TACTICOS Combat Management System
Exploiting the Full DDS Potential
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DDS as an enabler for the success of the TACTICOS Combat Management System (CMS)

- Combat Management System
- TACTICOS CMS
- Architectural principles
- Role of the DDS
- Information centric approach
Decision making processes:

- Situation Awareness
- Recognition & Identification
- Threat Evaluation
- Weapon Deployment
Vast amounts of information
Thousands of tracks
High degree of automation
Automatic multi-sensor data fusion
Automatic threat evaluation
Automatic sensor + weapon pairing
Extensive Command Support
Easy to Operate
Easy to Maintain
Flexible in Missions, and Manning
On-board Training & Simulation
Total System Integration
Field proven architecture

- In service since 1993
- Used by 15 navies world wide
- 22 Ships classes from patrol boats to destroyers
TACTICOS Architecture Concepts

Fault-tolerant: High combat survivability & maintainability (no single-point-of-failure)
Flexible: Mission-based configuration, on-board training & simulation
Evolvable: Evolutionary upgrading based on COTS & Open Standards
Scalable: From patrol-boats up to destroyers

Applications dynamically distributed over a “Pool of Computers”
- Distributed Processing
- Distributed Sensor & Weapon Interfaces
- Distributed Sensor – Weapon Deployment
Fully Distributed Processing

- No single point of failure
- N-fold redundancy
- High combat survivability

Software freely distributed over a pool of N x Multifunction Operator Consoles

SENSORS

REDUNDANT VIDEO NETWORK

EFFECTORS

REDUNDANT DATA NETWORK
3 Tier Architecture

Sensors & Actuators
- RT

Business Logic
- nRT
  - Dependability
  - High availability
  - Correlation
  - Fusion
  - Hypothesis testing

User Interface
- Platform independence

Data

Information

DDS Information Backbone

THALES NEDERLAND B.V.
Data-traffic: 4,000 publications per second over the system-data bus
Programs: 2,200 programs allocated over 150 processors
Accuracy: 100 us. time-alignment accuracy within the distributed system
Metrics: Code & Re-usability

- Product-line approach: total 6 Mln. LOC’s
- HCI = C (X/Motif) → Java, Ada → Java
- generic-parts re-use: 95%
- backwards-compatibility: 99%

- Generic high-level services
- 1 Major release/yr, 3 patch-releases/yr
- No project/customer-specific releases

- Splice-1 → SpliceDDS → OpenSplice

- Applications are unaware of OS & HW
- Major technology upgrades: every 2 yr
  - ‘94: SparcEngine 1E (SPARC)
  - ‘96: CPU2CE (microSparc-I)
  - ‘98: CPU5V (microSparc-II)
  - ‘00: Workstations (UltraSparc) & PPC (IO)
  - ‘02: Sparc/Solaris, PPC/vxWorks
  - ‘04: PC/Linux

THALES NEDERLAND B.V.
Role of the DDS

- Focus is on information
  - That’s the stable factor

- Provides scalability
  - Through publish - subscribe

- Provides a database view with fast and efficient access to the data
  - Track database with keyed data types, queries & filters

- Provides tuneable data transport & data storage services
  - Latencies, reliability, durability

- Provides logical partitioning of Publishers and Subscribers
  - Training & simulation

- Enables replication of system state and application state
  - Fault tolerance & Dynamic application management
### DDS QoS Policy Usage

<table>
<thead>
<tr>
<th>DDS QoS Policy</th>
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<tbody>
<tr>
<td>DURABILITY</td>
<td>USER DATA</td>
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<tr>
<td>HISTORY</td>
<td>TOPIC DATA</td>
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<tr>
<td>READER DATA LIFECYCLE</td>
<td>GROUP DATA</td>
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<tr>
<td>WRITER DATA LIFECYCLE</td>
<td>PARTITION</td>
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<td>LIFESPAN</td>
<td>PRESENTATION</td>
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<tr>
<td>ENTITY FACTOR</td>
<td>DESTINATION ORDER</td>
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<td>RESOURCE LIMITS</td>
<td>OWNERSHIP</td>
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<tr>
<td>RELIABILITY</td>
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<tr>
<td>TIME BASED FILTER</td>
<td>LIVELINESS</td>
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<td>DEADLINE</td>
<td>LATENCY BUDGET</td>
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<tr>
<td>CONTENT FILTERS</td>
<td>TRANSPORT PRIORITY</td>
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<tr>
<td>DDS QoS Policy</td>
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<td>TRANSPORT PRIORITY</td>
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<tr>
<td>NOT USED (DEFAULT VALUE)</td>
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</tr>
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Dynamic Resource Management

- What – When – Where
  - Role dependant
  - Resource needs versus available resources
- Fault detection & Recovery
  - Functional degradation
- Software replication management
  - State replication & alignment
Autonomous components
Interacting only with the information-bus
Spontaneous: Z, Self-healing: D'
Redundant & Replicated: L', Y'
QOS-driven Data Distribution Service (reliability, persistency, latency): DDS
Design Authority
Joint Program Team

Joint Government & Industry team

Common Entity Model

Standards based
ATP1, STANAG, ADaTP3

EADS

Thales

Raytheon

DDS Information Backbone

A B C D E F G H I J K L
### Openness: integration-capability

<table>
<thead>
<tr>
<th>SURVEILLANCE</th>
<th>LINK</th>
<th>TRACKERS</th>
<th>MISSILES</th>
<th>GUNS</th>
<th>ECM</th>
</tr>
</thead>
<tbody>
<tr>
<td>APAR, SMART-L</td>
<td>LINK 10</td>
<td>APAR</td>
<td>SSM</td>
<td>Guns</td>
<td>Active</td>
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<tr>
<td>SMART-S, MW08, DA08 VARIANT</td>
<td>LINK 11</td>
<td>STIR</td>
<td>HARPOON</td>
<td>127mm</td>
<td>EW APECS II</td>
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<tr>
<td>MRR</td>
<td>LINK 14</td>
<td>STING-EO</td>
<td>Exocet</td>
<td>115mm</td>
<td>ECM SALAMANDRE</td>
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<tr>
<td>SCOUT</td>
<td>LINK 16</td>
<td>LIROD Mk2</td>
<td>OTOMAT</td>
<td>100mm</td>
<td>RDF MAIGRET</td>
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<tr>
<td>IRSCAN</td>
<td>LINK 22 (study)</td>
<td>LIOD</td>
<td>PENGUIN</td>
<td>76mm</td>
<td>ECM (various)</td>
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<tr>
<td>ESM DR3000 SKW, SLC</td>
<td>LINK Y</td>
<td>MIRADOR</td>
<td>GABRIEL</td>
<td>57mm</td>
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<tr>
<td>KH 1007 NAV RAD</td>
<td>LINK Y Mk2</td>
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<td>Polyphem</td>
<td>40mm</td>
<td>Passive</td>
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<tr>
<td>SPS 64 NAV RAD</td>
<td>VESTA</td>
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<td>NSM (study)</td>
<td>30mm</td>
<td>DAGAIE</td>
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<tr>
<td>RACAL NAV RAD</td>
<td>INT/EXT comm</td>
<td></td>
<td>RBS15 Mk3</td>
<td>25mm</td>
<td>SAGAIE</td>
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<tr>
<td>BridgeMaster E</td>
<td></td>
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<td>SAM</td>
<td>27mm</td>
<td>SRBOC/ALEX</td>
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<tr>
<td>Various other NAV RAD</td>
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<td>RAM</td>
<td></td>
<td>MASS</td>
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<tr>
<td>AWS 4, AWS 5, AWS 6 Dolphin</td>
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<td>Crotale</td>
<td></td>
<td>SUPER BARRICADE</td>
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<tr>
<td>AWS 9</td>
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<td>BARAK</td>
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<td>SPS 49</td>
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<td>SEAWOLF</td>
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<td>Sea Giraffe AMB</td>
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<td>SADRAL</td>
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<td>TRS 3D</td>
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<td>VT1</td>
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<td>IFF MKX/XII (various)</td>
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<td>SM1 and SM2</td>
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<tr>
<td>ESM SUSIE, APECS II</td>
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<td>NSSM</td>
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<tr>
<td>ESM CUTLASS, ALTESSE</td>
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<td>ESSM</td>
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<td>INT/EXT COMMS (various)</td>
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Integrated subsystems (own & 3rd party)
Conclusions (1)

- The DDS provides the necessary non-functional properties for the TACTICOS CMS
  - Fault tolerance, scalability, low latency

- Use of the DDS allows for dynamic resource management
  - State replication

- The information centric approach allows for autonomous components, autonomous development and ease of integration
Conclusions (2)

DDS is Sailing the Seven Seas
Thanks for Your Attention