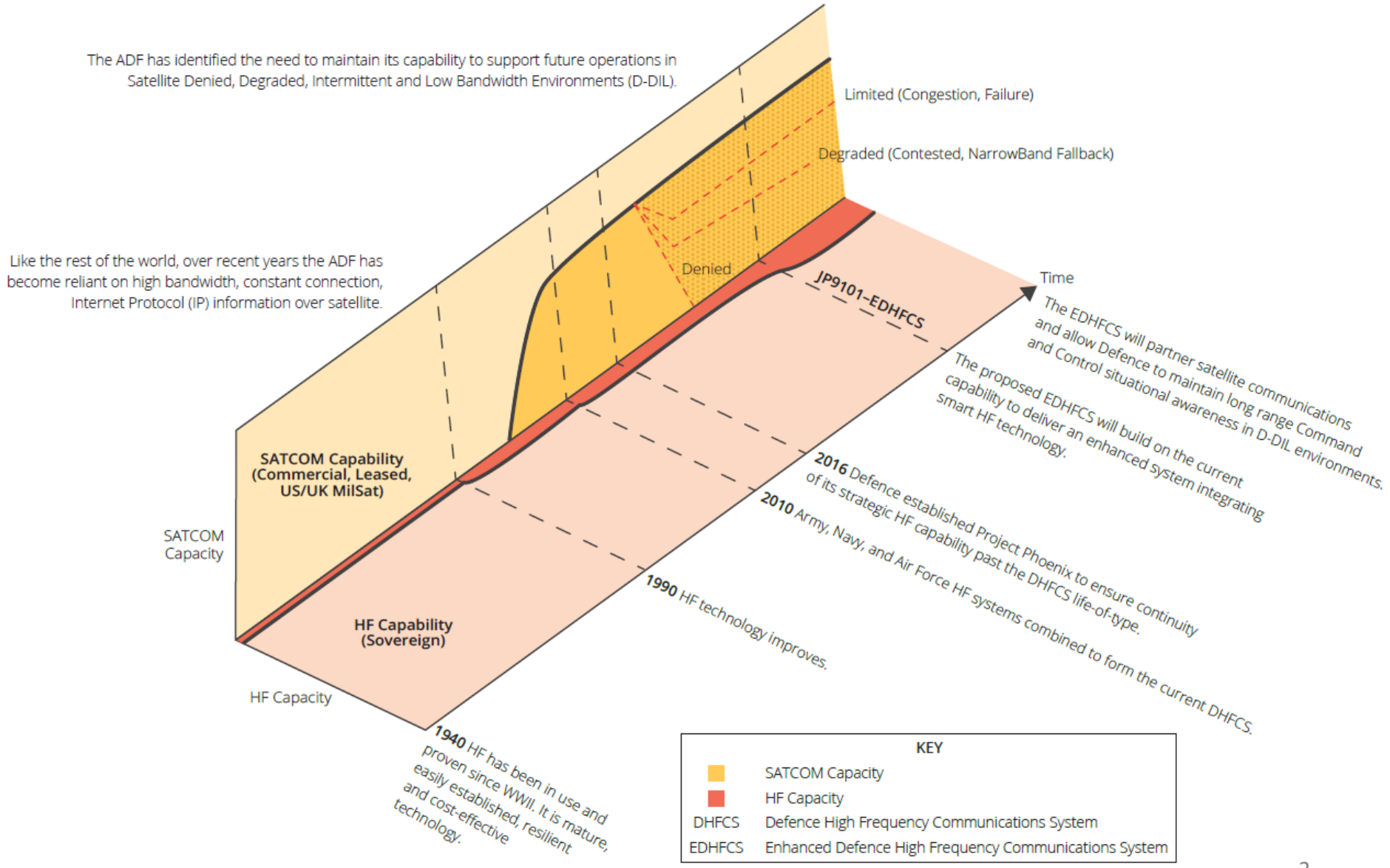
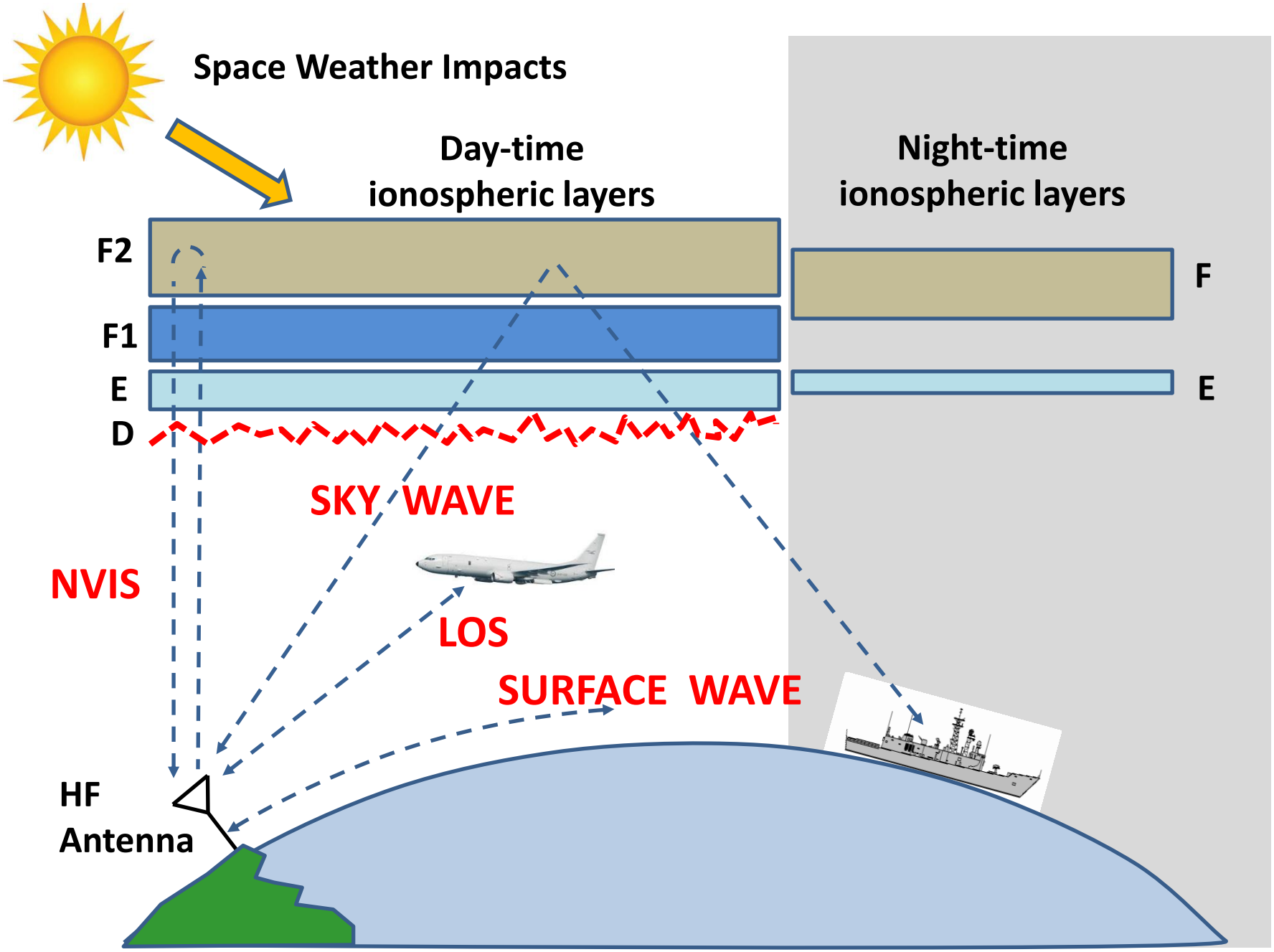
ENHANCED DEFENCE HIGH FREQUENCY COMMUNICATIONS SYSTEM (EDHFCS)

Lieutenant Colonel James Brownlie, Deputy Director High Frequency, Joint Capabilities Group

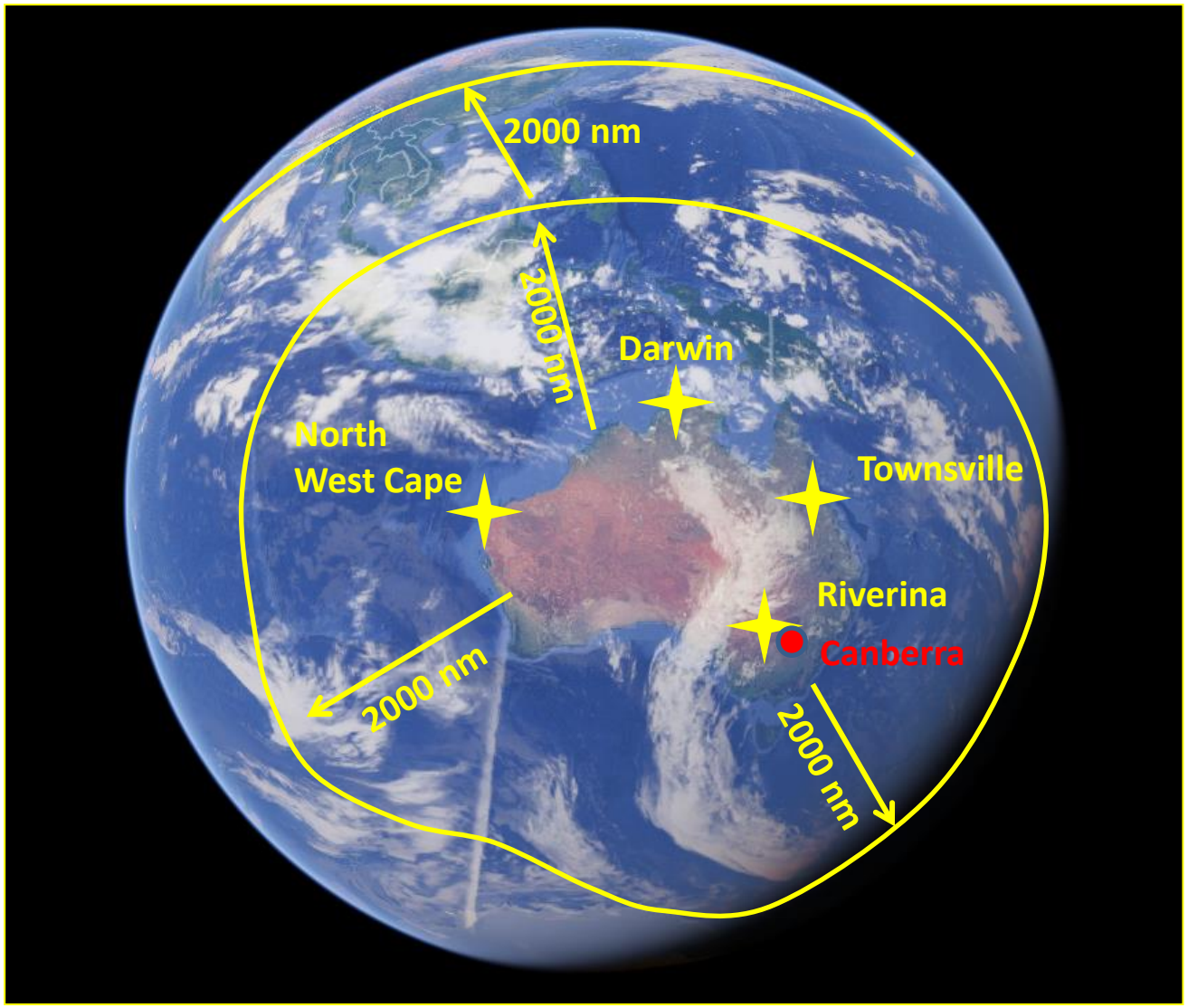
Mr Milan Koprek, Engineering Manager JP9101, Joint Capabilities Group

High Frequency vs Satellite Comms




Space Weather Impacts
Day-time
ionospheric layers
Night-time
ionospheric layers
F2
F1
E
D
F
E
SKY WAVE
NVIS
LOS
SURFACE WAVE
HF
Antenna

Existing System Operational Availability



98% comms Availability out to 2000nm (3700 km) from Australian Coast

(current Voice & Military Message)

Global Coverage in successive Sky Wave hops

	LOS	Surface Wave	Sky Wave	NVIS
Day time frequency	3 – 30 MHz	3 – 30 MHz	10 – 30 MHz	4 – 10 MHz
Night Time frequency	3 – 30 MHz	3 – 30 MHz	2 – 12 MHz	2 – 5 MHz
Range	Air ~ 366 km Surface ~ 46 km	Land ~ 100 km Sea/Air ~550km	Multiple hops, 3500 - 3700km per hop, but very probabilistic	50 – 300 km
Signal loss	• minimal • reflected wave	• surface absorption • reflected wave	• D layer absorption • Skip zone • Snell's Law	minimal
Distortion effects	minimal	minimal	• Polarisation • Doppler • multipath	minimal
Antenna	Vert Polarised	Vert Polarised	Vert Polarised	Horiz pol

Traffic Comparison

<table>
<tr><th></th><th colspan="2">EXISTING DHFCS</th><th colspan="2">PROPOSED EDHFCS</th></tr>
<tr><td>VOICE</td><td colspan="2">Voice (3 kHz)</td><td colspan="2">Voice (3 kHz)</td></tr>
<tr><td rowspan="7">DATA</td><td colspan="2">Military Messaging (3 kHz)</td><td colspan="2">Military Messaging (3 kHz)</td></tr>
<tr><td colspan="2"></td><td rowspan="5">TCP/IP</td><td>Text / Chat</td></tr>
<tr><td colspan="2"></td><td>E-mail (HTTP / SMTP)</td></tr>
<tr><td colspan="2"></td><td>IP - image</td></tr>
<tr><td colspan="2"></td><td>IP – video</td></tr>
<tr><td colspan="2"></td><td>IP – Tactical Data Links</td></tr>
<tr><td colspan="2"></td><td colspan="2">3 kHz (HF) Tactical Data Links
(Link 22)</td></tr>
</table>

- 3 kHz based upon minimum intelligible telephony
- Desire more bandwidth for all of the TCP/IP traffic
- Current MIL-STD-188-110C defines bandwidths up to 24 kHz

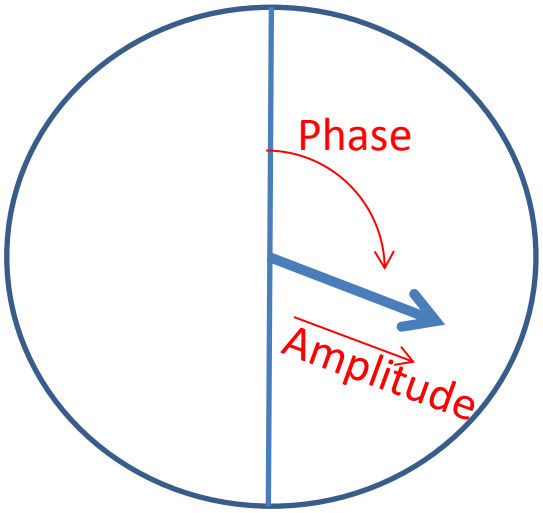
HF Digital Throughput bps (Waveform Modulation against Bandwidth)

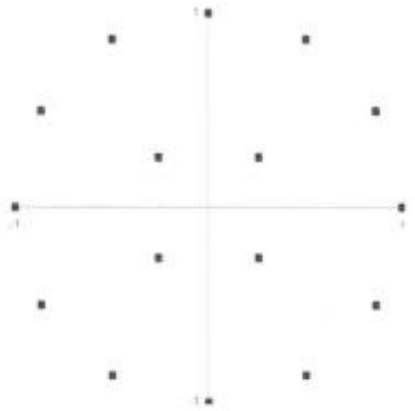
WID	Modulation	3 kHz	6 kHz	12 kHz	24 kHz
0	Walsh	75	150	300	600
1	2-PSK	150	300	600	1,200
2	2-PSK	300	600	1,200	2,400
3	2-PSK	600	1,200	2,400	4,800
4	2-PSK	1,200	2,400	4,800	9,600
5	2-PSK	1,600	3,200	6,400	12,800
6	4-PSK	3,200	6,400	12,800	25,600
7	8-PSK	4,800	9,600	19,200	34,800
8	16-QAM	6,400	12,800	25,600	51,200
9	32-QAM	8,000	16,000	32,000	64,000
10	64-QAM	9,600	19,200	38,400	76,800
11	64-QAM	12,000	24,000	48,000	96,000
12	256-QAM	16,000	32,000	64,000	120,000

Extracted from MIL-STD-188-110C

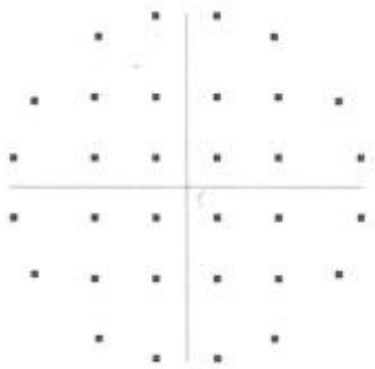
Waveforms - Quadrature Amplitude Modulation (QAM)

At any particular frequency you modulate amplitude and Phase

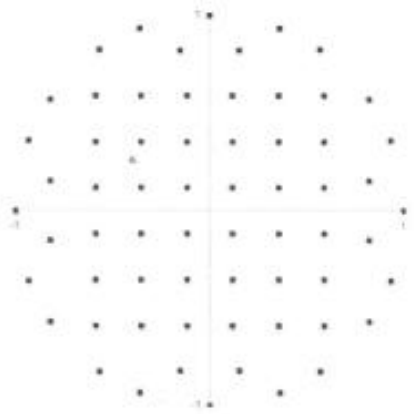




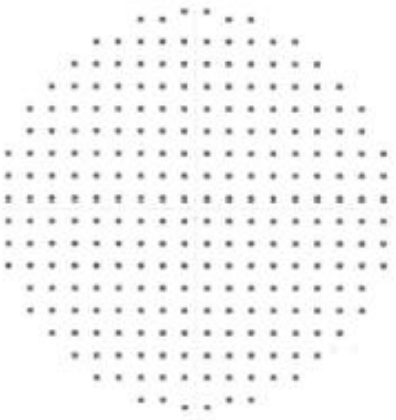
16-QAM



32-QAM



64-QAM



256-QAM

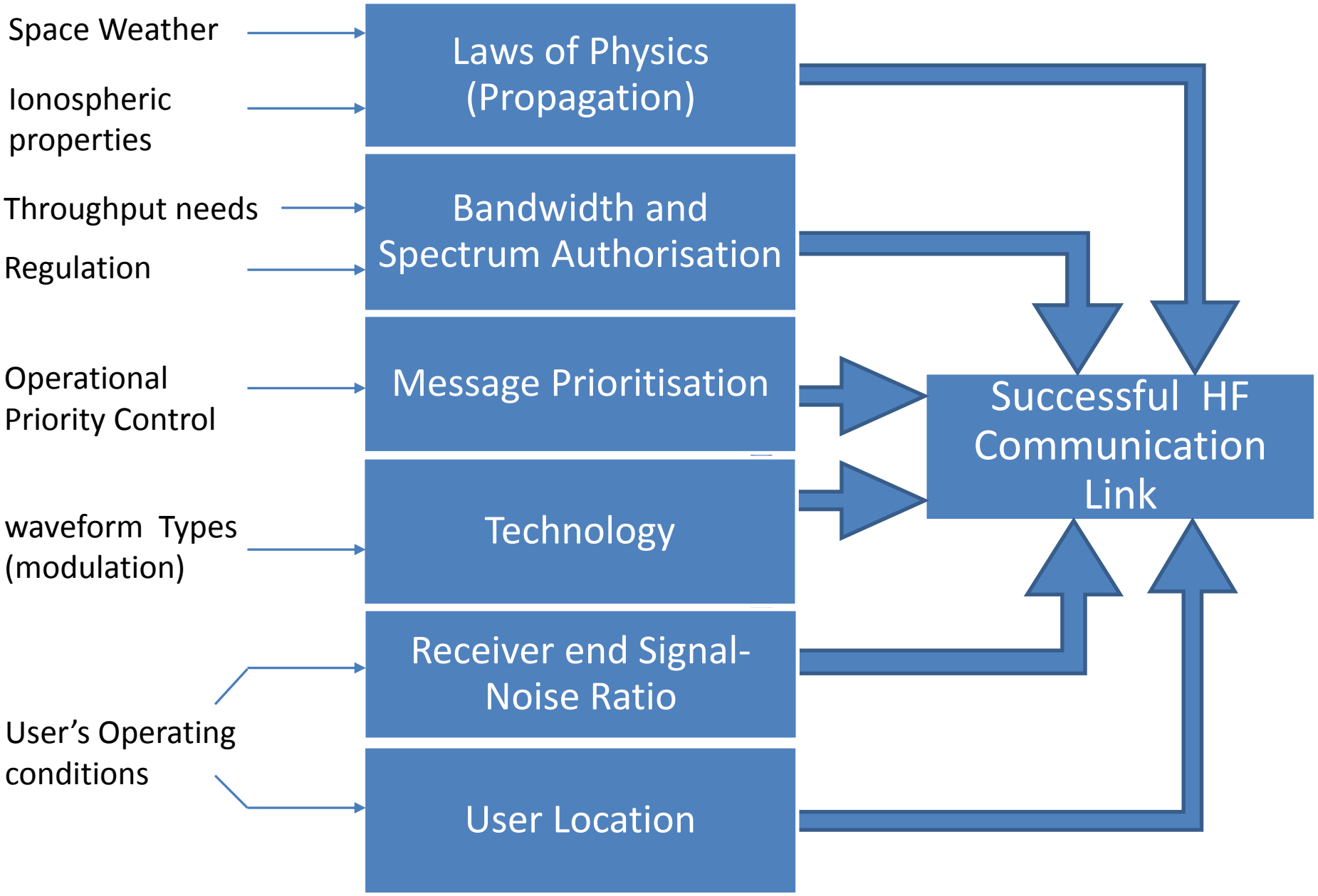
Comparison

CURRENT DHFCS FEATURES

- Narrow band
- 2nd Generation Automatic Link Establishment for ease of connection
- Voice traffic - analogue
- Serial data (Military message)
- Intelligent Networked Communication Software
- Direction finding capability
- Signal improvement capability
- Supports emergency situations

PROPOSED EDHFCS CAPABILITY

- Wideband for more capacity
- 3rd Generation and potential 4th Generation Automatic Link Establishment for more automation and less user involvement in linking
- Voice traffic – analogue and digital
- Serial data (Military message)
- Advanced Intelligent Networked Communication Software
- HF Tactical Data Link – Link 22 and IP based TDL including JREAP-C and VMF
- Internet Protocol communications including chat, email and HTTP exchange
- Retain direction finding and signal improvement capability
- Support whole of Government activities and activities of other Government agencies and organisations


Space Weather
Ionospheric properties
Throughput needs
Regulation
Operational Priority Control
waveform Types (modulation)
User's Operating conditions
Laws of Physics (Propagation)
Bandwidth and Spectrum Authorisation
Message Prioritisation
Technology
Receiver end Signal-Noise Ratio
User Location
Successful HF Communication Link

Questions?

If you would like to contact JP9101 Project Phoenix:

Project Management - james.brownlie@defence .gov.au

Engineering – milan.koprek@defence.gov.au