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Can Network-Centric Warfare Save Undersea Warfare?

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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15. Abstract: Proponents of Network-Centric Warfare (NCW) claim we are in the midst of a "revolution in military affairs" (RMA) that will prove to be the most important in the past 200 years. The promise of powerful sensor grids combined with high-performance information grids to provide shared battlespace awareness and enable massing of effects vice massing of forces is seductive and is clearly the wave of the future for many warfare areas. The movement towards NCW follows a long trend of doing more with fewer, more technologically advanced assets. Our ability to conduct Undersea Warfare (USW), however, is in danger of missing out on the bulk of the benefits to be derived from NCW and constitutes a key vulnerability to the operational commander's ability to provide operational protection, security, surprise, and ultimately to fight and win. As our investment in information technology has increased exponentially in recent years, our USW capabilities have suffered from concurrent trends in decreasing U.S. force structure and an increasingly more capable threat. Recent years have seen the elimination of some USW platforms and the reduction of others, increased demands on existing platforms to perform more missions at higher operational tempos, and decreased training levels. At the same time, the threat has become more prolific, stealthy, and deadly. Our current USW sensor grid is incapable of providing the information relevance, accuracy, and timeliness required to realize the promises of NCW. Barring significant advances in USW sensor and communications technology, the promise of shared battlespace awareness will instead be the reality of shared *lack* of awareness and the submarine will remain a threat the commander cannot effectively counter.

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Can Network-Centric Warfare Save Undersea Warfare?

Proponents of Network-Centric Warfare (NCW) claim we are in the midst of a "revolution in military affairs" (RMA) that will prove to be the most important in the past 200 years.[1] The promise of powerful sensor grids combined with high-performance information grids to provide shared battlespace awareness and enable massing of effects vice massing of forces is seductive and is clearly the wave of the future for many warfare areas. The movement towards NCW follows a long trend of doing more with fewer, more technologically advanced assets. Our ability to conduct Undersea Warfare (USW), however, is in danger of missing out on the bulk of the benefits to be derived from NCW and constitutes a key vulnerability to the operational commander's ability to provide operational protection, security, surprise, and ultimately to fight and win. As our investment in information technology has increased exponentially in recent years, our USW capabilities have suffered from concurrent trends in decreasing U.S. force structure and an increasingly more capable threat. Recent years have seen the elimination of some USW platforms and the reduction of others, increased demands on existing platforms to perform more missions at higher operational tempos, and decreased training levels. At the same time, the threat has become more prolific, stealthy, and deadly. Our current USW sensor grid is incapable of providing the information relevance, accuracy, and timeliness required to realize the promises of NCW. Barring significant advances in USW sensor and communications technology, the promise of shared battlespace awareness will instead be the reality of shared *lack* of awareness and the submarine will remain a threat the commander cannot effectively counter.

USW: Relevance to the Operational Commander

"Power projection from the United States, achieved through rapid strategic mobility, will enable the timely response critical to our deterrent and warfighting capabilities" [2]

"The only thing that really frightened me during the war was the U-boat peril" Winston Churchill [3]

"What is of supreme importance in war is to attack the enemy's strategy" Sun Tzu[4]

Since the end of the Cold War, the U.S. has increasingly adopted a strategy relying upon strategic mobility of U.S. based forces vice continuous overseas presence, with the lion's share of U.S. strategic mobility capabilities resident in strategic sealift forces. During Operation Desert Storm, for example, 94% of the nearly 10 million tons of cargo shipped to theater moved by sealift. [5] Clearly the success of such a strategy depends on unimpeded access to sea lanes of communication (SLOCs) and offers potential adversaries the means to attack our strategy directly without necessarily engaging in a symmetric force on force engagement. The sinking of the "Atlantic Conveyor" and its cargo of helicopters, landing strip materials, and spare parts during the Falklands War meant "The land forces were going to have to walk across East Falkland"[6] and forced the British Commanders to radically revise land campaign planning assumptions. A torpedo attack by a lone submarine resulting in the sinking of an U.S. pre-positioning ship could likewise have a significant impact on the sequencing of forces and capabilities into theater.

USW has historically been an extremely asset-intensive warfare area. Admiral Gorshkov observed that in World War II there were 25 Allied ships and 100 aircraft

involved in USW operations for each German submarine at sea.[7] During the more recent Falklands Island war, the British maintained the equivalent of four Sea King USW helicopters continuously airborne for a month,[8] expended 200 rounds of USW ordnance, and devoted a significant portion of the operating time of two anti-submarine carriers, more than a dozen frigates and destroyers, four nuclear submarines and one diesel submarine to counter one diesel submarine.[9] In the event, despite the enormous expenditure of British effort and ordnance, the Captain of the lone Argentine submarine at sea claims he was never under direct attack.[10] The USW challenges facing U.S. commanders in a Korea scenario, where North Korea could field between 40 and 60 diesel submarines,[11] are significant and would surely complicate any attempts to conduct resupply and reinforcement operations during a crisis on the Korean peninsula. Exacerbating matters in a Korea scenario is the extant treaty between North Korea and the People's Republic of China (PRC) specifying automatic PRC involvement in any war in the Korean peninsula in which the U.S. was involved.[12] The combined threat of PRC and North Korean submarine forces would face allied commanders with over 100 diesel submarines and several nuclear submarines, including ballistic missile submarines.[13] Such a threat would make force protection and battlespace dominance extraordinarily difficult if not impossible, and at a minimum would cause significant disruption in planned Time Phased Force Deployment List (TPFDL) timelines.[14] The diesel submarine can be likened to the Scud missile: Relatively unsophisticated, extremely difficult and asset intensive to detect, even more difficult to prosecute to destruction, and potentially disruptive to a commander's ability to execute missions well out of proportion to its individual military capabilities.[15] The ability of a lone diesel submarine to tie up significant

numbers of assets poses an increasingly difficult problem to commanders faced with fewer assets performing multiple missions.

The submarine poses a threat that directly challenges the operational commander's ability to realize the ideals of dominant maneuver, focused logistics, full-dimensional protection, and ultimately full spectrum dominance called for in "Joint Vision 2010".[16] Current deficiencies in U.S. USW capabilities can be attributed to two concurrent trends: The evolving threat and the decline of USW as a priority since the end of the cold war.

The Evolving Threat

The nature of the submarine threat faced by the United States and its allies has changed in capability, scope, and environment. The days of the blue water acoustic superiority once enjoyed by the U.S. over noisy nuclear submarines operating in predictable areas has given way to a spectrum of threats ranging from state of the art Russian nuclear attack and guided missile submarines operating in the open ocean to large numbers of increasingly sophisticated conventional boats operating in the littoral. The U.S. Navy's shift from a blue water focus to power projection from the littorals[17] exposes U.S. forces to the threat of close to 475 conventional submarines[18] operating in their home waters. 44 nations currently operate diesel submarines, among them Russia, China, India, North Korea, Pakistan, Iran, Libya, Syria, Cuba, and Serbia.[19] Russia and China have publicly declared the submarine as the capital ship of their navies, and many potentially adversarial Third World countries have essentially done the same, including Iran, North Korea, India, and Pakistan.[20]

The submarines available on the world market are becoming increasingly more difficult to counter because of two trends: Quieting (stealth) and lethality.

Across the range of potential adversaries, submarines are growing increasingly quieter. Technology including outer hull acoustic coatings, skewed seven-bladed propellers, and compound machinery isolation using sound mounts has significantly reduced the acoustic signature of modern submarines. Anechoic rubber coating can reduce the active sonar return signal to 12% - 50% of the return from an uncoated submarine.[21] Russia is actively seeking customers for its new "Amur" class diesel submarines, which are being advertised as being three times quieter than the already stealthy Kilo.[22] Future quieting can be achieved through the use of pumpjet propulsors, magnetic bearings, improved outer hull coatings, and active machinery vibration suppression.[23] Taken together, the passive detection range of modern submarines is well within their maximum weapons release range. Compounding the problem for U.S. USW forces operating in the littoral is the increased background noise from shipping and biologics as well as the significantly less uniform acoustic propagation found there. In addition to quieting trends, numerous countries are developing air-independent propulsion technology that dramatically increases submerged endurance thus significantly reducing non-acoustic detection opportunities.[24]

Increased lethality: The upper end of the threat spectrum to friendly shipping remains the Former Soviet Union (FSU) Oscar II guided missile submarine (SSGN) with its 300 nautical mile range SS-N-19 anti-ship cruise missile (ASCM),[25] but the threat at the lower end of the spectrum is becoming increasingly lethal. Modern heavyweight torpedoes are capable of inflicting serious damage to or sinking with a single hit even the largest ships, including major combatants and amphibious vessels.[26] Acoustic and anti-surface warfare

(ASUW) wake homing torpedoes and submarine-launched ASCM are widely available on the world market[27] and will greatly increase the effectiveness of threat submarines from lesser-developed countries. The Russians recently introduced an export version of a 200kt supercavitating torpedo capable of carrying a 210 kg warhead 10 km,[28] and are reportedly developing a torpedo that will transit at 300kt and search at 60kt.[29] In addition to torpedoes and ASCM, submarine-launched naval mines (including propelled warhead mines available from Russia and China) will increasingly be found in naval inventories.[30] Modern automated fire control systems simplify the development of a fire control solution[31] and can mitigate to some degree the training deficiencies sometimes attributed to developing navies.

The end of the cold war has had little effect on the development and proliferation of submarines. Russia continues to build state of the art conventional and nuclear submarines both for its own Navy and for export. China is aggressively pursuing indigenous production of both types of submarines and is anticipated to have the ability to strike some portions of the United States from ballistic missile submarines in home waters early this century.[32] North Korea continues its high priority construction program of Sango submarines and is expected to have a force of over 60 submarines by 2005.[33] The U. S. Office of Naval Intelligence assesses that the trend for the foreseeable future is towards regional powers operating fewer but more capable submarines[34] in numbers sufficient to significantly delay, disrupt, and demoralize U.S. forces.[35]

The Decline of U.S. USW

The decline of U.S. USW capabilities since the end of the cold war has been the result of a wide range of factors. The lack of consensus on a perceived submarine threat and

competing warfare priorities, combined with mounting pressures on the overall defense budget, have seen funding and emphasis on USW decrease dramatically.[36] Integrated Undersea Surveillance Systems (IUSS), ships, submarines and aircraft have all experienced significant force level reductions.[37] The reduction in force levels has seen the rise of increased multi-mission tasking and competition for scarce assets. The optimum towed array sonar in the area of a known submarine threat, for example, may be located on a cruiser that is also conducting TLAM strikes, Air Warfare duties in defense of a aircraft carrier, or Theater Ballistic Missile Defense as part of the Navy's Cooperative Engagement Concept (CEC). Likewise, P-3 Orion maritime patrol aircraft (already at half of their 1990 force levels),[38] are increasingly being employed in the overland Electro-optics/Infrared (EO/IR) reconnaissance role and no longer have the S-3B Viking to assist in acoustic USW duties. USW helicopters are performing a wide range of non-USW missions, including SOF insertion, combat search and rescue, and plane guard duties. Nuclear attack submarine (SSN) forces are well below the number validated by fleet commanders-in-chiefs[39] and are increasingly serving in Indications and Warnings and strike roles. Fewer assets performing more missions has seen a decrease in USW training emphasis in favor of other mission areas. Major exercises often either discount a submarine threat entirely or artificially remove the threat early in the exercise to allow a flow of events that would in reality be impeded by unlocated submarines. Quality of life concerns have driven senior leadership to direct fewer days at sea during the inter-deployment training cycle, further decreasing training opportunities. Finally, training opportunities against quiet diesel submarines in cluttered littoral waters are extremely limited.

The doctrinal shift towards power projection from the littorals significantly complicates the USW problem. Systems and tactics used for detecting nuclear submarines in the open ocean are inadequate for detecting quiet diesel submarines operating in the complex, dynamic, and cluttered littoral environment.[40]

The combination of fewer assets, more missions, less training, fewer people, and more capable adversaries make USW a mission ripe for revolution. Can NCW save USW?

NCW: Isn't that the way we've always done USW?

It could be argued that USW has been network-centric for decades. USW is a team effort by its nature, and contact information has long been exchanged between USW assets by a variety of means. Cueing from the Sound Surveillance System (SOSUS) network was passed down the line, eventually resulting in individual "shooters" (ships, aircraft, or submarines) gaining contact within the weapons employment envelope of the shooter. Widely dispersed USW units maintained common pictures via Link-11, and in some cases integrated systems (Lamps MkI/III) used tactical data links to transfer information real time between airborne sensor (radar and acoustic processor data on the helicopter) and the parent ship for additional processing and command and control. Deployed sensors (sonobuoys) have been monitored by multiple aircraft simultaneously, or in some cases by both aircraft and ships.

While somewhat NCW-like in appearances, traditional USW has failed to live up to the information relevance, accuracy, and timeliness promised by NCW proponents.[41] USW has been characterized by uncertainty with regards to friendly unit positions and capabilities,

sensor positions, environmental conditions and predictions, and threat/neutral positions that fall far short of the battlespace awareness promised by NCW. Stove-piped acquisition systems, proprietary software, incompatibility between hardware and man-machine interfaces on different platforms, and cumbersome communications paths have made true shared awareness impossible.

The Potential for Network Centric USW

"Network centric warfare will require the exchange of the proper information to the proper level of command in the proper format at the proper time."[42]

The very nature of USW makes it both the warfare area that has the most potential to benefit from NCW and the area that will be the most difficult to realize the benefits. Achieving a useful USW "common tactical picture" requires a sensor grid capable of detecting and maintaining contact on submarines throughout their operational range and environment with positional accuracy and timeliness sufficient to act upon. The improved quieting of modern submarines, the high background noise and crowded shipping lanes in the littoral, and the decrease in sensors, assets, and training time conspire to minimize detection opportunities on existing sensors. Initial detection is just the tip of the iceberg: Effective USW requires an unbroken chain of contact from initial detection through localization, classification, tracking to attack criteria, and attack. Often the sensor gaining initial contact is unable to classify, localize, and attack the target and must rely on a "chain of systems" to successfully neutralize a threat. Given adequate sensors and communications, however,

NCW has enormous potential to enable U.S. forces to win the undersea battle. In some cases the benefits realized will be due to the synergy enabled by the network (decreasing the area of probability for a contact through real-time data fusion of multiple sensor inputs, for example). In other cases benefits may be realized through the use of powerful information technology (enabling a single sensor operator to more effectively detect a contact in a cluttered acoustic environment, for example). The following paragraphs will explore some potential benefits, as well as possible limitations, of applying information technology and NCW to USW.

Friendly force position: The ability to visualize friendly force positions in real time significantly improves the relevance of sensor information from each unit. GPS positioning combined with self-reporting of position into the Common Tactical Picture would reduce uncertainty and enable meaningful exchange of contact data. In theory, real time reporting of friendly subsurface contacts could radically change current waterspace management doctrine. USW commanders could use the best available shooter to engage threat submarines without necessarily having to respect the large volumes of waterspace currently reserved for U.S. SSNs.

Just as real-time data fusion using multiple dispersed sensors has served TBMD and counter-battery artillery well by dramatically reducing the area of probability,[43] so too could USW benefit. The ability to fuse information from deployed sensors (sonobuoys, SOSUS, future deployable sensor networks) with data from active sonars, towed array sensors, and non-acoustic cueing has potential to both reduce areas of probability and to accurately validate or reject contact data.

Multi-static sonar is increasingly seen as an option for the littoral, and is inherently network-centric in nature.[44] Using multiple receivers to exploit a single 'ping' event, the system is significantly more effective at mitigating active sonar degraders in the littoral than traditional sonors. A similar concept could be realized by using multiple surface units to process the ping of a single unit's active sonar.

While it is unlikely that ocean basin scale sensor networks along the lines of the SOSUS network will be seen in the future, rapidly and covertly deployable arrays capable of covering significant areas are in development and could be deployed as a regional crisis developed. Advanced Deployable System is a rapidly deployable, short-term undersea surveillance system designed for monitoring of a shallow water littoral operating area. It will use an expendable large-area field of passive acoustic arrays, interconnected and cabled to shore with fiber-optic cables.[45] Ideally, future systems will be completely stand-alone and will not need shore station connectivity.

Assuming an adequate sensor grid exists, NCW will allow operational command to direct action by the appropriate tactical unit in the shooter grid.[46] The evolving nature of USW may see previously unexplored roles for some assets. Consider the possibilities of using MK 80 series iron bombs armed with hydrostatic fuses[47] as depth bombs against a shallow water threat. The use of this type of ordnance increases the types of aircraft capable of carrying USW ordnance, and in theory any type of fighter/attack aircraft (Air Force and Marine Corps included) capable of dropping MK 80 series ordnance could be employed as an USW shooter. Another possible non-traditional USW shooter could be a surface combatant with extended range guns. Cued perhaps by an Automatic RADAR Periscope Detection and Discrimination radar on a P-3,[48] the 5" gun might be the only reactive asset in the shooter

grid capable of exploiting the limited detection opportunity. Coupled with a highly accurate sensor grid, real-time awareness of shooter location and weapons load-out, and in-cockpit awareness of threat and U.S. force location, an increased number of shooters could help mitigate the elimination of some assets and the multi-mission tasking of others. Such concepts raise troublesome Rules of Engagement (ROE) issues, however. Shared awareness of U.S. force positions does not equate to shared awareness of coalition or neutral force positions, nor does the presence of a submarine known not to be a U.S. or coalition submarine necessarily equate to a threat. Thirteen different countries operate Type 209s, six countries operate Kilos, and five countries operate Foxtrots and Romeos.[49] The end result of a successful 5" gun engagement of a suspected North Korean Romeo in a Korean peninsula contingency scenario could be quite different if it turned out to be Chinese, for example. The ability to prosecute targets beyond visual range will obviously be situation and ROE dependent, but NCW clearly opens the door for new options in the shooter grid.

NCW connectivity and evolving tactical display technology offers the ability to make quantum leaps in shared awareness of the undersea environment. Starting with a standard prediction model baseline of bottom topography, magnetic characteristics, and historical water temperature, salinity, and current velocity, environmental data bases could be updated near real time. Fused data from deployed sensors, space-based visual, infrared, and radar sensors, and blue force units could be combined and displayed in 3-D views tailored to available search sensors.[50]

Unmanned Undersea Vehicles (UUV) offer one possible solution to decreases in USW assets. Manta UUVs are currently under development and offer an impressive array of capabilities that could extend the coverage of naval forces at a reduced risk to manned

platforms. Capable of carrying sonars, non-acoustic sensors, above surface sensors, multi-static sources/receivers, and weapons, Mantas could be major force multipliers for current SSNs. UUVs could provide high-resolution data sets to populate environmental data bases and assist in developing accurate prediction and tactical decision aids.[51] Significant command and control and information flow hurdles remain to be overcome before this technology will provide the commander with real time information, but the concept appears to be promising.

The ability for an individual sensor operator to be assisted either by enhanced recognition processing enabled by current processors, "reach back" capability to central nodes with advanced processing and experience, or "chat room" capabilities with operators from other units will be key as units are manned by fewer people.[52] DD-21, for example, is projected to have 70% less manning than current DDG 51-class vessels.[53]

As promising as NCW is for USW, significant challenges remain. Adequate bandwidth for transmitting large volumes of acoustic information needs to be established. A balance between the covertness of U.S. SSNs and their ability to provide timely information to the sensor grid needs to be achieved. Common protocols for sharing information need to be established. Decisions need to be made about what level of the USW hierarchy will fuse data from national, deployed, and organic sensors. In the medium to long term, the future has the potential to be bright for U.S. USW but not without significant investment.

Conclusion

"...If we cannot command the seas and airspace above them, we cannot project power to command or influence events ashore; we cannot deter; we cannot hope to shape the security environment." Admiral J. L. Johnson[54]

Network Centric Warfare *can* save USW, and in fact may be the only way to overcome the effects of force structure and threat trends. It offers enormous promise that will require equally enormous investment to realize. The sensor grid currently in place is inadequate to provide the timeliness, accuracy, and relevance required to exploit the possibilities offered by NCW, however. Commanders and planners may need to rethink TPFDL assumptions for forces flowing into theater for major regional contingencies until the current decline in USW capabilities is overcome.

The possibilities of UUVs, ADS, multi-static sonar, improved automated processing, and network-centric connectivity offer significant hope for the future and should be pursued. Wide bandwidth communications pipes and common protocols need to be established to enable the Common Operational Picture to become a reality. Clearly the ability to fuse disparate data into a cohesive whole would offer commanders significant advantages in threat avoidance or engagement of hostile submarines and should be pursued. Trends indicate that the threat is capable and is growing more so, and the promise of NCW offers an inviting way to counter that threat. Effective implementation will require an approach that transcends individual warfare community stovepipes for acquisition and connectivity and may require rethinking who our USW assets really are. As the trend towards a smaller, more distributed

force continues, NCW may very well be the only option U.S. forces have to effectively protect our vital national interests.

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