



sigint.development



S455N – Israeli UAV Digital Video



Golf Section, JSSU(CYP)

Analyst: [REDACTED]

TOP SECRET STRAP1 SPOKE

CONTENTS

1.INTRODUCTION.....	3
2.MODULATION.....	3
3.FORWARD ERROR CORRECTION (FEC) AND ERROR DETECTION.....	3
4.RANDOMISER.....	4
5.PAYLOAD.....	5
6.VIDEO & S455E.....	6
7.CONCLUSION.....	7

TOP SECRET STRAP1 SPOKE

1. INTRODUCTION

- 1.1 This report covers analysis of S455N a High Data Rate (HDR) signal emanating from an Israeli UAV. The Signal of Interest (SOI) was first intercepted in April 2009 however, the original recording was too weak for full analysis. This report is based on the analysis of a recording made in April 2010.
- 1.2 S455N is a complex signal utilising a number of error correction and detection techniques to successfully convey Internet Protocol (IP) data carrying streaming digital video.

2. MODULATION

- 2.1 The SOI employs FSK modulation and is keyed at 9.11MBauds occupying approximately 10MHz bandwidth. Demodulation of the SOI was attempted using various demodulators including m2Extra however, the resultant bits were poor quality. The SOI was successfully demodulated using an FM demod in Black Magic.
- 2.2 Data is NRZL and frames consist of 4140 bits with a 44 bit synchronisation pattern – 11101011010101001101001101110011011111110000.

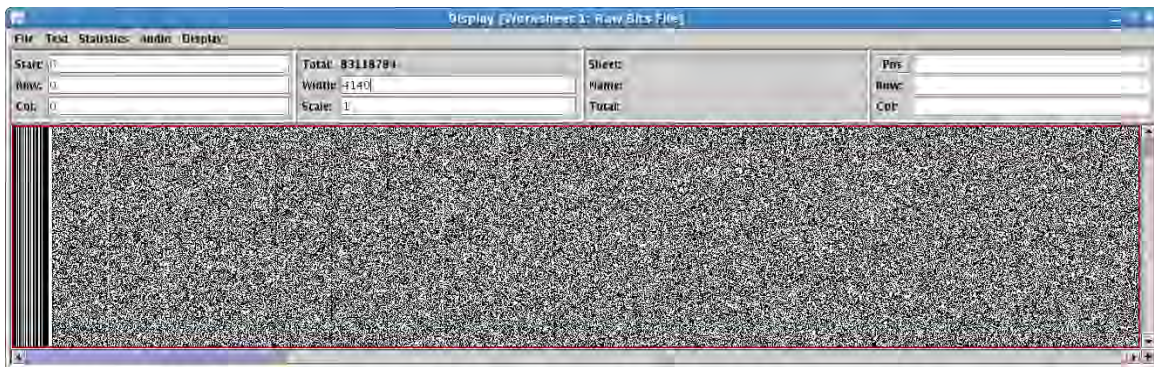


Fig 1: DVT Sync'd Data Frames

3. FORWARD ERROR CORRECTION (FEC) AND ERROR DETECTION

- 3.1 FEC and EDAC are achieved utilising a block interleaver and a two dimensional Turbo Product Code (TPC). The interleaver is a 64x64 bit block interleaver used to spread the data to improve the performance of the TPC. The TPC is a (64, 57)*(64,57) 2 dimensional code employing parity with a generating polynomial of:-

$$g(x) = x^6 + x^1 + 1$$

- 3.2 The FEC can be utilised to correct the data using magyk or removed by applying a t3648s448 to remove the vertical dimension and a t57s7 to remove the horizontal dimension.

TOP SECRET STRAP1 SPOKE

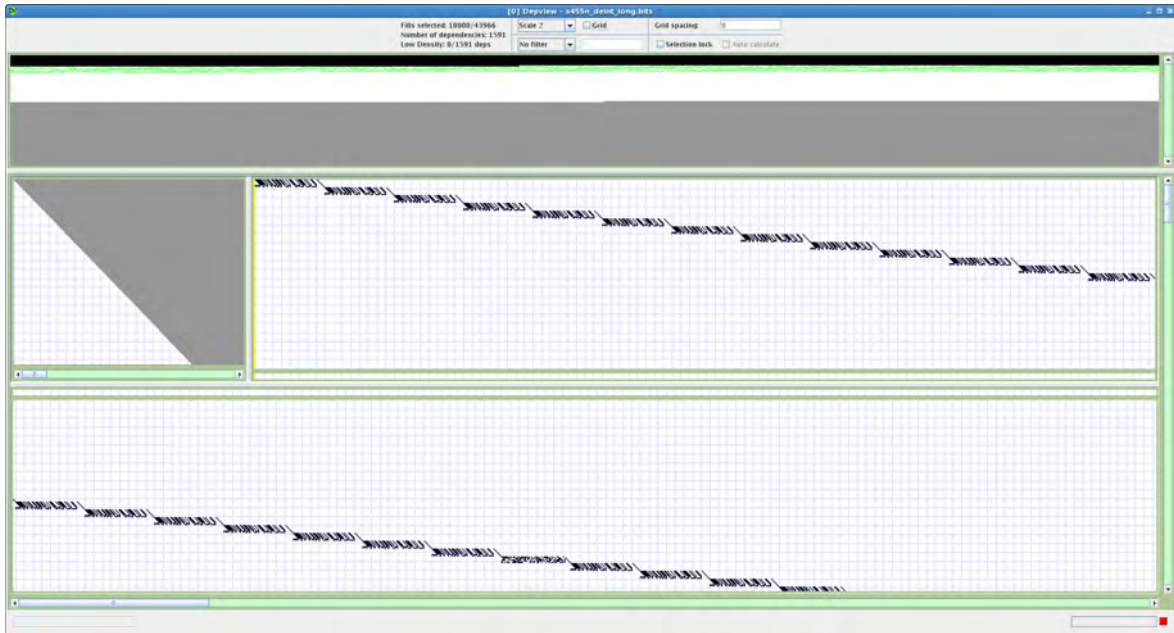


Fig 2: Depview showing horizontal dimension

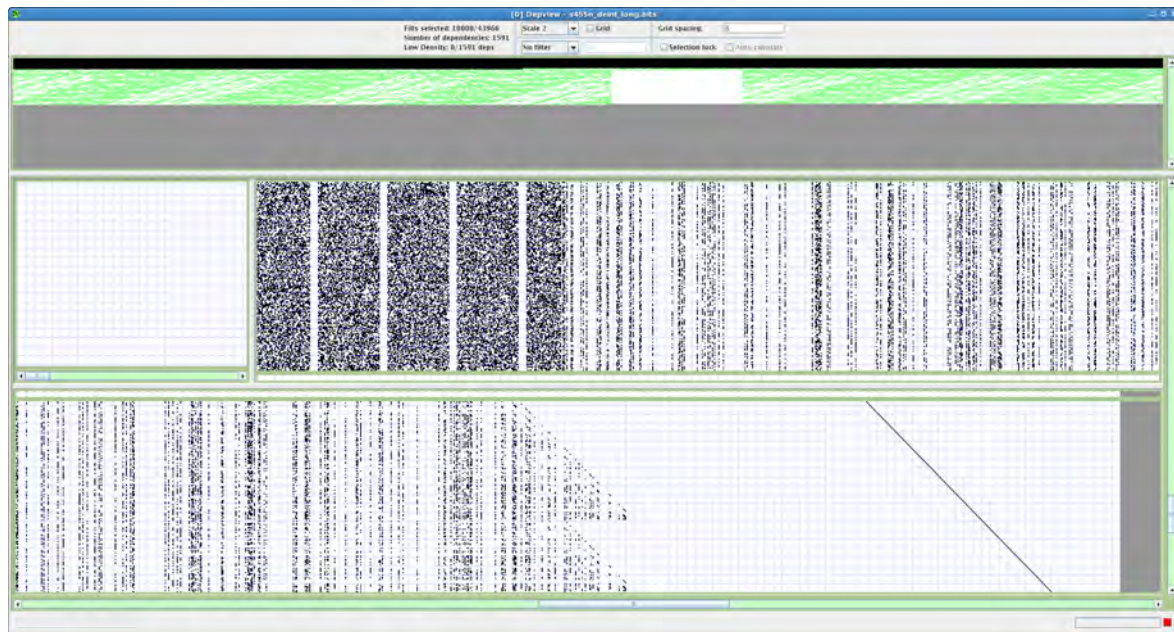


Fig 3: Depview showing vertical dimension

4. RANDOMISER

- 4.1 After deinterleaving the data and removing the FEC the frame width should be 3249 (57*57). The frame begins with a 10 bit sync except on every third frame where 10 bits of data are sent. These 10 bits of data raster on a width of 512 and conform to S455E. Removal of the 10 bits of sync/S455E from each frame will result in a frame width of 3239. The remaining data is randomised using a feed through randomiser F15(0,1,15).

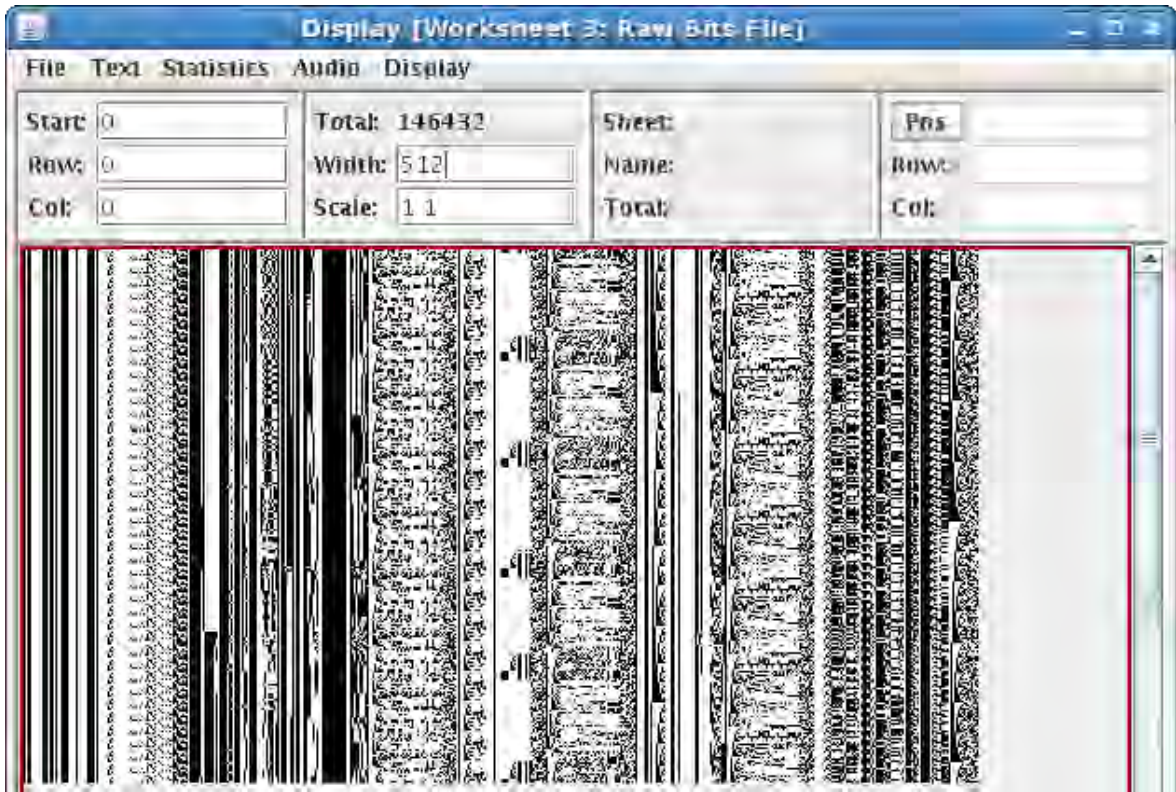


Fig 4: DVT Showing S455E Frames

5. PAYLOAD

5.1 Following removal of the randomiser the data was found to be HDLC. The packets contained IP data carrying Universal Datagram Protocol (UDP) conveying a number of different protocols. The main protocol in use was Real Time Protocol (RTP) and this was being used to carry MPEG 4 streaming video. Analysis of the video revealed multiple video streams from different cameras. The exact video encoding parameters have not been fully resolved and this should be taken in to consideration when viewing any outputted files.

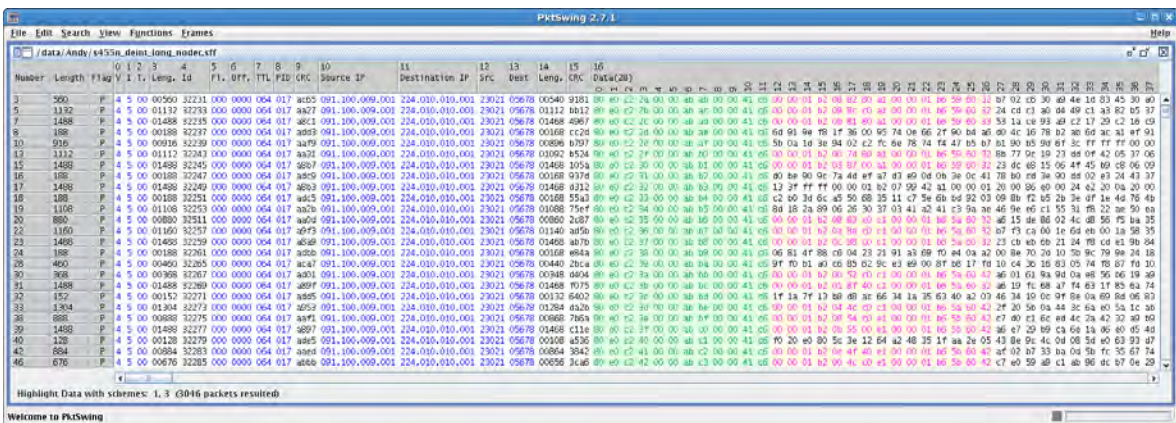


Fig 5: PktSwing showing IP packets carrying RTP conveying MPEG 4

TOP SECRET STRAP1 SPOKE

6. VIDEO & S455E

6.1 The Video is MPEG 4 and appears to contain multiple streams; each stream appears to be capable of scanning through different camera views



Snapshots from Video

6.2 Telemetry is transmitted using normal S455E



Fig 6: GEO Plot extracted from S455E

TOP SECRET STRAP1 SPOKE

7. CONCLUSION

7.1 A number of elements of this SOI need further analysis

- Video – Being analysed by OPC-SPF, GCHQ
- Remaining IP Data – They are a number of protocols in use that need resolving

7.2 This is potentially a significant upgrade to the normal analogue video we see, this new system adds the capability to see a number of video feeds simultaneously. We currently have no collection system capable of processing this signal due to the high data rate and complexity of the underlying data. There are a number of SIGINT collection solutions that would be more than capable of dealing with this signal should there be a requirement to do so.

Further information:

Intercept information and screen shots of associated S455A/E can be found on this wiki page:-

[REDACTED]

This report was issued as:

TOP SECRET STRAP1 SPOKE

STRAP HANDLING NOTICE

(See Annexe H of the STRAP Security Manual for detailed guidance) SECRET STRAP reports may be seen by STRAP-induced SC cleared readers who have a valid need-to-know. STRAP-induced readers who hold a DV clearance may only see TOP SECRET reports at any STRAP level.

CONTACT:

Originator: [REDACTED],
OPA-AN

Non Secure: [REDACTED]
[REDACTED]

ACKNOWLEDGEMENTS:

[REDACTED]