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**GAME CHANGING INNOVATIONS AND THE  
FUTURE OF SURFACE WARFARE**

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HEARING

BEFORE THE

SUBCOMMITTEE ON SEAPOWER AND  
PROJECTION FORCES

OF THE

COMMITTEE ON ARMED SERVICES  
HOUSE OF REPRESENTATIVES

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HOUSE OF REPRESENTATIVES,  
COMMITTEE ON ARMED SERVICES,  
SUBCOMMITTEE ON SEAPOWER AND PROJECTION FORCES,  
*Washington, DC, Wednesday, December 9, 2015.*

The subcommittee met, pursuant to call, at 3:30 p.m., in room 2212, Rayburn House Office Building, Hon. J. Randy Forbes (chairman of the subcommittee) presiding.

**OPENING STATEMENT OF HON. J. RANDY FORBES, A REPRESENTATIVE FROM VIRGINIA, CHAIRMAN, SUBCOMMITTEE ON SEAPOWER AND PROJECTION FORCES**

Mr. FORBES. We would like to welcome our witnesses today to this hearing on game-changing innovations and the future of surface warfare.

As we have previously told you, we may be interrupted with a vote. So Mr. Courtney and I both have agreed that we are just going to put our opening statements in for the record so that we can go ahead and begin and try to get all the testimony in and then hopefully get to our questions and answers.

Today joining us are two thought leaders in the area of surface warfare, Mr. Bryan McGrath, the Managing Director of the Ferry-Bridge Group, and Mr. Jonathan Solomon, Senior Analyst, Systems Planning and Analysis, Incorporated.

And gentlemen, both of you, we appreciate you being here today.

And Bryan, it is my understanding you are going to start us off. So with that, we yield the floor to you.

First of all, Joe, did you have anything you wanted to add?

[The prepared statement of Mr. Forbes can be found in the Appendix on page 19.]

Mr. COURTNEY. No—I waive my opening statement.

[The prepared statement of Mr. Courtney can be found in the Appendix on page 21.]

Mr. FORBES. Okay.

**STATEMENT OF BRYAN McGRATH, MANAGING DIRECTOR,  
THE FERRYBRIDGE GROUP, LLC**

Mr. McGRATH. Great. Chairman Forbes, thank you. Ranking Member Courtney, members of the subcommittee, thanks again for the opportunity to testify with you on a matter of importance to our Navy and to the Nation.

The discussion today revolves around game changers and innovations in the future of surface warfare. And I have a few of those

in my written statement that I submitted. I'd love to answer some questions about them if you have them later.

Some of those game changers include—they flow almost all from the concept of Distributed Lethality which is something I know you have heard a lot about lately, including long-range surface-to-surface missile improvements, multi-source maritime targeting and tracking, real-time ISR [intelligence, surveillance, and reconnaissance] vulnerability assessment, electromagnetic spectrum warfare and medium-altitude long-endurance UAVs [unmanned aerial vehicles].

But I think before we jump into the sort of tactical and operational stuff, I would like to elevate it back to some first things.

I realize no one was being glib when the title of this hearing was chosen, but I think it is important that we think about exactly what game it is that we are seeking to change.

And as we watch China reprise its ancient role of dominance in the East and we watch Russia exhibit its modern version of its historic geographic paranoia, we are confronted with the obvious reality of multi-polar, great-power competition.

This reality leads me to conclude that the game, for want of a better term, is conventional deterrence. This is a game for which I think the United States Navy is somewhat less prepared than I would like.

There are many reasons for this, and we can discuss them as you desire. Among them, however, is the accreted effects of decades without a competitor and the Navy's slow realization that this is no longer the case.

That this realization has occurred late is bad enough, but it is compounded by the impact of ruinous resource constraints.

The second issue, and what I would like to close on in this statement, is I think we have a little bit of a collective fascination with technology. Senior officials in the Defense Department will tell you with a straight face that the Third Offset Strategy is not all about technology and then commence a 40-minute discussion about the Third Offset Strategy that is all technology.

Offset strategies one and two occurred when the United States dominated the technology world worldwide. And even within the United States, technology was dominated by the government and by the military. Neither of those conditions applies today.

Technology has been commercialized and globalized. And trying to pull a rabbit out of the technology hat again is going to prove much more difficult this time. There is no substitute for the Nation spending what is required in order to see to its security and prosperity. There is no substitute for the time-honored contributions of stockpiled weapons, powerful, forward-deployed surface ships, combat-ready surge forces, and a robust industrial base.

There is no substitute for the psychology of conventional deterrence, which suggests to potential aggressors that not only is your aggression going to be punished, but it is likely to be unsuccessful.

I counsel against ignoring these simpler notions while we search for technological silver bullets. World leadership cannot be had on the cheap and we must decide whether we continue to value our position and role in the world and then resource it accordingly.

Thank you, and I look forward to your questions.

[The prepared statement of Mr. McGrath can be found in the Appendix on page 24.]

Mr. FORBES. Mr. Solomon.

**STATEMENT OF JONATHAN F. SOLOMON, SENIOR SYSTEMS AND TECHNOLOGY ANALYST, SYSTEMS PLANNING AND ANALYSIS, INC.**

Mr. SOLOMON. Thank you. Thank you, Chairman Forbes—

Mr. FORBES. Mr. Solomon, can you pull that a little bit closer and make sure it is turned on?

Mr. SOLOMON. First, I apologize. Okay, I thank you, Chairman Forbes and Ranking Member Courtney, and all the members of the Seapower and Projection Forces Subcommittee for granting me the honor of testifying today.

I am going to keep my remarks about 3½ minutes because I am very excited to go forward into the open question-and-answer.

So a bit of background. I am a former U.S. Navy Surface Warfare Officer and I served as Anti-Submarine Warfare Officer and a fire control officer of destroyers during my two division officer tours before leaving active duty.

My civilian job for the past 11 years at Systems Planning and Analysis, Incorporated, has been to provide programmatic and systems engineering support to various surface combat systems acquisition programs within the portfolio of the Navy's Program Executive Officer Integrated Warfare Systems.

This work has provided me an opportunity to participate, however peripherally, in the development of some of the surface Navy's future combat systems technologies. It has also enriched my understanding of the technical principles and considerations that affect cost and performance. This is no small thing considering I am not an engineer by education.

Before I continue, I want to make clear that the views I express today are presented solely in my personal capacity. They do not reflect the official positions of Systems Planning and Analysis, Incorporated, and to my knowledge do not reflect the positions or policies of the U.S. Department of Defense, any U.S. armed service, or any other U.S. Government agency.

In recent years, and with the generous support and encouragement of Mr. Bryan McGrath, I have taken up the hobby of writing articles that connect my academic background in maritime strategy, naval history and naval technology, and deterrence theory, with my professional experiences.

One of my favorite topics concerns the challenges and opportunities surrounding the potential use of electronic warfare [EW] in modern maritime operations, a subject that I first encountered while in active duty and later explored in great detail during my master's thesis investigation, how advanced wide-area oceanic surveillance-reconnaissance-targeting systems of systems were countered in the Cold War and might be countered again in the future.

Electronic warfare receives remarkably little attention in the ongoing debates over future operating concepts and the like. Granted, classification serves as a barrier with respect to specific capabilities and systems.

But electronic warfare's basic technical principles and effects are and have always been unclassified. I believe that much of the present unfamiliarity concerning electronic warfare stems from the fact it has been almost a quarter century since U.S. naval forces last had to be prepared to operate under conditions in which victory, not to mention survival, in battle hinged upon achieving temporary localized mastery of the electromagnetic spectrum over the adversary.

America's chief strategic competitors intimately understand the importance of electronic warfare to fighting at sea. Soviet Cold War-era tactics for anti-ship attacks have been leveraged with what they termed "radio-electronic combat" and there is plenty of open-source evidence available to suggest this remains true in today's Russian military as well.

The Chinese are no different with respect to how they conceive of fighting under "informatized conditions."

In a conflict against either of these two great powers, U.S. maritime forces' sensors and communications pathways would surely be subjected to intense disruption, denial, and deception via jamming tactics.

Likewise, ill-disciplined electromagnetic transmissions by U.S. maritime forces in the combat zone might very well prove suicidal in that they could provide an adversary a bull's-eye for aiming its long-range weapons.

To their credit, the Navy's senior-most leadership have gone to great lengths to stress the importance of electronic warfare in recent years, most notably in the new Maritime Strategy.

They have even launched a new concept they call electromagnetic maneuver warfare, which appears geared toward exactly the types of capabilities I outline in my prepared statement.

It is therefore quite likely that major elements of the U.S. Navy's future war, surface warfare vision, Distributed Lethality, will take electronic warfare considerations into account.

I would suggest that Distributed Lethality's developers do so in three areas in particular: command and control doctrine, force-wide communications methods, and over-the-horizon targeting and counter-targeting measures.

I want to be clear that the tools and tactics I advocate for in my prepared statement will not serve as silver bullets that shield our forces from painful losses, and there will always be some degree of risk and uncertainty involved in the use of these measures. It will be up to our force commanders to decide when conditions seem right for their use in support of particular thrusts.

Such measures should be viewed as force multipliers that grant us much better odds of perforating an adversary's oceanic surveillance and reconnaissance systems of systems temporarily and locally, if used smartly, and thus better odds of operational and strategic successes.

And with that, I look forward to your questions and discussion that will follow. Thank you.

[The prepared statement of Mr. Solomon can be found in the Appendix on page 39.]

Mr. FORBES. Thank you.

Mr. McGrath, you have talked a lot about Distributed Lethality as kind of a game changer for surface fleet operations, especially with our carrier groups. There is a huge risk to that, however, though. For Distributed Lethality to work, we are going to have to distribute our force away from the carrier where we have normally used it for protection.

Two questions I have for you. Describe that risk. How do we know that that risk is worth taking? Because do we not increase the vulnerability that we would have for a carrier in that particular situation?

And the second thing is we don't get to tell the Navy how to fight, we simply help provide them resources for them to utilize when they have made those decisions. What shifts would we have to make in our resourcing if we were to move to a Distributed Lethality concept or operation of fighting?

Mr. MCGRATH. The risks, your first question, Chairman Forbes, the surface leadership has been very clear from the beginning that job one remains high-value unit protection, that the anti-surface, anti-submarine, integrated air and missile defense capabilities that they provide to the strike group through the ships of the surface force cannot and will not be diminished.

But there are other surface ships in the war plans that are not necessarily allocated just to supporting high-value units. It is with these ships and hopefully in a future where we build more ships that Distributed Lethality will have its greatest impact.

The second question with respect to where you might shift your resources, long-range, surface-to-surface missiles, job one, the quicker the better, more pressure on the Navy rather than less. You don't get to tell them how to fight, but you can ask really hard questions and make them give really hard answers.

Why would we not harvest low-hanging fruit in order to take our longest-range, surface-to-surface weapon from approximately 70 miles to a thousand miles in 5 or 6 years? That seems to me like it is worth considering. That is turning the Tomahawk land-attack missile into a hybrid surface and land-attack missile.

So I would urge you to push hard on surface-to-surface missiles, and I would urge you to push hard on closing the grand fire control loop.

We have national technical means, we have UAVs, we have battle group assets, theater assets, fleet assets. All of these assets are creating data, taking measurements, information. We need to make sure that that data is fused and that fire control quality tracks are sent back out to the ships in a way that can be tactically useful and relevant.

We have all the pieces, they are just not very well connected yet. And you should make the Navy tell you how they are going to do that.

Mr. FORBES. So let me just make one clarifying or add one clarifying question. As I hear you, you are suggesting that we are not taking away any of our defensive capabilities, we are simply adding a supplement to that, which would have offensive capabilities.

Because it was my understanding from most of the briefings that I have gotten from the Navy on Distributed Lethality that they were talking about something a little different, where they were

trading off current defensive capabilities for more offensive capabilities.

But that is not the way you see Distributed Lethality?

Mr. MCGRATH. Not at all.

Mr. FORBES. Okay, good.

Okay, Mr. Courtney.

Mr. COURTNEY. Thank you, Mr. Chairman.

And thank you to the witnesses.

The title of the hearing is about game-changing innovations. And I think, again, we have heard a good discussion about offensive sort of game-changing innovations.

In terms of, you know, electronic warfare, in terms of hardening, I think that was the term that Mr. McGrath used in his testimony, our fleet, maybe you could talk a little bit about that sort of piece of game changing.

Mr. SOLOMON. So I think it is twofold, it is both technological and psychological.

From the technological standpoint, and this is my personal opinion again, the Navy has not invested in electronic warfare to the extent that it did during the Cold War over the last 30 years or so.

There is certainly fantastic capabilities out there and certainly new fantastic capabilities in the development path. But you get the sense that the Navy is a little bit behind in terms of pacing types of threats that we are seeing right now from other great powers.

So there is certainly a technological aspect to it, and procuring new systems will give us the new capability. But I personally see that the psychological is actually perhaps the more disconcerting one. And that is, again, in 30 years we haven't conditioned our forces for operations under opposed electromagnetic conditions.

You know, back in the Cold War we routinely operated our carrier battle groups at emissions control conditions, EMCON. They would be dark for days on end driving around the Atlantic, driving the Soviets nuts in terms of trying to find them.

During my research, I found that in 1981, this has, again, not been confirmed by the Navy, but it is enough anecdotal evidence to show that something like this probably happened, we drove a combined U.S. naval battle force up into the Norwegian Sea right out of Norfolk and the Soviets didn't find it until we started running offensive drills right off of the Northern Cape.

And the amount of discipline required to do that is just kind of staggering. It is disciplining when we talk on the radio, when we radiate, who radiates, flying an E-2 off the carrier using an emissions control profile so it gets outbound, pops up to make it difficult for the opponent to figure out where it is actually flying from.

These are all tactics that you don't get proficient overnight, it takes a long time.

And on the other side of the coin, it takes a long time to build up the psychological hardening for when the adversary starts jamming your communications, jamming your radars.

You know, we used to have drills where we would jam ourselves harder than, you know, the Russians might have, you know, so I have been told. And certainly they used various tricks when they came out to visit us back in those days I have been told as well.

And I am not sure we have done that type of training in the last couple of decades. Certainly when I was on active duty we didn't do that.

So if you look at what we would have to be able to do, both in terms of hardening ourselves against the adversary's electronic warfare and being able to do the kinds of things we did to the Soviets, to great powers today, I am not sure we are there.

I think it requires a great deal of training, a great deal of experimentation, and a great deal of just basic conditioning from the highest levels of the Navy on down where we let captains and deck-plate sailors and officers know that it is okay to take some risk, it is okay to take the tactical mission out.

You are not going to have some senior officer back on the carrier even further away micromanaging your decisions over a comms [communications] net because we know that net wouldn't be survivable in the event of war.

And so we are willing to take some of those tactical risks to do that. And I think that that is a big missing piece of that.

Mr. COURTNEY. Okay.

Mr. McGrath, I mean, you were sort of alluding to the same sort of innovation. It is not all about technology, it is also about, I guess, a psychological frame of mind. I don't know if you want to just maybe embellish on that.

Mr. McGRATH. I have sort of a vignette for you. In March of 2014 when the Navy went up to the Naval War College to do the LCS [Littoral Combat Ship] war game that was directed by the Secretary of Defense when he first started to truncate the LCS program, they played the game in a manner in which at some point they gave the U.S. Navy side a medium-range, 130-or-so nautical mile, surface-to-surface missile and put it on the previously not-so-armed LCSs.

And they looked at the psychological difference between how the blue commander operated that force and then also how the red commander responded to that force.

And what was interesting about the blue commanders was those ships were no more capable of taking a punch than they previously were. They were capable only of delivering a punch more effectively at a longer range.

But what that did for the risk calculus in their minds was for them to say it is harder and he is going to pay a higher cost if he initiates conflict. Therefore, I can take more risk with my force. I think that is important.

Mr. FORBES. Mr. Bridenstine is recognized for 5 minutes.

Mr. BRIDENSTINE. Thank you, Mr. Chairman.

I am a Navy pilot myself. Loved your discussion about the E-2 Hawkeye. I was one of those guys that flew off the carrier. And of course, we did tactics so that they wouldn't know where we were coming from necessarily.

And then, of course, doing the EMCON recoveries required high-intensity operations from the Hawkeye because we would offset a pretty significant distance and then control the recovery.

I would just share with you, one of the challenges we faced over and over again with network-centric warfare as a capability was the interoperations of all the different systems.

We would have, you know, one kind of system for the E-2 Hawkeye, and then the other systems weren't necessarily interoperable with what the Hawkeye was using at the time.

Is there evidence today that there is more interoperability and integration in this network-centric capability that we are developing?

Mr. MCGRATH. Sir, I think you and I are probably—I am probably a little bit older than you are.

Mr. BRIDENSTINE. Not probably much.

Mr. MCGRATH. But we probably served as contemporaries. And I underwent the same nightmare that you did.

It is primarily a function of the way we buy and develop systems and the way we implement standards, technical standards. This ship, this version of this ship implements the Link 16 standard to this degree.

Mr. BRIDENSTINE. Yes.

Mr. MCGRATH. The E-2C to this degree, the AWACS [Airborne Early Warning and Control System] to this degree. Where there are implementation differences, there is mischief.

Mr. BRIDENSTINE. Right.

Mr. MCGRATH. And my ship shows the track as a neutral, yours shows it as an unknown, assumed friend. These are things that take operator time.

We work through that. I think you are seeing more integrated development, more adherence to standards, better what we used to call SIAP, one and only one track per object.

Mr. BRIDENSTINE. Single integrated air picture.

Mr. MCGRATH. Right, single integrated air picture. That sort of thinking is much more well-established in the fleet and in the joint force.

One of the things that really drove that was CEC [Cooperative Engagement Capability].

Mr. BRIDENSTINE. Right, which was the Hawkeye initiative.

Mr. MCGRATH. The Hawkeye, what you had were a bunch of nodes in the system who had the same exact computer algorithms in their combat systems.

Mr. BRIDENSTINE. Right.

Mr. MCGRATH. And they were sharing data so that they all reached the same conclusion. That is not the way it happens in most combat systems out there in the fleet and in the joint force. But within CEC, the Cooperative Engagement Capability developed in the early 1990s and worked out through the 1990s and 2000s. That is what we got to use during that time.

Mr. BRIDENSTINE. So when we network together sufficient target information to where we have got actually fire control coordinates that we can launch on from a non-associated platform, obviously that extends the stick out a lot further, which is optimum given the threats that we face. We need to be able to effect lethality much further away.

And the challenge that we have in that environment is ID [identification], whether it is maybe emitting something, we can ID it, there are non-cooperative means that we can ID. But as you push, you know, the engagement further away, the ID piece gets more and more difficult.

Are there thoughts about how to solve that issue?

Mr. SOLOMON. So I agree with you wholeheartedly. One of the chief problems with the Soviet approach, which was to try and build a remote picture using electronic signals, direction finding, remote radar, they had their radar ocean reconnaissance satellites during the 1970s and 1980s, was, you know, they wanted to be able to build their picture remotely and shoot from a distance, because they knew if they got close they would get whacked.

Mr. BRIDENSTINE. Right.

Mr. SOLOMON. But they couldn't do it because the technology wasn't there and their command and control architecture wasn't there. And so they had to rely on Pathfinders. These suicidal bombers were tattletale surface combatants that they pushed in and really would only work in peacetime once, where it is marking the carrier, marking whatever important surface force that they see important in the given area and passing the coordinates and the contact identification back to a centralized controller, who then uses that to generate the ray targeting.

Well, like I said, it only works once. And if you are reliant on long-range exploitation of someone's emissions, maybe they won't oblige you.

Mr. BRIDENSTINE. Right.

Mr. SOLOMON. If you are reliant on a radar picture, well, radars can be deceived. You know, jamming a radar is one option. You can, you know, throw out a lot of noise, but there are ways of overcoming that. Deception is a lot harder.

One of the great tricks we used in the Cold War was putting an integrated cover-and-deception system package onboard destroyers. It is called, I believe, the AN/SSQ-74. It is not really talked about much, but existed.

And this trailer was able to emulate the, later versions, acoustics, but even the electronic emissions.

Mr. BRIDENSTINE. Well, I am out of time. But I want to get this on the record just so everybody is aware and for the chairman's sake as well.

The greatest network-centric capability pushing the threat out as far as we can get it, we all love that.

At the end of the day, if you have to send a pilot to the merge in order to get a VID [visual identification], that is not the answer we are looking for. So we have got to have solutions for that.

And with that, I will yield back, Mr. Chairman.

Mr. FORBES. I thank the gentleman for his questions.

The gentlelady from Hawaii is recognized, Ms. Gabbard, for 5 minutes.

Ms. GABBARD. Thank you, Mr. Chairman.

Thanks, gentlemen, for being here.

You know, Mr. Solomon, you made a lot of references to the Cold War and some of the things that we were able to do then. Can you talk about the contemporary environment that we are operating in with both our advanced technology and others and either really what the differences are when you are talking about deception, between now and, you know, a previous generation?

Mr. SOLOMON. Well, the focus hasn't changed. We are still dealing with electronic emissions exploitation, direction finding. Per-

haps they have become more accurate in their ability to refine areas of uncertainty, where a given emitter might be.

Certainly during the Cold War, the Russians only had a couple of satellites up at a time. Now it looks like various competitors might have satellite constellations capabilities, these types of triangulations up more regularly.

We are still looking at space-based radar, the use of synthetic aperture radar to build a picture. But it only visits a certain area of ocean space for a given period during the day. And so that really hasn't changed, it depends upon how many satellites you have up there.

The ability to use unmanned vehicles, whether surface, sub-surface, aerial, that is kind of different. You know, there might have been a little bit more hesitance perhaps to use a manned bomber in that role, although the Soviets didn't seem to have that hesitance.

Now that you can perhaps use an unmanned system in that role, that is a major concern. But it also flips it around, from our perspective, and getting back to the gentleman's point, you know, if I can't be absolutely sure of what I am targeting using remote means, using an unmanned system to do a relatively close range, whether visual, infrared, electrical optical, whatever identification, make sure I am looking at a real contact as opposed to a decoy or someone pretending to be something that they are not. That is a bit of a difference.

And the technology in that realm is certainly more advanced than it was during the Cold War. I am not sure who is ahead in that regard. I certainly think that is an area of important investment for us. I don't have a sense of where potential adversaries are on that.

Ms. GABBARD. Thank you.

Mr. McGrath, with the Distributed Lethality concept, what are the major points of resistance within the Navy to adopting this? And building off the chairman's question, how do those changes really come about?

Mr. MCGRATH. You know, the more I hear it talked about, the more it seems like the surface guys are pushing on an open door.

I think there are some bureaucratic and budgetary rice-bowl issues. If we spend X amount of dollars on increasing the lethality of the surface force, those dollars have to come from somewhere, where will they come from, whose ox gets gored in that process?

So I think that would be—but you know, that is the Pentagon, you know, that is just overhead associated with the way that the Department is run. That sort of stuff gets worked through. It is pretty much an open door.

Ms. GABBARD. I think the Navy Institute has a quote, saying that there are no leaps of technology required, no massive funding increases necessary. Do you think that that is accurate?

Mr. MCGRATH. I think it is accurate to a point. I think there are a whole slew of technologies and capabilities that are 7 years and in that the surface force could integrate that aren't—there is no magic involved, there is no, you know, leap of faith required.

There are leaps of faith in the 2030, 2040 force that we have to invest in S&T [science and technology] and R&D [research and de-

velopment] to get to. But a good, solid instantiation of Distributed Lethality in the 2025 timeframe is not a budget breaker.

Ms. GABBARD. Thank you.

Thank you, Mr. Chairman.

Mr. FORBES. Mr. Conaway is recognized for 5 minutes.

Mr. CONAWAY. All right. Thank you, Chairman.

Can you talk to us about where lasers and electromagnetic railguns and even improvements in powder projectiles fit within this innovative timeframe? And are those something that the Navy is serious about? Where do they fit?

Mr. SOLOMON. Okay. Well, I personally think the Navy is very serious about those technologies. You know, the Navy leadership is very, very excited, from what I have seen in the open press, about railgun in particular and there are plans to demo it onboard, I think, the JHSV [Joint High Speed Vessel] *Millinocket* next year.

And there are certainly, you know, people looking at how to get that into the fleet sometime in the late 2020s. I think it is to be determined what type of combatant you put that on, you know, whether you might use a DDG-1000, in my personal opinion, or whether we look to a new combatant sometime in the late 2020s that, if this technology proved out, that you could put that on.

But for railgun, I think we alluded to this earlier, that the projectile itself is probably even more important, the ability for the projectile to survive these electromagnetic forces in the barrel and do all kinds of things we want it to do, whether it is land attack or missile defense, that is an open question.

As for laser, I think the Navy is also very much in support of that. You see the talking points on what we have done out in the Persian Gulf on AFSB [Afloat Forward Staging Base]. And I certainly think that the Navy is looking at, you know, solid-state laser technologies that might be used for point defense, because that is really what it seems like laser would be best capable of doing, especially, in my opinion, for unmanned aerial vehicle defense.

You don't want to be burning up hard ordnance shooting a bunch of UAVs out of the sky. So I think there is a lot of enthusiasm for that in Navy leadership.

Mr. CONAWAY. So where do both these technologies fit in the existing structure? I mean, are there—you said the DDG-1000 for the railgun or whatever. Is that adaptable to everything that is in the fleet now, or do we have to have a whole new class of ships to make this deal work, make those weapons work?

Mr. MCGRATH. I don't think we need a whole new class of ship, we need to bring the integration costs down. The railgun is not a cheap capability. It is a wonderful capability and it is something that will and should join the fleet, but it is expensive.

And when you start to look at the trades and what you could get, what other things you could get, those trades sometimes look less attractive.

Mr. CONAWAY. So in terms of the weapon itself, but not the usage? Because the idea with the railgun is that you could shoot a lot of them for less than—

Mr. MCGRATH. And you would wind up spending less per shot than you would with a missile, that is for sure.

Mr. CONAWAY. Okay.

Mr. MCGRATH. And that, in the long run, it is hard to get organizations in the Department of Defense to think life cycle. They like to think acquisition and they like to think, you know, the budget that is in front of them like this.

But when you start to bring in those longer-range life cycle things, they make a compelling case for both lasers and the railgun.

Mr. CONAWAY. Okay.

Thank you, Mr. Chairman.

Mr. FORBES. Mr. Russell is recognized for 5 minutes.

Mr. RUSSELL. Thank you, Mr. Chairman.

And you know, I had almost identical questions, so along that vein, and then I will add an extra in.

It would seem to me in a 40- to 50-year overmatch capacity, you know, we are going to continue to have diminishing budgets, China will continue to have increasing budgets. That will create a delta that will be double between now and 2030 probably of \$2 trillion.

Given that, we have got some great potential with the railgun technologies. So when you talk expenses, are you saying is that based upon the power generation piece of this? Is it based upon the ordnance piece of it? Where would that be?

Mr. MCGRATH. It is an expensive piece of gear to buy and integrate. Over the cost of operating it over 20 or 30 years, its per-shot versus a missile system is a great savings. And we have to think more like that. I am not saying that the railgun shouldn't be integrated. I am trying to give an idea of why it isn't happening faster.

Mr. RUSSELL. But don't you think it would even go beyond that when you look at terms of versatility? You can use it for air defense. You can use it for direct fire. You can use it for long distance. You can use it for land-based interservice use.

It would seem that if it had the appropriate level of, look, as you say, to look at life cycle, that there would be great utility, great overmatch and, in the long run, maybe even a cost saving.

Mr. MCGRATH. My personal view is that the railgun's greatest contribution is going to be in missile defense.

Mr. RUSSELL. Yes, which is our number-one threat towards our carrier fleet—newsflash.

Mr. MCGRATH. You know, as a direct fire weapon from the sea, even at the energy levels that we are talking about and the biggest railgun that we are talking, I think we are talking about something like 200 miles.

Two hundred miles from a land target in some of these fights that we are talking about in the future is pretty close. So I would like the IMD [integrated missile defense], the missile defense, capability as fast as we can get it.

Mr. RUSSELL. And I will waive the UAV laser question because that got answered.

But in terms of capability and capacity, we hear at all of these briefings about, you know, the 11th carrier and the turnaround, and now we are seeing allies, fortunately, like Great Britain to launch a couple, and France maybe they are going to get a different look at adding carrier number two, we don't know.

But regardless, with the amphibious assault ships and the last iteration of the *Wasp* class and then the *America* class that is roll-

ing out, under terms of sea control and forward staging, you know, particularly in the Pacific, there is a lot of versatility there. These are *Midway*-size carriers. You know, in appearance they certainly provide an awful lot of capacity.

What thinking is the Navy doing with regard to that, if we have forward staged-based stuff and now we can have sea control with the amphibious assault ships? Is that even part of the equation when looking at carrier structure and presence?

Mr. MCGRATH. The amphibious assault ships with the F-35B embarked are going to be incredible assets in the Navy and Marine Corps—the maritime fight.

That plane is a fantastic combat vehicle for doing a whole lot of things. It is not just air-to-mud. This stuff that it can do in terms of this anti-surface, integrated air and missile defense, there are all sorts of things that the Navy and the Marine Corps need to cooperate much more closely in order to get the benefits out of that to the warfight. They are thinking and working in that regard.

I think, and I have written pretty widely about this, it is not correct to think of the *America* class with F-35Bs as a substitute. And I am not saying you said this—

Mr. RUSSELL. No, that is the versatility.

Mr. MCGRATH. It is a—

Mr. RUSSELL. And a gap filler which we hear all the time we need.

Mr. MCGRATH. It is an extender, a gap filler, it is a capability that we are going to get a whole lot more out of than we can get currently out of the AV-8Bs in that.

Mr. RUSSELL. Okay, yes, thank you.

Thank you, Mr. Chair.

Mr. FORBES. Mr. McGrath, Mr. Solomon, thank you so much for your testimony.

Ms. Graham has waived any questions she might have for you.

And you heard the bells, they toll for us. But we want to make sure that we have given you a last couple of minutes for any wrap-up that either of you might have before we adjourn.

Mr. McGrath.

Mr. MCGRATH. I would like to thank Mr. Courtney, in his absence, for using the phrase “hardening.” The Air Force, when we talk about air bases we talk about hardening, hardening air bases, air bases that aren’t going anywhere, they are just going to stay there.

We talk about survivability with respect to ships. And I think it levies a rhetorical weight upon the Navy that I am personally trying to change by using the word “hardening,” we want to harden the surface force, make it fight through damage and deliver more damage to the other guy. And I thank Mr. Courtney for using that word.

Mr. FORBES. Mr. Solomon.

Mr. SOLOMON. I think that it is important to view Distributed Lethality as a set of options; it is not purely offensive, or at least it shouldn’t be.

And I don’t believe, as Mr. McGrath said earlier, that it is going to be subtracting from defensive unless we, you know, make a mistake in how we define the concept.

I see Distributed Lethality as a tool for our force commanders, for our theater commanders, to give them more options at every stage of the conflict spectrum. And to the extent that electronic warfare supports that, you know, there are certainly less things you can do during phase zero, phase one, the shaping, the turns that you can do when you are actually in combat, but there are things you can do there.

I think there are a lot of rich historical examples of how we did psychological shaping of the Soviets during the late Cold War to help deter them from any belief that they would be successful in a first salvo. I think that is pretty crucial.

And so to the extent that the Navy can look at that rich history, which is still largely classified, and derive new ideas for how we might condition some of our great-power adversaries or potential adversaries, that today is not the day, using tools like these, I think that is very important to think about.

Mr. FORBES. Okay.

I thank you both for being here today and for the contributions you make to the national defense of our country.

And with that, we are adjourned.

[Whereupon, at 4:10 p.m., the subcommittee was adjourned.]

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**A P P E N D I X**

DECEMBER 9, 2015

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**PREPARED STATEMENTS SUBMITTED FOR THE RECORD**

DECEMBER 9, 2015

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**Opening Remarks of the Honorable J. Randy Forbes  
for the  
Seapower and Projection Forces Hearing on  
Game Changing Innovations and the Future of Surface Warfare  
December 9, 2015**

Today the subcommittee meets to discuss innovations that could “change the game” for the U.S. Navy’s surface fleet.

Joining us today are two thought leaders in the area of surface warfare.

- Mr. Bryan McGrath, Managing Director, The FerryBridge Group; and
- Mr. Jonathan Solomon, Senior Analyst, Systems Planning and Analysis, Inc.

Thank you for being with us today and for all the analysis and writing you have done on this topic.

One month ago, this subcommittee held a hearing on undersea warfare game changers in which our expert witnesses laid out a compelling vision of the future of undersea warfare and the challenges and opportunities that our submarine force will confront in the years ahead. I am hopeful that you gentlemen can do the same for our Navy’s surface fleet in today’s hearing.

The United States Navy’s surface fleet is the most capable and professional such force in existence today. Since the end of the Cold War, that fleet’s command of the seas has gone largely uncontested, but today it is being challenged and undermined on multiple fronts.

Looking around the world, we see strategic competitors fielding anti-access area-denial capabilities that can hold our surface ships at risk and constrain their freedom of maneuver and action. While China and Russia remain the pacing threats in this regard, the proliferation of A2/AD capabilities to the littorals of the Arabian Gulf and even now the Eastern Mediterranean are turning these areas into increasingly non-permissive operating environments.

At the same time, we see in China a rising power that clearly understands the influence of seapower upon history. China is fielding a surface fleet of its own that experts tell us could, by 2030, have an order of battle comparable to our own.

Like the rest of the service and the Department of Defense, the Navy’s surface fleet must adapt to mitigate the challenges and exploit the opportunities that will accompany these changing circumstances. For decades, our surface combatants have been largely relegated to defensive escort duties or tied down performing critically important but unglamorous presence and missile-defense missions. These ships now find themselves “out-sticked” by adversaries with longer-range and more capable anti-ship missiles, and some analysts have predicted that the proliferation of these and other A2/AD capabilities

will result in American surface ships, including carriers, being relegated to the sidelines in future high-intensity conflicts.

That said, things might be looking up for our surface forces. Earlier this year, the Navy unveiled a new concept of “distributed lethality,” which calls for our surface ships to be up-armed with offensive weapons. While still in its infancy, this new concept could help our surface fleet regain a more substantial role in anti-surface warfare, and force our competitors to deal with new dilemmas.

Meanwhile, a number of combat systems currently under development or already out with the fleet have the potential to empower concepts like this. These include longer-range and more capable anti-ship missiles that could greatly enhance surface combatants’ offensive firepower, as well as high-energy lasers, railguns, new projectiles for traditional guns, and cyber and electronic-warfare systems that could change the way we do air and missile defense.

Taken together, these emerging concepts and capabilities suggest that our surface Navy is entering an era of growing capability and importance.

While I am pleased with the overall direction in which I see the Navy heading, I believe it is incumbent upon this subcommittee to flesh out new concepts like “distributed lethality” and push the Navy and the Department of Defense to innovate and change the game at a faster rate. To highlight just one example, I remain dissatisfied by the lack of discernable progress toward fielding a long-range anti-ship missile. The fact that we are “out-sticked” not only by the Chinese, but by the export variant of our own Harpoon missile, is unacceptable.

In closing, I want to note that talk of game-changing concepts and capabilities and broader “offset strategies” should not distract us from the inescapable realities of naval warfare: that quantity still has a quality all its own, and that for all our advanced technology, an American ship or aircraft can still only be in one place at one time.

That said, I think we should be doing everything in our power to multiply the effectiveness of our scarce naval forces; maintain our qualitative edge; and sustain America’s command of the seas.

**Opening Remarks for Congressman Joe Courtney  
Ranking Member  
Seapower and Projection Forces Subcommittee  
Game Changing Innovations and the Future of Surface Warfare  
December 9, 2015**

Mr. Chairman, thank you for calling today's hearing on game changing innovations and the future of surface warfare. Thank you to both witnesses for providing their insight.

Today, our surface warfare combatant fleet consists of destroyers, cruisers and the littoral combat ship. Due to the truncation or cancellation of recent surface navy recapitalization programs such as DD(X) and CG(X), our Navy is forced to rely on ships that were designed decades ago with different security challenges in mind. As a result, even if we achieve the shipbuilding levels laid out in the Navy's current 30-year shipbuilding plan, we still face sustained periods of shortfalls in both our small and large surface combatant fleet. That means that we have to ensure that we are doing all we can to not only build up the size of our surface fleet, but also do more with the fleet we have.

I recently visited the production facility where the air and missile defense radar (AMDR) is being developed. This new radar will be the backbone of the next flight of Arleigh Burke class destroyers. To say that this new radar is an improvement as compared to the current radar is an understatement. While I am very impressed by this and the innovations made with the associated weapons, most of these improvements are defensive in nature. While very effective, they are, in most cases, very costly. We must continue to work on new systems like directed energy weapons, electromagnetic rail gun, and hypersonic projectiles that can assume the defensive missions at a much lower cost. This will allow the Navy to

pursue new offensive weapons that can operate and be effective in any combat environment.

On the small surface combatant side, while initially skeptical, I am encouraged by recent news regarding Frigate improvements being considered and the potential for back fitting those improvements on LCS. Modest improvements like the inclusion of an over the horizon missile could have dramatic impacts to the overall effectiveness of both ships. I look forward to hearing from our witnesses on what their views of what a small surface combatant should be.

I also believe that the Navy should start yesterday on designing a new large surface combatant as a follow on to the current Ticonderoga class cruisers. Even with the current modernization plan for cruisers, those ships can only be stretched into the 2030s and with very limited numbers during the years leading up to that. That puts us way behind for fielding a replacement capability. Adversaries are going to continue to try and develop weapons that will challenge our ability to effectively utilize our aircraft carriers. It is, therefore, all the more important that we have a ship capable of defending the carrier in any environment. This new ship design could also enable the Navy to possess the space, weight, power and cooling necessary to incorporate high energy weapons. As I mentioned earlier, the inclusion of the AMDR will make our current Arleigh Burke destroyers the most advanced in the world, but we must begin looking at what the future will require of a large surface combatant.

In the near term, we must also look at how we fight and ask ourselves if there are innovative ways in which we can maximize the capabilities of our current fleet. Concepts like "distributed lethality", which is an approach being developed

by some of our top strategic thinkers in the Navy, attempts to do just that. I look forward to learning more about this novel concept as it continues to take shape.

Lastly, I understand that Deputy Secretary Work is initiating what he calls the Third Offset strategy which will seek to regain the technological and operational advantage as compared to other forces around the world. I am encouraged by this and feel that the surface Navy is in a position to contribute and benefit greatly from this new effort. I am however concerned that, unlike previous "offset" efforts, the current fiscal environment will challenge our ability to achieve the same innovations that occurred previously. This and the challenges I described earlier are just a few of the many reasons why we need to remove the burdens of the budget control act and sequestration. If we expect to have a realistic shot of achieving "game changing" innovations, we can't do it with one hand tied behind our back.

Whether it is providing missile defense in the Middle East, conducting strike missions on terrorist targets, or deterring aggression in the South China Sea, our surface warfare fleet is being called on to perform a diverse set of missions at an unsustainable rate. It is imperative that we continue to modernize and recapitalize our surface Navy in order to meet the expectations our country demands of it.

I want to thank the Chairman for holding this hearing today and to the witnesses for appearing here today. I look forward to their comments.

December 9, 2015

Testimony before the House Armed Services Committee  
Subcommittee on Seapower and Projection Forces

Prepared Statement of Bryan McGrath  
Managing Director, The FerryBridge Group LLC and Assistant Director, Hudson  
Institute Center for American Seapower

All testimony herein submitted represents the personal views of Bryan McGrath

Thank you Chairman Forbes, Ranking Member Courtney and members of the Seapower and Projection Forces subcommittee for the opportunity to testify and to submit this written statement for the record.

In April of this year, I was honored to testify before you on my views of the role Surface Forces in presence, deterrence, and warfighting, and today I have been asked to provide views on "Game Changing Innovation and the Future of Surface Warfare".

It is particularly gratifying to testify alongside Mr. Jon Solomon, whose thinking about the employment of naval forces at the operational level of war is of unparalleled quality and depth.

I served for 21 years in our nation's Surface Forces, from 1987 until 2008, with tours in frigates and cruisers and command of the Destroyer BULKELEY out of Norfolk. It was an honor and a privilege to take to sea under our nation's flag, and in my present-day work, I continue to advocate for powerful and numerous Surface Forces as part of our Navy's approach to meeting its global commitments.

This hearing is forward looking, and asks Mr. Solomon and me to think and speak about "game changers" and innovation as they relate to surface warfare. The timing of this hearing—one month before the annual Surface Navy Association Symposium—could not be better, as there is a great deal of intellectual ferment underway within the surface warfare community, spurred largely by its leaders' visionary concept of "Distributed Lethality".

I offer one initial caution, however. The Secretary of Defense's "Third Offset Strategy" effort is in the news quite a bit these days, and despite senior officials' continuing denials that it is NOT primarily about technology, it appears that most of the narrative does indeed revolve around technology. Given the globalization and commercialization of technology, any sense that the U.S. military is likely to or capable of gaining advantage through technology alone must be eyed warily. We are just as likely to be scrambling to counter technological advantages GAINED by adversaries as we are to force them into countering us. What will ultimately be determinative is not technology per se, but the speed and ease with which technology and advantage can be put in the hands of the war-fighter. Put another way, the 80% solution tomorrow is better than the 100% solution next month. I would urge this committee to do all it can to remove impediments to this sense of urgency.

### **Distributed Lethality**

In January of 2015, VADM Tom Rowden – Commander of Naval Surface Forces – debuted new thinking about how the Surface Force would be organized, trained, equipped, and operated – both as a peacetime conventional deterrent and as an element of the Joint war-fight. This relatively simple idea--branded “Distributed Lethality” – holds that if unit level lethality were increased across the surface fleet, and that fleet were then operated differently, a greater number of adversary targets could be held at risk, a larger cost would be imposed on adversary intelligence, surveillance, and reconnaissance (ISR) systems, and adversary weapons loads would be diluted as a function of individual attack density.

It is my view that this single idea represents the most important “game changer” or innovation pertinent to the Surface Force. From it are derived a number of concepts and capabilities that should be prioritized in order to realize the benefits of a more lethal and distributed fleet. First though, some background is provided.

The concept of Distributed Lethality was an outgrowth of the March 2014 LCS wargame conducted as a result of then Secretary of Defense Hagel’s direction to truncate the LCS program and evaluate options for a follow-on frigate program. The wargame at the Naval War College revealed that the addition of even a modest, medium range surface to surface weapon system to existing variants of the LCS caused behavioral changes in both the adversary team and the “Blue” or U.S. team. On the adversary side of the equation, ships that could earlier be ignored – that is, remain only loosely targeted (because they were unthreatening) – had to remain tracked and targeted on a more continuous basis. These requirements resulted in a larger drain on adversary ISR forces, which in turn precluded them from as effectively locating and targeting high value units. Additionally, since these modestly enhanced LCS could now engage adversary fleet assets, the costs associated with initiating combat were raised. This of course, is the essence of conventional deterrence.

On the “Blue” side of the conflict, operational commanders had at their disposal in pre-conflict phases, a platform that did not have to be retired at the first sign of violence. Blue commanders actively employed these “up-gunned” assets in important roles including chokepoint patrols and high value unity area defense. The psychology of this employment is important to grasp. The ships were not any more capable of *sustaining* damage; they were only more capable of delivering it. This more lethal stance created in the minds of Blue commanders the perception of an altered risk environment. In other

words, they believed that in pre-hostilities phases, these more powerful ships would act as a greater inducement to the adversary to postpone aggression.

As a committed navalist and former surface warrior, I am grateful for the attention that the Chairman, the Ranking Member, and this entire Subcommittee have drawn to the problem of our Surface Force being “outsticked” by adversary surface to surface weapons. The unfortunate fact that this disadvantage has grown as the result of conscious decisions made in harvesting the “peace dividend” of the 1990’s makes it no easier to bear. Simply put, the U.S. Navy has not fielded a surface warship capable of organically neutralizing another surface warship over the horizon since the commissioning of the USS PORTER (DDG 78) in 1999. This was the last ARLEIGH BURKE class destroyer to be fitted with the Harpoon Anti-Ship Missile System, which was useful at ranges of up to about 70 miles. Since that time, not only have no other ships been built that employ an over the horizon surface to surface missile, but the U.S. Navy variant of the Harpoon has declined in effectiveness versus the threat.

The Surface Force leadership evidently also looked at this growing deficit and realized that if a modern ASuW weapon employed by a modestly capable ship (LCS) could cause notable, desired behavioral change in Blue and Red commanders, then even more capable weapons employed by even more capable ships could further this phenomenon. Furthermore, if taking relatively non-lethal ships and increasing their lethality worked for small combatants, would not similar initiatives create similar effect when affixed to other ships that are not traditionally thought of as “surface combatants” – such as amphibious ships, or even ships of the logistics force? This thinking animates the core of Distributed Lethality.

While increasing the lethality of individual ships is necessary, it is insufficient to realize the full value of that investment. In order to do so, the Surface Force must be operated differently, in a more distributed manner. By doing so (therein limiting concentration of naval forces) the fleet thins the surveillance network and brings its offensive capabilities to bear across a larger geography threatening a larger number of adversary targets. This does not mean that the Surface Force can or should diminish its role in providing support to high value units. Quite the contrary. It must continue to do so. However, by spreading its own ability to threaten adversary capabilities, it reduces the adversary’s capability to concentrate its efforts largely or solely on high value units, thereby increasing their survivability and combat effectiveness.

#### **Distributed Lethality and Conventional Deterrence**

The most important quality that Distributed Lethality brings to the Surface Force is the degree to which it presents a potential adversary with a more potent conventional deterrent; this is why I believe Distributed Lethality to be a “game changer”. Clearly, an all-out, high end war with a peer or near peer competitor would result in devastating combat losses on both sides. Anything operating on, under, above, or next to the ocean and within adversary weapon and sensor range will be at risk once open conflict begins. Critics often point to the risk to the Surface Force in such warfare as justification for reducing its prominence in Navy force structure, preferring to redistribute harvested resources into other elements of the fleet design, primarily undersea warfare which is deemed to be less at risk in “Phase 3 Operations”.

There is little doubt that our nation’s dominance in undersea warfare is one of the crown jewels in both our ability to gather intelligence and in our ability to wage unrestricted warfare – when that time comes. Submarines are however, relatively ineffective instruments of conventional deterrence when compared to surface ships. The quality of being able to be seen by a potential aggressor cannot be underestimated in its contribution to deterrence by denial or punishment. This is not to say that un-located U.S. submarines are without deterrent value; only that their deterrent value is less relative to that of a visible and continuous surface presence.

However, (and as indicated earlier) the quality of that surface based deterrent has declined in the past fifteen years as the Surface Force largely abandoned the ASuW mission area in the face of a declining threat to blue-water operations. Without a peer threat on the open ocean, the Navy could concentrate its ASuW capability in the carrier air wing and to a lesser extent, the submarine force. This was a prudent path to take in the post-Cold War era, and it was likely a source of savings that went into other capabilities. But the result is that now – in an era of increasing great power competition – our Surface Force is at a decided disadvantage, which in turn diminishes its value as a deterrent. Put another way, exactly at the time when we need once again the capacity to deter great powers conventionally, our primary naval conventional deterrent – the surface ship – has been diminished.

If the Navy moves forward with a robust instantiation of Distributed Lethality, the deterrent quality of its forward presence will increase. By increasing that conventional deterrent posture, the ruinous war it is meant to deter becomes less likely to happen. Not only is this a “game changer”, but it is a prudent, necessary, and economical one. The remainder of this written testimony consists of a series of desired capabilities that would enable this innovative new concept.

**Long Range Over the Horizon Surface to Surface Weapons**

No ship in our inventory can disable another ship with its organic weapons at ranges greater than approximately 70 miles (the range of the Harpoon missile), and no ship has been added to the inventory since 1999 that can fire the Harpoon missile. In order to raise the level of conventional deterrence represented in our forward deployed surface vessels, the Navy must move quickly to close this gap. The pursuit of an elegant solution for the future should not preclude the immediate fielding of useful weapons available on the world market.

First, no new LCS should be built without a surface to surface missile system that is at least as capable as that which is desired for the FF class. When that missile is decided upon, it should be backfit into every LCS at its first major maintenance availability.

Second, the Navy should capitalize on ongoing testing of the Tomahawk Land Attack Missile (TLAM) in the Anti Surface Mode and move to production of dual use TLAM's, effectively taking over 3000 land attack missiles (employed by nearly 90 surface ships from over 8000 vertical launch cells) and turning them into ship killers out to approximately 1000 miles. This single act will bring the most return on investment the fastest, and will guarantee that both the Flight III DDG and the DDG 1000 are also capable of firing this extended range surface to surface missile. Some analysts believe that against the most capable air defense units in potential adversary fleets, the subsonic TLAM will lack necessary capability. It must be remembered however, that not all adversary platforms are that capable, and the most capable units can be targeted and neutralized by other portions of the fleet architecture (carrier air wing, submarines). In the meantime, every single cruiser and destroyer in the fleet would be capable of holding targets at risk on land and at sea out to 1000 miles. Congress should direct the Navy to fast track this missile modification with desired deployment in the early 2020's.

Finally, the Navy must move quickly to specify the requirements for a 21<sup>st</sup> century ASuW weapon or weapons—but without allowing this process to delay the TLAM modification discussed in the previous paragraph. Commonality between air and surface missiles should be a goal but not a requirement that delays fielding. This missile must be capable against the world's most advanced defense systems, and should be targetable against fixed and moving targets, at sea and ashore. The development effort for such a missile would extent into the latter part of the 2020's, which makes the TLAM modification that much more important. However, thinking that the TLAM

modification solves the ASuW problem in the long term is incorrect. A new missile with advanced characteristics is required.

#### **Multi-Source Maritime Targeting and Tracking**

The Surface Force employed a comparatively long range surface to surface missile in its past. Known as the Tomahawk Anti-Ship Missile (TASM), it was pulled from the inventory in the 1990's. Strictly speaking, the Navy did not at the time possess the ability to consistently and confidently target this missile out the full extent of its range. It simply did not have the persistent sensors nor the networking required to employ the weapon. Those days are over, but the extended range fire control loop must still be closed.

To explain, if the Navy does indeed field the TLAM in the ASuW role (or any long range surface to surface weapon for that matter) the requisite tracking and targeting infrastructure to employ the weapon at its maximum range largely exists. Overhead assets, persistent air breathing UAV's and manned aircraft, and a variety of passive systems that exploit both acoustic and electromagnetic emissions all generate sufficient active and passive targeting data to provide for effective weapon employment. The problem to be solved, and the potential game changer, is that all of this information/data/measurements must be analyzed to provide target quality inputs to the weapon during the various stages of its employment (pre-launch, in-flight, end-game). Although it is trite to attribute all manner of miracles to "big data", it does not seem to stretch the art of the possible to suggest that the considerable passive and active targeting data can be correlated, reported, and shared in tactically relevant timelines. This data fusion effort would combine information gathered from National Technical Means (NTM), theater assets, strike group assets and individual units and via networks of sufficient latency deliver target quality data to the missile. This closed loop data fusion and targeting capability does not currently exist.

#### **Real-Time ISR Vulnerability Assessment**

Much of the capability of potential adversary ISR complexes is known. Generally speaking, we know where these capabilities are, at what frequencies they operate, what their likely effective ranges and sensitivities are, and how weather, time of day, or sunspots impact them. One of the benefits of forward presence is that our platforms

operate day in and day out in an electromagnetic environment much like the one they may be called to fight in (although there will be “war-time reserve modes” in which some equipment operates). The Navy needs the capability (again, tapping into the wonders of big data) to “map” and display the density and effectiveness of an adversary ISR complex in real time, taking into account the factors previously stated and rolling into them the impact of attrition. The purpose of this capability would be to enable risk mitigated operations within an opponent’s Anti-Access/ Area Denial (A2AD) envelope.

This capability is required in no small measure because there are always more and less risky places and times to operate within an adversary A2AD environment. The suggestion that the effectiveness of his surveillance and targeting complex is equal throughout its volume simply fails to understand the considerable variability that exists within it. What is required is to *know and understand* that vulnerability, and then use it to our tactical and operational advantage. This requires a real-time tool that assesses the ISR environment and displays areas of relatively greater and lesser vulnerability. These areas are then likely areas for power projection operations and or deception operations.

#### **Electromagnetic Spectrum Warfare**

As indicated by the suggestion that a real time ISR vulnerability assessment tool is required, our ability to operate and exploit the electromagnetic spectrum is increasingly important. We are fortunate indeed that Bryan Clark and Mark Gunzinger of the Center for Strategic and Budgetary Assessments (CSBA) only last week (2 December 2015) released a superbly informative report on the subject “Winning the Airwaves: Regaining America’s Dominance in the Electromagnetic Spectrum” (CSBA 2015). It effectively describes Electromagnetic Spectrum Warfare, its evolution and its challenges to U.S. forces. It further goes on to describe a number of useful operating concepts that would enable U.S. power projection operations in this environment and suggests new technologies and capabilities required to achieve them. It concludes with a discussion of some of the barriers to implementing such concepts and capabilities.

The Surface Electronic Warfare Improvement Program (SEWIP) is bringing considerably upgraded electronic warfare capability across the fleet. Much of what is available in SEWIP Block II and SEWIP Block III is classified, but the unclassified information available indicates that Block II brings considerably enhanced passive sensitivity to enable ships to exploit the emissions of other ships, aircraft, or missiles. These emissions can now be sensed from greater distances than ever before available,

and their directionality can be more finely honed to enable target quality passive cross-fixing. Block III incorporates all of the capabilities resident in Block II, but then adds considerable “Electronic Attack” (or jamming) capability.

It is advisable to have as much of the full Block III capability as possible integrated into every surface combatant irrespective of size. The demands of electromagnetic spectrum warfare suggest that the creation of electromagnetic haves and have nots in the environment will limit the utility of less than capable ships and make them more vulnerable. Additionally, the Navy must work to fully network shipboard combat systems in a manner in which both hard kill and soft kill options can most effectively be employed against demanding threats while conserving consumable weapons such as missiles and decoys. Networking a surface action group together to enable smart employment of hard kill and soft kill options, driven by tactical decision algorithms embedded in the network, create a “hardened”, task oriented SAG that is better able to exploit its lethality in an A2AD environment.

#### **Surface Ship Medium Altitude Long Endurance (MALE) UAV's**

Distributed Surface Force operations must be underpinned by sufficient overhead ISR and communications relay/networking capability, especially in a satellite denied environment. Current embarked helicopters lack the persistence necessary to perform these tasks (though they are vitally necessary for others), and the current/planned generation of combatant employed UAV's lack both persistence and payload carrying capability.

Distributed Surface Operations require an organic, Medium Altitude Long Endurance UAV capability such as is currently being studied by DARPA's Tactically Exploited Reconnaissance Node (TERN) Program. The following description of TERN comes from DARPA's web page (<http://www.darpa.mil/program/tactically-exploited-reconnaissance-node>):

*“In May 2014 DARPA and the Office of Naval Research (ONR) signed a memorandum of agreement making the program a joint effort – calling it Tern. Tern builds on DARPA's TERN program and seeks to combine the strengths of both land- and sea-based approaches to supporting airborne assets. Tern envisions using smaller ships as mobile launch and recovery sites for medium-altitude long-endurance (MALE) unmanned aircraft (UAVs). Named after the family of seabirds known for flight endurance – many species migrate thousands of miles each year –*

*Tern aims to make it much easier, quicker and less expensive for DoD to deploy persistent ISR and strike capabilities almost anywhere in the world.*

*Ideally, Tern would enable on-demand, ship-based unmanned aircraft systems (UAS) operations without extensive, time-consuming and irreversible ship modifications. It would provide small ships with a "mission truck" that could transport ISR and strike payloads to very long distances from the host vessel. The solution would support field-interchangeable mission packages for both overland and maritime missions. It would operate from multiple ship types and in elevated sea states.*

*DARPA and ONR envision Tern as improving aviation capabilities from smaller ships substantially beyond the current state-of-the-art. The program has three planned phases. The first two phases focus on preliminary design and risk reduction for the Tern system. In Phase 3, a performer would be selected to build a full-scale demonstrator Tern system for ground-based testing, culminating in an at-sea demonstration of launch and recovery."*

Distributed surface action groups (SAG) require persistent ISR support, and if conflict results in the reduction of satellite communications and networking, ships operating distant from the carrier strike group will need the ability to generate these capabilities organically.

Of additional interest is the possibility that a surface combatant based MALE UAV could assume some or all of the UCLASS ISR requirement currently being debated for employment from the aircraft carrier, so that the carrier air wing would then be left to concentrate on the contested strike requirement that exists in UCLASS.

### **Conclusion**

The presence, persistence, and flexibility of the Surface Force makes it a powerful component of this nation's forward deployed conventional deterrence posture. In order to continue to carry out this role, new ways of thinking must be applied to its organization, training, equipping, and employment. Distributed Lethality provides for an initial concept for moving the Surface Force in the direction of providing such an enhanced deterrent posture. The reality of growing great power contention demands this kind of thinking, and whatever support this Sub-Committee can lend to ensuring that sufficient resources are applied to support the lethality and hardening of the Surface Force would be of great importance to meeting the challenges posed.

## Bryan G. McGrath

CDR USN (ret.)

### WORK HISTORY

- Managing Director, The FerryBridge Group LLC (2013-Present)
- *Founder of an independent consultancy focusing on National Security issues, Maritime Strategy, and Defense Technology development.*
- Adjunct Faculty, Naval War College (2014-Present)
- *Adjunct Professor of Joint Maritime Studies*
- Director of Consulting, Studies and Analysis, Delex Systems, Inc, Herndon, VA (2009-2013)
- *Founding Director of a consultancy focusing on Naval and National Security issues*
- Manager, Strategic Planning, Northrop Grumman Marine Systems, Washington, DC (2008-9)
- *Primary Strategic Planner for a \$500M line of business in commercial energy and defense.*
- Director, Navy Strategic Actions Group. Washington DC (2006-8)
- *Senior Advisor to the uniformed leader of the US Navy (and member of the Joint Chiefs of Staff); responsible for formulating and implementing global strategy for the US Navy*
- Commanding Officer, USS BULKELEY. Norfolk, VA (2004-2006)
- *CEO level position directing the activities of a \$1 billion warship and crew of 320*
  - *Air and Missile Defense Commander for Commander, IWO JIMA Expeditionary Strike Group*
- Chief of Interoperability, Joint Staff, Washington DC (2001-2004)
- *Director level position coordinating missile defense oriented acquisition programs of the US Armed Services*
- Executive Officer, USS PRINCETON. San Diego, CA (1999-2001)
- *COO level position managing the activities of a \$1 billion warship and crew of 410*
- Special Assistant to the Chief of Naval Operations. Washington DC (1997-1999)
- *Director level position as Communications Director and Speechwriter to the uniformed leader of the US Navy (and member of the Joint Chiefs of Staff)*
- Junior Officer Naval Service (1987-1997)

### RELEVANT EXPERIENCE

#### Chief Navy Strategist (2006/7)

- **Key Contribution.** Led the Washington based team of USN, USMC, and USCG officers who developed the nation's current Maritime Strategy "A Cooperative Strategy for 21<sup>st</sup> Century Seapower", and served as its primary author.
- **Managing Complexity.** Led a team of nearly 200 senior military officers, academics, and government officials in developing the United States Maritime Strategy, the plan for investing nearly \$120 billion dollars annually for the next ten years.
  - Hand-picked by Navy leadership to manage this first comprehensive strategy development effort in 20 years.
- **Public Speaker.** Created and executed an extensive national advocacy and outreach program in support of the development of the National Maritime Strategy, including symposia, newspaper editorials, targeted media, and Congressional liaison.
- **Foresight.** Coordinated an in-depth alternative futures and strategic environment assessment process to support the development of the Maritime Strategy, creating a visionary look at the major trends in globalization, trade, finance, technology and labor now used as the standard for Department of Defense planning.

**Command at Sea (2004-2006)**

- **Proven Leader.** Received the 2006 “Zumwalt Award for Inspirational Leadership” from the Surface Navy Association.
- **Efficient.** In command of USS BULKELEY, managed over \$20 million in resources with recognition for operating fiscal efficiency. Earned 2006 USS ARIZONA Trophy for “most combat ready ship” in the Navy
- **Operational.** Served as the Air and Missile Defense Commander for the IWO JIMA Expeditionary Strike Group, responsible for the seamless integration of the Strike Group into existing Joint Air Defense Networks and the creation of such networks where none previously existed.
- **Organizational Improvement.** Re-organized the management team in USS BULKELEY to reflect functional areas related to combat operations, rather than historic administrative alignment. This innovation created increased communication among the stake-holders and ultimately contributed to the ship’s recognition as the most combat ready ship in the Navy.
- **Process Improvement.** Reduced maintenance and repair costs in USS BULKELEY by implementing an in-depth analysis of maintenance request procedures, resulting in 10% faster turn-around on high priority repairs with 50% fewer requests rejected for errors. Maintenance costs were maintained at 80% of the class average throughout command tenure.

**Joint Staff Officer (2001-2004)**

- **International Expertise.** Experience working with European, Middle Eastern, Asian and Latin American partners. Served as the primary Joint Staff representative to the international data link community, with deep expertise in Link 16, CEC and other missile defense oriented information and weapon systems.
  - Dynamic leadership and emphasis on personal excellence resulted in a 20% increase in retention of key Sailors and a 75% increase in personnel promotion rates.
- **Skilled Negotiator.** Excelled as primary agent of the Joint Chiefs of Staff for oversight of weapon system interoperability. Aided defense acquisition process by coordinating 25 separate programs (totaling over \$15 billion) in implementing higher levels of Joint interoperability, resulting in greater combat efficiency at lower total cost to the taxpayer.

**EDUCATION**

MA, Political Science, *The Catholic University of America*, 1999  
 BA, History, *University of Virginia*, 1987  
 Navy Fellow, *Massachusetts Institute of Technology Foreign Policy Seminar XXI*, 2007  
 Graduate, *Naval War College*, 1999 (JPME Phase I)  
 JPME Phase II (2006)

**MISCELLANEOUS**

Adjunct Fellow, Hudson Institute and Assistant Director of the Hudson Center for American Seapower (2013-Present)  
 Navy Policy Team Lead, Romney for President (2011-2012)

**DISCLOSURE FORM FOR WITNESSES  
COMMITTEE ON ARMED SERVICES  
U.S. HOUSE OF REPRESENTATIVES**

**INSTRUCTION TO WITNESSES:** Rule 11, clause 2(g)(5), of the Rules of the U.S. House of Representatives for the 114<sup>th</sup> Congress requires nongovernmental witnesses appearing before House committees to include in their written statements a curriculum vitae and a disclosure of the amount and source of any federal contracts or grants (including subcontracts and subgrants), or contracts or payments originating with a foreign government, received during the current and two previous calendar years either by the witness or by an entity represented by the witness and related to the subject matter of the hearing. This form is intended to assist witnesses appearing before the House Committee on Armed Services in complying with the House rule. Please note that a copy of these statements, with appropriate redactions to protect the witness's personal privacy (including home address and phone number) will be made publicly available in electronic form not later than one day after the witness's appearance before the committee. Witnesses may list additional grants, contracts, or payments on additional sheets, if necessary.

Witness name: Bryan G. McGrath

Capacity in which appearing: (check one)

Individual

Representative

If appearing in a representative capacity, name of the company, association or other entity being represented: \_\_\_\_\_

**Federal Contract or Grant Information:** If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts) or grants (including subgrants) with the federal government, please provide the following information:

2015

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
N00178-04-D-4148	USN (OPNAV N96)	\$70K	Strategic Comms/Planning
N00189-12-D-0024	USN (COMNAVSURFOR)	\$70K	Strategic Comms/Planning N00124-14-P-000
N00124-14-P-00001	Naval War College	\$15K	Professor, Distance Education

2014

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
N00178-04-D-4148	USN (OPNAV N96)	\$70K	Strategic Comms/Planning

2013

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
N00178-04-D-4148	USN (OPNAV N96)	\$6K	Strategic Comms/Planning

**Foreign Government Contract or Payment Information:** If you or the entity you represent before the Committee on Armed Services has contracts or payments originating from a foreign government, please provide the following information:

2015

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
NA			

2014

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
NA			

2013

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
NA			

**Bryan  
McGrath**

Digitally signed by Bryan McGrath  
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Date: 2015.12.06 11:55:37 -05'00'

Testimony before the House Armed Services Committee  
Subcommittee on Seapower and Projection Forces

Prepared Statement of Jonathan F. Solomon  
Senior Systems and Technology Analyst, Systems Planning and Analysis, Inc.  
December 9<sup>th</sup>, 2015

The views expressed herein are solely those of the author and are presented in his personal capacity on his own initiative. They do not reflect the official positions of Systems Planning and Analysis, Inc. and to the author's knowledge do not reflect the policies or positions of the U.S. Department of Defense, any U.S. armed service, or any other U.S. Government agency. These views have not been coordinated with, and are not offered in the interest of, Systems Planning and Analysis, Inc. or any of its customers.

Thank you Chairman Forbes and Ranking Member Courtney and all the members of the Seapower and Projection Forces subcommittee for granting me the honor of testifying today and to submit this written statement for the record.

I am a former U.S. Navy Surface Warfare Officer (SWO), and served two Division Officer tours in destroyers while on active duty from 2000-2004. My two billets were perhaps the most tactically-intensive ones available to a junior SWO: Anti-Submarine Warfare Officer and AEGIS Fire Control Officer. As the young officer responsible for overseeing the maintenance and

operation of my destroyers' principal combat systems, I obtained an unparalleled foundational education in the tactics and technologies of modern naval warfare. In particular, I gained a fine appreciation for the difficulties of interpreting and then optimally acting upon the dynamic and often ambiguous "situational pictures" that were produced by the sensors I "owned." I can attest to the fact that Clausewitz's concepts of "fog" and "friction" remain alive and well in the 21<sup>st</sup> Century in spite of, and sometimes exacerbated by, our technological advancements.

My civilian job of the past eleven years at Systems Planning and Analysis, Inc. has been to provide programmatic and systems engineering support to various surface combat system acquisition programs within the portfolio of the Navy's Program Executive Officer for Integrated Warfare Systems (PEO IWS). This work has provided me an opportunity to participate, however peripherally, in the development of some of the surface Navy's future combat systems technologies. It has also enriched my understanding of the technical principles and considerations that affect combat systems performance; this is no small thing considering that I am not an engineer by education.

In recent years, and with the generous support and encouragement of Mr. Bryan McGrath, I've taken up a hobby of writing articles that connect my academic background in maritime strategy, naval history, naval technology, and deterrence theory with my professional experiences. One of my favorite topics concerns the challenges and opportunities surrounding the potential uses of electronic warfare in modern maritime operations. It's a subject that I first encountered while on active duty, and later explored in great detail during my Masters thesis investigation of how

advanced wide-area oceanic surveillance-reconnaissance-targeting systems were countered during the Cold War, and might be countered in the future.

Electronic warfare receives remarkably little attention in the ongoing debates over future operating concepts and the like. Granted, classification serves as a barrier with respect to specific capabilities and systems. But electronic warfare's basic technical principles and effects are and have always been unclassified. I believe that much of the present unfamiliarity concerning electronic warfare stems from the fact that it's been almost a quarter century since U.S. naval forces last had to be prepared to operate under conditions in which victory—not to mention survival—in battle hinged upon achieving temporary localized mastery of the electromagnetic spectrum over the adversary.

America's chief strategic competitors intimately understand the importance of electronic warfare to fighting at sea. Soviet Cold War-era tactics for anti-ship attacks heavily leveraged what they termed "radio-electronic combat," and there's plenty of open source evidence available to suggest that this remains true in today's Russian military as well.<sup>i</sup> The Chinese are no different with respect to how they conceive of fighting under "informatized conditions."<sup>ii</sup> In a conflict against either of these two great powers, U.S. maritime forces' sensors and communications pathways would assuredly be subjected to intense disruption, denial, and deception via jamming or other related tactics. Likewise, ill-disciplined electromagnetic transmissions by U.S. maritime forces in a combat zone might very well prove suicidal in that they could provide an adversary a bullseye for aiming its long-range weapons.

To their credit, the Navy's seniormost leadership have gone to great lengths to stress the importance of electronic warfare in recent years, most notably in the new Maritime Strategy. They have even launched a new concept they call electromagnetic maneuver warfare, which appears geared towards exactly the kinds of capabilities I am about to outline. It is therefore quite likely that major elements of the U.S. Navy's future surface warfare vision, Distributed Lethality, will take electronic warfare considerations into account. I would suggest that Distributed Lethality's developers do so in three areas in particular: Command and Control (C<sup>2</sup>) doctrine, force-wide communications methods, and over-the-horizon targeting and counter-targeting measures.

First and foremost, Distributed Lethality's C<sup>2</sup> approach absolutely must be rooted in the doctrinal philosophy of "mission command." Such doctrine entails a higher-echelon commander, whether he or she is the commander of a large maritime battleforce or the commander of a Surface Action Group (SAG) consisting of just a few warships, providing subordinate ship or group commanders with an outline of his or her intentions for how a mission is to be executed, then delegating extensive tactical decision-making authority to them to get the job done. This would be very different than the Navy's C<sup>2</sup> culture of the past few decades in which higher-echelon commanders often strove to use a "common tactical picture" to exercise direct real-time control, sometimes from a considerable distance, over subordinate groups and ships. Such direct control will not be possible in contested areas in which communications using the electromagnetic spectrum are—unless concealed using some means—readily exploitable by an electronic warfare-savvy adversary. Perhaps the adversary might use noise or deceptive jamming, deceptive emissions, or decoy forces to confuse or manipulate the "common picture." Or perhaps the

adversary might attack the communications pathways directly with the aim of severing the voice and data connections between commanders and subordinates. An adept adversary might even use a unit or flagship's insufficiently concealed radiofrequency emissions to vector attacks. It should be clear, then, that the embrace of mission command doctrine by the Navy's senior-most leadership on down to the deckplate level will be critical to U.S. Navy surface forces' operational effectiveness if not survival in future high-end naval combat.

Let me now address the question of why a surface force must be able to retain some degree of voice and data communications even when operating deep within a contested zone. As I alluded earlier, I consider it highly counterproductive if not outright dangerous for a higher-echelon commander to attempt to exercise direct tactical control over subordinate assets in the field under opposed electromagnetic conditions. But that doesn't mean that the subordinate assets should not share their sensor pictures with each other, or that those assets should not be able to spontaneously collaborate with each other as a battle unfolds, or that higher-echelon commanders should not be able to issue mission intentions and operational or tactical situation updates—or even exercise a veto over subordinates' tactical decisions in extreme cases. A ship or an aircraft can, after all, only “see” on its own what is within the line of sight of its onboard sensors. If one ship or aircraft within some group detects a target of opportunity or an inbound threat, that information cannot be exploited to its fullest if the ship or aircraft in contact cannot pass what it knows to its partners in a timely manner with requisite details. In an age where large salvos of anti-ship missiles can cover hundreds—and in a few cases thousands—of miles in the tens of minutes, where actionable detections of “archers” and “arrows” can be extremely fleeting, and where only minutes may separate the moments in which each side first detects the

other, the side that can best build and then act upon a tactical picture is, per legendary naval tactical theorist Wayne Hughes, the one most likely to fire first effectively and thus prevail.<sup>iii</sup>

This requires the use of varying forms of voice and data networking as tailored to specific tactical or operational C<sup>2</sup> purposes. A real-time tactical picture is often needed for coordinating defenses against an enemy attack. A very close to real-time tactical picture may be sufficient for coordinating attacks against adversary forces. Non-real time communications may be entirely adequate for a higher-echelon commander to convey mission guidance to subordinates.

But how to conceal these communications, or at least drastically lower the risk that they might be intercepted and exploited by an adversary? The most secure form of communications against electronic warfare is obviously human courier, and while this was used by the U.S. Navy on a number of occasions during the Cold War to promote security in the dissemination of multi-day operational and tactical plans, it is simply not practicable in the heat of an ongoing tactical engagement. Visible-band and infrared pathways present other options, as demonstrated by the varying forms of “flashing light” communications practiced over the centuries. For instance, a 21<sup>st</sup> Century flashing light that is based upon laser technologies would have the added advantage of being highly directional, as its power would be concentrated in a very narrow beam that an adversary would have to be very lucky to be in the right place at the right time to intercept. That said, visible-band and infrared systems’ effective ranges are fairly limited to begin with when used directly between ships, and even more so in inclement weather. This may be fine if a tactical situation allows for a SAG’s units to be operating in close proximity. However, if unit dispersal will often be the rule in contested zones in order to reduce the risk that an adversary’s

discovery of one U.S. warship quickly results in detection of the rest of the SAG, then visible-band and infrared pathways can only offer partial solutions. A broader portfolio of communications options is consequently necessary.

It is commonly believed that the execution of strict Emissions Control (EMCON) in a combat zone in order to avoid detection (or pathway exploitation) by an adversary means that U.S. Navy warships would not be able to use any form of radiofrequency communications. This is not the case. Lower-frequency radios such as those that operate in the (awkwardly titled) High, Very High, and Ultra High Frequency (HF, VHF, and UHF) bands are very vulnerable because their transmission beams tend to be very wide. The wider a transmission beam, the greater the volume through which the beam will propagate, and in turn the greater the opportunity for an adversary's signals intelligence collectors to be in the right place at the right time. In order to make lower-frequency radio communications highly-directional and thereby difficult for an adversary to intercept, a ship's transmitting antennas would have to be far larger than is practical. At the Super High Frequency (SHF) band and above, though, transmission beamwidth using a practically-sized antenna becomes increasingly narrow and thus more difficult to intercept. This is why the Cold War-era U.S. Navy designed its Hawklink line-of-sight datalink connecting surface combatants and the SH-60B helicopter to use SHF; the latter could continually provide sonarbuoy, radar, or electronic support measures data to the former—and thereby serve as an anti-submarine “pouncer” or an anti-ship scout—with a relatively low risk of the signals being detected or exploited. In theory, the surface Navy might develop a portfolio of highly-directional line-of-sight communications systems that operate at SHF, Extremely High Frequency (EHF), or in the Millimeter-wave (MMW) bands in order to retain an all-weather voice and data

communications capability even during strict EMCON. The Navy might also develop high-band communications packages that could be carried by manned or unmanned aircraft, and especially those that could be embarked aboard surface combatants, so that surface units could communicate securely over long-distances via these “middlemen.” Shipboard and airframe “real estate” for antennas is generally quite limited, though, so the tradeoff for establishing highly-directional communications may well be reduced overall communications “bandwidth” compared to what is possible when also using available communications systems that aren’t as directional. Nevertheless, this could be quite practicable in a doctrinal culture that embraces mission command and the spontaneous local tactical collaboration of ships and aircraft in a SAG.

High-directionality also means that a single antenna can only communicate with one other ship or aircraft at a time—and it must know where that partner is so that it can point its beam precisely. If a transmission is meant for receipt by other ships or aircraft, it must either be relayed via one or more “middleman” assets’ directional links to those units or it must be broadcast to them using less-directional pathways. Broadcast is perfectly acceptable as a one-way transmissions method if the broadcaster is either located in a relatively secure and defensible area or alternatively is relatively expendable. An example of the former might be an airborne early warning aircraft protected by fighters or surface combatants broadcasting its radar picture to friendly forces (and performing as a local C<sup>2</sup> post as well) using less-directional lower-frequency communications. An example of the latter might be Unmanned Aerial Systems (UAS) launchable by SAG ships to serve as communications broadcast nodes; a ship could uplink to the UAS using a highly-directional pathway and the UAS could then rebroadcast the data within a localized footprint. Higher-echelon commanders located in a battlespace’s rearward areas might

also use broadcast to provide selected theater- and national-level sensor data, updated mission guidance, or other updated situational information to forward SAGs. By not responding to the broadcast, or by only responding to it via highly-directional pathways, receiving units in SAGs would gain important situational information while denying the adversary an easy means of locating them.

Low Probability of Intercept (LPI) radiofrequency communications techniques provide surface forces an additional tool that can be used at any frequency band, directional or not. By disguising waveforms to appear to be ambient radiofrequency noise or by using reduced transmission power levels and durations, an adversary's signals intelligence apparatus might not be able to detect an LPI transmission even if it is positioned to do so. I would caution, though, that any given LPI "trick" might not have much operational longevity. Signal processing technologies available on the global market may well reach a point, if they haven't already, where a "trick" works only a handful of times—or maybe just once—and thereafter is recognized by an adversary. Many LPI techniques accordingly should be husbanded for use only when necessary in a crisis or wartime, and there should be a large enough "arsenal" of them to enable protracted campaigning.

Finally, I want to briefly discuss the importance of providing our surface force with an actionable over-the-horizon targeting picture while denying the same to adversaries. The U.S. Navy is clearly at a deficit relative to its competitors regarding anti-ship missile range. This is thankfully changing regardless of whether we're talking about the Long-Range Anti-Ship Missile (LRASM), a Tomahawk-derived system, or other possible solutions.

It should be noted, though, that a weapon's range on its own is not a sufficient measure of its utility. This is especially important when comparing our arsenal to those possessed by potential adversaries. A weapon cannot be evaluated outside the context of the surveillance and reconnaissance apparatus that supports its employment.

In one of my earlier published works, I set up the following example regarding effective first strike/salvo range at the opening of a conflict:

*Optimal first-strike range is not necessarily the same as the maximum physical reach of the longest-ranged weapon system effective against a given target type (i.e., the combined range of the firing platform and the weapon it carries). Rather, it is defined by trade-offs in surveillance and reconnaissance effectiveness... This means that a potential adversary with a weapon system that can reach distance  $D$  from the homeland's border but can achieve timely and high-confidence peacetime cueing or targeting only within a radius of  $0.75D$  has an optimal first-strike range of  $0.75D$ ... This does not reduce the dangers faced by the defender at distance  $D$  but does offer more flexibility in using force-level doctrine, posture, plans, and capabilities to manage risks.<sup>iv</sup>*

Effective striking range is reduced further once a war breaks out and the belligerents take off their gloves with respect to each others' surveillance and reconnaissance systems. The qualities and quantities of a force's sensors, and the architecture and counter-detectability of the data pathways the force uses to relay its sensors' "pictures" to "consumers" matter just as much as the range of the force's weapons.<sup>v</sup> Under intense electronic warfare opposition, they arguably matter even more.

For a "shooter" to optimally employ long-range anti-ship weaponry, it must know with an acceptable degree of confidence that it is shooting at a valid and desirable target. Advanced

weapons inventories, after all, are finite. It can take considerable time for a warship to travel from a combat zone to a rearward area where it can rearm; this adds considerable complexities to a SAG maintaining a high combat operational tempo. Nor are many advanced weapons quickly producible, and in fact it is far from clear that the stockpiles of some of these weapons could be replenished within the timespan of anything other than a protracted war. This places a heavy premium on not wasting scarce weapons against low-value targets or empty waterspace. As a result, in most cases over-the-horizon targeting requires more than just the detection of some contact out at sea using long-range radar, sonar, or signals collection and direction-finding systems. It requires being able to classify the contact with some confidence: for example, whether it is a commercial tanker or an aircraft carrier, a fishing boat or a frigate, a destroyer or a decoy. An electronic warfare-savvy defender can do much to make an attacker's job of contact classification extraordinarily difficult in the absence of visual-range confirmation of what the longer-range sensors are "seeing."

A U.S. Navy SAG would therefore benefit greatly from being able to embark or otherwise access low observable unmanned systems that can serve as over-the-horizon scouts. These scouts could be used not only for reconnaissance, but also for contact confirmation. They could report their findings back to a SAG via the highly-directional pathways I discussed earlier, perhaps via "middlemen" if needed.

Likewise, a U.S. Navy SAG would need to be able to degrade or deceive an adversary's surveillance and reconnaissance efforts. There are plenty of non-technological options: speed and maneuver, clever use of weather for concealment, dispersal, and deceptive feints or

demonstrations by other forces that distract from a “main effort” SAG’s thrust. Technological options employed by a SAG might include EMCON and deceptive emissions against the adversary’s signals intelligence collectors, and noise or deceptive jamming against the adversary’s active sensors. During the Cold War, the U.S. Navy developed some very advanced (and anecdotally effective) shipboard deception systems to fulfill these tasks against Soviet sensors. Unmanned systems might be particularly attractive candidates for performing offboard deception tasks and for parrying an adversary’s own scouts as well.

If deception is to be successful, a SAG must possess a high-confidence understanding of—and be able to exercise agile control over—its emissions. It must also possess a comprehensive picture of the ambient electromagnetic environment in its area of operations, partly so that it can blend in as best as possible, and partly to uncover the adversary’s own transient LPI emissions. This will place a premium on being able to network and fuse inputs from widely-dispersed shipboard and offboard signals collection sensors. Some of these sensors will be “organic” to a SAG, and some may need to be “inorganically” provided by other Navy, Joint, or Allied forces. Some will be manned, and other will likely be unmanned. This will also place a premium on developing advanced signal processing and emissions correlation capabilities.

We can begin to see, then, the kinds of operational and tactical possibilities such capabilities and competencies might provide U.S. Navy SAGs. A SAG might employ various deception and concealment measures to penetrate into the outer or middle sections of a hotly contested zone, perform some operational task(s) of up to several days duration, and then retire. Other naval or Joint forces might be further used to conduct deception and concealment actions that distract the

adversary's surveillance-reconnaissance resources (and maybe decision-makers' attentions) from the area in which the SAG is operating, or perhaps from the SAG's actions themselves, during key periods. And still other naval, Joint, and Allied forces might conduct a wide-ranging campaign of physical and electromagnetic attacks to temporarily disrupt if not permanently roll back the adversary's surveillance-reconnaissance apparatus. Such efforts hold the potential of enticing an adversary to waste difficult-to-replace advanced weapons against "phantoms," or perhaps distracting or confusing him to such an extent that he attacks ineffectively or not at all.

The tools and tactics I've outlined most definitely will not serve as "silver bullets" that shield our forces from painful losses. And there will always be some degree of risk and uncertainty involved in the use of these measures; it will be up to our force commanders to decide when conditions seem right for their use in support of a particular thrust. These measures should consequently be viewed as force-multipliers that grant us much better odds of performing an adversary's oceanic surveillance and reconnaissance systems temporarily and locally if used smartly, and thus better odds of operational and strategic successes.

With that, I look forward to your questions and the discussion that will follow. Thank you.

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<sup>i</sup> For example, see the sources referenced in my post "Advanced Russian Electronic Warfare Capabilities." Information Dissemination blog, 16 September 2015,

<http://www.informationdissemination.net/2015/09/advanced-russian-electronic-warfare.html>

<sup>ii</sup> For examples, see 1. John Costello. "Chinese Views on the Information "Center of Gravity": Space, Cyber and Electronic Warfare." Jamestown Foundation China Brief, Vol. 15, No. 8, 16 April 2015,

[http://www.jamestown.org/programs/chinabrief/single/?tx\\_ttnews%5Btt\\_news%5D=43796&cHash=c0f286b0d4f15adfcf9817a93ae46363#.v14aL00o7cs](http://www.jamestown.org/programs/chinabrief/single/?tx_ttnews%5Btt_news%5D=43796&cHash=c0f286b0d4f15adfcf9817a93ae46363#.v14aL00o7cs); 2. "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015." (Washington, DC: Office of the Secretary of Defense, 07 April 2015), 33, 38.

<sup>iii</sup> CAPT Wayne P. Hughes Jr, USN (Ret). *Fleet Tactics and Coastal Combat*, 2<sup>nd</sup> ed. (Annapolis, MD: U.S. Naval Institute Press, 2000), 40-44.

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<sup>iv</sup> Jonathan F. Solomon. "Maritime Deception and Concealment: Concepts for Defeating Wide-Area Oceanic Surveillance-Reconnaissance-Strike Networks." *Naval War College Review* 66, No. 4 (Autumn 2013): 113-114.

<sup>v</sup> See my posts 1. "21st Century Maritime Operations Under Cyber-Electromagnetic Opposition, Part II." Information Dissemination blog, 22 October 2014, [http://www.informationdissemination.net/2014/10/21st-century-maritime-operations-under\\_22.html](http://www.informationdissemination.net/2014/10/21st-century-maritime-operations-under_22.html); and 2. "21st Century Maritime Operations Under Cyber-Electromagnetic Opposition, Part III." Information Dissemination blog, 23 October 2014, [http://www.informationdissemination.net/2014/10/21st-century-maritime-operations-under\\_23.html](http://www.informationdissemination.net/2014/10/21st-century-maritime-operations-under_23.html)

**JONATHAN F. SOLOMON**

**Experience and Achievements:**

Senior Systems and Technology Analyst 2004 to Present  
*Systems Planning and Analysis Inc.*, Washington, D.C.

- Current: Policy Analyst supporting Navy Strategic Systems Programs Office
- June 2010-December 2015: Action Officer supporting PEO IWS 2.0 Air and Missile Defense Radar (AMDR) Program Office Hardware, Ship Integration, and Systems Engineering Teams
- September 2008-June 2010: Action Officer supporting PMS 502 CG(X) Ship Integration Team
- October 2004-September 2008: Action Officer supporting PEO IWS 1.0 Japan-United States Ballistic Missile Defense Open Architecture Research (BMDOAR) program and PEO IWS 2.0 international radar technology cooperation programs

Surface Warfare Officer 2000 to 2004  
*United States Navy*, Norfolk, VA

- October 2003-September 2004: Aegis Fire Control Officer, USS GONZALEZ (DDG 66)
- March 2003-October 2003: Liaison Officer, Commander Destroyer Squadron 18 Staff
- December 2000-January 2003: Anti-Submarine Warfare Officer, USS THORN (DD 988)

**Research and Publications:**

- Regular Guest Author on maritime strategy, future warfare concepts, and deterrence theory topics, *Information Dissemination* (October 2014-Present)
- “Facing Russia: Conventional Defence and Deterrence in Europe.” Co-Authored with Elbridge Colby of the Center for a New American Security. *Survival*, December 2015 – January 2016, Pg. 21-50: <http://www.iiss.org/en/publications/survival/sections/2015-1e95/survival--global-politics-and-strategy-december-2015-january-2016-522a/57-6-03-colby-and-solomon-ae7f>
- “Demystifying Conventional Deterrence: Great-Power Conflict and East Asian Peace.” *Strategic Studies Quarterly*, Winter 2013: <http://www.au.af.mil/au/ssq/fullarticle.asp?id=58>. Applies widely-accepted conventional deterrence theory to the problem of deterring Chinese aggression in East Asia.
- “Maritime Deception and Concealment: Concepts for Defeating Wide-Area Ocean Surveillance and Reconnaissance Networks.” *Naval War College Review*, Autumn 2013:

## JONATHAN F. SOLOMON

<http://www.usnwc.edu/getattachment/e2f92747-f9f1-4987-8db4-7e99874214b2/Maritime-Deception-and-Concealment--Concepts-for-D.aspx>. Discusses how maritime operational-tactical deception and concealment can support the Joint Operational Access Concept (JOAC) as well as theater-level conventional deterrence.

- “Defending the Fleet From China’s Anti-Ship Ballistic Missile: Naval Deception’s Roles in Sea-Based Missile Defense.” Georgetown University Master’s Thesis, April 2011: <https://repository.library.georgetown.edu/handle/10822/553587>. Analyzed the Chinese Anti-Ship Ballistic Missile system architecture, and assessed operational, tactical-technological, and doctrinal solutions that utilize electronic warfare in support of naval concealment and deception as well as theater-level conventional deterrence.
- “Cyberdeterrence Between Nation-States: Plausible Strategy or a Pipe Dream?” *Strategic Studies Quarterly*, Spring 2011: <http://www.au.af.mil/au/ssq/2011/spring/solomon.pdf>. Analyzed characteristics, employment considerations, and utility of various deterrence strategies against state-executed/sponsored cyberwarfare.
- “Remember War.” *U.S. Naval Institute Proceedings*, December 2006: 36-40. Described how naval warfare theories of late-19<sup>th</sup> century Russian admiral Stepan Osipovich Makarov apply to contemporary challenges facing the U.S. Navy.

**Education:**

Master of Arts in Security Studies, Georgetown University, Washington, D.C. (2011)

- Coursework in grand strategy, emerging technologies with defense applications, cyberwarfare, Eastern European/Eurasian security issues, ballistic missile defense technologies and analysis, and social science research methodologies.

Bachelor of Arts in International Relations, Boston University, Boston, MA (2000)

- Focused upon Soviet/Russian politics and foreign policy, strategic intelligence, and Cold War history.

**DISCLOSURE FORM FOR WITNESSES  
COMMITTEE ON ARMED SERVICES  
U.S. HOUSE OF REPRESENTATIVES**

**INSTRUCTION TO WITNESSES:** Rule 11, clause 2(g)(5), of the Rules of the U.S. House of Representatives for the 114<sup>th</sup> Congress requires nongovernmental witnesses appearing before House committees to include in their written statements a curriculum vitae and a disclosure of the amount and source of any federal contracts or grants (including subcontracts and subgrants), or contracts or payments originating with a foreign government, received during the current and two previous calendar years either by the witness or by an entity represented by the witness and related to the subject matter of the hearing. This form is intended to assist witnesses appearing before the House Committee on Armed Services in complying with the House rule. Please note that a copy of these statements, with appropriate redactions to protect the witness's personal privacy (including home address and phone number) will be made publicly available in electronic form not later than one day after the witness's appearance before the committee. Witnesses may list additional grants, contracts, or payments on additional sheets, if necessary.

Witness name: Jonathan Franciscus Solomon

Capacity in which appearing: (check one)

Individual

Representative

If appearing in a representative capacity, name of the company, association or other entity being represented: \_\_\_\_\_

**Federal Contract or Grant Information:** If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts) or grants (including subgrants) with the federal government, please provide the following information:

2015

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant

2014

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant

2013

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant

**Foreign Government Contract or Payment Information:** If you or the entity you represent before the Committee on Armed Services has contracts or payments originating from a foreign government, please provide the following information:

2015

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment

2014

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment

2013

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment