

# Naval ASW Sonar Review

**Bob Nugent**

Sonar is a key technology in naval warfare that is still widely used – from navigating a single ship or craft to oceanographic research on a global scale by fleets of sonar-equipped manned ships and unmanned vehicles.

As suggested by its name (actually acronym), SoNaR, or Sound Navigation and Ranging, uses the propagation, reflection and transmission of sound energy through water to sense, detect, classify and identify objects in and on the water. Sonar is also used to communicate using underwater telephones and other acoustic devices. In this respect, given the relatively constant and opaque nature of salt water as an operating medium for navies (more on this below), the sonar remains an enduring and relevant naval technology. This is especially true in two naval mission areas: mine warfare (MiW) and anti-submarine warfare (ASW).

This article will look at one specific naval sonar application – sonars on surface combatants used for ASW. It starts with a brief summary of the evolution of the surface ship ASW sonar and the impact of technological change on the current generation of sonar systems. Next, using AMI's proprietary data on current fleets and forecasted acquisitions of naval ships and their equipment, the article reviews current sonar ship fits and specifications for different types of platforms and across regions. This is followed by an analysis of future surface ship sonar procurements over the next 20 years by types of sonars (hull, towed array, variable depth). The article will close with a detailed look at some recent contract awards and other market developments affecting the surface ship sonar market.

## Background

Sonar is not a new naval technology. British active sonar systems (ASDIC) were tested in the late stages of WWI. By WWII sonar had developed sufficiently to play a key role in

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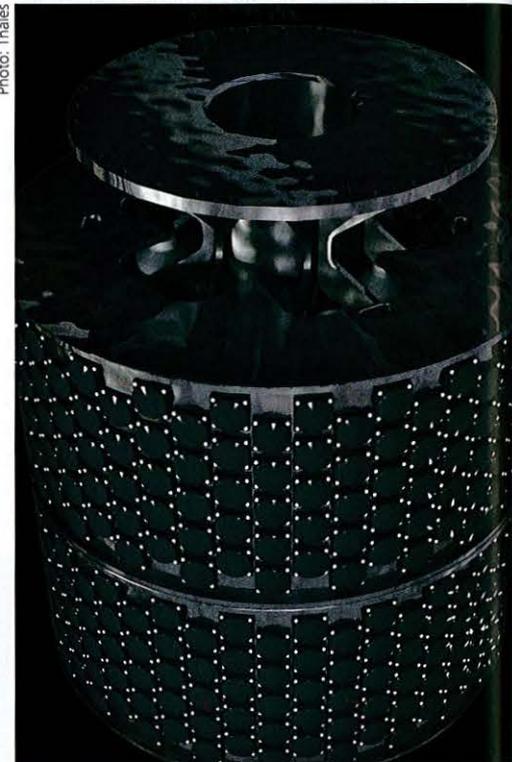
several navies' ASW operations in both the European and Pacific theatres. As a result of its demonstrated wartime effectiveness, sonar became standard fits in naval surface forces. With the growth of the Soviet submarine force in the 1960s and 70s, ASW became a focus of effort in NATO campaign plans. The result was a significant investment in a variety of ASW sonar systems during the Cold War. Sonar expanded beyond surface ships to subsurface (mobile and fixed) and aerial platforms. Surface ship sonar expanded from the traditional bow and hull mounts to systems that trailed behind and/or below often noisy deploying platform. This configuration allowed operators to place active sound generators and passive receivers to more effective locations below thermoclines (acoustic barriers) and thereby extend submarine detection ranges. These towed arrays and variable depth sonars, together with hull-mounted sonar, are the main elements comprising naval surface ship sonar fits today.

## Technology Trends

Improvements in technology in the quarter century since the Cold War ended have advanced the state of the art far beyond Cold War-era systems. The US Navy's SQS-23 hull-mounted ASW sonar, first deployed in 1958 and widely used up through the 1990s, weighed some 30 tons with a transducer then 20 feet in diameter. Improved materials have cut the weight of today's sonar arrays, including the transducer "domes," hydrophones and sound receivers as well as data transmission and load-bearing cabling. More efficient designs have also reduced the power demands placed on the host platform operating (and deploying in the case of variable depth and towed arrays) the sonar system. These improvements have expanded the numbers of platforms that can mount and operate ASW sonar to smaller ships (corvettes and patrol craft) and even unmanned surface vehicles.

That said, weight and power demands continue to constrain naval surface ship sonar. Even modern systems such as the Thales UMS-4110 bow-mounted sonar designed for medium and large combatants weighs some 10 tons and company information states the system's height and diameter is 2.2 metres and 2 metres respectively.

Photo: Thales



**Thales UMS-4110 bow-mounted sonar has been selected for the new FREMM Class frigates of the French and Italian navies.**

Improvements in the information processing and related technologies have also advanced surface ship sonars significantly over the same period. A survey of current naval sonar offerings from industry leaders such as Lockheed Martin, Raytheon, ATLAS ELEKTRONIK, Ultra Electronics and Kongsberg and others describe sonar sets as elements (modules) in a broader capability offering usually centred on sonar data processing and command and control systems. An example of this design approach is the ATLAS Modular ASW Combat System (AMACS) in which the bow-mounted sonar (ASO), Towed Array (TAS) and Variable Depth Sonar (ACTAS) can be integrated separately or together.

## Environmental Changes: Sonar Performance in Warmer Waters

Cold War ASW focused generally on colder waters of the northern European littoral

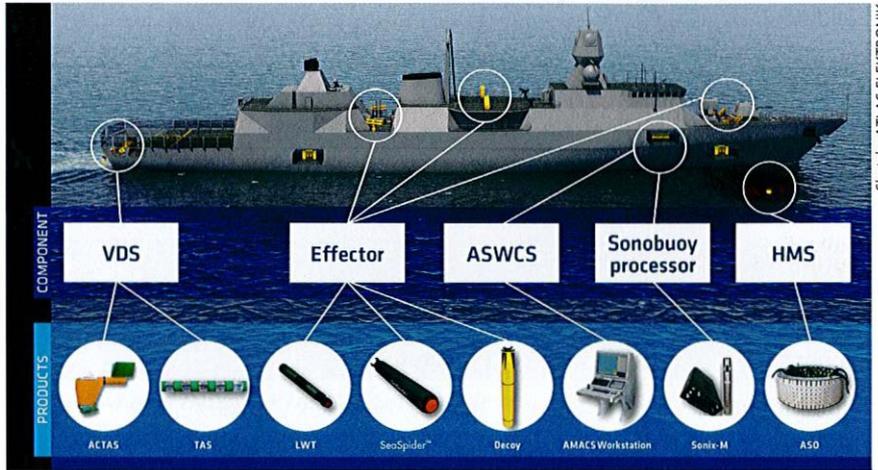
over the past decade\*\*, this “multistatic” approach to ASW, a network of sonar-capable platforms that present multiple active and passive sources in the same operational space, places an even greater premium on sonar system flexibility, effective informa-

tion management, and superior command and control systems.

## Current Surface Combatant Sonar Systems

**AN/SQQ-89V (Lockheed Martin)** is the primary ASW system equipping OLIVER HAZARD PERRY (FFG 7) Class frigates (foreign navies), ARLEIGH BURKE (DDG 51) Class destroyers, and TICONDEROGA (CG 47) Class cruisers. The V15 version of the system is designed as open architecture with regular software (bi-annual) and hardware upgrades (every 4 years). The system consists of active and passive sonar (AN/SQS-53) and towed arrays (AN/SQR-19 TACTAS, AN/SQR-20 (TB-37U) Multifunction Towed Array – MFTA). The SQR-20 is succeeding the SQR-19 TACTAS, providing improvements in coverage, detection capability, and reliability over the “19” first introduced in the early 1980s.

**AN/SQQ-90 (Raytheon)**, equipping the ZUMWALT Class DDG-1000, includes the AN/SQS-60 hull-mounted mid-frequency sonar, the AN/SQS-61 hull-mounted high-



and Arctic regions, although Soviet Navy deployments in the warmer climates of the Mediterranean and Indian Oceans complicated sonar performance.

With the end of the Cold War, and the proliferation of submarines to navies operating in warmer waters such as the South China Sea and Persian Gulf, sonar systems performance is affected. Temperature is the major variable affecting the movement of sound in water. As detailed in our earlier article on the future submarine market, more nations are acquiring submarines. Those submarines are harder to detect, using relatively quiet diesel-electric and even quieter air-independent propulsion systems. Operating in areas where ocean temperatures have warmed measurably in the past 15 years\* makes those platforms even harder to find. The result is an operating environment in which ship-mounted ASW sonars are increasingly challenged to meet ASW detection, classification, and target tracking requirements. Countering quieter submarines in warmer waters will drive ASW practitioners to employ an even wider array of sonar transmitters and receivers operating simultaneously. As US and NATO organisations have noted

tion management, and superior command and control systems.

## Current Platforms and Systems

An analysis of major naval sonar systems equipping most of the world’s leading navies (excepting Russia and China) shows that the systems are concentrated in the

Region	Country	Total (Hulls)	Frigate	Destroyer	Cruiser	Corvette	OPV	Amphib
Asia-Pacific (38%)	Japan	47	6	38	1			2
	Taiwan	24	20	4				
	India	23	15	8				
	South Korea	13	4	9				
	Australia	10	10					
	Indonesia	6	6					
	Thailand	2	2					
	New Zealand	2	2					
	Pakistan	1	1					
NATO (30%)	Italy	14	12	2				
	Canada	13	12	1				
	UK	13	13					
	Spain	10	10					
	Turkey	10	8			2		
	Denmark	9	5				4	
	France	7		7				
	Greece	6	6					
	Norway	5	5					
	Germany	4	4					
	Poland	3	2				1	
	Belgium	2	2					
	Netherlands	2	2					
Portugal	2	2						
US (25%)	US	85		63	22			
Rest of World (7%)	(Latin America and MENA)	26	22			4		
<b>Totals</b>		<b>339</b>	<b>171</b>	<b>132</b>	<b>23</b>	<b>7</b>	<b>4</b>	<b>2</b>

frequency sonar, and the AN/SQR-20 multi-function towed array sonar and handling system.

**CAPTAS (Thales)** is the Low Frequency Active VDS equipping NATO countries and other navies. At least forty systems have already been ordered:

- 2 installation variants for CAPTAS 4:
  - 3 UK frigate
  - FREMM frigate (France, Italy)
- Royal Malaysian Navy (CAPTAS-2 on SGPV LCS)
- Royal Moroccan Navy (CAPTAS-4 on FREMM)
- Royal Norwegian Navy (CAPTAS-2 on NNF)
- Royal Saudi Navy (CAPTAS-2 on F4000)
- UAE Navy (CAPTAS-2 on ABUDHABI Class)

**Modular ASW Combat System (AMACS – ATLAS ELEKTRONIK)** consists of a sonar suite with hull-mounted sonar (ASO713/723), variable depth sonars (ACT-AS), diver detection sonar (CERBERUS) and sonobuoy processing (SONIX) systems and the unifying sensor and weapon management system. More than 100 of the ASO 713/723 active and passive hull-mounted sonars have been sold over the past 30 years.

### Future Procurements

AMI's naval market forecast for the period 2017-2037 identifies almost 2000 new sonar procurements globally. As the tables below highlight, almost 500 new frigates and destroyers are projected to enter service with the world's navies over the same period. As noted above, most of the world's

Future Naval Platform Procurements		
2017-2037	Procurements	%
Corvette	117	10%
OPV	313	26%
Frigate	311	26%
Destroyer	133	11%
Submarine	315	26%
<b>Total</b>	<b>1189</b>	

Future Naval Sonar Procurements		
2017-2037	Procurements	%
Sonar Type		
Hull-Mounted	1124	61%
Towed Array	217	12%
Variable Depth	504	27%
<b>Total</b>	<b>1845</b>	

navies operate ASW sonars primarily on frigates and destroyers. This means that frigates and destroyers will continue to see multiple sonar installations (hull, variable depth and towed array) on the same hull.

The hull-mounted sonar remains the centre-piece of future surface ship sonars, making up over 60% of all projected new system procurements forecasted for the next two decades. Variable depth sonars, usually smaller and lighter than towed array systems, are therefore able to be fitted on a wider array of ships. This helps explain why

almost 30 percent of future sonar procurements are VDS. Towed arrays, being heavier and typically found on larger surface combatants, make up a little more than 10% of the future surface ship sonar market.

### Recent Sonar Awards of Note

In 2017, several key surface ship sonar contracts were awarded, in the US, Europe, and other regions. Of note, the decision on the VDS for the LCS class would appear to mark the end of a long

Photo: wikipedia



**Lockheed Martin's AN/SQQ-89V is the primary ASW system for the US Navy's surface combatants. Shown here are the consoles on board the ARLEIGH BURKE Class destroyer DDG 92 (USS MOMSEN).**

Photo: Raytheon



**The Variable Depth Sonar (VDS) from Raytheon is part of the LCS ASW Mission Package selected for both the FREEDOM and INDEPENDENCE Class vessels.**

competition to equip the programme's ASW Mission Package. Thales' CAP-TAS series continues to show strength in the world market, despite not being selected for LCS. Finally, an award to ATLAS ELEKTRONIK for a USV-based ASW sonar system highlights the next step in the technological development of ASW sonar options beyond the traditional surface combatant host platform.

**May 2017: The U.S. Navy awarded Raytheon a \$27.9 million contract to provide a new variable depth sonar solution for the Littoral Combat Ship.** The VDS is part of the LCS ASW Mission Package and the same system will be installed on both the FREEDOM variant (LCS-1) built by Lockheed Martin/Fincantieri Marinette Marine and the INDEPENDENCE variant (LCS-2) built by Austal USA. The contract followed full scale demonstrations of the Raytheon

systems and competing LCS ASW variable depth sonar solutions, notably the Advanced Acoustic Concepts (DRS/Thales) entry based on the Thales CAPTAS-4 VDS. The contract includes options for production which, if exercised, would bring the total contract value to more than US\$300M.

**April 2017: The French government awarded DCNS (now Naval Group) a contract to construct the FTI, which includes the Compact CAPTAS-4 sonar.** The first frigate is scheduled for delivery in 2023 and would enter service in 2025. At Euronaval in October 2016 Thales introduced a new Compact CAPTAS-4 aimed at the LCS and the French Navy's new Frégate de Taille Intermédiaire (FTI) programme. Thales states the Compact version reduces weight by 20 percent and shipboard space required by 50 percent.

**February 2017: At IDEX 2017 in Abu Dhabi ATLAS ELEKTRONIK UK (AEUK) announced (another) major export contract award for its ARCIMS Mission System, likely to a customer among the GCC countries.** This variant of the ATLAS ARCIMS, originally designed for MiW, is modified to perform ASW surveillance against submarines, mini-submarines and diver delivery vehicles. This is one of the first operational ASW sonar systems that deploys the sensor from an unmanned surface vehicle rather than a surface combatant. As such the system is optimised to operate from shore facilities or fixed locations afloat. The system uses the ATLAS family of variable depth active and passive sonars. ■

**Footnotes**

\* [https://www.eurekalert.org/pub\\_releases/2016-05/asoa-tfo051316.php](https://www.eurekalert.org/pub_releases/2016-05/asoa-tfo051316.php)

\*\* See the NATO Research Center Paper "Multistatic sonar: a road to a maritime network enabled capability" published in 2007 and available at [www.cmre.nato.int](http://www.cmre.nato.int)

## Sea proven passive sonar suite



\* No need for industry support; customer-owned and secret intellectual properties

### WÄRTSILÄ CONNECTS THE DOTS

Wärtsilä ELAC KaleidoScope is a sea proven passive sonar suite designed for conventional submarines. The OpenSonarSuite is a high performance and low risk solution. The signal and data processing functions make ELAC KaleidoScope the most modern system available on the market.

