AOC MINI CONFERENCE

THREAT WARNING

21 July 2010

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TOPICS

- **SCOPE**
- **THE 30 WANTS OF RADAR WARNING SYSTEMS**
- **WHAT ABOUT ESM ?**
- **SOME REAL DATA**

WANT # 1

… IMMEDIATE, 100% ALERT

SA 2 GUIDELINE SAM

SA 2 GUIDELINE SAM

SA 2 FAN SONG RADAR

SA 3 GOA SAM

SA 3 GOA SAM

SA 3 LOW BLOW RADAR

SA 6 GAINFULL SAM

SA 6 STRAIGHT FLUSH RADAR

ZSU-23-4 AAA

SA 8 GECKO SAM

SA 8 GECKO SAM

WANT # 2

…SPECIFIC RESPONSE

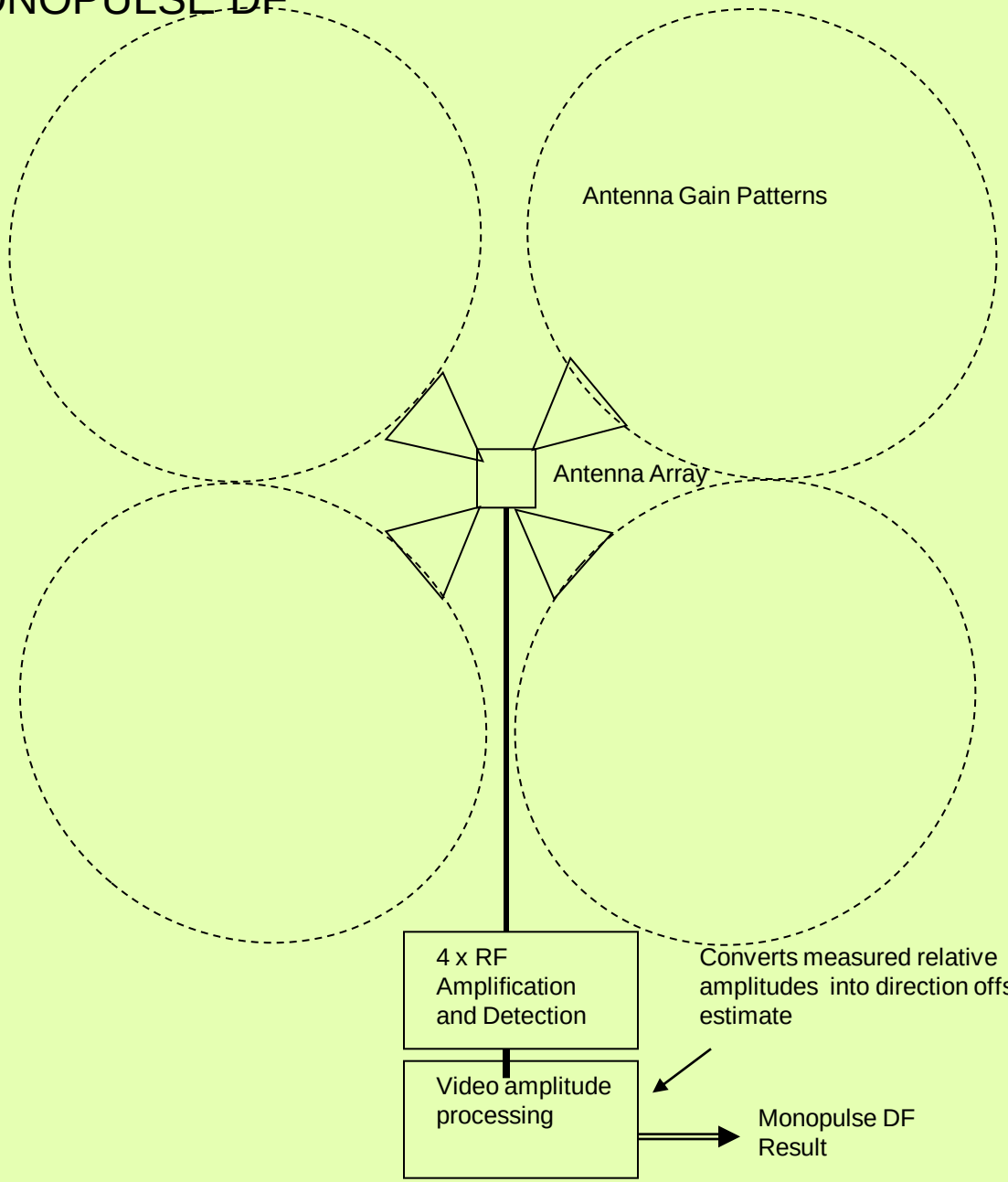
WANT # 3

… OMNI DIRECTIONAL COVERAGE

WANT # 4

… THREAT DIRECTION INDICATION

AMPLITUDE MONOPULSE DF



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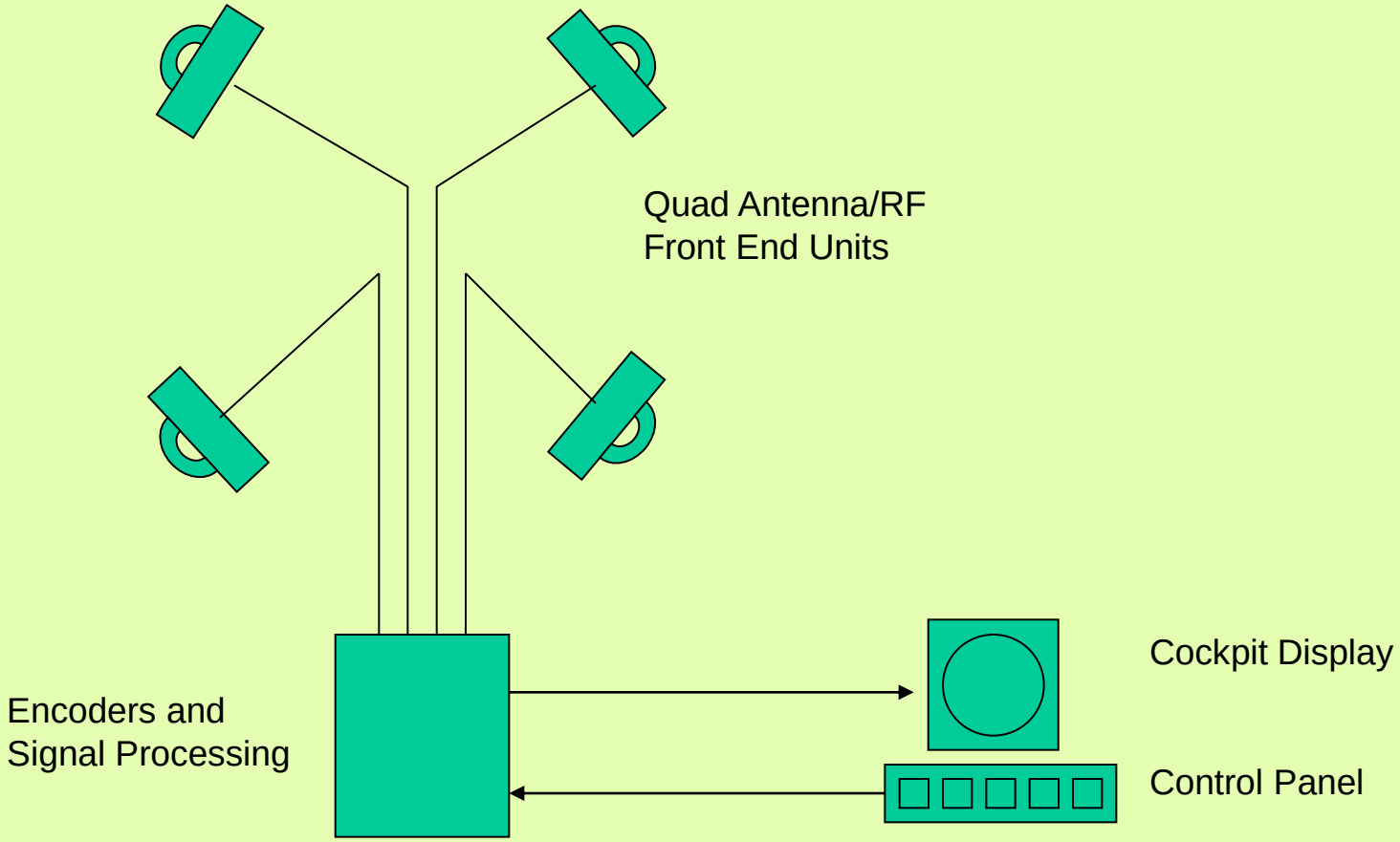
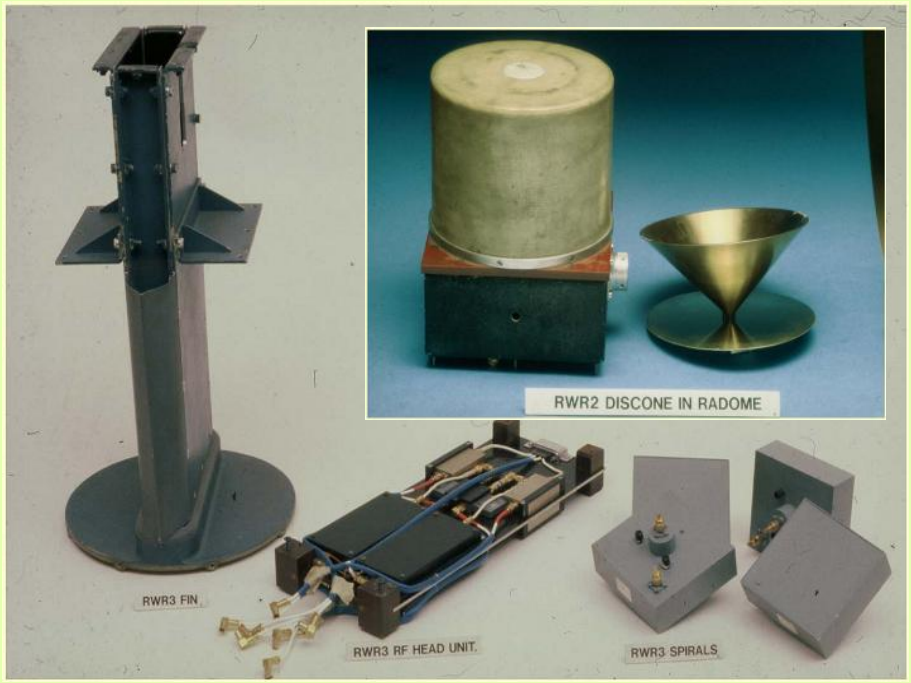


SIMPLIFIED RWR BLOCK DIAGRAM



Canberra : Cenotaph

RWR/ELINT receiver

1976

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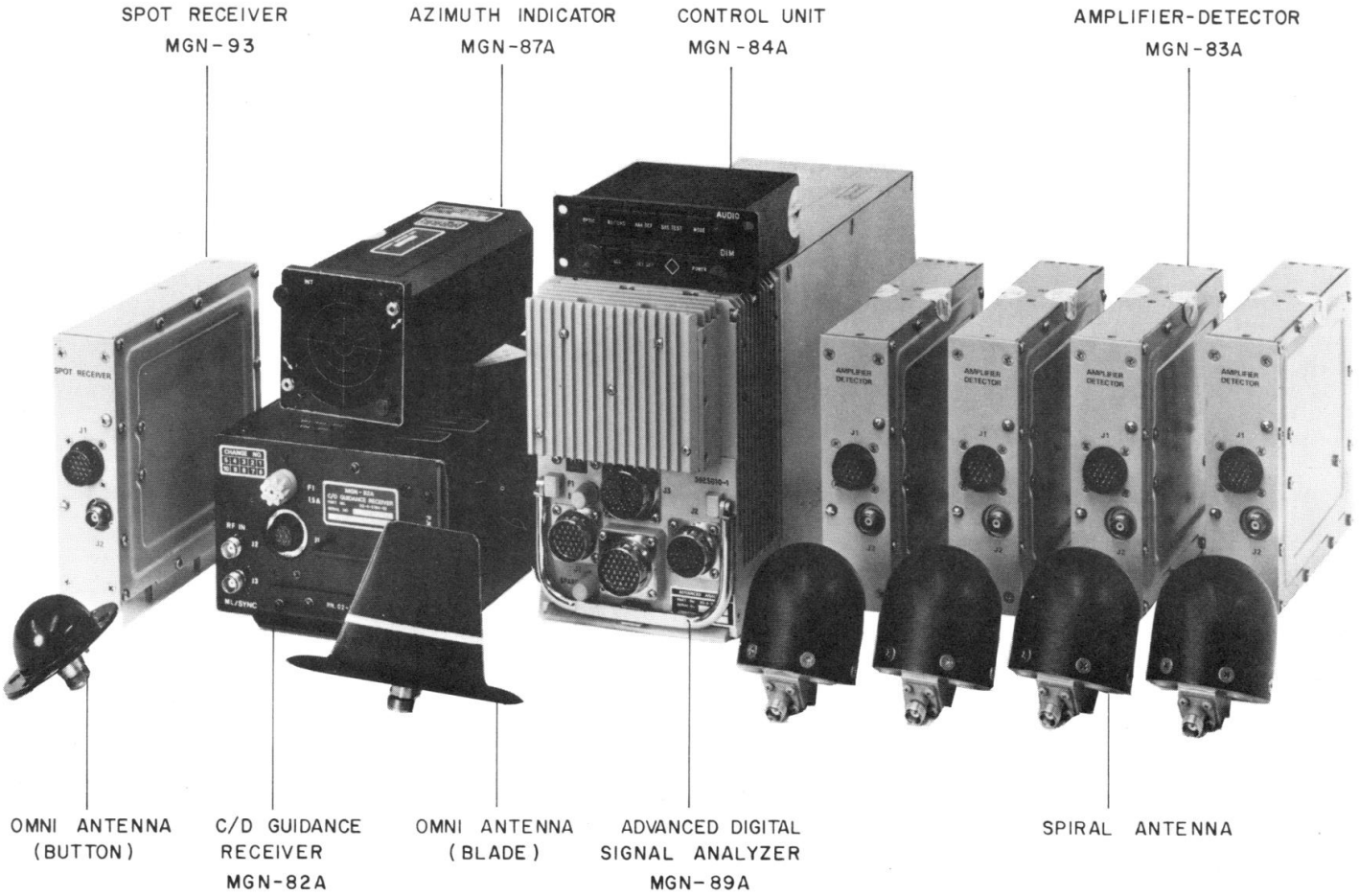
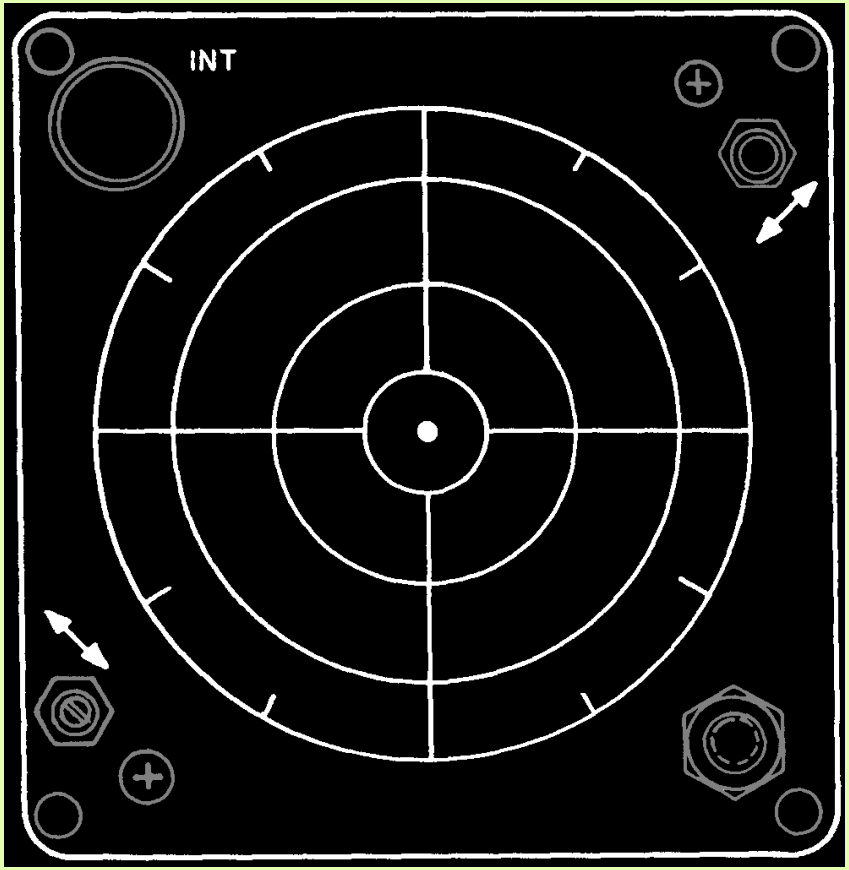
Cenotaph: NIDR Engineers

Compact Radar Warning System (Grinel)

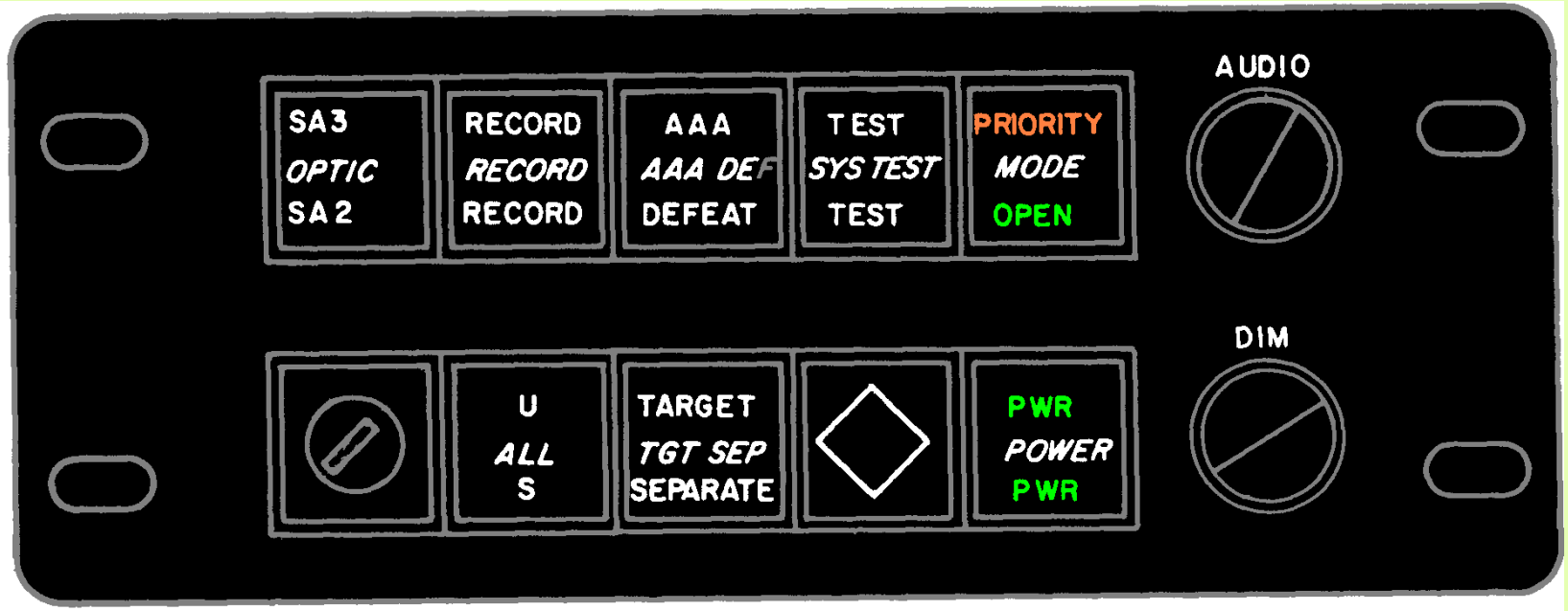


CRWS Azimuth Indicator



TYPICAL COCKPIT DISPLAY (mimic of Sea Raven CDU)

CRWS Control Panel



ROOIVALK MULTI SENSOR WARNING SYSTEM (AVITRONICS)

GRIPPEN WARNING SYSTEM (SAAB)

WANT # 5

… CHEAP

WANT # 6

… EASY TO RETRO FIT

>> Compact

>> Light weight

>> Low power consumption

>> Flexible installation

WANT # 7

… SURVIVE EXTREME ENVIRONMENT

WANT # 8

… THREAT IDENTIFICATION

>> Type

>> Status (mode, function)

>> Severity of threat

>> Range

WANT # 9

… EASY TO READ MMI

>> Simple

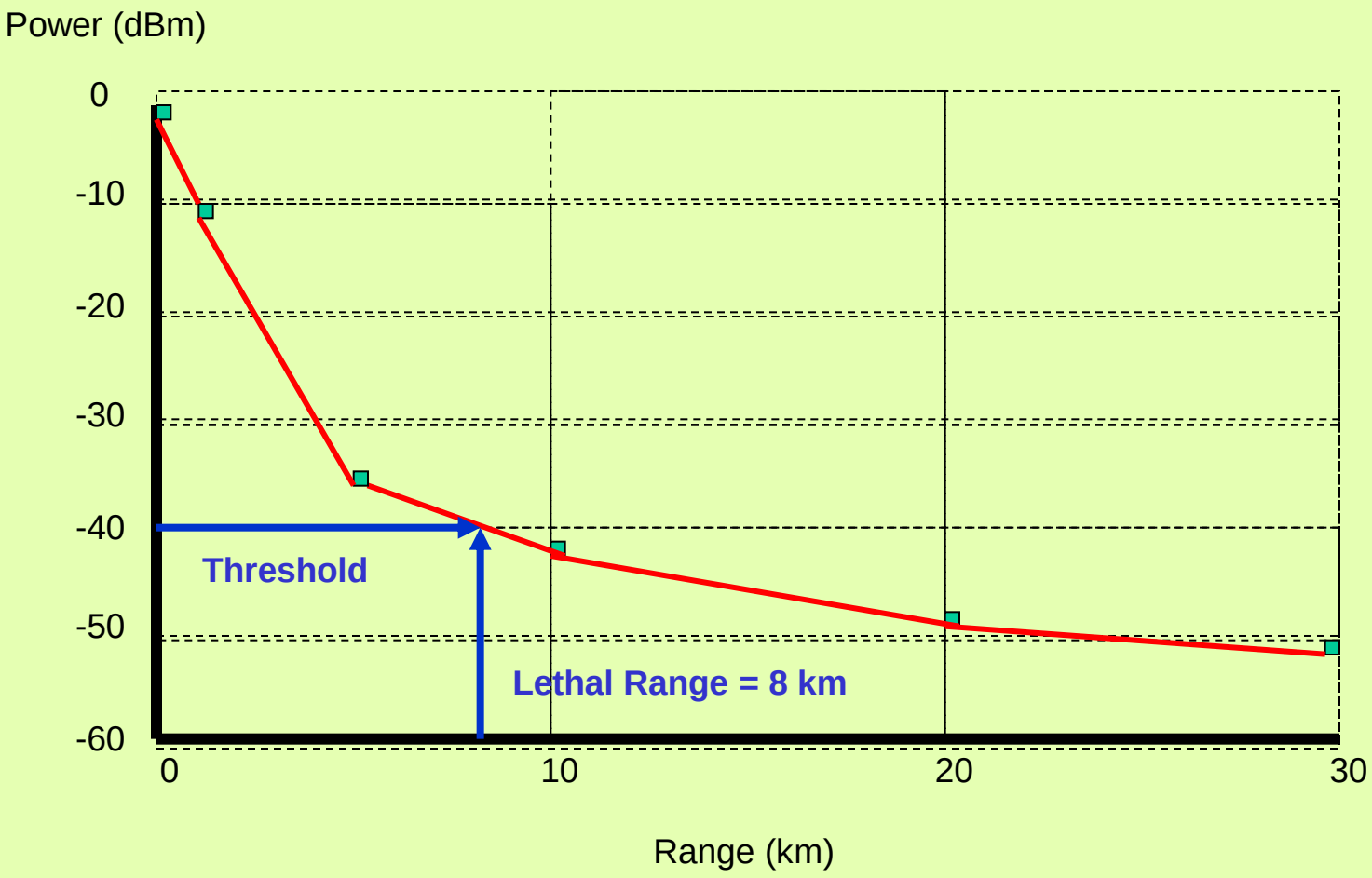
>> Graphical

>> Symbolic

WANT # 10

… THREAT LETHAL RANGE WARNING

INTERCEPT POWER vs RANGE



Radar ERP = 90 dBm

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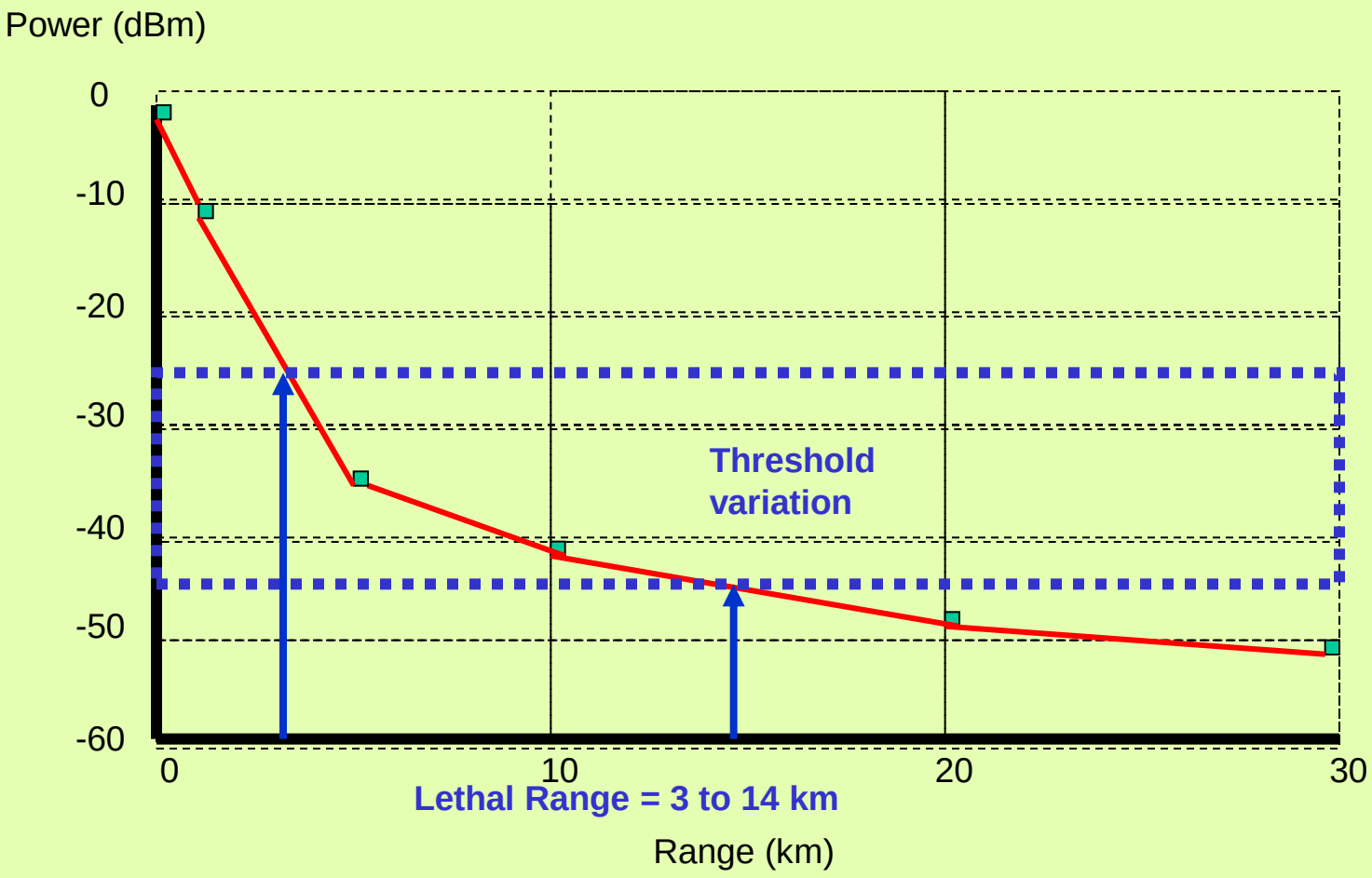
LETHAL RANGE ERROR BUDGET (dBs)

	+ve error	-ve error
Emitter Power intelligence	+3	-3
Antenna gain intelligence	+3	-3
Emitter beam offset	+0	-3
RWR antenna offset	+0	-5
RWR antenna gain variation (freq, polarisation, direction)	+3	-6
RWR Rx gain variation	+3	-3
Measurement error	+2	-2
Propagation error (multipath lobing etc)	+6	-30
SUBTOTALS	+20 dB	-55 dB

LETS ASSUME ERROR ONLY +5 dB to -15 dB

LETHAL RANGE WARNING ERROR



Radar ERP = 90 dBm

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WANT # 11

… COPE WITH EVER CHANGING/ESCALATING THREAT SCENARIO

WANT # 12

… EXTRA CAPABILITIES

>> Self protect resource management

>> ELINT capture

WANT # 12

… ADAPTIVITY (RE-PROGRAMMABILITY)

WANT # 14

… INCREASED FREQUENCY COVERAGE

WANT # 15

… ALL POLARISATIONS RESPONSE

WANT # 16

… GREATER SENSITIVITY

WANT # 17

… GREATER DYNAMIC RANGE

WANT # 18

… DEAL WITH DENSE ENVIRONMENTS

Probability of Pulse Overlap

Assume : 1 KHz PRF, 1% duty cycle:

2 radars	**>>**	**1,9 %**
5 radars	**>>**	**4,9 %**
10 radars	**>>**	**9,6 %**
20 radars	**>>**	**18,2 %**
50 radars	**>>**	**39,5 %**

WANT # 19

… RESOLVE AMBIGUITIES

WANT # 20

… INTELLIGENT THREAT LIBRARY

WANT # 21

… COPE WITH DIVERSE SIGNAL TYPES

WANT # 22

… COPE WITH COMPLEX SIGNAL SIGNATURES

WANT # 23

… BETTER SIGNAL DE-INTERLEAVING AND CHARACTERISATION

WANT # 24

… MEASURE MORE SIGNAL PARAMETERS

WANT # 25

… MEASURE FREQUENCY

WANT # 26

… IMMEDIATE (PER PULSE) FREQUENCY MEASUREMENT

REB

JOURNALIS IFM ESM SYSTEM REBUILD (SYSDEL)

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ESM TECHNOLOGY DEMONSTRATOR (SYSDEL/EM LAB)

WANT # 27

… TO FINGERPRINT EMITTERS

(Intra Pulse AM, FM, PM)

WANT # 28

… PRECISION DF

WANT # 29

… EMITTER GEO-LOCATION

WANT # 30

… UNCONSTRAINED EMITTER GEO-LOCATION

HOLD ON !

THE ABOVE CAPABILITY EXISTS :

IT’S CALLED ESM

ESM (ELECTRONIC SUPPORT MEASURES)

ESM System Purpose:

Real time surveillance of all emitters in the environment for the purposes of electronic battlefield management.

RWR System Purpose:

Warning of platform illumination by terminal threat radar.

Typical ESM System provides:

- **Wideband (1 to 18 GHz) frequency coverage**
- **360 degree azimuth coverage**
- **Per pulse frequency measurement (IFM)**
- **Per pulse DF (AmpDF or Interferometer DF)**
- **Intelligent processing**
- **Flexible, Graphics User Interface.**

May also provide:

- geo-location and map display

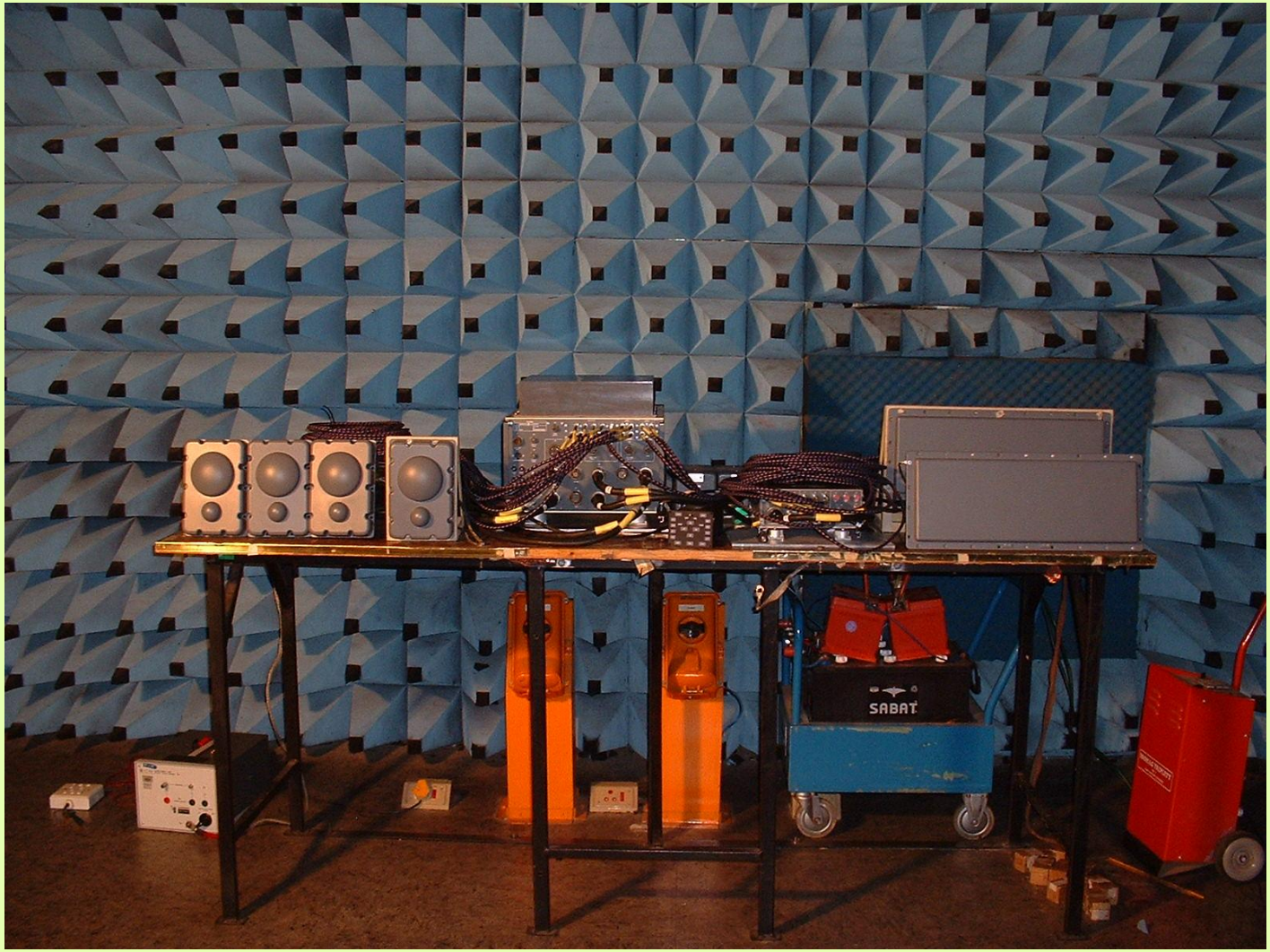
WHY NOT USE ESM AS RWR ?

- Cost
- No space in cockpit (or pilot's head)
- No space for Receiver/Processor
- Installation of Interferometer antenna
- MUST BE ADAPTED TO PROVIDE ONLY THREAT WARNING

SOME REAL DATA CAPTURED BY THE SEA RAVEN ESM SYSTEM OF THE LYNX HELICOPTER

SEA RAVEN ESM (+ELINT) on LYNX MARITIME HELICOPTER

SEA RAVEN ESM (+ELINT)



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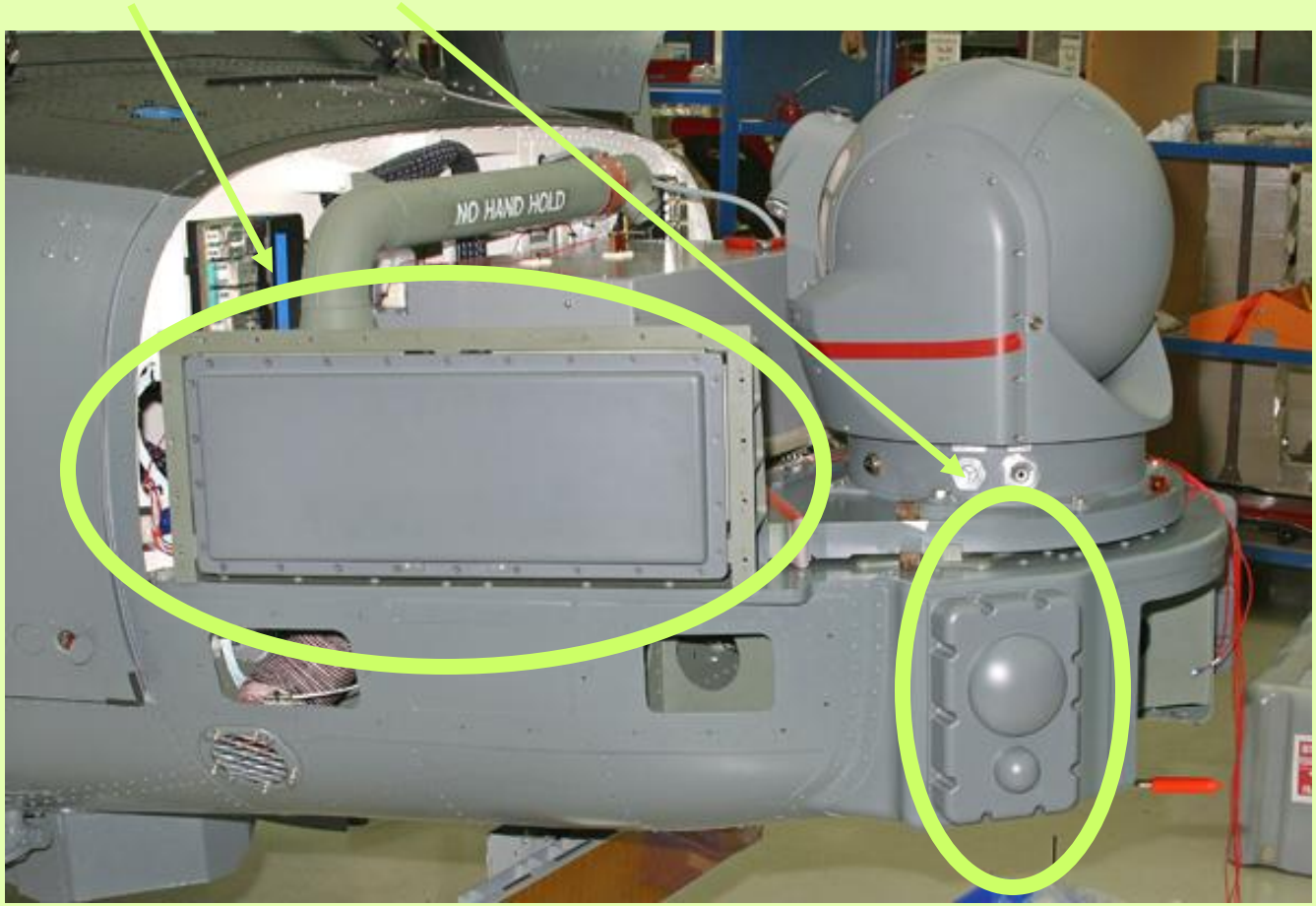
SEA RAVEN IntDF and AmpDF Antenna Installation



SEA RAVEN : Receiver/Processor Unit

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SEA RAVEN : ESM Control and Display Units

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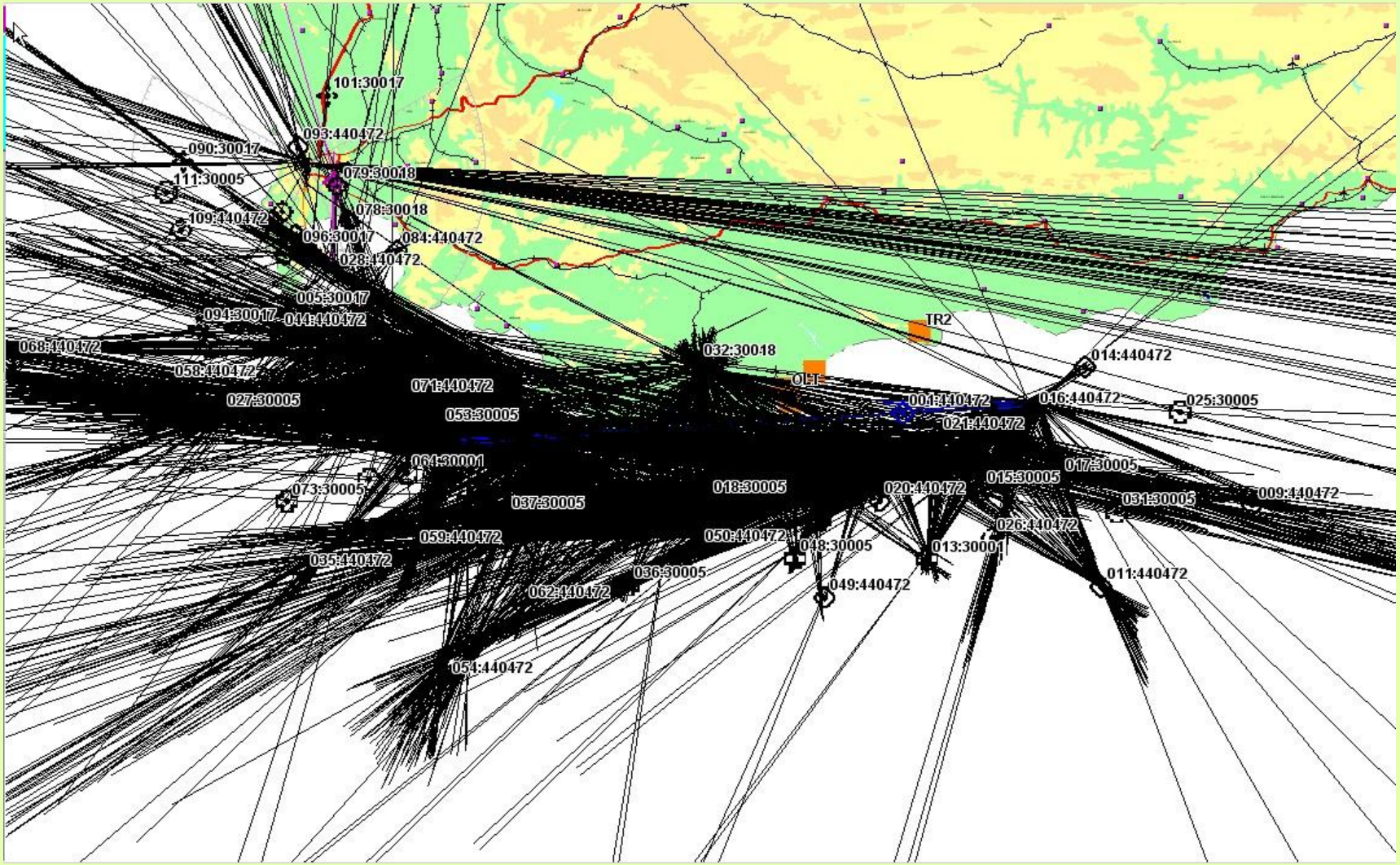
INT DF LOBS



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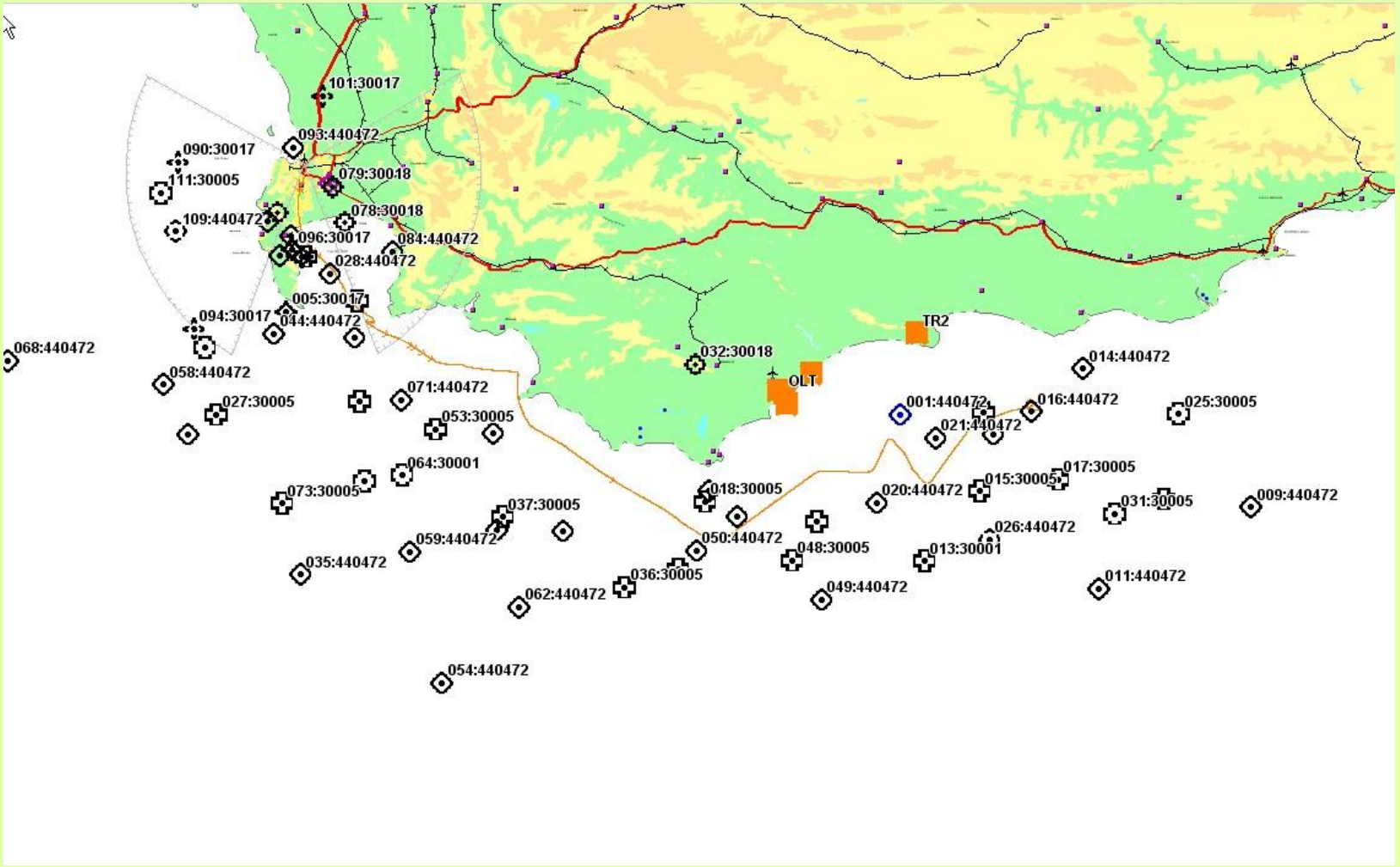
Geo-located Emitters



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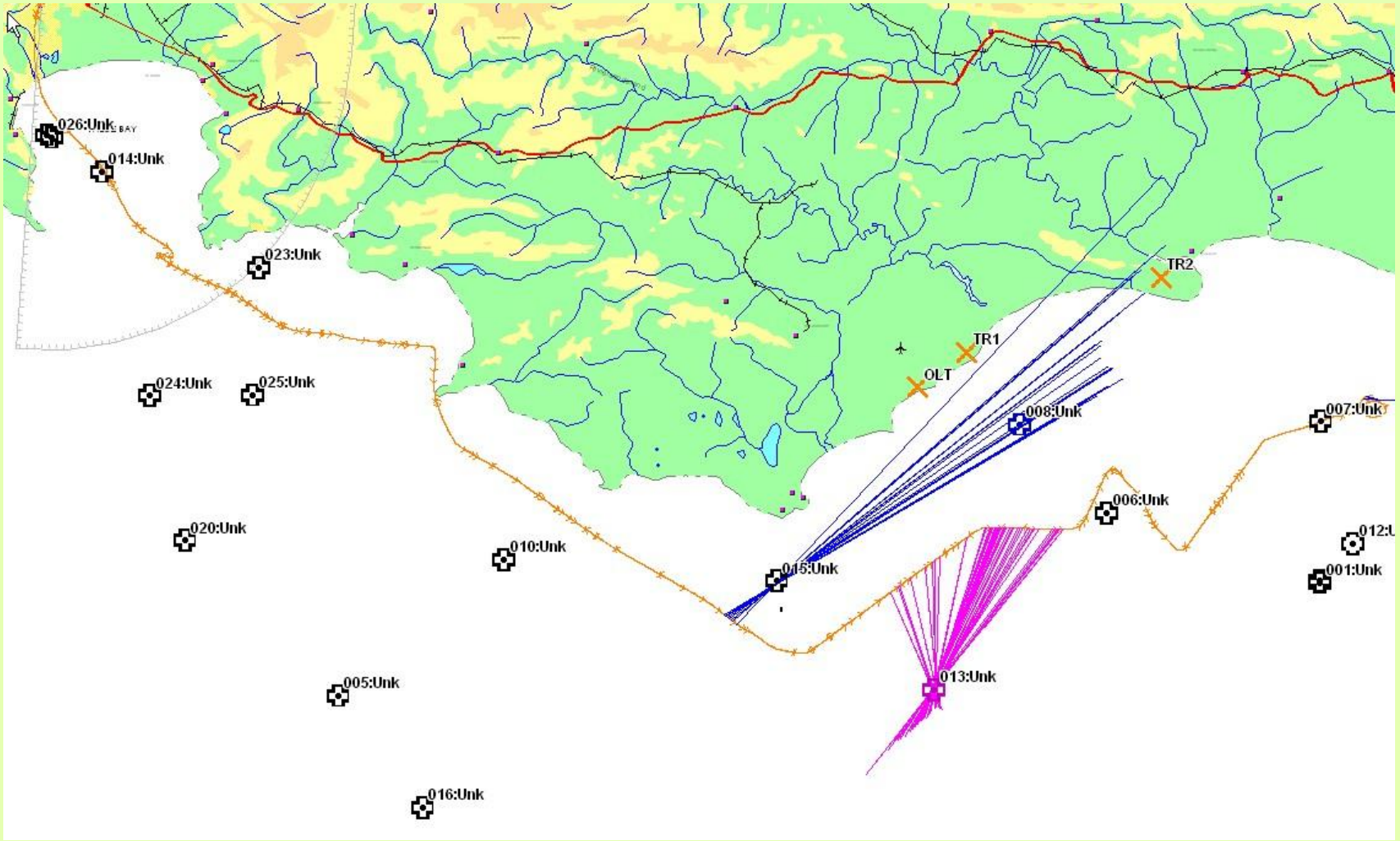
Selected Emitter LOBs



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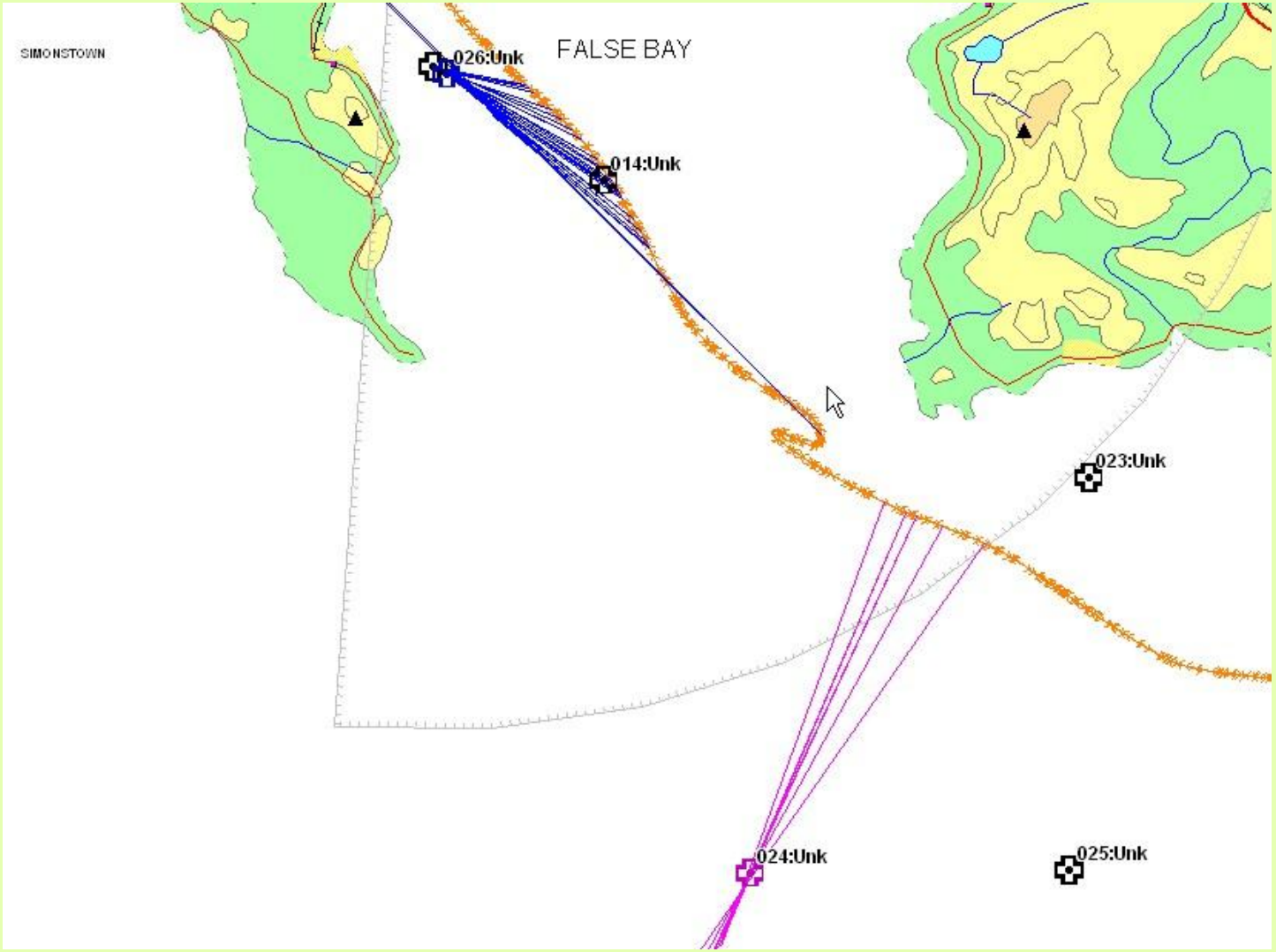

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WHAT WOULD CLASSICAL RWR HAVE MEASURED ?

NOTHING

ZERO

WHY?

BECAUSE :

IT MUST ONLY RESPOND TO TERMINAL THREATS

EFFECTIVE RADAR WARNING REQUIRES:

>> The best practical receiver & processor technology.

>> Fast and effective sorting/analysis algorithms

>> In depth threat intelligence.

>> An experienced User + pre- and post-mission briefing.

Ultra Short Baseline Geo-location

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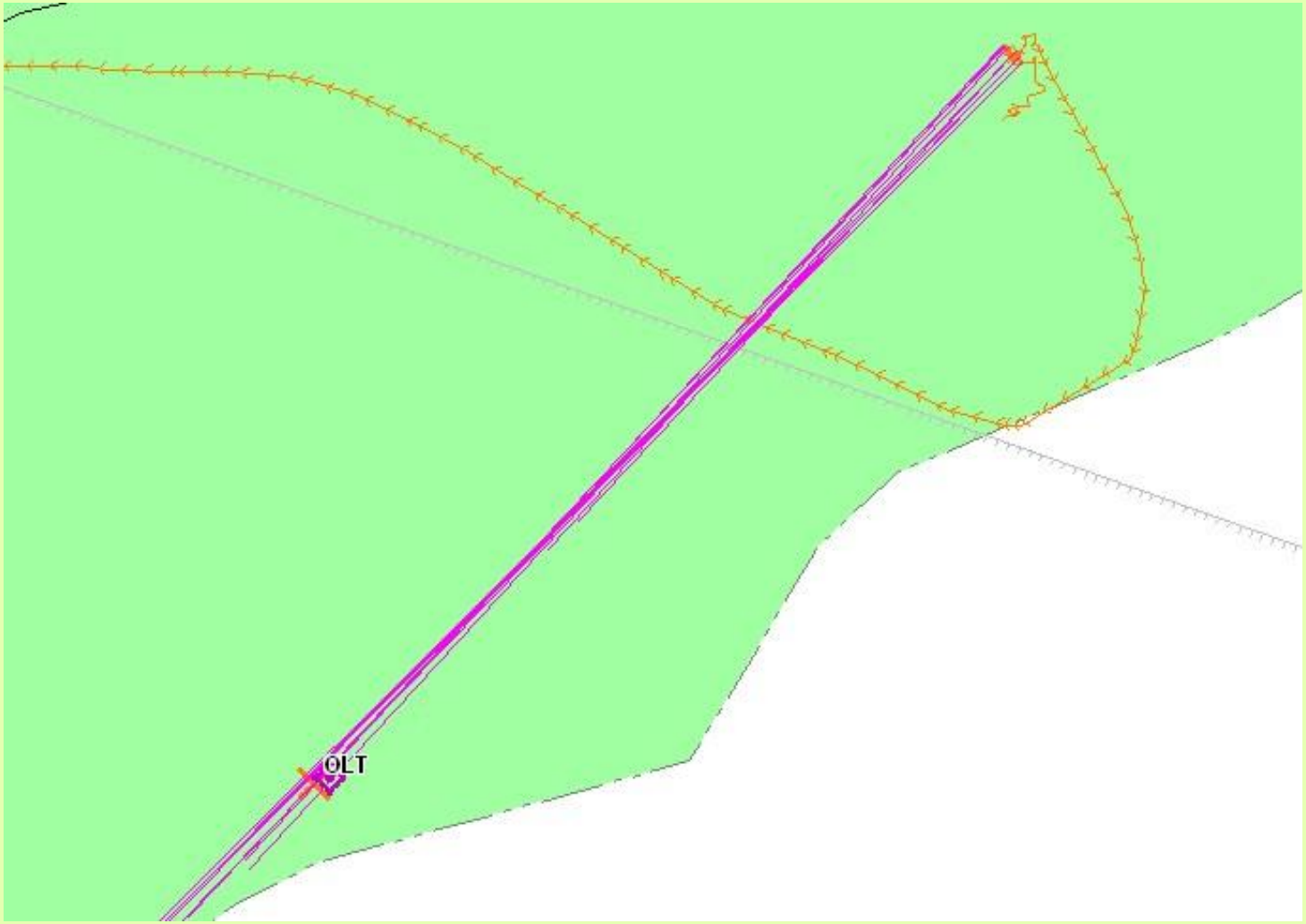
Ultra Short Baseline Geo-Location



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