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Thales, your trusted partner
• Unrivalled experience of naval combat systems
• Vast expertise in systems integration
• Flexible open architecture approach
• Pedigree in international programmes
• Long-term industrial partnerships
• Transfer of technology opportunities
• Software development centres worldwide
• High value-added lifetime support

TACTICOS
COMBAT MANAGEMENT SYSTEM

CONTINUOUS IMPROVEMENT THROUGH CONSTANT INNOVATION

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The maritime battlespace of the 21st century presents a multitude of command challenges to the naval warfighter. Picture compilation in crowded littoral operating areas, force protection against irregular and asymmetric threats, coordination of joint and combined forces afloat and ashore, and the requirement to interoperate within wider international coalitions all demand a real-time command information infrastructure that is capable, resilient, adaptable and responsive to change.

Concurrently, maritime operations are being transformed by network-enabled information architectures that exploit wide bandwidth connectivity and high-speed communications. This in turn demands command and information management platforms that can exchange, fuse and synchronise multi-source tactical data into a clear and unambiguous tactical picture.

Embedded training, ranging from individual operator skill refresh to full mission rehearsal is another important user requirement as force generation imperatives drive the provision of high quality afloat training. There is also a growing recognition of the importance that architecture plays in life-cycle management, with the adoption of Commercial-Off-The-Shelf (COTS) products and open systems environments intrinsic to delivering a capability that is robust, sustainable, upgradeable and affordable through-life.

The Thales TACTICOS Combat Management System (CMS) captures these diverse user requirements, building on a continuous evolution in hardware, middleware, software and operational applications to deliver a fully distributed system architecture for tactical picture compilation, decision support, unit and force coordination, sensor and weapon assignment, information exchange, mission planning and embedded training.

By aligning proven systems engineering pedigree to a certified Open Architecture Computing Environment (OACE) Level 4 compliant open architecture, TACTICOS has been continuously developed to meet emerging operational needs, while at the same time leveraging the best and latest innovations in commercial information and communication technology. It also capitalises on leading edge human factors research to optimise both the operator interface and the command environment.

Now firmly established as the international market leader in surface ship command and battlespace management, TACTICOS offers a proven equipment integration record for low risk implementation, an extensive library of functionalities and an assured future growth path. Capitalising on over one million man hours of software development, its track record of success extends across 16 navies and over 135 platforms, and includes licensed software development and system customisation to meet specific user needs and business models.
PROVEN SALES RECORD

BANGLADESH
Banga Bandhu Class
FGHM (1x)

GERMANY
Sachsen Class
FGHM (3x)

GERMANY
Braunschweig Class
FSHM (5x)

GERMANY
Bremen Class
FFHM (9x)

GERMANY
Brandenburg Class
FGHM (4x)

GREECE
Eli Class (Mod)
FFHM (8x)

GREECE
Akdns Class (Mod)
PGGF (4x)

GREECE
Pyroplax Class Batch 2
PGC (4x)

GREECE
Rousen Class
PGGM (6x)

INDONESIA
Todak Class
PBO (4x)

INDONESIA
Sigma Class
FS (4x)

THE NETHERLANDS
Zeven Provincien Class
FGHM (Infra, 4x)

OMAN
Daher Class
FGSM (2x)

POLAND
Orkan Class (Mod)
FGSM (3x)

PORTUGAL
Domidante Joao Reis Class
FF (3x)

QATAR
Barzan Class
PGGF (4x)

SOUTH KOREA
Kwanggaeto The Great Class
DDGHM (3x)

SOUTH KOREA
KDX-II Class (FC)
DDGHM (3x)

SOUTH KOREA
Dokdo Class
LPD (1x)

THAILAND
T91 Class
CPC (3x)

TURKEY
Barbaros Class
FGHM (4x)

TURKEY
Dogan Class (Mod)
PGGF (4x)

TURKEY
Kılıç Class
PGGF (9x)

TURKEY
Yildiz Class
PGGF (2x)

SPAIN
PVL (4x)

SPAIN
POV (4x)

UNITED STATES OF AMERICA
GD LCS (1x)
JOMS in license by Northrop Grumman

OMAN
Qahir Class
FGSM (2x)

POLAND
Orkan Class (Mod)
FGSM (3x)

THE NETHERLANDS
Zeven Provincien Class
FGHM (Infra, 4x)
Above Water Systems business line of Thales designs, develops and integrates maritime combat system solutions to meet the demanding requirements of navies worldwide.

Our total capability in the maritime domain is underpinned by the skills, expertise and technology necessary to engineer sensor, weapon and command systems scaled to individual customer needs. These extend from basic surveillance and fire control capabilities through to the most complex net-enabled multi-warfare combat systems.

Thales understands that every customer is different, and so we offer total flexibility in our scope of supply, from full service turnkey solutions to stand-alone product sales. We offer comprehensive lifecycle support services, and have frequently demonstrated our ability to work with a diverse range of local industrial partners and systems houses to meet requirements for inward technology transfer and indigenous capability management through life.

Working in partnership with our customers and suppliers, Thales is able to offer holistic combat system solutions for the full spectrum of surface vessel applications. Over the last 40 years, we have managed and delivered over 30 programmes, encompassing more than 150 individual platforms.

By combining our proven expertise in combat system engineering with an extensive experience of programme management, we are able to take a full lead systems integrator role on behalf of our clients. Our scope of service embraces all phases of acquisition - from requirements capture, functional analysis and cost/capability trade-off through to subsystem selection, interface management, physical and functional integration, test and acceptance.

Thales has integrated weapons of US, Asian and European origin. Our capability has also been proven in major mid-life modernisation programmes, where we have overcome the constraints and complexities of legacy installations to innovatively introduce new sensors and command systems. This allows our customers to maximise their platform investment while still reaping the benefits of new, state-of-the-art functionality.
The TACTICOS CMS integrates all constituent parts of the combat system to deliver a fully optimised 'system of systems' capability that meets all essential requirements for:

- Picture compilation and track management
- Navigation
- Threat evaluation and resource allocation
- Coordination of tactical assets (including helicopters and watercraft)
- Tactical information exchange
- Mission planning and command support
- Onboard training and simulation
- CMS configuration management

In addition, TACTICOS can be adapted to meet the specific operational requirements of its host platform. These functional capabilities can encompass both warfighting tasks (such as anti-air warfare, anti-surface warfare, anti-submarine warfare, electronic warfare, mine warfare and aviation support) and Operations Other Than War (OOTW, for example, search and rescue, pollution control, logistics and law enforcement).

TACTICOS has been continuously evolved through its life, and has successfully integrated with a wide variety of guided weapons, naval guns, surveillance radars, tracking sensors, EW systems, sonars, soft-kill decoys, datalinks and communications. To date, over five million lines of application software have been coded for TACTICOS, enabling customers to select proven functional modules available off-the-shelf.

TACTICOS is architectured according to the principals of segmentation, model-driven engineering and component-based design, all underpinned by a robust realtime information backbone. It contains three principal functional segments:

- Command and Control, providing real-time situational awareness, multi-source sensor data fusion, sensor management, automated recognition and identification, threat evaluation/resource allocation, and tactical information exchange
- Combat Execution, providing automated threat prioritisation and engagement scheduling, and optimising ship weapon systems responses to maximise the probability of survival against multiple simultaneous threats
- Command Support, providing an environment for medium-to-long term mission planning and execution, force coordination, dissemination of the recognised maritime picture, formatted data handling, and access to intelligence repositories and databases

This approach corresponds to a three-tier net-centric model, represented by an awareness grid, an engagement grid and a planning grid, that ensures optimum information flow, seamless interoperability and robust multi-level security.
TACTICOS has been continuously evolved to embody a COTS-based open systems architecture certified to QACE Level 4, and a Data Distribution Standard (DDS) compliant to the Object Management Group (OMG) DDS standard. By partitioning the system into a hierarchical structure that isolates the application layer from changes in the underlying hardware, modifications and upgrades to system functionality or performance can be accomplished at one or more layers without altering the existing equipment, procedures, and protocols elsewhere.

This approach permits regular upgrades so as to enable additional functionality to be rapidly inserted to meet emerging threats. Also, through the wholesale adoption of vendor-independent COTS hardware and software, new lifecycle support and sparing schedules can be introduced that are matched to performance, reliability and product obsolescence.

What’s more, TACTICOS software has been developed to offer full functional redundancy. The system has no single point of failure because the proven OpenSplice DDS middleware manages system availability through the dynamically allocation of software modules across any available computing resource.

The use of an open system architecture, not linked to any bespoke hardware standards, provides our customers with a futureproofed and supplier neutral solution that simplifies lifecycle support, promotes adaptation, enables legacy integration, readily accepts technology insertion and avoids proprietary lock-in.

TACTICOS adheres to a Common Entity Model (CEM) as implemented by the OpenSplice-DDS middleware product. Fully accredited to the OMG’s DDS standard, OpenSplice DDS is an information broker architecture, built on unmodified COTS standards for networking, operating systems and hardware platforms, that provides a comprehensive set of distributed infrastructure services to support a guaranteed quality of service for reliability, latency and persistency.

As both an architecture and a supporting middleware, OpenSplice DDS delivers fault-tolerant, real-time performance by promoting autonomous software components that used a normalised interaction environment to share properly modelled and distributed system information. This ensures the right data at the right place at the right time.

A comprehensive set of infrastructure services ensures reliable, robust and real-time information exchanger, allowing application development to focus on business logic rather than infrastructure coding. In addition, the OpenSplice DDS architecture is characterised by maximum application component autonomy, translating into reduced complexity, true scalability, enhanced re-usability and simplified component integration.

Our OpenSplice-DDS implementation of the OMG-DDS standard is currently available for the following languages and platforms:

<table>
<thead>
<tr>
<th>Language</th>
<th>Platforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/C++</td>
<td>Sparc/Solaris</td>
</tr>
<tr>
<td>Java</td>
<td>Intel/Linux</td>
</tr>
<tr>
<td>Ada</td>
<td>PowerPC/VxWorks</td>
</tr>
</tbody>
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The OMG-DDS description and Application Program Interface specification are publicly available on the internet.
Effective decision making for command and control is dependent upon a clear and comprehensive understanding of the location and behaviour of objects within a dynamic and complex battlespace. This in turn drives the need for objective, timely and accurate detection, robust classification and unambiguous identification of entities within a volume of time and space to provide a full appreciation of the tactical picture and how it may change in the near future.

TACTICOS achieves Situational Awareness across the air, land, surface and subsurface environments by assimilating and associating multi-source information from both organic sensors and non-organic information feeds. By applying a range of automated fusion, identification and correlation techniques, the system is able to provide the command with a complete and up-to-date visualisation of the operational situation.

Key TACTICOS attributes contributing to situational awareness include:
- Picture Compilation, provides the Common Tactical Picture (CTP), which is an unambiguous representation of the tactical situation around the own ship and/or the force
- Recognition and Identification, using available sensor information (including kinematics, IFF responses and signatures) combined with empirical knowledge of expected and deviant behaviours
- Sensor management, providing automated and semi-automated optimisation of organic sensor performance settings and sensor cueing according to the current operational situation
- Geographical Situation Display, provides a geographical overview of the tactical situation, including maps in several map formats (for example S57 or Digital Terrain Elevation Data (DTED)) and monitor and control facilities for radar video and TV video display

The Sensor Services group within TACTICOS hosts modules related to the provision of continuous surveillance and recognition by shipborne sensors. There are three functional areas:
- Above Water Fusion provides measurement of real-world objects to situational awareness capabilities based on organic sensor data
- Sensor Control hosts functionality relating to the integration, monitoring and technical control of all integrated sensor subsystems (typically including radar, IFF, electro-optics, electronic warfare and sonar)
- Own Ship Data and Environment Data takes responsibility for the integration of own ship data (such as course and speed) and environmental data (for example, air temperature and barometric pressure)
The Operational Support group encompasses the control of air assets, and support for navigation functions. These are grouped as three segments:

- **Air Support** provides functionality for airspace control and aircraft control (including operator functions and automated support for airspace management, tactical air operations, and helicopter control and recovery)
- **Unmanned Vehicle Support (UxV)** enables remote control of Unmanned Aerial Vehicles (UAV), Unmanned Surface Vehicles (USV), and Unmanned Underwater Vehicles (UUV), primarily for intelligence, surveillance, and reconnaissance missions.
- **Navigation Support** supports the command team in navigation operations, encompassing both general navigation and safety at sea (such as navigation route handling and collision avoidance) and tactical navigation (for example, Closest Point of Approach calculations and stationing calculations).

The Assessment, Decision and Execution group incorporates functionality to assess the tactical situation, to decide which actions are to be prepared and subsequently take the appropriate actions, with respect to:

- **Threat evaluation**, (non-short term) decision-making for target engagements and subsequently target engagement planning, at both own ship and force level
- **Anti-Air Warfare (AAW)**
- **Anti-Surface Warfare (ASuW)**
- **Anti-Submarine Warfare (ASW)**
- **Electronic Warfare (EW)**
- **Land Attack Warfare (LAW)** provides support to combat shore targets with own ship effectors
- **Warfare Management** includes target engagement execution and additional engagement support facilities like kill assessment and splash spotting
- **Mine Warfare (MW)** provides support in mine laying operations in patterns or at random
- **Asymmetric Warfare** encompasses facilities to encounter threats that have markedly different military capabilities and uses non-standard tactics such as terrorism
- **Amphibious Operations (AMOP)** enable the Command team to conduct amphibious operations, for example dealing with fast insertion of a moderate sized landing force

**Operations Other Than War (OOTW)** focuses on maritime aspects like maritime safety, maritime law enforcement, national defence and humanitarian assistance.
Tactical information exchange via datalink provides important contributions to situational awareness, force level warfare and air control, and is acknowledged as a prerequisite for participation in current and future network-enabled operations. The full integration of the Multiple Tactical Data Link System (MTDLS) in TACTICOS provides the capability to manage NATO standard military data link processing for Link 11 (conforming to STANAG 5511), Link 16 (to STANAG 5516) and, in due course, Link 22 (growth potential to STANAG 5522).

The MTDLS enables the exchange of tactical information such as track data, engagement status, weapon system and platform status data, command messages and air control data. It also supports network track management processing such as link track number handling, reporting responsibility processing, correlation and de-correlation, and conflict detection and resolution.

A flexible and futureproof solution, MTDLS is able to incorporate various types of datalink and communications bearers. It supports data forwarding and Link 16 relaying, and optionally dual Link 11 operation and Link 16 network management. Growth potential exists for Link 22 and Link 16 Satellite Tactical Data Link.

For non-NATO navies, TACTICOS can also be integrated with Link Y Mk 2 or existing Link systems. Offering performance at least equivalent to Link 11, Link Y enables the reliable transfer of tactical data amongst participating units and pickets via an encrypted radio network.

Complex joint and/or coalition operations involving multiple assets and high volumes of information require the operational command to effect comprehensive mission preparation and operational planning.

Mission planning and control functionality available through TACTICOS offers a full range of command support tools. This includes the display of the Recognised Maritime Picture (RMP), automated facilities for the generation, presentation and execution of an operational plan for own ship and other units, message handling (using IRIS or equivalent), and access to a range of decision aids and operational databases.

Our command support environment is fully compatible and interoperable with government furnished RMP software such as the Maritime Command and Control Information System (MCCIS). Extensions to MCCIS, using additional software segments, include amphibious warfare, intelligence, mine warfare, logistics and NATO/national intranet.
**TRAINING AND SIMULATION**

Tactical training can be performed in any one of three modes:

- **Operational mode,** where the system is used with real sensors, weapons and real-world objects.
- **Central System Simulation mode,** where the system is fully operational with real sensors, weapons (with appropriate inhibitors) and real-world objects, as well as simulated objects.
- **Full System Simulation mode,** where (as part of) the system is used in a simulated environment with simulated sensors and weapons.

Based on the HLA standard, the training and simulation functionality within TACTICOS contains a large set of instructor applications enabling the creation, execution and monitoring of training exercises. Stimulators and simulators embedded at subsystem level allow suitably scaled scenarios to be created in a high-fidelity synthetic environment, accurately replicating the performance and behaviours associated with real-world assets and live operations. A 3D viewer is available to allow for the evaluation of training scenarios in a 3D environment.

TACTICOS can be configured so that even if part of the CMS is being used in training mode, the rest of the system can remain fully operational. Furthermore, the system can use an HLA gateway to allow federated or confederated training to be performed with other training partners across a wide area simulation network.

**Human Computer Interface**

Increasing flows of sensor and intelligence data, accompanied by a shift towards smaller command teams, demands the provision of an effective, efficient and intuitive operator interface. By matching the latest graphical user interface techniques to a wealth of ergonomic and human factors expertise, Thales has created a Human Computer Interface that is both operationally flexible and operator-friendly.

Our innovative CMS user interface concept is based on the definition and application of worksets, each of which is a functionally coherent set of system services providing the operator with all information, data and controls necessary to perform a dedicated operational task. The workset concept offers high flexibility for the customer and industry in defining, designing and maintaining the content and layout of screens of the operator consoles.

TACTICOS is used by a collective operator team that shares common systems and resources, with each operator allocated a number of operational tasks, responsibilities and authorisations. A Multifunction Operator Console (MOC), comprising a high resolution display and input devices (a pointing device, a keyboard and programmable display keys) provides the physical interface.

All available data is processed by TACTICOS, but only the relevant data and derived information that an operator needs to perform his operational task is required to be displayed.
Requirements for managing increased information flow, effective command chain management, enhanced interoperability and reduced manning are collectively driving the need for optimised Operations Room environments taking full account of operator ergonomics and command team cohesion.

Thales draws on long experience, deep expertise and a culture of innovation to help customers design, engineer, configure, test and commission Operations Room environments that are optimised against both mission and cost. Our extensive knowledge of human factors and collaborative working environments, taking into account verbal communications, fields of regard, and operator interactions, enables us to perform task analysis, evaluate and decompose the functional chains within the command team, and develop interaction concepts so as to optimise the Operations Room organisation.

Working in close cooperation with the end user, we harness the powerful visualisation capabilities afforded by computer-aided design toolsets and synthetic environments to model and assess alternative layout concepts. These facilities include real-time interactive layout design with embedded facilities for online evaluation in a 3D visual environment, and a state-of-the-art Virtual Reality Theatre in which the nascent operational environment is presented, modelled and designed in a high fidelity synthetic environment.

The complex nature of the modern maritime combat system demands an integrator with the experience and expertise to effectively manage all activities required to deliver an integrated sensor, weapon and command suite as part of a fully functional naval platform.

Thales excels in this field. Our proficiency in combat systems engineering, aligned to strong management disciplines, allows us to provide a total integrated weapon system solution that achieves the optimum balance between cost, risk and programme. We also understand the critical dependencies that exist between the combat system and the host ship platform and services, and therefore the need to minimise impacts on new construction or refit programmes.

An objective and rigorous systems engineering process is critical to achieving success. We work in close cooperation with end users, shipyards and prime contractors to decompose functional, physical, technical and logistical integration activities and so derive credible task-based schedules and delivery milestones. Intrinsic to this approach is a robust risk management process applied at all stages of the project lifecycle to control and retire programme risk.

Applying the wealth of our systems engineering expertise, allied to the most advanced development and simulation tools, Thales can offer a full spectrum of combat system integration services. These include concept analysis, feasibility and performance modelling, requirements capture, system design and manufacture, functional and physical integration, test and acceptance, training and post-design support.

Our knowledge and skills translate into added value for our customers. Furthermore, the inherent scalability of the TACTICOS open architecture enables us to provide solutions for all ship types, ranging from low intensity patrol craft right through to the most capable multi-warfare surface combatants.

Thales works in partnership with major shipbuilders and prime contractors to ensure delivery on time, at cost, and to specification. We are unfettered by corporate allegiance, and agnostic in our choice of partners. This is demonstrated by the successful relationships we have forged with shipbuilders and prime contractors in Germany, Greece, Indonesia, the Netherlands, South Korea, Spain, Thailand, Turkey, the United Kingdom and the United States.
In an increasingly globalised world, Thales recognises the value of a business model that is open, adaptable, and meets the sovereign industrial and security requirements of our customers.

TACTICOS demonstrates how these ideals can be put into practice. Through the adoption of a product line philosophy, and exploiting the resource available across the Global Asset Store, we can foster collaboration so as to promote efficient software re-use and maintenance. This may be delivered through domestic Thales subsidiaries, via joint ventures, or in partnership with local companies and/or government agencies. The Global Asset Store contains approximately 60 application software modules and about 30 infrastructure software modules.

By taking responsibility for software development and maintenance in-house, customers can configure and upgrade TACTICOS to meet their own unique requirements. This could include post-design adaptations to accommodate new peripherals, modified or new interfaces, or new functionalities matched to specific systems and operating doctrines.

Thales has extensive experience and expertise to fully support the establishment of local software development centres. This includes transfer of technology and training provision to enable the establishment and development of in-country knowledge.
THE NET-CENTRIC FACTORY

- Australia (Thales Australia)
- Canada (Thales Canada)
- France (Thales Underwater Systems)
- Germany (Atlas Elektronik, Computer Sciences Corporation (CSC), EADS, Thales Defence Deutschland, T-Systems, and the German Navy’s Erprobungszentrum/Ausbildungszentrum (EZ/AZ) centre)
- Greece (Signaal Hellas)
- Netherlands (Thales Nederland)
- Poland: (Marine Technology Center)
- Portugal (Edisoft)
- South Africa (ADS)
- South Korea (STC)
- Turkey (Yaltes, Turkish Navy Software Development Centre)
- United Kingdom (Thales Underwater Systems)
- United States (Thales North America, Northrop Grumman, Raytheon)