



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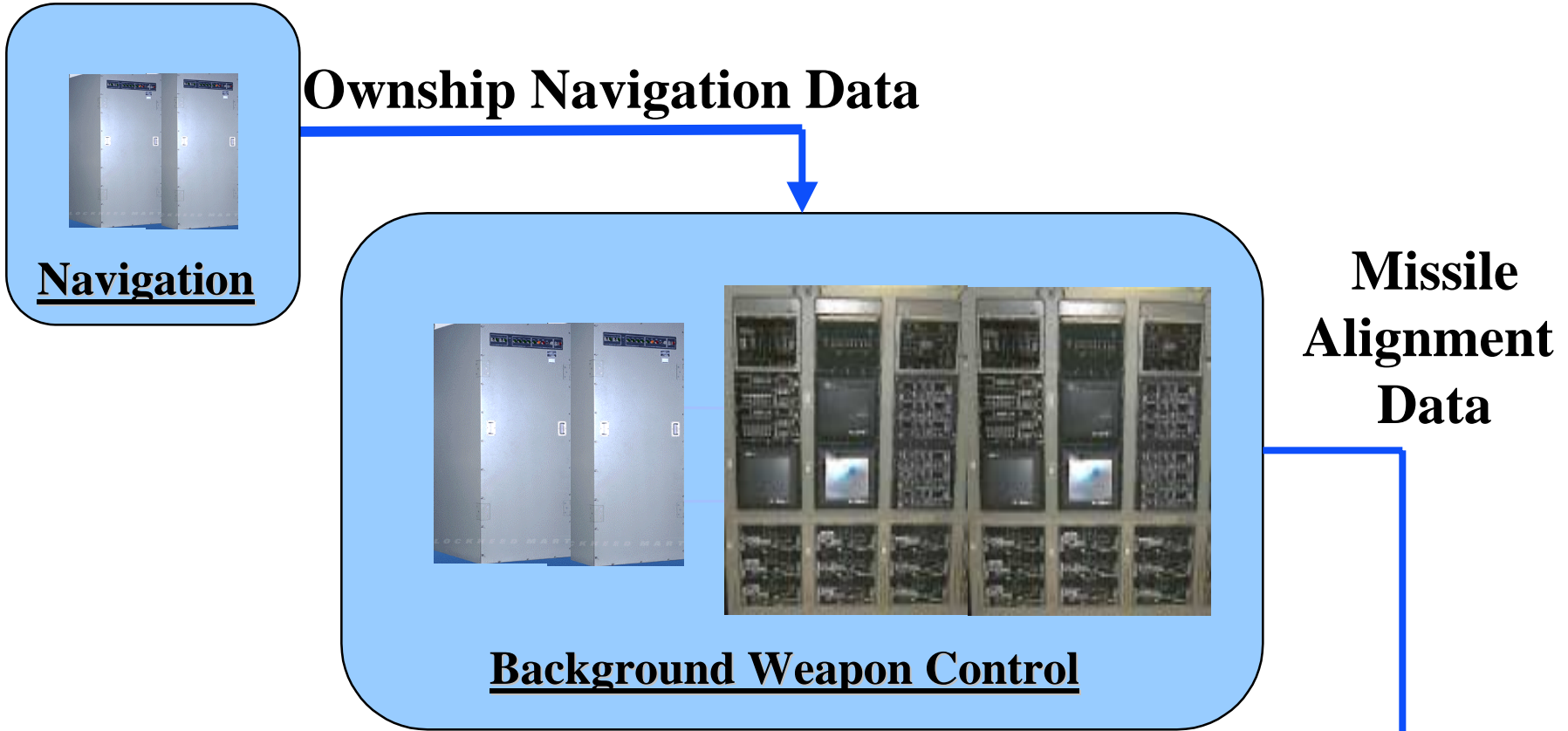
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- **Platform: Sensor-to-Shooter - 1st step toward NCCS**
- **Problem Statement**
- **Current State - Fielded System**
- **Complicating the Situation**
- **Proposed Future State**
- **Dynamic RT Middleware**
- **Contact Information**
- **Conclusions**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



Platform: Sensor-to-Shooter 1st step toward NCCS

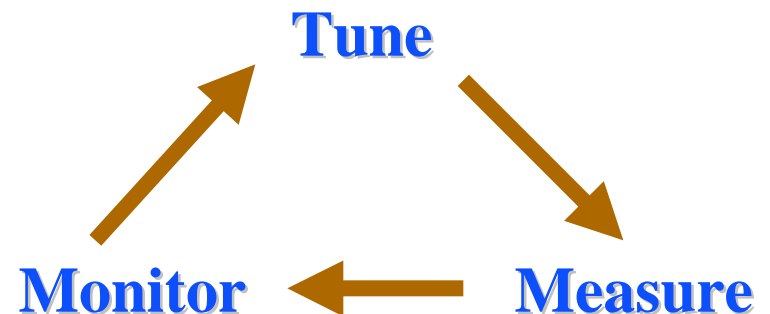


Hard Deadline for Missile Alignment Demands QoS...



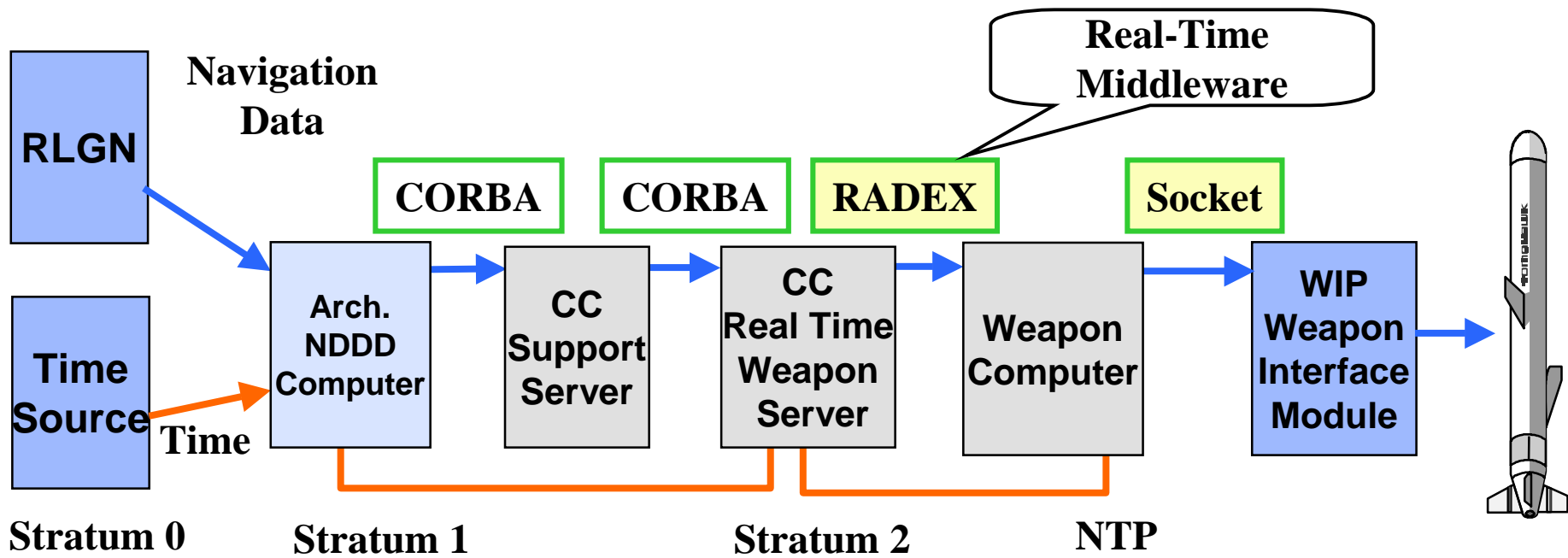


- **Assure navigation data reaches missile gyro, consistently:**
 - Within periodicity constraints
 - With a maximum defined latency
 - Within accuracy requirements
- **Verify under load condition**
- **Monitor that performance is maintained through system evolution**
 - Application Software
 - COTS Software
 - Configuration Changes





Current State - Fielded System

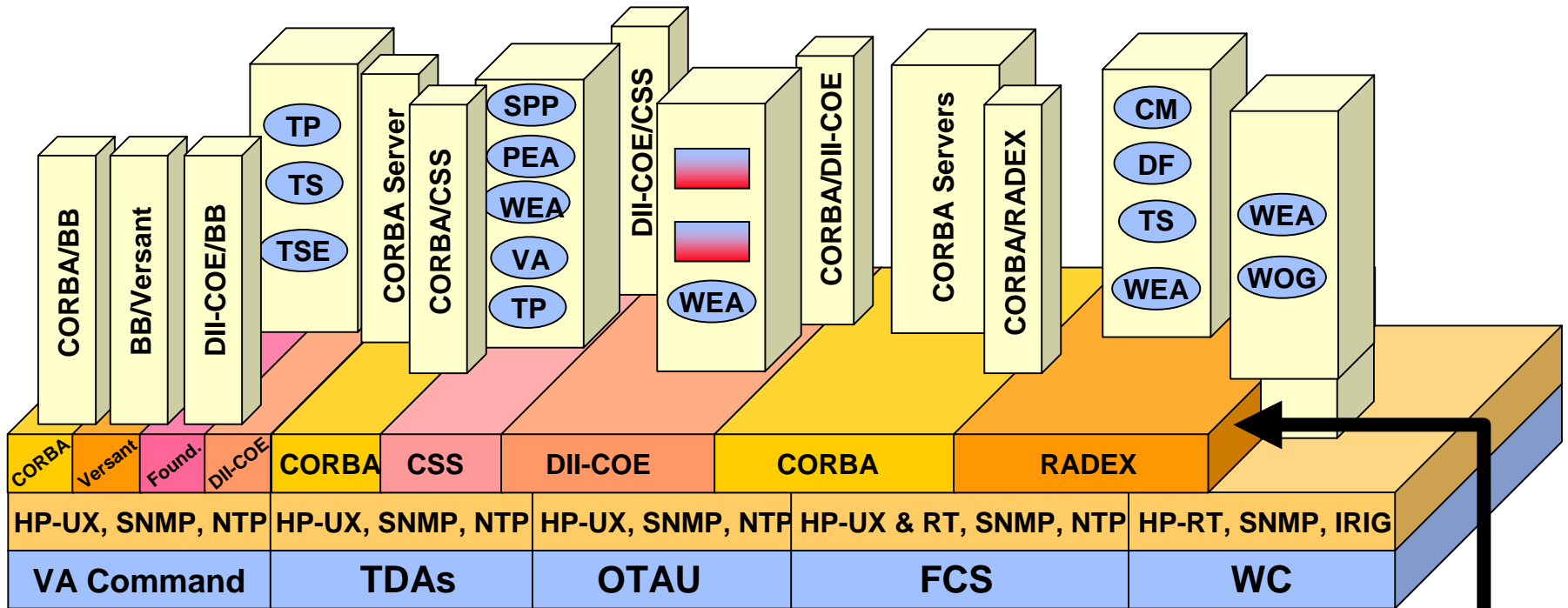


- **Multiple Middleware products employed in current fielded system**
- **Extensive integration of multiple middleware products required**
- **Tuning of Sensor-To-Shooter Thread required to meet hard deadlines for missile alignment**



Complicating the Situation

Multiple Middleware(s) Employed across the submarine platform!



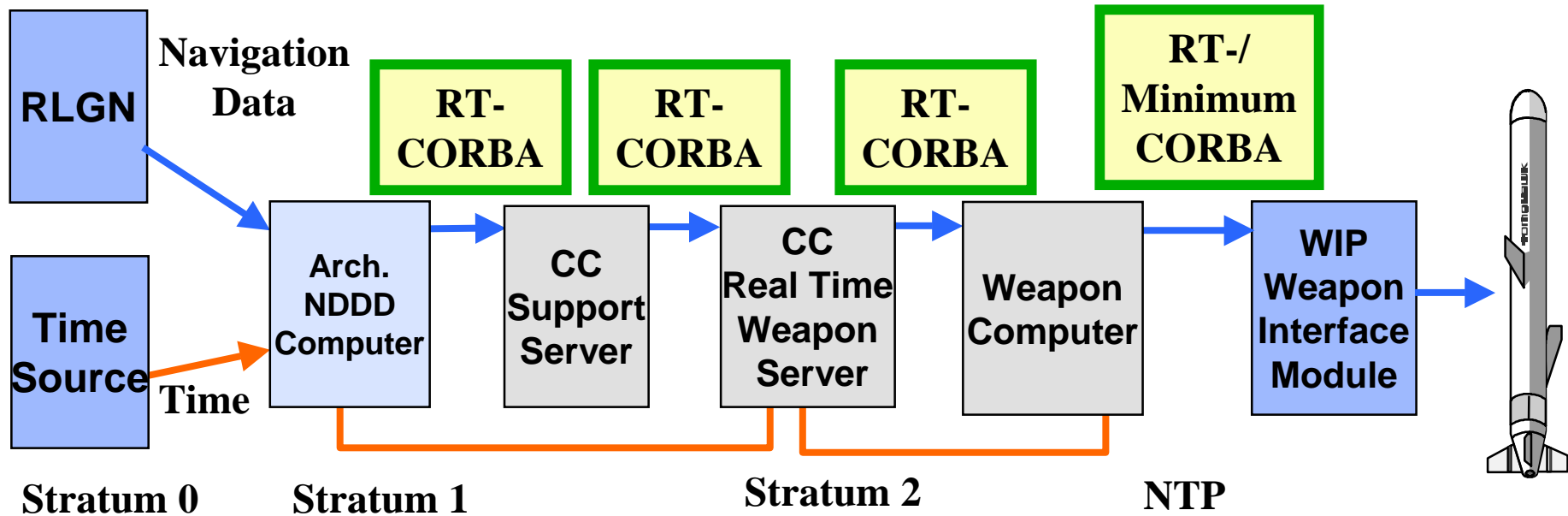
CM - Contact Management
 DF - Data Fusion
 TS - Tactical Scene
 WEA - Weapons Employment
 WOG - Weapons Orders

SPP - Sensor Performance
 PEA - Platform Employment
 VA - Vulnerability Assessment
 TP - Tactical Planning

Middleware Layer



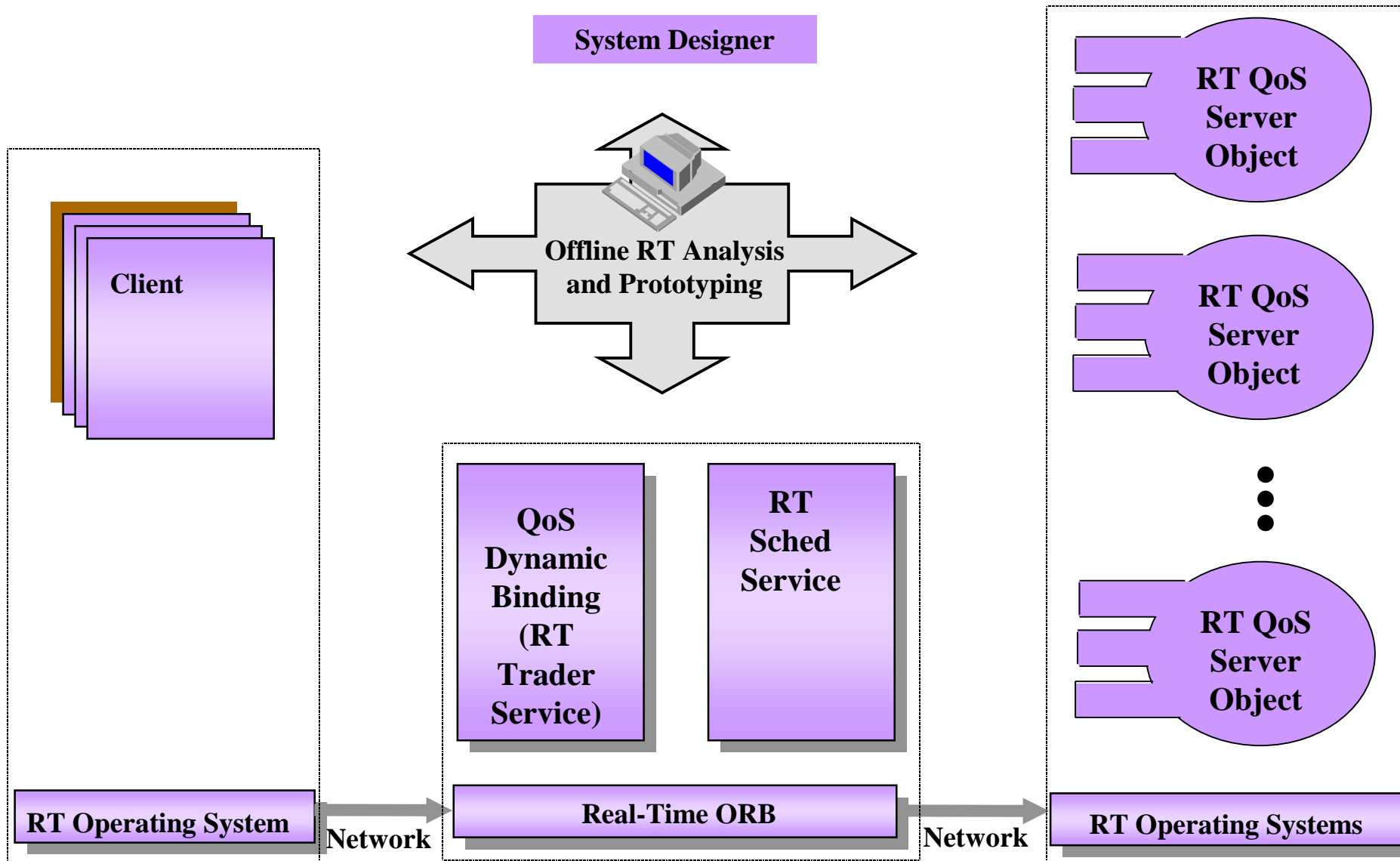
Proposed Future State



- 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





- **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)**



- **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**



Contact Information



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.

Lou is currently Manager of the Submarines & Sensors Software Design and Development Engineering Department and has an interest in the infusion of new technology into the Submarine & Sensors Programs Product Line.

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