Submarine Navigation
Cutting-edge Solutions for Integrated Navigation and Retrofit

- Integrated navigation
- Specialized product range
- Experienced consultancy and retrofit capabilities
- After sales service
Deep knowledge and experience for customized Submarine Navigation

Through the past decades Raytheon Anschütz has, in close cooperation with the shipyards, specified and developed a wide-ranging product line for submarine applications. These systems cover tailor-made solutions as well as serial products for stand-alone installation or submarine retrofit programs. Worldwide more than 50 navies rely on submarine navigation solutions from Raytheon Anschütz.

Each program is accompanied closely by a team of specialists, if needed including onboard surveys to identify project-specific requirements. Thanks to a long lasting experience and own user level operational expertise we have the intimate know-how in submarine system integration with regard to system construction, requirement engineering and standards applied.

Our submarine solutions cover 3-dimensional control and monitoring systems, oceanographic sensors, navigation and data management systems as well as navigation equipment, which are either adapted to the mechanical elements for platform control or are interfaced with respective electronic units in order to optimize operational tasks. Thereby, Raytheon Anschütz uses cutting-technology within an open architecture approach to reach highest levels of system integration and interoperability while being able to simplify logistics and realize savings during operation.

For all deliveries, a wide variety of services, such as Integrated Logistic Support (ILS) or in-service support (ISS), is offered to support all systems through their whole life cycle. All services are defined in close cooperation with the respective customer.

WHY SHOULD YOU DECIDE FOR RAYTHEON ANSCHÜTZ?
- Reliable project processing with years of experience in integration of customer-specific solutions
- Intimate know-how of submarine specific requirements
- Individual support from system layout through whole project stage

HOW DO WE TAILOR COTS TECHNOLOGY TO YOUR NEEDS?
- Realizing special needs through requirements engineering
- Flexible integration through modern network structures
- Full responsibility from early system outline to setting in operation

WHAT CAN YOU EXPECT FROM OUR SUPPLY?
- Well-proven reliability and accuracy in operation
- Harmonized system design with standard system framework
- Consistent user interfaces (customizable to customers needs)

DO YOU NEED SUPPORT BEYOND DELIVERY?
- Customer-orientated after sales management
- ILS and ISS proposals tailored to respective customers
- Optimized lifecycle costs and thru life support
Integrated Navigation enhances the submarine’s manoeuvring and operation capabilities by providing much more than the sum of the abilities of individual navigation components. The focus on functional integration and the application of open architecture standards enables highly customized solutions, ranging from small packages up to sophisticated installations.

Integrated Navigation from Raytheon Anschütz seamlessly integrates the various surface and subsurface sensors, control systems, submarine steering control as well as platform management functions into one single navigation solution. The integration of sensors and systems not only maximizes data availability and system functionality at any workplace, but increase operational safety through fully redundant system layouts and network structures. Being the core of an Integrated Navigation solution, the Raytheon Anschütz Navigation Data and Management Center (NDMC), together with the redundant Ethernet navigation network, assembles all the data from various sources, pre-processes them in real time as necessary and distributes them to various end users, e.g. the Raytheon Anschütz Navigation commander console, comprising electronic sea charts, radar overlays and tactical data.

Finally, a harmonized design of hardware controls and a consistent HMI of all display systems contribute to both, increased safety and simplicity in operation:

- Highest availability of data and navigation capabilities throughout the whole network
- Common operating philosophy (“look and feel”) and standard hardware controls simplifies operation
- Full redundancy in sensors, systems and the Ethernet navigation network leads to additional safety
- Increased efficiency in spare parts logistics through standardized components and customized logistic concepts
The idea of open architecture was first concisely formulated to move away from closed and proprietary platform infrastructure. This approach incorporates hardware as well as software design requirements and guidelines. Open architecture can reach higher levels of system integration and interoperability while at the same time being able to reduce costs though usage of industry standards and proven technology concepts.

The open architecture efforts at Raytheon Anschütz provided at first a common architectural approach for the steering systems for current projects, among them the German U212 submarines.

This includes hardware selection (e.g. industry standard cPCI CPU boards, industrial Ethernet components) as well as use of an in-house developed infrastructure software framework based entirely on a stack of Open Source solutions with wide spread in industrial applications.
Raytheon Anschütz offers several steering, navigation and 3-dimensional control systems for submarines, which are tailored to the specific needs of a program. Apart from the NDMC data management and the navigation commander console as a multifunctional workplace, at Raytheon Anschütz the expertise in submarine navigation also includes tailored 3D-steering control systems and wireless battery monitoring systems. Available sensors include the MINS inertial navigation platform, the proven Standard 22 gyro compass in a tailored version for submarines as well as a precise measurement system of sea water conductivity, temperature and pressure. The product range is completed by a tailored series of pressure-resistant displays and repeaters.
Navigation and data management center (NDMC)
Data management and distribution by Raytheon Anschütz is a customized approach tailored to specific applications and customer needs. The NDMC collects, monitors and processes all the data from various connected to the navigation network. The data distribution to end users features an integrated degradation management, which continuously monitors the availability and quality of sensor information. The most reliable set of data is distributed automatically to all connected workstations to ensure consistent and common information.

The data handling ranges from different navigational and other sensor data to decision aids for operational and tactical purposes. Typical interfaces to sensors and systems include surface and navigation sensors, navigation commander console, display and control units, external communication, automation and platform management as well as combat management system, sonar and weapon control.

The NDMC provides outstanding features:
• Multi-redundant hot-standby function for an intelligent management of redundancies
• Integrated navigation filter enhance accuracy and reliability of navigation data
• Common and consistent data thanks to Kalman filter algorithms (spatial and time correction, automatic plausibility and integrity checks)
• Extended Dead-Reckoning capability

Submarine steering control incl. 3D autopilot
Submarine steering control by Raytheon Anschütz takes a customized approach to ensure safe and complete submarine steering and diving control. The man-machine interface is laid out to the customer’s desires to adapt to specific user habits and conventions.

Submarine steering stands always are customized to the individual customer. Solutions are available in various configurations for 3-man, 2-man or 1-man operation. Common to all versions is the use of state-of-the-art technology including fully integrated 3D autopilot functions and user-friendly display and operating concepts. Depending on the configuration, a submarine 3D steering control can offer three modes of operation, namely automatic, manual/semi-automatic and a direct (open loop) mode.

Navigation commander console (Nav/cdr console)
The Nav/cdr console is a centralized information system especially designed for submarines. The highest level of integration is achieved, if the Anschütz data management system is linked with the Nav/cdr console.

In radar mode the Nav/cdr console enables radar control and display. The particular functions are determined by the radar itself. In ECDIS mode the functions available include complete IMO ECDIS functionality, route planning and monitoring, radar overlay, display of tactical targets (ARPA, system targets, mines), torpedo track display and further WECOIS capabilities. In addition to the main modes various functions such as sonar audio, limited periscope and optronic mast operation or video image display can be performed in connection with the weapon control and communication system.
Marine Inertial Navigation System (MINS 2)
For specialized use as a main or stand-by system in submarines, the Marine Inertial Navigation System is available for highly accurate inertial navigation at low lifecycle costs. It provides heading, roll and pitch angles/angular rates, linear velocity and acceleration, position, heave rate and status. MINS is based on proven, state-of-the-art strap down ring laser gyro technology. The system is equally suited for both new built and retrofit solutions, since the interface and connection unit (ICU) is free configurable.

Wireless Battery Monitoring System
The Battery Monitoring System SS2 is the central measuring and evaluation system for main batteries aboard submarines. It continuously and directly indicates the most important data on the condition of the batteries and consequently supplies decision aids for operational and tactical intents.

Featuring new wireless technology the SS2 system measures voltage, acid temperature and acid level of every battery cell and calculates all relevant data of the complete battery bank of the submarine such as battery power, discharged capacity and status of all battery cells. The wireless layout of the sensors reduces the cabling and mounting effort of units in the battery room for newbuilding and refit.

Hoistable Masts Electronic Unit
The Hoistable Masts Electronic Unit (HMEU) controls hoisting, retracting and positioning of masts consisting of one or more telescopic elements on board a submarine. The HMEU is designed for low noise and safe mast control with minimal load on the hydraulic system.

Rudder Position Transmitter
The Rudder Position Transmitter (RPT) senses the absolute value of the rudder angle. Up to three independent measuring devices can be integrated to the system.
The typical life span of a submarine runs up to 20 to 40 years. During this period most navies require at least one midlife modernization in order to keep up with changing operational requirements and technological developments.

A retrofit program always bears challenges with regard to individual requirements of ship type, mission, hull construction, ship system layout and interfacing. The size of the hull and the room available for installations as well as for transportation of equipment into the ship is given. Therefore, in order to minimize adaptation requirements, the physical dimensions of the retrofit equipment must meet these limitations. Dedicated customer consultancy, on-board surveys, requirement engineering and years of experience in submarine technology are the key elements, that make Raytheon Anschütz a reliable partner in the implementation of customized retrofit solutions.

In general, the Raytheon Anschütz submarine product line is well suited for retrofit purposes or can be adapted accordingly. If suitable, third party products will become an integral part of our solution, whereby we will accept full responsibility for these sub-supplier products.

Superior technical expertise and experience with retrofit programs is needed to cope with:

• On-board surveys to analyze existing systems and environment on board
• Adaptation of retrofit proposal to the physical and environmental requirements
• Construction and design of retrofit solutions in accordance with submarine-specific rules and regulations as well as environmental requirements
• Flexible interfacing to seamlessly integrate technology of different generations
• Planning of power consumption with regard to the existing energy balance
• Integration of new functional capabilities into existing consoles
• Adaptation of the retrofit solutions to the HMI of existing or replaced equipment
• Simplification and standardization of operator interfaces to reduce need for training
• Technical documentation about interfacing as well as about the new evolving system
• Introduction of new documentation methods, such as the production, distribution and use of technical manuals by pure electronic means

Our customized retrofit solutions help to maintain reliability in operation and excellence in mission performance due to our strength in integration of high-performance sensors, heading, positioning and further navigation data as well as 3D steering control systems.
Raytheon Anschütz offers a wide variety of services throughout the whole program, from early customer consulting and customized designs up to obsolescence management and world-wide maintenance during operation. For all solutions, a large worldwide service network is available for maintenance, repair and spare part logistics.

After sales management
Due to the long lifetime of a submarine, military designed components with long-term support do not keep up with the newest technology. To anticipate to the continuous need for obsolescence management Raytheon Anschütz offers long term based update und logistic services. This can include regular software updates for new integrated functionalities as well as customer specific updates. Customer-oriented handling of repairs and warranty processes complete the Raytheon Anschütz after sales management services.

Interactive Electronic Technical Documentation (IETD)
The amount and density of information as well as the required topicality and availability of technical documentation are good reasons to introduce an Interactive Electronic Technical Documentation (IETD) system. The Raytheon Anschütz IETD is based on modular design and allows retrieving technical information easily from the linked modules by use of hyperlinks and search terms.

In-service support (ISS)
Raytheon Anschütz offers ISS packages that support the respective customer with a low-risk, forward-looking support solution. Customized solutions cover performance-related payments to ensure highest availability at predictable costs for the entire period of performance. Further key factors are coverage of obsolescence and refreshing through technical updating, ensuring a suitable training level, and documentation.

Integrated Logistic Support (ILS)
Raytheon Anschütz looks back upon many years of experience in supporting its customers while always striving to utilize the latest tools in customizing logistics. An ILS proposal describes all relevant logistic support measures as a prerequisite for economical and effective operation of technical equipment.
Raytheon Anschütz supports its customers through the whole lifecycle of vessel and equipment – this starts with dedicated customer consultancy and program management until setting in operations, continues with customized logistics and worldwide service solutions, and ends up with tailored upgrade and retrofit suggestions.
We offer extensive know-how and personal support for naval system integration programmes. Experienced engineers guide you from programme outline and specification of systems through program realisation to setting in operation. The customer benefits from the synergies of having all the important processes of project engineering, development and production centralized at the Raytheon Anschütz headquarter. A close cooperation with the world’s leading shipyards mean high flexibility in order processing, engineering, testing and setting-in-operation.

Of course, integration of customer-specific requirements always remains possible. Therefore our requirement engineering analyses and understands customer needs, advises customers and transfers the final set of requirements into a suitable technical solution.

Proven Standards
All solutions developed, produced and engineered by Raytheon Anschütz are in compliance with a quality management system according to ISO 9001-2008 as well as in compliance with an environmental protection system according to ISO 14001-2004.

We consistently use an iterative process of improvement concerning processes, projects, program and products and maintain the certification of the CMMI® (Capability Maturity Model Integration) level 3. Where required, program can be processed according to further military standards.

* CMMI is registered in the U.S. Patent and Trademark Office by Carnegie Mellon University.
More than 200 service stations all around the world.