z/TPF V1.1

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SOAP Provider Support:
A performance analysis

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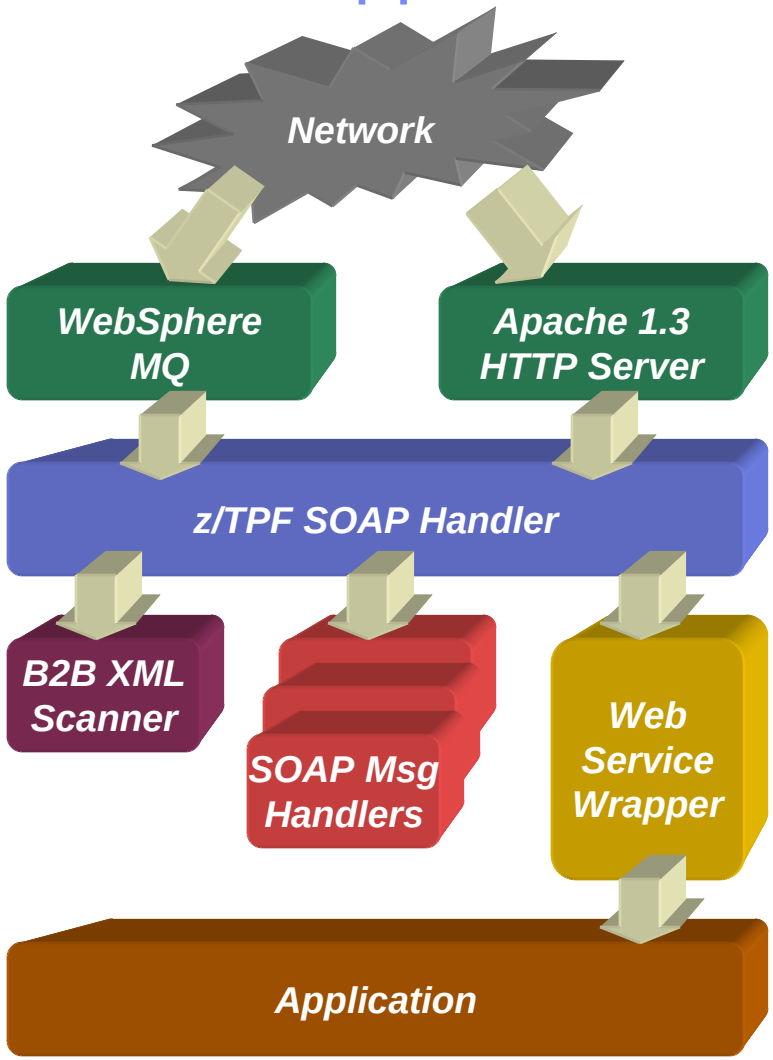
AIM Enterprise Platform Software
IBM z/Transaction Processing Facility Enterprise Edition 1.1.0

Performance-focused SOAP provider support

- **Transport-independent mechanism for processing Web service requests using the SOAP standard**
- **Highly efficient XML scanner for parsing SOAP requests**
- **Infrastructure exists to implement Web service extensions**
- **Componentized processing model separates business logic from invocation method**

z/TPF SOAP handler provides lean, yet extensible, layer for processing SOAP requests.



Major factors that may impact SOAP performance

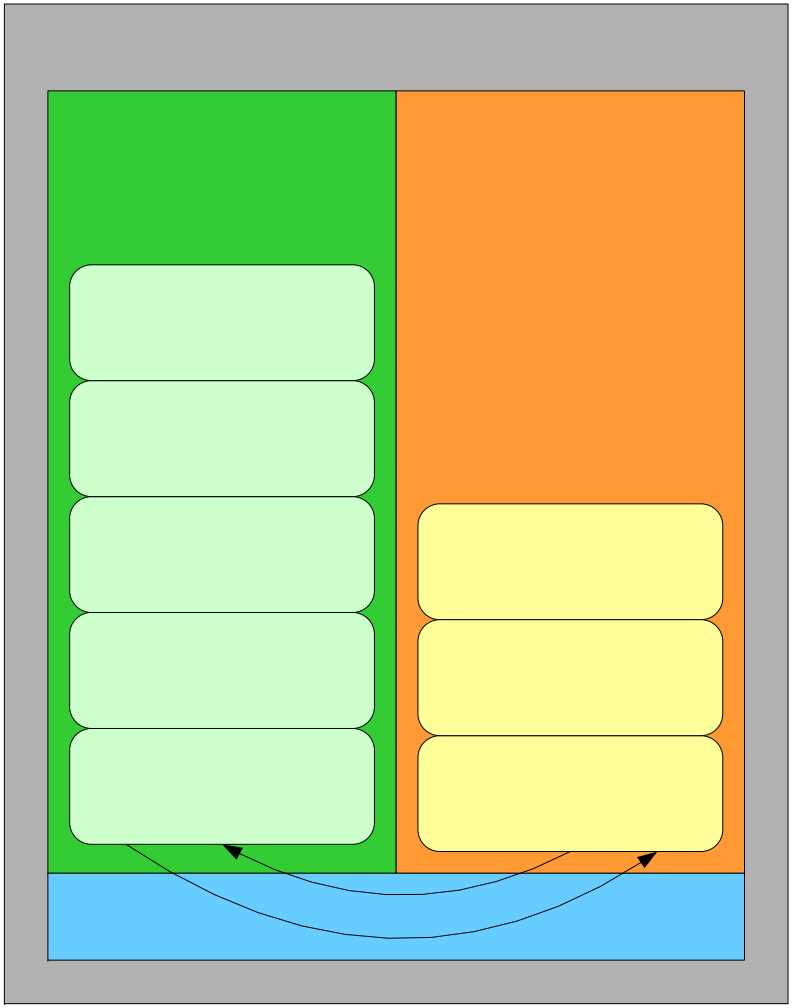
- **Communications binding used:**
  - Apache HTTP Server
  - WebSphere MQ
- **XML parsing required:**
  - XML message size (total bytes)
  - XML message complexity (*content density)*
    - Measure of the amount of *structure* in an XML document
    - A ratio of the sum of all element and attribute character data on the size of the entire XML document
- **User-written extensibility points:**
  - SOAP message handlers
  - Web service wrapper program

z/TPF SOAP performance testing objectives

- **Determine the mean path length and throughput associated with processing Web service requests**
- **Determine the effect of the communications binding used on the path length**
- **Determine the effect of message size and message complexity on the path length**

z/TPF SOAP performance testing configuration

- **IBM System z (z9)**
  - 298 MIPS per CPU
  - 2 LPARs dedicated to the test (shared a single OSA card)
- **LPAR 1: z/TPF**
  - Code level: PUT 04
  - Single CPU (dedicated PR/SM)
  - Apache 1.3 HTTP server (configured to only handle SOAP traffic)
  - WebSphere MQ server support
  - Web service provider (`/performance`)
- **LPAR 2: Linux for zSeries**
  - Web service consumer
  - Lab-written PERL scripts used to send SOAP requests



z/TPF SOAP performance test scenarios

- **All process-level and system-level traces were disabled**
- **`/performance` Web service**
  - Contains no business logic
  - The same hard-coded response message is built and returned regardless of the input SOAP request (228 bytes) *
  - Resulting path length observations are thus mostly restricted to non user-written components
- **24 different test observations (5-minute sampling period for each):**
  - 8 different SOAP requests continually sent over HTTP
  - 8 different SOAP requests continually sent over WebSphere MQ client channel
  - 8 different SOAP requests continually sent over WebSphere MQ sender and receiver channels (local queue manager support)

* Logic for sample Web service wrapper is available in the *Backup* section of this presentation

Sample SOAP message selection criteria

- **Various message sizes (~500 bytes to 34 KB)**
- **Various message complexities (content density of 8% to 16%) ***
- **Messages should be relevant to the TPF customer set**
  - Open Travel Alliance (OTA) defines XML messaging standards for the travel and transportation industry
  - Sample messages chosen from amongst various industries: Airline, Rail, and Hotel

* Instructions on how to calculate *content density* are available in the *Backup* section of this presentation

Sample SOAP messages used

Message Type	Size (Bytes)	Content Density
OTA_AirFlifoRQ2.xml	578	9.86%
OTA_RailAvailRQ2.xml	1358	10.68%
OTA_RailBookRQ2.xml	1967	10.07%
OTA_AirCheckInRQ3.xml	2119	14.25%
OTA_AirPriceRQ2.xml	2687	9.56%
OTA_AirBookModifyRQ7.xml	5267	8.06%
OTA_HotelEventRQ3.xml	15841	16.53%
OTA_HotelRoomListRQ3.xml	35566	9.74%

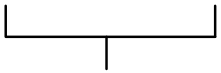
* All samples available for download on the OTA Web site (http://www.opentravel.org).
Samples were updated to include SOAP envelope around base XML messages.

DISCLAIMER

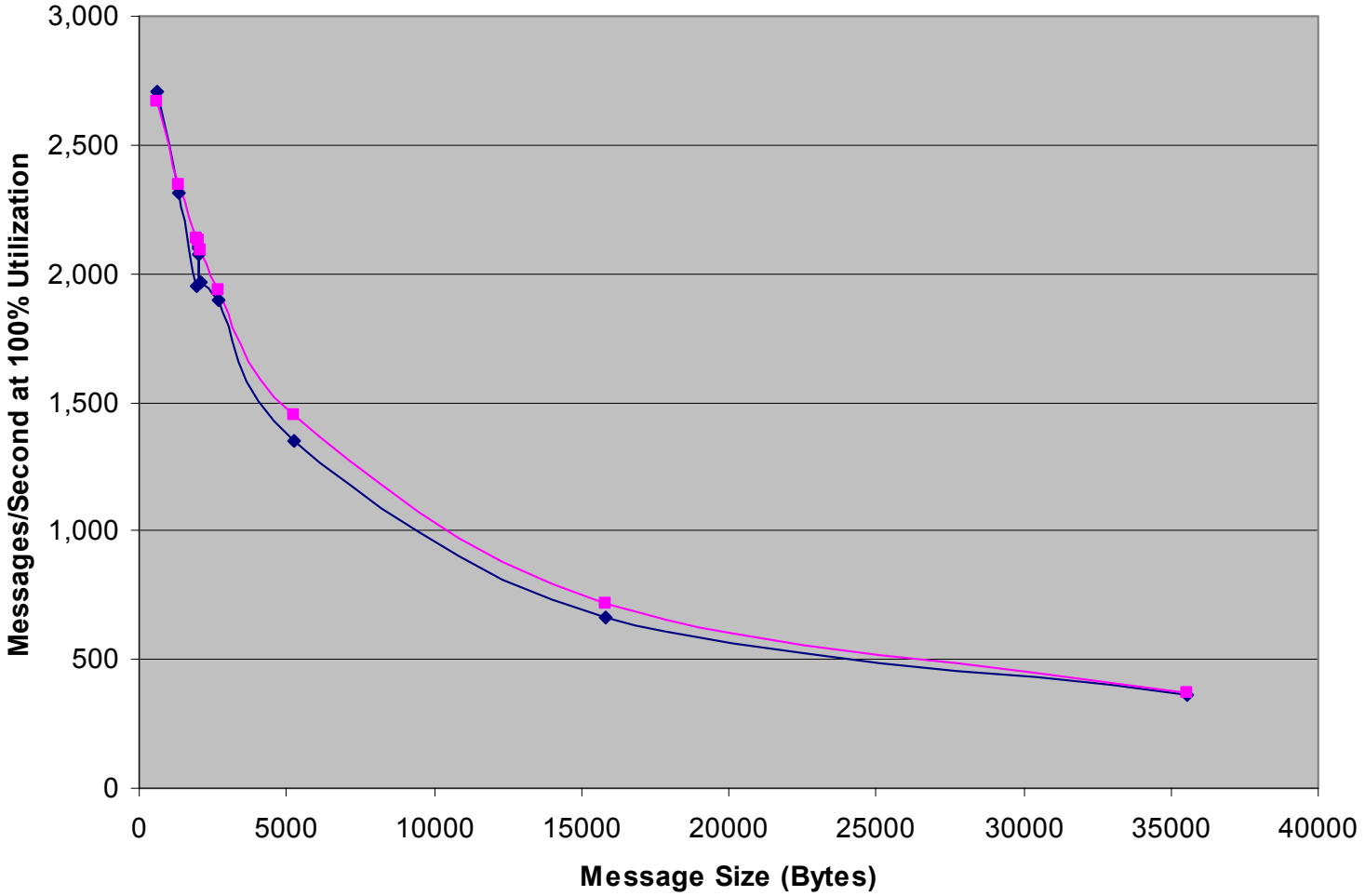
Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput equivalent to the performance stated here.

z/TPF SOAP performance testing results

- **Mean path length and throughput are highly dependent upon the size of the SOAP requests being received by the z/TPF SOAP handler**
  - The ***fixed cost*** of processing a SOAP request is dominant at ***smaller*** message sizes
  - The ***variable cost*** of processing a SOAP request is dominant at ***larger*** messages sizes
- **The primary component of the *fixed cost* of processing SOAP requests is the communications protocol used**
- **The primary component of the *variable cost* of processing SOAP requests is the B2B XML scanner for parsing the XML messages**

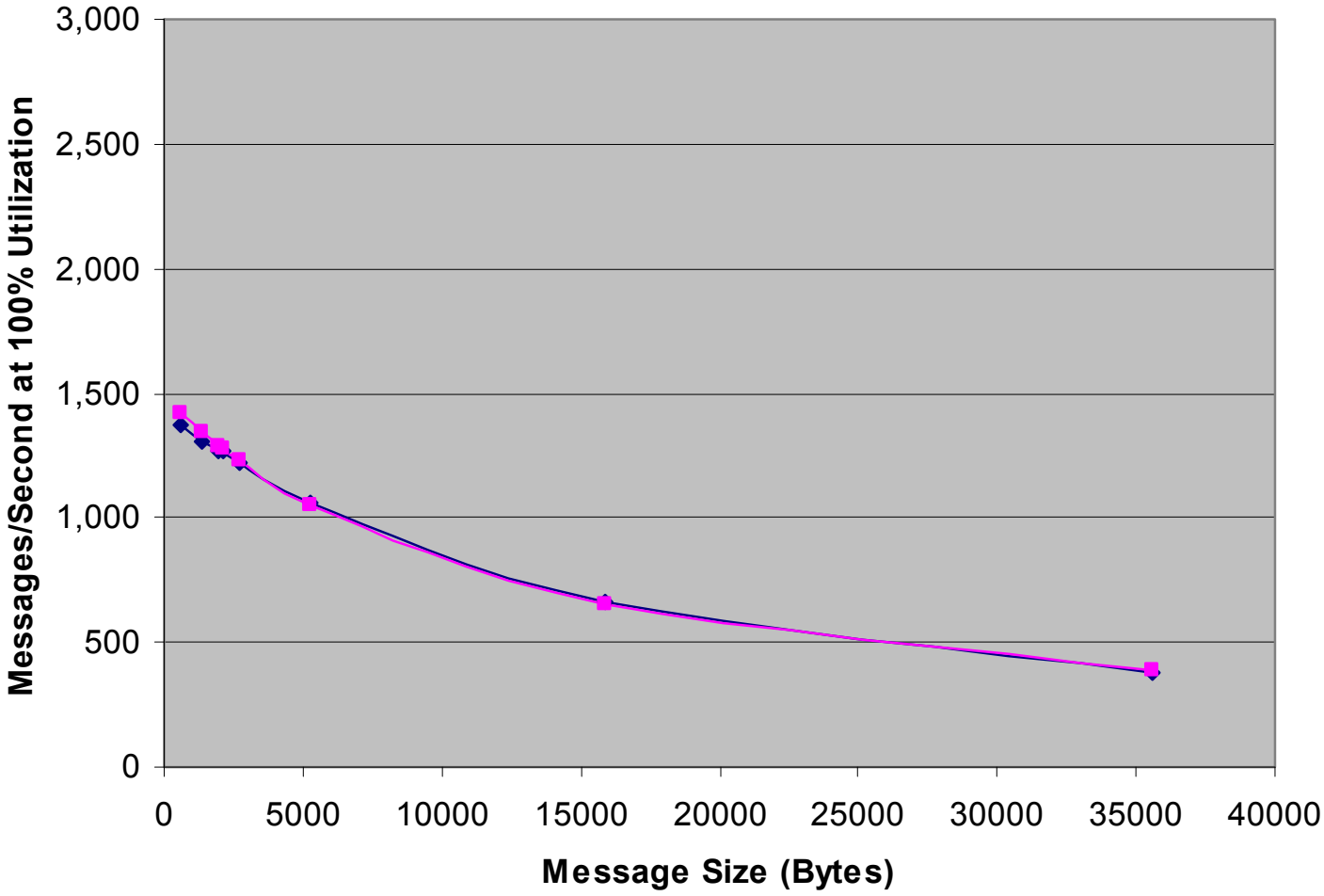


Effect of message size on throughput with Apache



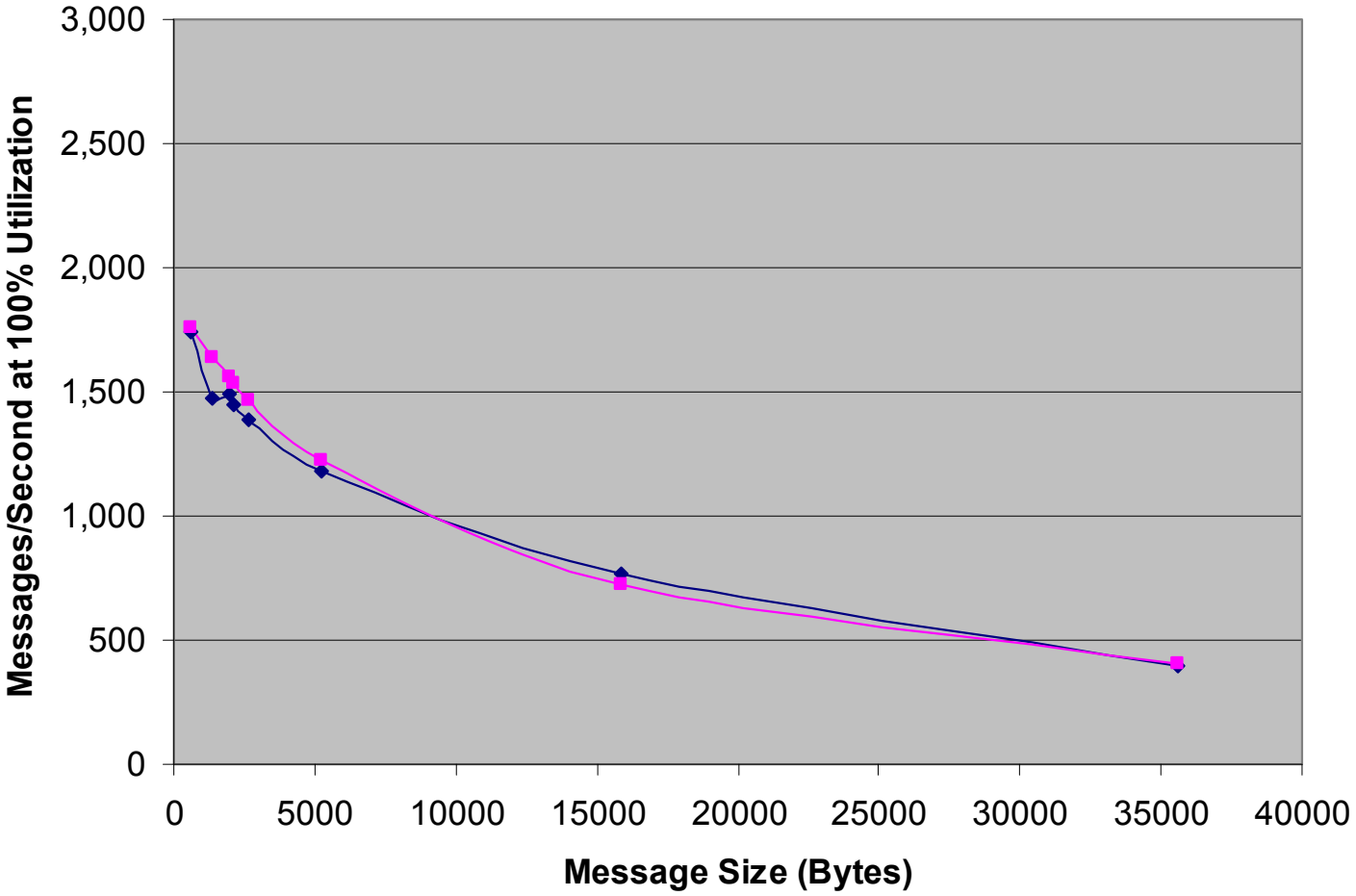
$$\lambda = \frac{298{,}000{,}000}{100{,}000 + (20 * size)}$$

Effect of message size on throughput with MQ Client



$$\lambda = \frac{298{,}000{,}000}{200{,}000 + (16 * size)}$$

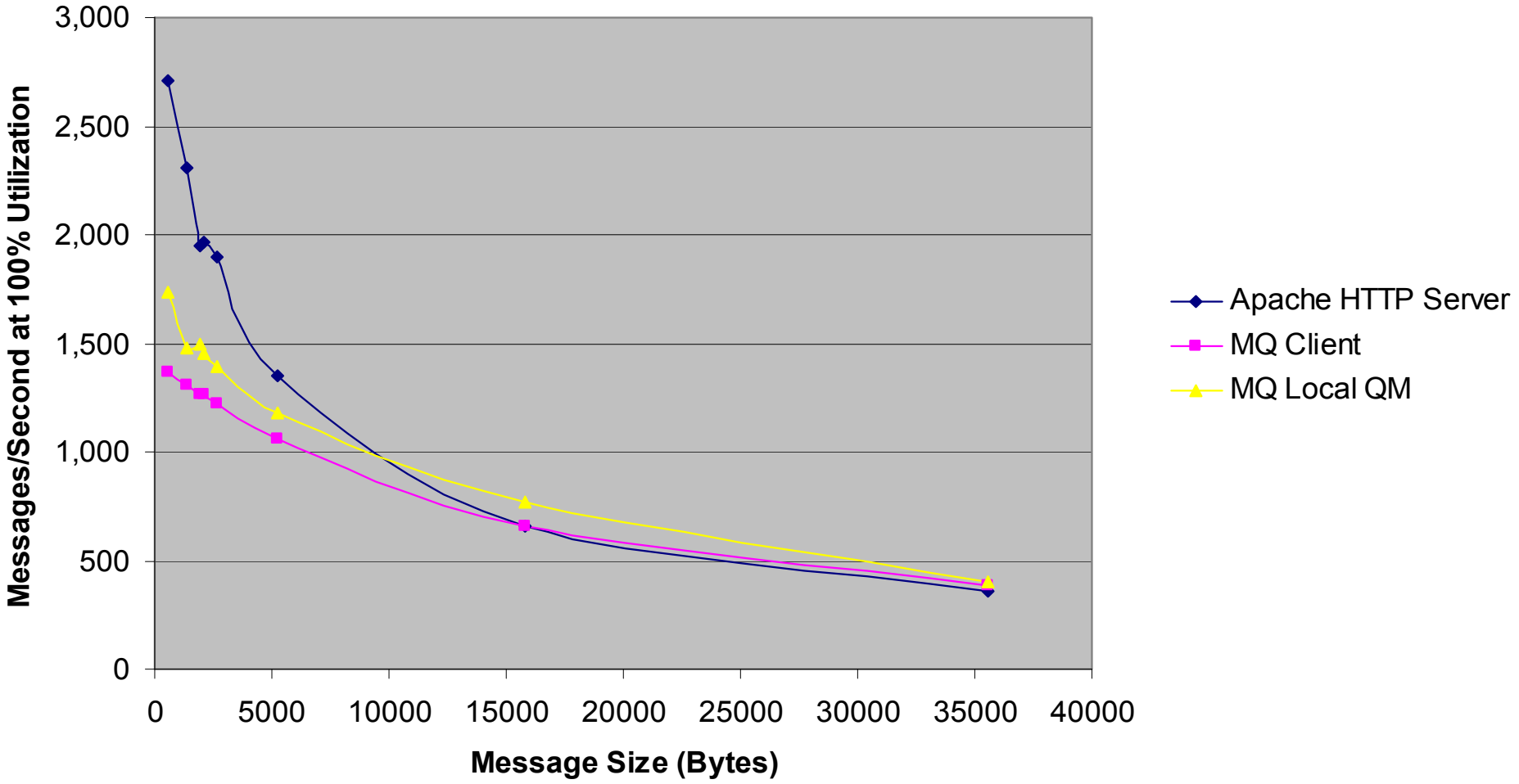
Effect of message size on throughput with MQ QM



Effect of communications binding on performance

- **Apache 1.3 HTTP server**
  - Most efficient with smaller message sizes
  - Message size impacts performance more than with WebSphere MQ (multiplier = 20 in model)
- **WebSphere MQ**
  - WebSphere MQ client has a higher *fixed cost* than WebSphere MQ local queue manager support
  - Message size impacts performance, but not as much as with Apache 1.3 HTTP server (multiplier = 16 in model)

Throughput comparison with different transports

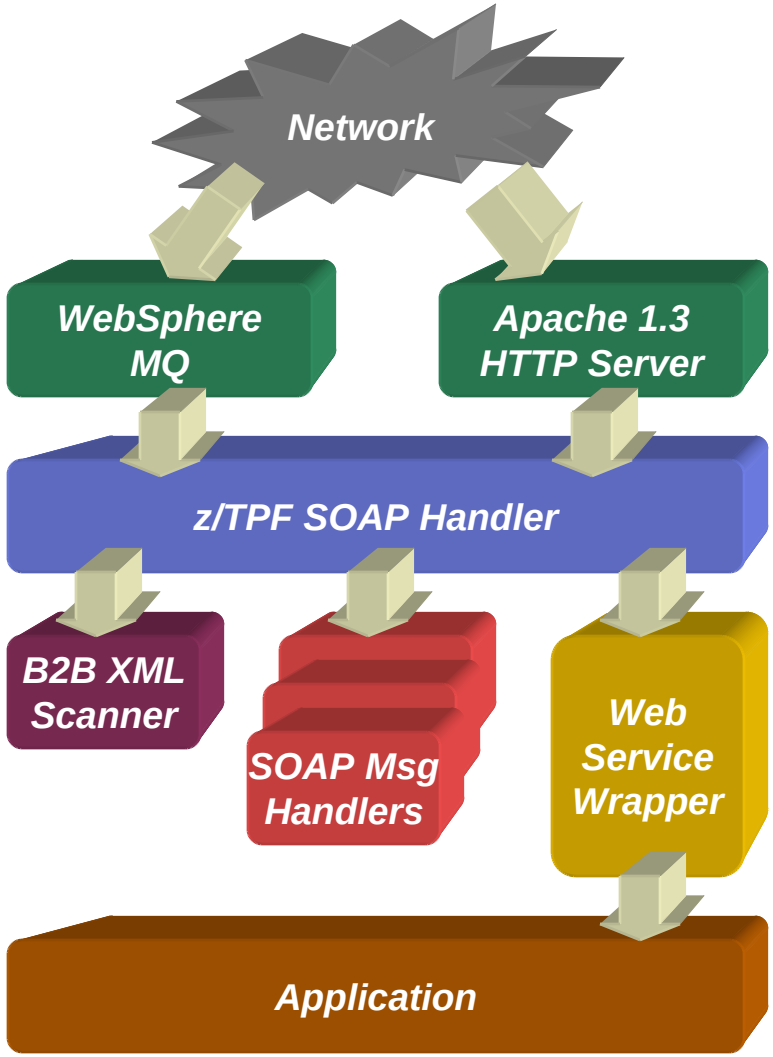


Effect of message complexity on throughput

- **The OTA sample SOAP messages were generally of a similar content density (8% - 16%)**
  - These samples are considered *highly structured* or *highly complex* (XML markup dominates the size of the messages)
  - These samples are not sufficient to isolate the effect of content density on SOAP performance
- **Manually created 3 additional sample SOAP messages using OTA_AirFlifoRQ2.xml as the base (originally 578 bytes)**
  - Increased size to 2000 bytes and created varying content densities of 40%, 60%, and 90%
  - No additional XML elements were created, but rather existing elements and attributes were given larger tag names to increase amount of XML markup
  - Bytes were removed from markup and added to attribute and element content to create greater content densities while keeping overall document size unchanged
- **Results: Path length and throughput were nearly identical to those of messages in the original sample of similar size (~2000 bytes)**
- **Conclusion: Content density as a measure of complexity is less meaningful than total message size for estimating SOAP provider support performance**

z/TPF SOA value enhancement

- **Workload License Charging (WLC)**
  - Monthly license pricing metric designed to support today's on-demand business requirements
  - Based on 4 hour rolling average
- **Sub Capacity Reporting Tool (SCRT)**
  - Certain functionalities are discounted from WLC calculations
  - CPU utilization in the following components are ignored:
    - Apache 1.3 HTTP server
    - z/TPF SOAP handler
    - B2B XML scanner
    - z/TPF XML APIs



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Backup

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/performance Web service wrapper program

- **Web service wrapper logic:**

```
tpf_xml_initialize_handle( );
tpf_xml_createXMLstructure( );
tpf_xml_appendElement( ); /* Envelope*/
tpf_xml_appendElement( ); /* Body */
tpf_xml_appendElement( ); /* Response */
```

- **Sample SOAP response:**

```
<?xml version="1.0" encoding="utf-8" ?>
<SOAP-ENV:Envelope
 xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Body>
      <Response>
         SOAP request received
      <Response>
   </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Apache 1.3 HTTP server configuration

- **Apache 1.3 HTTP server built to route all traffic to SOAP**
  - Build instructions (section 4.0): http://www.ibm.com/software/htp/tpf/download/modztpfsoap_readme.pdf
- **HTTP configuration file used (to the right →)**

```
ServerName apache.pok.ibm.com
User nobody
StartServers 50
MinSpareServers 2
MaxSpareServers 50
MaxClients 50
MaxRequestsPerChild 500
ResourceConfig /dev/null
AccessConfig /dev/null
<Directory />
AllowOverride None
</Directory>
Timeout 2
KeepAliveTimeout 2
LogLevel Error
EBCDICConvertByType Off=InOut */*
```

WebSphere MQ configuration

- **Messages were added to queue with the `MQPER_PERSISTENCE_AS_Q_DEF` option and queues defined with a default persistence of *NON PERSISTENT***
- **All SOAP requests were placed on the same local queue, which was defined as `TRIGTYPE-EVERY`***
- **"Consumer" on Linux did an MQOPEN of both request and response queues followed by a loop of MQPUT (request) followed by MQGET (response); after the looping was complete, issued MQCLOSE on both the request and response queues**
- **In the queue manager-to-queue manager test cases, the negotiated batch size was set to 50**
  - Observed batch sizes for < 15 KB messages: 7-10 (mean), 15-19 (max)
  - Observed batch sizes for > 15 KB messages: 25-50 (mean), 50 (max)

* Sample MQ trigger program that invokes `tpf_soap_handler` is available for download at http://www.ibm.com/software/htp/tpf/download/ztpfsoap.htm

Calculating content density

- **Reference: http://www.w3.org/TR/exi-measurements/**
- **Sum the total bytes of all attribute content:**
  - The `xxxx` of `attributeTag="xxxx"`
  - Leave in all `xmlns="http://....."` attributes since this is part of the XML markup overhead and not real content
- **Sum the total bytes of all element content:**
  - The `xxxx` of `<Element>xxxx</Element>`
- **Divide the sum of attribute content and element content by the original document size**

$$cd = \frac{\Sigma(\text{attribute content}) + \Sigma(\text{element content})}{\text{original document size}}$$

z/TPF SOAP performance results (raw data)

Message	HTTP		MQ Client		MQ Queue Mgr	
	Mean Path Length	Msg/Sec at 100%	Mean Path Length	Msg/Sec at 100%	Mean Path Length	Msg/Sec at 100%
OTA_AirFlifoRQ2.xml	109,951	2,710	217,811	1,368	171,483	1,738
OTA_RailAvailRQ2.xml	128,972	2,311	227,408	1,310	201,866	1,476
OTA_RailBookRQ2.xml	152,891	1,949	235,478	1,266	199,469	1,494
OTA_AirCheckInRQ3.xml	151,393	1,968	235,732	1,264	205,600	1,449
OTA_AirPriceRQ2.xml	157,256	1,895	244,260	1,220	214,421	1,390
OTA_AirBookModifyRQ7.xml	221,156	1,347	281,336	1,059	253,034	1,178
OTA_HotelEventRQ3.xml	451,462	660	452,592	658	389,324	765
OTA_HotelRoomListRQ3.xml	820,660	363	778,291	383	744,690	400

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