How can ELINT deal with modern radar

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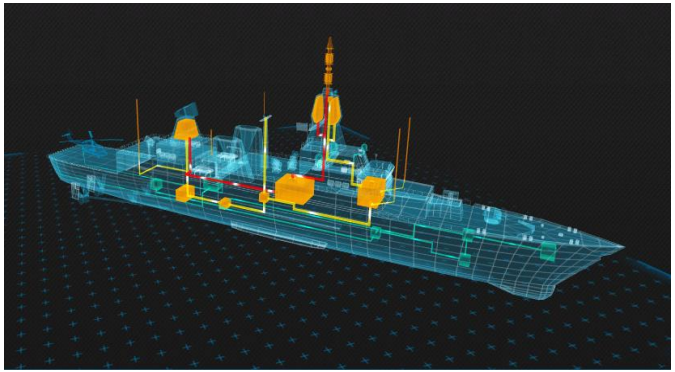
Agenda

- What is ELINT?
- The Target
- Are Radar collection receivers fit for purpose?
- How can ELINT deal with modern radar

ELINT is NOT!

- A Tactical Asset tasked by Operational Commander
- For Force protection/Situation awareness
- Dependent on an on-board library
- Providing an Emitter location/Line of Bearing



ELINT is…….

- An Intelligence gathering Strategic Asset
- Radar Intelligence collection
- Focused, ELINT targets a specific Set of Radars
- Aiming is to discover the capability of the target
- Providing technical parametric data
- Operator/analyst knowledge of the target is key

Modern Radar

- Electronic Scanning Arrays
- Solid State GaN technology
- Frequency Agile
- Wide Band
- Framed signals/Very Complex Modulation
- Almost impossible to seduce/distract effectively
- Very difficult/impossible to fingerprint
- Potential use of extended RF ranges

Target examples






Typical radar collection receivers

Receiver Type	Advantages	Disadvantages
Channelized Receiver	Wide bandwidth and/or narrow bandwidth	**Poor sensitivity** for wide bandwidth
Wideband crystal video receiver	Simple, inexpensive, instantaneous **High Probability of intercept (POI)** in frequency range	No frequency resolution **Poor sensitivity** Poor simultaneous signal
Tuned RF crystal video receiver	Simple Frequency measurement **Higher sensitivity** than wideband	Slow response time **Poor POI**
Narrow Band Scanning super heterodyne receiver	**High sensitivity** Good frequency resolution No simultaneous signals problem	Slow Response **Poor POI** Poor against frequency agility
Wideband super heterodyne receiver	Better response time **Better POI**	Spurious signals maybe generated **Poorer sensitivity**

POI Definition

‘The probability of time coincidence of two or more parametric window functions such as scanning antennas, sweeping or stepping receivers and frequency agile emitters’.

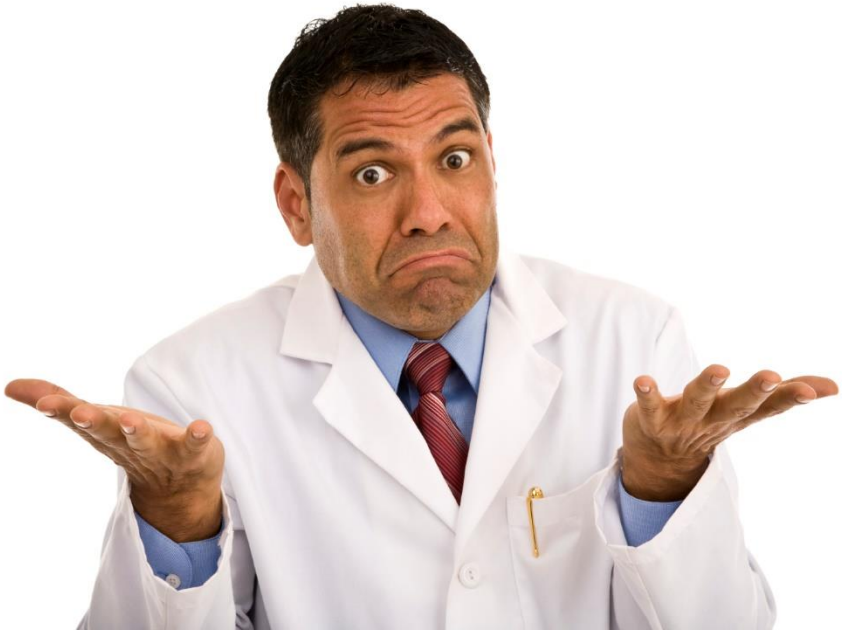
Who actually defines POI?

The manufacturer

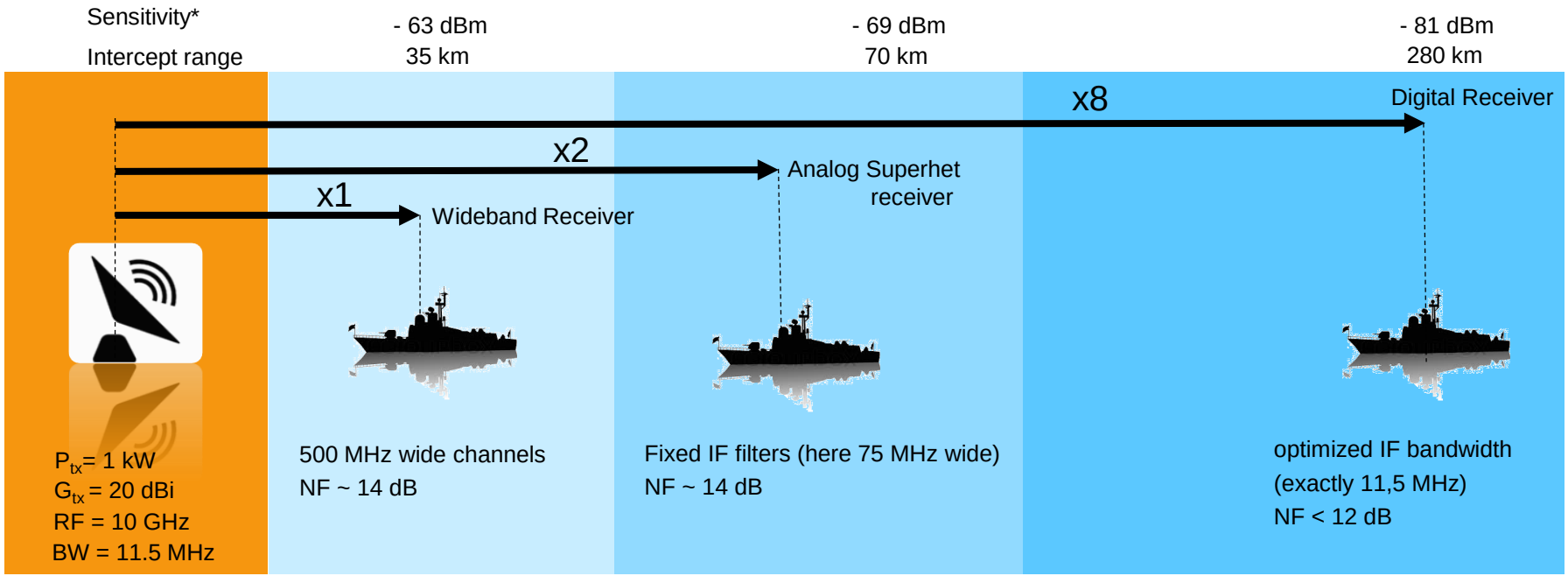
Wideband Receiver – 100% POI

- Platform independent automatic wideband receiver continuously staring to monitor the radar spectrum
- Operating between 2.0 - 18.0 GHz can be extended down to 0.5 GHz and up to 40 GHz
- Outputs a Pulse Descriptor Word (PDW) every time a radar pulse is detected
- Frequency range is normally separated into individual frequency blocks using 1 GHz filters
- Individual filters are normally selectable and switched off in the event of strong interference, radar signals are rejected across the whole filter bandwidth

What about sensitivity?



Sensitivity Impact on Detection Range



Wideband System - POI 100%

Against typical COTS navigation radar (mechanical oscillator)

- Sensitivity -61 dBm (Good for wideband radar collection receiver)

Transmit Power	12	kW	##	Sensitivity	-61.01	dBm	Receiver NF	14	dB
Antenna Gain	20	dBi	##	Maximum Range	98.60	km	Antenna Gain	0	dBi
Transmit Frequency	9.4	GHz	0				Receiver BW	500	MHz
							SNR	12	dB

- Range Advantage

Wideband System - POI 100%

- Against modern solid state COTS navigation radar (high power)
- Sensitivity -61 dBm (Good for wideband radar collection receiver)

Transmit Power	0.5	kW		Sensitivity	-61.01	dBm	Receiver NF	14	dB
Antenna Gain	20	dBi		Maximum Range	20.13	km	Antenna Gain	0	dBi
Transmit Frequency	9.4	GHz					Receiver BW	500	MHz
							SNR	12	dB

- Range Advantage

Wideband System - POI 100%

- Against modern solid state COTS navigation radar (high power)
- Sensitivity -61 dBm (Good for wideband radar collection receiver)

Transmit Power	0.1	kW	##	Sensitivity	-61.01	dBm	Receiver NF	14	dB
Antenna Gain	20	dBi	##	Maximum Range	9.00	km	Antenna Gain	0	dBi
Transmit Frequency	9.4	GHz	0				Receiver BW	500	MHz
							SNR	12	dB

- Range Advantage

Wideband System - POI 100%

- Against modern solid state COTS navigation radar (high power)
- Sensitivity -55 dBm (Typical for wideband radar collection receiver)

Transmit Power	0.1	kW	##	Sensitivity	-55.01	dBm	Receiver NF	14	dB
Antenna Gain	20	dBi	##	Maximum Range	4.51	km	Antenna Gain	0	dBi
Transmit Frequency	9.4	GHz	0				Receiver BW	500	MHz
							SNR	18	dB

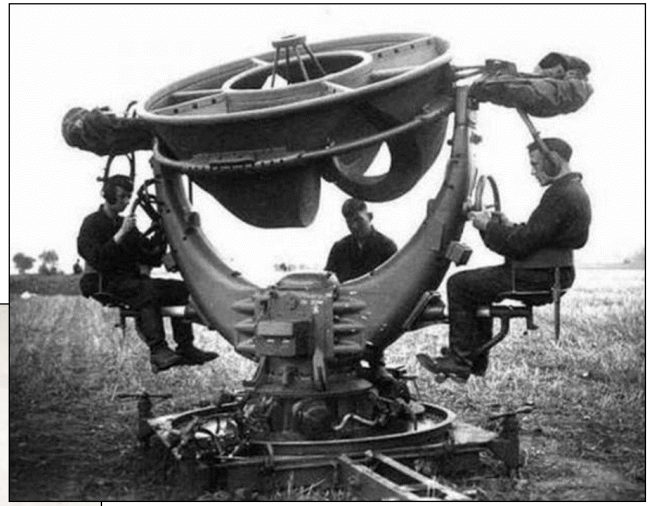
- Range Advantage

Hard Facts 100% POI but…….

Wideband receivers:

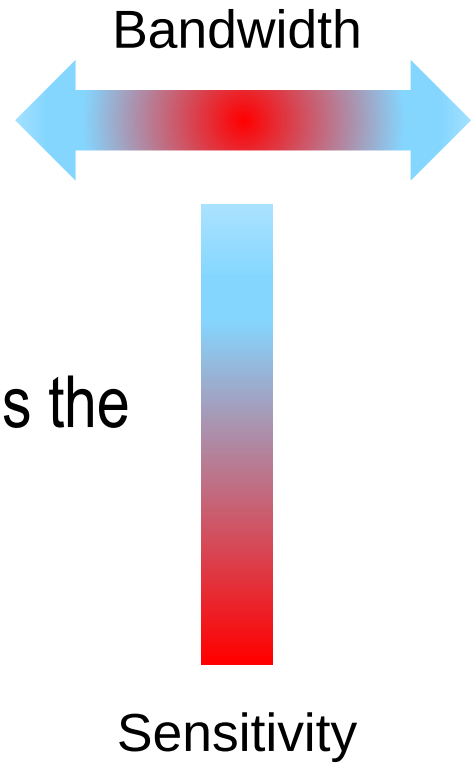
- Cannot deal with the modern radar environment because of the technology approach
- Are not sensitive enough
- Do not have enough dynamic range to deal with high power radars
- Struggle with Pulse-on Pulse on CW situations

So how can ELINT can deal with modern radar

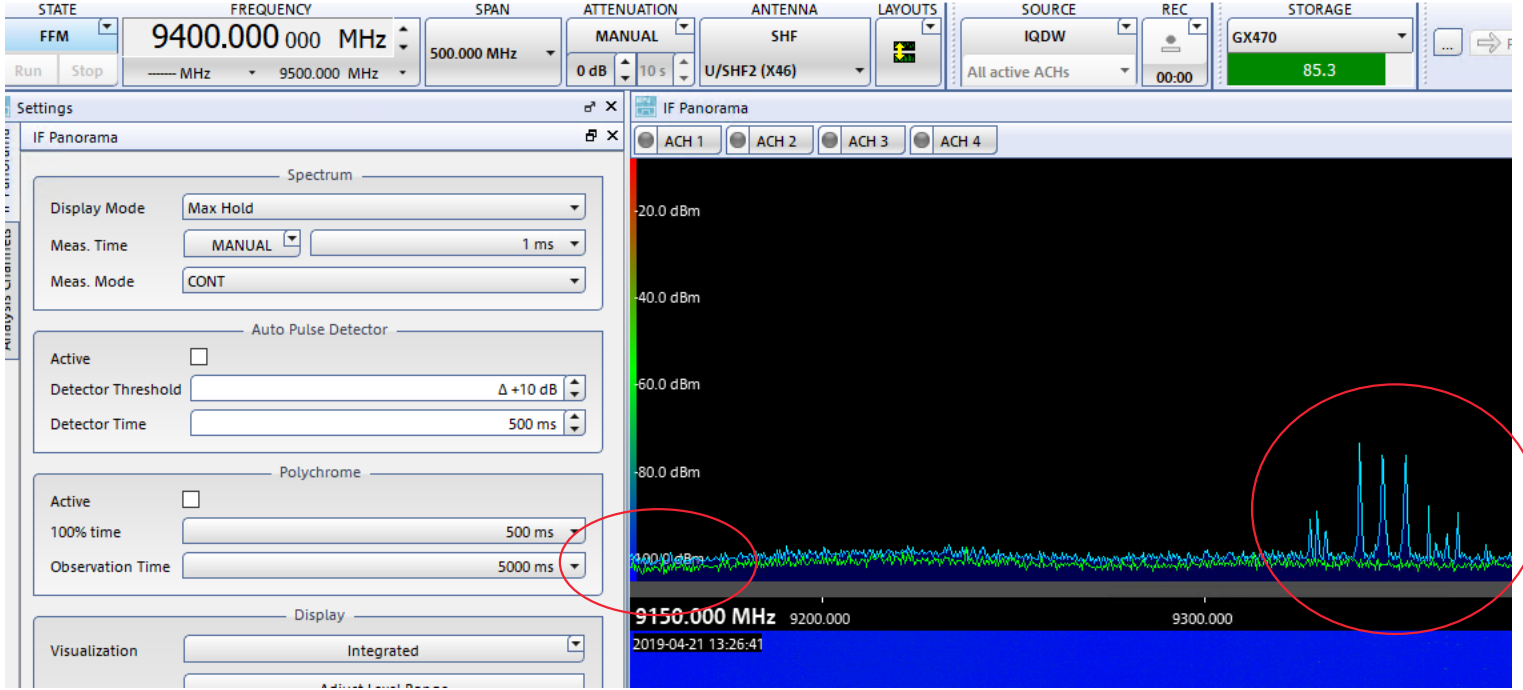


Bandwidth has always been King!

Unfortunately Physics is the enemy!

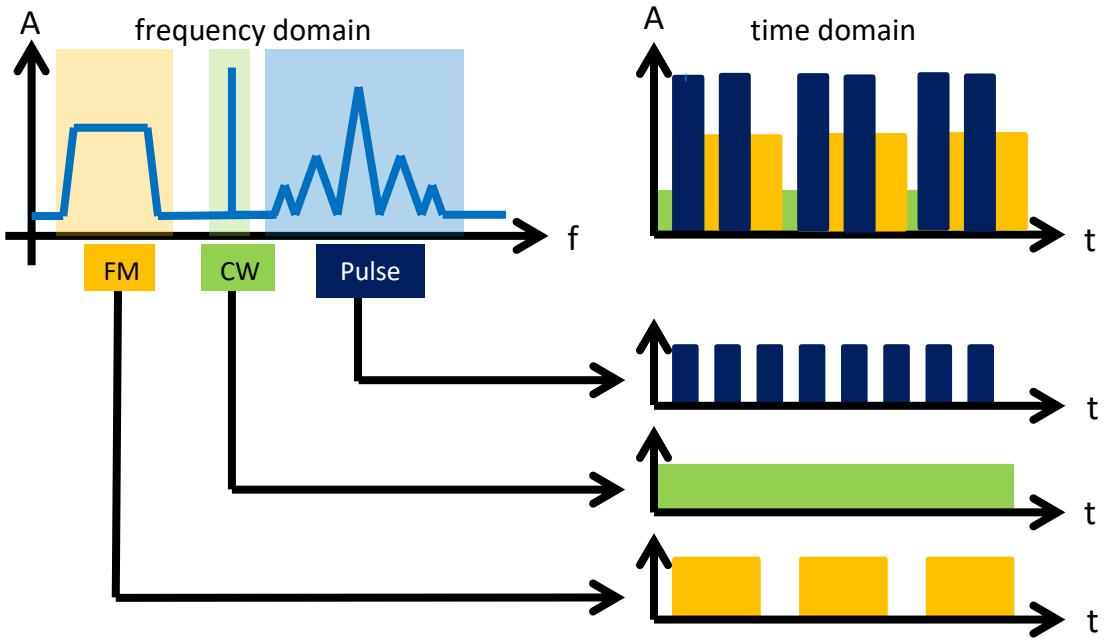


Against a modern radar sensitivity IS the most important parameter



Signal separation in frequency and time domain

Quasi-matched filtering



Signal separation before analysis, significantly reducing pulse on pulse problems.

Manageable data

- IQ data impractical for large files (TBs)
- Dramatic data reduction is essential up to 75% could be noise
- A bursted data format containing the metadata but also the frequency, phase and IQ data
- Must be coherent preserving instantaneous intrapulse phase, amplitude and frequency
- Essential if radar signals use intrapulse modulation (FMOP, PMOP etc.)

Other requirements for an ELINT system

- Wide frequency range to cover all radar functions (including legacy systems)
- Digital system for data manipulation
- High collection quality

Conclusion

- Radar technology has a significant lead over EW/ELINT technologies
- Industry needs to understand the Application and build fit for purpose solutions
- Current Wideband systems can not deal with modern radars
- Bandwidth is no longer the primary parameter
- Sensitivity is the new King
- ELINT is NOT easy

Questions?