

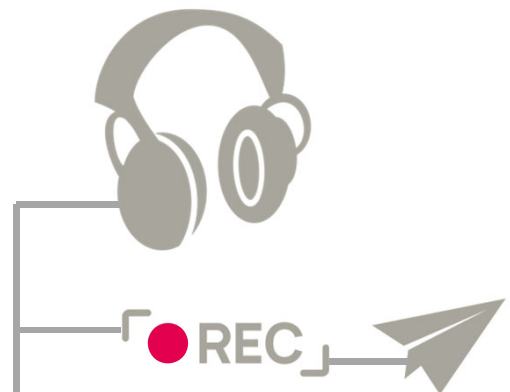
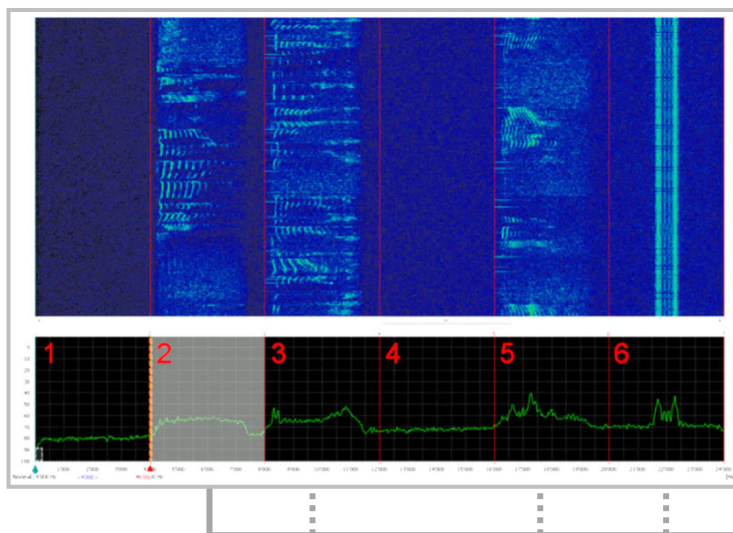
CASE STUDY 1001 v1.0

Prosecution of V/UHF FM-FDM 'Multichannel' Links

INTRODUCTION

This Case Study explores the use of **go2signals** to identify, demultiplex, demodulate and monitor active Voice-Grade Channels (VGCs) carried within V/UHF Frequency Modulated - Frequency Division Multiplexed (FM-FDM) Terrestrial Line-Of-Sight (LOS) links. These Links are sometimes referred to as "Analogue Multichannel".

FDM Channels 2, 3, 5 & 6 active in demodulated Baseband



Sequentially monitoring
extracted audio-channels

BACKGROUND

Employing legacy analogue technologies but still marketed by some manufacturers, V/UHF FM-FDM 'Multichannel' networks remain in contemporary use around the globe. Users of these networks can include friendly, neutral & potentially adversarial state & non-state actors.

For example, such actors include static Border Surveillance & Coastal Monitoring Stations, which use various RADAR, Electro-Optical/Infra-Red (EO-IR) & other proximity-detection systems to detect, monitor & report incursion, intrusion & transit of foreign & domestic entities at and near their borders.

These 'Border Monitoring' Stations then verbally report these surveillance results and other information to their Command & Control HQ using FM-FDM clear-speech channels which then propagate via directional antennas.

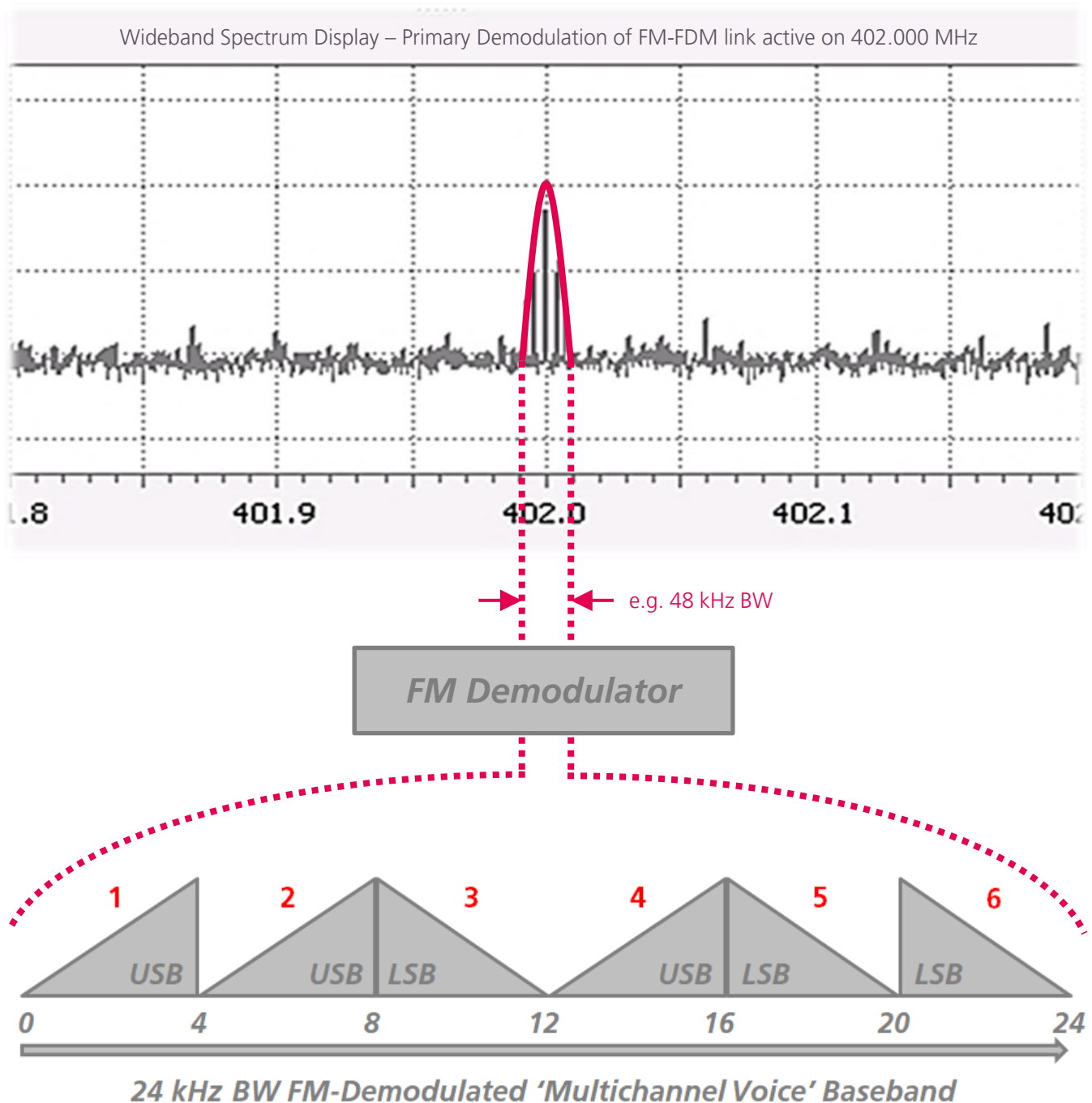
The image (R) shows an example Border Monitoring Station (sub-tropical region) which is employing vertically-polarized directional Yagi-Uda antenna arrays to propagate their FM-FDM 'Multichannel' emissions to other sites.



Border/Coastal Monitoring Station

THE NEED

During manual or automated search initiatives, Electronic Surveillance (ES) Operators can often miss or disregard these potentially valuable Signals-Of-Interest due to possible lack of awareness, but equally, due to lack of suitable FM-FDM de-multiplexing & de-channelling capabilities (either hardware or software based).



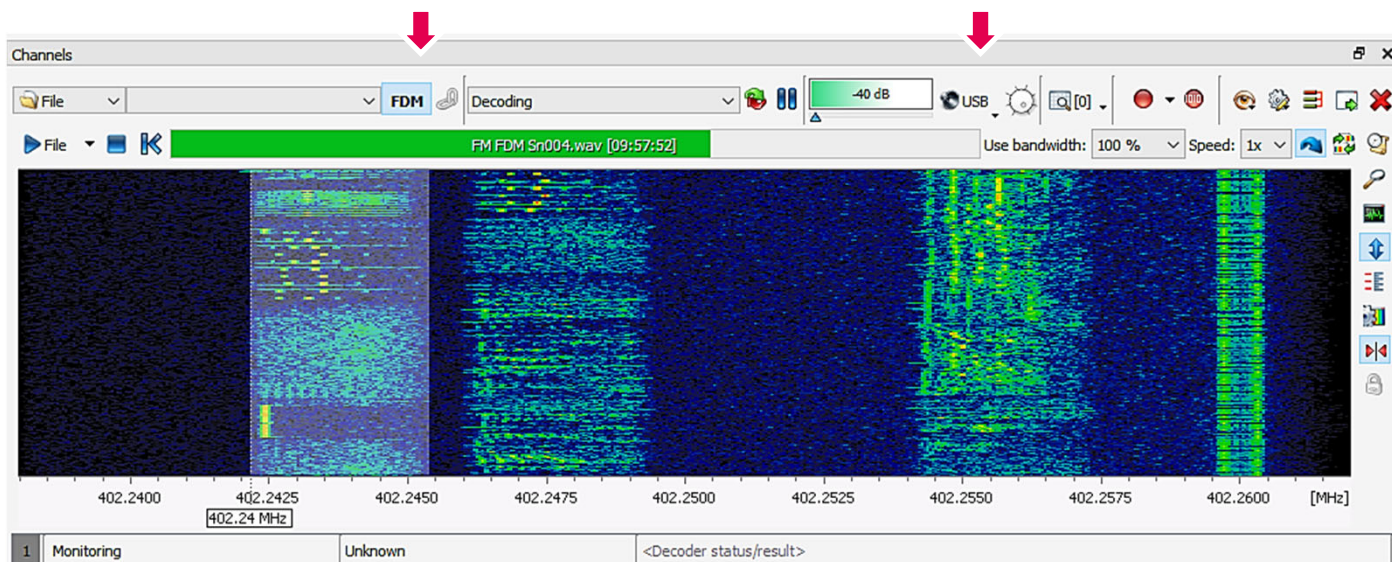
In the example above, the demodulated baseband is carrying **6x** 'stacked' 4 kHz Voice-Grade Channels (VGCs); some using Upper-Sideband (USB) & others using Lower-Sideband (LSB) modulation. Each VGC can be extracted & demodulated to audio using specific techniques & procedures.

There remains an operational need for ES Operators to recognise, de-channel & monitor/record the content of these 'legacy technology' but still currently active V/UHF FM-FDM 'multichannel' LOS links, so how can this need be mitigated using only ES software capabilities?

go2MONITOR 'FDM'

The Narrowband 'Production' Channels of **go2MONITOR** include the capability to enable live, real-time demultiplexing, de-channelling, monitoring and recording of extracted FM-FDM VGCs.

To visualise and monitor each active VGC in the Signal-Of-Interest's de-multiplexed baseband, the Operator simply selects the '**FDM**' button in the appropriate Narrowband 'Production' Channel of **go2MONITOR**, which then demultiplexes the FDM baseband, enabling visualization of all VGCs being carried. Each active VGC can now be demodulated, monitored & recorded using the Narrowband 'Production' Channel's audio-demodulator.

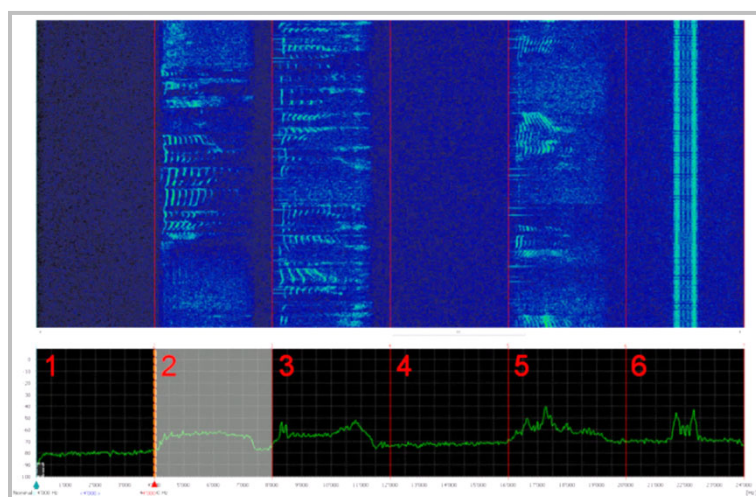


'FDM' selected - viewing/extracting & monitoring active channels in the baseband

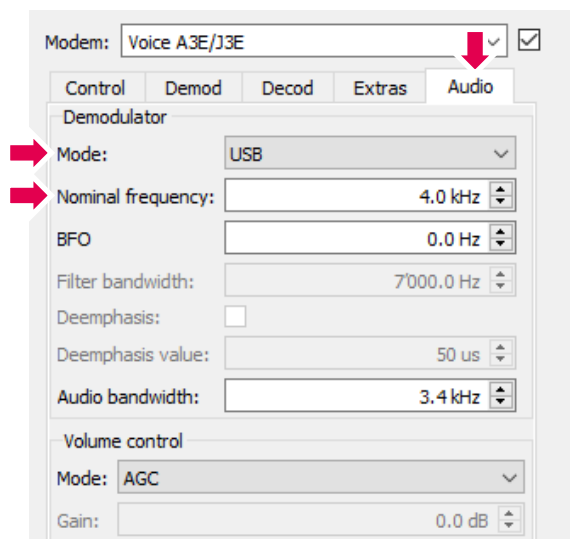
go2DECODE – DANA 'FM demodulation'

In this operational example, an Operator has encountered & recorded a new SOI in a UHF sub-band during persistent-search initiatives. Using **go2DECODE**, the Operator plays back & 'FM demodulates' the recording in **DANA**, & notes apparent clear-speech 'voice-formants' in VGCs 2, 3 and 5, and apparent digital content running in VGC 6.

Using **go2DECODE**'s manual extraction capabilities, the Operator sequentially increases the audio-demodulator's Nominal frequency & Mode to monitor and record the clear-speech content of the active VGCs.



FDM Channels 2, 3, 5 & 6 active in FM-demodulated baseband



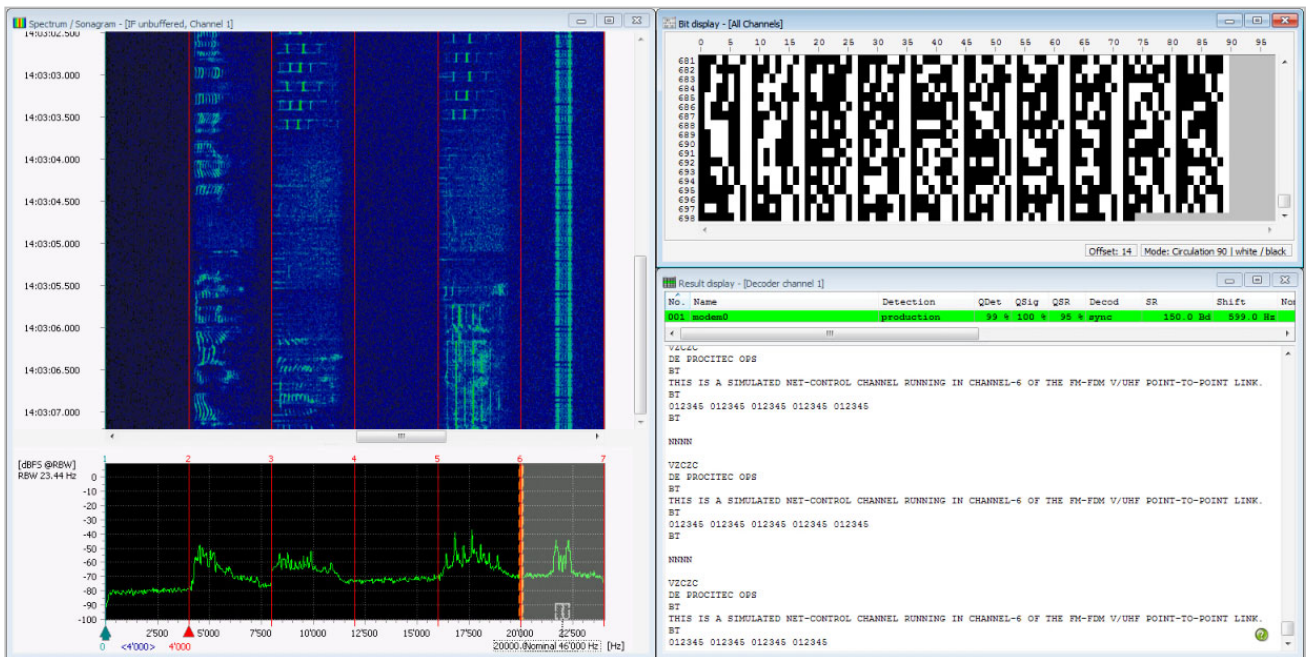
OPERATIONAL EXAMPLE - DECODING THE CONTROL CHANNEL

The Operator now wishes to manually analyse & decode the digital content in VGC 6 to confirm signalling protocol & content.

Using the **go2DECODE** manual data signals analysis toolsets, the Operator confirms that the digital content is 2-level Frequency-Shift Keyed (FSK2) with a frequency-shift of 600 Hz

and Symbol Rate of 150 Bauds (delivering a Modulation Index of 4).

Analysis of the demodulated bitstream determines that the traffic is ASCII-7 character coding with 1 start-bit and 1 stop-bit for each character. The Operator decodes the demodulated bitstream, confirming that the digital content is a cyclical net-control signal.



Decoding the content of FM-FDM VGC-6

ONLINE OPERATIONS WORKSHOPS & TRAINING

Ops Workshops & Training Modules are available for those **go2signals** user-groups who may wish to further explore the prosecution of these V/UHF FM-FDM networks. Please contact us for further information & scheduling.



FURTHER INFORMATION

relating to the Prosecution of V/UHF LOS FM-FDM networks, please contact sales@procitec.com

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