. Up/Down arrows allow an analyst to move through the list of files as they listen. They can use the two buttons with file icons to sort files of interest into either of two file locations, identified at the top of the display at the left. Any retuning, filtering, or demod setting applied to a signal to improve audibility is retained with the file, so that time is not wasted later. Unwanted files can be discarded with the button with the red “X.” If “Auto Refresh” is turned on, the file list will automatically update as the Voice Activity Detection System records new files to the disc. Audio Player can be linked via a software socket to a Voice Activity Detection System so that discarding a file can add its center frequency to the VADS “Ignore List.” This is useful when a particularly active frequency is determined to not be of interest. The Ignore List prevents the VADS from saving signals at the specified center frequencies, saving critical system resources and analysts’ time.

### Snapshot File Manager

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<th>File Name</th>
<th>Date</th>
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<tr>
<td>UVAD_04-10-04_08-55-43.747_155.843732MHz.cap</td>
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</tbody>
</table>

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96 channels of voice detection and recording

96 channel system in only 5 slots. This configuration has two E9821As, with a total of 10 G4 processors. It provides a total of 96 channels of voice detection and recording in a portable 5-slot VXI mainframe.

Smaller, higher value systems. With the DDC plug-in, the E9821A can perform search and collection in a single DSP module. This produces a smaller, less conspicuous system. Previous Voice Activity Detection Systems were over twice this size. When used with an external laptop PC, this 96 channel system is very portable.
Adding direction finding to voice detection.
Direction finding can be integrated with voice detection, allowing a user to see the direction of voice transmissions. The top E3238 display shows all the recorded voice signals with additional information, such as the sub-audible tone frequency. It provides an overview of the system as it automatically tests candidate signals to see if they are voice. When the E3238 identifies a voice signal, it can automatically tip a DF system with the signal’s center frequency and bandwidth. The returned direction information is then added to the signal’s information in the signal database, where it can be used as an alarm criteria. Alarms can then be generated only for voice signals coming from a particular direction. The direction display at the right is a live display of direction as signals are being acquired. The compass shows an analog and digital readout of direction, with a red bar on the right showing the quality of the DF reading.
Configuration Example:
96 Channel VADS System

Measurement hardware

Mainframe
- MFRAME1 5-slot VXI mainframe
  or
- E1421B 6-slot VXI mainframe
- E1421-80921 RFI shields
- E1421B-xxx power cord
  or
- E8403A 13-slot VXI mainframe
- E1401-80918 RFI shields
- E8403A-xxx power cord
  or
- E8404A 13-slot VXI mainframe
- E1401-80918 RFI shields
- E8404A-xxx power cord

Tuner
- E2730B 20-2700 MHz
  or
- E2731B 20-6000 MHz

ADC
- N6830A 70 MHz IF ADC

DSP
- 1 - E9821A - Signal Processor Module
- 3 - E9821A-101 Add dual G4 processor card with extended RAM
- 1 - E9821A-200 Add 32-channel DDC
- 1 - E9821A - Signal Processor Module
- 2 - E9821A-101 Add dual G4 processor card with extended RAM
- 2 - E9821A-200 Add 32-channel DDC

Controller and interface
- LTPC2 Windows laptop controller
- E8491B VXI FireWire® interface

Measurement software
- 35688E Intercept and Collection software
- 35688E-VA2 VHF/UHF voice activity detection application
- 35688E-AU1 Realtime Audio Processing
- N6829B Audio Player (formerly 35682A Snapshot Radio)

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Physical Characteristics

<table>
<thead>
<tr>
<th>MFRAME1 5-Slot</th>
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<tbody>
<tr>
<td>Dimensions</td>
</tr>
<tr>
<td>Width</td>
</tr>
<tr>
<td>Height</td>
</tr>
<tr>
<td>Depth</td>
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</table>

<table>
<thead>
<tr>
<th>Configured system</th>
<th>power</th>
<th>lbs</th>
<th>kg</th>
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<tr>
<td>VADS - 32 Channel</td>
<td>200 watts</td>
<td>47.5</td>
<td>21.57</td>
</tr>
<tr>
<td>VADS - 96 Channel</td>
<td>285 watts</td>
<td>51.5</td>
<td>23.38</td>
</tr>
</tbody>
</table>
Remove all doubt

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