From the JED Archives: EW, the EMS Domain and Air Superiority

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The EMS Domain. There, I said it. What are you going to do about it? Every now and then, I sit around with friends and banter back and forth on a myriad of Electronic Warfare (EW) topics. On occasion, the discussion evolves into whether or not the electromagnetic spectrum (EMS) is a medium or domain. To frame the discussion, a medium has intrinsic military value but is not decisive to operations or strategy. A domain is critical to military employment from tactical to strategic levels – i.e., land, sea, space, and air. Each is undeniably reliant on others for successful operations. In these debates, I am always the EMS domain advocate, and recently something interesting has been happening – my arguments and positions are getting stronger. While I wish I could attribute the increases of success on my ever-improving oratory skills, I don't believe that's the case. I believe, as every day goes by and the US military becomes increasingly dependent on the EMS, eventually, the EMS will gain its rightful place as a warfare domain alongside Air, Land, Sea, Space and Cyber.

HISTORIC TRANSITIONS OF MEDIUMS INTO WARFARE DOMAINS

Just as the sea was initially a medium for many, many years (even before the creation of seaworthy vessels), man viewed waterways as logistical avenues for transporting personnel and goods over water. That application progressed to controlling those routes by building war ships. Eventually, the ability of sea battles to impact warfare at strategic levels proved the sea was no longer just a medium; it had become a full-fledged domain. A similar argument can be applied to the air domain. During the American Civil War, air (think reconnaissance

balloons) was just a medium. It was not until well after Orville and Wilbur harnessed flight that militaries gained the opportunity to consider air as a domain. Interestingly, even after the technological leap into the air (no pun intended), it took years for the air medium to become a domain. This most likely happened sometime after Billy Mitchell's sinking of the *Ostfriesland.* The important point is not *when* air turned from a medium to a domain; rather that air *did* transition, given new technologies. Technology (manned flight) facilitated new military capabilities with profound operational and strategic impacts on the other domains (land and sea). The three domains (air, land, and sea) became intrinsically reliant and interdependent on each other for military actions – tactical to strategic.

Realizing that it was new technologies which transitioned sea and air (and space, as well) from mediums to domains, it is not hard to envision that the EMS – given technological development – will also someday become a domain. The military has increasingly leveraged the EMS medium over the years. From radios, radars, data link systems, video feeds, millimeter wave systems and a myriad of others, EMS usage and reliance exponentially grows. EMS reliance arguments are becoming increasingly easy. As an aviator, let me provide an example: an aviator's primary tasks are to "aviate, navigate, and communicate." Years ago, the EMS only enabled *communication* via VHF/UHF radios. Soon thereafter, radars, navigational aids, and Doppler enabled *navigation*. In the 1990s, RF signals from the satellite-based Global Positioning System (GPS) solidified reliance on the EMS to *navigate* (not just aircraft, but also weaponry). And today, the evolution to radio frequency-controlled remotely piloted vehicles has forced some aviators into complete reliance on the EMS to "aviate, navigate, and communicate." Similar arguments can be made for other domain (Land, Sea, Space, and Cyber) EMS dependencies. Given this continually increasing reliance, at some point, DOD must realize a full and utter dependence on the EMS, and it is at that point the EMS will become a domain. Soon thereafter,

DOD will realize the value of EMS supremacy, much like air supremacy and sea supremacy. More importantly, it will become apparent if a future adversary were to gain EMS supremacy, because the US and its allies would suffer a significant strategic disadvantage across all other domains (Air, Land, Sea, Space and Cyber).

OTHER EMERGING DOMAINS IN THE MILITARY

Efforts to validate other military operational domains are not a new concept, and today DOD is moving forward with the Cyber Domain. I must confess, I'm not sold. While Cyber does follow the aforementioned domain interdependency theory, like the air domain, I am leery to give Cyberspace the domain nod for one reason: Cyber did not start as a natural medium – it is man-made. Just as man has become increasingly dependent on Cyber and the Internet, man still has (and will always have) the ability to cease information processing and "turn off" the Internet – as scary as that might be. (A humorous side note here: For over a year, I've debated an Internet "off switch," and the response is always, "Fisch, there is NO WAY to turn off the Internet or Cyber. It's just too big." I chuckle knowing the US Congress is working on legislation that would give the President of the United States that very capability – a Cyber "kill switch." Given an ability to turn off a domain, I'm willing to bet during WWII when London was being bombed frequently, the British seriously wished they had an Air Domain ON/OFF switch.)

Anyway, I digress. The point is, the domains of Air, Sea, Land, Space and EMS naturally occur in the environment. Because of this, they are bound by laws of physics – gravity, Archimedes's principles, Newton's Laws, Bernoulli's principles, aerodynamics, hydrodynamics, speed of light, line of sight, propagation, attenuation, vacuums, etc. While humans can choose not to fly, sail, march, orbit, or transmit, that will not stop flying birds, swimming fish, roaming animals, orbiting planets, and electromagnetic disturbances. Because of this, I firmly believe a true warfighting domain must first

exist in nature whether man exists or not.

While I don't think senior leaders will reverse course on the creation of the Cyber domain, I do provide words of caution. Two serious dilemmas face DOD and policy makers: emerging man-made domains and an "unbounded" Cyber domain. First, creating a man-made domain opens future doors for additional man-made domains. In the Capitol Beltway, Air, Land, and Sea services cringe at "emerging new domains," as it directly correlates to a loss of budgetary strength (the DOD Top Line is most likely not going to increase). Limiting domains to physical entities might have been a better approach, as the EMS was the last known natural domain. Man-made domains will continually emerge (maybe the "artificial intelligence" domain is next) which will continually spur "domain debates." Additionally, the Internet (what most people equate to the Cyber domain) is an ever-evolving entity, and therefore the domain's definition will also continually evolve (as stated earlier, Cyber is not bound by Natural physical laws). Can you imagine an Air Force defining policy, strategy, operations and tactics for the "Air" domain if Bernoulli's principle, gravity, and other bounding natural laws continually changed?

Usually, at this point, many of my verbal sparring partners try to encompass the EMS into Cyber domain. Additionally, I hear Cyber is more than the Internet. I don't dispute that and I also do not dispute the US's reliance on Cyber is massive. However, I do argue that Cyber is *not* the EMS and the EMS is *not* Cyber. EMS systems (radar, comms, targeting systems, EW, navigation, IFF, etc.) resident in aircraft, satellites, ships or land vehicles in *no way* make the EMS a part of the Air, Space, Sea and Land domains. Similarly, Cyber's reliance on EMS systems also does not provide linkages to make EMS part of the Cyber domain.

WHAT'S STOPPING THE EMS FROM DOMAIN STATUS?

While I argue the US should have already made the EMS a domain, the more important question is, "Why hasn't the US established the EMS domain already?" Three reasons are readily

apparent: organizational issues, the invisibility of the EMS, and a limited pool of advocates. The US military machine is organized in a “domain based” construct. As Air (and Space), Land and Sea domains exist, so do their respective domain departments – Air Force, Army, and Navy. Given the DOD’s fiscal constraints, services hesitate to champion the creation of new domains (and potentially new departments). Case in point, the fight and consternation over the recent creation of Cyber. Historically, services aggressively challenge any program or idea that threatens service (domain)-related funding. (Think about the Space domain and the Rand Report, for instance). Another organizational problem is preexisting EMS reliance and a fear of oversight and control. From intelligence collection, command and control, bandwidth congestion, sister services and other governmental agencies usage, industry stakeholders, FCC oversight, and many more organizations, the stakes involved in surrendering established EMS footholds to a “domain manager” is untenable and most likely an idea very few senior leaders in DOD or other agencies are willing to consider.

Another potential reason the EMS is not already a domain is its “invisibility” and relative mystery to the average human. Unlike Air, Land, Sea and Space, we cannot see, touch, or feel the EMS. To many, it is an enigma and poorly understood. For those who use cell phones, watch TV, listen to satellite radio, connect to WiFi hotspots or navigate their automobiles with GPS, the EMS is likened to a heart pacemaker. People might not notice when it is working, but they sure know when it isn’t. Additionally, people have little idea of the inner-workings of a pacemaker – just as very few understand the EMS. Because of this, gaining support to transition the EMS from medium to domain is difficult. On the other hand, EMS experts usually attempt to explain it to decision makers with words like,” frequency, pulse width, PRF, PRI, monopulse, right-hand circular polarization, etc.” From my experiences, this is where most of the decision makers fall victim to the medical condition known as the “EMS induced coma.”

The final reason the EMS has yet to achieve domain status is a significant lack of manpower (think advocacy) across the services. Just as aviators advocate air issues and space operators advocated space issues; it is the EW specialists who must champion and advocate EMS issues. Today, three services have advocates – Air Force Electronic Warfare Officers (EWO) and Navy / Marine Electronic Counter Measures Officers (ECMO). The US Army recently established a new EW Military Occupational Specialty (MOS), and it will eventually stand up a significant number of trained electronic warfare specialists. But today, the Army currently lacks EW specialists. Operations in Afghanistan and Iraq exacerbate the limited USAF, USN, and USMC EW specialist pool, as EWOs and ECMOs from stateside critical billets fill ground combat EW positions. Another problem is the shortage of EMS advocates available to generate the horsepower needed to adequately push EW agendas. Within the US Air Force, few EWOs rise to the ranks required to champion EW. And if they do, too few O-6 EWO billets exist, causing the Colonel's Group problems for assignment matching. The Air Force personnel system categorizes EWOs the following way: Aviator first, Navigator second, type airframe (heavy or fighter) third and EWO is fourth. Case in point: a recent EWO who's past includes weapons officer graduate, Air Staff EWO and Electronic Warfare Deputy Group Commander graduated from the Industrial College of the Armed Forces (he received the CJCS strategic paper award writing on Information Ops), was assignment matched to a foreign country's air attaché assignment as he was an aviator (assignment match requirement) and had studied two years of that country's language in college (desired). His EWO knowledge was most likely not considered.

"Corporate culture" hurdles within the services exacerbate the manpower problem. In the Air Force, few EWOs man weapon systems in which the primary mission is offensive airborne electronic attack. The majority of EWOs fly kinetic strike (B-52, B-1, F-15E) and collection (RC-135) platforms. In no way is this statement derogatory ; these EWOs are awesome at

what they do – be it protecting their airframe or intelligence exploitation. But these assignments cultivate a mindset in line with the platform's mission, rather than EMS dominance. In the Navy/USMC, a large pool of EMS-dominance trained ECMOs exist. However, EA-6Bs will soon be replaced with EA-18Gs, reducing ECMO manning by 66%. Similarly, the USMC eventually plans to transition from EA-6Bs to the single-seat (pilot only) F-35 – culling EMS corporate knowledge. Today, the only service increasing EW manpower capacity is the Army.

The services' limited EW personnel and thin "corporate knowledge" amplifies the problem of too few EMS advocates in DOD. Given this manpower limitation, it is not a stretch to say that today's EMS advocates are nearly nonexistent, especially when compared to aviation personnel of the 1930-40s who advocated the creation of a separate air service or the number of space personnel in the 1970-80s who advocated its domain establishment.

Finally, the last advocacy problem is the lack of industry backing. Within the scope of the DOD budget, EMS-related programs represent a relatively small portion of industry dollars and quite often are subcontracts or subcomponents on much larger military programs. It is large-dollar programs that influence DOD and Congress.

NEVER FORGET: FUTURE POTENTIAL ADVERSARIES ALWAYS GET A VOTE

Given the hurdles that hinder the growth of EMS into a domain, it is interesting to investigate what other nations are doing with their EMS programs. Over our nation's past wars, the world witnessed the US dominate both the Iraqi and Yugoslavian air defense systems during Operations DESERT STORM, IRAQI FREEDOM, and ALLIED FORCE. The world quietly learned the undeniable value of EMS dominance. One of these countries is the People's Republic of China. Over the past few years, the Chinese have created a high-level office in charge of Information Operations and Electronic Warfare. This office is on par in level to the Chinese Army, Navy, and Air Force; reporting directly to the Ministry of National Defense (see

Figure 1).[1] A four-star general oversees EW in China. A Colonel oversees it in the USAF. There is no question China's placement of Electronic Warfare in their national defense system is much higher than the US.

APPLICATION OF AIR EW OPS – TODAY'S RELEVANCE AND RELIANCE

As stated earlier, Cyberspace has become a domain due to the continual increasing reliance by other domains. Cyber assets are critical components to how the US fights wars in Land, Sea, Air and Space. Interestingly, the components that comprise the Cyber domain – computers, the Internet, SiPRnet, PDAs, open and closed networks, information feeds from JTIDS and Blue Force Tracker, etc. – are all physical entities that exist. While the EMS is "invisible," today's warfighter is no less reliant on it than Cyber. From Command and Control (C2) nets, GPS, MTI, SAR, and Doppler Radars, tactical datalinks, wideband reachback capabilities, all these systems are critical to the way the US fights wars. Suffice it to say, until the US military hard-wires every satellite, aircraft, surface vehicle, ship, soldier, sailor, airman, or marine, it will be enslaved to the EMS. To put into context, a US versus near-peer large-scale conflict where the US and coalition lose EMS superiority might look like this: First, Air Operations Center command and control efforts would be at a minimum degraded, if not denied. Air Tasking Order generation and distribution would be difficult and senior-level control of Time Sensitive Targeting / Time Critical Targeting would be impossible. Datalink and voice communications between control assets, fighters, bombers, tankers, and other aircraft will most likely be hindered, denied, or even deceived. GPS navigation for aircraft/munitions could be denied, especially around strategic targets, forcing weapons delivery back to more traditional guidance methods such as laser. Obviously, it's an ominous position to consider. To be fair, all is not lost. I do believe the US military can still fight a major conflict while losing a contested EMS battlespace, but if it intends to do so, I recommend it begin training to the

scenario. AOCs should practice limited ability to control, and all assets must rehearse comm.-out operations, as well as placing their GPS and Cyber systems in the “OFF” position.

WINNING THE NEXT WAR

While I might be in the minority – and my belief most likely isn’t shared with many of today’s US military leaders – the EMS will become a domain. I doubt Admiral Sergei Gorschkov, former Commander of the Soviet Navy, 1956, who once said, “Whoever controls the electromagnetic spectrum on the battlefield will win the next war,”[2] realized how profound his statement would be 50 years later. To put his 1956 visionary statement in context, in 1960, Sony introduced the first transistorized radio.[3] Interestingly, he wasn’t alone in his vision. 20 years later, ADM Thomas H. Moorer, former Chairman of the Joint Chiefs of Staff (1970-1974), also commented, “If there is a World War Three, the winner will be the side that can best control and manage the electromagnetic spectrum.”[4] At the time of Admiral Moorer’s statement, EMS knowledge and understanding would include the cutting-edge technology of LORAN[5].

Just as the air medium and space medium were seized and converted into revolutionary military operational domains, an opportunity exists again to leverage a new domain into operational and strategic advantages in their nation’s future wars. Unfortunately, this opportunity exists not just for the United States. It’s up for the taking. Earlier, I referenced Gen Billy Mitchell. As we know from history, his career was tumultuous. But without question, his efforts proved the Air domain worthiness and shaped the Air Force we know today. I don’t know if the EMS needs a Billy Mitchell to push it into domain status, but I must confess, the tactic is proven.

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REFERENCES

[1] The Republic of China Yearbook 2008, Chapter 8 – National Defense, http://www.gio.gov.tw/taiwan-website/5-gp/yearbook/ch8.html

[2] http://einaudi.cornell.edu/europe/academics/courses.asp?detail=4604&prefix=COM+L&num=683

[3] http://en.wikipedia.org/wiki/Radio

[4] http://einaudi.cornell.edu/europe/academics/courses.asp?detail=4604&prefix=COM+L&num=683

[5] http://en.wikipedia.org/wiki/Radio