Air
Land
Sea
Space
Cyberspace
Innovation. In all domains.

Middleware Transports

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Systems Need Modularity

- Increasing Complexity
- Diversity of Hardware
  - GPPs, DSPs, FPGAs
- Diversity of Software
  - Applications
  - Devices

Modularity can be Achieved through Partitioning
Partitioning Strategies

- **Standard Middleware**
  - World Wide Web Consortium (W3C)
    - Web Services
  - Object Management Group (OMG)
    - Data Distribution Service (DDS)
    - Common Object Request Broker Architecture (CORBA)

- **Non-Standard Middleware**
  - Role Your Own
    - C/C++ APIs
    - Berkeley Sockets
C/C++ APIs

- Advantages:
  - Good performance
  - Ease of use

- Disadvantages
  - Less modular
  - Client and server must be co-located
  - Potential side effects
  - Can be difficult to mix computer languages
Berkeley Sockets

■ Advantages:
   – Available on most operating systems

■ Disadvantages:
   – Usually requires Ethernet
   – Programmers may need to write code to accommodate different Endian architectures
   – Programmers may need to write code to forward inbound messages to correct destination
   – Programmers may need to write code to serialize/deserialize some of the data types
     • Need to be aware of how data types are serialized
     • Different computer languages may serialize differently
CORBA

- Example of the Object Request Broker Pattern
  - An architecture pattern

- Defines:
  - Serialization
  - Transport Mechanism
  - Other possibilities include things such as threading, message prioritization, etc.

- Advantages:
  - Language independent
  - Platform independent
  - Location independent

- Disadvantages:
  - Size
  - Performance
OMG Extensible Transport Framework (ETF)

- Document number: ptc/04-01-04
- Provides a way for users to supply a transport
  - Examples include shared memory and message queues
  - Could role-your-own with custom hardware
- The ETF Standard defines IDL and the expected behavior
  - Users implement the IDL methods
  - CORBA implementation calls the methods
VxWorks

![Graph showing performance comparison between different VxWorks communication methods.](image)
## Mini-Trade Study (a little subjective)

<table>
<thead>
<tr>
<th></th>
<th>C/C++ APIs</th>
<th>Sockets</th>
<th>Shared Memory</th>
<th>CORBA</th>
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</thead>
<tbody>
<tr>
<td>Modularity</td>
<td>Requires co-location</td>
<td>Endian</td>
<td>Requires co-location</td>
<td>Maximized</td>
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<tr>
<td>User code/debugging</td>
<td>Initialization done by hand</td>
<td>Initialization done by hand</td>
<td>Initialization done by hand</td>
<td>Initialization done with policies</td>
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<td>Sub-Total</td>
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<td>15</td>
<td>12</td>
<td>20</td>
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<tr>
<td>Size</td>
<td>Build only what you need</td>
<td>Requires message forwarding</td>
<td>Requires message forwarding</td>
<td>Thread and priority management</td>
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<td>Performance</td>
<td>Function call</td>
<td>Kernel/user switching</td>
<td>Kernel/user switching</td>
<td>Buffer copies</td>
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<tr>
<td>Total</td>
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<td>31</td>
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</table>
Summary

- Increasing complexity makes partitioning necessary
- Partitioning can be done with middleware
  - Standard
  - Non-standard
- CORBA
  - Clearly superior if size and performance are not critical
  - Otherwise can be inferior
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