

The Elbit Systems logo features the company name in a bold, blue, sans-serif font. The text is positioned on a yellow, angular shape that resembles a stylized arrow or a mountain peak, pointing towards the right. The background of the slide is a composite image: the top half shows a blue sky with white, curved, grid-like lines, and the bottom half shows a dark, curved horizon of the Earth from space, with a faint world map visible in the white area below.

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Standards in Tactical HF

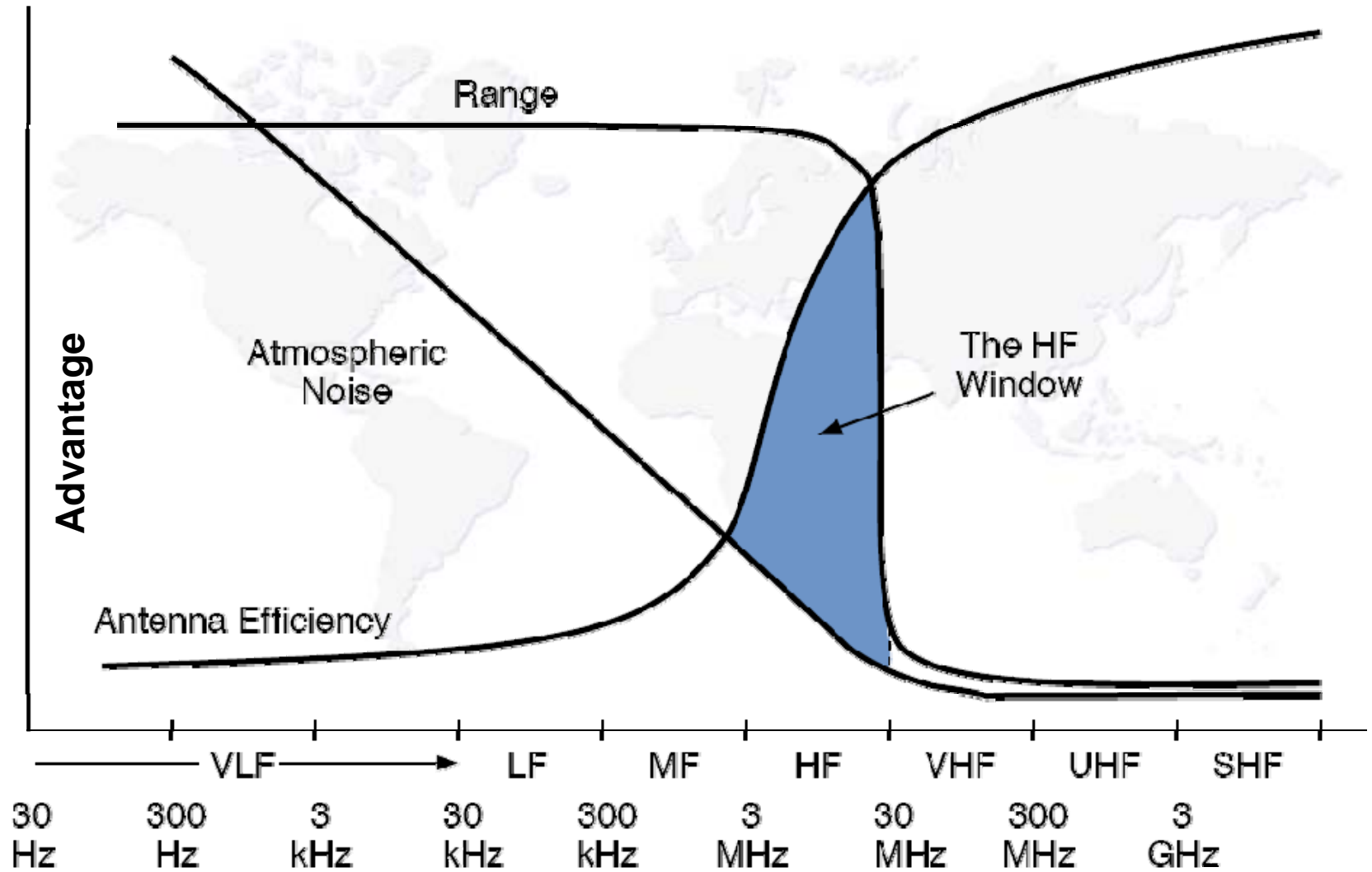
Implementation Challenges

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Long Range Communication division

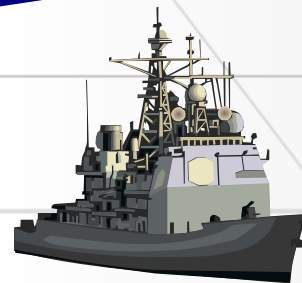
Why HF?



Portable -20W

Vehicular-100W

Base-Station 400W & Higher



1000km

2000km

10,000km

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A horizontal banner with a dark blue background. The left side shows a satellite view of Earth's surface with a grid of white lines. The right side shows a horizon line over a dark, textured landscape, possibly a desert or a night view of a city.

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A faint, light gray world map is centered in the background of the slide, showing the outlines of the continents.

Standards & Protocols

▲ **MIL-STD: Military Standards of DoD (US)**

▬ MIL-STD-188-110B

▬ MIL-STD-188-141B

▲ **STANAG: NATO STANdardization AGreement**

▬ STANAG 4285

▬ STANAG 4538

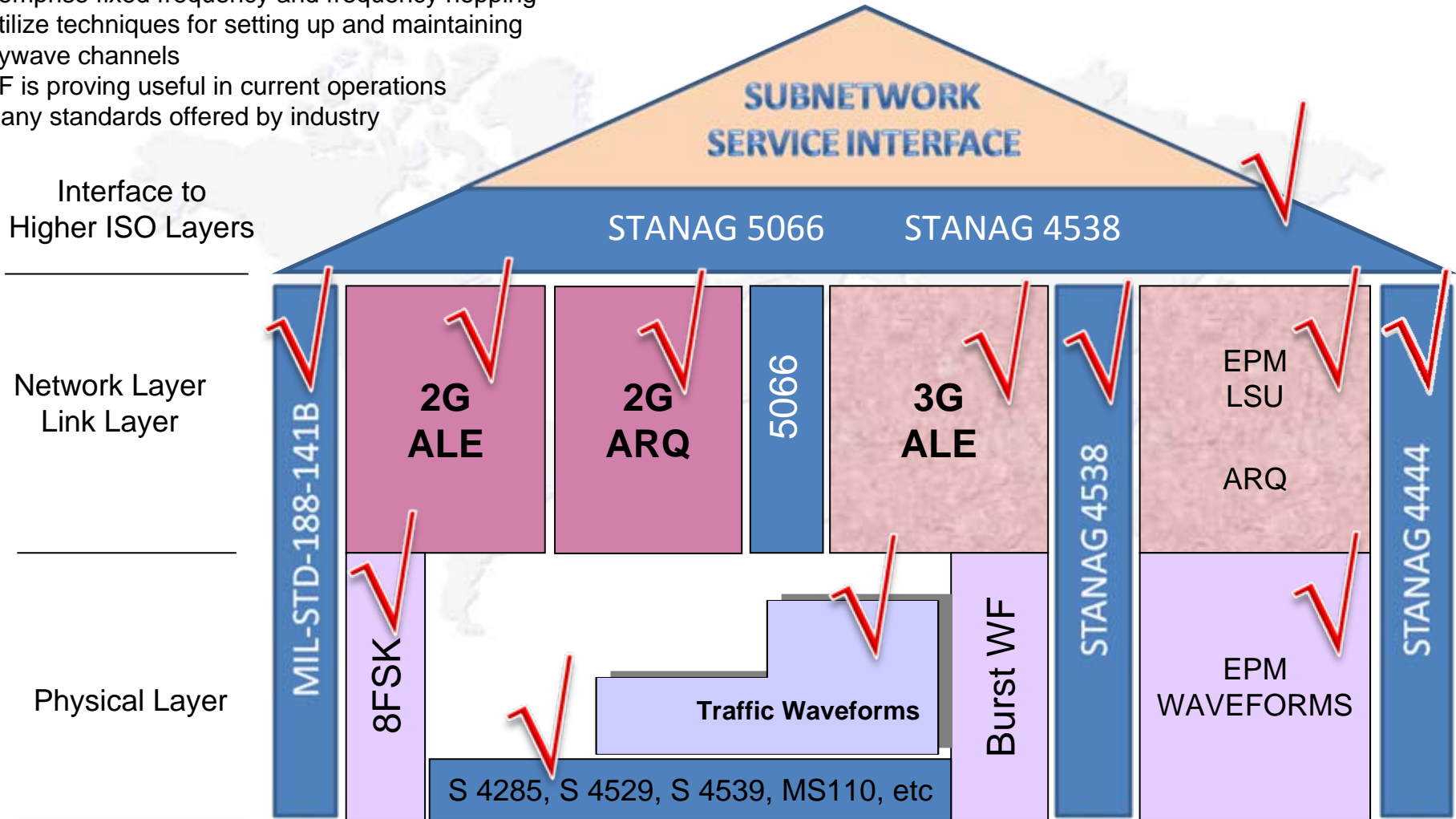
▬ STANAG 5066

▲ **HF House**

▬ Collection of actual standards for HF communications

HF House

HF standards are described in the "HF House":
 Comprise fixed frequency and frequency hopping
 Utilize techniques for setting up and maintaining
 skywave channels
 HF is proving useful in current operations
 Many standards offered by industry



Abbreviation: 5xxxx: STANAG xxxx MSxxxx: MIL-STD-188XXXX 2G: second Generation 3G: third Generation

▲ Main Standards

➤ 2G ALE: MIL-STD-188-141B

➤ 3G ALE: STANAG 4539

▲ Performance Comparison

Fast link setup (from HFIA's last meeting)

Characteristic	2G ALE	3G ALE
Link Time	15.3s -3 character call sign	8.4s (Average values)
Link Robustness	0dB(3kHz BW)(0dB PAPR)	-8dB(3kHz BW)(4dB PAPR)
Waveform	8-FSK – 125 sym/s	8-PSK – 2400 sym/s
Main mode of Operation	Asynchronous	Synchronous Asynchronous Supported
Link Protection	Y – Not widely used	Y – Widely used
Channel Evaluation	LQA & Traffic Monitor	LQA & Traffic Monitor

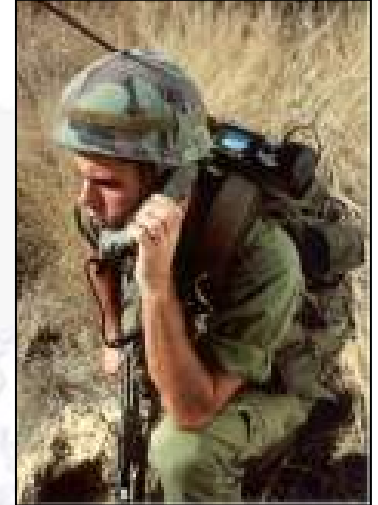


3G ALE – Improved the link setup time but tactical operations require even faster links

▲ Proprietary protocols

▬ ALE Systems from early 80s

- Collins Selscan
- Harris Autolink
- Sunair Scancall
- Tadiran AutoCall



▲ Most of the proprietary protocols are faster than 2G and 3G ALE



▲ SCANNING

- ▬ Scans the set of frequencies
- ▬ Monitors the traffic on each frequency
- ▬ Monitors the local noise level on the non-active frequencies
- ▬ Registers the signal strength
- ▬ Registers the software BER
- ▬ Updates the radio set with grade for multiple stations and frequencies

▲ Channel frequency assignment parameters:

- Traffic type (Voice or Data)
- Link quality measured at both ends
- Information validity management of the “link quality”
- Link busy Information (traffic on the available frequencies)
- The decision is based to the Link quality measured during the “current” link establishment process

▲ Requirements for link establishment:

- Link quality is higher than a preset minimum quality level
- If the minimum required quality is not available the Autocall algorithm chooses the best available frequency

▲ The final establishment of the link is made by means of a “Handshaking” protocol

The result: Linking in less than 4 seconds!

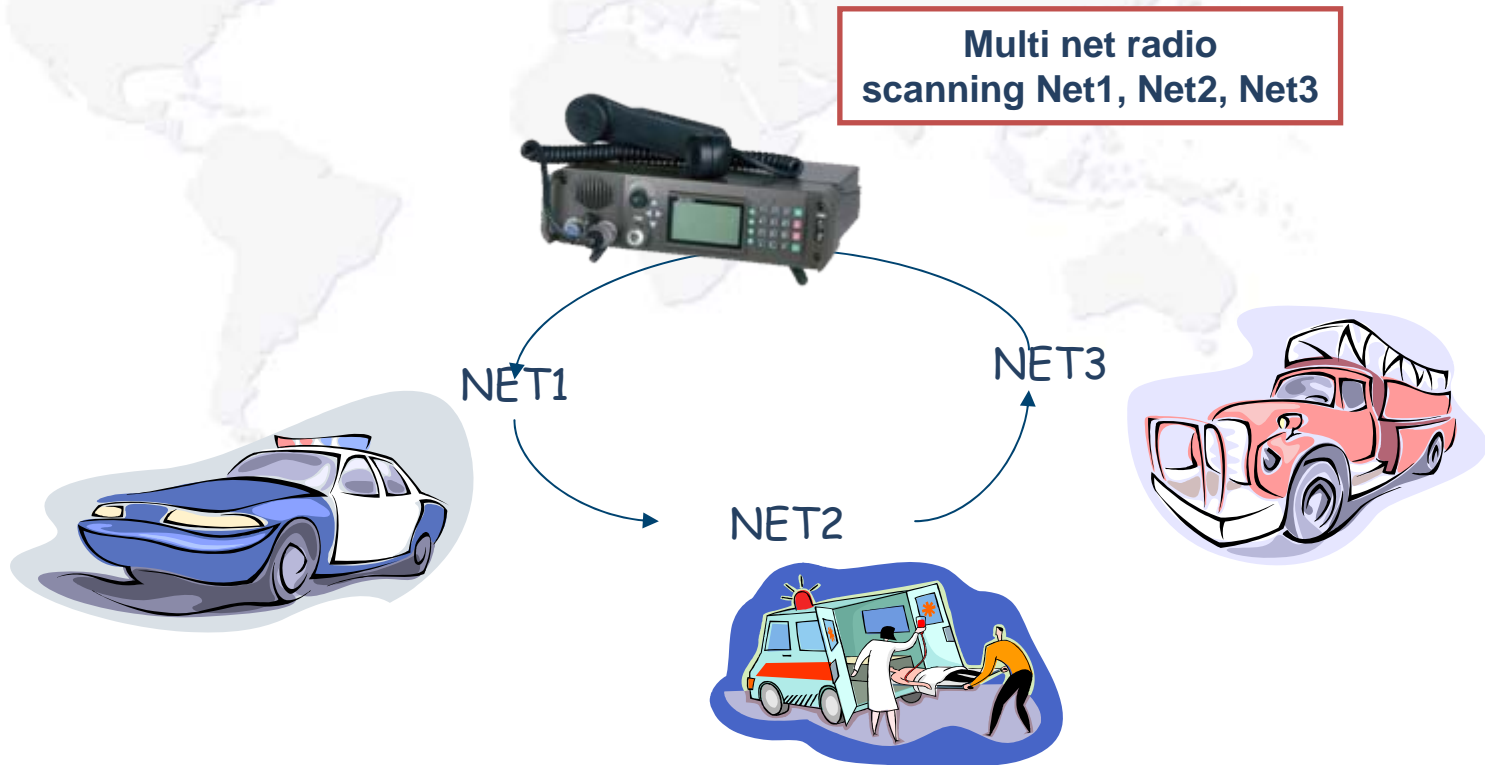
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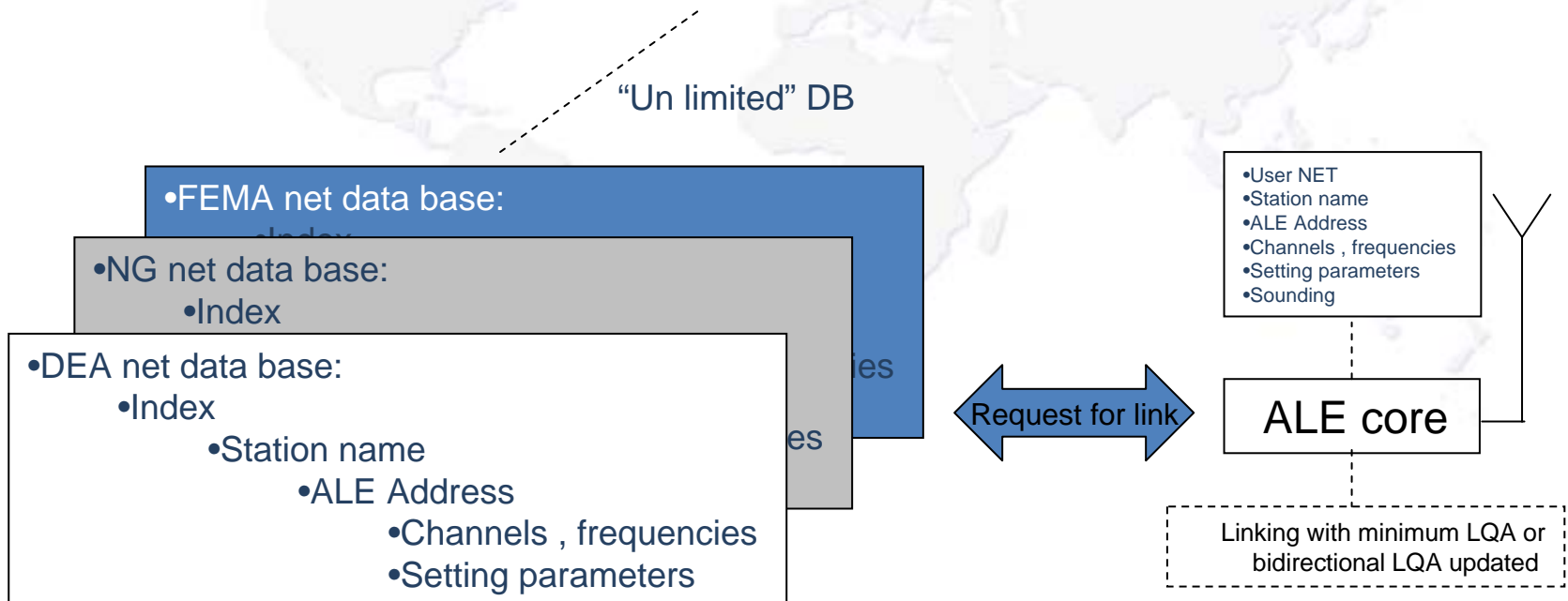
Large Networks Management

- ▶ Enhanced MIL-STD188-141B
- ▶ Scanning multiple NETs simultaneously
- ▶ Enhanced System configuration

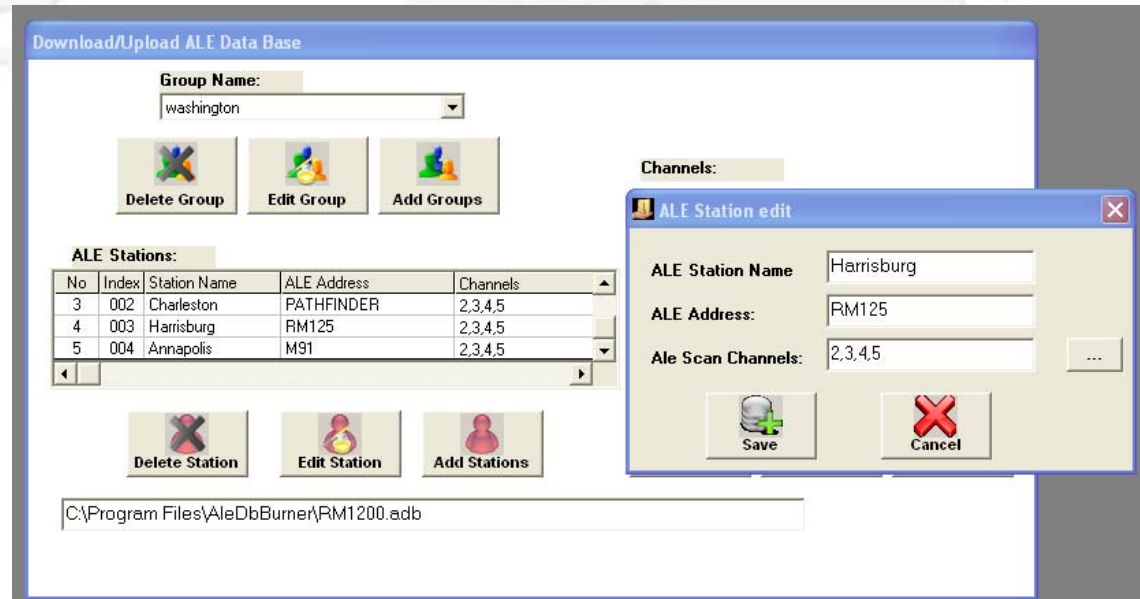


Operational environment challenges

- Agencies need to managing large networks , multi networks ,channels and addresses
- The need to communicate between agencies in crisis situations



- ▶ ALE Data Base Managing from external ALE core
- ▶ Keeping - JITC Certification per MIL-STD188-141B
- ▶ Interoperable with all ALE - MIL-STD188-141B networking system
- ▶ Fast Dialing



Download/Upload ALE Data Base

Group Name: washington

Delete Group Edit Group Add Groups

ALE Stations:

No	Index	Station Name	ALE Address	Channels
3	002	Charleston	PATHFINDER	2,3,4,5
4	003	Harrisburg	RM125	2,3,4,5
5	004	Annapolis	M91	2,3,4,5

Delete Station Edit Station Add Stations

C:\Program Files\AleDbBurner\RM1200.adb

ALE Station edit

ALE Station Name: Harrisburg

ALE Address: RM125

Ale Scan Channels: 2,3,4,5

Save Cancel

- ▶ ALE Index Linking in minimum LQA to save sounding
- ▶ Linking on best CH with Bidirectional LQA update
- ▶ Dialing (index) feature

Download/Upload ALE Data Base

Group Name:

Delete Group Edit Group Add Groups

ALE Stations:

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5	004	Annapolis	M91	2,3,4,5

Delete Station Edit Station Add Stations

Channels:

No	Channel	Frequency [MHz]
1	0	8
2	1	12
3	2	16
4	3	19
5	4	22
6	5	25
7	6	4

Del Channel Edit Channel Add Channels

C:\Program Files\AleDbBurner\RM1200.adb

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A horizontal banner image showing a dark, curved horizon over a landscape, with a blue sky and a dark, textured ground. The text 'NEXT IS NOW™' is centered in the sky area.

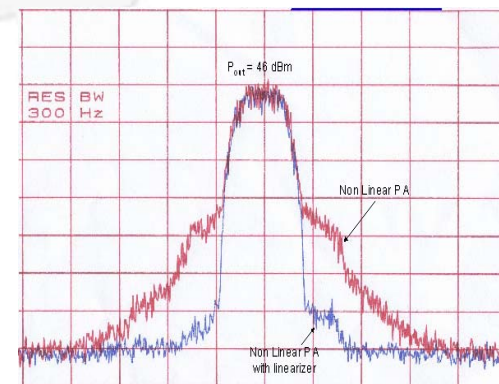
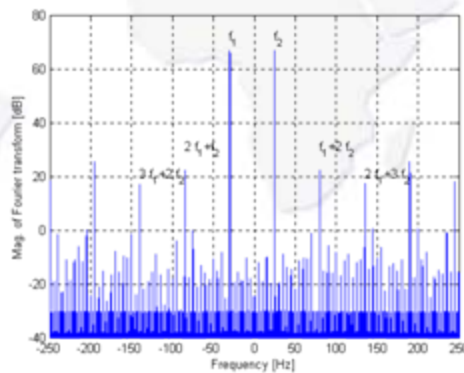
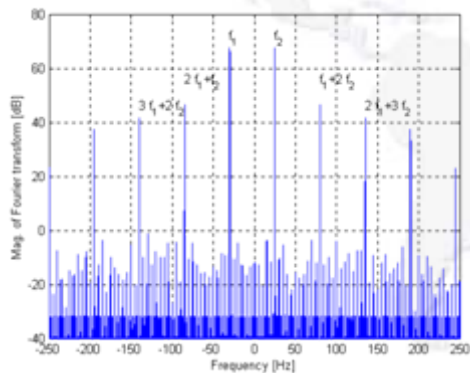
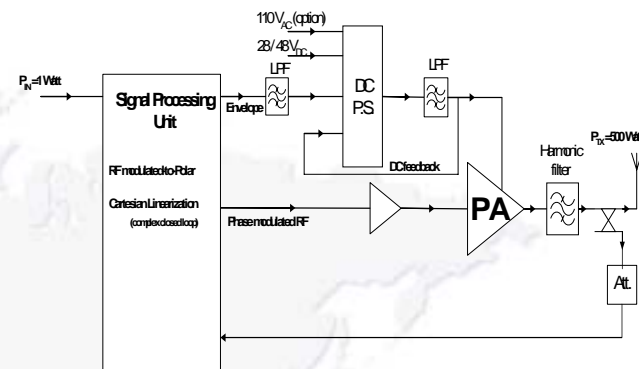
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Data over HF

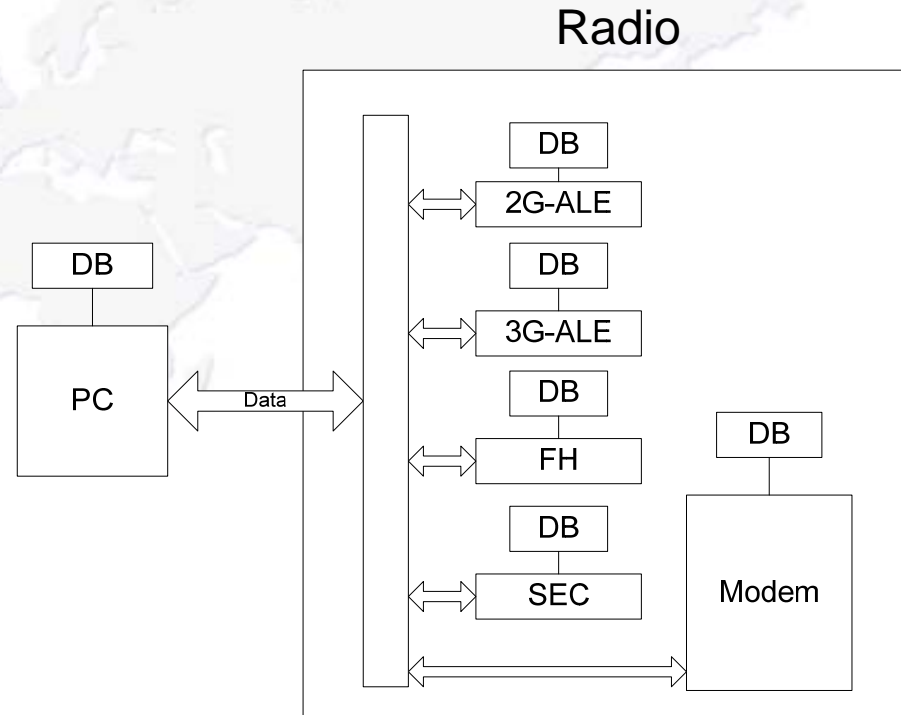
64 QAM over linear with high efficiency amplifier

- Radio performance required -24dbc
- Modem WF for 64 QAM required above 33db SNR
- 24dbc and 33db SNR can not works together ,
linearization techniques are needed



Advances in WF's and Protocols
But radio performance still lags behind...

- ▲ Data base management – ALE , FH ,5066 ..
- ▲ Many Self Addresses with different lengths
- ▲ E-mail addresses management
- ▲ “other” addresses management



Real life: In most common implementations, due to the distributed DB's, PC & Radio form unique pair → logistic nightmare...

▲ Mode of operation

▬ Linking

- Activating the Data mode

- STANAG 5066 is running on the tactical PC
- Switching to FH – now what ? The frame should be adapted to 5066 packets



▲ The problem

	<u>HTT</u>	<u>AGC</u>	<u>IT</u>	<u>DATA</u>	<u>MP</u>
# of Symbols	16	12		n x symbols	32
PSK Modulation Order	4	4	4	2/4/8	4
Duration					

n x symbols – needs to be adapted to 5066 rates with FEC and interleaver delays → Hop duration adaptation will be required

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A horizontal banner with a dark blue, wavy, textured background on the left side that transitions into a landscape view of a horizon over a dark, textured ground under a light sky.

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Summary

- ▶ **Faster Communication Protocol is required**
- ▶ **Managing large networks – processes is recommended to define**
- ▶ **Radio performance should be updated**
- ▶ **Data Base addressing definition is required**
- ▶ **FH – Frames adaptation to accurate rate is required**





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Thank you