The Role of Middleware in Distributed, Real-Time, Embedded (DRE) Systems for Network Centric Combat Control - (A Naval Combat Systems Perspective)

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Outline

- Platform: Sensor-to-Shooter - 1st step toward NCCS
- Problem Statement
- Current State - Fielded System
- Complicating the Situation
- Proposed Future State
- Dynamic RT Middleware
- Contact Information
- Conclusions
- Contact Information
Platform: Sensor-to-Shooter
1st step toward NCCS

Ownship Navigation Data

Navigation

Background Weapon Control

Missile Alignment Data

Hard Deadline for Missile Alignment Demands QoS...
Problem Statement

- Assure navigation data reaches missile gyro, consistently:
  - Within periodicity constraints
  - With a maximum defined latency
  - Within accuracy requirements

- Verify under load condition

- Monitor that performance is maintained through system evolution
  - Application Software
  - COTS Software
  - Configuration Changes
Current State - Fielded System

- Multiple Middleware products employed in current fielded system
- Extensive integration of multiple middleware products required
- Tuning of Sensor-To-Shooter Thread required to meet hard deadlines for missile alignment
Complicating the Situation

Multiple Middleware(s) Employed across the submarine platform!

Middleware Layer

CM - Contact Management
DF - Data Fusion
TS - Tactical Scene
WEA - Weapons Employment
WOG - Weapons Orders

SPP - Sensor Performance
PEA - Platform Employment
VA - Vulnerability Assessment
TP - Tactical Planning
• Migration for Technology Refresh funded/led by broader industry
• Dials and settings replace wizards and horseshoes
• Ideally, QoS maintained through dynamic configuration changes
• Standard applications drive more standard implementation and consistent availability
Dynamic RT Middleware

- RT QoS Server Object
- RT QoS Server Object
- RT QoS Server Object

System Designer

Offline RT Analysis and Prototyping

QoS Dynamic Binding (RT Trader Service)

RT Sched Service

RT Operating System

Real-Time ORB

Client
Clients have QoS requirements (e.g. deadline, importance, period)

Severs have QoS capabilities (e.g. execution time of methods, expected accuracy of results)

Middleware has dynamic scheduling service that assigns dynamic (changeable) global priorities that are to be enforced throughout the distributed system.
Clients have QoS parameters (deadline, importance) and need specific services at QoS levels from one of a possibly many servers that can provide the services.

Servers provide services at varying QoS levels (accuracy of service, execution time)

Middleware binds a client to a server to best support system-wide QoS criteria

Binding may be:

- Per request (current implementation and pattern)
- Binding (previous implementation)
- Dynamically reconfigured binding (current new work, needs augmented pattern)
Conclusions

- Current DRE Systems are too “stove-piped”
- COTS is essential to DRE R&D Success and R&D may be essential to COTS DRE Success
- R&D required to achieve vision of NCCS
- Dynamic RT Middleware offers promise in providing needed QoS
  - Global Dynamic Scheduling
  - Real-Time Binding
Lou DiPalma received his Bachelor of Science degree in Computer Engineering, from the University of Bridgeport, graduating Cum Laude in 1983. Additionally, he received his Master of Science degree in Computer Science from Brown University in 1989. Lou has been at Raytheon N&MIS, Portsmouth, RI since 1983 involved in the development of Submarine Combat Systems.

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