Design Principles and Optimizations for High-performance, Real-time CORBA

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Limitations of CORBA for Real-time Systems

- Lack of QoS specifications
- Lack of QoS enforcement
- Lack of real-time programming features
- Lack of performance optimizations

Research Problems: Meeting QoS Requirements

- Specifying QoS requirements
- Determining operation schedules
- Alleviating priority inversion and non-determinism
- Reducing latency/jitter for demultiplexing
- Reducing presentation layer overhead
- Maintaining small footprint

The ACE ORB (TAO)

- TAO Overview
  - A high-performance, real-time ORB
    * Telecom and avionics focus
  - Leverages the ACE framework
    * Runs on VxWorks, POSIX, and Win32

Related Work

- U. RI, MITRE
- ARMADA (U. Mich.)
- QuO (BBN)
Aniruddha S. Gokhale
Doctoral Research

**Research Contributions: TAO Optimizations**

- Efficient IDL and skeleton generation
- Presentation layer optimizations
- Data copying optimizations
- Request demultiplexing and dispatching optimizations
- Communication protocol optimizations
- Layered demultiplexing
- Perfect hashing
- Dynamic hashing

**Research Contributions: IIOP and Demux Engines**

- Optimizing operation dispatching
- Incoming CORBA requests dispatched to servant operation
- Goal is to minimize dispatching overhead

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Using GPERF to Optimize Operation Dispatching

Demultiplexing Performance Results

<table>
<thead>
<tr>
<th>Demultiplexing scheme</th>
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<tbody>
<tr>
<td>Linear</td>
</tr>
<tr>
<td>GPERF</td>
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<tr>
<td>Dynamic Hash</td>
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<tr>
<td>Active Demux</td>
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</tbody>
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Optimization Principles

<table>
<thead>
<tr>
<th>Number</th>
<th>Principle</th>
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<tbody>
<tr>
<td>1</td>
<td>Optimize for the common case</td>
</tr>
<tr>
<td>2</td>
<td>Eliminate gratuitous waste</td>
</tr>
<tr>
<td>3</td>
<td>Replace inefficient general-purpose methods with efficient special-purpose ones</td>
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<tr>
<td>4</td>
<td>Precompute values, when possible</td>
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<td>5</td>
<td>Store redundant state to speed up expensive operations</td>
</tr>
<tr>
<td>6</td>
<td>Pass information between layers</td>
</tr>
<tr>
<td>7</td>
<td>Optimizations for cache</td>
</tr>
</tbody>
</table>

Related Work

- G. Varghese, SIGCOMM’96
- Clark:90, Abott:93 – ILP
- Peterson:94 (PathFinder), Engler:96 (DPF), Mahesh:95 (packet filters)
Throughput Comparisons

Original SunSoft

Optimized TAO

www.cs.wustl.edu/~schmidt/HICSS-97.ps.gz (Best Paper Award)

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