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Pacific Air Forces

Integrity - Service - Excellence

Electromagnetic Operations



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This presentation is
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PACAF delivers agile air, space, and cyberspace capabilities in support of USINDOPACOM's objectives, uniting allies and partners to enhance regional stability and security.

- PACAF Mission Statement

U.S. Indo-Pacific Command will implement a combat credible deterrence strategy capable of denying our adversaries sustained air and sea dominance by focusing on posturing the Joint Force to win before fighting while being ready to fight and win, if required.

- USINDOPACOM Mission Statement



Overview

- Introduction
 - INDO-PACIFIC Region
 - History
 - Electronic Warfare (EW)
 - Electromagnetic Spectrum Operations (EMSO)
 - Joint Electromagnetic Spectrum Operations (JEMSO)
 - South China Sea
 - Issues/Interactions between nation states
 - Futures
 - Summary
-



BASICS

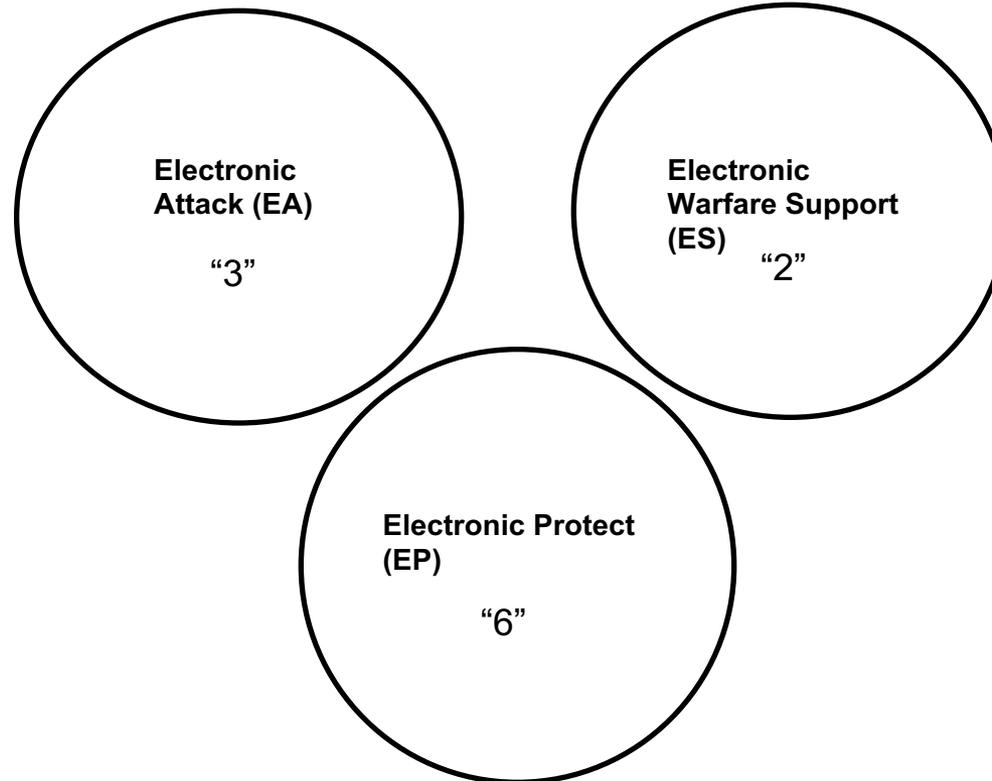
- **Electronic Warfare (EW)**
 - **EW refers to military action involving the use of EM energy and directed energy (DE) to control the EMS or to attack the enemy. EW consists of three divisions: electronic attack (EA), electronic protect (EP), and electronic warfare support (ES)**

- **Electromagnetic Spectrum Operations (EMSO)**
 - **Electromagnetic spectrum operations (EMSO) comprise all coordinated military actions to exploit, attack, protect, and manage the electromagnetic environment (EME) to achieve the commander's objectives**

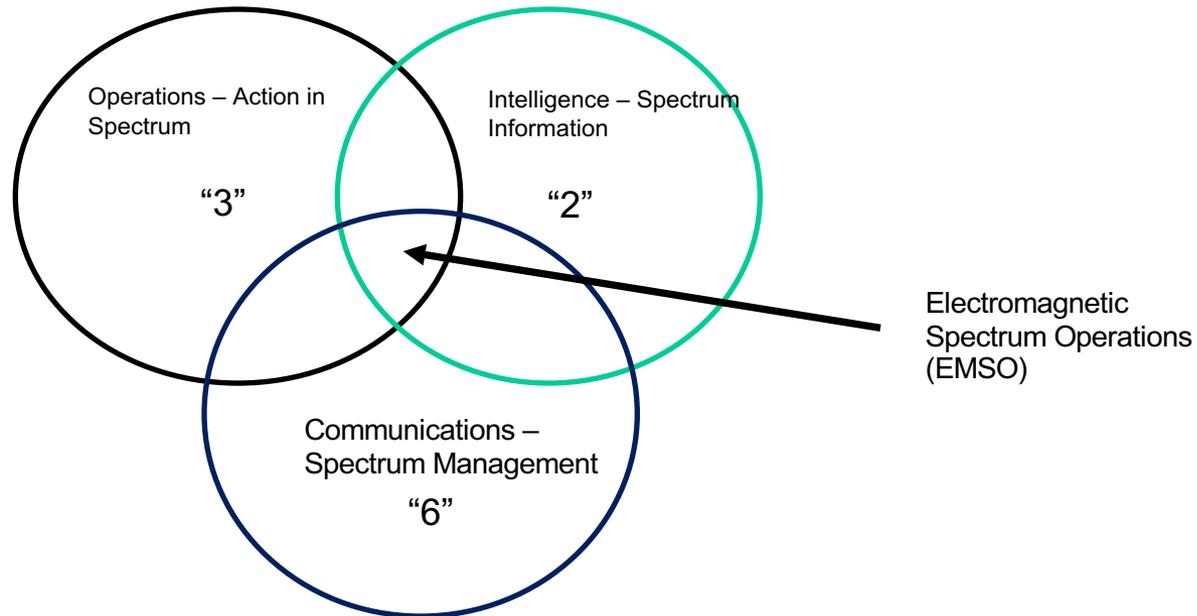
- **Joint Electromagnetic Spectrum Operations (JEMSO)**
 - **JEMSO are the coordinated efforts of EW and joint electromagnetic spectrum management operations (JEMSMO) to exploit, attack, protect, and manage the electromagnetic operational environment (EMOE).**



ELECTRONIC WARFARE



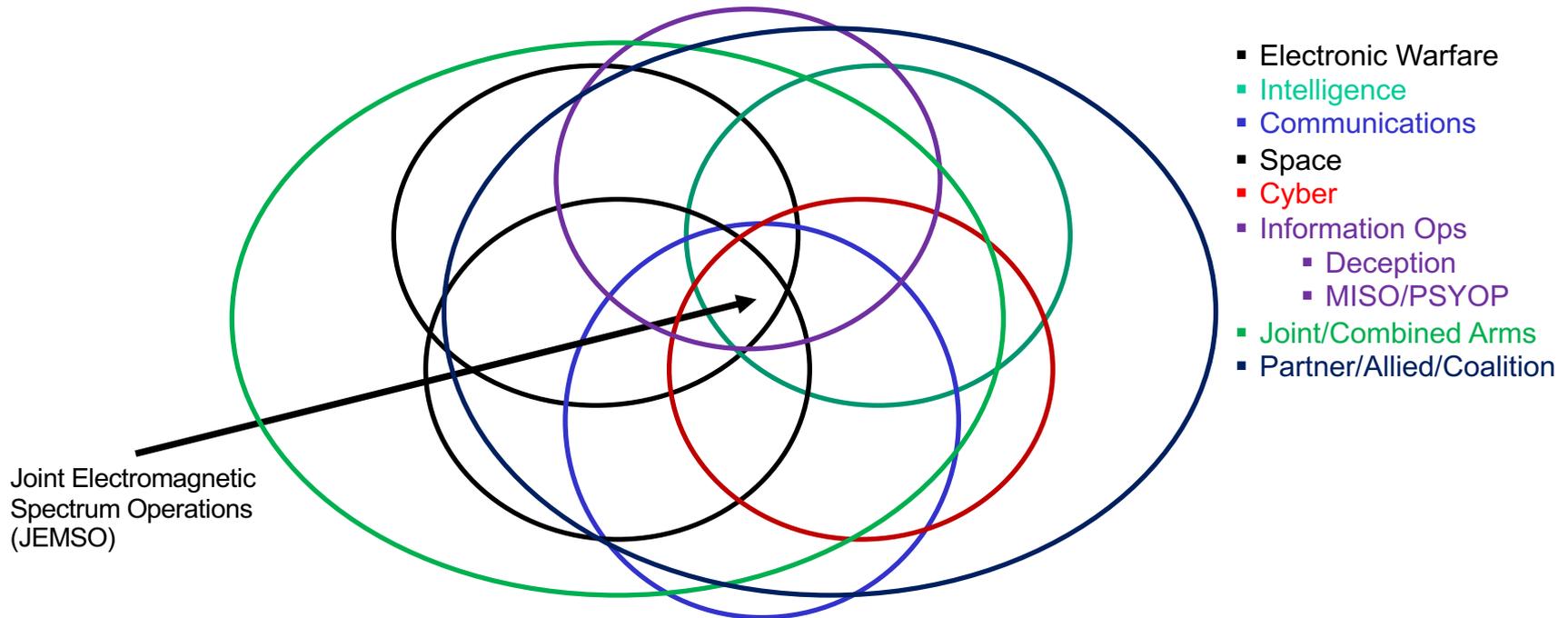
Three “pillars” of Electronic Warfare to attack (EA), exploit (ES), and protect the EMS (EP)



EMSO is a combined effort of looking at the EMS battlespace (Intel), Operating/maneuvering in the EMS (Ops), and managing the EMS (Comms).



JEMSO



JEMSO is the next step in the EMSO evolution to ensure all aspects of military operations requires the EMS are synergized



SPECTRUM

■ Modern Day Spectrum

- Everyone cannot live without the electromagnetic spectrum (EMS)
- Is spectrum a resource, commodity, basic necessity?
 - To Live
 - Cell phone (4G/5G)
 - Communications (radio/tv/internet)
 - Cook (microwave ovens)
 - Organize (meetings/collaborations)
 - Farming efficiency (GPS for boundaries)
 - Military Use:
 - Command and Control
 - Communications
 - Battlefield awareness (radar, laser)
 - Weapons (directed energy)



The EMS is being used by everyone in the modern world. EMS is as critical in modern nations as a national resource.



RESOURCE

- **Resource**
 - **Limited: Cannot make more**
 - **Usage/Innovation**
 - **AM/FM/multiplexing, CW, Pulse, DRFM, laser & other means of carrying data on a frequency**
 - **National (based on agreed upon boundaries)**
- **Government vs. Civil**
 - **Federal Communication Commission (FCC)/Korea FCC**
- **Since invention of radio/telegraph**
- **Oversight to protect freedom of movement in the EMS**

The resource of EMS gets limited/congested, defending the EMS becomes a governmental/military mission



CONGESTION IN THE EMS

UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

AIR FORCE SERVICE	AIR FORCE AUXILIARY	AIR FORCE RESERVE
AIR NATIONAL GUARD SERVICE	LAND MOBILE	AIR NATIONAL GUARD RESERVE
AIR NATIONAL GUARD RESERVE	LAND MOBILE RESERVE	BROADCASTING
MARITIME	MARITIME AUXILIARY	BROADCASTING RESERVE
MARITIME RESERVE	MARITIME AUXILIARY RESERVE	BROADCASTING RESERVE
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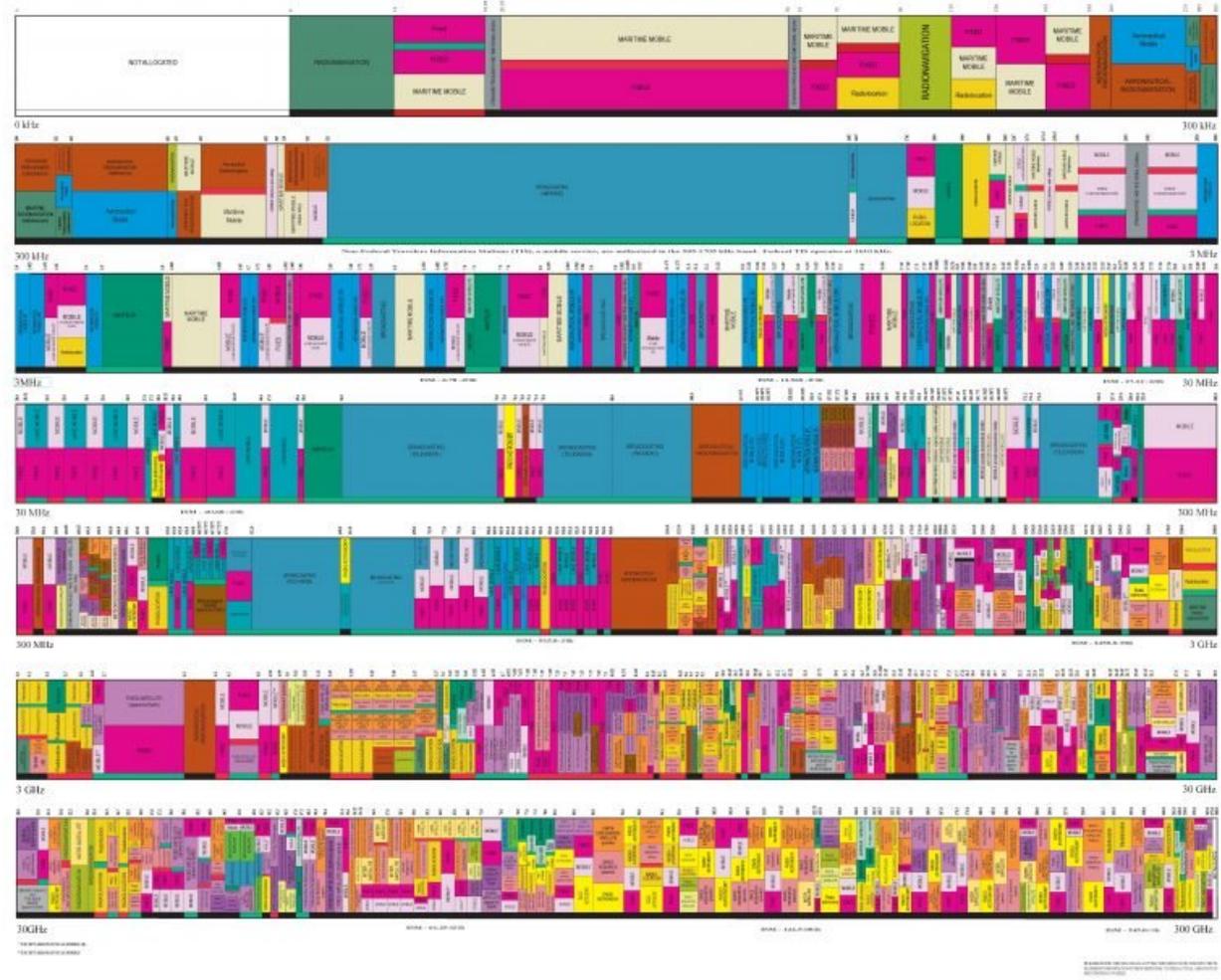
ACTIVITY CODE

F1 - Fixed	F2 - Mobile
F3 - Maritime	F4 - Earth-Space

ALLOCATION USAGE DESIGNATION

MODES	CHARACTER	DESCRIPTION
FM	F1	Fixed
AM	F2	Mobile
SSB	F3	Maritime
SSB	F4	Earth-Space

U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management
ANNEX 204





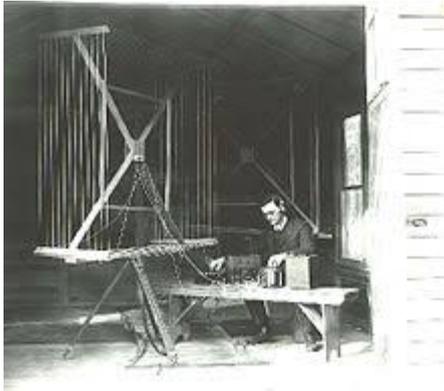
INDO-PACIFIC AREA



- Top 3 Economies of world
 - United States
 - China
 - Japan
- 50% of World's Population
- Large Militaries
- 3,000 Different Languages
- \$3T Use South China Seas



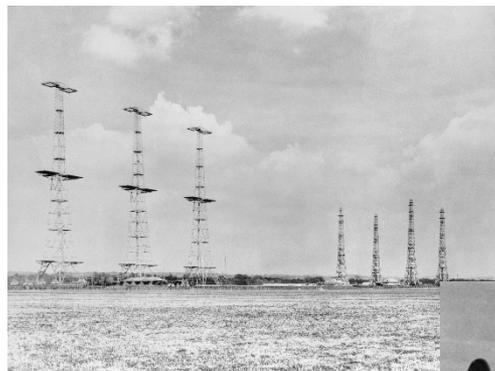
BEGINNING to 1939



- **Electronic Warfare (EW):**
 - Prior to World War II
 - Radio
 - Direction Finding (DF)
- **Tactical**
 - Ship to ship
 - Individual Units
- **World War I**
 - Communication herding
 - Cable cutting (LOC)
 - Signals Intelligence
 - Battlefield radio interception
 - Movement
 - Size
 - Resiliency



1939-1945



Radar "chain"
at RAF Poling



Lancaster
dropping chaff



Dive Bomber at
Midway

- **Electronic Warfare (EW):**
- **World War II**
 - **Radar**
 - **Battle of Britain**
 - **Navigation Beacon**
 - **Bombing Campaigns**
- **Jamming**
 - **Chaff – USAF**
- **SIGINT**
 - **MAGIC**
 - **Key Pacific Battles**
 - **Battle of the Atlantic**



1945-2000s



Navigational
Buoy

shutterstock.com • 737843269

TACAN/VOR



Kolchuga
passive sensor

■ Electronic Warfare (EW):

- Navigational Aids (NAVAIDs)
- Passive EW
- Fire Control/Direction Finding
- Proximity Fuses
- Battlespace awareness

■ Electromagnetic Spectrum Operations (EMSO)

- More than just EW pillars
- Evolution of “joint” warfare
 - Combined Arms Doctrine

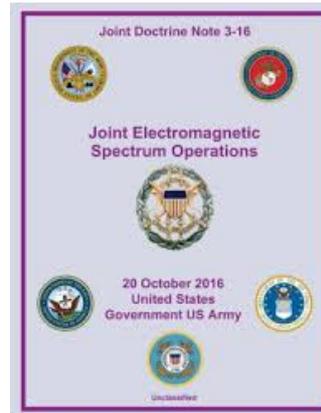
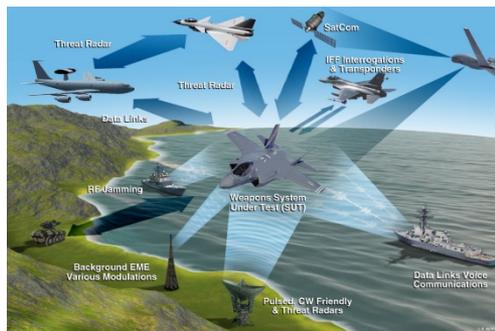


2000s-now



四、美陆军网络空间/电子战行动能力的应用 (二) 联合电磁频谱作战概述

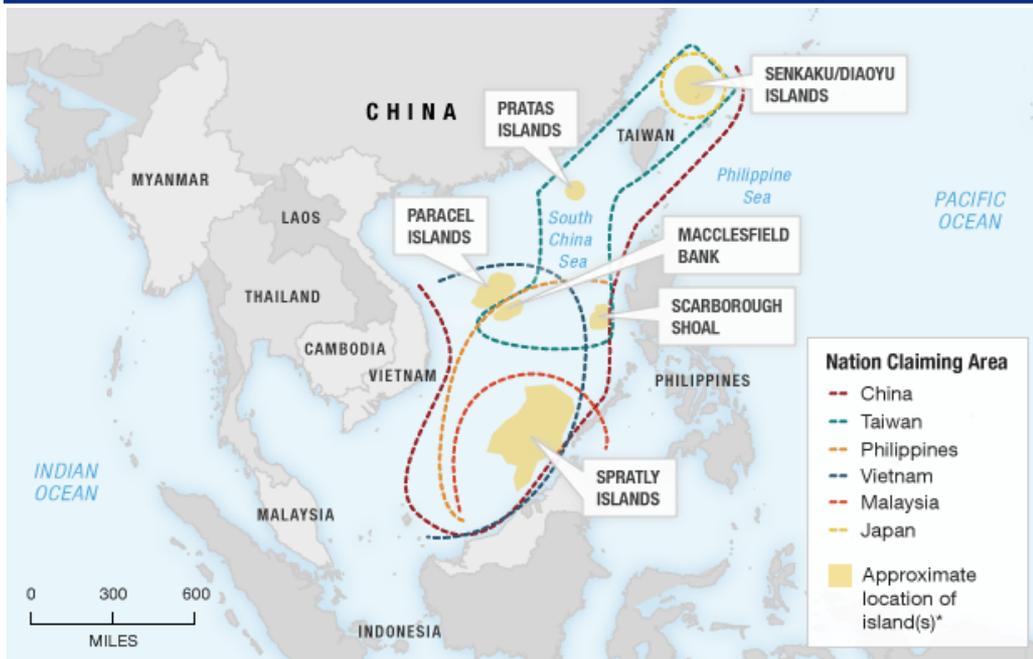
联合电磁频谱作战 (JEMSO), 目的是刺探、进攻、防御和电磁作战环境管理 (信号情报、电磁频谱管理、电子战等式)。最终要形成电磁作战环境内集成式的兵力运用方案, 以夺取电磁频谱优势并实现联合部队指挥官的作战意图。



- **Joint Electromagnetic Spectrum Operations (JEMSO)**
 - **Joint Doctrine Note 3-16**
 - **Proactive and deliberate not reactive**
- **Joint/Combined Evolution**
 - **Near real time/real time**
 - **Electromagnetic Battle Management (EMBM)**
- **Strategic Planning**
 - **Effect based not capabilities based**



SOUTH CHINA SEA

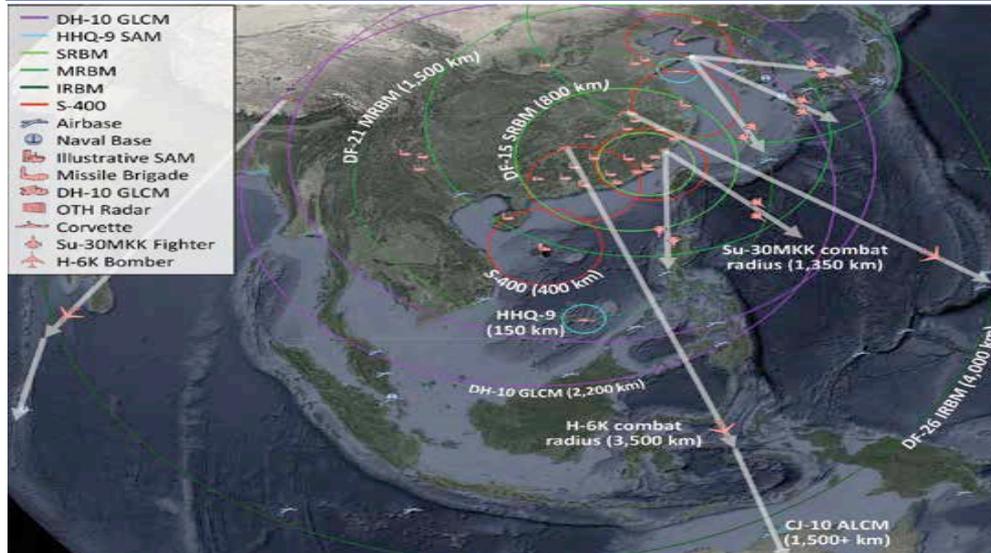


- Congestion
 - National Borders
 - Resources
 - Trade Routes
- Boundaries
 - Conflicts
 - EM transcends borders
 - EMS/EMI
 - Rule of Law (UN)





Asia Issue



- Some EM stats from area
- Include borders
 - Conflicts
 - EM doesn't stop
 - Standards
 - Resources (EMS)
 - C2 critical
 - Affects everything
 - Military
 - Civilian
 - International orgs/norms



NATIONS



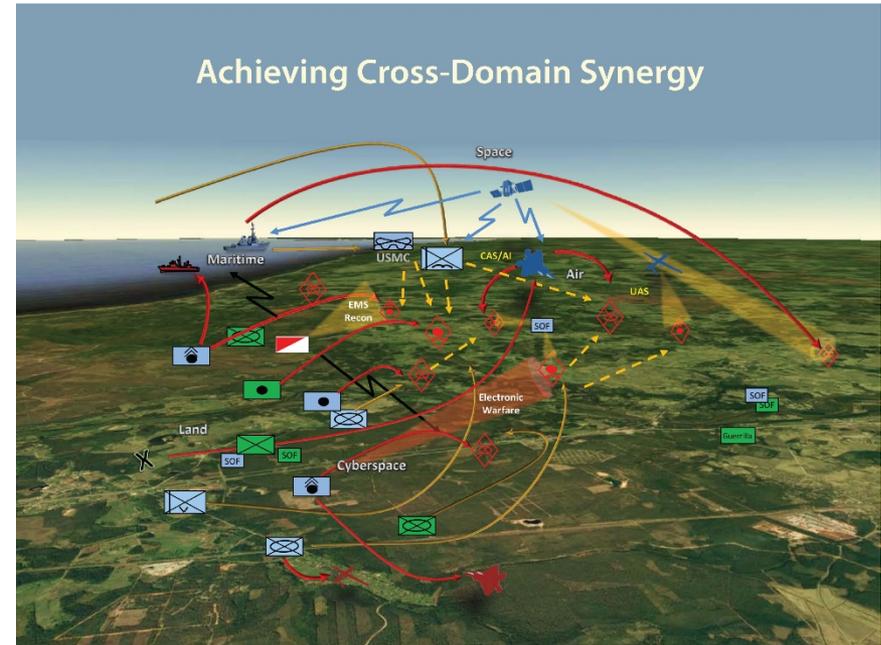
EW Arms race

- Increased EW/EMS equipment
 - Battlespace Awareness
 - Space Assets
 - Early Warning
 - Communications
 - Command & Control
 - Defend
 - Spectrum Management
 - EMS Awareness
 - Attack
 - Jammers
 - EW support of effects
 - Cyber
 - Space
 - Information Operations



JEMSO CONSIDERATIONS

- **EMS Congestion**
 - **Collaboration**
 - EMBM
 - Multi-service/coalition/partnerships
 - Planning vs reacting
 - Speed of information
 - EMI (fratricide) vs Jamming
 - Intelligence/surveillance/reconnaissance (ISR)
 - Identification
 - Effects
 - Support multidomain operations
 - Suppression vs destruction



JEMSO enables spectrum resiliency to allow for all aspects of modern multi-domain military operations (JADC2)

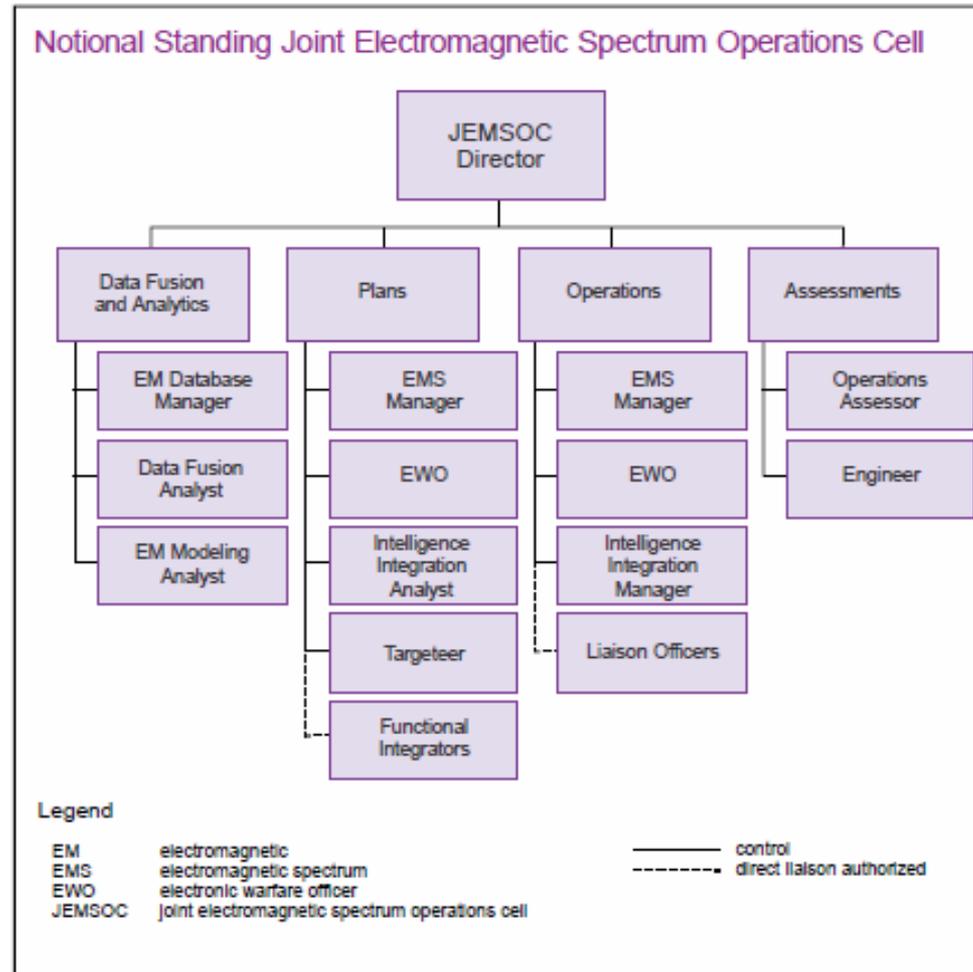


- **“Traditional” EW/EMSO/JEMSO Missions:**
 - **Electronic Attack – Disrupt/destroy enemy’s EMS**
 - **Electronic Protect – Prevent friendly forces EMS**
 - **Electronic Warfare Support – Collect/Exploit the EMS**
- **Support to:**
 - **Cyber – Platform delivers cyber package through EMS (WIFI)**
 - **Space – Defend EMS link to Space Assets**
 - **CC&D – Use EMS systems to mask, change, deceive**
 - **Kinetics Strikes – Suppression/Destruction of Enemy Air Defense (S/DEAD) or Integrated Air Defense System (IADS)**
 - **PSYOP/MISO – EMS broadcast (TV/Radio/Internet)**

JEMSO enables and support effects in other domains by maneuvering in the EMS

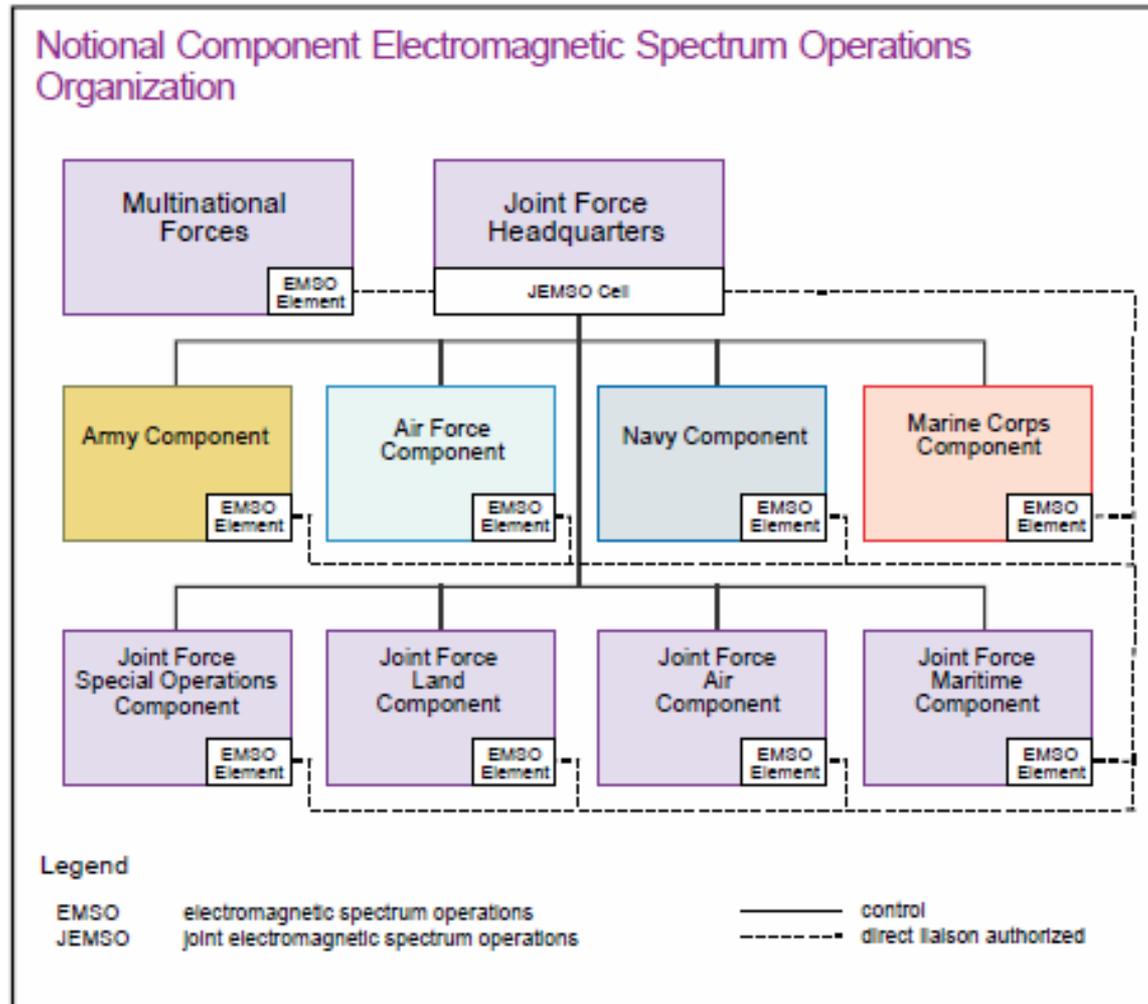


JEMSO CELL





JEMSOC/EMSOC





FUTURE

■ Emerging/Developed concepts systems

■ Materials

- Spectrum energy absorption/reflective
- Concealment, Camouflage, and Deception



■ Science

■ Artificial Intelligence

- Data processing
- Resiliency
- Autonomy



Future EMS systems using AI/automation will increase the speed of data processing, resiliency and enable multi-domain ops in a rapid changing battlespace environment



“人皆知我所以勝之形，而莫知吾所以制勝之形。”

“All men can see the tactics whereby I conquer, but what none can see is the strategy out of which victory is evolved..”

-Sun Tzu



QUESTIONS