Performance of Web Services

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Contents

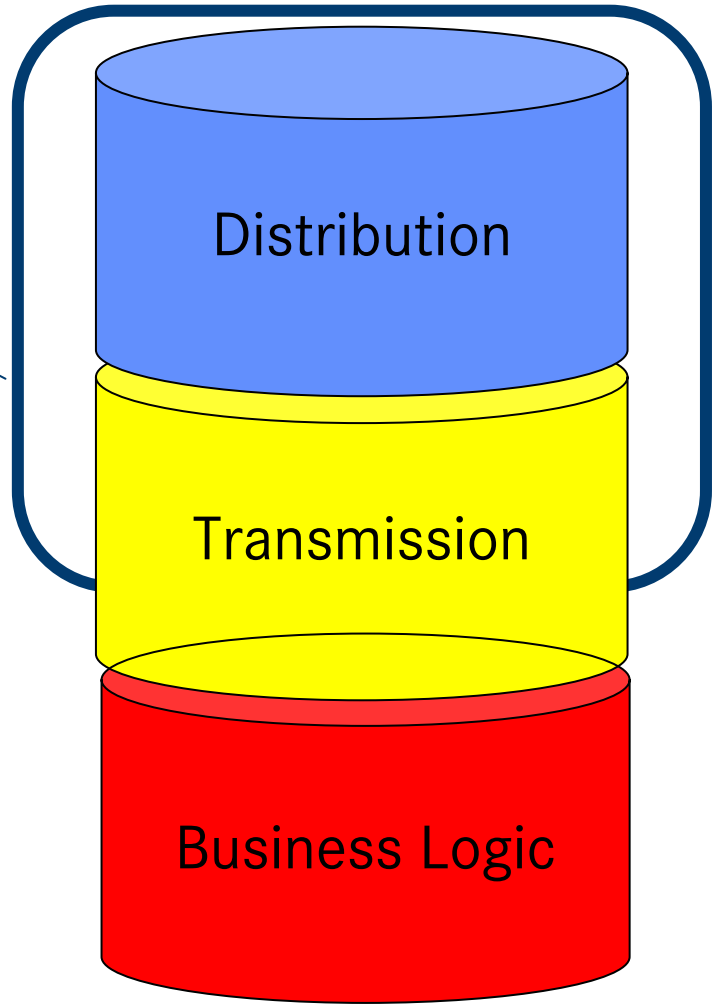
Introduction

Influenced by

Looking at:

- RMI
- CORBA
- SOAP
- HTTP

- Response Time
- Network Traffic
- CPU Load



Test Configuration

- Standards: SOAP v1.1, HTTP/1.1
- Ethernet: 10Mbit/s, Connected by hub
- Client configuration
  - AMD Athlon 1800Mhz
  - SUN J2SE v1.4.1_02-b06
  - Apache Axis v1.1 RC2
  - Windows XP Home (v5.1 Build2600.xpsp1.020828-1920, SP1)
- Server configuration
  - Dual AMD Athlon 1200Mhz
  - SUN J2SE v1.4.1_02-b06
  - Apache Axis v1.1 RC2
  - Jakarta Tomcat v4.1.26
  - Apache v1.3.27
  - Perl v5.8.0
  - Suse Linux v8.1 (Kernel 2.4.19)

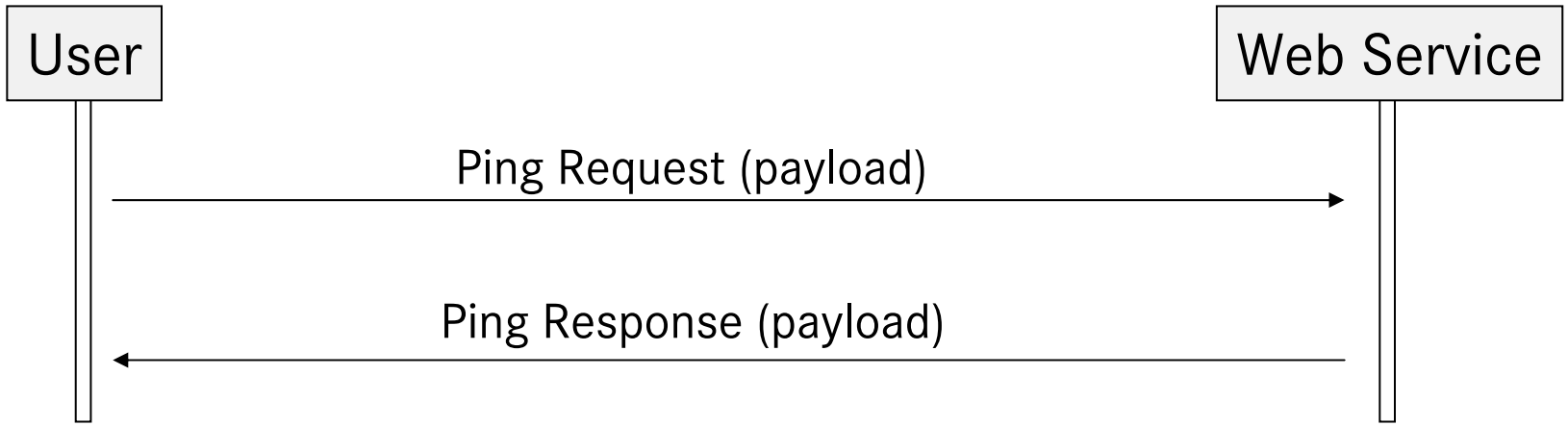
Measurements

- More than 1,200,000 single data points (RMI, CORBA and SOAP)
- What we measured
  - Response time
  - CPU load
- Points of interest
  - Scalability
  - Faults
- No Optimization
  - No process modifications
  - No low level timing optimizations
- No other network traffic

Methodology - Goals

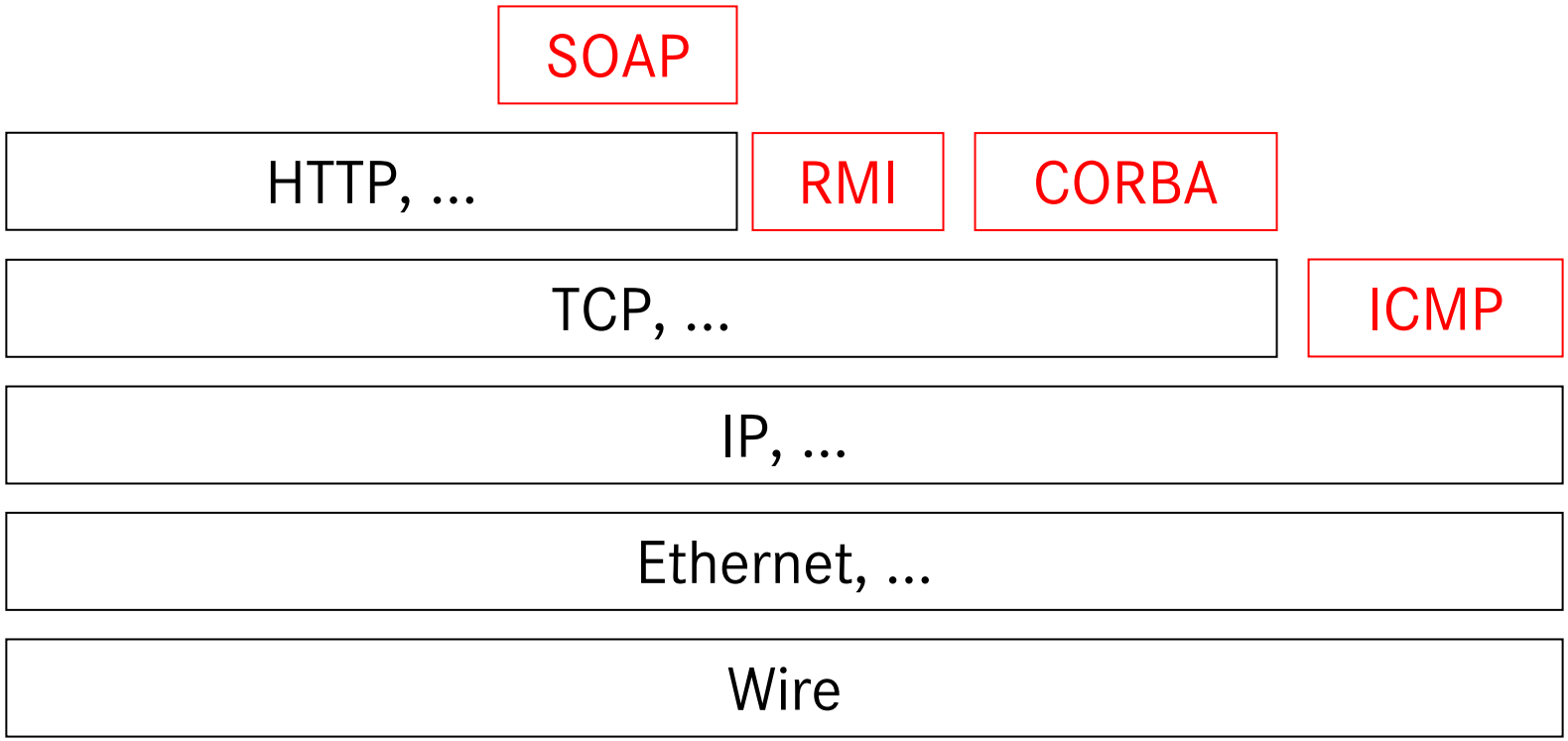
- No side effects
  - I.e. no additional system or communication requirements
- Scalable methodology
- Technology/Toolkit agnostic
- Different communication styles
  - RPC- and document style
- Multiple protocols tested
  - HTTP, TCP, ICMP

Methodology - Our Ping Service



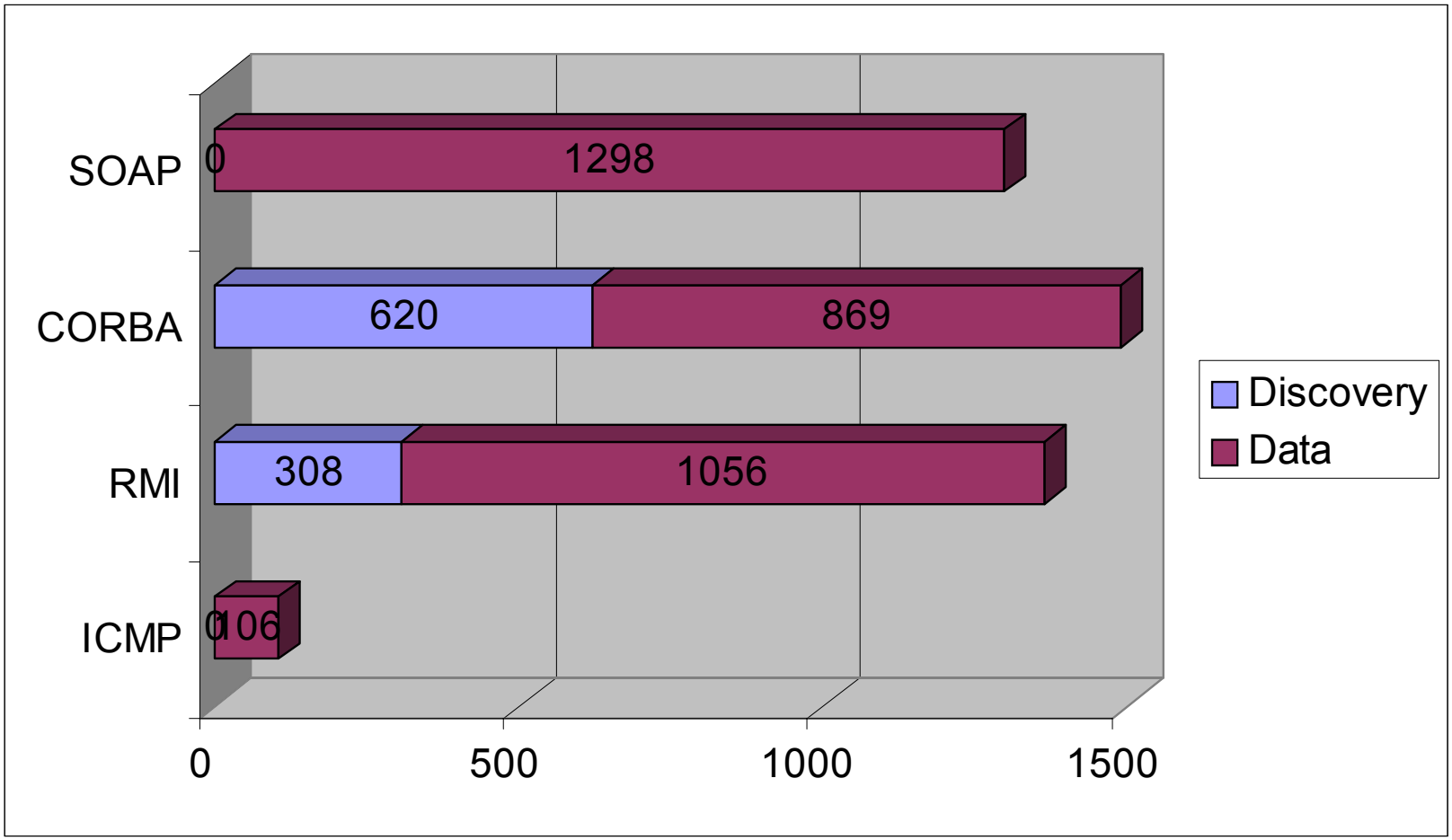
- Modeled after ICMP Echo-Service (Ping, RFC 792)
  - Symmetric Network load
  - No logic on server
  - Virtually no requirements on execution environments
- Only three lines of code in Perl
- Portable Java-Client

Protocol Hierarchy



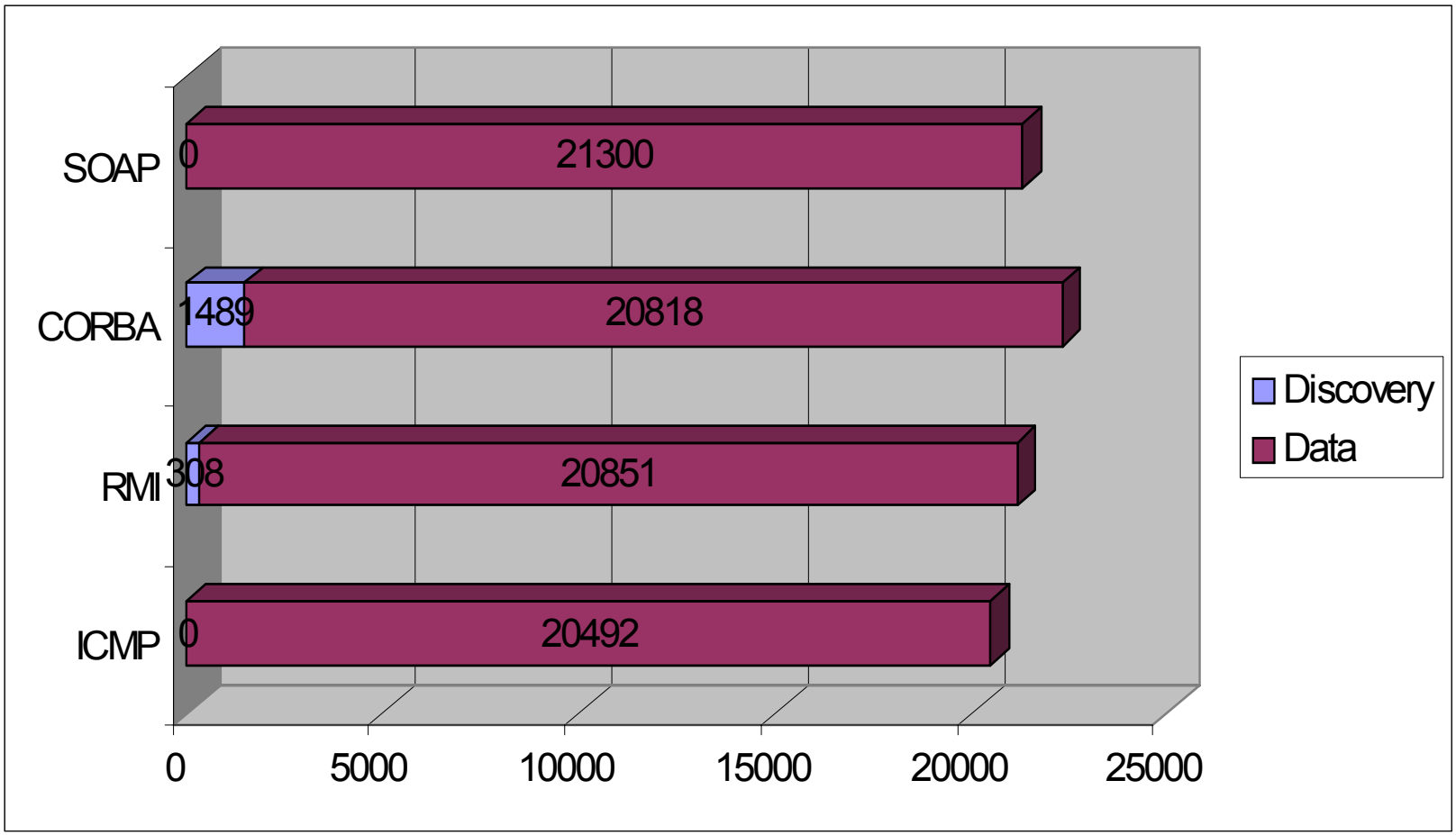
Direct comparison of results is difficult because they operate on different conceptual levels

Results I: Package Size



Payload size: 0 bytes

Results I: Package size



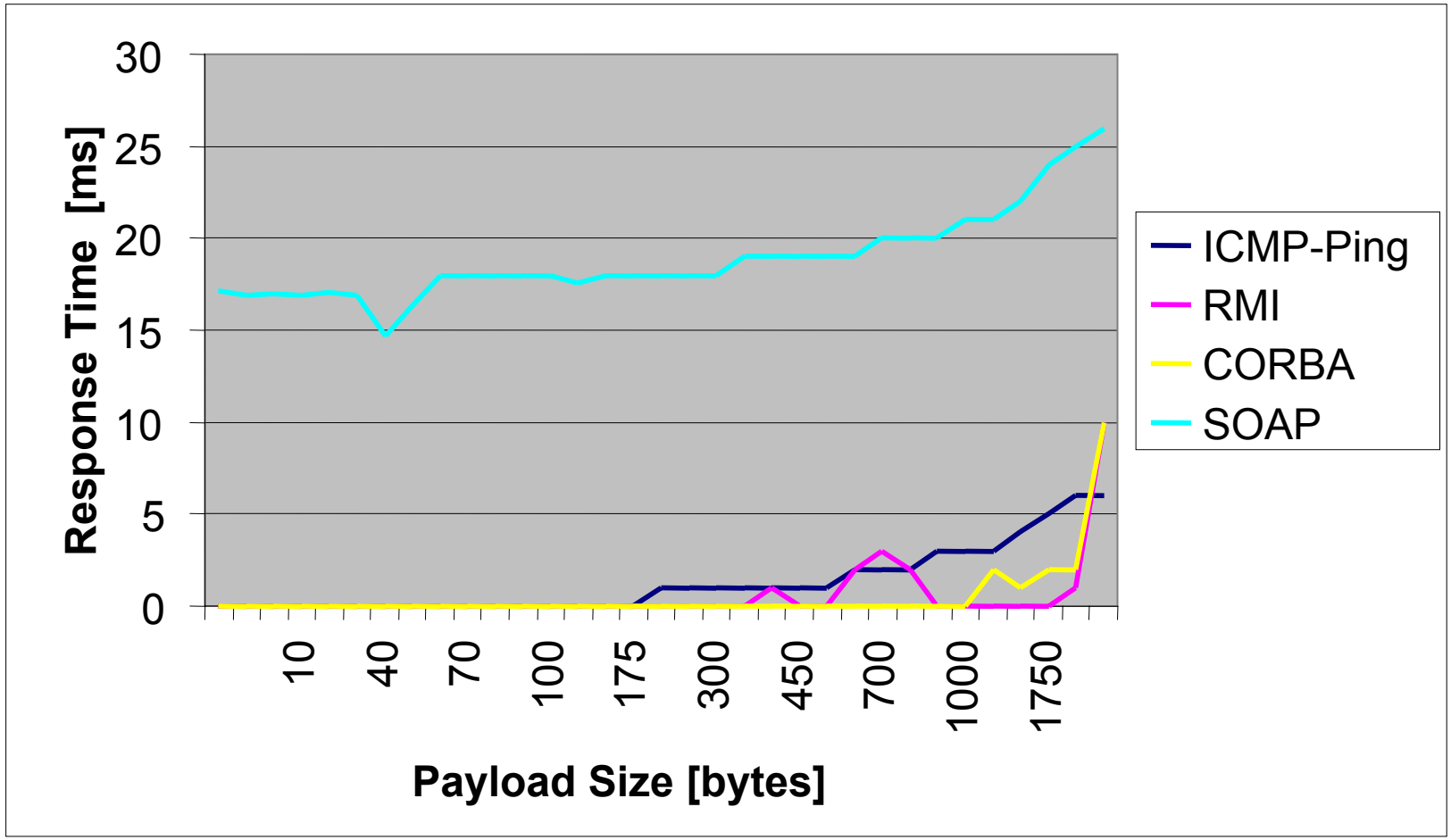
Payload size: 10,000 bytes

Results I: Package Size

Conclusion: package size scales linear with payload size

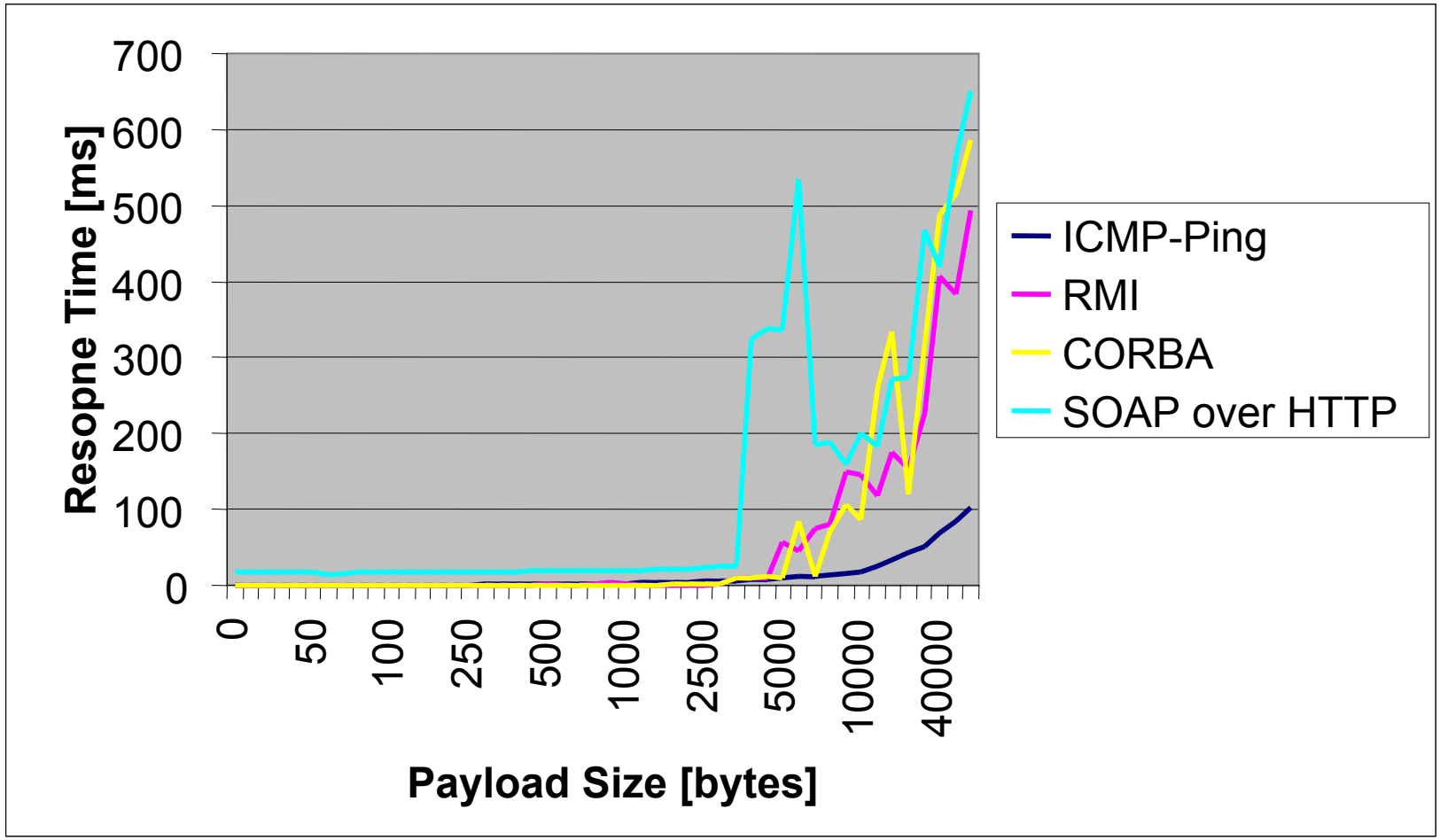
- SOAP
  - 0 bytes payload
    - As measured: 1298 bytes
  - 20,000 bytes payload (10,000 request + 10,000 response)
    - Expected value: **21298 bytes**
    - As measured: **21300 bytes**
- CORBA
  - 0 bytes payload
    - As measured: **869 bytes**
  - 20,000 bytes payload (10,000 request + 10,000 response)
    - Expected value: **20869 bytes**
    - As measured: **20818 bytes**
- RMI
  - 0 bytes payload
    - As measured: 1056 bytes
  - 20,000 bytes payload (10,000 request + 10,000 response)
    - Expected value: **21056 bytes**
    - As measured: **20851 bytes**

Results II: Response Time



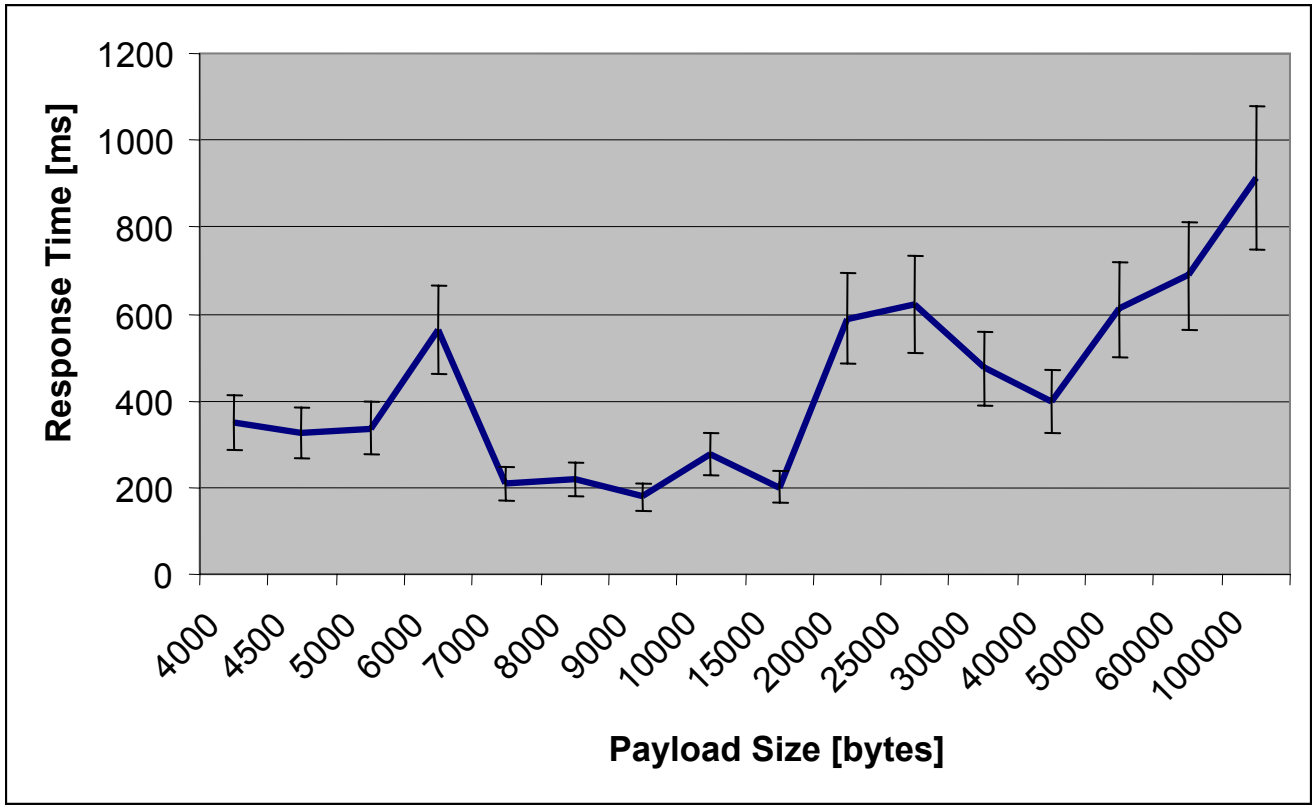
HTTP Overhead causes higher response times for SOAP packages

Results II: Response Time



Response time grows exponentially

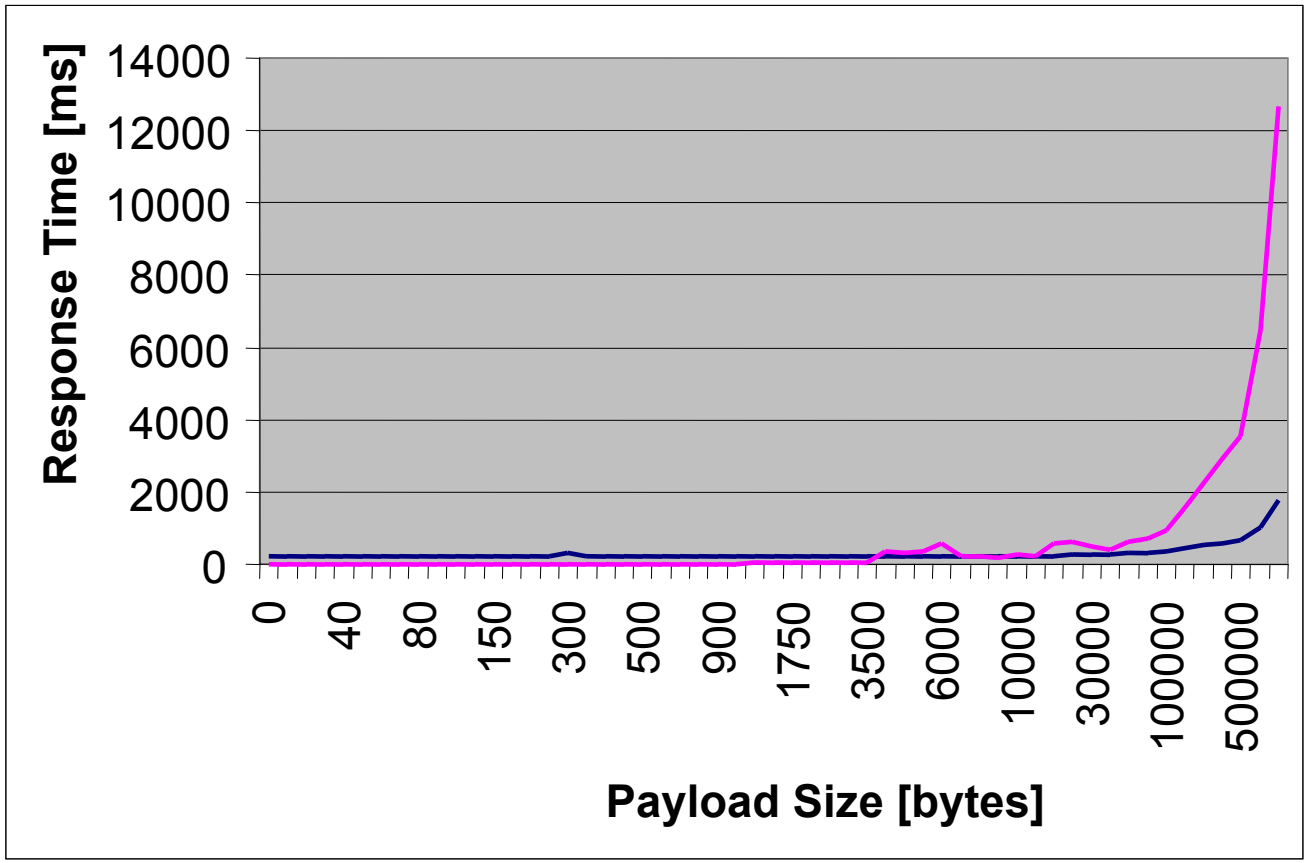
Results II: Response Time



measurement inaccuracy: 18%

Observation: reproducible, extreme fluctuations
Explanation: TCP Retransmission-Time (RTO) exceeded

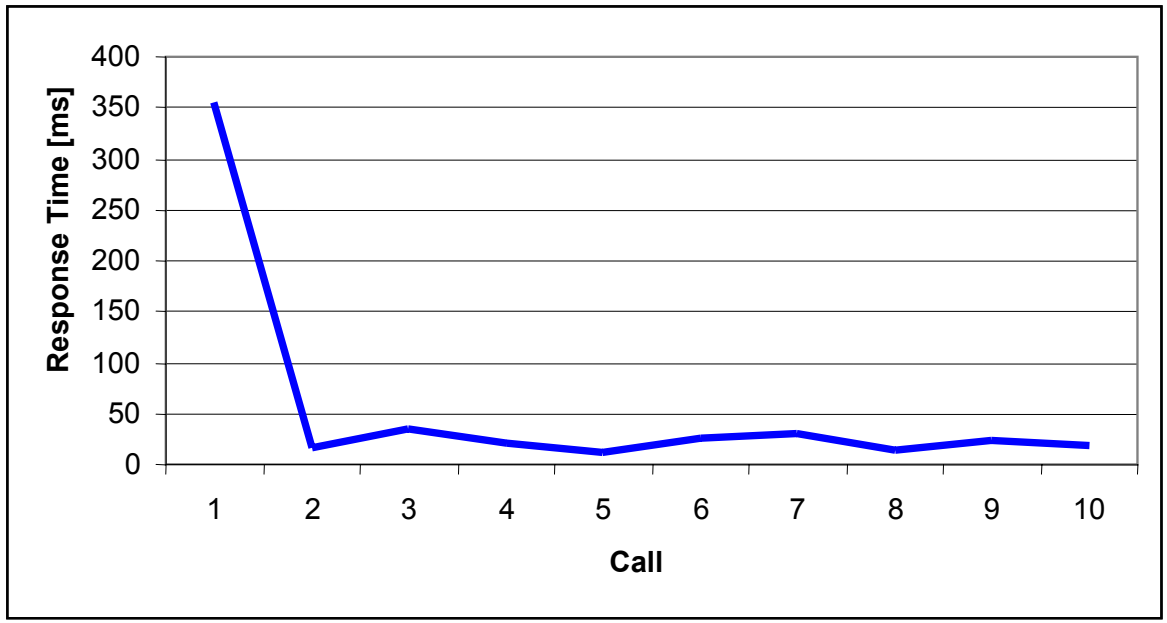
Results II: Response Time



Perl over TCP

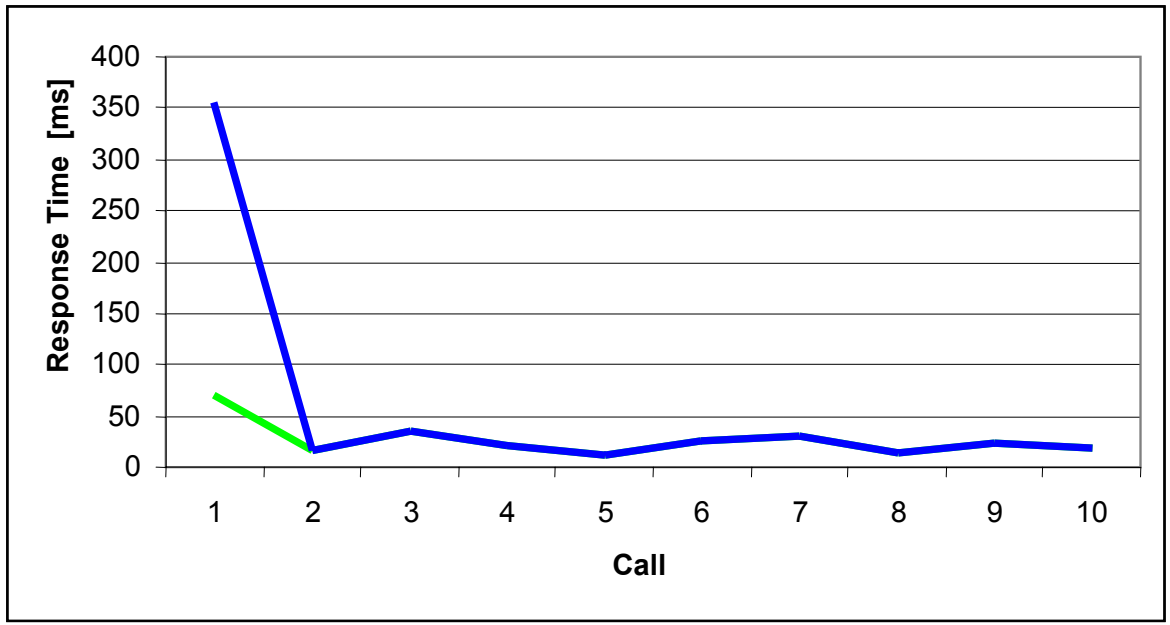
Java over HTTP

Results II: Response Time



- AXIS SOAP, Web Service not precompiled (JWS deployment).
- First call requires compiling;
  - Response time is 16 times higher
- Compiled code is cached, but only for a short time

Results II: Response Time

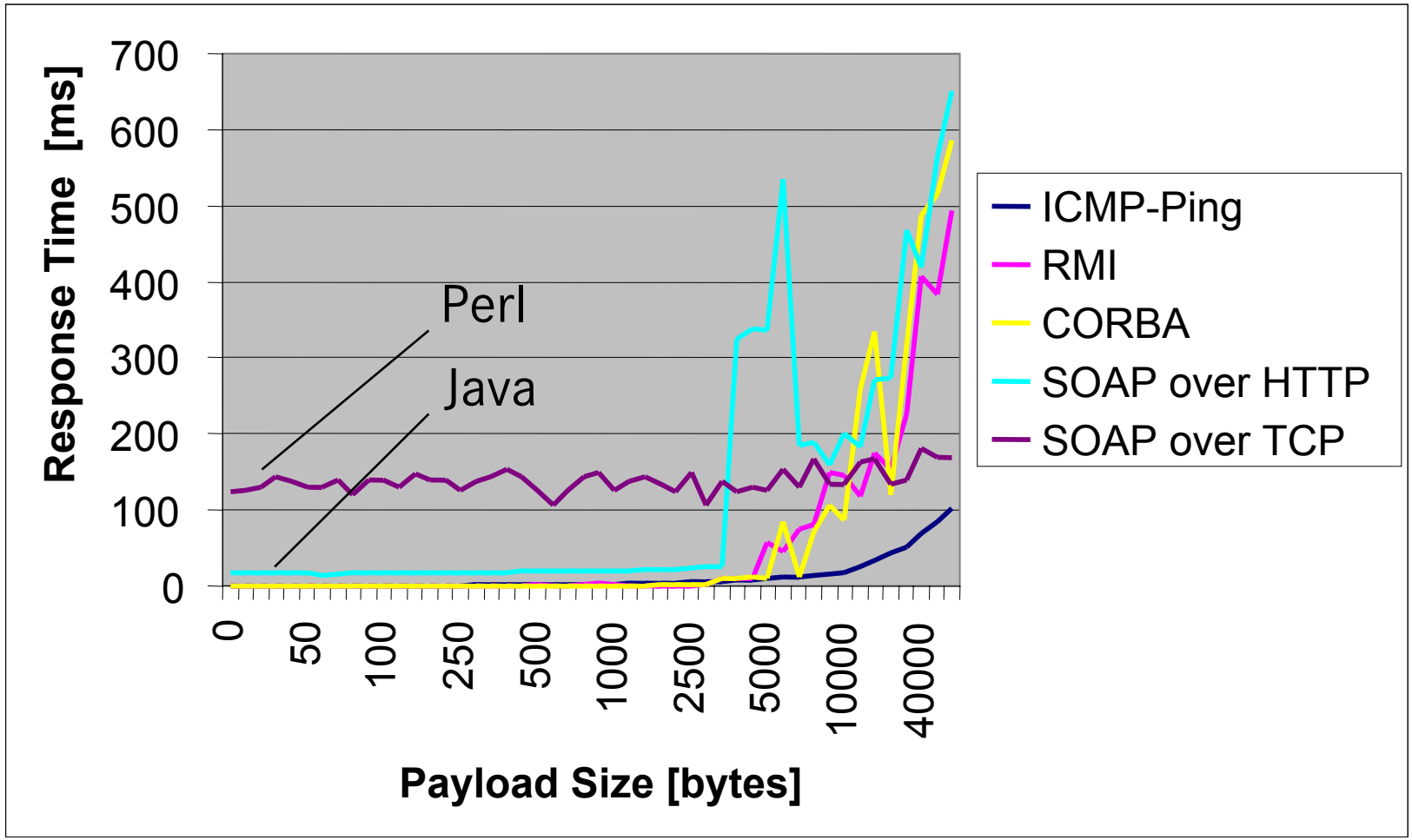


Not precompiled (JWS)

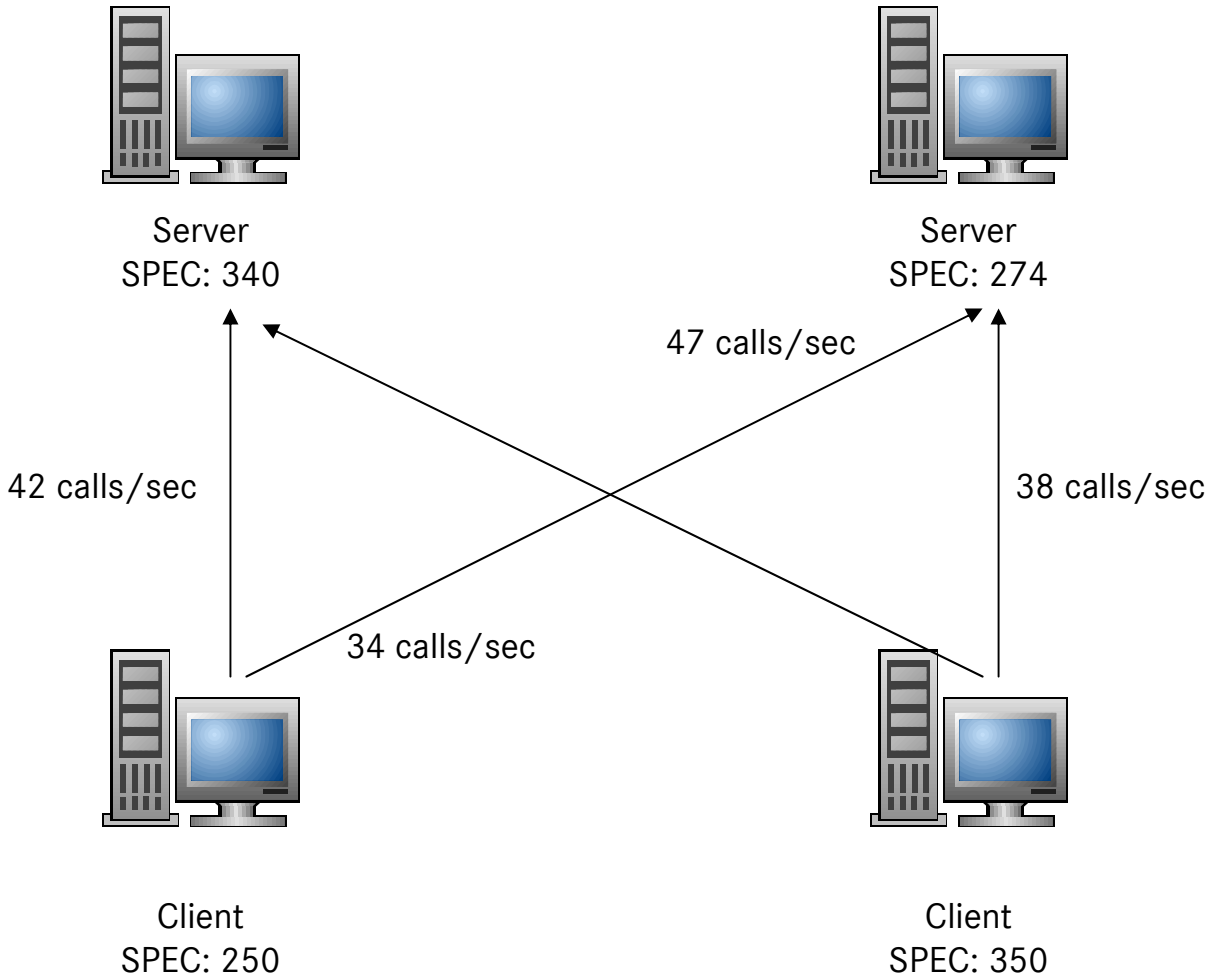
Precompiled

- Precompiled code is much faster on the first call

Results II: Response Time, Different Transport Protocols



Results III: Load



Results III: Load

- What we measured
  - 10000 calls with 3000 byte payload each
  - Client/server performance according to published SPEC2000 data
- Results
  - 40% faster client: 10% more calls
  - 20% faster server: 20% more calls
- Conclusion
  - SPEC2000 value of **server** makes good estimate for web service performance

Results III: Load

Server	Spec 2000	Expected Performance [calls/sec, 3000 bytes paylod]
Pentium III 750 Mhz	340	47
Pentium IV 1,3 Ghz	561	77
Pentium IV 2,66 Ghz	957	132
Dual Intel Xeon 2,8 Ghz	926	128
Dual AMD Opteron 1,8 Ghz	1023	141
Intel Xeon 3,06 Ghz	1113	155

Conclusion

- Network load (influenced by package size) can have a large impact on overall performance.
- SOAP often performs much better than expected.
- HTTP is the bottleneck.
- SPEC values deliver good estimates for server performance.
- There is lots of potential for performance optimization.
- SOAP Ping is a good benchmark for comparing SOAP implementations.