Opening Session, Welcome & Keynote Address

The 55th Annual AOC Symposium and Convention opened this morning with a warm greeting from the 33rd outgoing president, Ms. Lisa Frugé-Cirilli. Lisa invited all nations in attendance to stand and be recognized, highlighting the AOC’s success in bringing a global EW community together within the membership of the Association of Old Crows. She commented on the collaborative efforts of Georgia Tech and the AOC to realize an advanced degree, and licensed professional courses in EW. Mr. Terry Crimmins, President of Electronic Systems for BAE, spoke on behalf of the Convention Host, BAE Systems. The Gold Award Recipient, Dr. Bill Conley, was presented his award, as were the Tech Hall of Fame inductees. Mr. Glenn Powder Carlson and Mr. Jesse Judge Borque co-introduced the symposium’s exciting session and speaker lineup. Mr. Borque remained on stage to introduce the first Keynote speaker, Mr. Dana Deasy, DoD CIO.

Mr. Deasy began his remarks by commenting on the impressive lineup of speakers for this year’s symposium. He confessed it was his first time addressing the AOC, and commented on how honored he was to be asked to speak. He dove into his speech by calling out Secretary Mattis’ three priorities for the National Defense Strategy (NDS): deliver lethality to the warfighter, foster partnerships across barriers for mission success, and adopt reforms to maximize resources and minimize risk. Mr. Deasy took the challenge of answering the NDS call very seriously, and in his 7 short months as CIO, he prioritized his organization around four areas to meet the intent of the NDS: Cloud, Artificial Intelligence (AI), C3, and Cyber. He made the point of saying these are in order of integration, and that access to the EMS was essential to enable all four of them. The DoD is fully committed to a multi-vendor, multi-cloud environment, highlighting the DoD’s intent to incorporate open systems architectures for its future capabilities. “AI is growing,” he remarked, and in response to this he has stood up the Joint AI Center (JAIC, pronounced, “Jake”) to showcase the importance of AI in enabling future EMS capabilities. The Cyber priority will focus on security for critical network systems. In deference to the audience he was addressing he showcased C3, explaining that complete freedom to maneuver and uncontested access to the EMS was critical to enabling mission success. He pointed out that the military will require a change to how it approaches EMSO for spectrum superiority, both in overcoming the cultural undertone of deconfliction, and focusing its efforts on efficient access in a contested, congested environment.

He remarked that “not a day goes by” without a news story about our adversaries’ increasing efforts to deny, exploit, degrade and confuse our access to the spectrum. This establishes the critical nature of EMS for modern warfare and global cooperation. The EMS possesses unique “cross-cutting” presence across all of the warfighting domains (Air, Land, Sea, Space, and...
Cyber), and this presence must be leveraged to achieve access, speed and advantage. The DoD CIO has a responsibility to see that the EMS is properly managed to ensure our military C3 is entirely effective and resilient to enemy attack. One latent challenge for his office is managing the ever-expanding use of spectrum by the civilian population (across the globe), and to properly balance growing military requirements with the demands for economic growth.

Mr. Deasy recognizes that the right technologies, tighter integration, and appropriate policy will enable freedom of maneuverability in the EMS. Congress’ recently-signed National Defense Authorization Act (NDAA) is calling for the DoD to realize EMS roles, and develop a compelling Electronic Battle Management capability for Joint EMSO. The NDAA also calls for new spectrum policy, and the DoD will be responsible for reporting on spectrum requirements in the future.

The DoD intends to leverage the Cloud, AI, and Cyber to achieve its military objectives. As such, the CIO office developed the Joint Spectrum Data Repository (JSDR) to enable delivery of near-real time data for mission critical applications. This repository presents a single source for ease of access, global distribution, and seamless interoperability, making data available for numerous mission applications (no mention was made of how Title 10/Title 50 would be addressed). His office is working to develop cutting-edge waveforms for security and resiliency of satellite and ISR missions. The demand for massive amounts of data has placed a burden on analysts, and he intends to leverage AI, and the new JAIC, to help lift this burden.

Mr. Deasy completed his talk by congratulating the AOC on its showcasing of STEM for the last four years. He expressed his sincere devotion to seeing young people choose careers in government, and reminded the audience that the U.S. Government cannot compete with industry for high-paying occupations. Young people’s minds and hearts must be won over with commitment to a higher calling, that of protecting our warfighters, and our nation. That may be a stretch for some young people today, so he proposed that we suggest to them that their ability to upload photos to Instagram and Snapchat was at stake. This engendered a warm laugh from the audience, but the point was made. All of us in the EW community need to entice our “young crows to become old crows,” as a decisive measure in ensuring military dominance in future engagements.

In summarizing Mr. Deasy’s comments, he clearly demonstrated that he understands the importance and vulnerability of EMS Superiority. As DoD CIO, he is addressing the new and evolving challenges of managing the electromagnetic spectrum to provide access when and where it is needed.

- Melinda Tourangeau, Warrior Support Solutions, LLC
Spotlight Session - Framework for EMS Superiority

This panel discussion brought together senior leaders from the EW EXCOM, the Intelligence Office of OUSD, the Joint (J8) Staff for requirements and capability development, and the Joint EW Center (JEW) / USSTRATCOM to demonstrate the practical implementation of EW/EMSO strategy. Dr. Conley led off by addressing the current buzzwords for Multi-Domain and Information Warfare: EW, EMS and EMSO, the “lightning bolt”, cross-domain, multi-domain. He pointed out that while some of these words may be new, the concepts are drawn from the Vietnam Era, and we are tasked to reinvent them to address current threats. For example, China has developed strategy to defeat “our systems,” not our platforms. Our approach to EW/EMSO needs to evolve (aka undergo a “paradigm shift”) to be responsive to this new family of threats.

Our community is dealing with not just complicated operations, which can be dissected using traditional systems engineering fundamentals, but also complex relationships that dismantle the easy approach to “measure EMS Superiority.” This calls us to embrace inherent diversity in our community, which is why his panel is comprised of members from Intelligence, Requirements, and the Joint Force. He drew examples for EW collaboration from many areas of the DoD: Congress and its FY 19 NDAA, the EW EXCOM, the JROC, industry collaboration events, and finally, a strong look at the budget. Dr. Conley’s office dissected the entire national budget, culling out how much is spent each year on electronic warfare. He made this information available on a Distribution A CD, and handed it to Lisa Fruge’-Cirilli to distribute to the entire AOC membership. He was sincere in getting the word out that an average of $5B is intended to be spent through early 2020s on EW/EMSO R&D, Prototypes, System Development and Demonstration (SDD), and RDT&E, and the total will remain over $4B after that.

Dr. Conley then opened the panel to the session members, starting off with the SES Director for the OUSD Office of Intelligence, Mr. Jake Schaffner. Mr. Schaffner started out his career as a U.S. Navy SWO (Surface Warfare Officer). He brings a wealth of knowledge to his position, and is leveraging his experience to drive decisions in his organization. Mr. Schaffner has observed that the Marines are leading the charge to embrace Information Operations, the Army and Navy are on the fast path and close behind, and the Air Force is bringing up the rear. The Intel community’s business is about raw data, turning that into information, and finally, knowledge (the understanding of information). It is his job to align the DoD’s Intel efforts to support Sec. Mattis’s NDS. They are examining the possible over-classification of data, high-speed machine to machine intelligence transfer to operate systems, overcoming the [Title 10-Title 50] labeling of information for wartime use. He stated emphatically that we must be able to make faster decisions. His office is focusing on four areas: 1) we need not just better intel, but intel that is integrate-able with machines and operators, 2) all intel starts out as bits that look the same so we don’t need to keep compartmentalizing, 3) we mistakenly turned over modeling and simulation to industry resulting in proprietary solutions that now need to be standardized and rearchitected for open systems, and finally, 4) he is a Cold War veteran who sees a lot of future capability coming from the “wayback machine;” i.e. everything old is new again.
BG Lance Landrum spoke next, explaining the overall big picture environment of the J8 in regards to the EMS. Looking back on the last 10-15 years, the U.S.’s competitive advantage has eroded. His office has used this fact, and the NDS’s three priorities, to drive progress in three areas: modernizing equipment, addressing EMSO across the entire DOTMLPF-P as a joint force/one team with great synergy, and performing a Joint Military Net Assessment to take a hard look at where our advantages and disadvantages lie in EMSO. In response to this investigation, his office is focusing on small distributed platforms, Cognitive EW (where he would like industry participation), and effective Electromagnetic Battle Management (EMBM), to secure and maintain Situational Awareness (SA) to take both offensive and defensive postures in the field of battle. Dr. Conley made the point that BG Landrum’s focus on EMSO capabilities indicate just how important EMS Superiority is to the joint force.

Col. “COZ” Kosnowski filled in for BG Stevenson, who was prohibited from getting to Washington DC due to snowy weather in the Midwest. As director of the JEWC, Col. Kosnowski is overseeing efforts to combine resources and capabilities from industry partners, laboratories, academia, the Intelligence Community, Program Offices, Test Organizations, and Tactical Units. The JEMSO Cell combines People, Product, and Process to achieve vital C2 operations for the Joint Force. His organization evaluates how every platform in the arsenal (regardless of where it came from) can become a sensor to contribute data to create a fused EMBM view.

Dr. Conley made another contribution to the audience: a self-assembled org chart of the new USD, which now falls into two camps: R&D, and A&S (Acquisition and Sustainment). He said the right people occupy these new offices to support industry’s needs, and he wanted people in the audience to know about them. He made the point of saying that all the players/offices on the org chart believe EW/EMSO is important. He summarized the panel by identifying a few recent efforts associated with his organization and beyond: Middle Tier Acquisition (FY17 NDAA Section 804; Policy April 2018), where industry can field a prototype and have it turn into a fielded capability, and leveraging Air Education and Training Command for its Project Spartacus, diverse teams examining strategic threats.

The panel concluded by fielding several questions from the audience. Questions centered on what technologies are out there today for operators to use, what is the outlook for future procurement opportunities in EW, what is the outcome of the AF EW/EMS Superiority ECCT, Quantum supremacy, where will current capabilities (e.g. Compass Call) fit in to the future fight, and cognitive radar. One conclusion from the panel is that software and Open Systems Architectures will rule the day for future capabilities. Being able to upgrade capabilities and systems in a combat-active, timely manner will ensure EMS Superiority in the future fight.

- Melinda Tourangeau, Warrior Support Solutions, LLC
Current EMSO Warfighting Applications

The Current EMSO Warfighting Applications session provided warfighter perspectives on Electromagnetic Spectrum Operations (EMSO) and how they are employed across the other domains, to include manned and unmanned platform considerations.

Col. John Edwards, Commander of the 28th Bomb Wing at Ellsworth Air Force Base, chaired a panel of EMSO experts who had more than 1000 flight hours and many combat tours. Discussions included a multitude of topics which addressed warfighter perspectives on integrating EMSO with activities from other non-kinetic disciplines such as SIGINT, Cyber and platform weapon systems and associated challenges.

The first question asked of the panel was “In your years of experience, how has EMSO warfare changed?” Col. Karl Fischbach, Commander of the 7th Operations Group explained how the technology is much more dynamic and advanced, with heavy reliance on sensors. Colonel Kurt Schendzielos, Commander of the 7th Air Force noted that the spectrum is much more congested and utilized with easy access by anyone. EW operations in the EMS is no longer a niche capability.

When asked “Have we improved our ability to prepare our future EWO’s on the advanced threats that are out there”, Col. Charles McElvain, Commander of the 479th Flying Training Group said “I’d say we are in the process of getting better, but we’re certainly not there yet... we are training EW as a part of the electromagnetic spectrum. Part of our responsibility is to train all combat officers of the US Air Force. High end training specifically for our EWO’s is being implemented. We are taking the undergraduate training to the next level of realism so we’re not just teaching concepts, but concepts through the lens of practical applications.”

Another panelist, Col. Mark Dotson, TRADOC Capability Manager for Electronic Warfare, US Army Cyber Center of Excellence noted “One area that we are really looking to improve upon is to teach that electronic warfare is only a small subset of electromagnetic spectrum operations. They must have that awareness from an early age. We now have PORs and QRC capabilities in the force and are teaching the theory behind the systems and operation.”

Another question asked of the panel was “What EMSO capability and concepts that you’ve seen today during this conference would be beneficial to fight near peer.” The subsequent discussion included topics such as interoperability, networked solutions, upgrading training infrastructure and threat simulation, leveraging other service capabilities and industry capabilities such as AI and ML.

The EMS as a domain was discussed to include factors such as persistent ES, EA and
Foundations of Battlespace Awareness

The session was chaired by Dr. Richard H. Wittstruck, Associate Director, Field Based Experiment and Integration, U.S. Army CERDEC Space/Terrestrial Dir. He introduced the topic by explaining that Battlespace Awareness was previously geospatial focused, but has recently evolved to include location in spectrum space and location in cyberspace. In the multidomain battlespace, combat commanders must have an appreciation of the role played by EW and Cyber. Dr. Wittstruck also introduced Paolo Sanchietti of Elettronica, whose paper could not be presented due to session time constraints.

Leading off was Dr. David Stupples, Professor of Electronic Warfare Systems Research at the City University of London, UK, speaking on the topic of “Integrating SIGINT into the Information Space”. SIGINT gives insight into enemy activity and their state of readiness. It has proved useful in asymmetric warfare but needs to be scaled up to perform in real time in force on force level engagements. This will require Machine Learning, which represents a key technical challenge if a dynamic Electronic Order of Battle is to be achieved. Dr. Stupples discussed many challenges in real time SIGINT updates. In addition to the challenge of receiving and processing a multitude of diverse RF signals, there are challenges in recruiting, training, and retaining qualified military personnel; delays in procurement of rapidly evolving technical equipment, and in integrating high value airborne and maritime sensor assets into the SIGINT networks.
The next speaker was Dr. Kris Merkel, President and CEO of S2 Corporation; speaking on “Full Spectrum Staring Receiver with Geolocation of RF Emitters and Other Applications”. Prior S2 efforts focused on the problem of wideband spectral awareness through conversion of the RF domain into the optical domain where optical fourier transform processing can be employed. The analysis is based upon a Tm:YAG crystal and covers the entire UHF through mmW spectrum in four bands. The most recent activity involved demonstrating a geolocation capability based upon time difference of arrival between three widely spaced receivers. The receiver sites are linked using stabilized and locked fiber optic networks. Achieving a level of stabilization suitable for TDOA was a key technical challenge solved by the S2 team.

The third speaker was Dr. Peter Kinget, Department Chair and Bernard J. Lechner Professor of Electrical Engineering at Columbia University. His subject matter was “Compressed Sensing Based Radio Architectures for Rapidly Finding Interferers in the Spectral and Spatial Domains”. The central idea is that compressive sampling has applications in RF receivers that can cover a wide bandwidth using far less SWAP than comparable bandwidth digital processing techniques. The key to the approach is to use an RF conversion oscillator that is modulated by a pseudorandom bit stream. This allows the full spectrum to be recovered by post processing if need by through a reversal of the compression operation, but has value of its own in functions like identifying the presence of interfering signals in band. The function can be implemented monolithically. The same approach can be applied to multichannel phased arrays by modulating the individual antenna phase shifters with a set of PRBS functions. This has the effect of scanning the array over the full field of view very rapidly and scales easily to large receiving arrays.

The final speaker was Mr. Benjamin McMahon, Technology Development Manager for BAE Systems FAST Labs, whose presentation was “Functionally Converged RF Systems Paving Way for New Paradigm in EW Payloads”. His challenging question was “Can we afford federated EW, SIGINT, Radar, and Comms Payloads?” BAE currently has worked on the integration of radar, ESM, and jammer but not using the same hardware. He briefly discussed the DARPA CONCERTO program which combined MTI Radar, EA, ESM, and Comms at a TRL 4 level as well as 2016 microdrone autonomous swarm behavior as pointing toward a future. His second challenge is “We built the hardware, where will the apps come from?” Smart sensor management and resource control is the issue. It all needs to start with requirements.

- Arnold Feineman