Applying CORBA in a Contemporary Embedded Military Combat System
(A Submarine Combat System Perspective)

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The US Navy has **fully and openly embraced** CORBA. CORBA has been endorsed throughout the entire US Navy Submarine fleet. This infusion of CORBA is not limited to **future system upgrades**, but also includes several **potential backfit platforms**.

CORBA has been designated as the **technology of choice for integrating** the many subsystems onboard the submarine platform. CORBA is being employed on virtually all the **inter-subsystem interfaces** on the New Attack (Virginia) Class Submarine.

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<td>- Virginia Combat Control Sell-Off</td>
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Non-Propulsion Electronic Subsystem Interfaces

All Subsystems Are Physically Connected to the Architecture ATM LAN. Logical Connections (Established at IPL) Provide Data Pathways Among Subsystems.
CORBA Data Organization

• Data shared between systems was organized into CORBA and Non-CORBA Groups

• CORBA data was grouped by like objects
  – Orientation is shared data v.s. supplier-consumer view
  – Most involved subsystem assigned as lead to define interface
  – Interface designed as superset of all user needs
  – Modules logically organized within an interface

• Interfaces employ Push/Push event channel
  – Supports shared data view with multiple suppliers and consumers
  – Naval Undersea Warfare Center OMG CORBA compliant implementation event channel developed due to lack of COTS

• Redundant CORBA Name Servers custom designed and implemented for availability
  – Name Servers monitor each other as hot spares
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CC Middleware Was Influenced by Many Factors

- Virginia CC development was based on extensive reuse
- Weapon Interfaces Have Unique Demands
  - real-time constraints
  - resource limitations and resource requirements
- Existing In-house middleware for distributed systems (Realtime Distributed Environment for POSIX (RADEX))
- Compatibility with other SoS subsystems, particularly Architecture subsystem
- DII COE Components
- Maturity level of CORBA products and standards when the system architecture was established
- Benefits of CORBA in a heterogeneous distributed environment (anticipating ever-present interface issues)
Naval and Maritime Integrated Systems

Infrastructure Profile

X Windows, CDE, Application remote launch, DII-COE

RADEX Registration & Control Flow, DII-COE, Network Node Manager

CORBA Data Servers, RADEX Data Tables, RADEX Messaging, DII-COE Data Services

HP-UX, SNMP, NTP, DII-COE, TCP/IP, UDP, LANE

HP Processors, FORE ATM, Q-70 Consoles, VME, FWD SCSI
Virginia FCS Software Profile

- CORBA External Interfaces
- RADEX Internal Data Services & Run-time Management

“Real organizations have to use multiple middlewares,” Andrew Watson
Lessons Learned

• ORB Selection
• Common to all embedded COTS . . .
  – Plan vendor support, monitor vendor directions, plan version migrations
  – Not all ORBs or ORB vendors are equal
  – Not all ORBs are equally inter-operable
• Due diligence required in crafting IDL
  – Per object methods (accessor functions)
  – Aggregate (batch) methods for performance efficiency
• CORBA Services, especially Event and Naming Service, are critical to the systems we build
  – Events act primarily as notifications to minimize throughput
• Size of executables are a concern
Lessons Learned (cont.)

• Develop robust interface early with initialization, error recovery leading application integration
• Create auxiliary functions once and share across classes
• Learning Curve - Training and Mentoring needs
Goal System Model for Combat System

- Common Shared Data Exchange Mechanisms
- Common Coordinated Run-Time Environment
- Common But Architecturally Isolated Tactical Control and Weapon Control Functions

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Next Steps

- Mk 2 Combat Control System Open System Enhancement
  ECP 004 takes the next evolutionary step
  - Migrating to more current ORB, selected within constraints of system of systems
- Long term goal is to move to common middleware for CC internal and external communications
- RT-CORBA
  - Real-time performance
  - QoS guarantees
- Fault Tolerance
  - Common COTS based solution/ dynamic reconfiguration
  - Avoid re-implementing unique system solutions
  - Investigating use of FT-CORBA
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