Survivability Input to Resilient Packet Ring Study Group

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Introduction

- **NSWC Dahlgren Division Mission**: U.S. Navy's principal research, development, and test & evaluation activity for
  - surface ship combat systems,
  - ordnance,
  - mines and mine countermeasures,
  - strategic systems,
  - amphibious warfare, and
  - special warfare systems
- **Information Transfer Technology Group Mission**: Provide technical leadership to the surface Navy community for shipboard networking technology for application in current and future baselines
  - Focus on technology issues critical to the real-time environment of the tactical Navy

Background

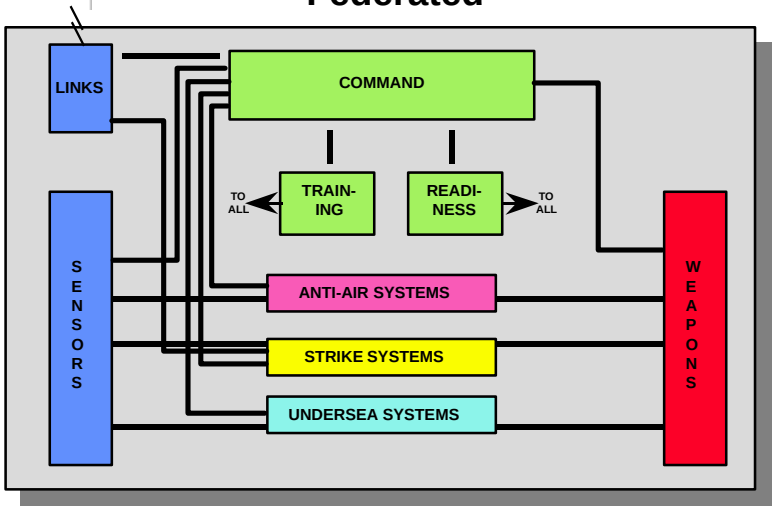
- The shipboard environment has many of the same communications requirements that face commercial organizations
  - Support for voice, data, video and imaging, etc…
  - Security
  - Quality of Service (e.g., bandwidth, latency)
- Historically, each shipboard system would address its communications requirements in its own way, typically with built-to-spec systems and point-to-point links
  - Advantages: met initial requirements
  - Disadvantages: Scalability, technology refresh, cost ?

Background

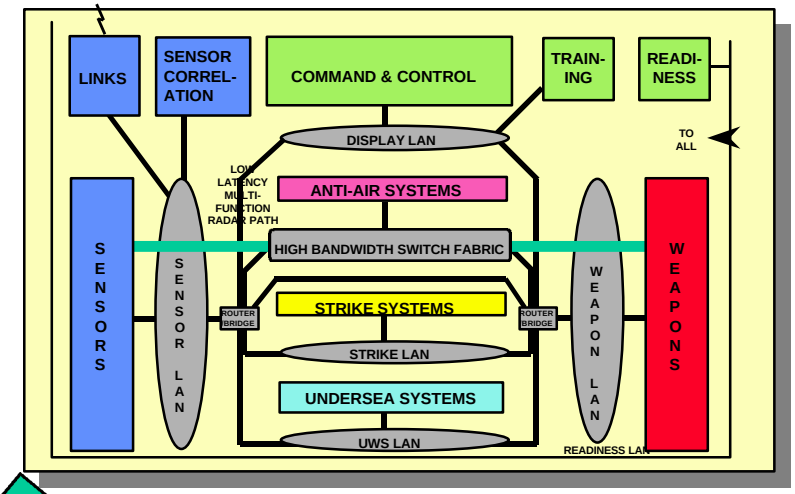
- Today, various commercial off-the-shelf (COTS) components and technologies are being used by shipboard systems.
  - Advantage: Scalability, bandwidth, technology refresh, cost ?
  - Disadvantages: Mission critical system requirements, component and technology obsolescence
- Some of the standard networking technologies in use:
  - FDDI
  - ATM and LAN Emulation
  - Ethernet and Fast Ethernet
  - Internet Protocol (IP) and associated protocols

Architecture Evolution
(Equipment)

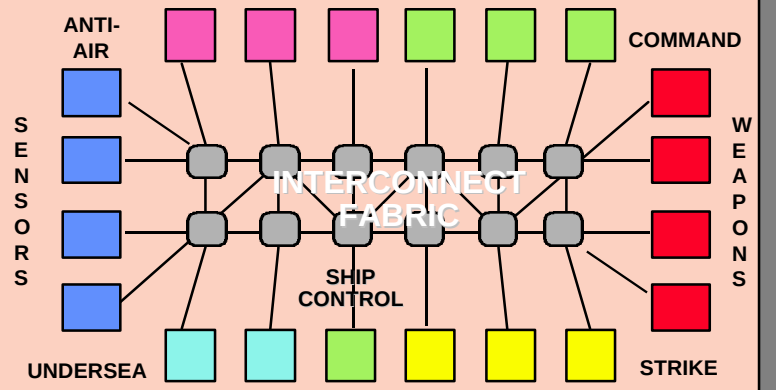
Federated



Network-of-Networks



Total Ship Computing



Technical characteristics

- COTS-based open equipment
- Fault tolerant, scaleable
- Instrumental and verifiable
- Uniform high throughput, low latency
- Guaranteed quality of service
- System-wide resource sharing
- Dynamic resource allocation

Mission Critical Networking Requirements

- Requirements vary by shipboard system. The include
  - Survivability,
  - Performance,
  - Security, and
  - Scalability

- Survivability
  - Availability and reliability.
  - Redundancy. This refers to the components, the links, and the ability to continue operation in the event of failures.

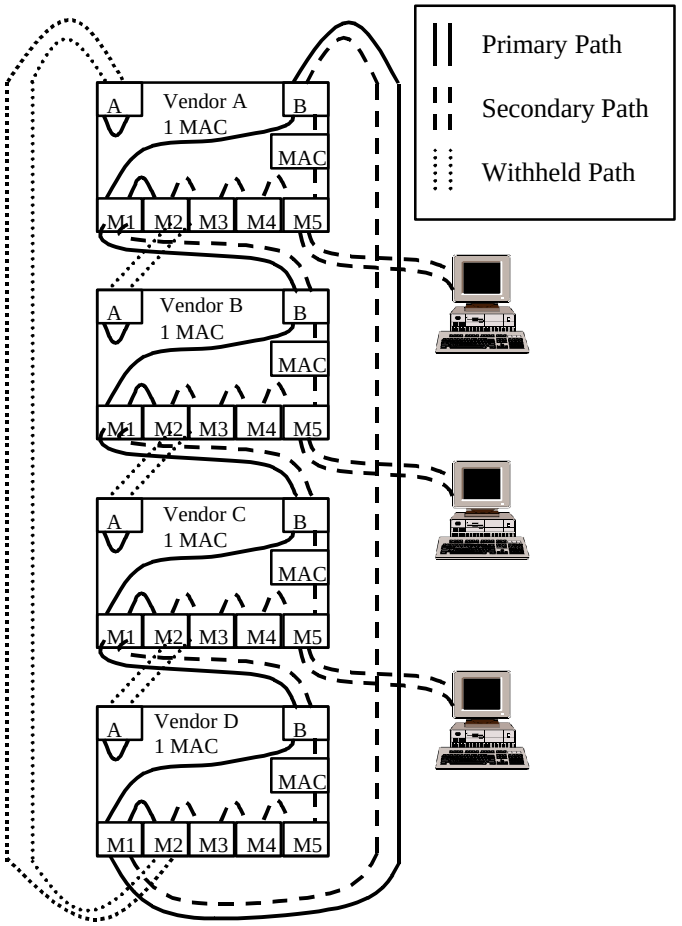
Mission Critical Networking Requirements

- Performance
  - Throughput. This is measured from application to application across the network infrastructure.
  - Latency. This is also measured from application to application, across the network infrastructure.
- Security
  - This includes data classification (e.g., Unclassified, Secret) security and information security and protection (e.g., encryption, filtering, access control, logging).
- Scalability
  - Bandwidth. This implies the ability add bandwidth between end systems or between components of the network infrastructure.
  - Systems. This implies the ability to add additional end systems or components of the network infrastructure

FDDI for Mission Critical LANs

- Advantages:
  - Hardware redundancy and survivability are built into FDDI standard
  - Reconfiguration on order of hundreds of milliseconds
  - End-to-end or backbone technology
- Disadvantages:
  - Small FDDI market

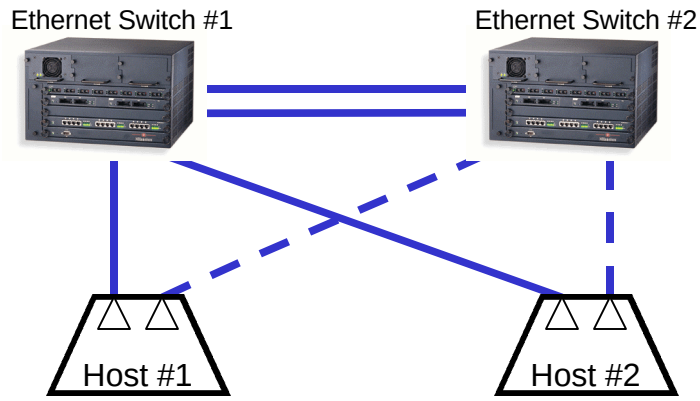
FDDI is going away!



*[Hiles and Marlow, **Experimentation on the Concentrator Tree with Loopback**, 1993]

Ethernet for Mission Critical LANs

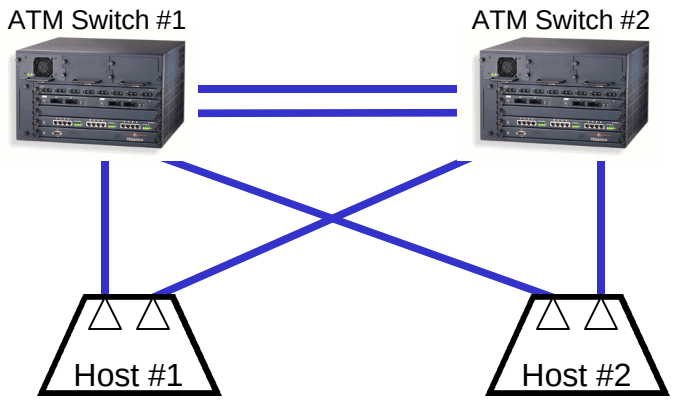
- Advantages:
  - Bandwidth Scalability
    - 10/100/1000/… Mbps
    - Link Aggregation
  - Switching
  - End-to-end or backbone technologies
- Disadvantages:
  - Slow reconfiguration (Spanning Tree)
  - Scalability WRT survivability
  - Survivability not transparent to applications



Add a 3rd Switch!

ATM for Mission Critical LANs

- Advantages:
  - PNNI for infrastructure survivability
  - Bandwidth scalability
  - Native QoS
  - End-to-end or backbone technology
- Concerns
  - Survivability of servers
  - Scaling of multicast / broadcast
  - Small market
- Disadvantages:
  - Survivability not transparent to applications
  - ATM servers



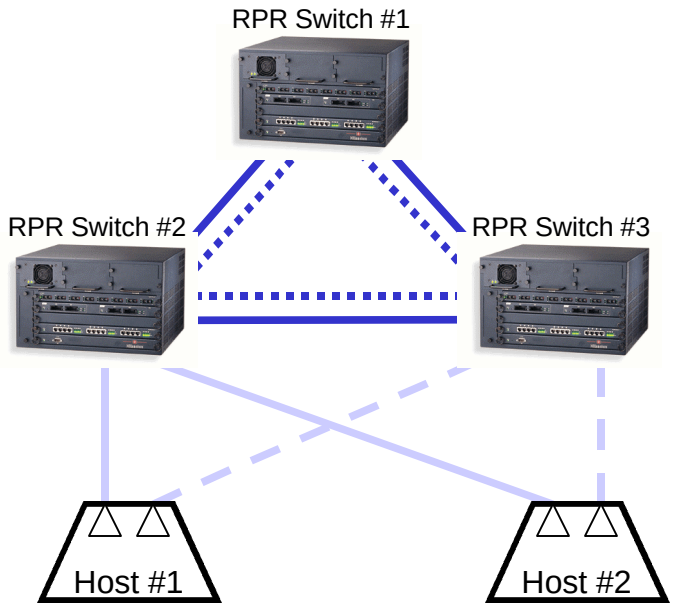
Is this the next FDDI ?

Why an Interest in Resilient Packet Ring?

Backbone technology

- Survivability
  - multiple paths
  - rapid reconfiguration (?)
  - FDDI-like characteristics (?)
- Scalability
  - bandwidth
  - addition of nodes
- Quality of Service (?)
- Multicast / Broadcast Support (?)

- End-to-end technology
  - Survivability
  - Quality of Service (?)
  - Multicast / Broadcast Support (?)



Is this the next FDDI ?
Is that good or bad ?

Summary

- The U.S. Navy is interested in open, COTS-based networking solutions that are fault tolerant and scalable.
- The U.S. Navy would be interested in such networking solutions that can provide
  - End-to-end latencies of less than 200 microseconds
  - Scalable end-to-end throughput greater than 100 Mbps
  - End-to-end outage of less than 1 second due to a network fault (i.e., reconfiguration time includes the detection and recovery from the network fault)
  - The ability to interface with other open, COTS-based networking solutions (e.g., routers, switches, encryption devices)