Performance assessment of CORBA for the transport of user-plane data in future wideband radios

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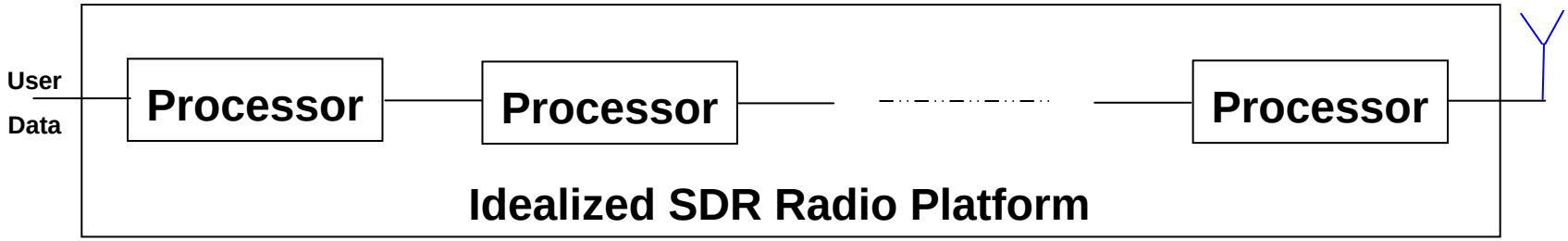
Outline

- Introduction to the problem
- Test Setup
- Results
- Conclusion

Problem Statement



Background

- Idealized SDR Radio platform is represented with interconnected computing elements
- Portable software modules execute on one or more hardware processors to accomplish functionality and performance requirements
- Software modules provide control plane and user data plane functionality
- User data is increasingly in the form of IP packets
- Objective is for the use of CORBA for inter-connection between software modules

Issue

Should future wideband radios use CORBA to internally transport user-plane data?

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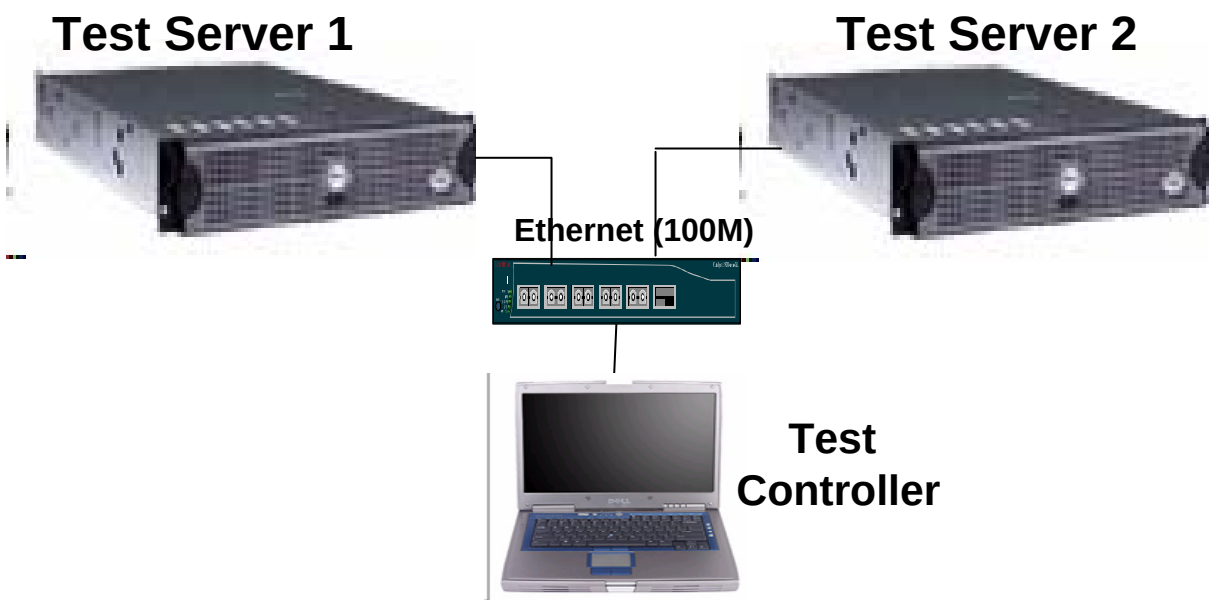
ORB Performance Assessment Methodology

Objective: Benchmark throughput that can be achieved as a function of CPU utilization for:

1. ORB-encapsulated data transfer
2. Non ORB-based data transfer



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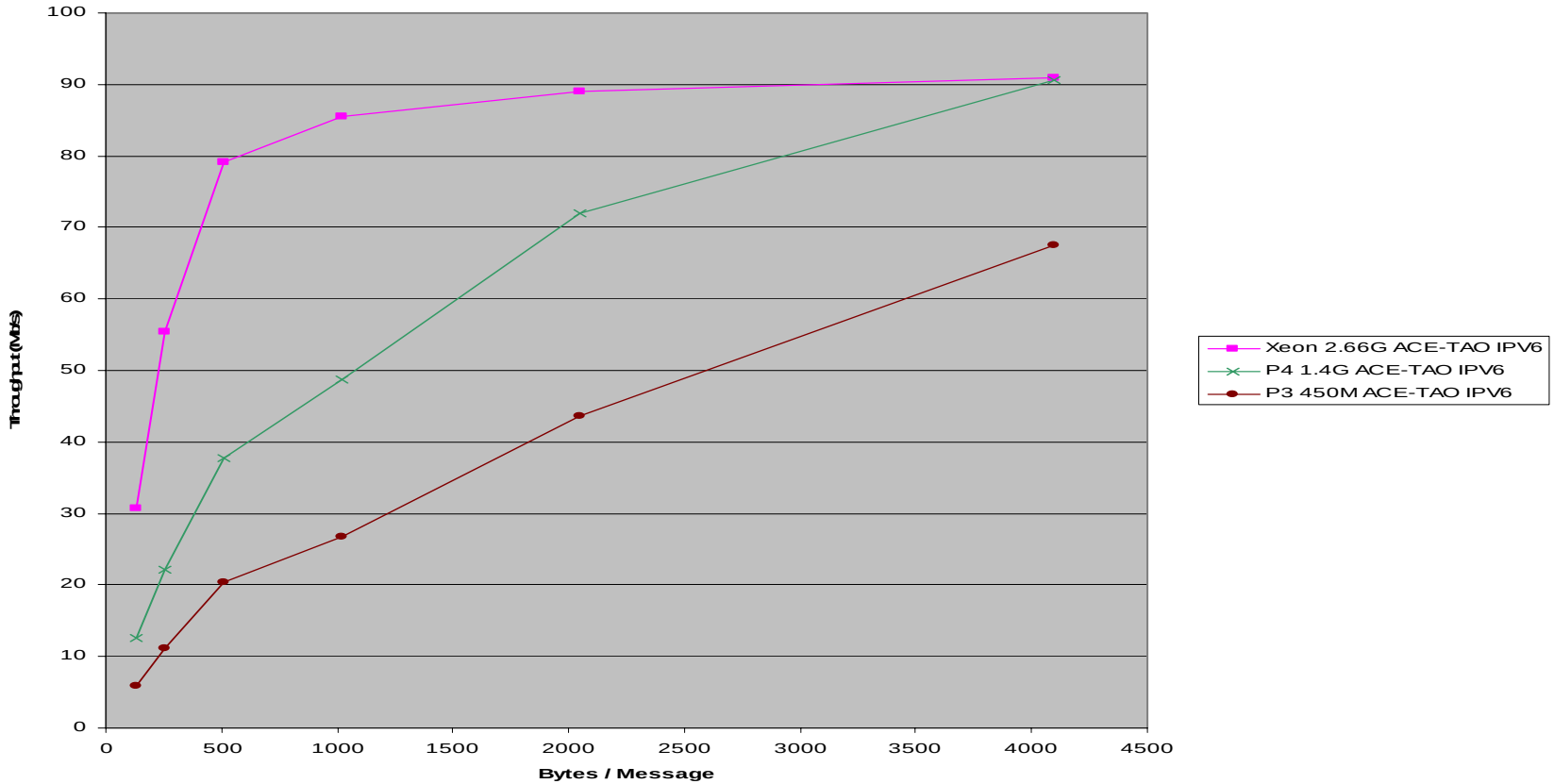
Test Methodology

- ORB-based data transfer: One-way asynchronous CORBA call used to benchmark throughput performance
- Server's CPU utilization is the bottleneck to higher throughput; the sender is time-spaced resulting in differing CPU utilizations on server
- For servers with INTEL processors:
  - Pentium III at 450MHz, Pentium IV at 1.4GHz, Xeon at 2.66GHz
  - OS: Linux
  - ORB: ACE 5.5.1/TAO 1.5.1
  - IPv6 on 100M Ethernet
  - UDP-based data transfer; server verifies that all packets are received
  - Message size – Internet mix (defined later) with effective message size of 345 bytes
- For embedded platform,
  - IBM PPC405 GP at 200 MHz
  - OS: VxWorks
  - ORB: ACE 5.3a-OCI/TAO 1.3a-OCI
  - IPv4 on 100M Ethernet
  - TCP-based data transfer is used
  - Message size is constant (1024 bytes)
- CPU utilization of 20% is used as a comparison between ORB-based and non-ORB-based data transfer

Sensitivity of Throughput to Message Size



- **Selection of message size is an important criteria**
- **Desired goal – Use a mix of message sizes representative of the Internet**

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Internet Packet Monitoring Data

- Packet size distributions collected by Sprint IP Monitoring Project (IPMON) (http://ipmon.sprint.com/packstat/packetoverview.php)
- Uses 60+ monitoring systems on the Sprint IP backbone on 30+ bidirectional OC3/12/48 links
  - Large amount of data available; regular collections from 2003

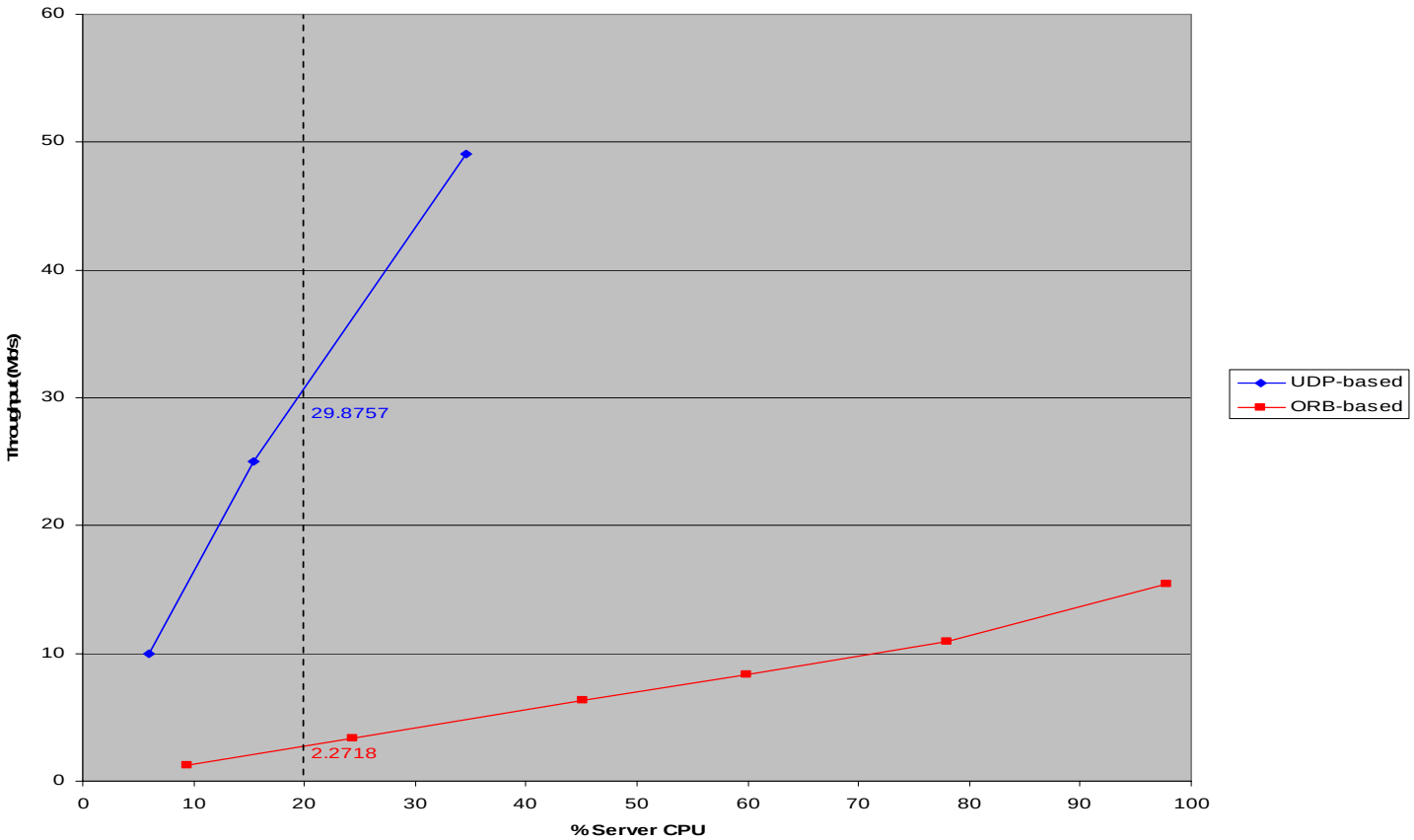
Bin Size	2/6/2004	1/28/2004	8/13/2003	7/1/2003	5/7/2003
40	24.52%	20.31%	37.45%	44.52%	25.15%
48	6.58%	3.08%	6.08%	5.6%	3.3%
52	5.86%	5.62%	6.77%	7.16%	4.13%
576	2.2%	2.6%	1.3%	0.9%	3.5%
1420	3.2%	5.06%	2.16%	2.3%	4.28%
1500	5.86%	9.2%	6.99%	3.3%	11.11%
Remainder	51.78%	54.13%	39.25%	36.22%	48.53%

Methodology to obtain packets similar to Internet

1. Select packet size distributions from the largest collections
2. Apply selective filter applied to reduce the data size
3. Form packet size bins across the collections
4. Average the packet size bins
5. Distribute unspecified packet size to bins by the relative weights
6. Extrapolate IPv4 packet size for IPv6
7. Create XML input file for six peak message sizes including min size, max size and average frequency
8. Generate messages using XML file with uniform distributions of messages for size and frequency

Bin Size	Average
40	56.4
48	9.1
52	10.9
576	3.9
1420	6.3
1500	13.4

ORB-based/non-ORB-based Throughput Comparison
(Pentium III at 450MHz)



For a CPU utilization of 20%, non-ORB-based throughput is 13 times the ORB-based throughput

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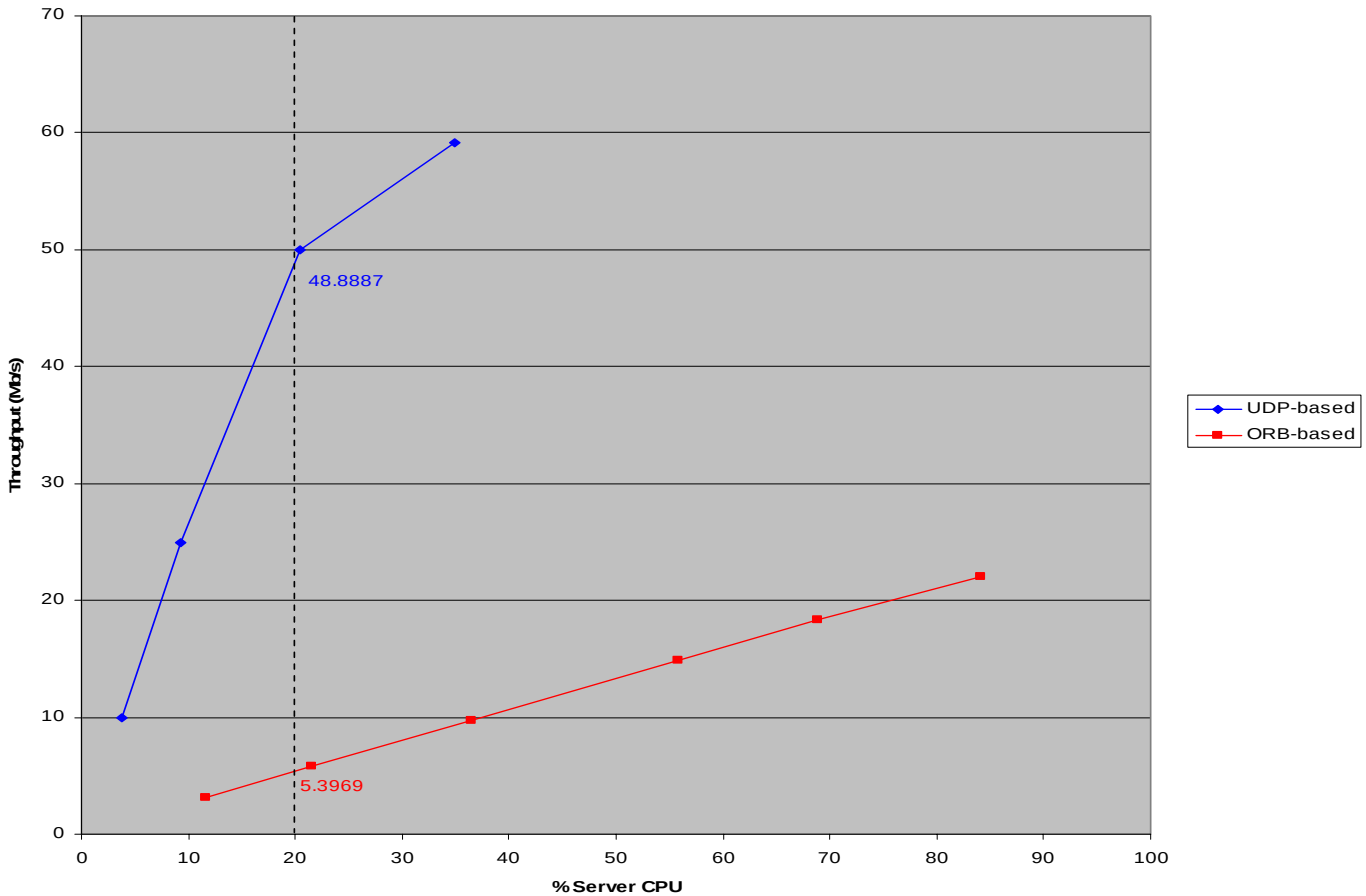
ORB-based/non-ORB-based Throughput Comparison
(Pentium IV at 1.4GHz)



For a CPU utilization of 20%, non-ORB-based throughput is 8 times the ORB-based throughput

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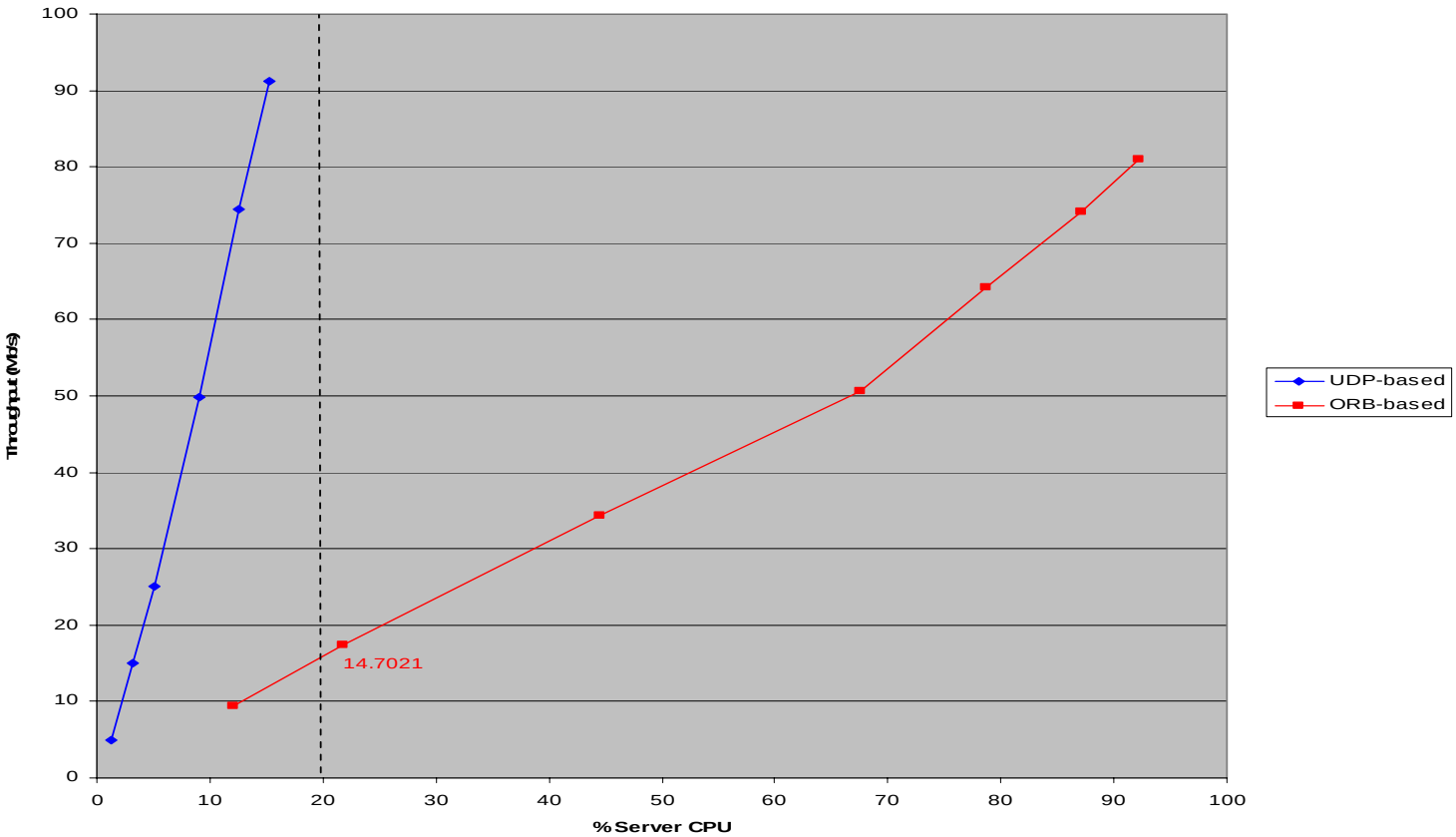
ORB-based/non-ORB-based Throughput Comparison
(Xeon at 2.66 GHz)



For a CPU utilization of 20%, non-ORB-based throughput is 8 times(*) the ORB-based throughput

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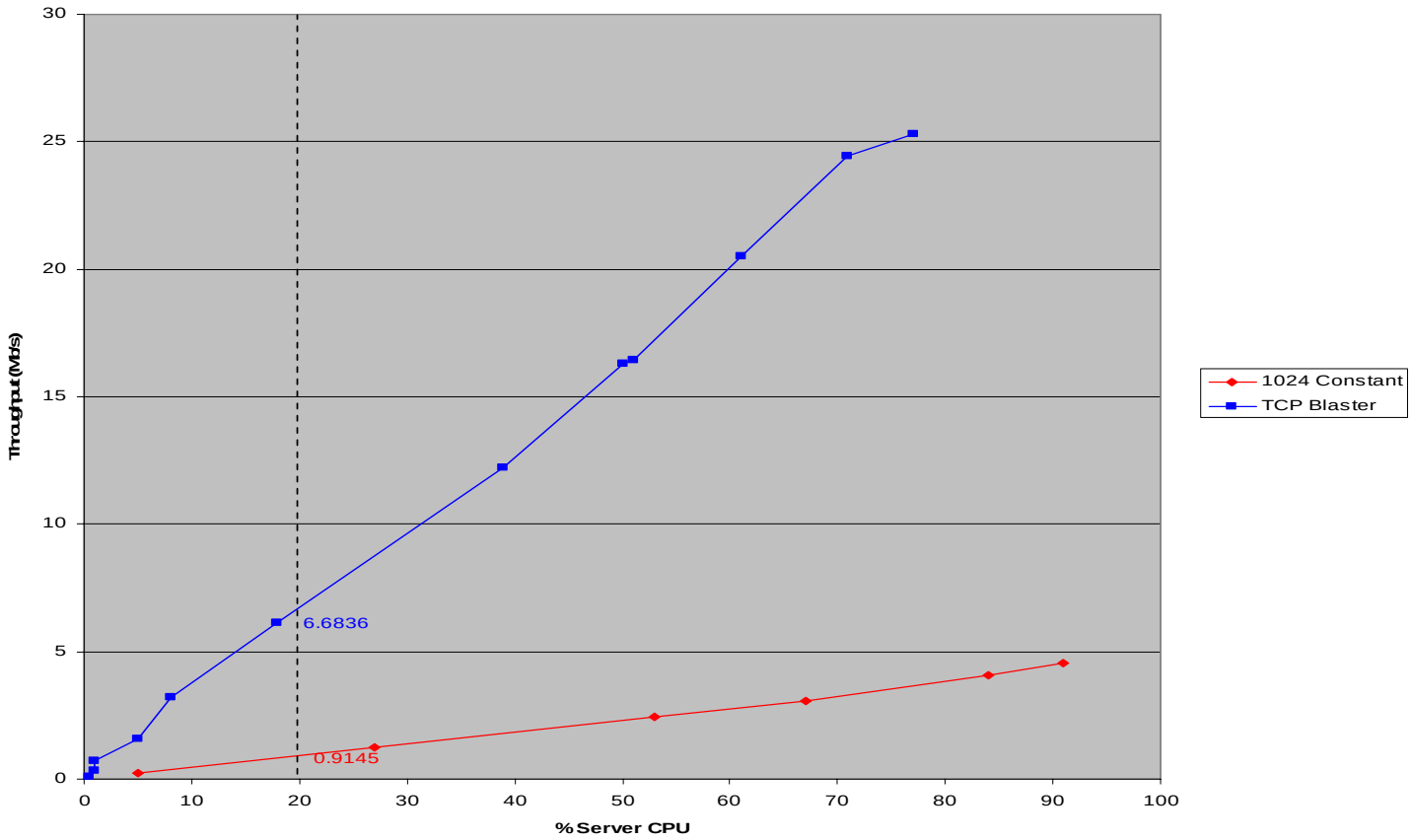
*** Note: Obtained with 1G Ethernet**

ORB-based/non-ORB-based Throughput Comparison
(IBM PPC 405 at 200 MHz)



For a CPU utilization of 20%, non-ORB-based throughput is 7 times the ORB-based throughput

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Conclusion

- With today's hardware processors and speeds, non-ORB-based data transfer was measured to be 7 to 13 times faster than CORBA-based data transfer
- Recommend non-ORB-based user-plane data transfer for ongoing development work
  - Especially for wideband radios under development at the current time
- Recommend that ORB-based user-plane data transport be considered in the future
  - With increases in processor speeds and ORB optimizations