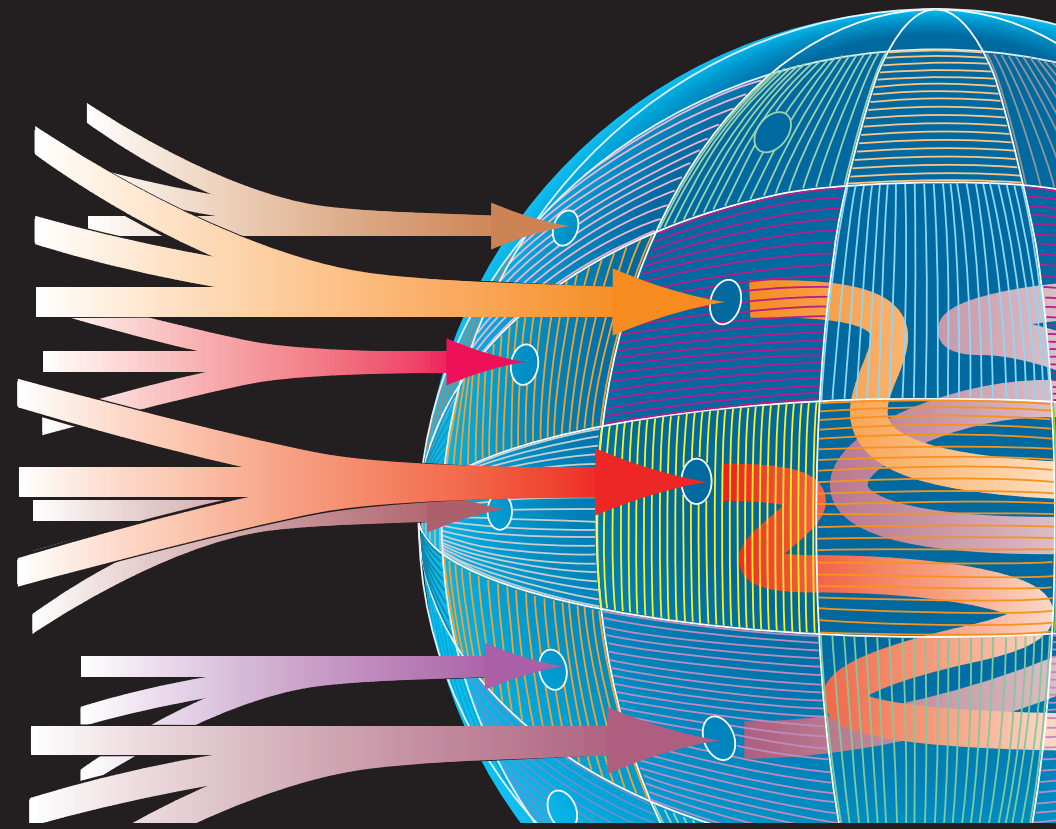
Space and Naval
Warfare Systems Center
San Diego, CA
92152–5001

SPAWAR
Systems Center
San Diego

Navigation Sensor System Interface



Integrated Navigation

Excellence in Navigation

On the modern battlefield where threats include ballistic missiles, cruise missiles, submarines, airframes, and minefields, battlegroup coordination and pinpoint accuracy are critical in maintaining the U.S. warfighting edge.

The Marine Navigation Division at the Space and Naval Warfare (SPAWAR) Systems Center, San Diego (SSC San Diego) makes systems that provide warfighters with the navigation data they need. We develop complete navigation suites, install them aboard ships, and support them through their operational life. We have a long history of successfully outfitting ships and submarines with navigation systems. For over 80 years, we have provided technical expertise to field state-of-the-art integrated navigation systems and ocean survey systems into the Fleet.

Navigation Sensor System Interface (NAVSSI)

NAVSSI provides highly accurate, robust, real-time navigation information to shipboard weapon systems and combat support systems. In addition, NAVSSI provides the ship's navigation team with a dedicated workstation to plan and monitor ship maneuvers on highly accurate Digital Nautical Charts.

NAVSSI Functions and Features

- Integrates multiple sources of navigation information including global positioning system (GPS) and inertial systems
- Maintains high accuracy, even in a heavily jammed environment
- Provides a single, commonly referenced, shipwide navigation solution
- Provides operational availability exceeding 99.9%
- Uses commercial-off-the-shelf (COTS) components to minimize system costs
- Designed to support the Navy's initiative to adopt paperless navigation
- Delivers more accurate and robust performance than that of GPS by itself
- Complies with Defense Information Infrastructure Common Operating Environment (DII COE)
- Meets the Global Command and Control System–Maritime (GCCS-M) standard
- Uses Joint-services-developed Command Display and Control–Inertial Navigation System (COMDAC-INS) software segment
- Uses National Imagery and Mapping Agency (NIMA) data products
- Meets the standards of the Software Engineering Institute Capability Maturity Model
- Provides optimum filtering of inertial, satellite, and Doppler sonar for best position

This all adds up to

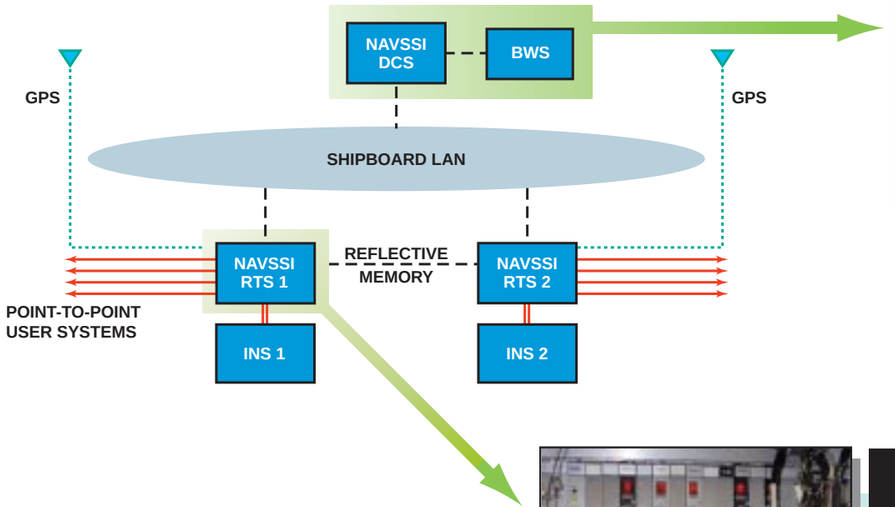
Navigation systems that work—accurately, effectively, reliably, and economically

Systems that are adaptable to new mission requirements as they evolve

Systems that perform their mission

NAVSSI Components

System Architecture



Display Control Subsystem (DCS)

The DCS is a dedicated workstation for the ship's navigation team that automates navigation and piloting functions traditionally performed manually. The DCS provides a real-time display where own-ship data are overlaid on a Digital Nautical Chart (DNC). Additionally, the DCS uses a Joint-Services-developed, Electronic Chart Display and Information System–Navy (ECDIS-N)-compliant interface to enhance capability.

Bridge Workstation (BWS)
The BWS is a remote workstation located on the bridge/pilot house. The BWS enables the ship's navigator or quartermaster to perform all of the functions of the DCS from the ship's bridge.

DCS and BWS interfaces

Real-Time Subsystem (RTS)

The RTS analyzes navigation sensor data from a variety of sources and integrates the data into an optimal solution. These data are distributed to shipboard user systems by using a combination of point-to-point connections and Local Area Network (LAN) connections. The RTS hosts other functions such as an embedded GPS VME Receiver Card (GVRC) and a monitor for the ship's inertial navigation systems. The dual-RTS configuration ensures continued system operation in the event of the failure of any component.

RTS Integration

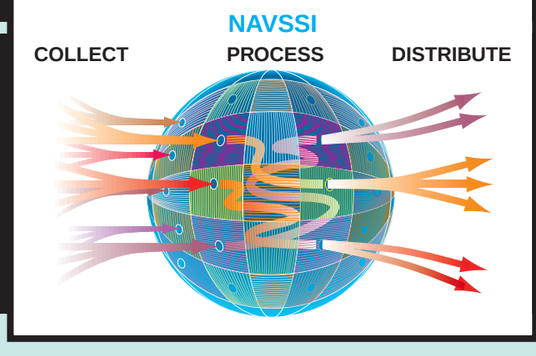
The integration philosophy of NAVSSI from its inception has been one of accommodation to every external system, whereby all interface changes required to support a user connection are provided by NAVSSI. Interfaces to external systems are customized depending on the needs of a specific platform and the connectivity to navigation and combat equipment suites available.

A Sampling of NAVSSI User Interfaces includes

- Tomahawk Engagement Planning and Exercise Evaluation (TEPEE)
- Advanced Tomahawk Weapons Control System (ATWCS)
- Mk-86 Gun Fire Control System (GFCS)
- Mk-160 GFCS and Extended Range Guided Munitions (ERGM)
- Tactical Mission Planning System (TAMPS)
- Advanced Combat Direction System (ACDS)
- Theater Ballistic Missile Defense (TBMD)
- Battle Force Tactical Trainer (BFTT)

INPUT
NAVSSI interfaces with the following Navy sensor systems:

- **GPS VME Receiver Card (GVRC)**
- **Aircraft Carrier Navigation System (CVNS)—AN/WSN-1**
- **Inertial Navigation System (INS)—AN/WSN-5**
- **Ring Laser Gyro Navigator (RLGN)—AN/WSN-7**
- **Doppler Sonar Velocity Log (DSVL)**
- **AN/UQN-4/4A Fathometer**
- **Electromagnetic Log (EM Log)**



OUTPUT
Information provided to systems:

- **Precise Time**
- **Position, Velocity, and Acceleration**
- **Roll, Pitch, and Heading**
- **GPS Receiver Initialization Data**
- **Course and Speed over Ground**
- **True and Relative Wind Speed and Direction**
- **Depth below Keel**

Production and Support Facilities

The NAVSSI production and support facilities provide a full range of life-cycle engineering support services for NAVSSI systems fielded in the Fleet including hardware and software problem identification and resolution, configuration management, logistics, installation, test and evaluation, and technical support.

Production System Laboratory

Contains in-house installations of shipboard systems, replete with navigation sensors identical to those found on U.S. Navy ships. Used for developing and improving equipment, algorithms, and techniques for navigation systems.

Display and Control Subsystem Development Laboratory

The DCS developers use this lab to enhance and troubleshoot the current subsystem. This area is also used to develop future builds.

Real-Time Subsystem Development Laboratory

The RTS developers use this lab to optimize the collection and distribution process of the navigation information.

NAVSSI's Technological Growth

The U.S. Navy is leaving behind the era of paper charts, and NAVSSI is leading the way. NAVSSI will provide an Electronic Chart Display and Information System–Navy (ECDIS-N)-compatible chart display on the bridge, thereby completely eliminating the need for paper charts.

NAVSSI's current initiatives include integrating surface radar inputs and video camera visual fixes into the DCS to help support the Navy-wide initiative to reduce shipboard manning. Due to its use of DoD-developed, common software applications (DII COE), it will be possible to display the NAVSSI Navy picture on any Information Technology for the 21st Century (IT-21) workstation onboard ships.

NAVSSI will serve charts from the National Imagery and Mapping Agency across the IT-21 LAN. Computer-Aided Dead-Reckoning Trace (CADRT), a new system in the Combat Information Center (CIC), will be able to use those capabilities to bring up NAVSSI in CIC. NAVSSI will support legacy systems and will continue to develop interfaces with new users.

Full Spectrum of Responsibility

SSC San Diego's navigation system engineers and scientists give our customers a continuing commitment of support throughout a system's life:

Systems Engineering Design

- Identify sponsor's requirements—mission goals
- Develop the system plan—the top-level system specification and diagram of sensors, processors, and system design
- Apply information-processing techniques—robust navigation source integration algorithms for optimal real-time navigation performance
- Develop the navigation distribution plan—solution to own-ship combat systems
- Select the system equipment suite—performance, seaworthiness, reliability, supportability, and cost
- Develop the integration plan—the hardware, installation fit, cabling, environmental services, and information flow
- Maintain laboratory facilities—operation and support of in-house equipment for mock-up integration, development, and testing

Sensor Integration Implementation

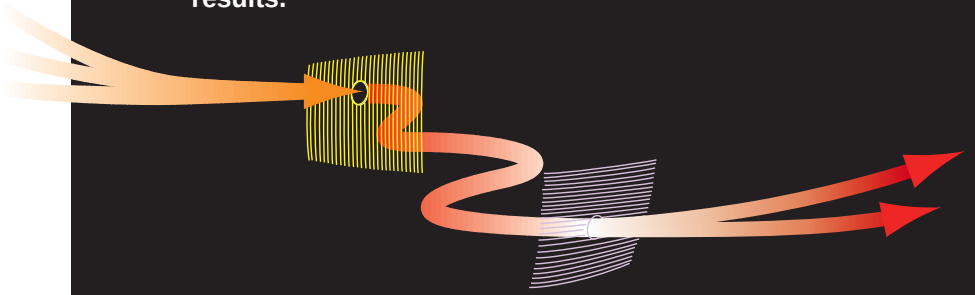
- Design and develop software—process and distribute navigation solutions to own-ship combat systems
- Incorporate charts and tools—provide digital nautical charts and mission planning tools for the navigator's use on dedicated workstations
- Meet software engineering goal—produce a product that meets the standards of the Software Engineering Institute Capability Maturity Model
- Employ operational monitoring and control—provide fully networked sensor and processing systems for user-friendly centralized control, processing, and information distribution.

Engineering Support

- Provide installation specifications—provide specification and drawings of equipment cabinets, foundations, cables, power, and other system needs
- Provide documentation and configuration control—produce system manuals and operating procedures and provide hardware and software configuration management and library resources
- Perform test and evaluation—develop test plans, conduct testing, evaluate, and report on results
- Provide system training—conduct in-house and shipboard classroom and hands-on training
- Provide logistic support—resolve problems over the life cycle of the system

AREAS OF EXPERTISE

- **Integrated Navigation: Provide network navigation sensors and other fleet systems for common and consistent real-time navigation data distribution.**
- **Algorithm Development: Develop optimum filtering of inertial, satellite, and Doppler sonar for best position and velocity.**
- **Software Design: Develop software that meets the standards of the Software Engineering Institute Capability Maturity Model.**
- **System Simulators: Produce computer-generated dynamic sensor data to simulate at-sea conditions for in-house development and shipboard testing.**
- **System Test: Develop test plans, conduct land-based and shipboard testing and evaluation, and report results.**



What Will NAVSSI Provide Your Ship?

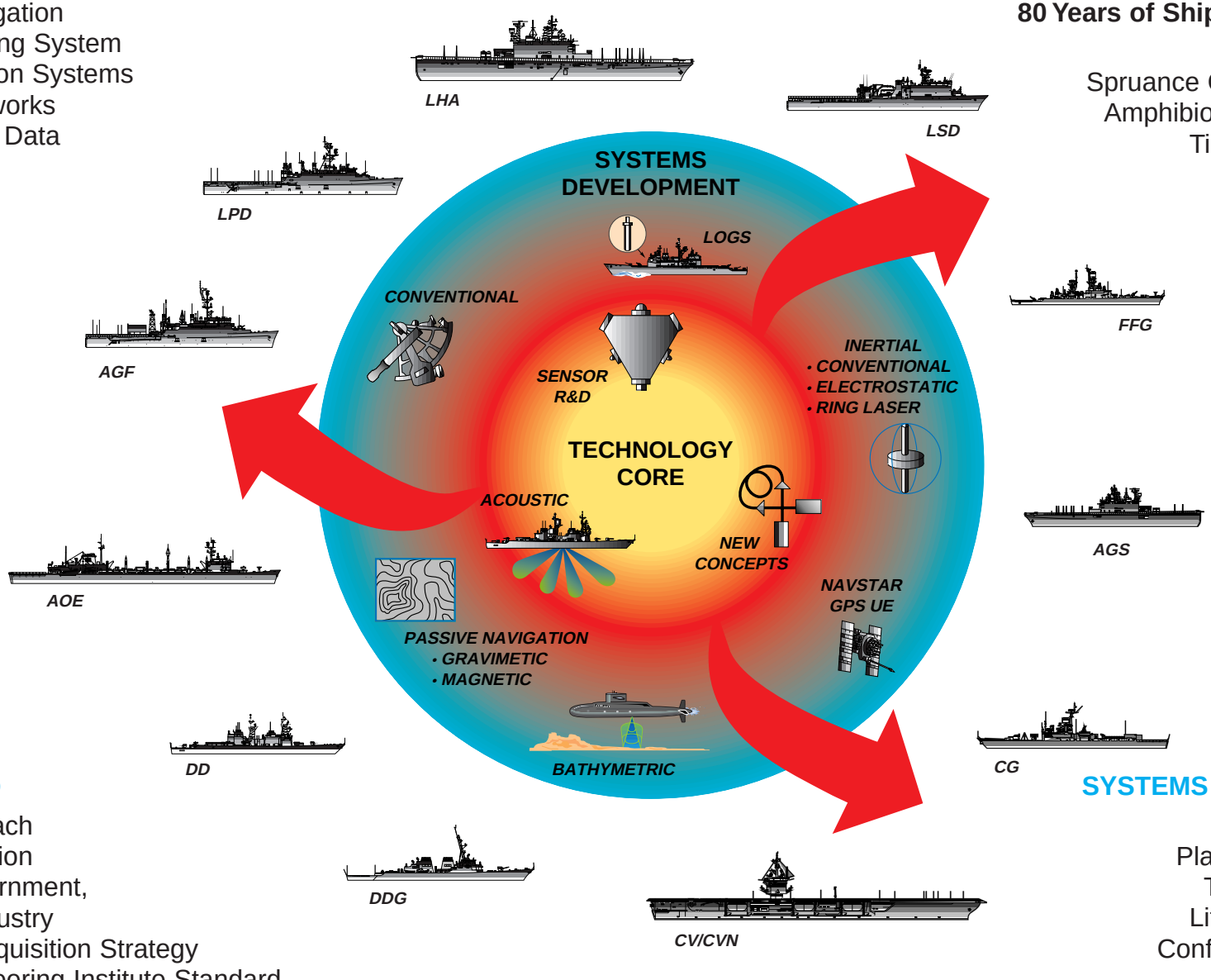
TECHNOLOGY EXPERTISE

Integrated Navigation
Global Positioning System
Inertial Navigation Systems
Local Area Networks
Information and Data Systems

EXPERIENCE

80 Years of Shipboard Systems

Aircraft Carriers
Spruance Class Destroyers
Amphibious Assault Ships
Ticonderoga Class Cruisers



VALUE ADDED

Systems Approach
System Integration
Synergy—Government, Academia, Industry
Evolutionary Acquisition Strategy
Software Engineering Institute Standard

SYSTEMS MANAGEMENT

System Design
Platform Integration
Turnkey Systems
Life-Cycle Support
Configuration Control

Further Information

For further information on the system integration services offered here, contact the Marine Navigation Division at SSC San Diego.

Reviewed and approved by
Executive Officer/
Base Operations Manager
SPAWAR Systems Center, San Diego

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